# Hyperparameter Tuning Cookbook

**A guide for scikit-learn, PyTorch, river, and spotPython**

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# Preface

The goal of hyperparameter tuning (or hyperparameter optimization) is to optimize the hyperparameters to improve the performance of the machine or deep learning model.

spotPython ("Sequential Parameter Optimization Toolbox in Python") is the Python version of the well-known hyperparameter tuner SPOT, which has been developed in the R programming environment for statistical analysis for over a decade. The related open-access book is available here: Hyperparameter Tuning for Machine and Deep Learning with R—A Practical Guide.

scikit-learn is a Python module for machine learning built on top of SciPy and is distributed under the 3-Clause BSD license. The project was started in 2007 by David Cournapeau as a Google Summer of Code project, and since then many volunteers have contributed.

PyTorch is an optimized tensor library for deep learning using GPUs and CPUs.

River is a Python library for online machine learning. It is designed to be used in real-world environments, where not all data is available at once, but streaming in.

> ❗ Important: This book is still under development.

## Citation

If this document has been useful to you and you wish to cite it in a scientific publication, please refer to the following paper, which can be found on arXiv: https://arxiv.org/abs/2305.11930.

```
@ARTICLE{bart23earxiv,
       author = {{Bartz-Beielstein}, Thomas},
        title = "{PyTorch Hyperparameter Tuning -- A Tutorial for spotPython}",
      journal = {arXiv e-prints},
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         year = 2023,
        month = may,
          eid = {arXiv:2305.11930},
```

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         pages = {arXiv:2305.11930},
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 primaryClass = {cs.LG},
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       adsnote = {Provided by the SAO/NASA Astrophysics Data System}
}
```

# 1 Introduction: Hyperparameter Tuning

Hyperparameter tuning is an important, but often difficult and computationally intensive task. Changing the architecture of a neural network or the learning rate of an optimizer can have a significant impact on the performance.

The goal of hyperparameter tuning is to optimize the hyperparameters in a way that improves the performance of the machine learning or deep learning model. The simplest, but also most computationally expensive, approach uses manual search (or trial-and-error (Meignan et al. 2015)). Commonly encountered is simple random search, i.e., random and repeated selection of hyperparameters for evaluation, and lattice search ("grid search"). In addition, methods that perform directed search and other model-free algorithms, i.e., algorithms that do not explicitly rely on a model, e.g., evolution strategies (Bartz-Beielstein et al. 2014) or pattern search (Lewis, Torczon, and Trosset 2000) play an important role. Also, "hyperband", i.e., a multi-armed bandit strategy that dynamically allocates resources to a set of random configurations and uses successive bisections to stop configurations with poor performance (Li et al. 2016), is very common in hyperparameter tuning. The most sophisticated and efficient approaches are the Bayesian optimization and surrogate model based optimization methods, which are based on the optimization of cost functions determined by simulations or experiments.

We consider below a surrogate model based optimization-based hyperparameter tuning approach based on the Python version of the SPOT ("Sequential Parameter Optimization Toolbox") (Bartz-Beielstein, Lasarczyk, and Preuss 2005), which is suitable for situations where only limited resources are available. This may be due to limited availability and cost of hardware, or due to the fact that confidential data may only be processed locally, e.g., due to legal requirements. Furthermore, in our approach, the understanding of algorithms is seen as a key tool for enabling transparency and explainability. This can be enabled, for example, by quantifying the contribution of machine learning and deep learning components (nodes, layers, split decisions, activation functions, etc.). Understanding the importance of hyperparameters and the interactions between multiple hyperparameters plays a major role in the interpretability and explainability of machine learning models. SPOT provides statistical tools for understanding hyperparameters and their interactions. Last but not least, it should be noted that the SPOT software code is available in the open source `spotPython` package on github[1], allowing replicability of the results. This tutorial descries the Python variant of SPOT, which is called

[1] https://github.com/sequential-parameter-optimization

spotPython. The R implementation is described in Bartz et al. (2022). SPOT is an established open source software that has been maintained for more than 15 years (Bartz-Beielstein, Lasarczyk, and Preuss 2005) (Bartz et al. 2022).

This tutorial is structured as follows. The concept of the hyperparameter tuning software spotPython is described in Section 1.1. Chapter 21 describes the execution of the example from the tutorial "Hyperparameter Tuning with Ray Tune" (PyTorch 2023a). The integration of spotPython into the PyTorch training workflow is described in detail in the following sections. Section 21.1 describes the setup of the tuners. Section 21.3 describes the data loading. Section 26.4 describes the model to be tuned. The search space is introduced in Section 21.5. Optimizers are presented in Section 21.6. How to split the data in train, validation, and test sets is described in Section 21.7. The selection of the loss function and metrics is described in Section 21.8. Section 25.13 describes the preparation of the spotPython call. The objective function is described in Section 21.10. How to use results from previous runs and default hyperparameter configurations is described in Section 21.11. Starting the tuner is shown in Section 21.12. TensorBoard can be used to visualize the results as shown in Section 21.13. Results are discussed and explained in Section 21.14. Finally, Section 21.15 presents a summary and an outlook.

> **Note**
>
> The corresponding .ipynb notebook (Bartz-Beielstein 2023) is updated regularly and reflects updates and changes in the spotPython package. It can be downloaded from https://github.com/sequential-parameter-optimization/spotPython/blob/main/notebooks/14_spot_ray_hpt_torch_cifar10.ipynb.

## 1.1 The Hyperparameter Tuning Software SPOT

Surrogate model based optimization methods are common approaches in simulation and optimization. SPOT was developed because there is a great need for sound statistical analysis of simulation and optimization algorithms. SPOT includes methods for tuning based on classical regression and analysis of variance techniques. It presents tree-based models such as classification and regression trees and random forests as well as Bayesian optimization (Gaussian process models, also known as Kriging). Combinations of different meta-modeling approaches are possible. SPOT comes with a sophisticated surrogate model based optimization method, that can handle discrete and continuous inputs. Furthermore, any model implemented in scikit-learn can be used out-of-the-box as a surrogate in spotPython.

SPOT implements key techniques such as exploratory fitness landscape analysis and sensitivity analysis. It can be used to understand the performance of various algorithms, while simultaneously giving insights into their algorithmic behavior. In addition, SPOT can be used as an optimizer and for automatic and interactive tuning. Details on SPOT and its use in practice are given by Bartz et al. (2022).

A typical hyperparameter tuning process with `spotPython` consists of the following steps:

1. Loading the data (training and test datasets), see Section 21.3.
2. Specification of the preprocessing model, see Section 21.4.1. This model is called `prep_model` ("preparation" or pre-processing). The information required for the hyperparameter tuning is stored in the dictionary `fun_control`. Thus, the information needed for the execution of the hyperparameter tuning is available in a readable form.
3. Selection of the machine learning or deep learning model to be tuned, see Section 21.4.2. This is called the `core_model`. Once the `core_model` is defined, then the associated hyperparameters are stored in the `fun_control` dictionary. First, the hyperparameters of the `core_model` are initialized with the default values of the `core_model`. As default values we use the default values contained in the `spotPython` package for the algorithms of the `torch` package.
4. Modification of the default values for the hyperparameters used in `core_model`, see Section 21.5.3.1. This step is optional.

    1. numeric parameters are modified by changing the bounds.
    2. categorical parameters are modified by changing the categories ("levels").

5. Selection of target function (loss function) for the optimizer, see Section 21.8.
6. Calling SPOT with the corresponding parameters, see Section 21.12. The results are stored in a dictionary and are available for further analysis.
7. Presentation, visualization and interpretation of the results, see Section 21.14.

## 1.2 Spot as an Optimizer

The `spot` loop consists of the following steps:

1. Init: Build initial design $X$
2. Evaluate initial design on real objective $f$: $y = f(X)$
3. Build surrogate: $S = S(X, y)$
4. Optimize on surrogate: $X_0 = \text{optimize}(S)$
5. Evaluate on real objective: $y_0 = f(X_0)$
6. Impute (Infill) new points: $X = X \cup X_0$, $y = y \cup y_0$.
7. Got 3.

Central Idea: Evaluation of the surrogate model `S` is much cheaper (or / and much faster) than running the real-world experiment $f$. We start with a small example.

## 1.3 Example: `Spot` and the Sphere Function

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
```

### 1.3.1 The Objective Function: Sphere

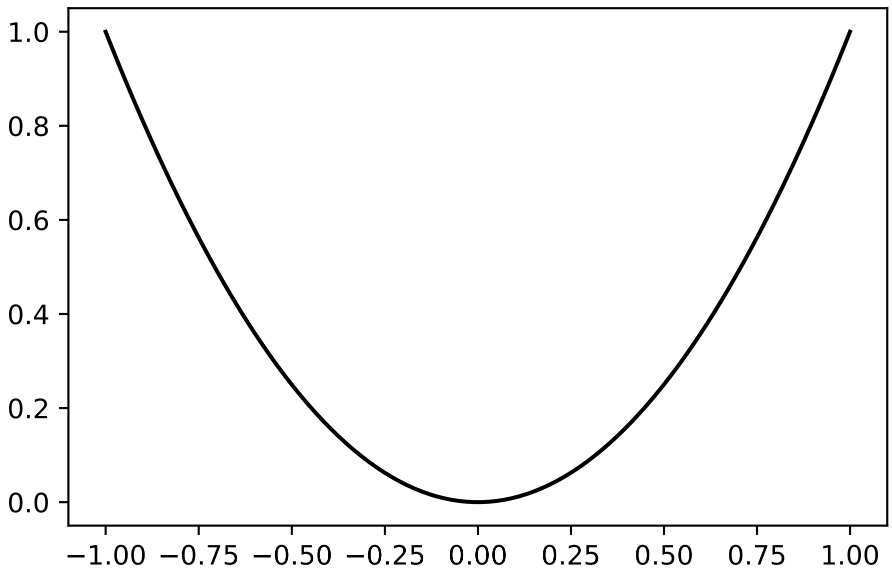
The `spotPython` package provides several classes of objective functions. We will use an analytical objective function, i.e., a function that can be described by a (closed) formula:

$$f(x) = x^2$$

```
fun = analytical().fun_sphere
```

We can apply the function `fun` to input values and plot the result:

```
x = np.linspace(-1,1,100).reshape(-1,1)
y = fun(x)
plt.figure()
plt.plot(x, y, "k")
plt.show()
```




```
spot_0 = spot.Spot(fun=fun,
                   lower = np.array([-1]),
                   upper = np.array([1]))
```

```
spot_0.run()
```

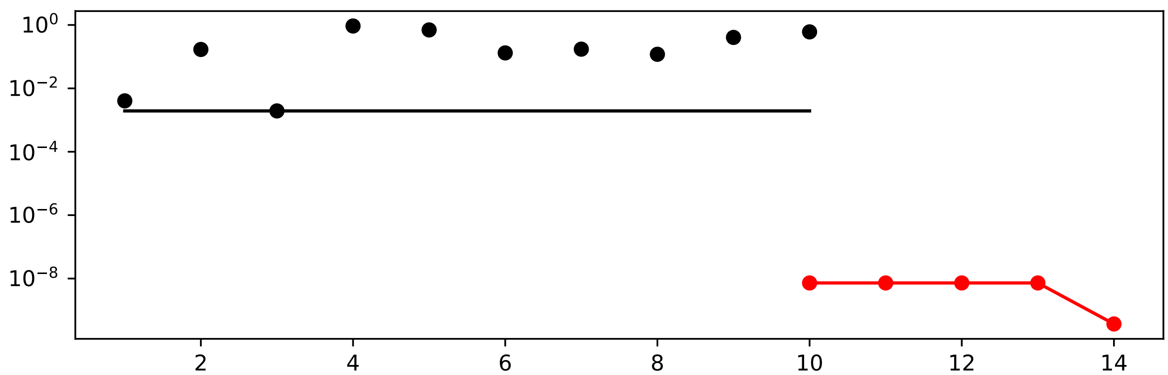
```
<spotPython.spot.spot.Spot at 0x14cc73e20>
```

```
spot_0.print_results()
```

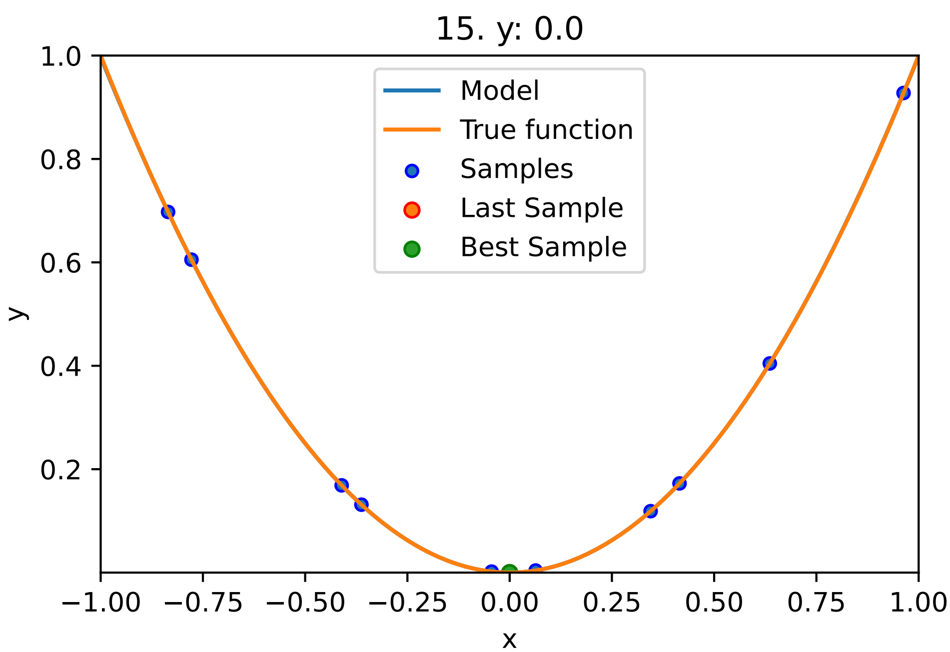
```
min y: 3.696886711914087e-10
x0: 1.922728975158508e-05
```

```
[['x0', 1.922728975158508e-05]]
```

```
spot_0.plot_progress(log_y=True)
```




```
spot_0.plot_model()
```




## 1.4 Spot Parameters: `fun_evals`, `init_size` and `show_models`

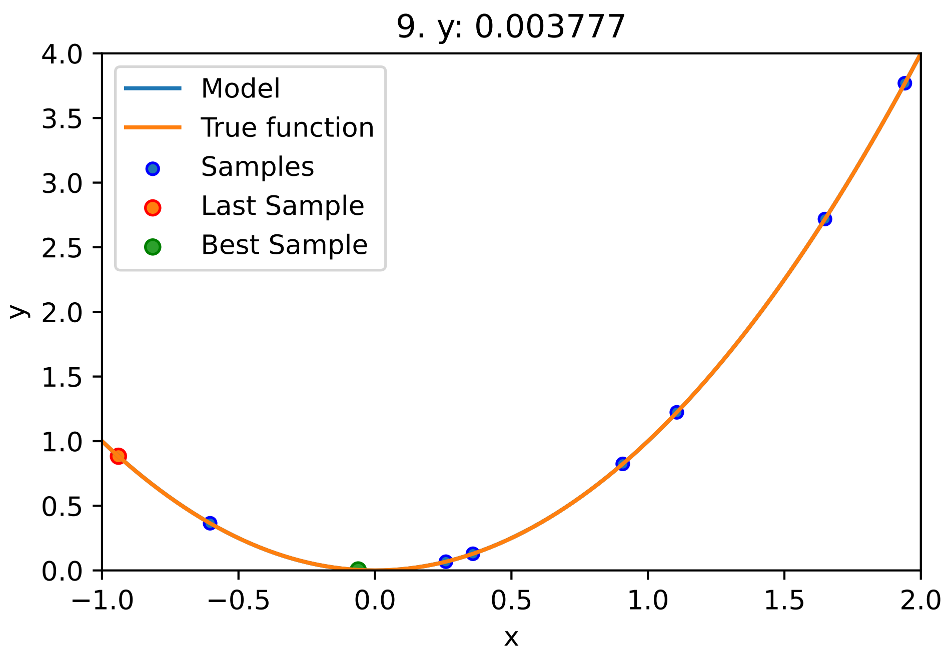
We will modify three parameters:

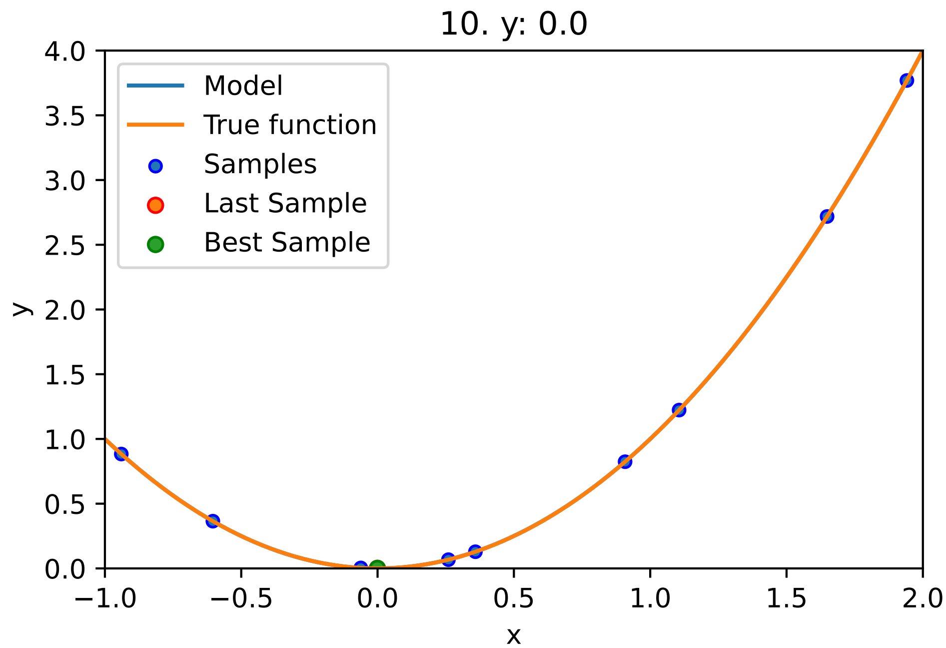
1. The number of function evaluations (`fun_evals`)
2. The size of the initial design (`init_size`)

3. The parameter `show_models`, which visualizes the search process for 1-dim functions.

The full list of the `Spot` parameters is shown in the Help System and in the notebook `spot_doc.ipynb`.

```
spot_1 = spot.Spot(fun=fun,
                   lower = np.array([-1]),
                   upper = np.array([2]),
                   fun_evals= 10,
                   seed=123,
                   show_models=True,
                   design_control={"init_size": 9})
spot_1.run()
```






```
<spotPython.spot.spot.Spot at 0x14d586d40>
```

## 1.5 Print the Results

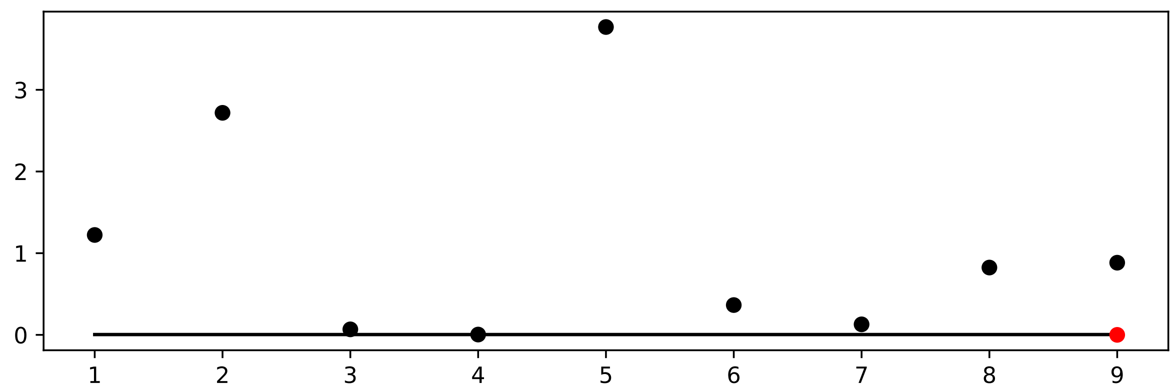
```
spot_1.print_results()
```

```
min y: 3.6779240309761575e-07
x0: -0.0006064589047063418
```

```
[['x0', -0.0006064589047063418]]
```

## 1.6 Show the Progress

```
spot_1.plot_progress()
```



0
1
2
3
1
2
3
4
5
6
7
8
9

# 2 Multi-dimensional Functions

This notebook illustrates how high-dimensional functions can be analyzed.

## 2.1 Example: `Spot` and the 3-dim Sphere Function

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
import pylab
from numpy import append, ndarray, multiply, isinf, linspace, meshgrid, ravel
from numpy import array
```

### 2.1.1 The Objective Function: 3-dim Sphere

- The `spotPython` package provides several classes of objective functions.
- We will use an analytical objective function, i.e., a function that can be described by a (closed) formula:
$$f(x) = \sum_i^n x_i^2$$
- Here we will use $n = 3$.

```
fun = analytical().fun_sphere
```

- The size of the `lower` bound vector determines the problem dimension.
- Here we will use `np.array([-1, -1, -1])`, i.e., a three-dim function.

- We will use three different `theta` values (one for each dimension), i.e., we set `surrogate_control={"n_theta": 3}`.

```
spot_3 = spot.Spot(fun=fun,
                   lower = -1.0*np.ones(3),
                   upper = np.ones(3),
                   var_name=["Pressure", "Temp", "Lambda"],
                   show_progress=True,
                   surrogate_control={"n_theta": 3})

spot_3.run()
```

```
spotPython tuning: 0.03443344056467332 [#######---] 73.33%

spotPython tuning: 0.03134865993507926 [########--] 80.00%

spotPython tuning: 0.0009629342967936851 [#########-] 86.67%

spotPython tuning: 8.541951463966474e-05 [#########-] 93.33%

spotPython tuning: 6.285135731399678e-05 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x16a5fbc70>
```

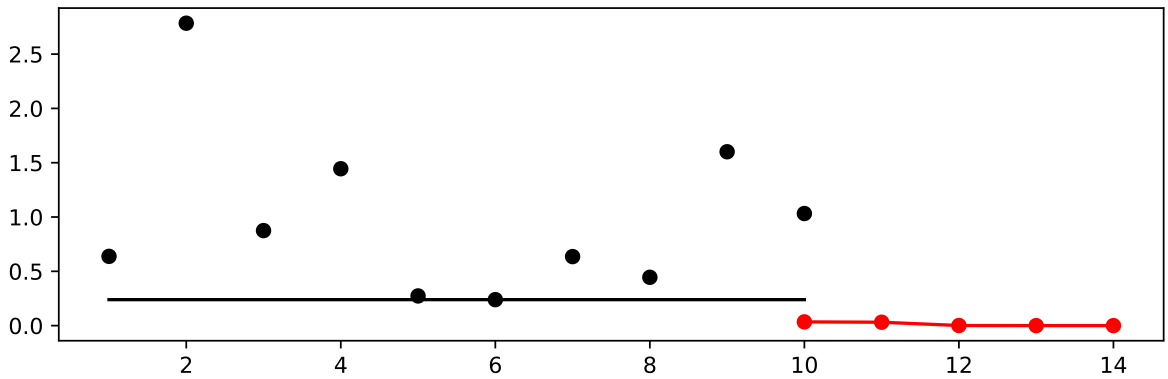
### 2.1.2 Results

```
spot_3.print_results()
```

```
min y: 6.285135731399678e-05
Pressure: 0.005236109709736696
Temp: 0.0019572552655686714
Lambda: 0.005621713639718905
```

```
[['Pressure', 0.005236109709736696],
 ['Temp', 0.0019572552655686714],
 ['Lambda', 0.005621713639718905]]
```

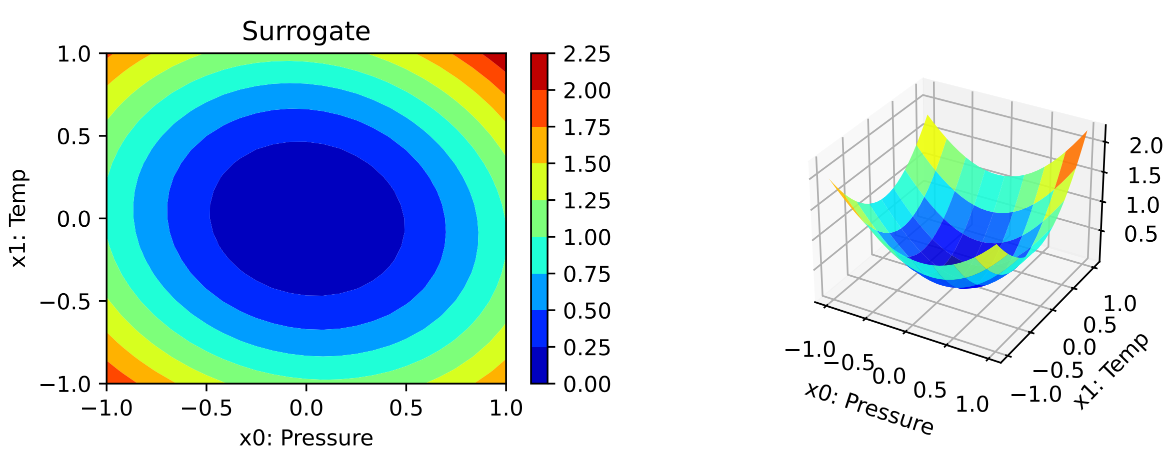
```
spot_3.plot_progress()
```




### 2.1.3 A Contour Plot

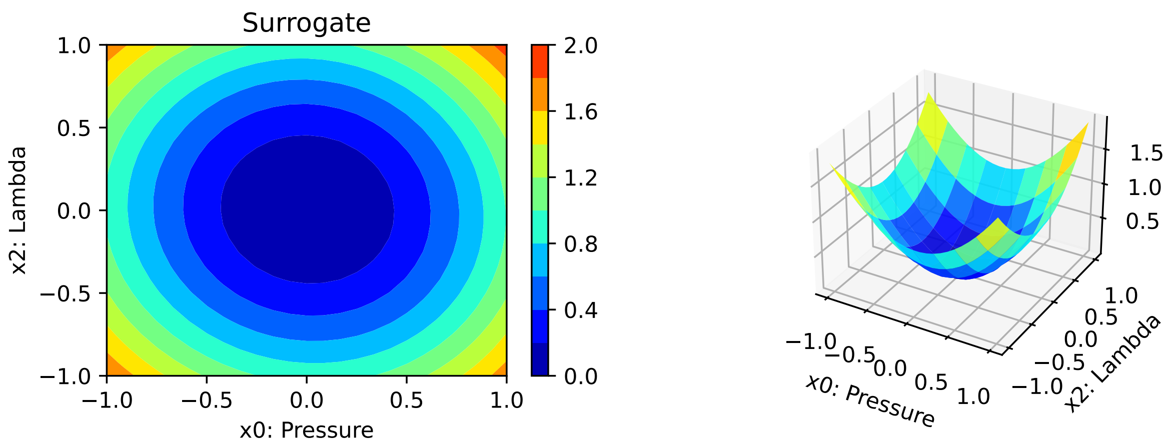
- We can select two dimensions, say $i = 0$ and $j = 1$, and generate a contour plot as follows.
  - Note: We have specified identical `min_z` and `max_z` values to generate comparable plots!

```
spot_3.plot_contour(i=0, j=1, min_z=0, max_z=2.25)
```



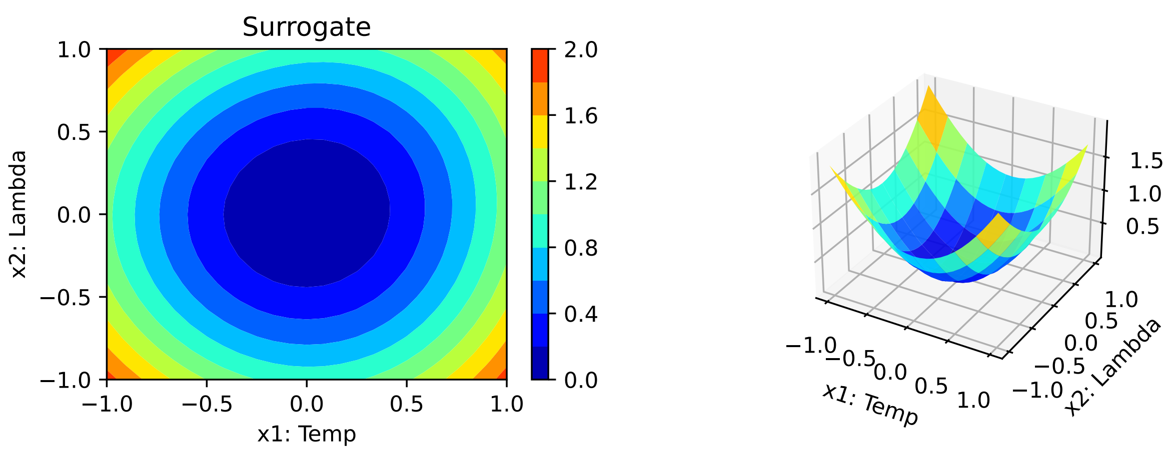

- In a similar manner, we can plot dimension $i = 0$ and $j = 2$:

```
spot_3.plot_contour(i=0, j=2, min_z=0, max_z=2.25)
```




- The final combination is $i = 1$ and $j = 2$:

```
spot_3.plot_contour(i=1, j=2, min_z=0, max_z=2.25)
```




- The three plots look very similar, because the `fun_sphere` is symmetric.
- This can also be seen from the variable importance:

```
spot_3.print_importance()
```

```
Pressure:  99.35185545837122
Temp:  99.99999999999999
```

```
Lambda:  94.31627052007231
```

```
[['Pressure', 99.35185545837122],
 ['Temp', 99.99999999999999],
 ['Lambda', 94.31627052007231]]
```

## 2.2 Conclusion

Based on this quick analysis, we can conclude that all three dimensions are equally important (as expected, because the analytical function is known).

## 2.3 Exercises

- Important:
  - Results from these exercises should be added to this document, i.e., you should submit an updated version of this notebook.
  - Please combine your results using this notebook.
  - Only one notebook from each group!
  - Presentation is based on this notebook. No addtional slides are required!
  - spotPython version `0.16.11` (or greater) is required

### 2.3.1 The Three Dimensional `fun_cubed`

- The input dimension is `3`. The search range is $-1 \leq x \leq 1$ for all dimensions.
- Generate contour plots
- Calculate the variable importance.
- Discuss the variable importance:
  - Are all variables equally important?
  - If not:
    - Which is the most important variable?
    - Which is the least important variable?

### 2.3.2 The Ten Dimensional `fun_wing_wt`

- The input dimension is `10`. The search range is $0 \le x \le 1$ for all dimensions.
- Calculate the variable importance.
- Discuss the variable importance:
  - Are all variables equally important?
  - If not:
    - Which is the most important variable?
    - Which is the least important variable?
  - Generate contour plots for the three most important variables. Do they confirm your selection?

### 2.3.3 The Three Dimensional `fun_runge`

- The input dimension is `3`. The search range is $-5 \le x \le 5$ for all dimensions.
- Generate contour plots
- Calculate the variable importance.
- Discuss the variable importance:
  - Are all variables equally important?
  - If not:
    - Which is the most important variable?
    - Which is the least important variable?

### 2.3.4 The Three Dimensional `fun_linear`

- The input dimension is `3`. The search range is $-5 \le x \le 5$ for all dimensions.
- Generate contour plots
- Calculate the variable importance.
- Discuss the variable importance:
  - Are all variables equally important?
  - If not:
    - Which is the most important variable?
    - Which is the least important variable?

# 3 Isotropic and Anisotropic Kriging

## 3.1 Example: Isotropic Spot Surrogate and the 2-dim Sphere Function

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
```

### 3.1.1 The Objective Function: 2-dim Sphere

- The `spotPython` package provides several classes of objective functions.
- We will use an analytical objective function, i.e., a function that can be described by a (closed) formula:

$$f(x, y) = x^2 + y^2$$

```
fun = analytical().fun_sphere
fun_control = {"sigma": 0,
               "seed": 123}
```

- The size of the `lower` bound vector determines the problem dimension.
- Here we will use `np.array([-1, -1])`, i.e., a two-dim function.

```
spot_2 = spot.Spot(fun=fun,
                   lower = np.array([-1, -1]),
                   upper = np.array([1, 1]))

spot_2.run()
```

```
<spotPython.spot.spot.Spot at 0x14f577c10>
```

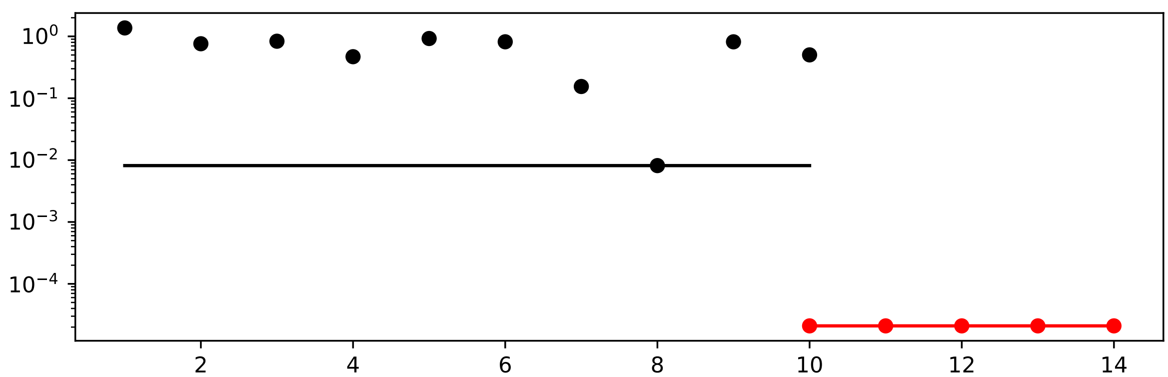
### 3.1.2 Results

```
spot_2.print_results()
```

```
min y: 2.093282610941807e-05
x0: 0.0016055267473267492
x1: 0.00428428640184529
```

```
[['x0', 0.0016055267473267492], ['x1', 0.00428428640184529]]
```

```
spot_2.plot_progress(log_y=True)
```




## 3.2 Example With Anisotropic Kriging

- The default parameter setting of `spotPython`'s Kriging surrogate uses the same `theta` value for every dimension.
- This is referred to as "using an isotropic kernel".
- If different `theta` values are used for each dimension, then an anisotropic kernel is used
- To enable anisotropic models in `spotPython`, the number of `theta` values should be larger than one.
- We can use `surrogate_control={"n_theta": 2}` to enable this behavior (`2` is the problem dimension).

```
spot_2_anisotropic = spot.Spot(fun=fun,
                     lower = np.array([-1, -1]),
                     upper = np.array([1, 1]),
                     surrogate_control={"n_theta": 2})
spot_2_anisotropic.run()
```

```
<spotPython.spot.spot.Spot at 0x15933f160>
```

### 3.2.1 Taking a Look at the `theta` Values

- We can check, whether one or several `theta` values were used.
- The `theta` values from the surrogate can be printed as follows:

```
spot_2_anisotropic.surrogate.theta
```

```
array([0.19447342, 0.30813872])
```

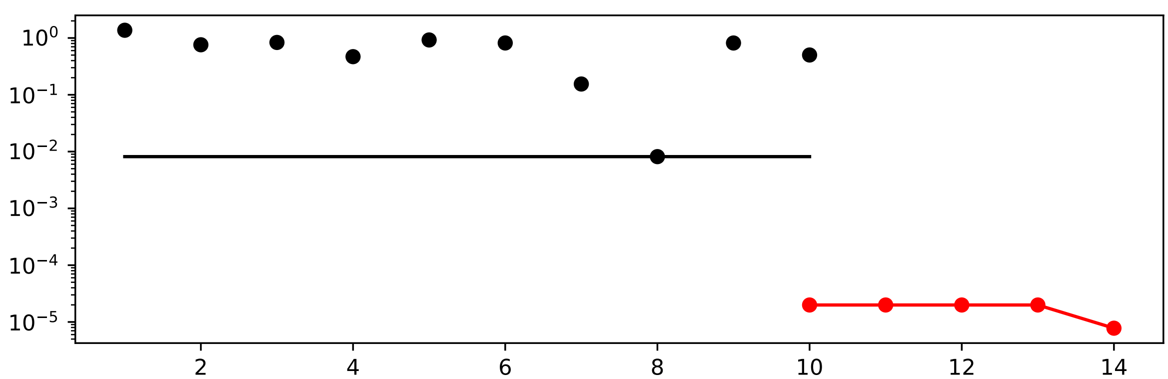
- Since the surrogate from the isotropic setting was stored as `spot_2`, we can also take a look at the `theta` value from this model:

```
spot_2.surrogate.theta
```

```
array([0.26287447])
```

- Next, the search progress of the optimization with the anisotropic model can be visualized:

```
spot_2_anisotropic.plot_progress(log_y=True)
```

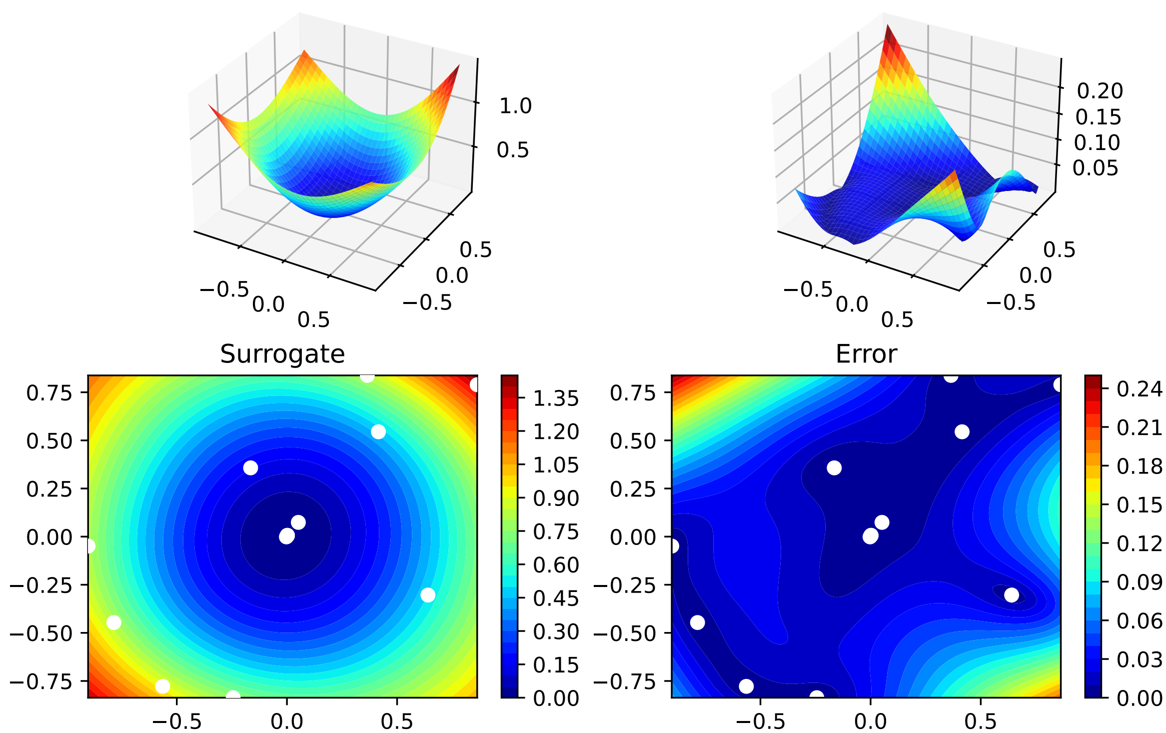


```
spot_2_anisotropic.print_results()
```

```
min y: 7.77061191821505e-06
x0: -0.0024488252797500764
x1: -0.0013318658594137815
```

```
[['x0', -0.0024488252797500764], ['x1', -0.0013318658594137815]]
```

```
spot_2_anisotropic.surrogate.plot()
```



# 4 Exercises

## 4.1 `fun_branin`

- Describe the function.
  - The input dimension is `2`. The search range is $-5 \leq x_1 \leq 10$ and $0 \leq x_2 \leq 15$.
- Compare the results from `spotPython` run a) with isotropic and b) anisotropic surrogate models.
- Modify the termination criterion: instead of the number of evaluations (which is specified via `fun_evals`), the time should be used as the termination criterion. This can be done as follows (`max_time=1` specifies a run time of one minute):

```
fun_evals=inf,
max_time=1,
```

## 4.2 `fun_sin_cos`

- Describe the function.
  - The input dimension is `2`. The search range is $-2\pi \leq x_1 \leq 2\pi$ and $-2\pi \leq x_2 \leq 2\pi$.
- Compare the results from `spotPython` run a) with isotropic and b) anisotropic surrogate models.
- Modify the termination criterion (`max_time` instead of `fun_evals`) as described for `fun_branin`.

## 4.3 `fun_runge`

- Describe the function.
  - The input dimension is `2`. The search range is $-5 \leq x_1 \leq 5$ and $-5 \leq x_2 \leq 5$.
- Compare the results from `spotPython` run a) with isotropic and b) anisotropic surrogate models.

- Modify the termination criterion (`max_time` instead of `fun_evals`) as described for `fun_branin`.

## 4.4 `fun_wingwt`

- Describe the function.
  - The input dimension is `10`. The search ranges are between 0 and 1 (values are mapped internally to their natural bounds).
- Compare the results from `spotPython` run a) with isotropic and b) anisotropic surrogate models.
- Modify the termination criterion (`max_time` instead of `fun_evals`) as described for `fun_branin`.

# 5 Using `sklearn` Surrogates in `spotPython`

This notebook explains how different surrogate models from `scikit-learn` can be used as surrogates in `spotPython` optimization runs.

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
```

## 5.1 Example: Branin Function with `spotPython`'s Internal Kriging Surrogate

### 5.1.1 The Objective Function Branin

- The `spotPython` package provides several classes of objective functions.
- We will use an analytical objective function, i.e., a function that can be described by a (closed) formula.
- Here we will use the Branin function:

  ```
  y = a * (x2 - b * x1**2 + c * x1 - r) ** 2 + s * (1 - t) * np.cos(x1) + s,
  where values of a, b, c, r, s and t are: a = 1, b = 5.1 / (4*pi**2),
  c = 5 / pi, r = 6, s = 10 and t = 1 / (8*pi).
  ```

- It has three global minima:

  ```
  f(x) = 0.397887 at (-pi, 12.275), (pi, 2.275), and (9.42478, 2.475).
  ```

```
from spotPython.fun.objectivefunctions import analytical
lower = np.array([-5,-0])
```

```python
upper = np.array([10,15])
```

```python
fun = analytical().fun_branin
```

### 5.1.2 Running the surrogate model based optimizer Spot:

```python
spot_2 = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = 20,
                   max_time = inf,
                   seed=123,
                   design_control={"init_size": 10})
```

```python
spot_2.run()
```

```
<spotPython.spot.spot.Spot at 0x11086e200>
```

### 5.1.3 Print the Results

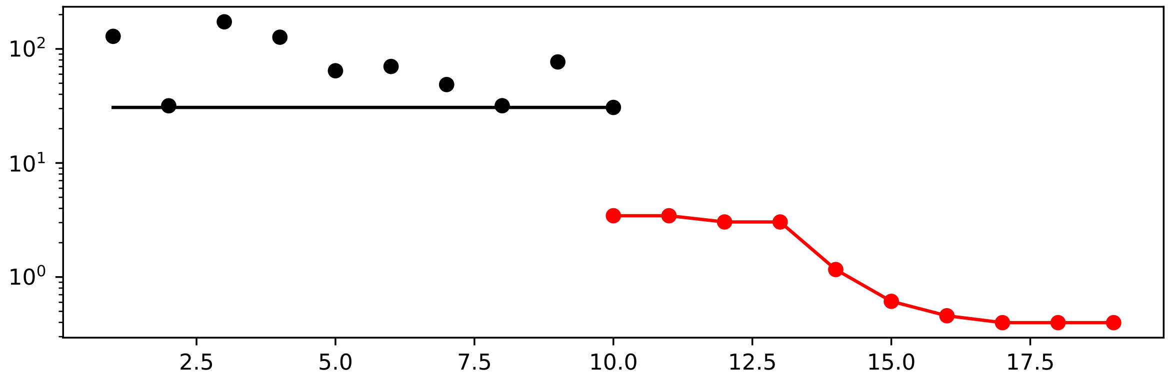
```python
spot_2.print_results()
```

```
min y: 0.3982295132785083
x0: 3.135528626303215
x1: 2.2926027772585886
```

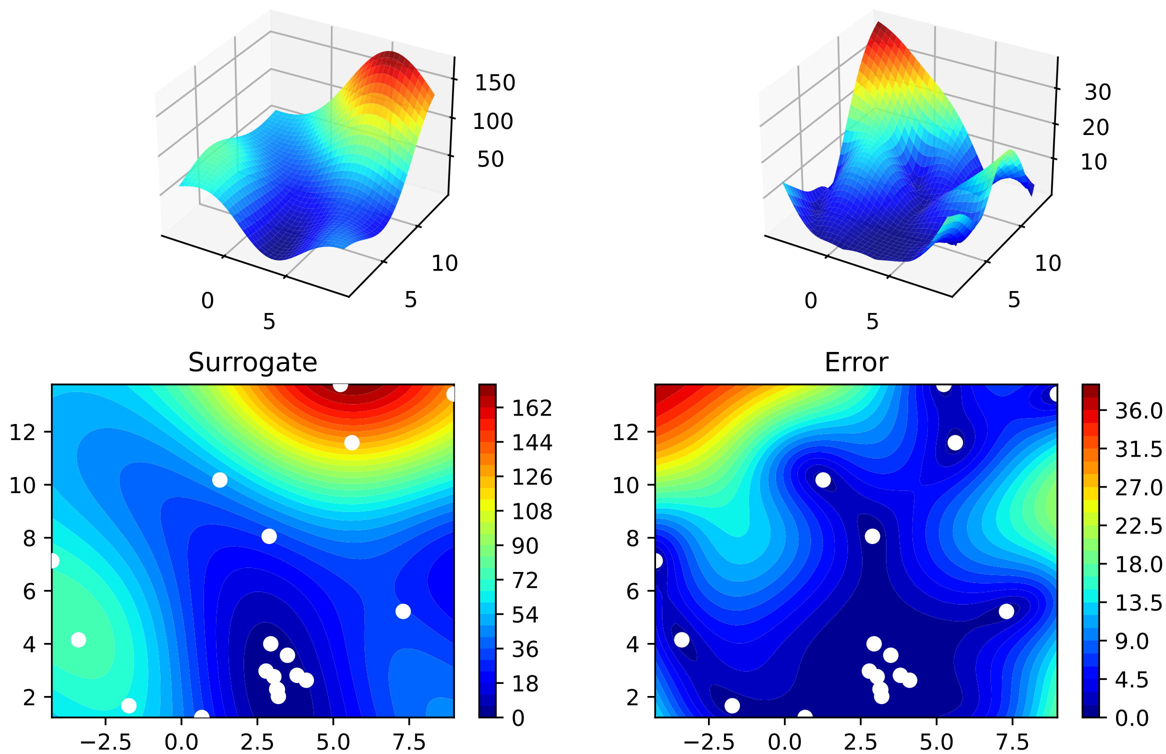
```
[['x0', 3.135528626303215], ['x1', 2.2926027772585886]]
```

### 5.1.4 Show the Progress and the Surrogate

```python
spot_2.plot_progress(log_y=True)
```




```
spot_2.surrogate.plot()
```




## 5.2 Example: Using Surrogates From scikit-learn

- Default is the `spotPython` (i.e., the internal) `kriging` surrogate.

- It can be called explicitely and passed to `Spot`.

```
from spotPython.build.kriging import Kriging
S_0 = Kriging(name='kriging', seed=123)
```

- Alternatively, models from `scikit-learn` can be selected, e.g., Gaussian Process, RBFs, Regression Trees, etc.

```
# Needed for the sklearn surrogates:
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.gaussian_process.kernels import RBF
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn import linear_model
from sklearn import tree
import pandas as pd
```

- Here are some additional models that might be useful later:

```
S_Tree = DecisionTreeRegressor(random_state=0)
S_LM = linear_model.LinearRegression()
S_Ridge = linear_model.Ridge()
S_RF = RandomForestRegressor(max_depth=2, random_state=0)
```

### 5.2.1 GaussianProcessRegressor as a Surrogate

- To use a Gaussian Process model from `sklearn`, that is similar to `spotPython`'s `Kriging`, we can proceed as follows:

```
kernel = 1 * RBF(length_scale=1.0, length_scale_bounds=(1e-2, 1e2))
S_GP = GaussianProcessRegressor(kernel=kernel, n_restarts_optimizer=9)
```

- The scikit-learn GP model `S_GP` is selected for `Spot` as follows:

  `surrogate = S_GP`

- We can check the kind of surogate model with the command `isinstance`:

```
isinstance(S_GP, GaussianProcessRegressor)
```

```
True
```

```
isinstance(S_0, Kriging)
```

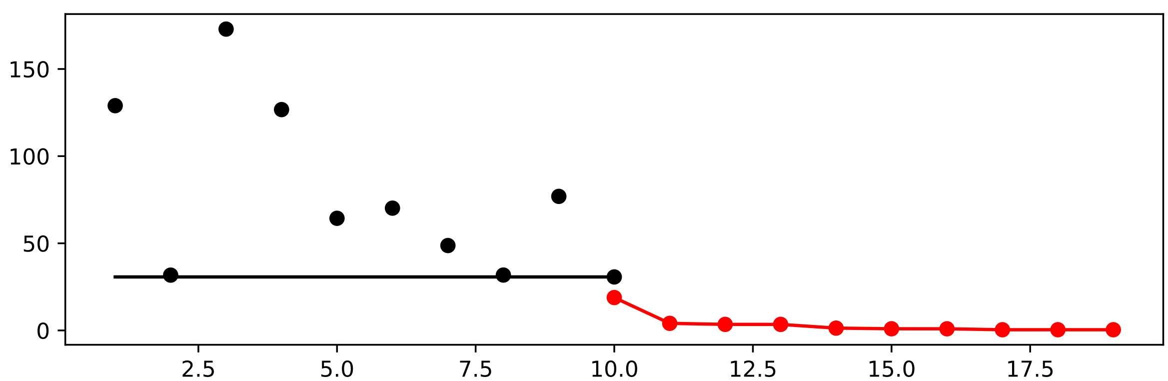
```
True
```

- Similar to the `Spot` run with the internal `Kriging` model, we can call the run with the `scikit-learn` surrogate:

```
fun = analytical(seed=123).fun_branin
spot_2_GP = spot.Spot(fun=fun,
                     lower = lower,
                     upper = upper,
                     fun_evals = 20,
                     seed=123,
                     design_control={"init_size": 10},
                     surrogate = S_GP)
spot_2_GP.run()
```

```
<spotPython.spot.spot.Spot at 0x15646a680>
```

```
spot_2_GP.plot_progress()
```




```
spot_2_GP.print_results()
```

```
min y: 0.3982328844079852
x0: 3.1500760136608945
x1: 2.26848948547406
```

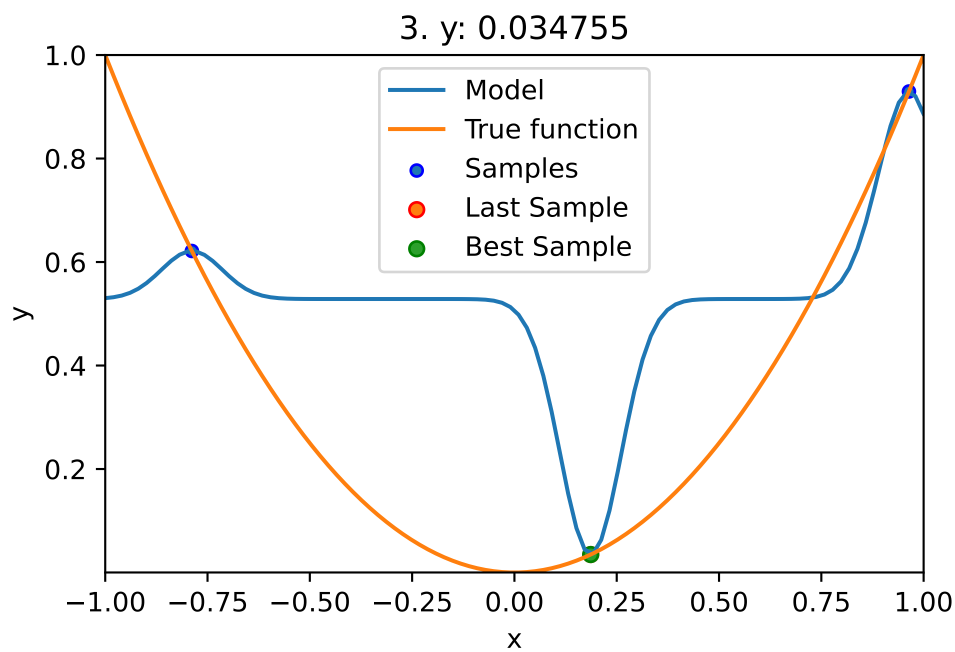
```
[['x0', 3.1500760136608945], ['x1', 2.26848948547406]]
```

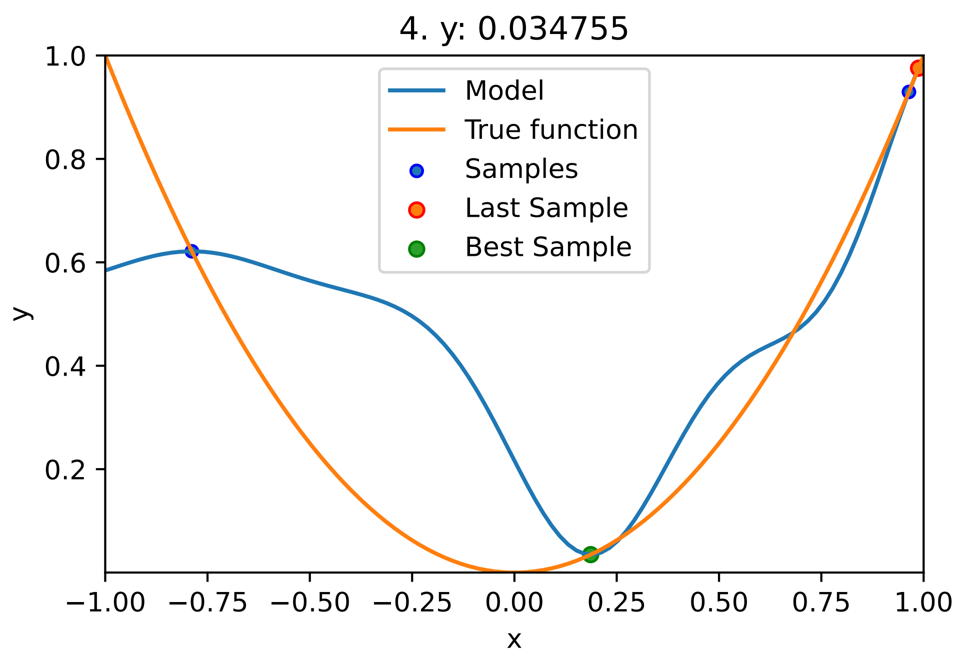
# 6 Example: One-dimensional Sphere Function With spotPython's Kriging

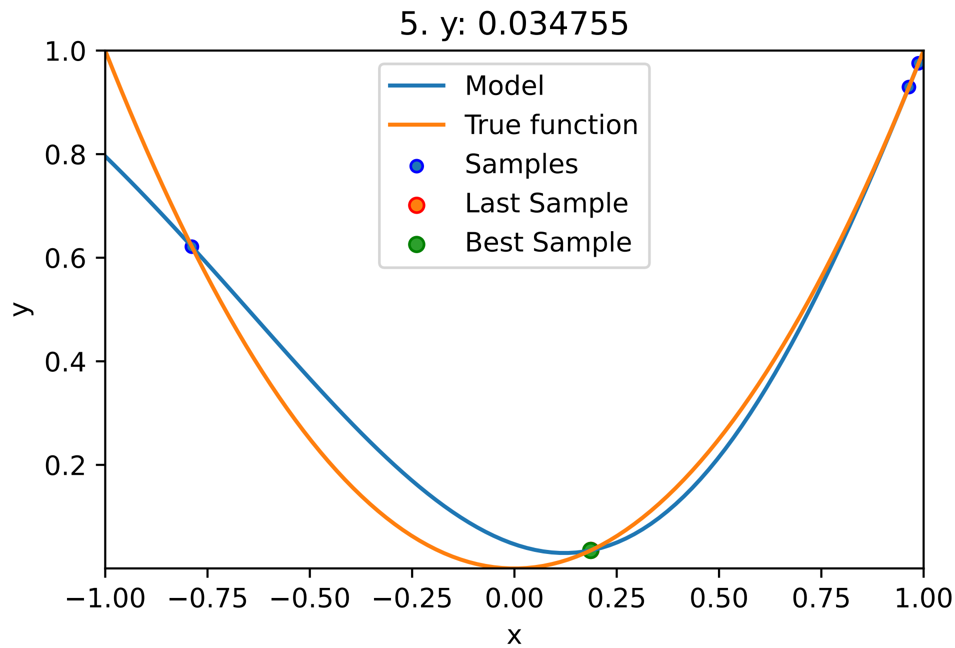
- In this example, we will use an one-dimensional function, which allows us to visualize the optimization process.
    - show_models= True is added to the argument list.

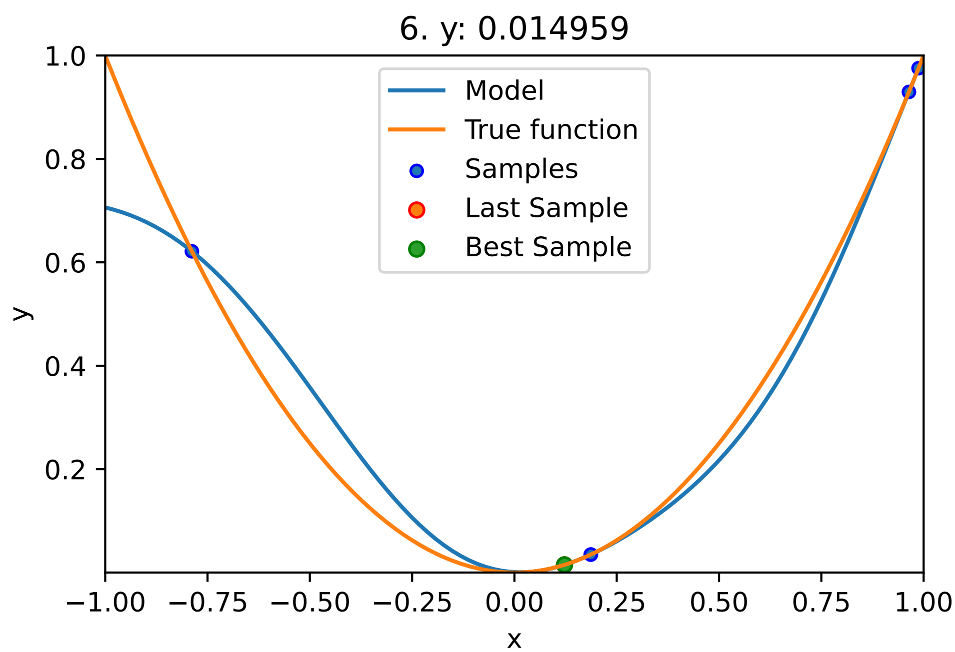
```
from spotPython.fun.objectivefunctions import analytical
lower = np.array([-1])
upper = np.array([1])
fun = analytical(seed=123).fun_sphere
```

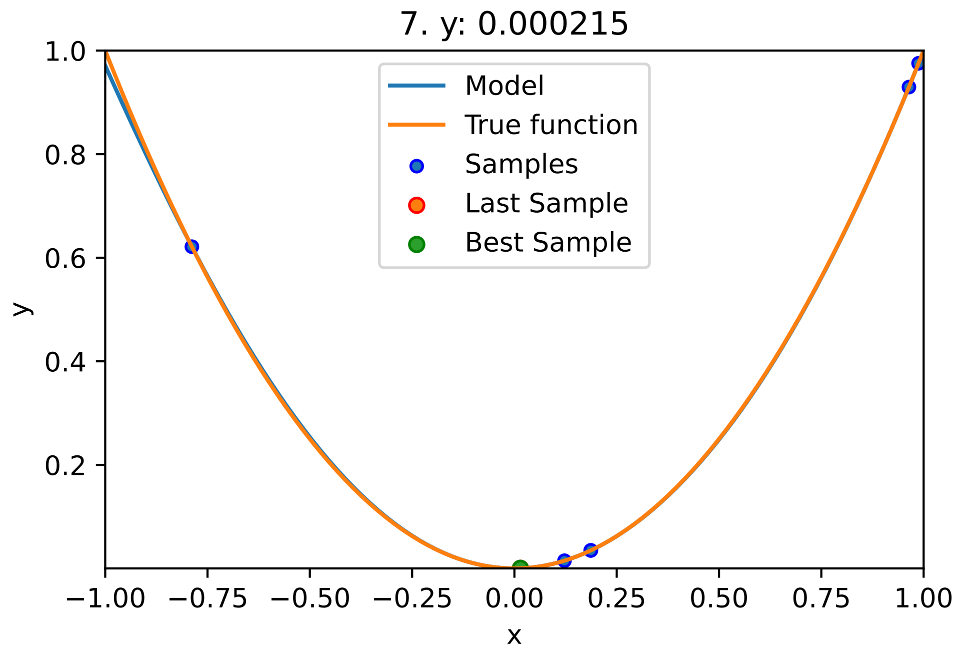
```
spot_1 = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = 10,
                   max_time = inf,
                   seed=123,
                   show_models= True,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   design_control={"init_size": 3},)
spot_1.run()
```

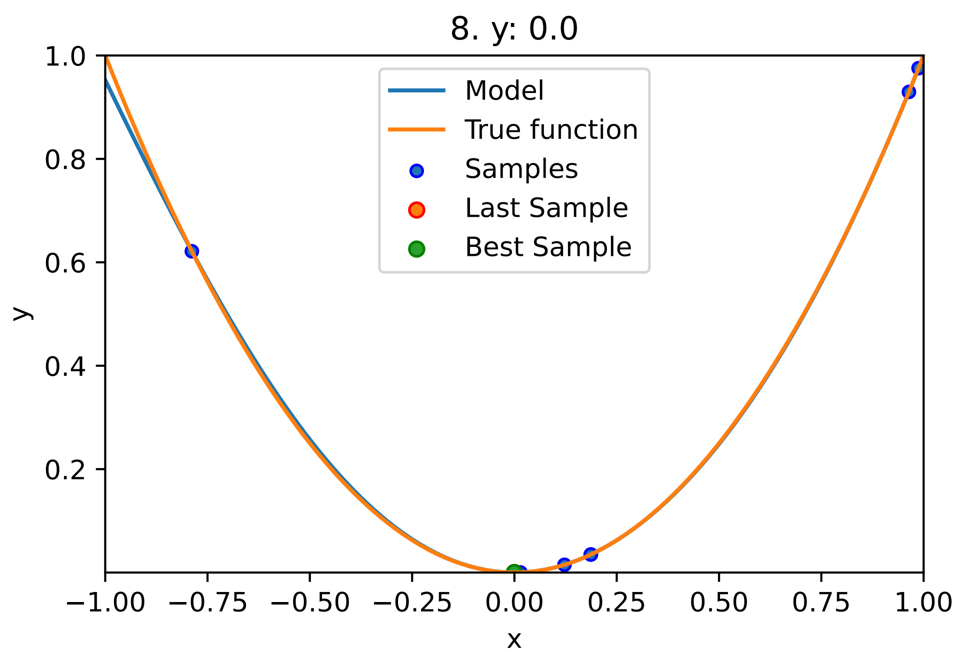

3. y: 0.034755
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x
Model
True function
Samples
Last Sample
Best Sample

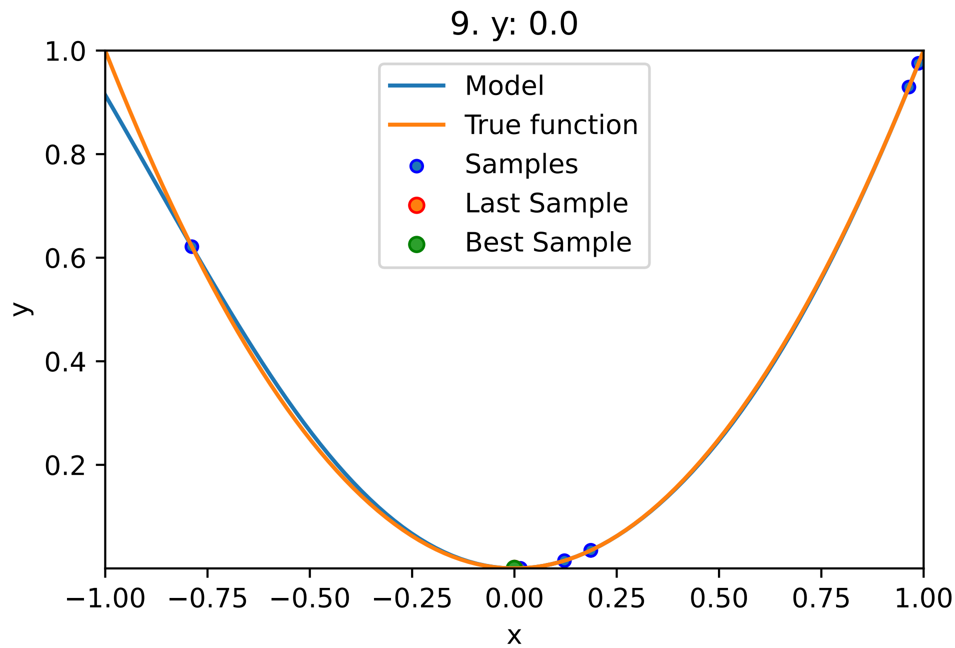

4. y: 0.034755
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x
Model
True function
Samples
Last Sample
Best Sample

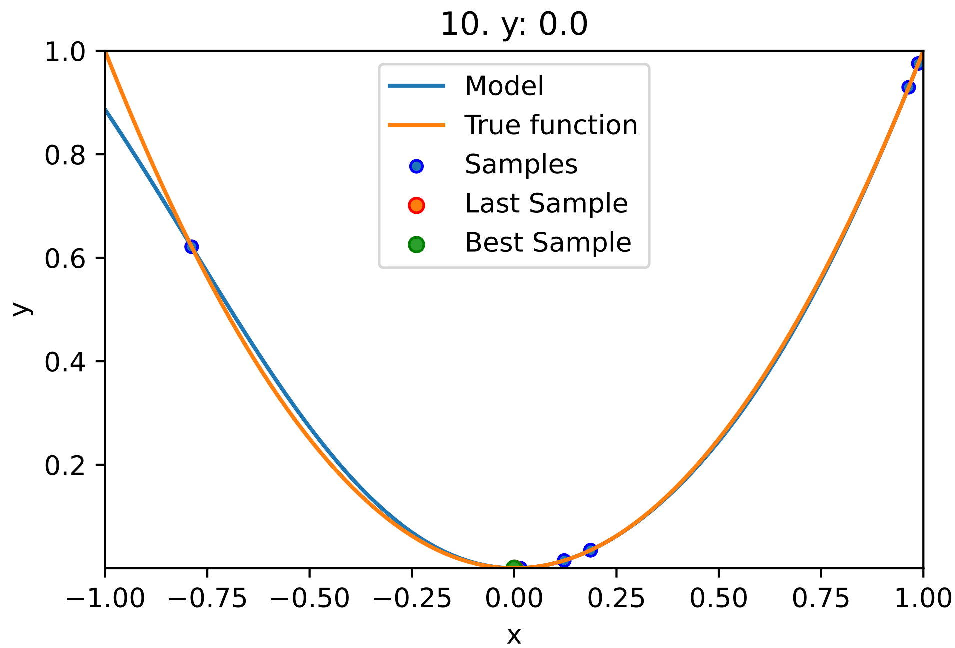

5. y: 0.034755
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x


6. y: 0.014959
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x


7. y: 0.000215
Model
True function
Samples
Last Sample
Best Sample
y
x
1.0
0.8
0.6
0.4
0.2
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00


8. y: 0.0
Model
True function
Samples
Last Sample
Best Sample
y
x
1.0
0.8
0.6
0.4
0.2
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00




```
<spotPython.spot.spot.Spot at 0x15646b670>
```

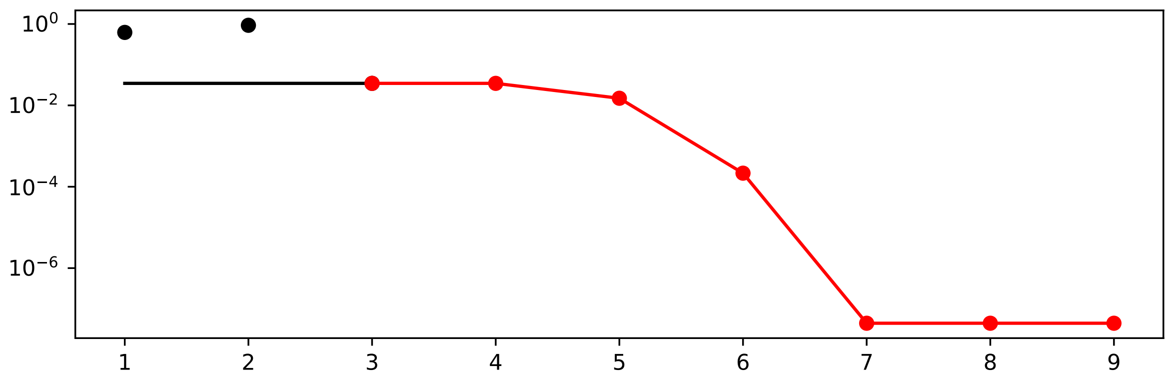
### 6.0.1 Results

```
spot_1.print_results()
```

```
min y: 4.41925228274096e-08
x0: -0.00021022017702259125
```

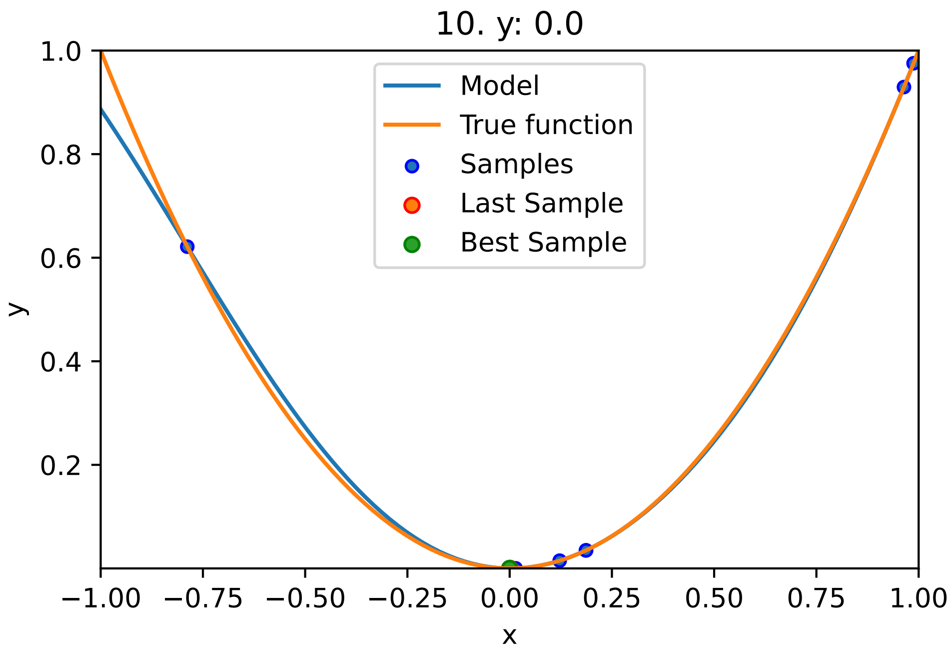
```
[['x0', -0.00021022017702259125]]
```

```
spot_1.plot_progress(log_y=True)
```




- The method `plot_model` plots the final surrogate:

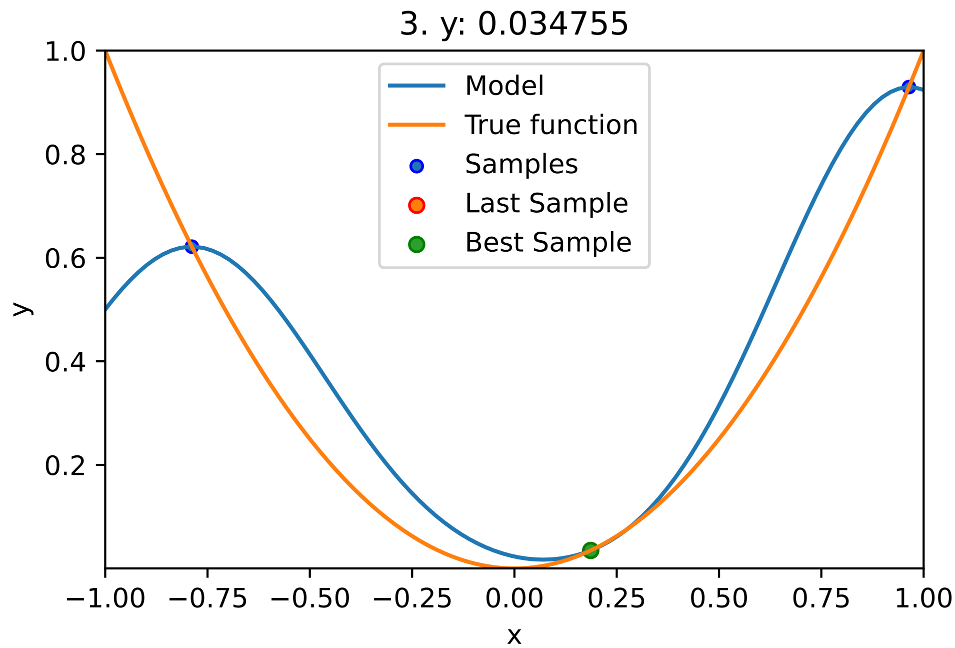
```
spot_1.plot_model()
```

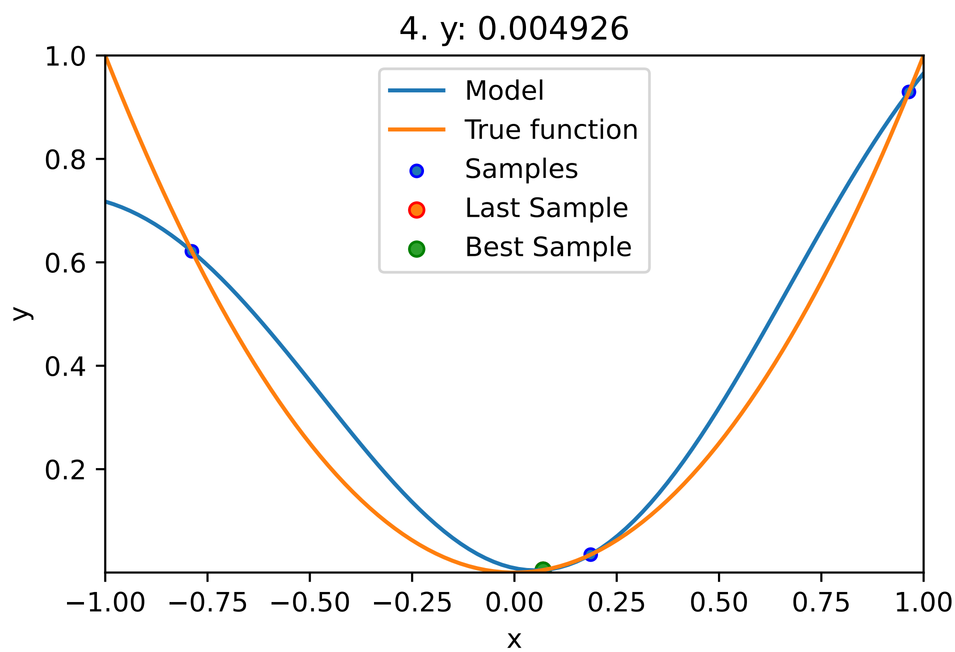


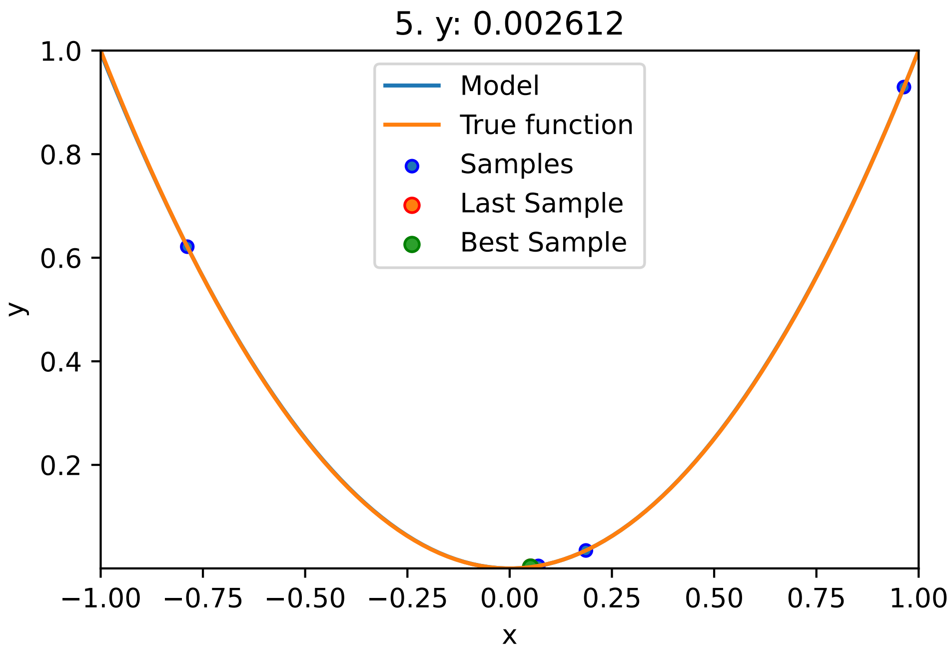

## 6.1 Example: `Sklearn` Model GaussianProcess

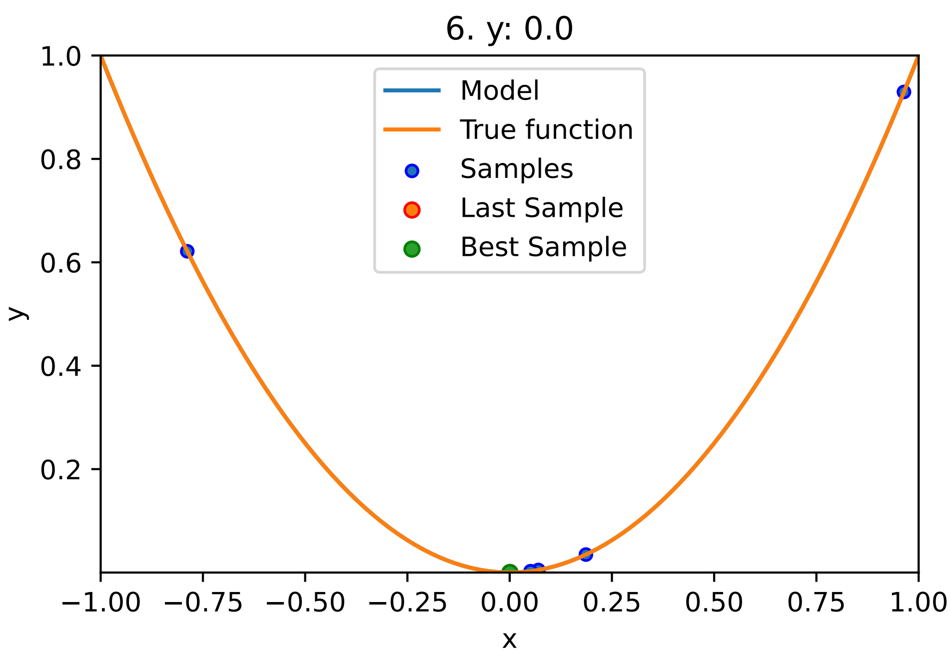
- This example visualizes the search process on the `GaussianProcessRegression` surrogate from `sklearn`.
- Therefore `surrogate = S_GP` is added to the argument list.

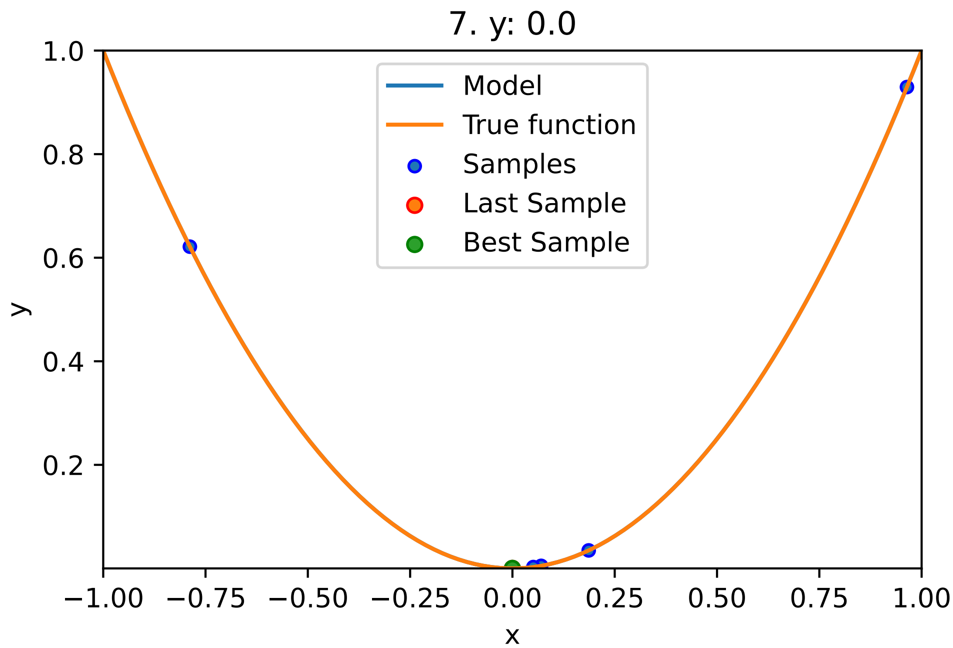
```
fun = analytical(seed=123).fun_sphere
spot_1_GP = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = 10,
                   max_time = inf,
                   seed=123,
                   show_models= True,
                   design_control={"init_size": 3},
                   surrogate = S_GP)
spot_1_GP.run()
```

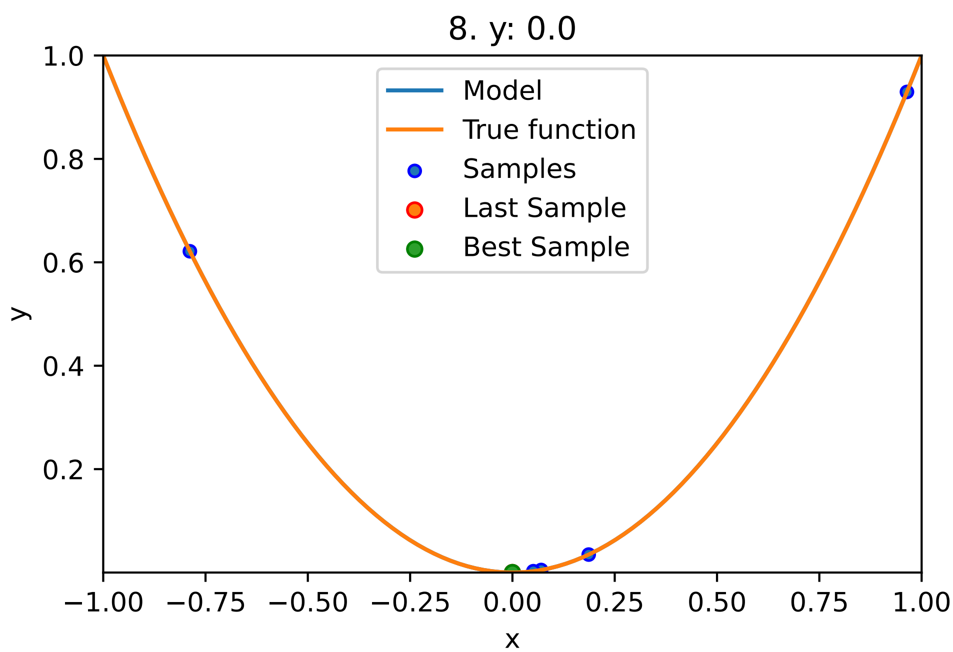

3. y: 0.034755
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x

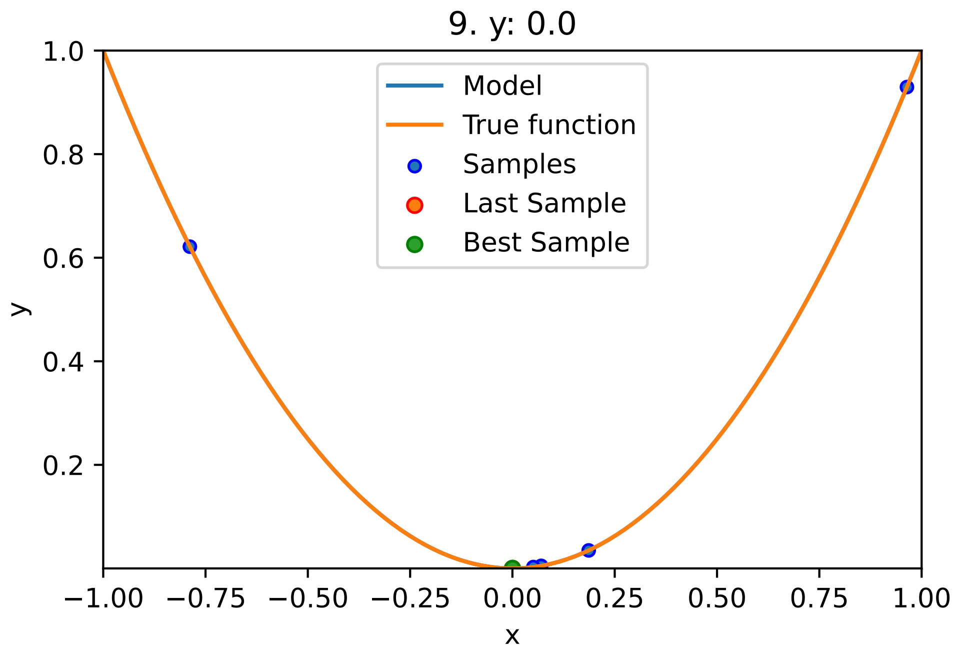

4. y: 0.004926
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x

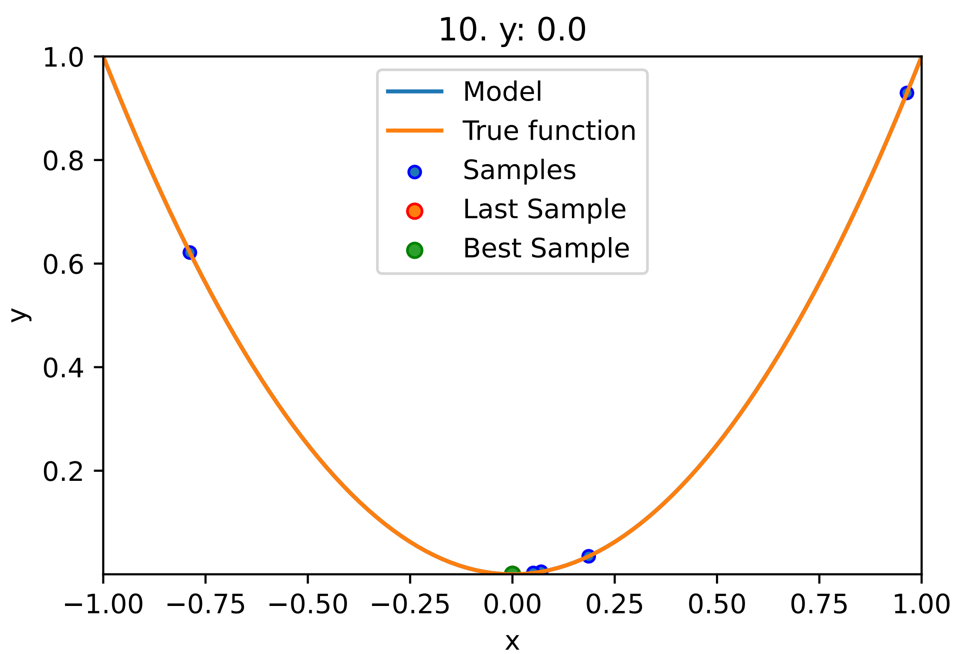

5. y: 0.002612
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x


6. y: 0.0
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x


7. y: 0.0
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x


8. y: 0.0
Model
True function
Samples
Last Sample
Best Sample
1.0
0.8
0.6
0.4
0.2
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x



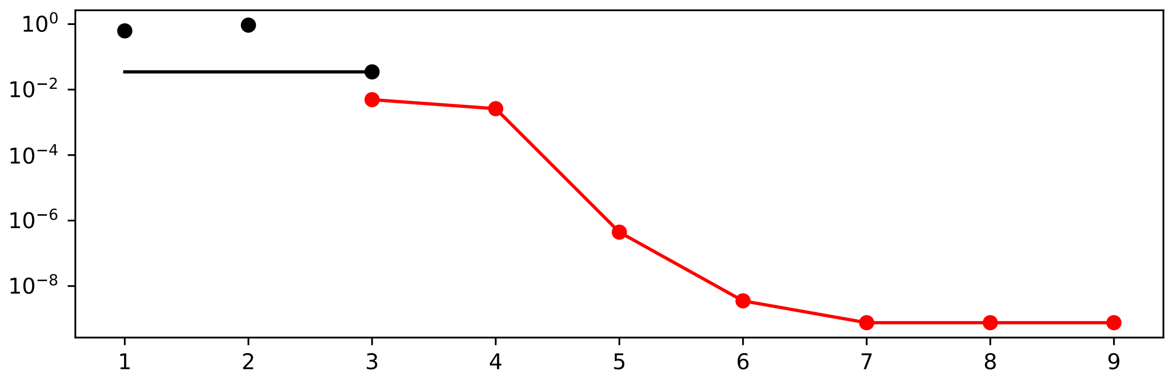

```
<spotPython.spot.spot.Spot at 0x294d9da50>
```

```python
spot_1_GP.print_results()
```

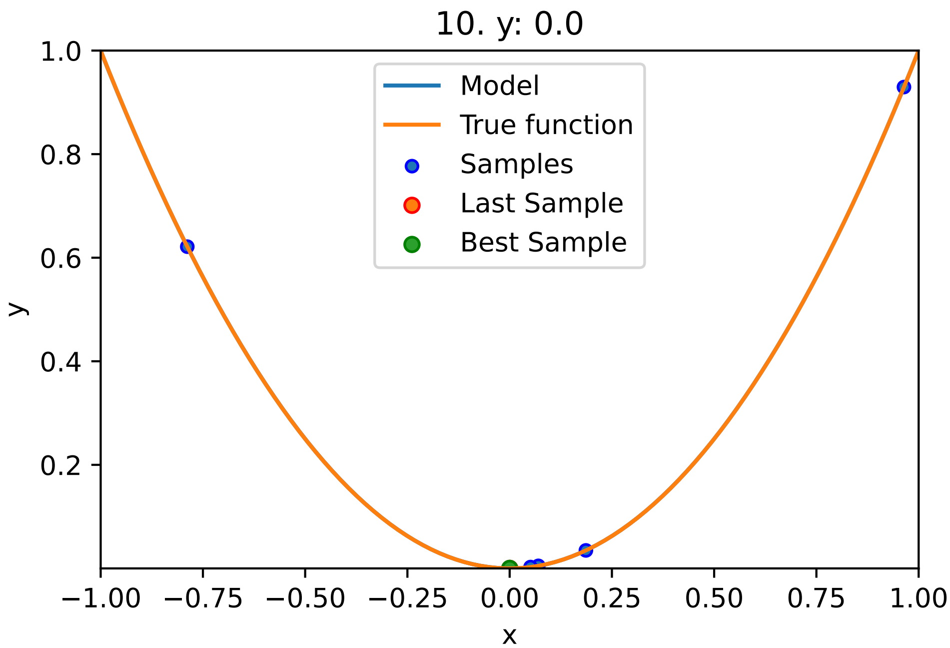
```
min y: 7.59908205148243e-10
x0: 2.7566432579284594e-05
```

```
[['x0', 2.7566432579284594e-05]]
```

```python
spot_1_GP.plot_progress(log_y=True)
```




```python
spot_1_GP.plot_model()
```


10. y: 0.0
Model
True function
Samples
Last Sample
Best Sample
y
x
1.0
0.8
0.6
0.4
0.2
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

# 7 Exercises

- Important:
  - Results from these exercises should be added to this document, i.e., you should submit an updated version of this notebook.
  - Please combine your results using this notebook.
  - Only one notebook from each group!
  - Presentation is based on this notebook. No addtional slides are required!
  - spotPython version `0.16.11` (or greater) is required.

### 7.0.1 `DecisionTreeRegressor`

- Describe the surrogate model.
- Use the surrogate as the model for optimization.

### 7.0.2 `RandomForestRegressor`

- Describe the surrogate model.
- Use the surrogate as the model for optimization.

### 7.0.3 `linear_model.LinearRegression`

- Describe the surrogate model.
- Use the surrogate as the model for optimization.

### 7.0.4 `linear_model.Ridge`

- Describe the surrogate model.
- Use the surrogate as the model for optimization.

## 7.1 Exercise 2

- Compare the performance of the five different surrogates on both objective functions:
  - `spotPython`'s internal Kriging
  - `DecisionTreeRegressor`
  - `RandomForestRegressor`
  - `linear_model.LinearRegression`
  - `linear_model.Ridge`

# 8 Sequential Parameter Optimization: Using `scipy` Optimizers

This notebook describes how different optimizers form the `scipy optimize` package can be used on the surrogate. The optimization algorithms are available from https://docs.scipy.org/doc/scipy/reference/optimize.html

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
from scipy.optimize import dual_annealing
from scipy.optimize import basinhopping
import matplotlib.pyplot as plt
```

## 8.1 The Objective Function Branin

- The `spotPython` package provides several classes of objective functions.
- We will use an analytical objective function, i.e., a function that can be described by a (closed) formula.
- Here we will use the Branin function. The 2-dim Branin function is

  $$y = a * (x2 - b * x1 * *2 + c * x1 - r) * *2 + s * (1 - t) * cos(x1) + s,$$

  where values of a, b, c, r, s and t are: $a = 1, b = 5.1/(4 * pi * *2), c = 5/pi, r = 6, s = 10$ and $t = 1/(8 * pi)$.
- It has three global minima:

  $f(x) = 0.397887$ at $(-\pi, 12.275)$, $(\pi, 2.275)$, and $(9.42478, 2.475)$.

- Input Domain: This function is usually evaluated on the square x1 in [-5, 10] x x2 in [0, 15].

```
from spotPython.fun.objectivefunctions import analytical
lower = np.array([-5,-0])
upper = np.array([10,15])
```

```
fun = analytical(seed=123).fun_branin
```

## 8.2 The Optimizer

- Differential Evalution from the `scikit.optimize` package, see https://docs.scipy.org/doc/scipy/reference/generated/scipy.optimize.differential_evolution.html#scipy.optimize.differential_evolution is the default optimizer for the search on the surrogate.
- Other optimiers that are available in `spotPython`:
  - `dual_annealing`
  - `direct`
  - `shgo`
  - `basinhopping`, see https://docs.scipy.org/doc/scipy/reference/optimize.html#global-optimization.
- These can be selected as follows:

  `surrogate_control = "model_optimizer": differential_evolution`
- We will use `differential_evolution`.
- The optimizer can use `1000` evaluations. This value will be passed to the `differential_evolution` method, which has the argument `maxiter` (int). It defines the maximum number of generations over which the entire differential evolution population is evolved, see https://docs.scipy.org/doc/scipy/reference/generated/scipy.optimize.differential_evolution.html#scipy.optimize.differential_evolution

```
spot_de = spot.Spot(fun=fun,
                    lower = lower,
                    upper = upper,
                    fun_evals = 20,
                    max_time = inf,
                    seed=125,
                    noise=False,
```

```
                           show_models= False,
                           design_control={"init_size": 10},
                           surrogate_control={"n_theta": 2,
                                              "model_optimizer": differential_evolution,
                                              "model_fun_evals": 1000,
                                              })
spot_de.run()
```

```
<spotPython.spot.spot.Spot at 0x105b5d210>
```

## 8.3 Print the Results

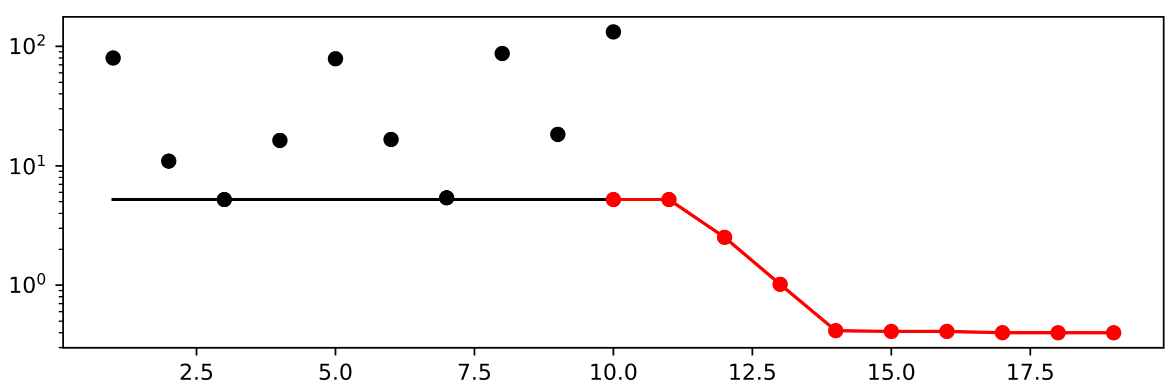
```
spot_de.print_results()
```

```
min y: 0.39951958110619046
x0: -3.1570201165683587
x1: 12.289980569430284
```

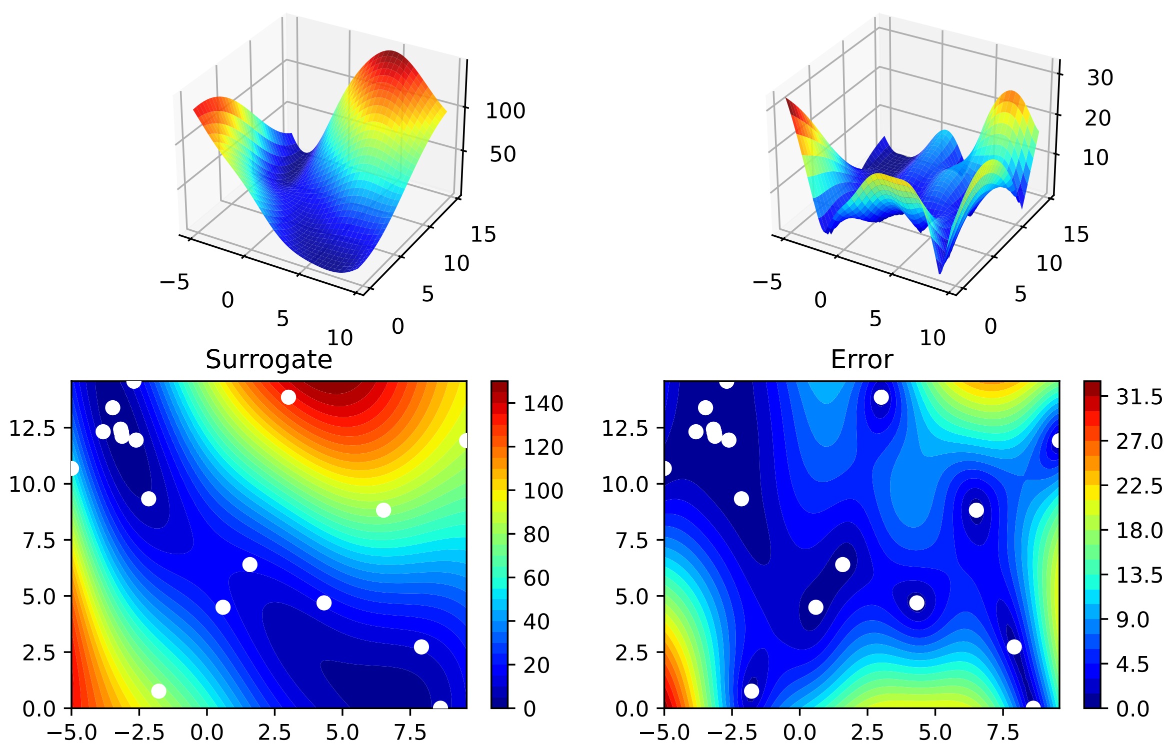
```
[['x0', -3.1570201165683587], ['x1', 12.289980569430284]]
```

## 8.4 Show the Progress

```
spot_de.plot_progress(log_y=True)
```



```
spot_de.surrogate.plot()
```



# 9 Exercises

## 9.1 `dual_annealing`

- Describe the optimization algorithm
- Use the algorithm as an optimizer on the surrogate

## 9.2 `direct`

- Describe the optimization algorithm
- Use the algorithm as an optimizer on the surrogate

## 9.3 `shgo`

- Describe the optimization algorithm
- Use the algorithm as an optimizer on the surrogate

## 9.4 `basinhopping`

- Describe the optimization algorithm
- Use the algorithm as an optimizer on the surrogate

## 9.5 Performance Comparison

Compare the performance and run time of the 5 different optimizers:

```
* `differential_evolution`
* `dual_annealing`
*  `direct`
* `shgo`
* `basinhopping`.
```

The Branin function has three global minima:

- $f(x) = 0.397887$ at
  - $(-\pi, 12.275)$,
  - $(\pi, 2.275)$, and
  - $(9.42478, 2.475)$.

- Which optima are found by the optimizers? Does the `seed` change this behavior?

# 10 Sequential Parameter Optimization: Gaussian Process Models

- This notebook analyzes differences between
  - the `Kriging` implementation in `spotPython` and
  - the `GaussianProcessRegressor` in `scikit-learn`.

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.design.spacefilling import spacefilling
from spotPython.spot import spot
from spotPython.build.kriging import Kriging
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
import math as m
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.gaussian_process.kernels import RBF
```

## 10.1 Gaussian Processes Regression: Basic Introductory `scikit-learn` Example

- This is the example from scikit-learn: https://scikit-learn.org/stable/auto_examples/gaussian_process/pl
- After fitting our model, we see that the hyperparameters of the kernel have been optimized.
- Now, we will use our kernel to compute the mean prediction of the full dataset and plot the 95% confidence interval.

### 10.1.1 Train and Test Data

```
X = np.linspace(start=0, stop=10, num=1_000).reshape(-1, 1)
y = np.squeeze(X * np.sin(X))
rng = np.random.RandomState(1)
training_indices = rng.choice(np.arange(y.size), size=6, replace=False)
X_train, y_train = X[training_indices], y[training_indices]
```

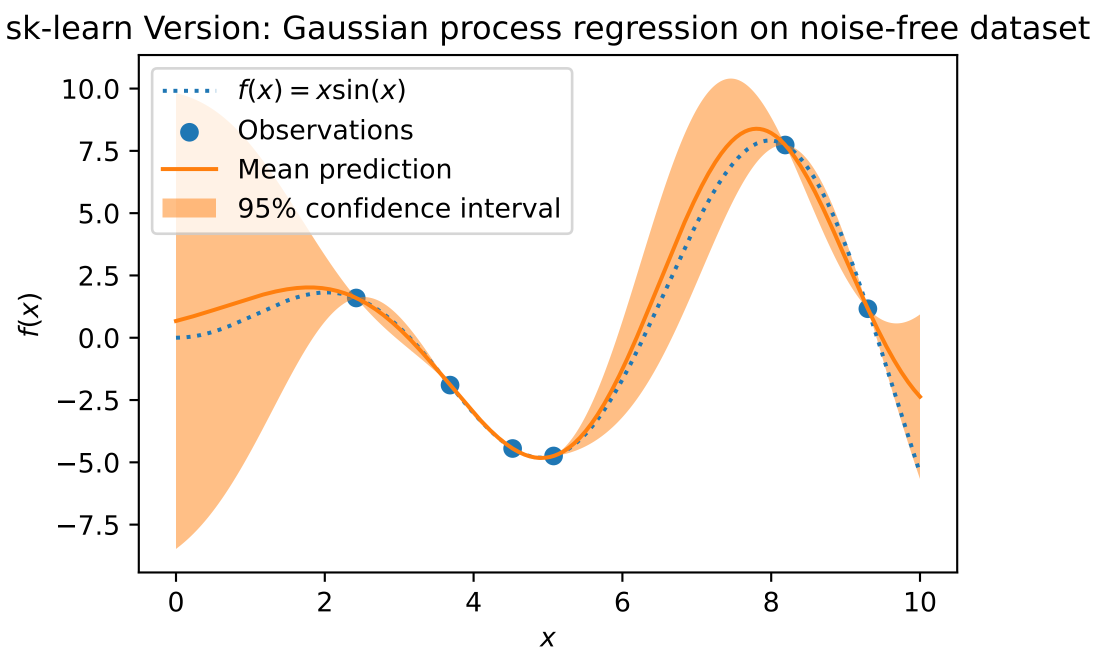
### 10.1.2 Building the Surrogate With `Sklearn`

- The model building with `sklearn` consisits of three steps:
    1. Instantiating the model, then
    2. fitting the model (using `fit`), and
    3. making predictions (using `predict`)

```
kernel = 1 * RBF(length_scale=1.0, length_scale_bounds=(1e-2, 1e2))
gaussian_process = GaussianProcessRegressor(kernel=kernel, n_restarts_optimizer=9)
gaussian_process.fit(X_train, y_train)
mean_prediction, std_prediction = gaussian_process.predict(X, return_std=True)
```

### 10.1.3 Plotting the `Sklearn`Model

```
plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, mean_prediction, label="Mean prediction")
plt.fill_between(
    X.ravel(),
    mean_prediction - 1.96 * std_prediction,
    mean_prediction + 1.96 * std_prediction,
    alpha=0.5,
    label=r"95% confidence interval",
)
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("sk-learn Version: Gaussian process regression on noise-free dataset")
```



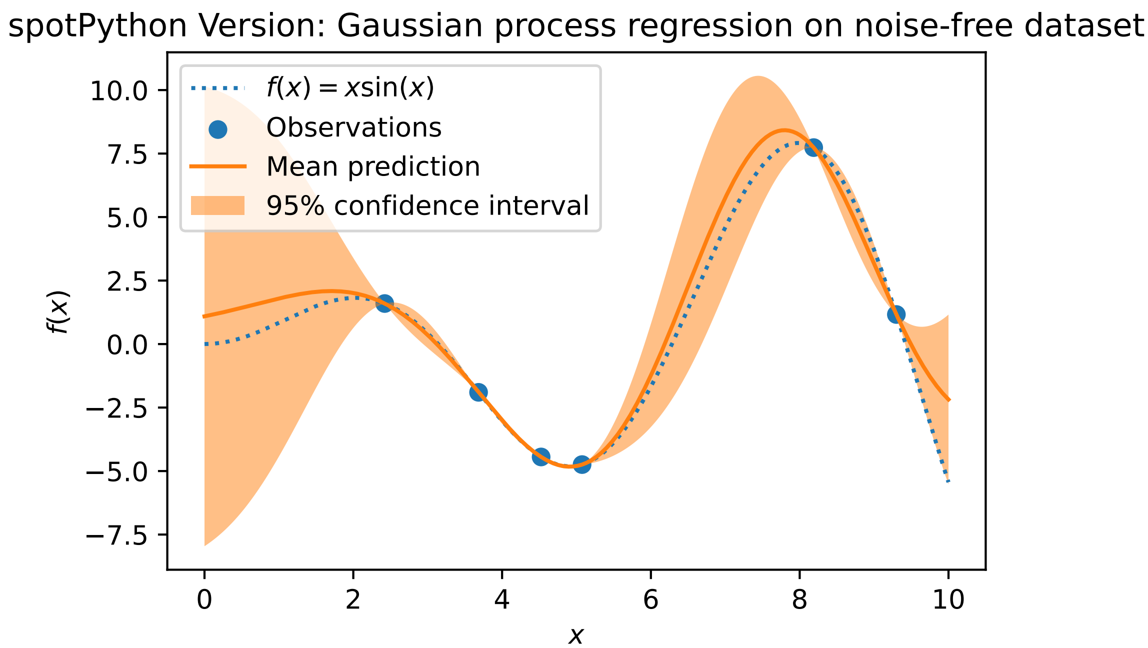

### 10.1.4 The `spotPython` Version

- The `spotPython` version is very similar:
    1. Instantiating the model, then
    2. fitting the model and
    3. making predictions (using `predict`).

```
S = Kriging(name='kriging',  seed=123, log_level=50, cod_type="norm")
S.fit(X_train, y_train)
S_mean_prediction, S_std_prediction, S_ei = S.predict(X, return_val="all")
```

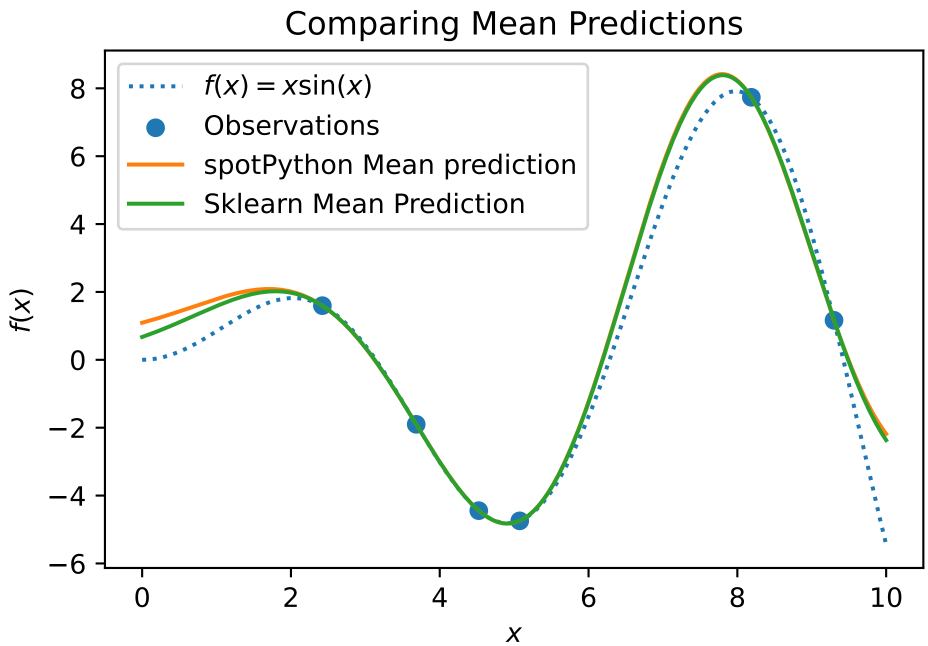
```
plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, S_mean_prediction, label="Mean prediction")
plt.fill_between(
    X.ravel(),
    S_mean_prediction - 1.96 * S_std_prediction,
    S_mean_prediction + 1.96 * S_std_prediction,
    alpha=0.5,
    label=r"95% confidence interval",
```

```
)
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("spotPython Version: Gaussian process regression on noise-free dataset")
```




### 10.1.5 Visualizing the Differences Between the `spotPython` and the `sklearn` Model Fits

```
plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, S_mean_prediction, label="spotPython Mean prediction")
plt.plot(X, mean_prediction, label="Sklearn Mean Prediction")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Comparing Mean Predictions")
```



Comparing Mean Predictions
f(x) = x sin(x)
Observations
spotPython Mean prediction
Sklearn Mean Prediction
f(x)
x
8
6
4
2
0
−2
−4
−6
0
2
4
6
8
10

# 11 Exercises

## 11.1 Schonlau Example Function

- The Schonlau Example Function is based on sample points only (there is no analytical function description available):

```
X = np.linspace(start=0, stop=13, num=1_000).reshape(-1, 1)
X_train = np.array([1., 2., 3., 4., 12.]).reshape(-1,1)
y_train = np.array([0., -1.75, -2, -0.5, 5.])
```

- Describe the function.
- Compare the two models that were build using the `spotPython` and the `sklearn` surrogate.
- Note: Since there is no analytical function available, you might be interested in adding some points and describe the effects.

## 11.2 Forrester Example Function

- The Forrester Example Function is defined as follows:

  `f(x) = (6x- 2)^2 sin(12x-4) for x in [0,1].`

- Data points are generated as follows:

```
X = np.linspace(start=-0.5, stop=1.5, num=1_000).reshape(-1, 1)
X_train = np.array([0.0, 0.175, 0.225, 0.3, 0.35, 0.375, 0.5,1]).reshape(-1,1)
fun = analytical().fun_forrester
fun_control = {"sigma": 0.1,
               "seed": 123}
y = fun(X, fun_control=fun_control)
y_train = fun(X_train, fun_control=fun_control)
```

- Describe the function.

- Compare the two models that were build using the `spotPython` and the `sklearn` surrogate.
- Note: Modify the noise level (`"sigma"`), e.g., use a value of `0.2`, and compare the two models.

```
fun_control = {"sigma": 0.2}
```

## 11.3 `fun_runge` Function (1-dim)

- The Runge function is defined as follows:

  `f(x) = 1/ (1 + sum(x_i))^2`

- Data points are generated as follows:

```
gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_runge
fun_control = {"sigma": 0.025,
               "seed": 123}
X_train = gen.scipy_lhd(10, lower=lower, upper = upper).reshape(-1,1)
y_train = fun(X, fun_control=fun_control)
X = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
y = fun(X, fun_control=fun_control)
```

- Describe the function.
- Compare the two models that were build using the `spotPython` and the `sklearn` surrogate.
- Note: Modify the noise level (`"sigma"`), e.g., use a value of `0.05`, and compare the two models.

```
fun_control = {"sigma": 0.5}
```

## 11.4 `fun_cubed` (1-dim)

- The Cubed function is defined as follows:

  `np.sum(X[i]** 3)`

- Data points are generated as follows:

```
gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_cubed
fun_control = {"sigma": 0.025,
               "seed": 123}
X_train = gen.scipy_lhd(10, lower=lower, upper = upper).reshape(-1,1)
y_train = fun(X, fun_control=fun_control)
X = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
y = fun(X, fun_control=fun_control)
```

- Describe the function.
- Compare the two models that were build using the `spotPython` and the `sklearn` surrogate.
- Note: Modify the noise level (`"sigma"`), e.g., use a value of `0.05`, and compare the two models.

```
fun_control = {"sigma": 0.05}
```

## 11.5 The Effect of Noise

How does the behavior of the `spotPython` fit changes when the argument `noise` is set to `True`, i.e.,

```
S = Kriging(name='kriging',  seed=123, n_theta=1, noise=True)
```

is used?

# 12 Expected Improvement

## 12.1 Example: `Spot` and the 1-dim Sphere Function

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
```

### 12.1.1 The Objective Function: 1-dim Sphere

- The `spotPython` package provides several classes of objective functions.
- We will use an analytical objective function, i.e., a function that can be described by a (closed) formula:

$$f(x) = x^2$$

```
fun = analytical().fun_sphere
```

```
fun = analytical().fun_sphere
fun_control = {"sigma": 0,
               "seed": 123}
```

- The size of the `lower` bound vector determines the problem dimension.
- Here we will use `np.array([-1])`, i.e., a one-dim function.

```
spot_1 = spot.Spot(fun=fun,
                   lower = np.array([-1]),
                   upper = np.array([1]))
```

```
spot_1.run()
```

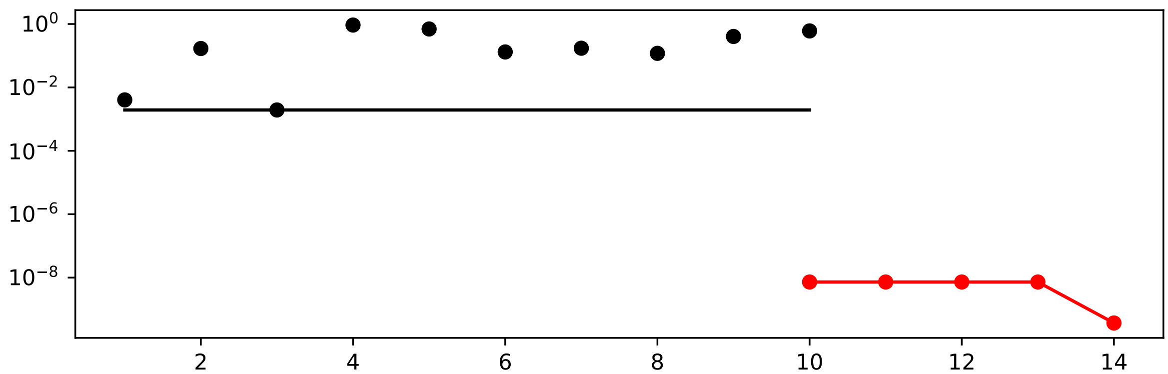
```
<spotPython.spot.spot.Spot at 0x17e02fc10>
```

### 12.1.2 Results

```
spot_1.print_results()
```

```
min y: 3.696886711914087e-10
x0: 1.922728975158508e-05

[['x0', 1.922728975158508e-05]]
```

```
spot_1.plot_progress(log_y=True)
```

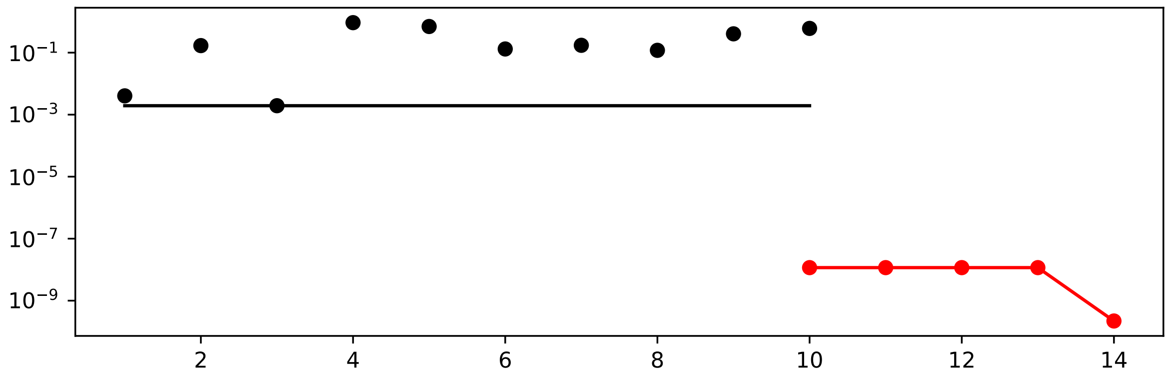



## 12.2 Same, but with EI as infill_criterion

```
spot_1_ei = spot.Spot(fun=fun,
                   lower = np.array([-1]),
                   upper = np.array([1]),
                   infill_criterion = "ei")
spot_1_ei.run()
```

```
<spotPython.spot.spot.Spot at 0x17fbb20e0>
```

```
spot_1_ei.plot_progress(log_y=True)
```




```
spot_1_ei.print_results()
```

```
min y: 2.207887258868953e-10
x0: 1.4858961130809088e-05

[['x0', 1.4858961130809088e-05]]
```

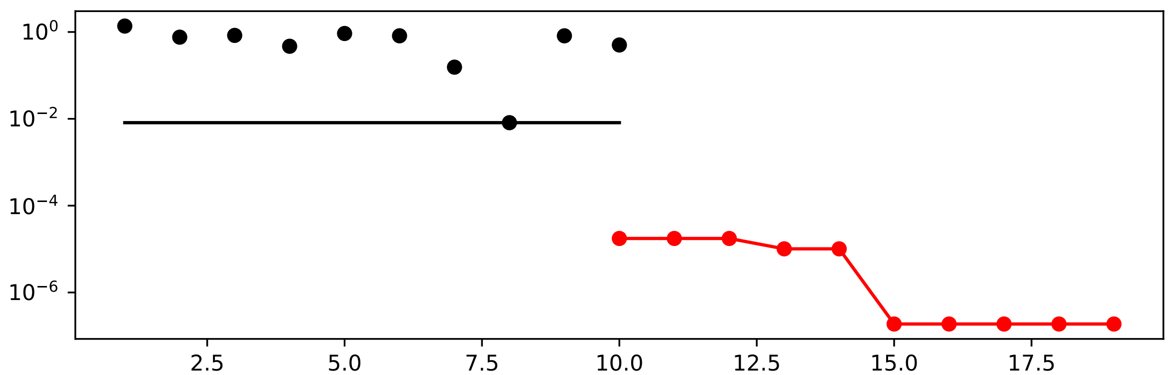
## 12.3 Non-isotropic Kriging

```
spot_2_ei_noniso = spot.Spot(fun=fun,
                    lower = np.array([-1, -1]),
                    upper = np.array([1, 1]),
                    fun_evals = 20,
                    fun_repeats = 1,
                    max_time = inf,
                    noise = False,
                    tolerance_x = np.sqrt(np.spacing(1)),
                    var_type=["num"],
                    infill_criterion = "ei",
                    n_points = 1,
                    seed=123,
                    log_level = 50,
                    show_models=True,
                    fun_control = fun_control,
```

```python
                    design_control={"init_size": 10,
                                    "repeats": 1},
                    surrogate_control={"noise": False,
                                       "cod_type": "norm",
                                       "min_theta": -4,
                                       "max_theta": 3,
                                       "n_theta": 2,
                                       "model_optimizer": differential_evolution,
                                       "model_fun_evals": 1000,
                                       })
spot_2_ei_noniso.run()
```

```
<spotPython.spot.spot.Spot at 0x17fd09ba0>
```

```python
spot_2_ei_noniso.plot_progress(log_y=True)
```

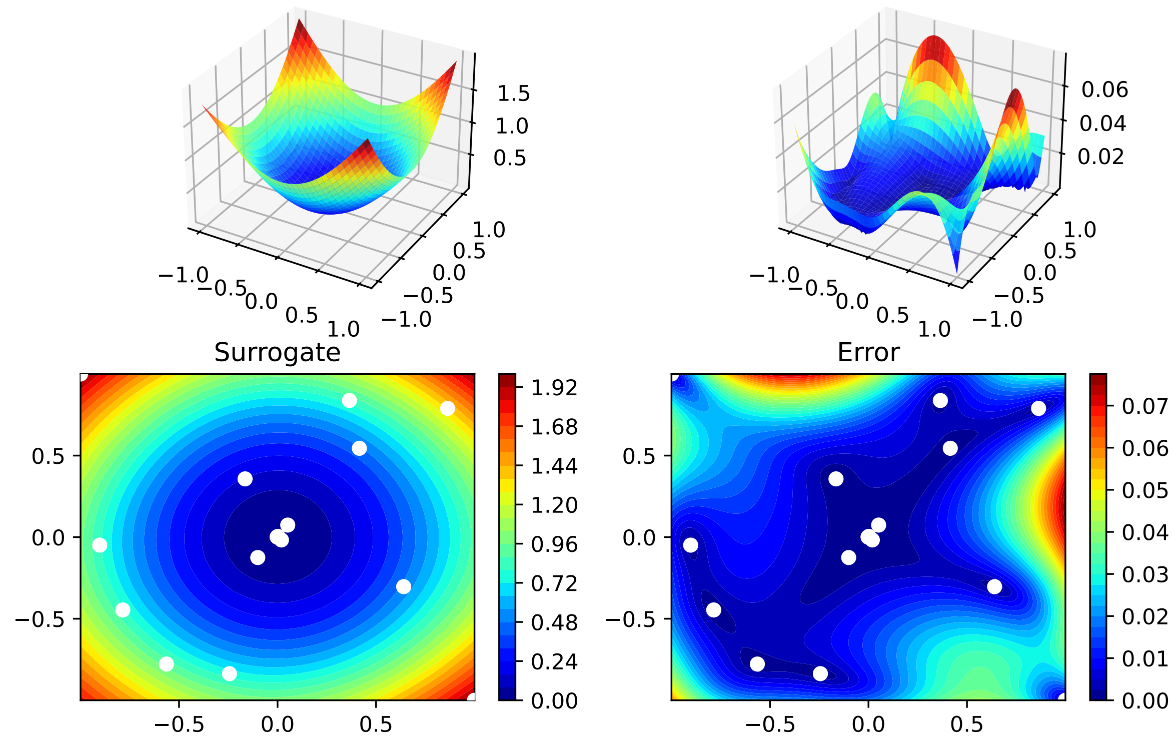


```python
spot_2_ei_noniso.print_results()
```

```
min y: 1.8779971830281702e-07
x0: -0.0002783721390529846
x1: 0.0003321274913371111
```

```
[['x0', -0.0002783721390529846], ['x1', 0.0003321274913371111]]
```

```python
spot_2_ei_noniso.surrogate.plot()
```




## 12.4 Using `sklearn` Surrogates

### 12.4.1 The spot Loop

The `spot` loop consists of the following steps:

1. Init: Build initial design $X$
2. Evaluate initial design on real objective $f$: $y = f(X)$
3. Build surrogate: $S = S(X, y)$
4. Optimize on surrogate: $X_0 = \text{optimize}(S)$
5. Evaluate on real objective: $y_0 = f(X_0)$
6. Impute (Infill) new points: $X = X \cup X_0$, $y = y \cup y_0$.
7. Got 3.

The `spot` loop is implemented in `R` as follows:

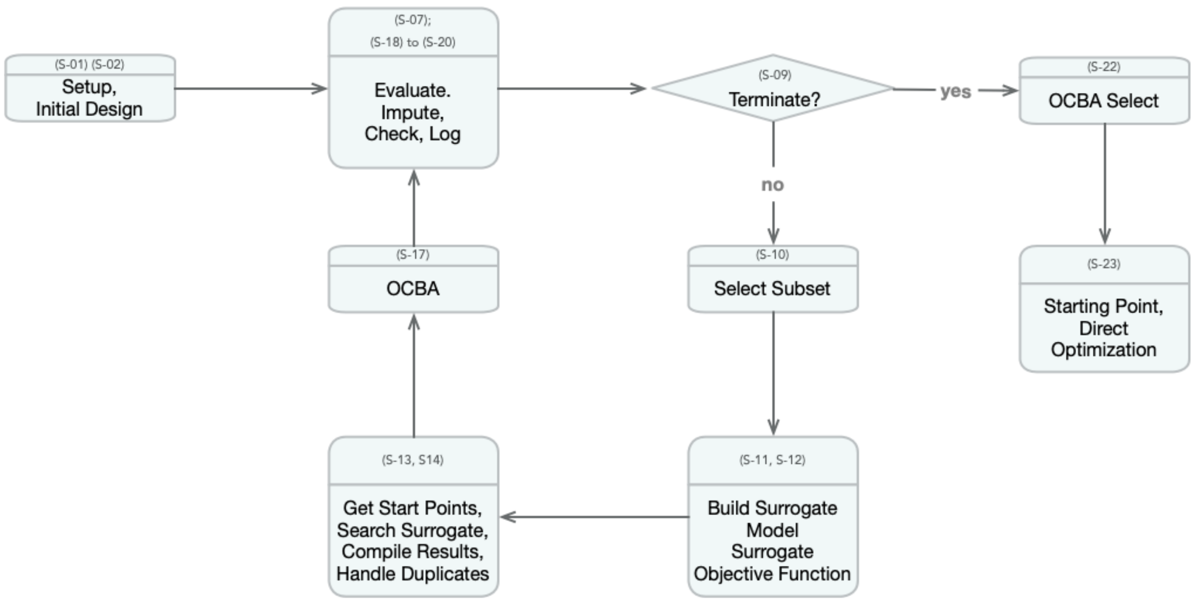



Figure 12.1: Visual representation of the model based search with SPOT. Taken from: Bartz-Beielstein, T., and Zaefferer, M. Hyperparameter tuning approaches. In Hyperparameter Tuning for Machine and Deep Learning with R - A Practical Guide, E. Bartz, T. Bartz-Beielstein, M. Zaefferer, and O. Mersmann, Eds. Springer, 2022, ch. 4, pp. 67–114.

### 12.4.2 spot: The Initial Model

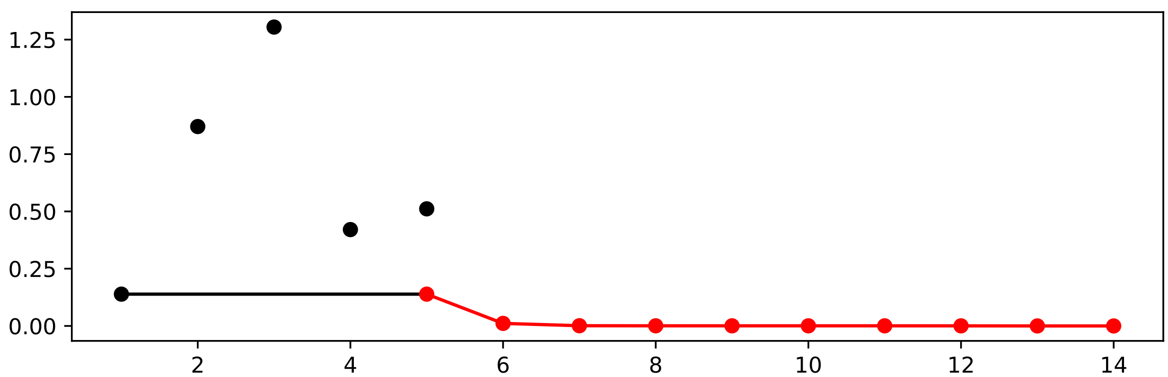
#### 12.4.2.1 Example: Modifying the initial design size

This is the "Example: Modifying the initial design size" from Chapter 4.5.1 in [bart21i].

```
spot_ei = spot.Spot(fun=fun,
                   lower = np.array([-1,-1]),
                   upper= np.array([1,1]),
                   design_control={"init_size": 5})
spot_ei.run()
```

```
<spotPython.spot.spot.Spot at 0x2aed51b40>
```

```
spot_ei.plot_progress()
```




```
np.min(spot_1.y), np.min(spot_ei.y)
```

```
(3.696886711914087e-10, 1.7928640814182596e-05)
```

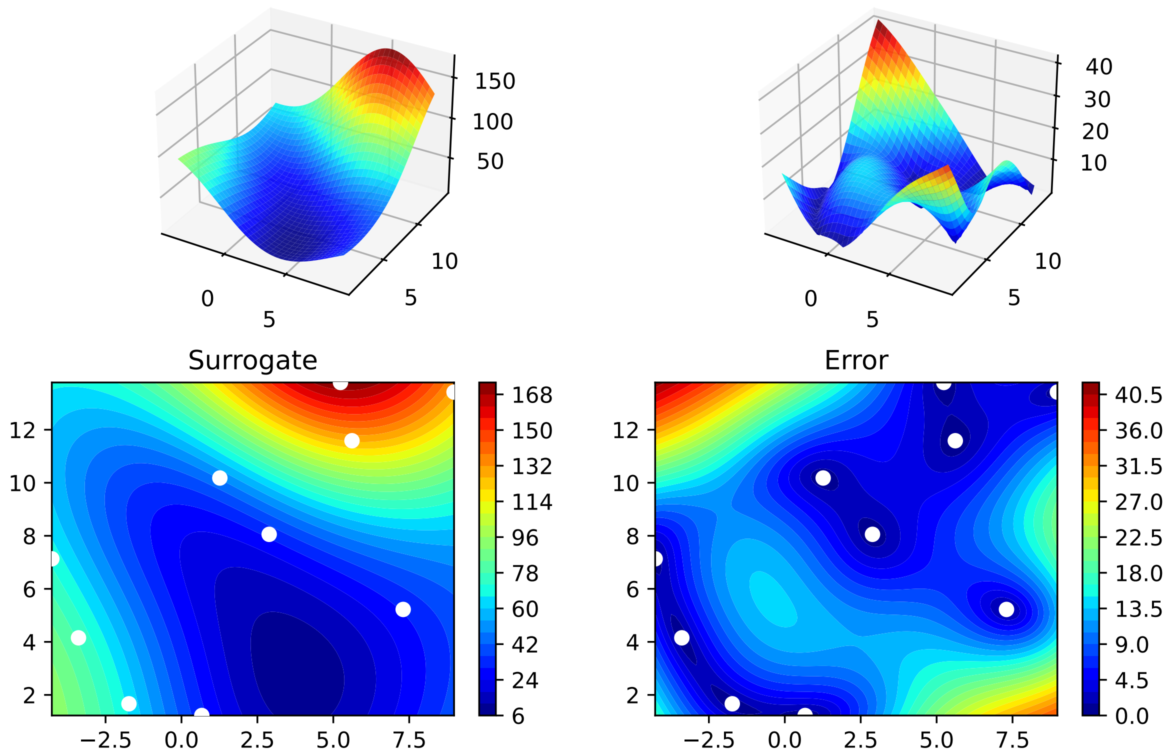
### 12.4.3 Init: Build Initial Design

```
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
from spotPython.fun.objectivefunctions import analytical
gen = spacefilling(2)
```

```python
rng = np.random.RandomState(1)
lower = np.array([-5,-0])
upper = np.array([10,15])
fun = analytical().fun_branin
fun_control = {"sigma": 0,
               "seed": 123}

X = gen.scipy_lhd(10, lower=lower, upper = upper)
print(X)
y = fun(X, fun_control=fun_control)
print(y)
```

```
[[ 8.97647221 13.41926847]
 [ 0.66946019  1.22344228]
 [ 5.23614115 13.78185824]
 [ 5.6149825  11.5851384 ]
 [-1.72963184  1.66516096]
 [-4.26945568  7.1325531 ]
 [ 1.26363761 10.17935555]
 [ 2.88779942  8.05508969]
 [-3.39111089  4.15213772]
 [ 7.30131231  5.22275244]]
[128.95676449  31.73474356 172.89678121 126.71295908  64.34349975
  70.16178611  48.71407916  31.77322887  76.91788181  30.69410529]
```

```python
S = Kriging(name='kriging',  seed=123)
S.fit(X, y)
S.plot()
```




```
gen = spacefilling(2, seed=123)
X0 = gen.scipy_lhd(3)
gen = spacefilling(2, seed=345)
X1 = gen.scipy_lhd(3)
X2 = gen.scipy_lhd(3)
gen = spacefilling(2, seed=123)
X3 = gen.scipy_lhd(3)
X0, X1, X2, X3
```

```
(array([[0.77254938, 0.31539299],
        [0.59321338, 0.93854273],
        [0.27469803, 0.3959685 ]]),
 array([[0.78373509, 0.86811887],
        [0.06692621, 0.6058029 ],
        [0.41374778, 0.00525456]]),
 array([[0.121357  , 0.69043832],
        [0.41906219, 0.32838498],
        [0.86742658, 0.52910374]]),
```

```
array([[0.77254938, 0.31539299],
       [0.59321338, 0.93854273],
       [0.27469803, 0.3959685 ]]))
```

### 12.4.4 Evaluate

### 12.4.5 Build Surrogate

### 12.4.6 A Simple Predictor

The code below shows how to use a simple model for prediction.

- Assume that only two (very costly) measurements are available:
  1. f(0) = 0.5
  2. f(2) = 2.5
- We are interested in the value at $x_0 = 1$, i.e., $f(x_0 = 1)$, but cannot run an additional, third experiment.

```
from sklearn import linear_model
X = np.array([[0], [2]])
y = np.array([0.5, 2.5])
S_lm = linear_model.LinearRegression()
S_lm = S_lm.fit(X, y)
X0 = np.array([[1]])
y0 = S_lm.predict(X0)
print(y0)
```

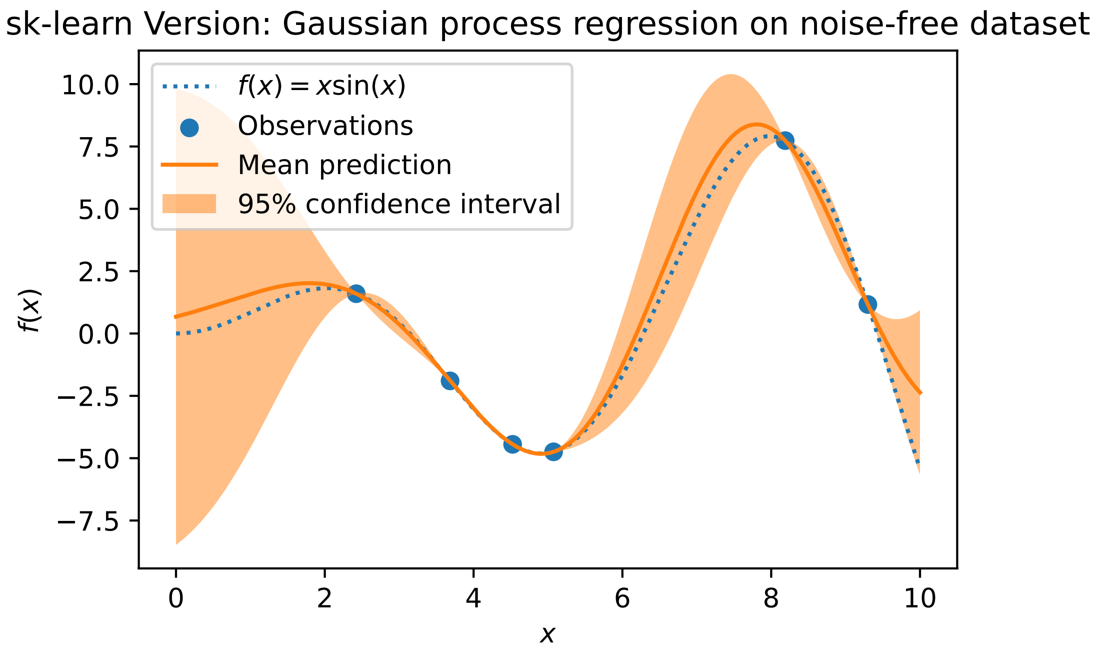
```
[1.5]
```

- Central Idea:
  - Evaluation of the surrogate model `S_lm` is much cheaper (or / and much faster) than running the real-world experiment $f$.

## 12.5 Gaussian Processes regression: basic introductory example

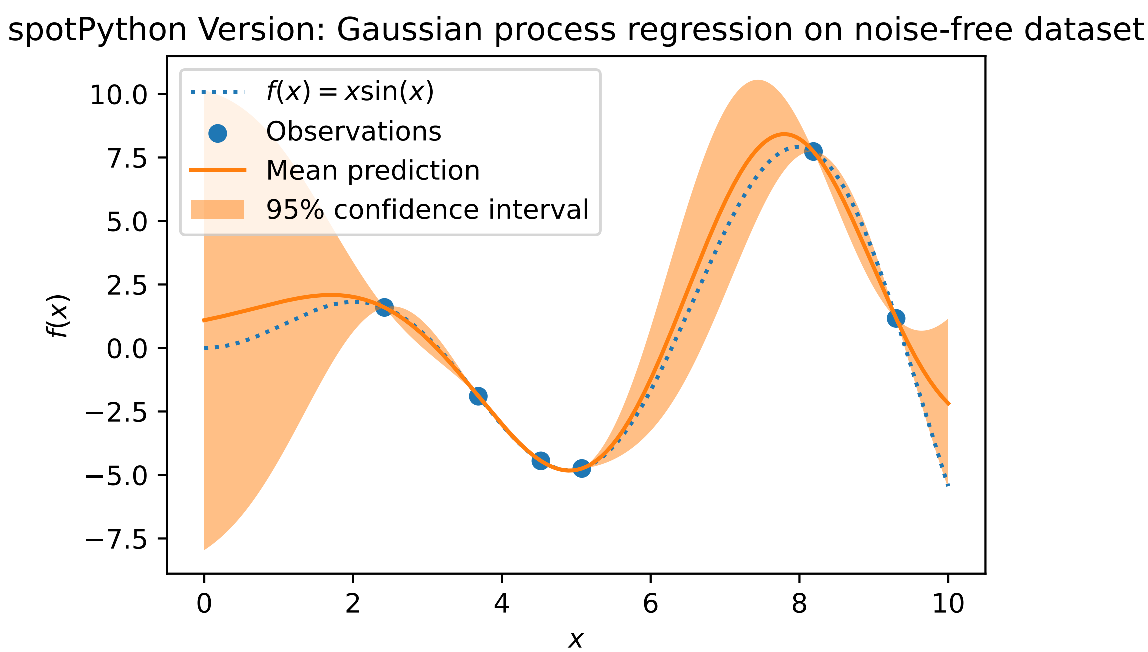
This example was taken from scikit-learn. After fitting our model, we see that the hyperparameters of the kernel have been optimized. Now, we will use our kernel to compute the mean prediction of the full dataset and plot the 95% confidence interval.

```python
import numpy as np
import matplotlib.pyplot as plt
import math as m
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.gaussian_process.kernels import RBF

X = np.linspace(start=0, stop=10, num=1_000).reshape(-1, 1)
y = np.squeeze(X * np.sin(X))
rng = np.random.RandomState(1)
training_indices = rng.choice(np.arange(y.size), size=6, replace=False)
X_train, y_train = X[training_indices], y[training_indices]

kernel = 1 * RBF(length_scale=1.0, length_scale_bounds=(1e-2, 1e2))
gaussian_process = GaussianProcessRegressor(kernel=kernel, n_restarts_optimizer=9)
gaussian_process.fit(X_train, y_train)
gaussian_process.kernel_

mean_prediction, std_prediction = gaussian_process.predict(X, return_std=True)

plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, mean_prediction, label="Mean prediction")
plt.fill_between(
    X.ravel(),
    mean_prediction - 1.96 * std_prediction,
    mean_prediction + 1.96 * std_prediction,
    alpha=0.5,
    label=r"95% confidence interval",
)
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("sk-learn Version: Gaussian process regression on noise-free dataset")
```




```python
from spotPython.build.kriging import Kriging
import numpy as np
import matplotlib.pyplot as plt
rng = np.random.RandomState(1)
X = np.linspace(start=0, stop=10, num=1_000).reshape(-1, 1)
y = np.squeeze(X * np.sin(X))
training_indices = rng.choice(np.arange(y.size), size=6, replace=False)
X_train, y_train = X[training_indices], y[training_indices]


S = Kriging(name='kriging',  seed=123, log_level=50, cod_type="norm")
S.fit(X_train, y_train)

mean_prediction, std_prediction, ei = S.predict(X, return_val="all")

std_prediction

plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, mean_prediction, label="Mean prediction")
plt.fill_between(
```

```
    X.ravel(),
    mean_prediction - 1.96 * std_prediction,
    mean_prediction + 1.96 * std_prediction,
    alpha=0.5,
    label=r"95% confidence interval",
)
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("spotPython Version: Gaussian process regression on noise-free dataset")
```




## 12.6 The Surrogate: Using scikit-learn models

Default is the internal `kriging` surrogate.

```
S_0 = Kriging(name='kriging', seed=123)
```

Models from `scikit-learn` can be selected, e.g., Gaussian Process:

```python
# Needed for the sklearn surrogates:
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.gaussian_process.kernels import RBF
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn import linear_model
from sklearn import tree
import pandas as pd
```

```python
kernel = 1 * RBF(length_scale=1.0, length_scale_bounds=(1e-2, 1e2))
S_GP = GaussianProcessRegressor(kernel=kernel, n_restarts_optimizer=9)
```

- and many more:

```python
S_Tree = DecisionTreeRegressor(random_state=0)
S_LM = linear_model.LinearRegression()
S_Ridge = linear_model.Ridge()
S_RF = RandomForestRegressor(max_depth=2, random_state=0)
```

- The scikit-learn GP model `S_GP` is selected.

```python
S = S_GP
```

```python
isinstance(S, GaussianProcessRegressor)
```

```
True
```

```python
from spotPython.fun.objectivefunctions import analytical
fun = analytical().fun_branin
lower = np.array([-5,-0])
upper = np.array([10,15])
design_control={"init_size": 5}
surrogate_control={
            "infill_criterion": None,
            "n_points": 1,
        }
spot_GP = spot.Spot(fun=fun, lower = lower, upper= upper, surrogate=S,
                    fun_evals = 15, noise = False, log_level = 50,
                    design_control=design_control,
                    surrogate_control=surrogate_control)
```

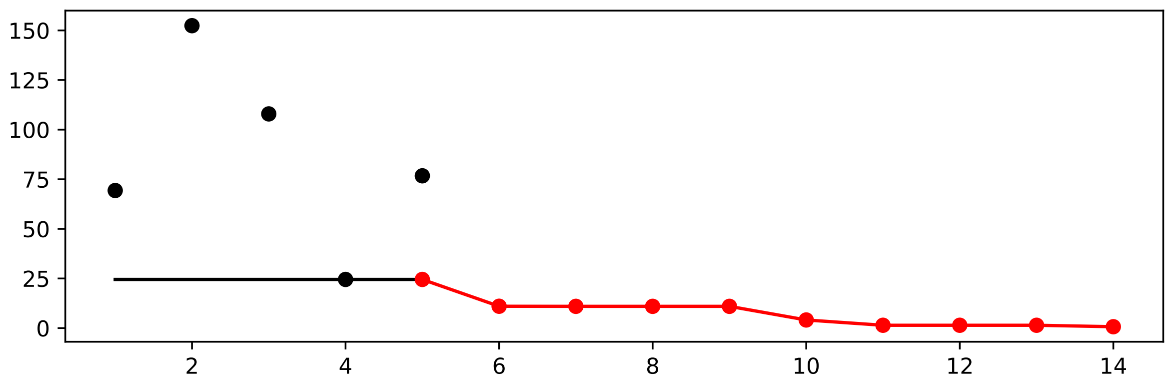
```python
spot_GP.run()
```

```
<spotPython.spot.spot.Spot at 0x17ff2f940>
```

```python
spot_GP.y
```

```
array([ 69.32459936, 152.38491454, 107.92560483,  24.51465459,
        76.73500031,  86.30426593,  11.00311423,  10.95958393,
        16.0666396 ,  24.08429177,   4.08948838,   1.42306267,
         1.47360142,  16.03474093,   0.69335579])
```

```python
spot_GP.plot_progress()
```




```python
spot_GP.print_results()
```

```
min y: 0.6933557854118035
x0: 3.356943193339169
x1: 2.384478378746314
```

```
[['x0', 3.356943193339169], ['x1', 2.384478378746314]]
```

## 12.7 Additional Examples

```python
# Needed for the sklearn surrogates:
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.gaussian_process.kernels import RBF
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn import linear_model
from sklearn import tree
import pandas as pd
```

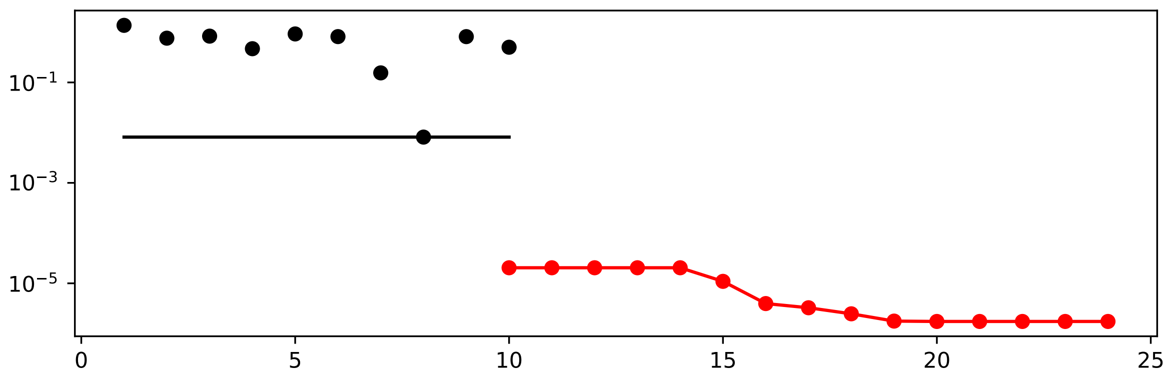
```python
kernel = 1 * RBF(length_scale=1.0, length_scale_bounds=(1e-2, 1e2))
S_GP = GaussianProcessRegressor(kernel=kernel, n_restarts_optimizer=9)
```

```python
from spotPython.build.kriging import Kriging
import numpy as np
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot

S_K = Kriging(name='kriging',
              seed=123,
              log_level=50,
              infill_criterion = "y",
              n_theta=1,
              noise=False,
              cod_type="norm")
fun = analytical().fun_sphere
lower = np.array([-1,-1])
upper = np.array([1,1])

design_control={"init_size": 10}
surrogate_control={
            "n_points": 1,
        }
spot_S_K = spot.Spot(fun=fun,
                     lower = lower,
                     upper= upper,
                     surrogate=S_K,
                     fun_evals = 25,
                     noise = False,
                     log_level = 50,
```

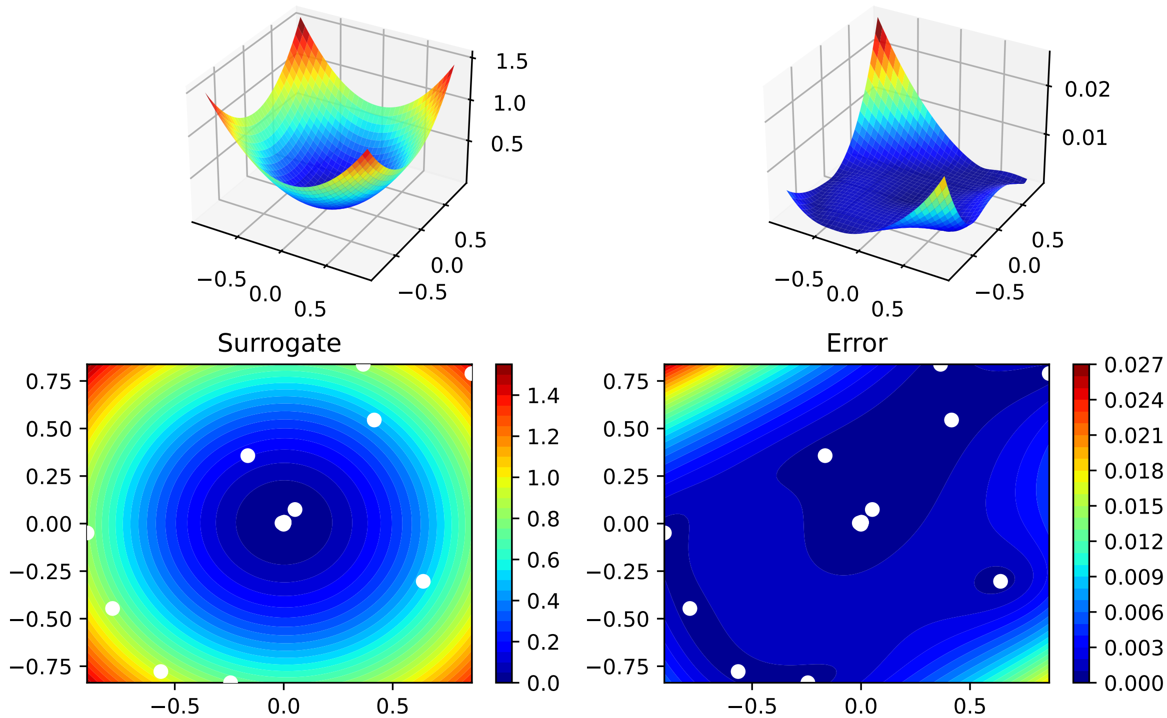
```
                              design_control=design_control,
                              surrogate_control=surrogate_control)

spot_S_K.run()
```

```
<spotPython.spot.spot.Spot at 0x17ff492d0>
```

```
spot_S_K.plot_progress(log_y=True)
```




```
spot_S_K.surrogate.plot()
```




```
spot_S_K.print_results()
```

```
min y: 1.7395335905335862e-06
x0: -0.0013044072412622557
x1: 0.00019507777780173277
```

```
[['x0', -0.0013044072412622557], ['x1', 0.00019507777780173277]]
```

### 12.7.1 Optimize on Surrogate

### 12.7.2 Evaluate on Real Objective

### 12.7.3 Impute / Infill new Points

## 12.8 Tests

```
import numpy as np
from spotPython.spot import spot
from spotPython.fun.objectivefunctions import analytical

fun_sphere = analytical().fun_sphere
spot_1 = spot.Spot(
    fun=fun_sphere,
    lower=np.array([-1, -1]),
    upper=np.array([1, 1]),
    n_points = 2
)

# (S-2) Initial Design:
spot_1.X = spot_1.design.scipy_lhd(
    spot_1.design_control["init_size"], lower=spot_1.lower, upper=spot_1.upper
)
print(spot_1.X)

# (S-3): Eval initial design:
spot_1.y = spot_1.fun(spot_1.X)
print(spot_1.y)

spot_1.surrogate.fit(spot_1.X, spot_1.y)
X0 = spot_1.suggest_new_X()
print(X0)
assert X0.size == spot_1.n_points * spot_1.k
```

```
[[ 0.86352963  0.7892358 ]
 [-0.24407197 -0.83687436]
 [ 0.36481882  0.8375811 ]
 [ 0.415331    0.54468512]
 [-0.56395091 -0.77797854]
 [-0.90259409 -0.04899292]
```

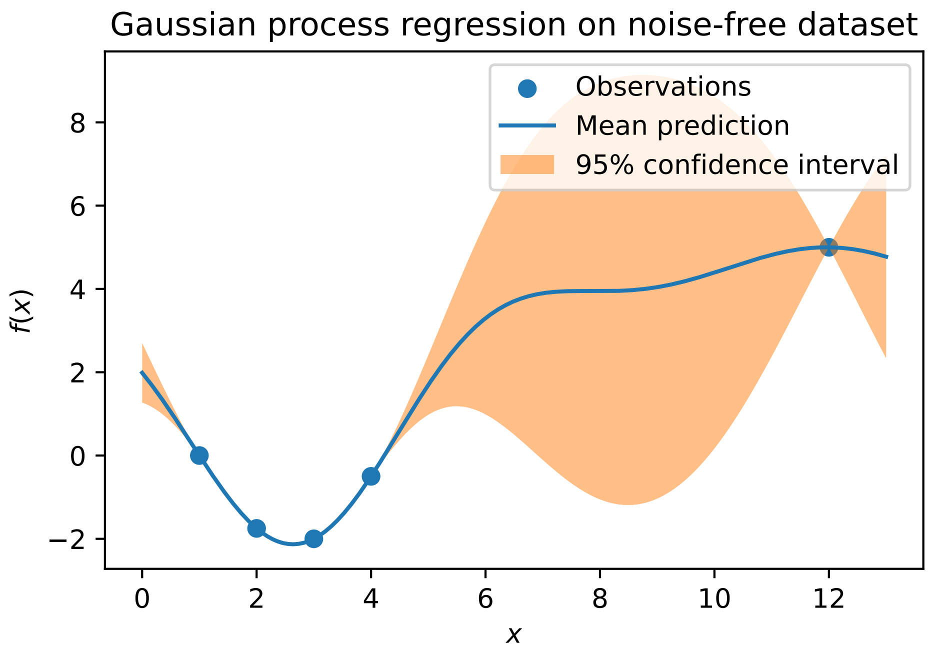
```
 [-0.16484832  0.35724741]
 [ 0.05170659  0.07401196]
 [-0.78548145 -0.44638164]
 [ 0.64017497 -0.30363301]]
[1.36857656 0.75992983 0.83463487 0.46918172 0.92329124 0.8170764
 0.15480068 0.00815134 0.81623768 0.502017  ]
[[0.00160553 0.00428429]
 [0.00160553 0.00428429]]
```

## 12.9 EI: The Famous Schonlau Example

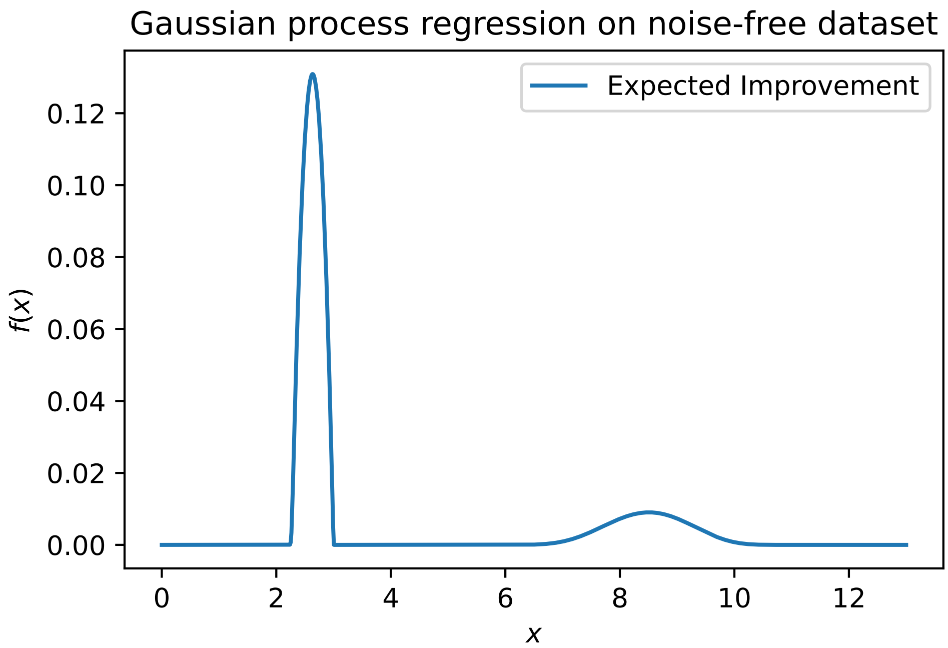
```
X_train0 = np.array([1, 2, 3, 4, 12]).reshape(-1,1)
X_train = np.linspace(start=0, stop=10, num=5).reshape(-1, 1)
```

```
from spotPython.build.kriging import Kriging
import numpy as np
import matplotlib.pyplot as plt

X_train = np.array([1., 2., 3., 4., 12.]).reshape(-1,1)
y_train = np.array([0., -1.75, -2, -0.5, 5.])

S = Kriging(name='kriging',  seed=123, log_level=50, n_theta=1, noise=False, cod_type="nor
S.fit(X_train, y_train)

X = np.linspace(start=0, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, mean_prediction, label="Mean prediction")
if True:
    plt.fill_between(
        X.ravel(),
        mean_prediction - 2 * std_prediction,
        mean_prediction + 2 * std_prediction,
        alpha=0.5,
        label=r"95% confidence interval",
    )
plt.legend()
plt.xlabel("$x$")
```

```
plt.ylabel("$f(x)$")
_ = plt.title("Gaussian process regression on noise-free dataset")
```




```
#plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
# plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, -ei, label="Expected Improvement")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Gaussian process regression on noise-free dataset")
```



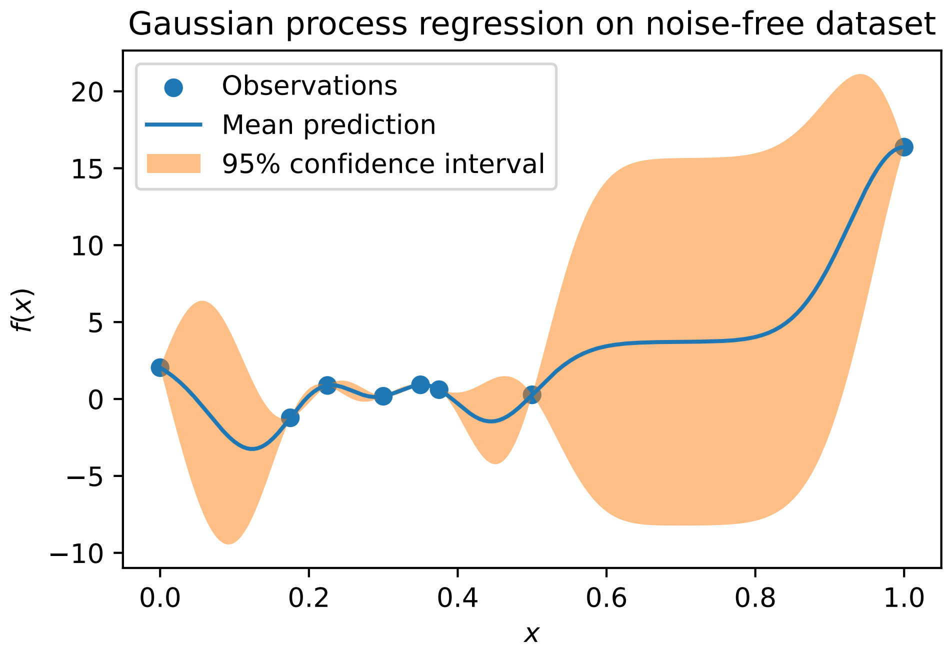

```
S.log
```

```
{'negLnLike': array([1.20788205]),
 'theta': array([1.09276]),
 'p': array([2.]),
 'Lambda': array([None], dtype=object)}
```

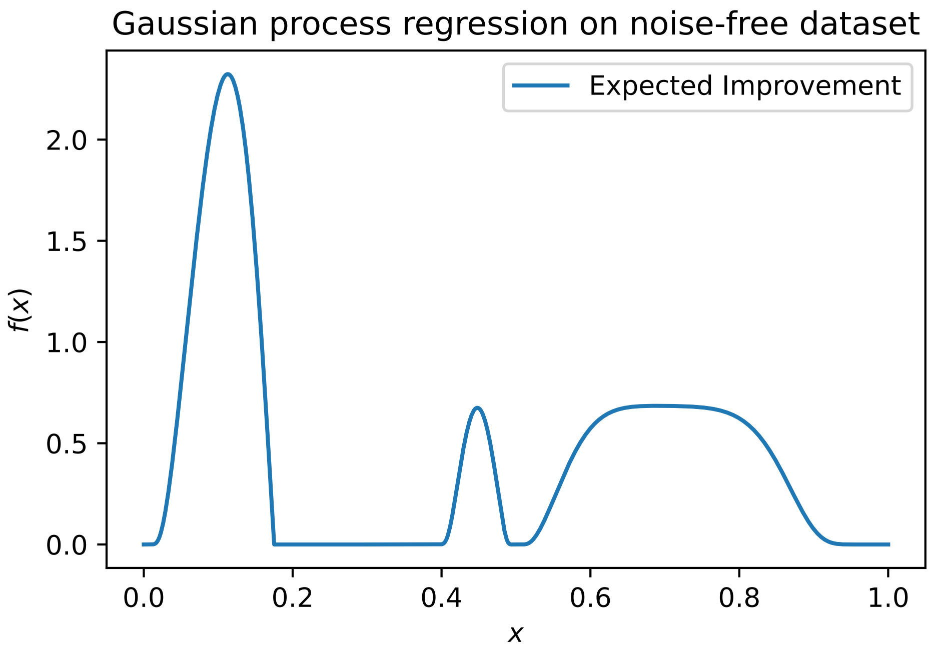
## 12.10 EI: The Forrester Example

```
from spotPython.build.kriging import Kriging
import numpy as np
import matplotlib.pyplot as plt
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot

# exact x locations are unknown:
X_train = np.array([0.0, 0.175, 0.225, 0.3, 0.35, 0.375, 0.5,1]).reshape(-1,1)
```

```
fun = analytical().fun_forrester
fun_control = {"sigma": 1.0,
               "seed": 123}
y_train = fun(X_train, fun_control=fun_control)

S = Kriging(name='kriging',  seed=123, log_level=50, n_theta=1, noise=False, cod_type="nor
S.fit(X_train, y_train)

X = np.linspace(start=0, stop=1, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, mean_prediction, label="Mean prediction")
if True:
    plt.fill_between(
        X.ravel(),
        mean_prediction - 2 * std_prediction,
        mean_prediction + 2 * std_prediction,
        alpha=0.5,
        label=r"95% confidence interval",
    )
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Gaussian process regression on noise-free dataset")
```




```
#plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
# plt.scatter(X_train, y_train, label="Observations")
plt.plot(X, -ei, label="Expected Improvement")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Gaussian process regression on noise-free dataset")
```

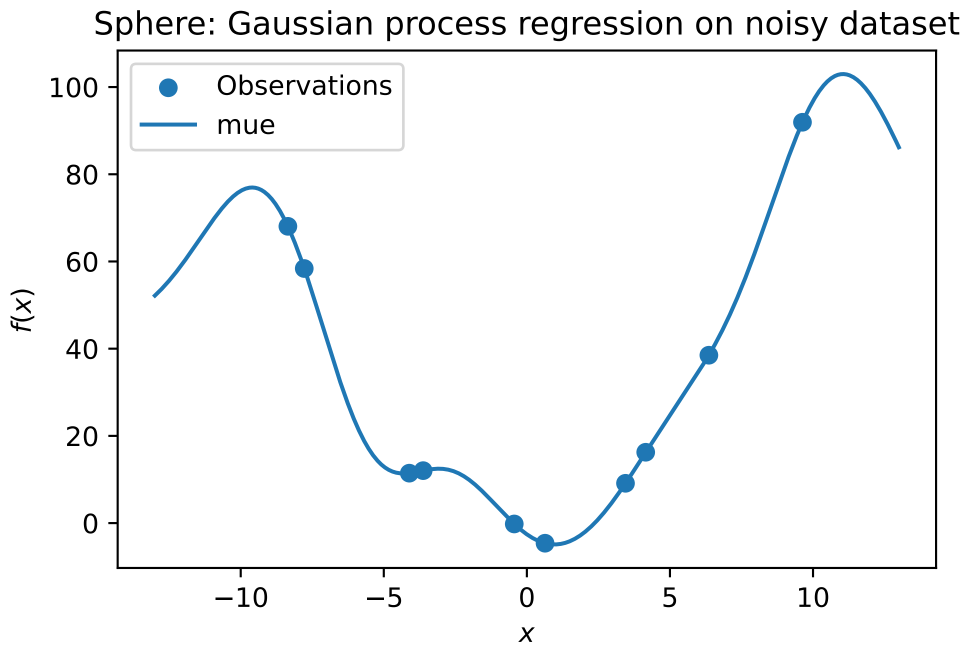



## 12.11 Noise

```
import numpy as np
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
import matplotlib.pyplot as plt

gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_sphere
fun_control = {"sigma": 2,
               "seed": 125}
X = gen.scipy_lhd(10, lower=lower, upper = upper)
print(X)
y = fun(X, fun_control=fun_control)
```

```python
print(y)
y.shape
X_train = X.reshape(-1,1)
y_train = y

S = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=False)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

#plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
#plt.plot(X, ei, label="Expected Improvement")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Sphere: Gaussian process regression on noisy dataset")
```

```
[[ 0.63529627]
 [-4.10764204]
 [-0.44071975]
 [ 9.63125638]
 [-8.3518118 ]
 [-3.62418901]
 [ 4.15331   ]
 [ 3.4468512 ]
 [ 6.36049088]
 [-7.77978539]]
[-4.61635371 11.44873209 -0.19988024 91.92791676 68.05926244 12.02926818
 16.2470957   9.12729929 38.4987029  58.38469104]
```

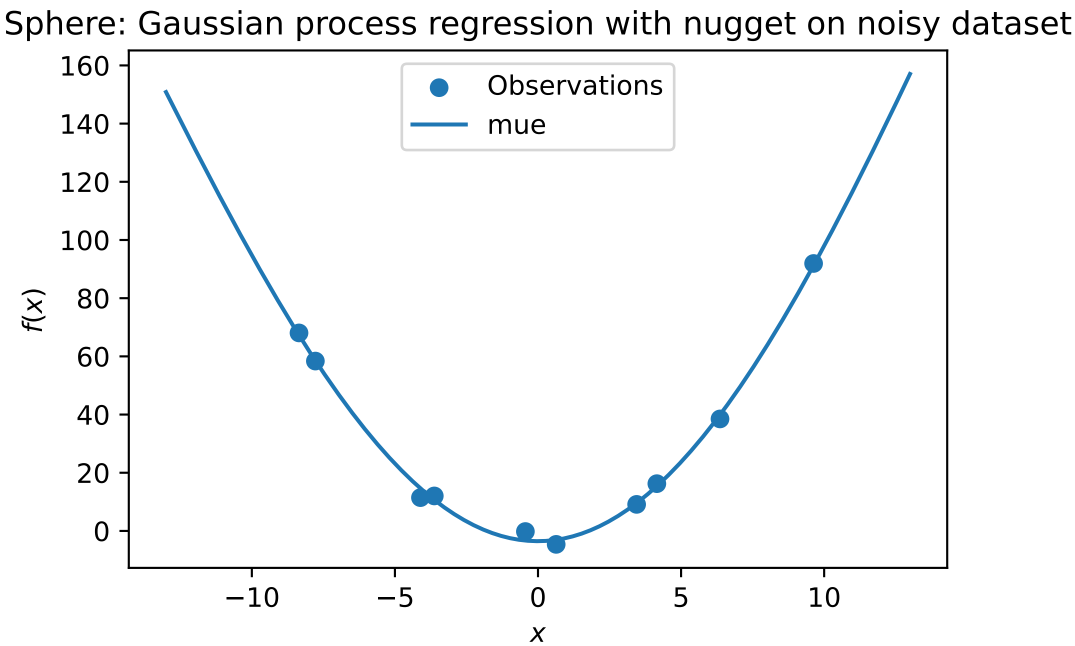



```
S.log
```

```
{'negLnLike': array([24.69806131]),
 'theta': array([1.31023943]),
 'p': array([2.]),
 'Lambda': array([None], dtype=object)}
```

```
S = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=True)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

#plt.plot(X, y, label=r"$f(x) = x \sin(x)$", linestyle="dotted")
plt.scatter(X_train, y_train, label="Observations")
#plt.plot(X, ei, label="Expected Improvement")
plt.plot(X_axis, mean_prediction, label="mue")
```

```
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Sphere: Gaussian process regression with nugget on noisy dataset")
```




```
S.log
```

```
{'negLnLike': array([22.14095646]),
 'theta': array([-0.32527397]),
 'p': array([2.]),
 'Lambda': array([9.08815007e-05])}
```

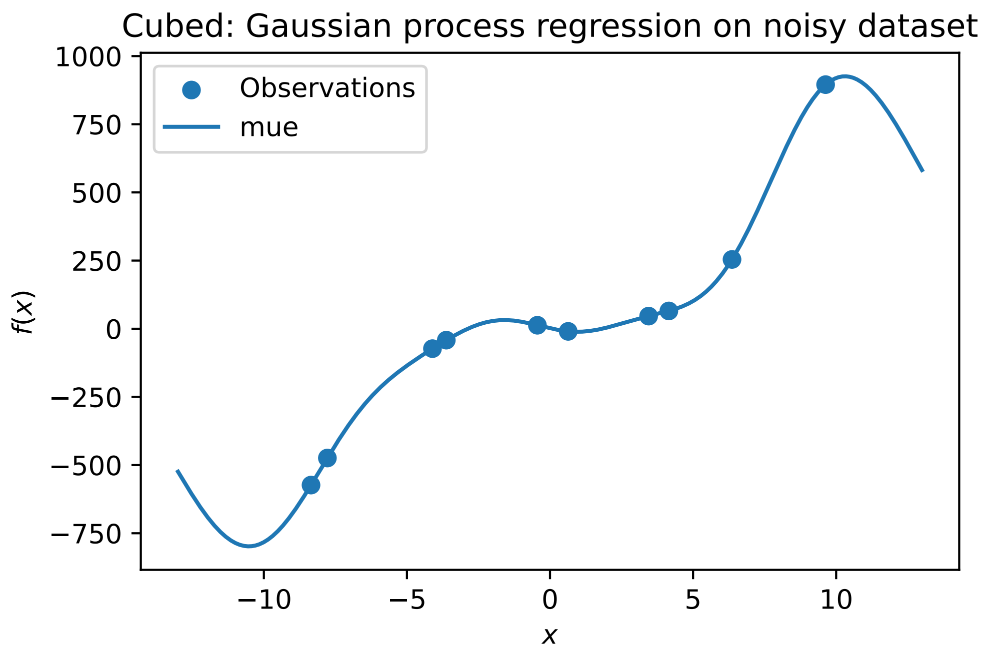
## 12.12 Cubic Function

```
import numpy as np
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from spotPython.design.spacefilling import spacefilling
```

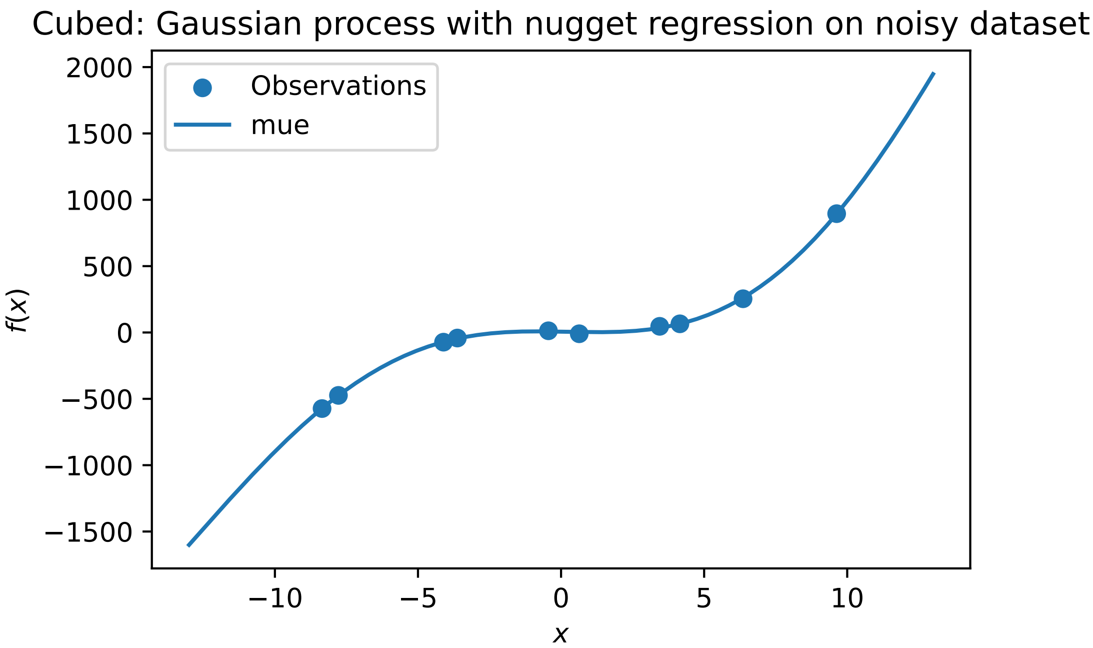
```python
from spotPython.build.kriging import Kriging
import matplotlib.pyplot as plt

gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_cubed
fun_control = {"sigma": 10,
               "seed": 123}

X = gen.scipy_lhd(10, lower=lower, upper = upper)
print(X)
y = fun(X, fun_control=fun_control)
print(y)
y.shape
X_train = X.reshape(-1,1)
y_train = y

S = Kriging(name='kriging',  seed=123, log_level=50, n_theta=1, noise=False)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
#plt.plot(X, ei, label="Expected Improvement")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Cubed: Gaussian process regression on noisy dataset")
```

```
[[ 0.63529627]
 [-4.10764204]
 [-0.44071975]
 [ 9.63125638]
 [-8.3518118 ]
 [-3.62418901]
 [ 4.15331   ]
 [ 3.4468512 ]
 [ 6.36049088]
```

```
 [-7.77978539]]
[  -9.63480707  -72.98497325   12.7936499   895.34567477 -573.35961837
  -41.83176425   65.27989461   46.37081417  254.1530734  -474.09587355]
```



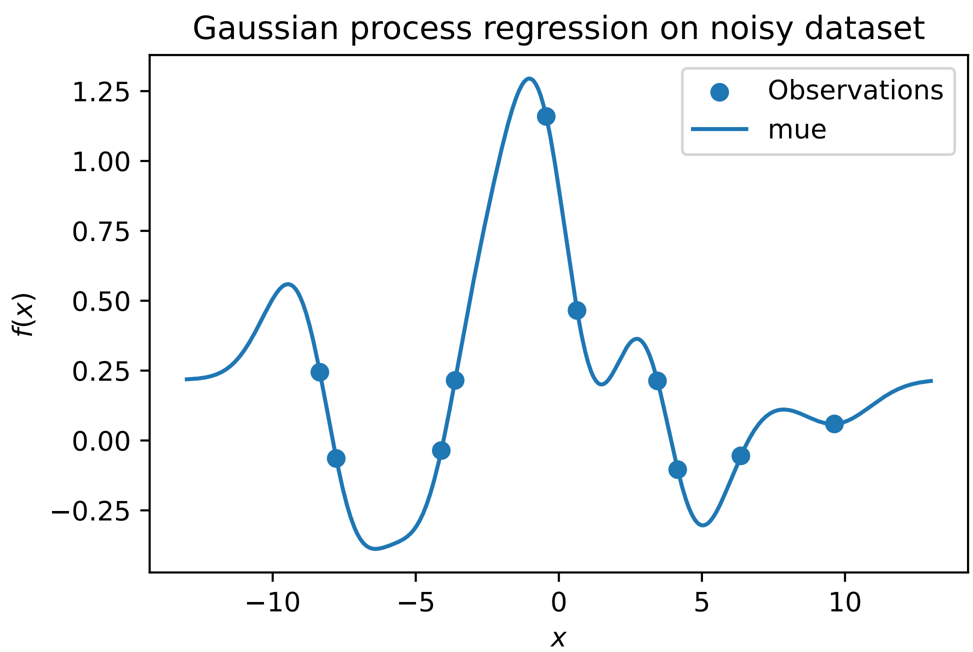

```python
S = Kriging(name='kriging',  seed=123, log_level=0, n_theta=1, noise=True)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
#plt.plot(X, ei, label="Expected Improvement")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Cubed: Gaussian process with nugget regression on noisy dataset")
```



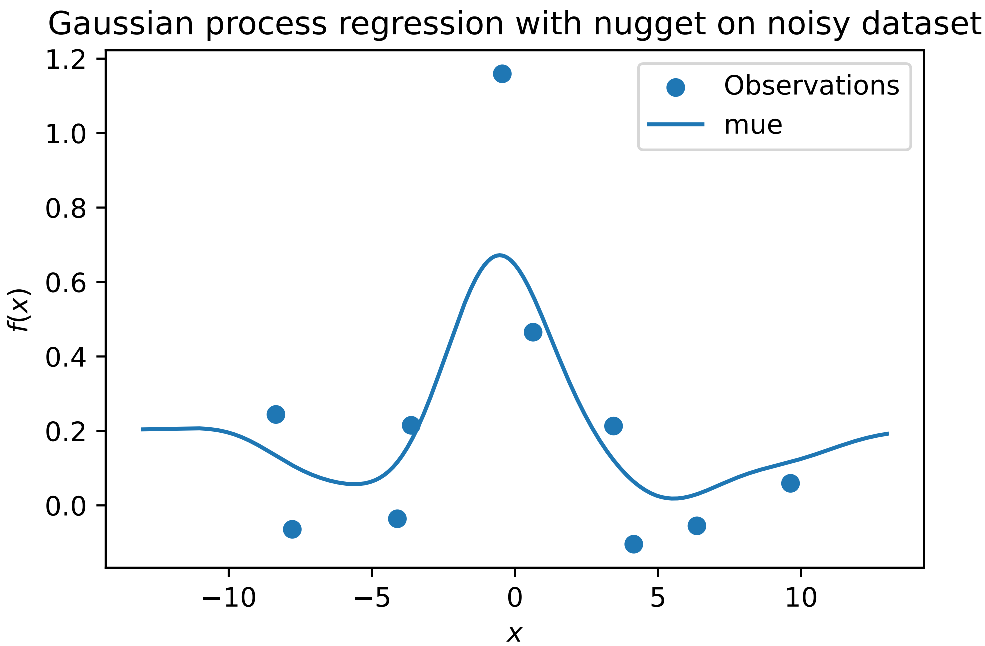

```
import numpy as np
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
import matplotlib.pyplot as plt

gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_runge
fun_control = {"sigma": 0.25,
               "seed": 123}

X = gen.scipy_lhd(10, lower=lower, upper = upper)
print(X)
y = fun(X, fun_control=fun_control)
print(y)
y.shape
```

```python
X_train = X.reshape(-1,1)
y_train = y

S = Kriging(name='kriging',  seed=123, log_level=50, n_theta=1, noise=False)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
#plt.plot(X, ei, label="Expected Improvement")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Gaussian process regression on noisy dataset")
```

```
[[ 0.63529627]
 [-4.10764204]
 [-0.44071975]
 [ 9.63125638]
 [-8.3518118 ]
 [-3.62418901]
 [ 4.15331   ]
 [ 3.4468512 ]
 [ 6.36049088]
 [-7.77978539]]
[ 0.46517267 -0.03599548  1.15933822  0.05915901  0.24419145  0.21502359
 -0.10432134  0.21312309 -0.05502681 -0.06434374]
```




```
S = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=True)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
#plt.plot(X, ei, label="Expected Improvement")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Gaussian process regression with nugget on noisy dataset")
```




## 12.13 Factors

```
["num"] * 3
```

```
['num', 'num', 'num']
```

```
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
from spotPython.fun.objectivefunctions import analytical
import numpy as np
```

```
gen = spacefilling(2)
n = 30
rng = np.random.RandomState(1)
lower = np.array([-5,-0])
upper = np.array([10,15])
fun = analytical().fun_branin_factor
#fun = analytical(sigma=0).fun_sphere
```

```
X0 = gen.scipy_lhd(n, lower=lower, upper = upper)
X1 = np.random.randint(low=1, high=3, size=(n,))
X = np.c_[X0, X1]
y = fun(X)
S = Kriging(name='kriging',  seed=123, log_level=50, n_theta=3, noise=False, var_type=["nu
S.fit(X, y)
Sf = Kriging(name='kriging',  seed=123, log_level=50, n_theta=3, noise=False, var_type=["n
Sf.fit(X, y)
n = 50
X0 = gen.scipy_lhd(n, lower=lower, upper = upper)
X1 = np.random.randint(low=1, high=3, size=(n,))
X = np.c_[X0, X1]
y = fun(X)
s=np.sum(np.abs(S.predict(X)[0] - y))
sf=np.sum(np.abs(Sf.predict(X)[0] - y))
sf - s
```

```
31.369621446188376
```

```
# vars(S)
```

```
# vars(Sf)
```

# 13 Hyperparameter Tuning and Noise

This chapter demonstrates how noisy functions can be handled by `Spot`.

## 13.1 Example: `Spot` and the Noisy Sphere Function

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
```

```
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '10-sklearn' + "_" + HOSTNAME + "_" + str(start_time).split(".", 1)[0].r
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
10-sklearn_p040025_2023-06-17_11-18-18
```

### 13.1.1 The Objective Function: Noisy Sphere

- The `spotPython` package provides several classes of objective functions.

- We will use an analytical objective function with noise, i.e., a function that can be described by a (closed) formula:

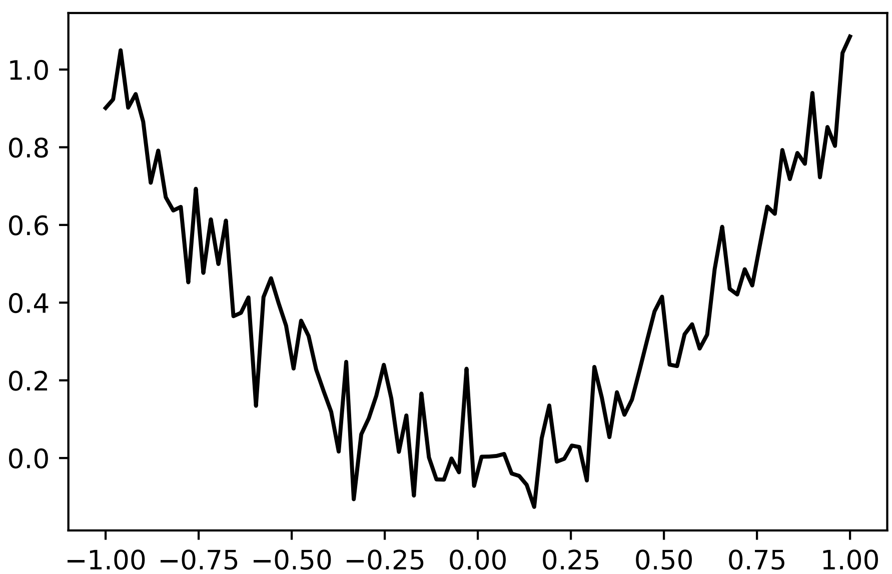
$$f(x) = x^2 + \epsilon$$

- Since `sigma` is set to `0.1`, noise is added to the function:

```
fun = analytical().fun_sphere
fun_control = {"sigma": 0.1,
               "seed": 123}
```

- A plot illustrates the noise:

```
x = np.linspace(-1,1,100).reshape(-1,1)
y = fun(x, fun_control=fun_control)
plt.figure()
plt.plot(x,y, "k")
plt.show()
```

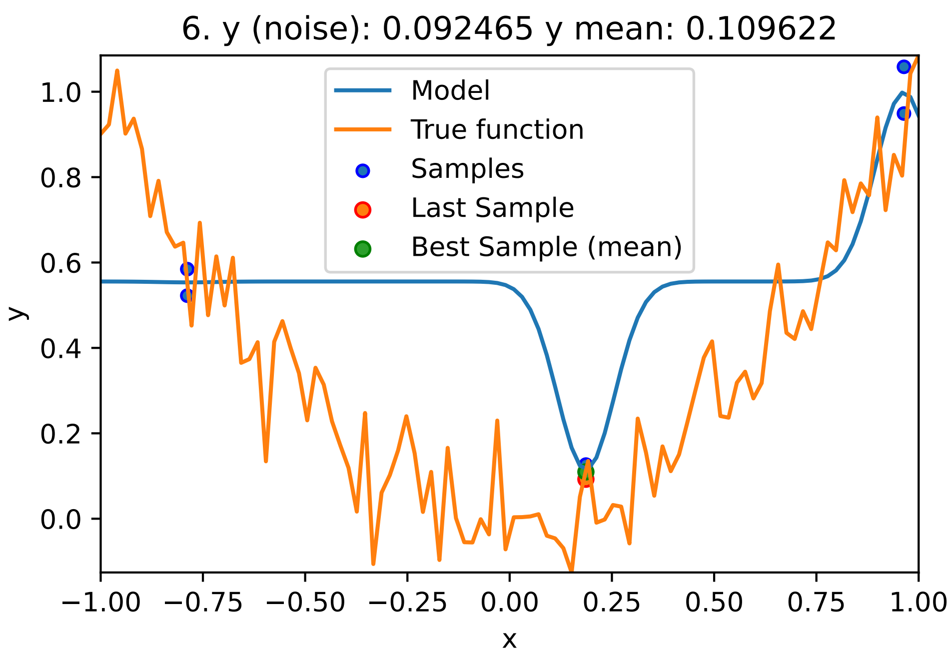


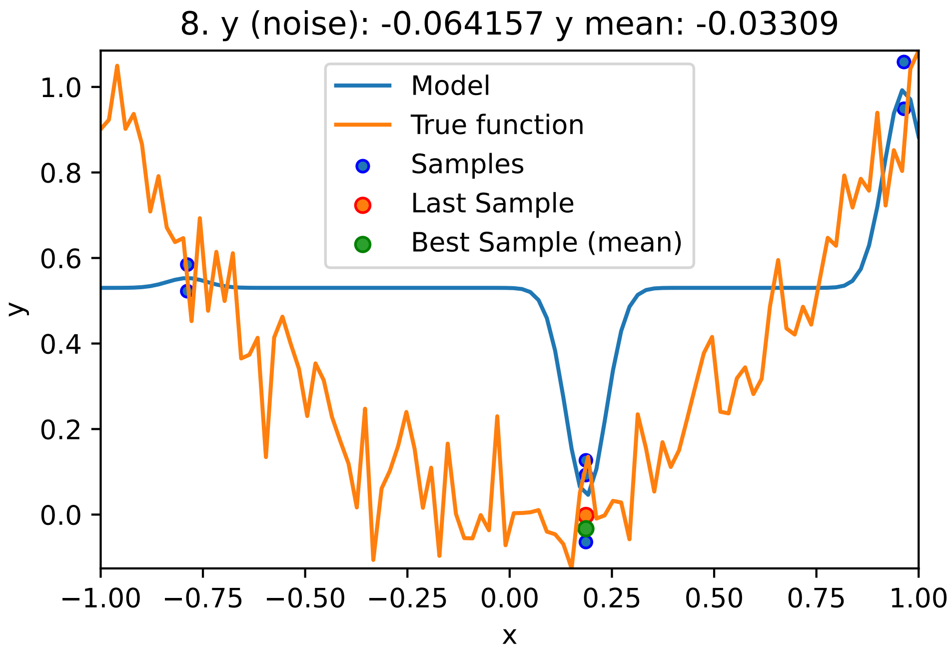

`Spot` is adopted as follows to cope with noisy functions:

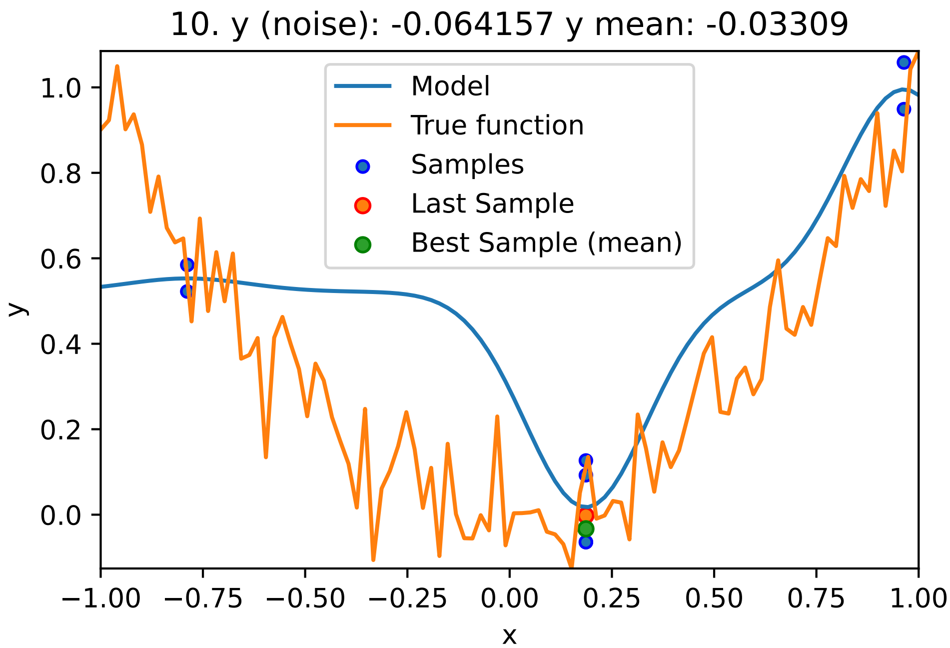
1. `fun_repeats` is set to a value larger than 1 (here: 2)
2. `noise` is set to `true`. Therefore, a nugget (`Lambda`) term is added to the correlation matrix
3. `init size` (of the `design_control` dictionary) is set to a value larger than 1 (here: 2)

```python
spot_1_noisy = spot.Spot(fun=fun,
                   lower = np.array([-1]),
                   upper = np.array([1]),
                   fun_evals = 10,
                   fun_repeats = 2,
                   noise = True,
                   seed=123,
                   show_models=True,
                   fun_control = fun_control,
                   design_control={"init_size": 3,
                                   "repeats": 2},
                   surrogate_control={"noise": True})
```

```python
spot_1_noisy.run()
```






```
<spotPython.spot.spot.Spot at 0x2961eb730>
```

## 13.2 Print the Results

```
spot_1_noisy.print_results()
```

```
min y: -0.06415721594238855
x0: 0.18642671238960512
min mean y: -0.03309048099839016
x0: 0.18642671238960512
```

```
[['x0', 0.18642671238960512], ['x0', 0.18642671238960512]]
```

```
spot_1_noisy.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

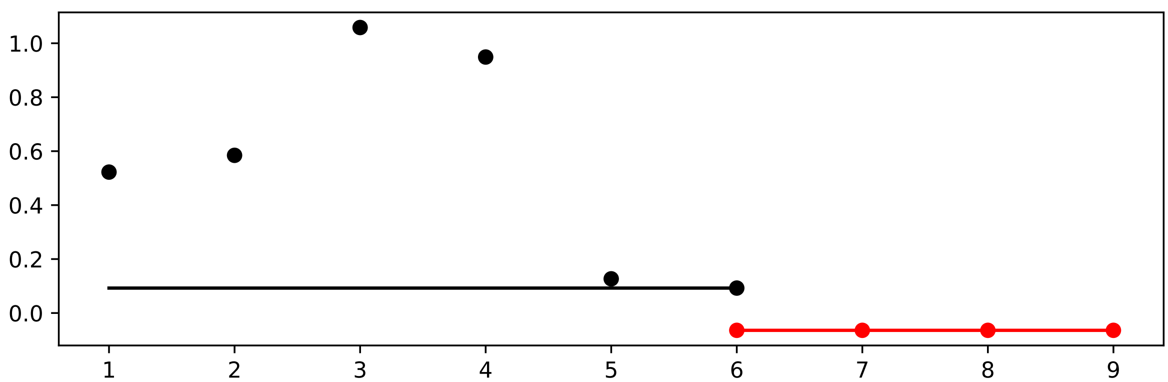



Figure 13.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

## 13.3 Noise and Surrogates: The Nugget Effect

### 13.3.1 The Noisy Sphere

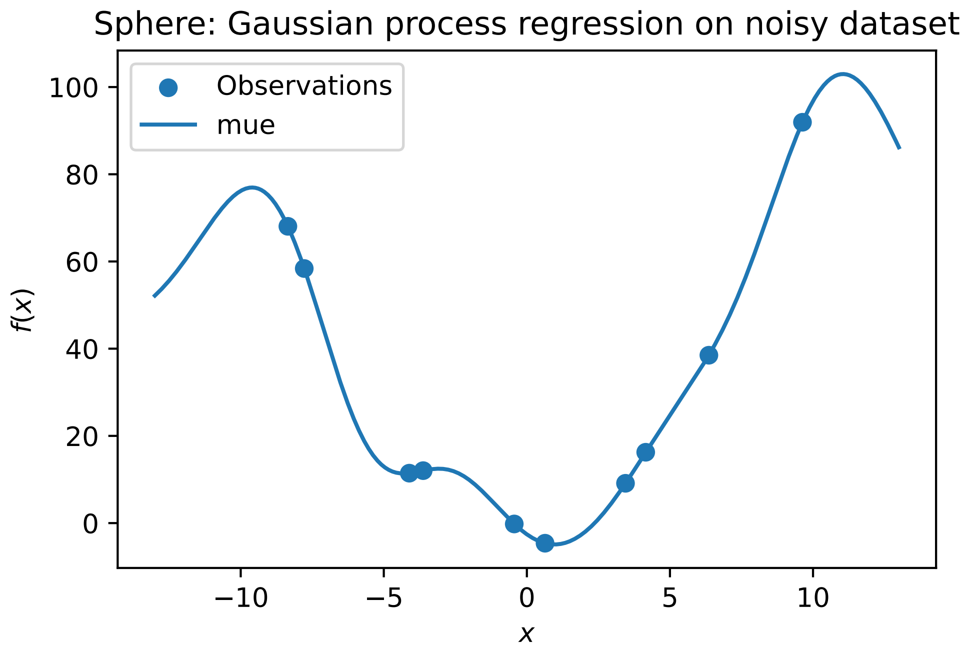
#### 13.3.1.1 The Data

- We prepare some data first:

```python
import numpy as np
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
import matplotlib.pyplot as plt

gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_sphere
fun_control = {"sigma": 2,
               "seed": 125}
X = gen.scipy_lhd(10, lower=lower, upper = upper)
y = fun(X, fun_control=fun_control)
X_train = X.reshape(-1,1)
y_train = y
```

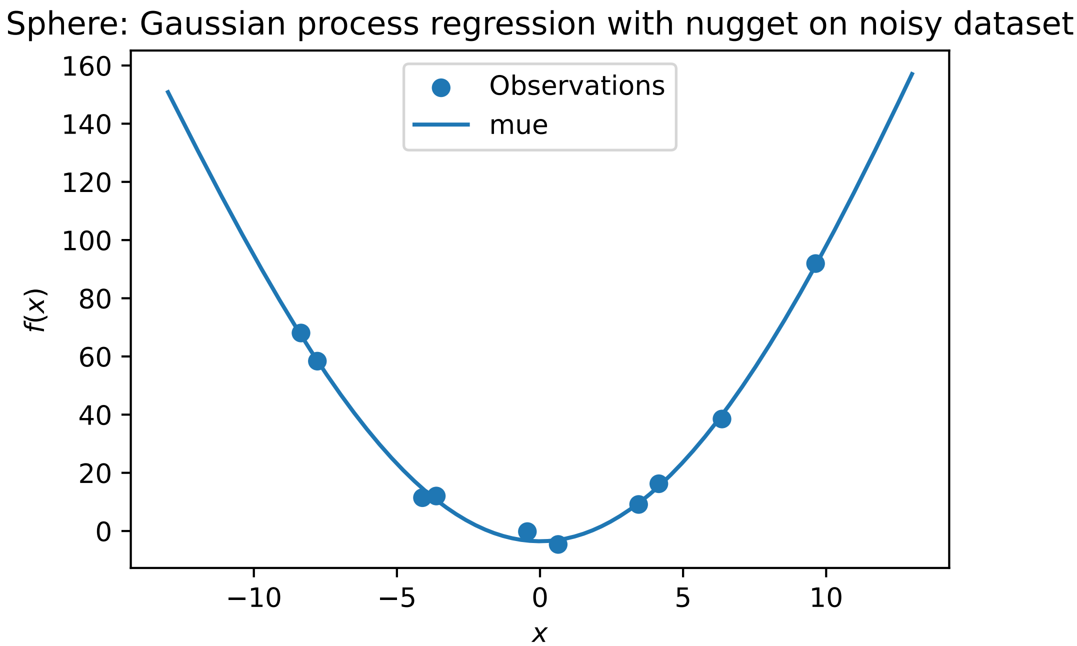
- A surrogate without nugget is fitted to these data:

```python
S = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=False)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Sphere: Gaussian process regression on noisy dataset")
```




- In comparison to the surrogate without nugget, we fit a surrogate with nugget to the data:

```
S_nug = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=True)
S_nug.fit(X_train, y_train)
X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S_nug.predict(X_axis, return_val="all")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Sphere: Gaussian process regression with nugget on noisy dataset")
```




- The value of the nugget term can be extracted from the model as follows:

```
S.Lambda
```

```
S_nug.Lambda
```

```
9.088150066416743e-05
```

- We see:
  - the first model `S` has no nugget,
  - whereas the second model has a nugget value (`Lambda`) larger than zero.

## 13.4 Exercises

### 13.4.1 Noisy `fun_cubed`

- Analyse the effect of noise on the `fun_cubed` function with the following settings:

```
fun = analytical().fun_cubed
fun_control = {"sigma": 10,
```

```
                  "seed": 123}
lower = np.array([-10])
upper = np.array([10])
```

### 13.4.2 fun_runge

- Analyse the effect of noise on the `fun_runge` function with the following settings:

```
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_runge
fun_control = {"sigma": 0.25,
               "seed": 123}
```

### 13.4.3 fun_forrester

- Analyse the effect of noise on the `fun_forrester` function with the following settings:

```
lower = np.array([0])
upper = np.array([1])
fun = analytical().fun_forrester
fun_control = {"sigma": 5,
               "seed": 123}
```

### 13.4.4 fun_xsin

- Analyse the effect of noise on the `fun_xsin` function with the following settings:

```
lower = np.array([-1.])
upper = np.array([1.])
fun = analytical().fun_xsin
fun_control = {"sigma": 0.5,
               "seed": 123}
```

# 14 Handling Noise: Optimal Computational Budget Allocation in `Spot`

This notebook demonstrates how noisy functions can be handled with OCBA by `Spot`.

## 14.1 Example: `Spot`, OCBA, and the Noisy Sphere Function

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
```

### 14.1.1 The Objective Function: Noisy Sphere

The `spotPython` package provides several classes of objective functions. We will use an analytical objective function with noise, i.e., a function that can be described by a (closed) formula:

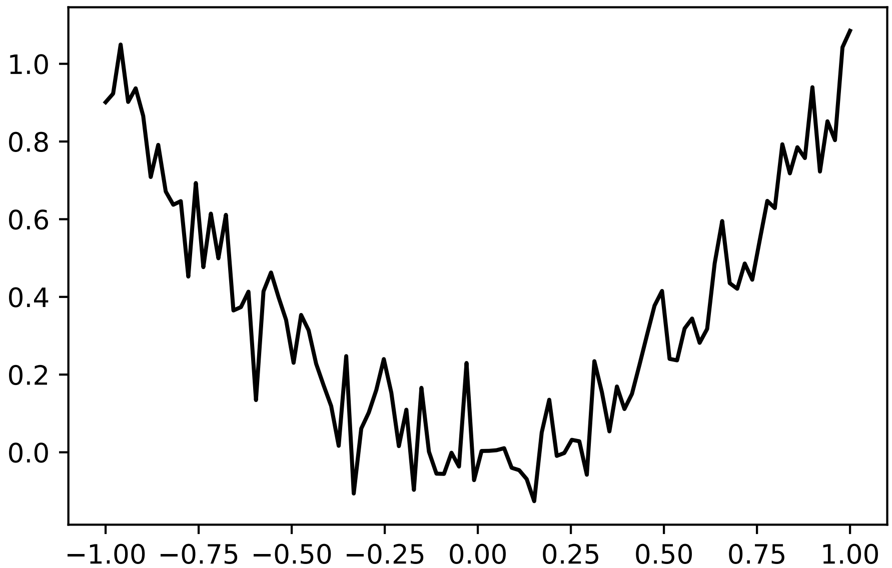
$$f(x) = x^2 + \epsilon$$

Since `sigma` is set to `0.1`, noise is added to the function:

```
fun = analytical().fun_sphere
fun_control = {"sigma": 0.1,
               "seed": 123}
```

A plot illustrates the noise:

```python
x = np.linspace(-1,1,100).reshape(-1,1)
y = fun(x, fun_control=fun_control)
plt.figure()
plt.plot(x,y, "k")
plt.show()
```



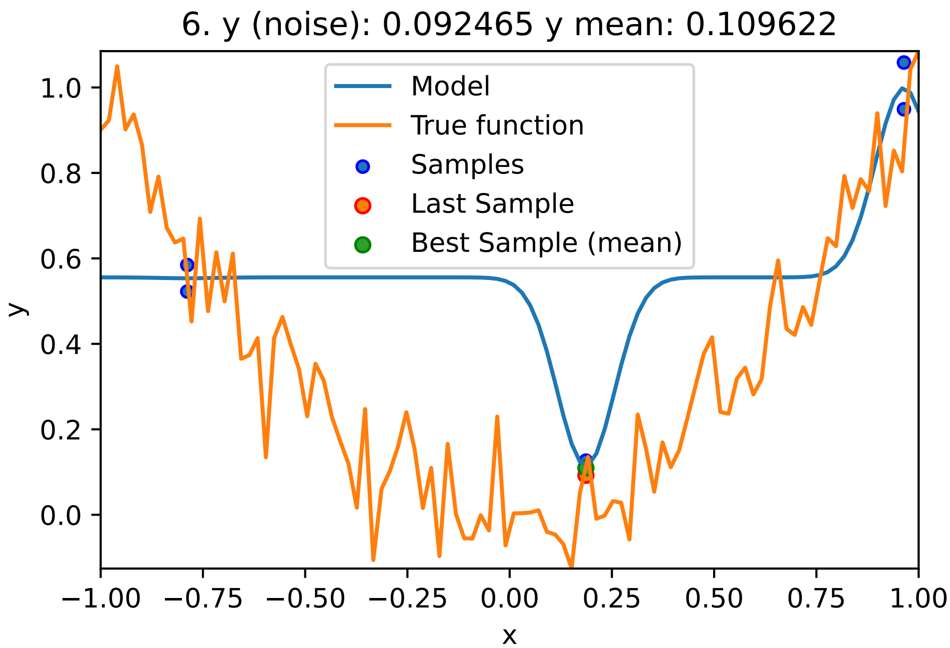

`Spot` is adopted as follows to cope with noisy functions:

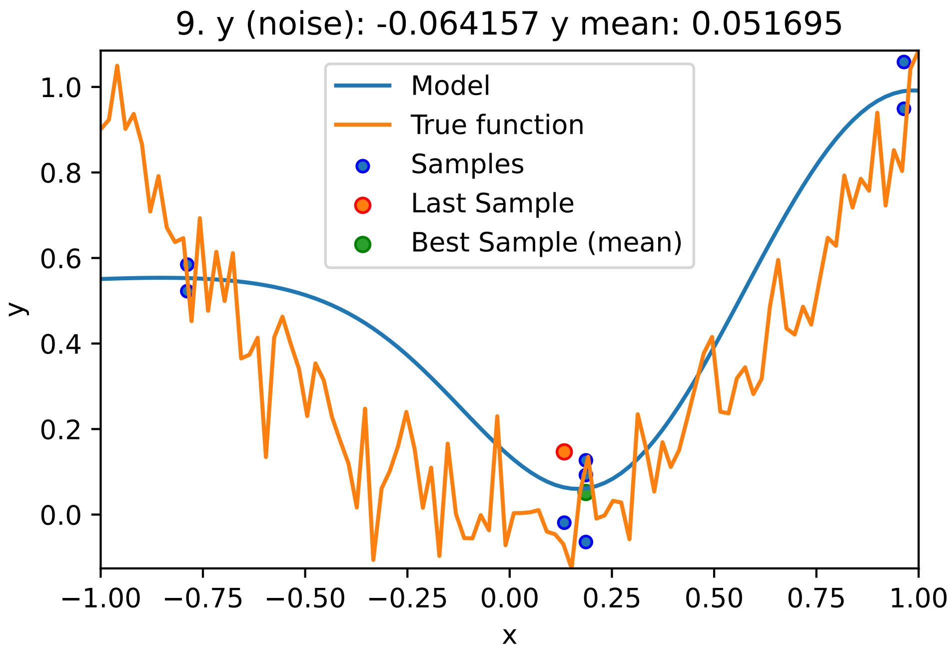
1. `fun_repeats` is set to a value larger than 1 (here: 2)
2. `noise` is set to `true`. Therefore, a nugget (`Lambda`) term is added to the correlation matrix
3. `init size` (of the `design_control` dictionary) is set to a value larger than 1 (here: 2)

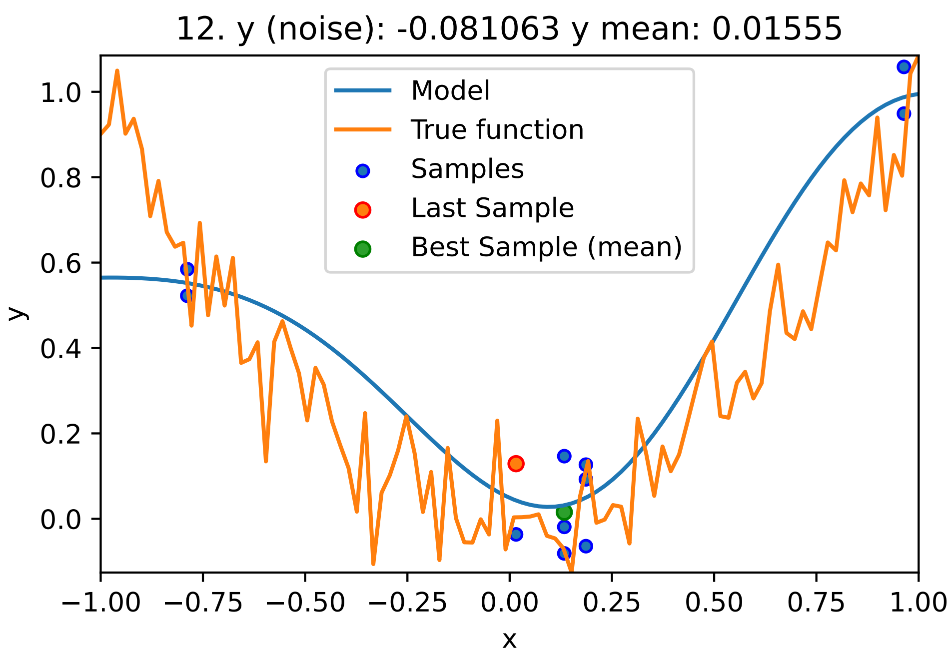
```python
spot_1_noisy = spot.Spot(fun=fun,
                   lower = np.array([-1]),
                   upper = np.array([1]),
                   fun_evals = 50,
                   fun_repeats = 2,
                   infill_criterion="ei",
                   noise = True,
                   tolerance_x=0.0,
                   ocba_delta = 1,
                   seed=123,
```

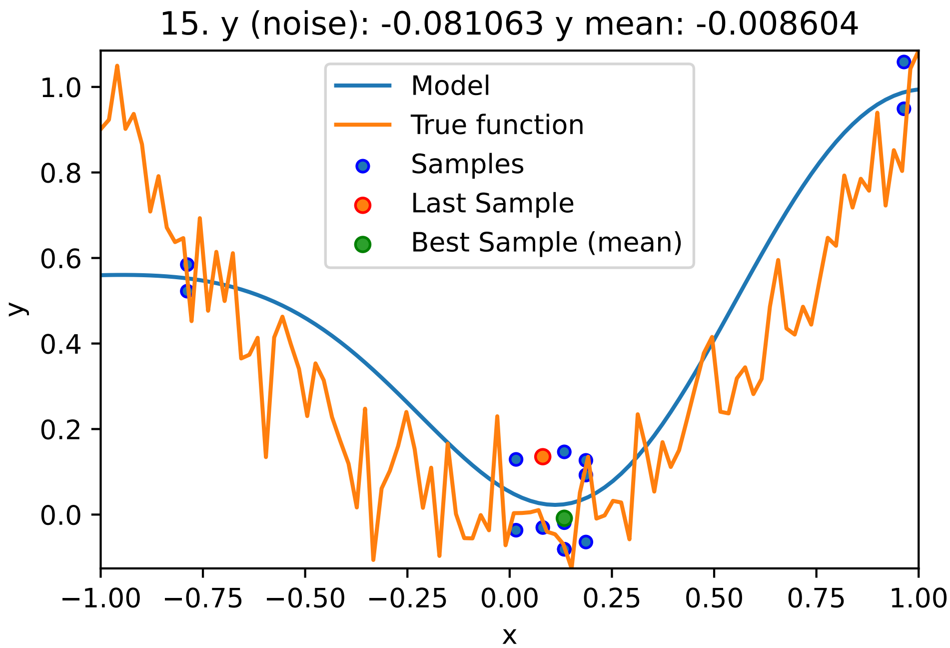
```
                     show_models=True,
                     fun_control = fun_control,
                     design_control={"init_size": 3,
                                     "repeats": 2},
                     surrogate_control={"noise": True})
```

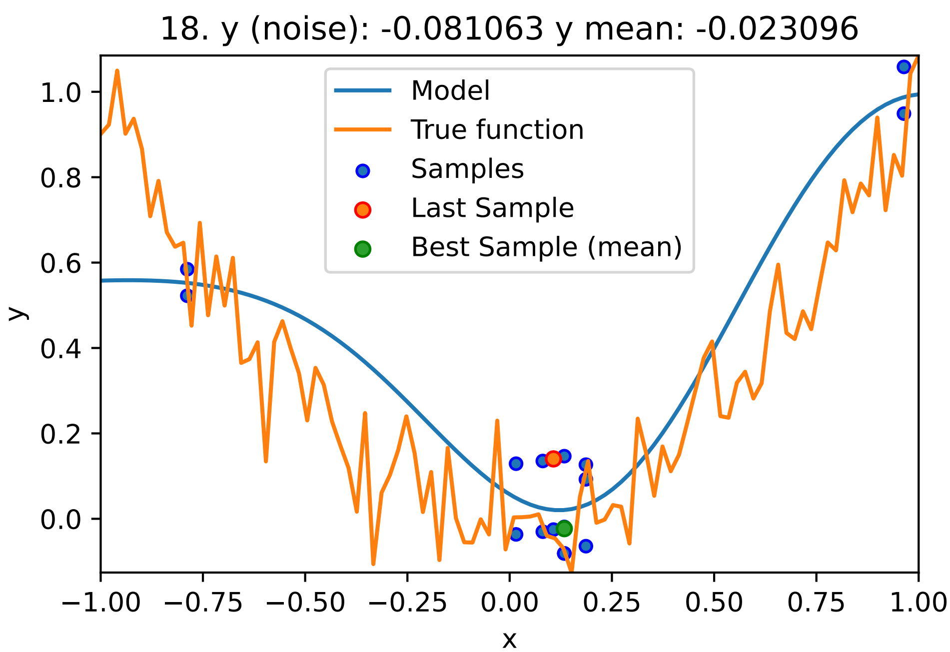
```
spot_1_noisy.run()
```

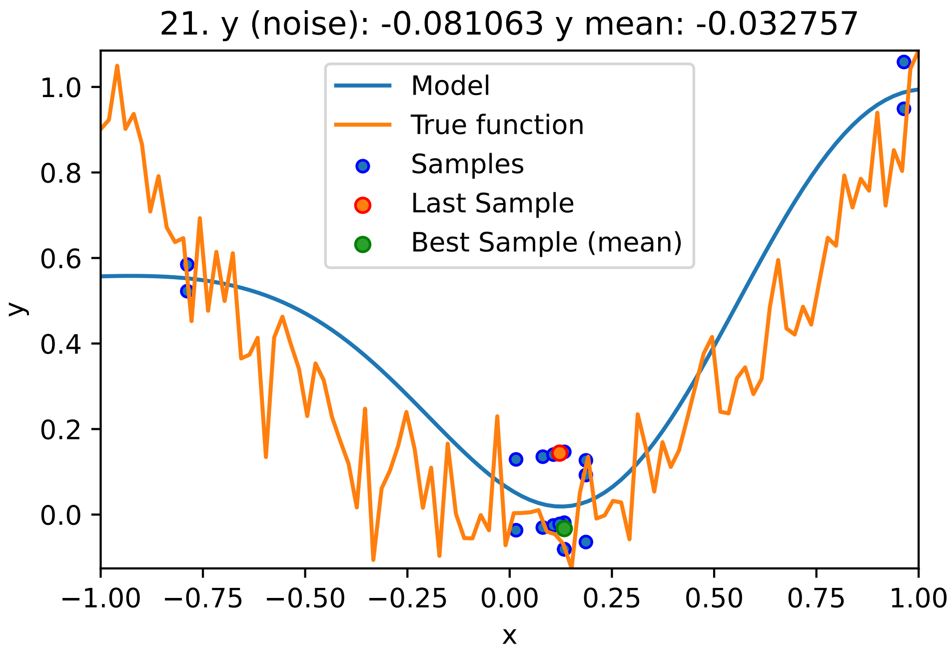



9. y (noise): -0.064157 y mean: 0.051695
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

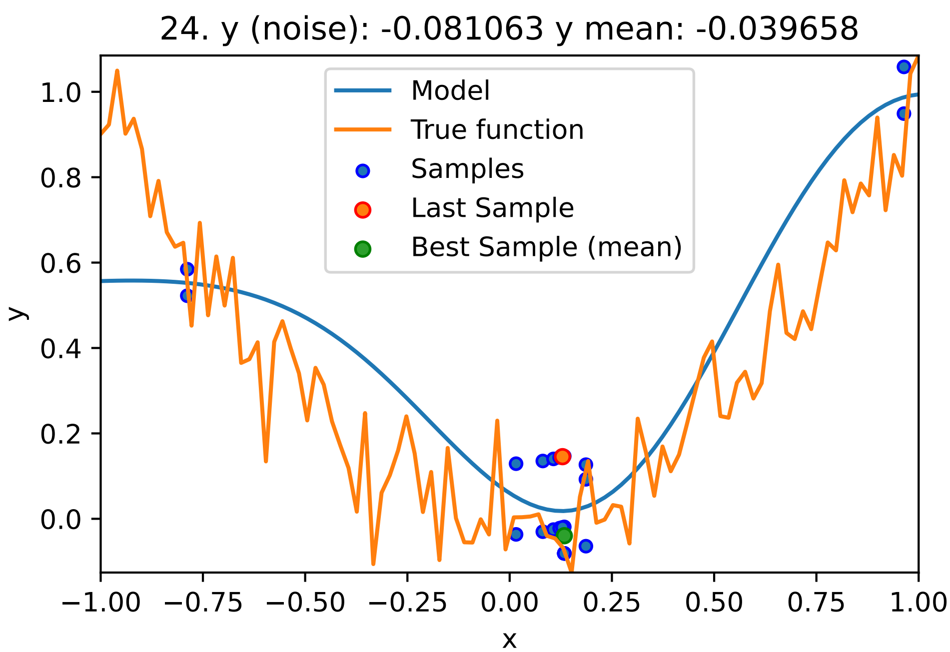

12. y (noise): -0.081063 y mean: 0.01555
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00


15. y (noise): -0.081063 y mean: -0.008604
Model
True function
Samples
Last Sample
Best Sample (mean)
1.0
0.8
0.6
0.4
0.2
0.0
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x

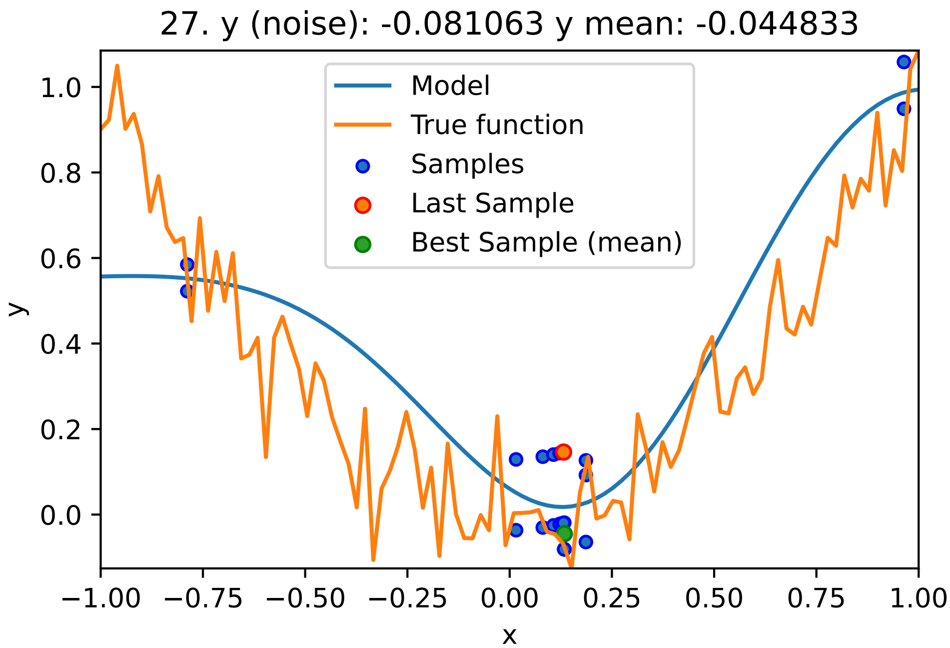

18. y (noise): -0.081063 y mean: -0.023096
Model
True function
Samples
Last Sample
Best Sample (mean)
1.0
0.8
0.6
0.4
0.2
0.0
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x

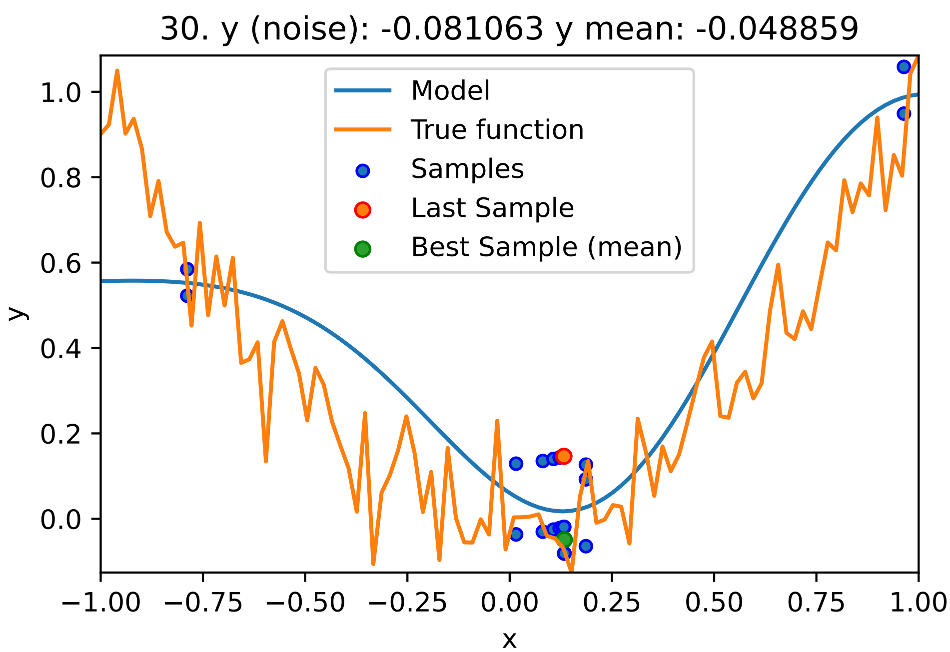


21. y (noise): -0.081063 y mean: -0.032757
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

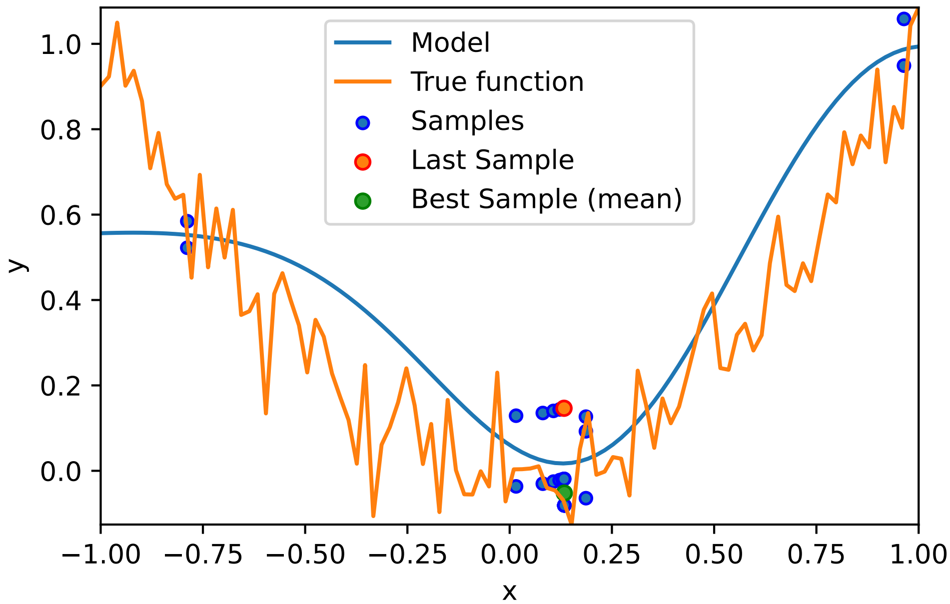



24. y (noise): -0.081063 y mean: -0.039658
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

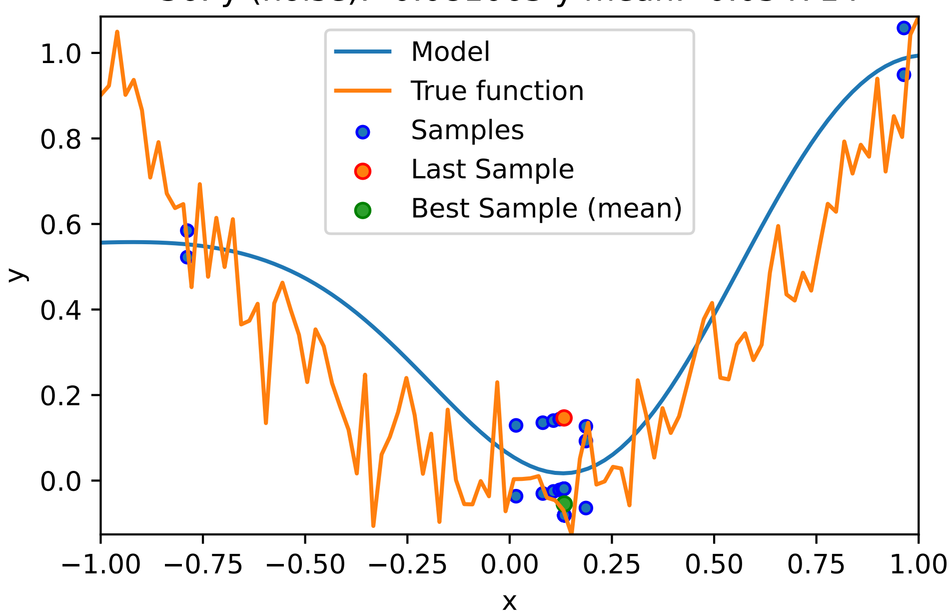

27. y (noise): -0.081063 y mean: -0.044833
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

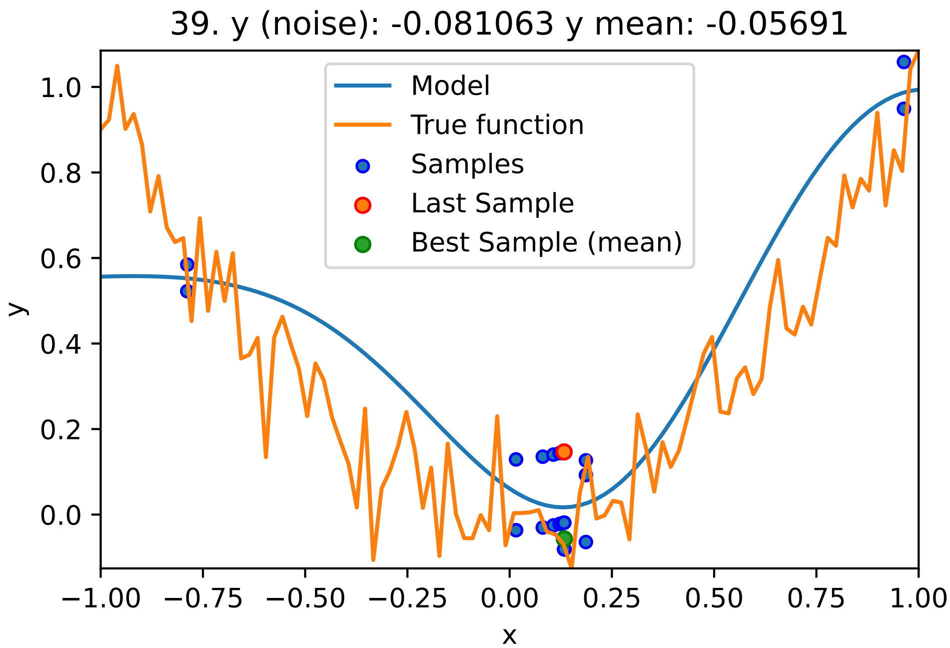

30. y (noise): -0.081063 y mean: -0.048859
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

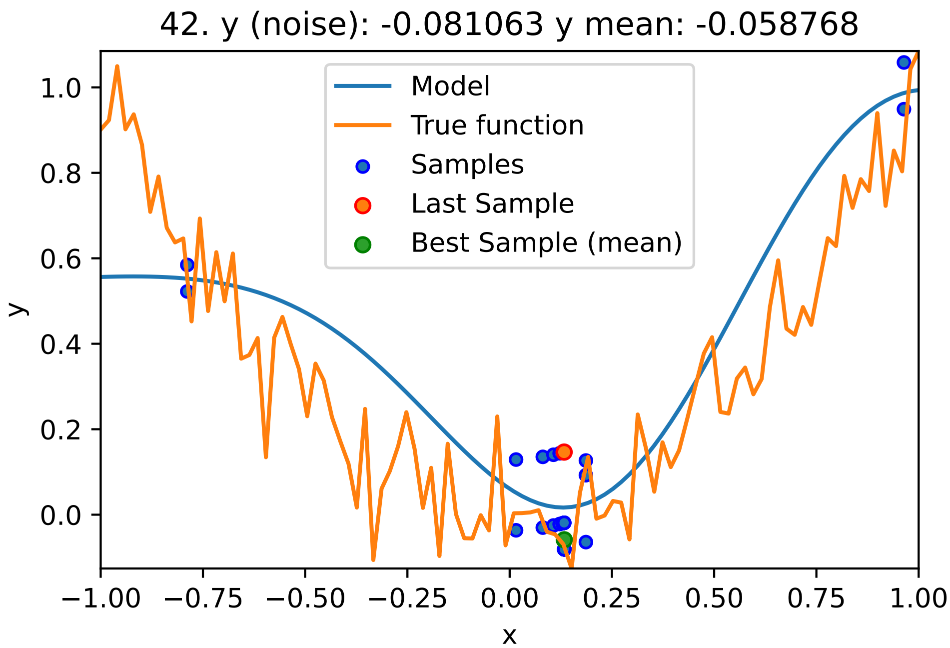
33. y (noise): -0.081063 y mean: -0.052079

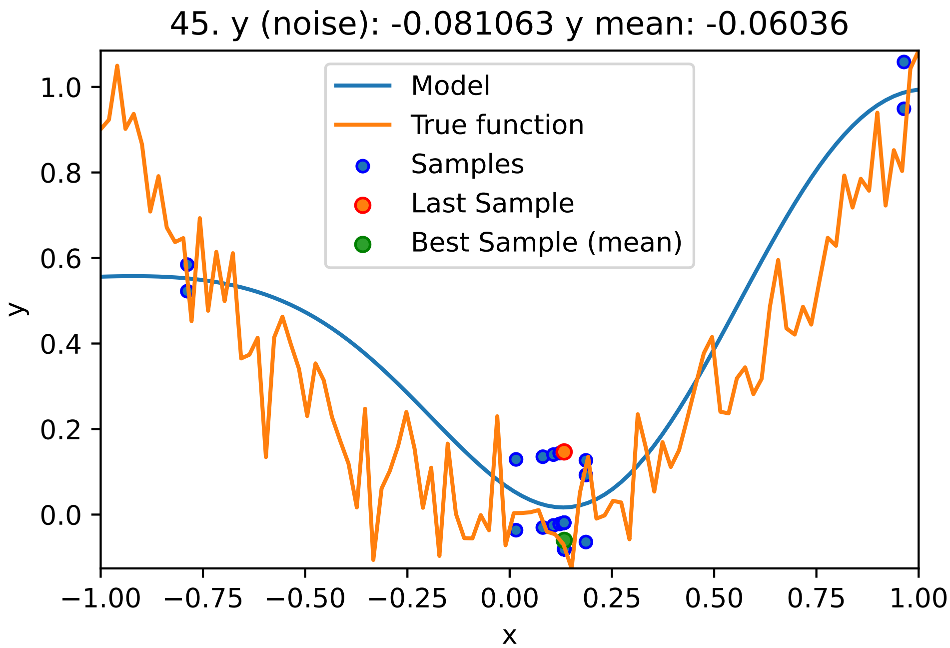


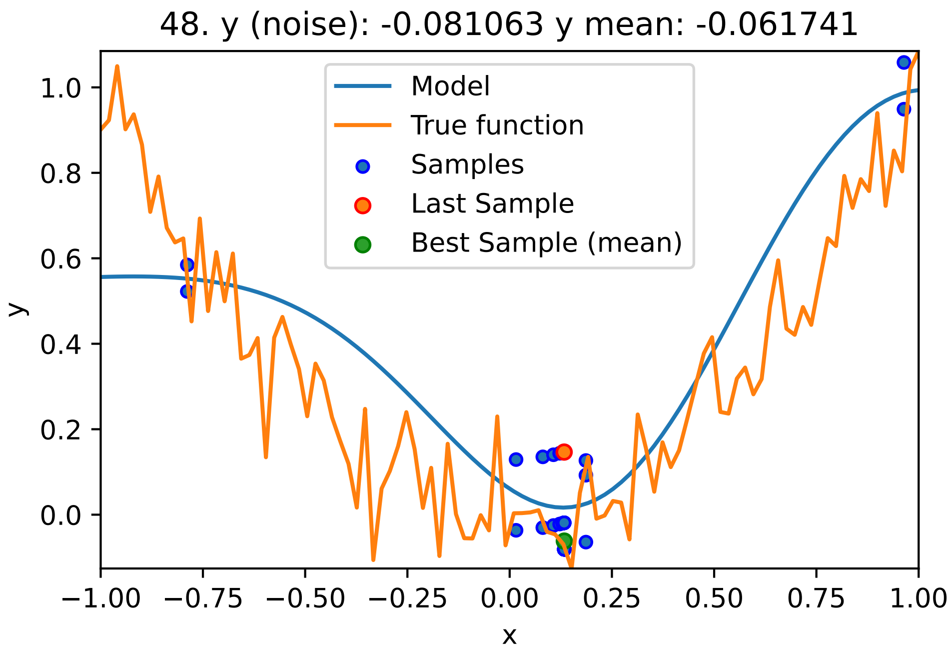

36. y (noise): -0.081063 y mean: -0.054714

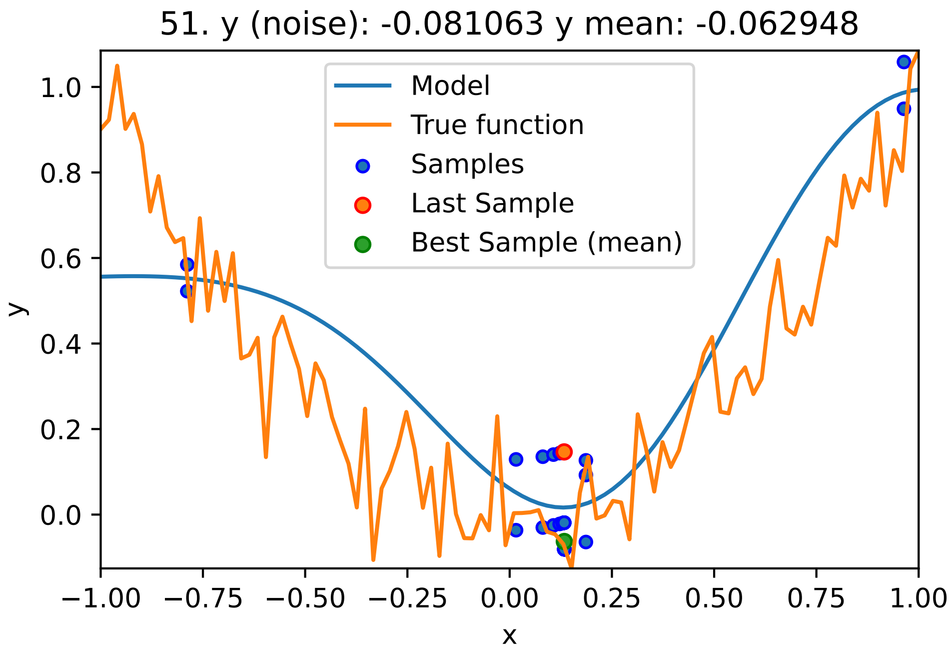



39. y (noise): -0.081063 y mean: -0.05691
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x


42. y (noise): -0.081063 y mean: -0.058768
Model
True function
Samples
Last Sample
Best Sample (mean)
y
x


45. y (noise): -0.081063 y mean: -0.06036
Model
True function
Samples
Last Sample
Best Sample (mean)
1.0
0.8
0.6
0.4
0.2
0.0
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x


48. y (noise): -0.081063 y mean: -0.061741
Model
True function
Samples
Last Sample
Best Sample (mean)
1.0
0.8
0.6
0.4
0.2
0.0
y
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
x




```
<spotPython.spot.spot.Spot at 0x147aef580>
```

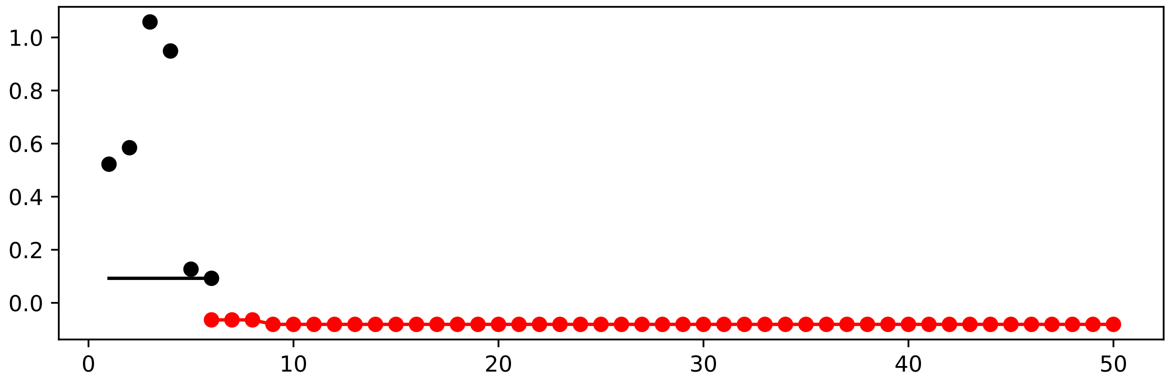
## 14.2 Print the Results

```
spot_1_noisy.print_results()
```

```
min y: -0.08106318979661208
x0: 0.1335999447536301
min mean y: -0.06294830660588041
x0: 0.1335999447536301
```

```
[['x0', 0.1335999447536301], ['x0', 0.1335999447536301]]
```

```
spot_1_noisy.plot_progress(log_y=False)
```




## 14.3 Noise and Surrogates: The Nugget Effect

### 14.3.1 The Noisy Sphere

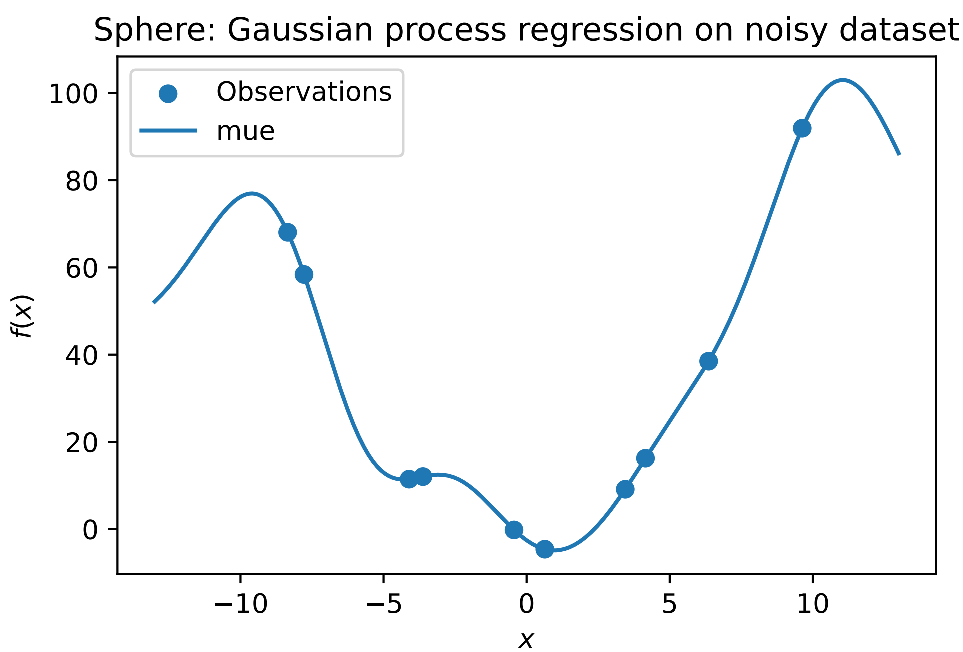
#### 14.3.1.1 The Data

We prepare some data first:

```
import numpy as np
import spotPython
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
import matplotlib.pyplot as plt

gen = spacefilling(1)
rng = np.random.RandomState(1)
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_sphere
fun_control = {"sigma": 2,
               "seed": 125}
X = gen.scipy_lhd(10, lower=lower, upper = upper)
y = fun(X, fun_control=fun_control)
X_train = X.reshape(-1,1)
y_train = y
```

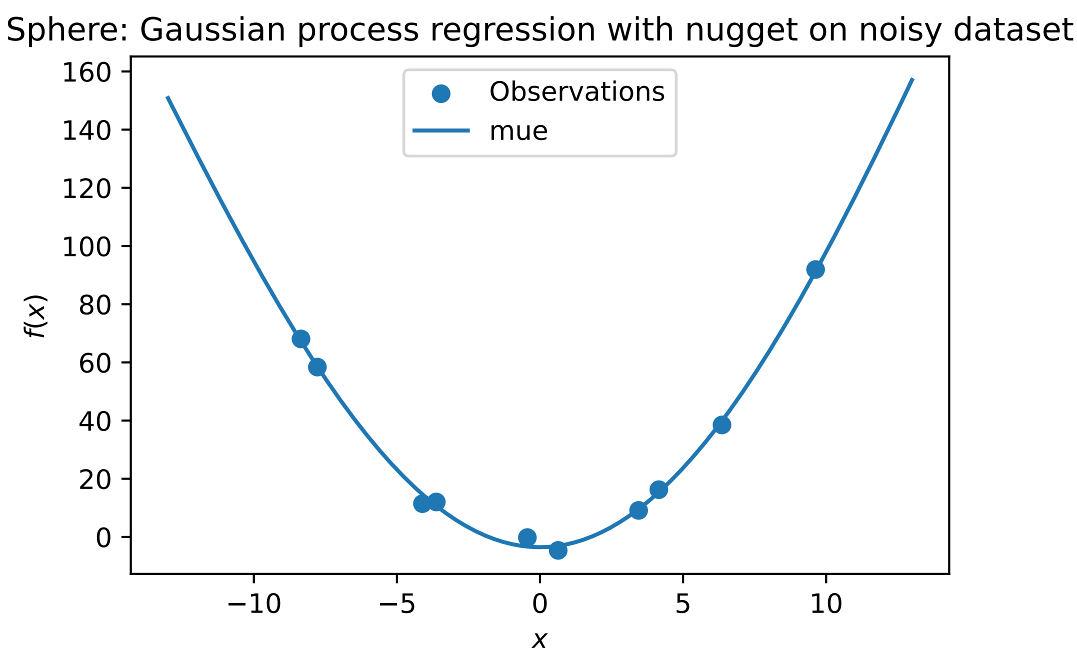
A surrogate without nugget is fitted to these data:

```
S = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=False)
S.fit(X_train, y_train)

X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S.predict(X_axis, return_val="all")

plt.scatter(X_train, y_train, label="Observations")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Sphere: Gaussian process regression on noisy dataset")
```




In comparison to the surrogate without nugget, we fit a surrogate with nugget to the data:

```
S_nug = Kriging(name='kriging',
            seed=123,
            log_level=50,
            n_theta=1,
            noise=True)
S_nug.fit(X_train, y_train)
X_axis = np.linspace(start=-13, stop=13, num=1000).reshape(-1, 1)
mean_prediction, std_prediction, ei = S_nug.predict(X_axis, return_val="all")
plt.scatter(X_train, y_train, label="Observations")
plt.plot(X_axis, mean_prediction, label="mue")
plt.legend()
plt.xlabel("$x$")
plt.ylabel("$f(x)$")
_ = plt.title("Sphere: Gaussian process regression with nugget on noisy dataset")
```




The value of the nugget term can be extracted from the model as follows:

```
S.Lambda
```

```
S_nug.Lambda
```

```
9.088150066416743e-05
```

We see:

- the first model `S` has no nugget,
- whereas the second model has a nugget value (`Lambda`) larger than zero.

## 14.4 Exercises

### 14.4.1 Noisy `fun_cubed`

Analyse the effect of noise on the `fun_cubed` function with the following settings:

```
fun = analytical().fun_cubed
fun_control = {"sigma": 10,
               "seed": 123}
lower = np.array([-10])
upper = np.array([10])
```

### 14.4.2 `fun_runge`

Analyse the effect of noise on the `fun_runge` function with the following settings:

```
lower = np.array([-10])
upper = np.array([10])
fun = analytical().fun_runge
fun_control = {"sigma": 0.25,
               "seed": 123}
```

### 14.4.3 `fun_forrester`

Analyse the effect of noise on the `fun_forrester` function with the following settings:

```
lower = np.array([0])
upper = np.array([1])
fun = analytical().fun_forrester
fun_control = {"sigma": 5,
               "seed": 123}
```

### 14.4.4 `fun_xsin`

Analyse the effect of noise on the `fun_xsin` function with the following settings:

```
lower = np.array([-1.])
upper = np.array([1.])
fun = analytical().fun_xsin
fun_control = {"sigma": 0.5,
               "seed": 123}
```

```
spot_1_noisy.mean_y.shape[0]
```

```
18
```

# 15 HPT: sklearn SVC on Moons Data

This document refers to the following software versions:

- `python`: 3.10.10

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                 0.2.34
spotRiver                  0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 15.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time and the initial design size.

```
MAX_TIME = 1
INIT_SIZE = 5
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '10-sklearn' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(INIT_
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
10-sklearn_p040025_1min_5init_2023-06-17_11-19-57
```

## 15.2 Step 1: Initialization of the Empty `fun_control` Dictionary

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/10_spot_hpt_sklearn_classification")
```

## 15.3 Step 2: SKlearn Load Data (Classification)

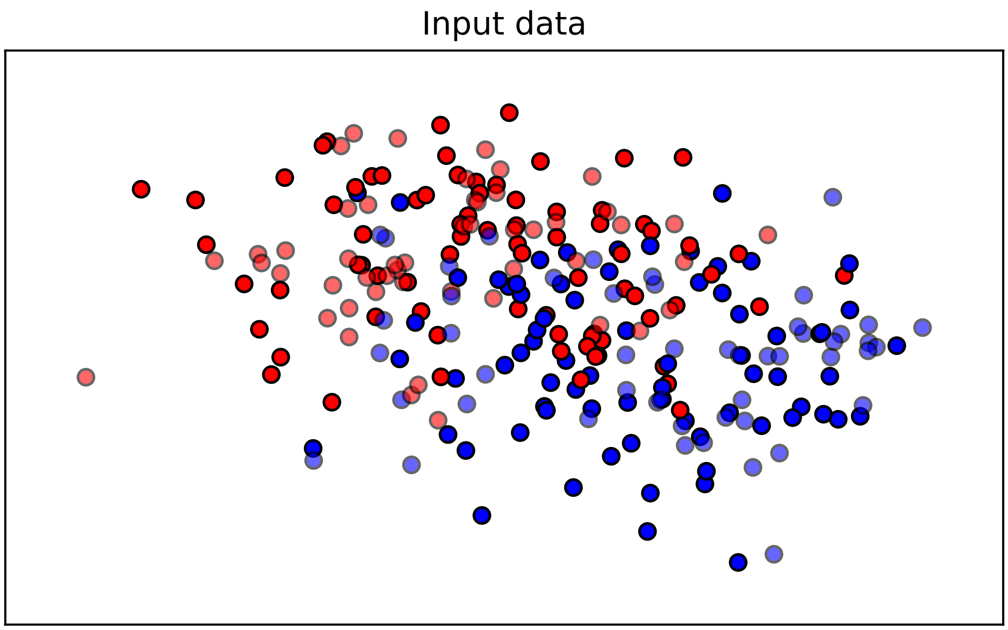
Randomly generate classification data.

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.datasets import make_moons, make_circles, make_classification
n_features = 2
n_samples = 250
target_column = "y"
ds =  make_moons(n_samples, noise=0.5, random_state=0)
X, y = ds
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.4, random_state=42
)
```

```python
train = pd.DataFrame(np.hstack((X_train, y_train.reshape(-1, 1))))
test = pd.DataFrame(np.hstack((X_test, y_test.reshape(-1, 1))))
train.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
test.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
train.head()
```

| | x1 | x2 | y |
|---|---|---|---|
| 0 | 1.083978 | -1.246111 | 1.0 |
| 1 | 0.074916 | 0.868104 | 0.0 |
| 2 | -1.668535 | 0.751752 | 0.0 |
| 3 | 1.286597 | 1.454165 | 0.0 |
| 4 | 1.387021 | 0.448355 | 1.0 |

```python
import matplotlib.pyplot as plt
from matplotlib.colors import ListedColormap

x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5
cm = plt.cm.RdBu
cm_bright = ListedColormap(["#FF0000", "#0000FF"])
ax = plt.subplot(1, 1, 1)
ax.set_title("Input data")
# Plot the training points
ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright, edgecolors="k")
# Plot the testing points
ax.scatter(
    X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6, edgecolors="k"
)
ax.set_xlim(x_min, x_max)
ax.set_ylim(y_min, y_max)
ax.set_xticks(())
ax.set_yticks(())
plt.tight_layout()
plt.show()
```




```
n_samples = len(train)
# add the dataset to the fun_control
fun_control.update({"data": None, # dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column})
```

## 15.4 Step 3: Specification of the Preprocessing Model

Data preprocesssing can be very simple, e.g., you can ignore it. Then you would choose the `prep_model` "None":

```
prep_model = None
fun_control.update({"prep_model": prep_model})
```

A default approach for numerical data is the `StandardScaler` (mean 0, variance 1). This can be selected as follows:

```
from sklearn.preprocessing import StandardScaler
prep_model = StandardScaler()
fun_control.update({"prep_model": prep_model})
```

Even more complicated pre-processing steps are possible, e.g., the follwing pipeline:

```
# categorical_columns = []
# one_hot_encoder = OneHotEncoder(handle_unknown="ignore", sparse_output=False)
# prep_model = ColumnTransformer(
#         transformers=[
#              ("categorical", one_hot_encoder, categorical_columns),
#         ],
#         remainder=StandardScaler(),
#     )
```

## 15.5 Step 4: Select `algorithm` and `core_model_hyper_dict`

The selection of the algorithm (ML model) that should be tuned is done by specifying the its name from the `sklearn` implementation. For example, the `SVC` support vector machine classifier is selected as follows:

```
from sklearn.linear_model import RidgeCV
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.linear_model import ElasticNet
from spotPython.hyperparameters.values import add_core_model_to_fun_control
from spotPython.data.sklearn_hyper_dict import SklearnHyperDict
from spotPython.fun.hypersklearn import HyperSklearn
```

```
# core_model  = RidgeCV
# core_model = GradientBoostingRegressor
# core_model = ElasticNet
# core_model = RandomForestClassifier
core_model = SVC
# core_model = LogisticRegression
```

```
# core_model = KNeighborsClassifier
# core_model = GradientBoostingClassifier
fun_control = add_core_model_to_fun_control(core_model=core_model,
                              fun_control=fun_control,
                              hyper_dict=SklearnHyperDict,
                              filename=None)
```

Now `fun_control` has the information from the JSON file:

```
    "SVC":
    {
        "C": {
            "type": "float",
            "default": 1.0,
            "transform": "None",
            "lower": 0.1,
            "upper": 10.0},
        "kernel": {
            "levels": ["linear", "poly", "rbf", "sigmoid"],
            "type": "factor",
            "default": "rbf",
            "transform": "None",
            "core_model_parameter_type": "str",
            "lower": 0,
            "upper": 3},
        "degree": {
            "type": "int",
            "default": 3,
            "transform": "None",
            "lower": 3,
            "upper": 3},
        "gamma": {
            "levels": ["scale", "auto"],
            "type": "factor",
            "default": "scale",
            "transform": "None",
            "core_model_parameter_type": "str",
            "lower": 0,
            "upper": 1},
        "coef0": {
            "type": "float",
            "default": 0.0,
```

```
            "transform": "None",
            "lower": 0.0,
            "upper": 0.0},
        "shrinking": {
            "levels": [0, 1],
            "type": "factor",
            "default": 0,
            "transform": "None",
            "core_model_parameter_type": "bool",
            "lower": 0,
            "upper": 1},
        "probability": {
            "levels": [0, 1],
            "type": "factor",
            "default": 0,
            "transform": "None",
            "core_model_parameter_type": "bool",
            "lower": 0,
            "upper": 1},
        "tol": {
            "type": "float",
            "default": 1e-3,
            "transform": "None",
            "lower": 1e-4,
            "upper": 1e-2},
        "cache_size": {
            "type": "float",
            "default": 200,
            "transform": "None",
            "lower": 100,
            "upper": 400},
        "break_ties": {
            "levels": [0, 1],
            "type": "factor",
            "default": 0,
            "transform": "None",
            "core_model_parameter_type": "bool",
            "lower": 0,
            "upper": 1}
    }
```

## 15.6 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

### 15.6.1 Modify hyperparameter of type numeric and integer (boolean)

Numeric and boolean values can be modified using the `modify_hyper_parameter_bounds` method. For example, to change the `tol` hyperparameter of the `SVC` model to the interval [1e-3, 1e-2], the following code can be used:

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_split", bounds=[3,
#fun_control = modify_hyper_parameter_bounds(fun_control, "merit_preprune", bounds=[0, 0])
fun_control["core_model_hyper_dict"]["tol"]
```

```
{'type': 'float',
 'default': 0.001,
 'transform': 'None',
 'lower': 0.001,
 'upper': 0.01}
```

### 15.6.2 Modify hyperparameter of type factor

Factors can be modified with the `modify_hyper_parameter_levels` function. For example, to exclude the `sigmoid` kernel from the tuning, the `kernel` hyperparameter of the `SVC` model can be modified as follows:

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["linear", "poly", "rbf
fun_control["core_model_hyper_dict"]["kernel"]
```

```
{'levels': ['linear', 'poly', 'rbf'],
 'type': 'factor',
 'default': 'rbf',
 'transform': 'None',
```

```
'core_model_parameter_type': 'str',
'lower': 0,
'upper': 2}
```

### 15.6.3 Optimizers

Optimizers are described in Section 21.6.

## 15.7 Step 6: Selection of the Objective (Loss) Function

There are two metrics:

1. `metric_river` is used for the river based evaluation via `eval_oml_iter_progressive`.
2. `metric_sklearn` is used for the sklearn based evaluation.

```
from sklearn.metrics import mean_absolute_error, accuracy_score, roc_curve, roc_auc_score,
fun_control.update({
               "metric_sklearn": log_loss,
               })
```

### 15.7.1 Predict Classes or Class Probabilities

If the key `"predict_proba"` is set to `True`, the class probabilities are predicted. `False` is the default, i.e., the classes are predicted.

```
fun_control.update({
               "predict_proba": False,
               })
```

## 15.8 Step 7: Calling the SPOT Function

## 15.9 Preparing the SPOT Call

The following code passes the information about the parameter ranges and bounds to `spot`.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
```

```
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name        | type   | default   |   lower |   upper | transform   |
|-------------|--------|-----------|---------|---------|-------------|
| C           | float  | 1.0       |   0.1   |   10    | None        |
| kernel      | factor | rbf       |   0     |    2    | None        |
| degree      | int    | 3         |   3     |    3    | None        |
| gamma       | factor | scale     |   0     |    1    | None        |
| coef0       | float  | 0.0       |   0     |    0    | None        |
| shrinking   | factor | 0         |   0     |    1    | None        |
| probability | factor | 0         |   0     |    1    | None        |
| tol         | float  | 0.001     |   0.001 |    0.01 | None        |
| cache_size  | float  | 200.0     | 100     |  400    | None        |
| break_ties  | factor | 0         |   0     |    1    | None        |
```

## 15.10 The Objective Function

The objective function is selected next. It implements an interface from `sklearn`'s training, validation, and testing methods to `spotPython`.

```
from spotPython.fun.hypersklearn import HyperSklearn
fun = HyperSklearn().fun_sklearn
```

### 15.10.1 Run the `Spot` Optimizer

- Run SPOT for approx. x mins (`max_time`).
- Note: the run takes longer, because the evaluation time of initial design (here: `initi_size`, 20 points) is not considered.

```
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=SklearnHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
X_start
```

```
array([[1.e+00, 2.e+00, 3.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 1.e-03,
        2.e+02, 0.e+00]])
```

## 15.11 Starting the Hyperparameter Tuning

```
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
                                      "model_fun_evals": 10_000,
                                      "log_level": 50
```

```python
                                         })
spot_tuner.run(X_start=X_start)
```

```
spotPython tuning: 5.691103166702708 [----------] 2.88%

spotPython tuning: 5.691103166702708 [----------] 4.74%

spotPython tuning: 5.691103166702708 [#---------] 6.27%

spotPython tuning: 5.691103166702708 [#---------] 7.68%

spotPython tuning: 5.691103166702708 [#---------] 9.08%

spotPython tuning: 5.691103166702708 [#---------] 11.46%

spotPython tuning: 5.691103166702708 [#---------] 13.74%

spotPython tuning: 5.691103166702708 [##--------] 15.93%

spotPython tuning: 5.691103166702708 [##--------] 18.20%

spotPython tuning: 5.691103166702708 [##--------] 20.45%

spotPython tuning: 5.691103166702708 [##--------] 22.99%

spotPython tuning: 5.691103166702708 [###-------] 25.65%

spotPython tuning: 5.691103166702708 [###-------] 34.02%

spotPython tuning: 5.691103166702708 [#####-----] 45.89%

spotPython tuning: 5.691103166702708 [######----] 58.45%

spotPython tuning: 5.691103166702708 [#######---] 71.20%

spotPython tuning: 5.691103166702708 [########--] 83.65%

spotPython tuning: 5.691103166702708 [##########] 95.95%

spotPython tuning: 5.691103166702708 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x2c0610df0>
```

### 15.11.1 Results

```
SAVE = False
LOAD = False

if SAVE:
    result_file_name = "res_" + experiment_name + ".pkl"
    with open(result_file_name, 'wb') as f:
        pickle.dump(spot_tuner, f)

if LOAD:
    result_file_name = "res_ch10-friedman-hpt-0_maans03_60min_20init_1K_2023-04-14_10-11-1
    with open(result_file_name, 'rb') as f:
        spot_tuner =  pickle.load(f)
```

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

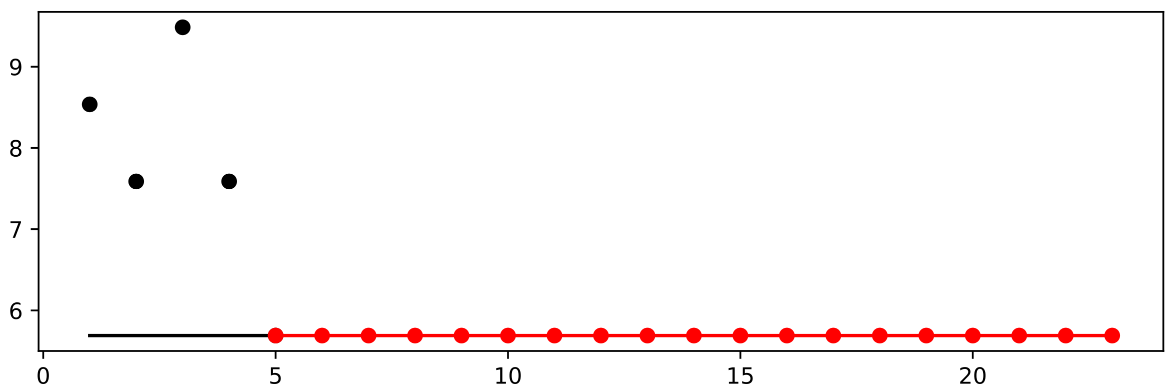



Figure 15.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name        | type   | default   |   lower |   upper |                tuned | transform
|-------------|--------|-----------|---------|---------|----------------------|-------------
| C           | float  | 1.0       |     0.1 |    10.0 |   3.6280771109650245 | None
| kernel      | factor | rbf       |     0.0 |     2.0 |                  1.0 | None
| degree      | int    | 3         |     3.0 |     3.0 |                  3.0 | None
| gamma       | factor | scale     |     0.0 |     1.0 |                  0.0 | None
| coef0       | float  | 0.0       |     0.0 |     0.0 |                  0.0 | None
| shrinking   | factor | 0         |     0.0 |     1.0 |                  1.0 | None
| probability | factor | 0         |     0.0 |     1.0 |                  0.0 | None
| tol         | float  | 0.001     |   0.001 |    0.01 | 0.006642600916881275 | None
| cache_size  | float  | 200.0     |   100.0 |   400.0 |   202.03372626175258 | None
| break_ties  | factor | 0         |     0.0 |     1.0 |                  1.0 | None
```

## 15.12 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

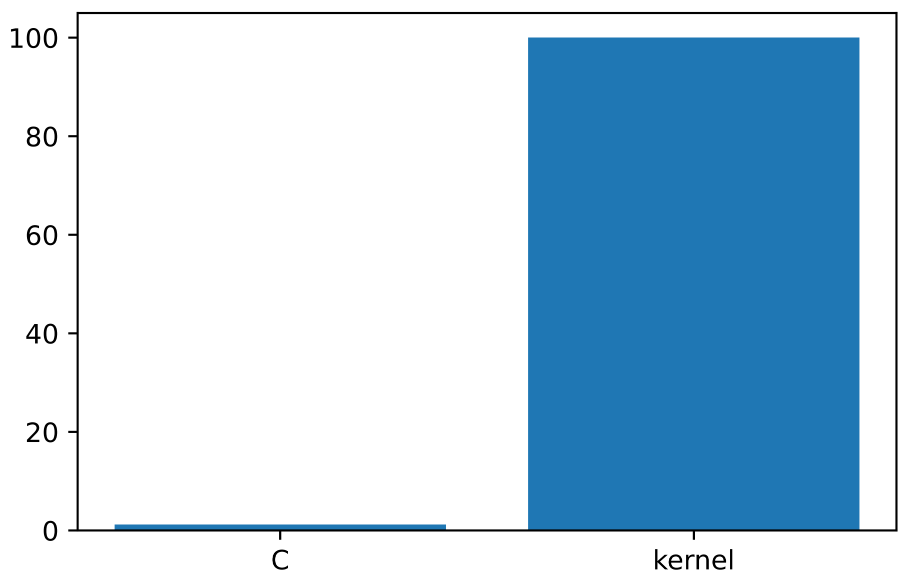



Figure 15.2: Variable importance plot, threshold 0.025.

## 15.13 Get Default Hyperparameters

```
from spotPython.hyperparameters.values import get_default_values, transform_hyper_paramete
values_default = get_default_values(fun_control)
values_default = transform_hyper_parameter_values(fun_control=fun_control, hyper_parameter
values_default
```

```
{'C': 1.0,
 'kernel': 'rbf',
 'degree': 3,
 'gamma': 'scale',
 'coef0': 0.0,
 'shrinking': 0,
 'probability': 0,
 'tol': 0.001,
 'cache_size': 200.0,
 'break_ties': 0}
```

```
from sklearn.pipeline import make_pipeline
model_default = make_pipeline(fun_control["prep_model"], fun_control["core_model"](**value
model_default
```

```
Pipeline(steps=[('standardscaler', StandardScaler()),
                ('svc',
                 SVC(break_ties=0, cache_size=200.0, probability=0,
                     shrinking=0))])
```

## 15.14 Get SPOT Results

```
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
print(X)
```

```
[[3.62807711e+00 1.00000000e+00 3.00000000e+00 0.00000000e+00
  0.00000000e+00 1.00000000e+00 0.00000000e+00 6.64260092e-03
  2.02033726e+02 1.00000000e+00]]
```

```python
from spotPython.hyperparameters.values import assign_values, return_conf_list_from_var_dic
v_dict = assign_values(X, fun_control["var_name"])
return_conf_list_from_var_dict(var_dict=v_dict, fun_control=fun_control)
```

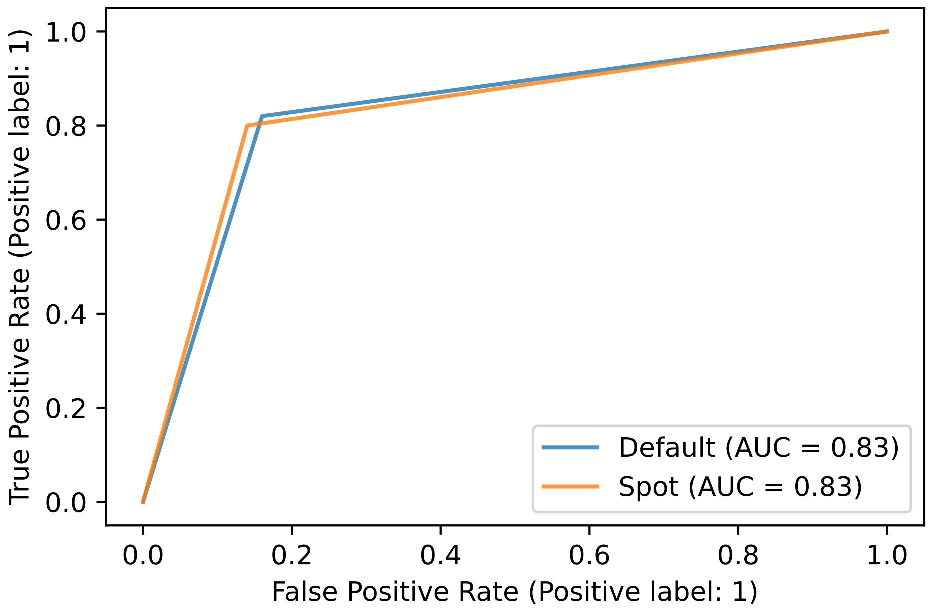
```
[{'C': 3.6280771109650245,
  'kernel': 'poly',
  'degree': 3,
  'gamma': 'scale',
  'coef0': 0.0,
  'shrinking': 1,
  'probability': 0,
  'tol': 0.006642600916881275,
  'cache_size': 202.03372626175258,
  'break_ties': 1}]
```

```python
from spotPython.hyperparameters.values import get_one_sklearn_model_from_X
model_spot = get_one_sklearn_model_from_X(X, fun_control)
model_spot
```

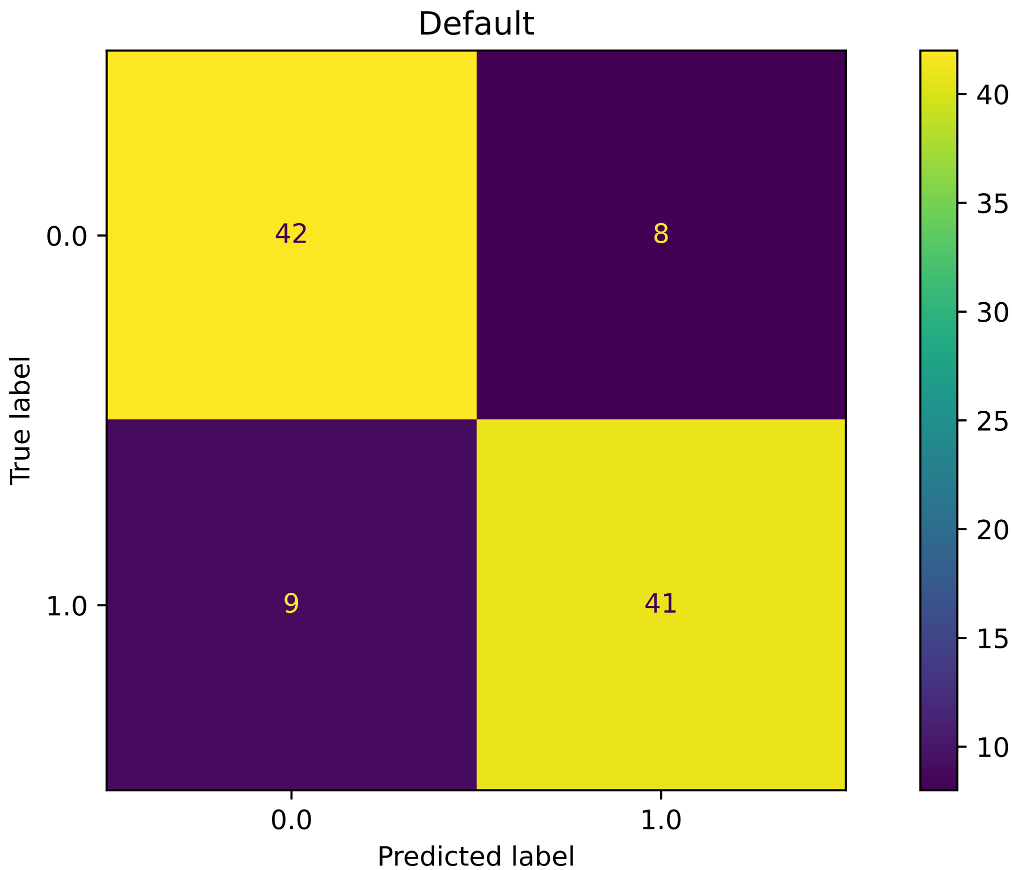
```
Pipeline(steps=[('standardscaler', StandardScaler()),
                ('svc',
                 SVC(C=3.6280771109650245, break_ties=1,
                     cache_size=202.03372626175258, kernel='poly',
                     probability=0, shrinking=1, tol=0.006642600916881275))])
```

## 15.15 Plot: Compare Predictions

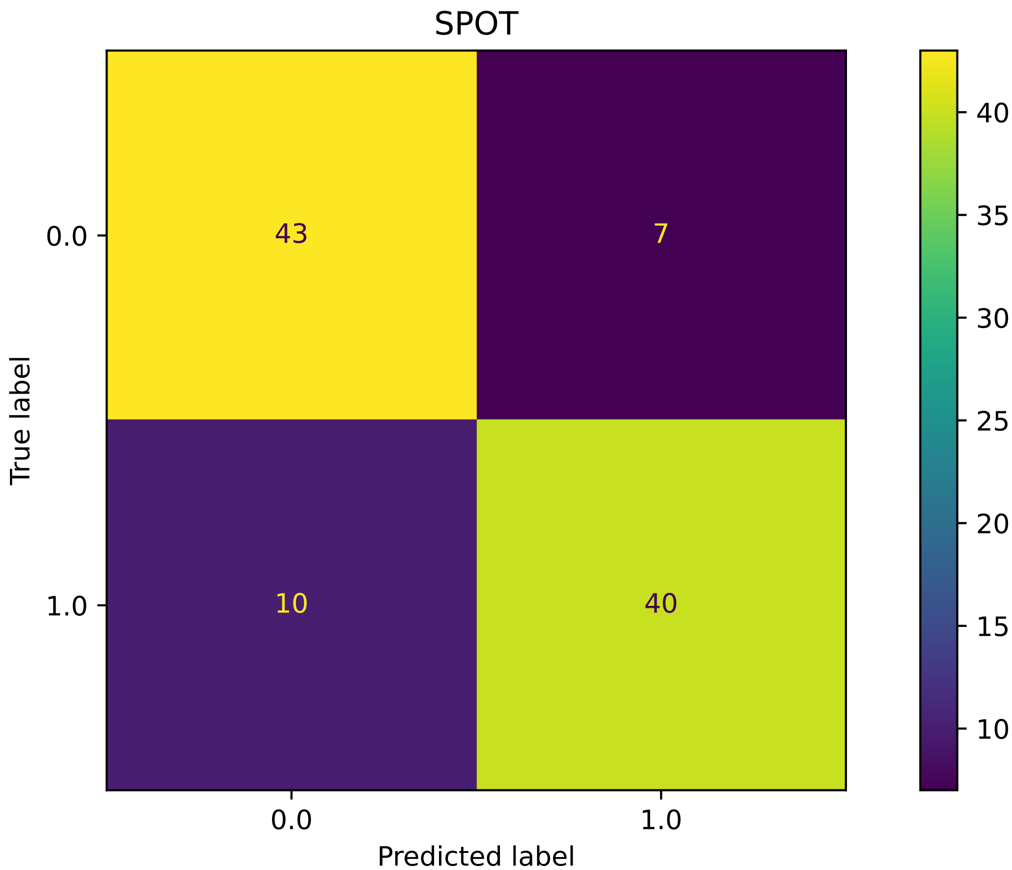
```python
from spotPython.plot.validation import plot_roc
plot_roc([model_default, model_spot], fun_control, model_names=["Default", "Spot"])
```




```
from spotPython.plot.validation import plot_confusion_matrix
plot_confusion_matrix(model_default, fun_control, title = "Default")
```




```
plot_confusion_matrix(model_spot, fun_control, title="SPOT")
```



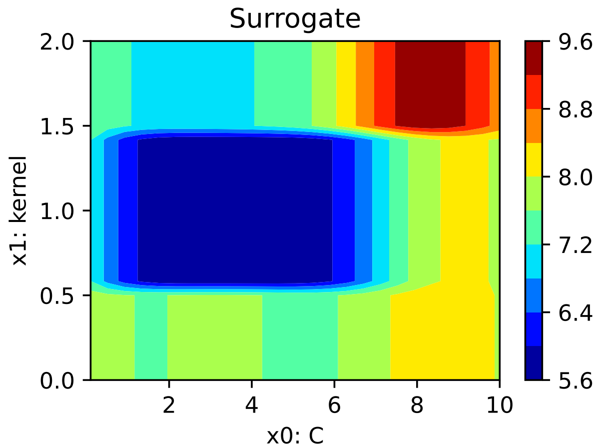

```
min(spot_tuner.y), max(spot_tuner.y)
```

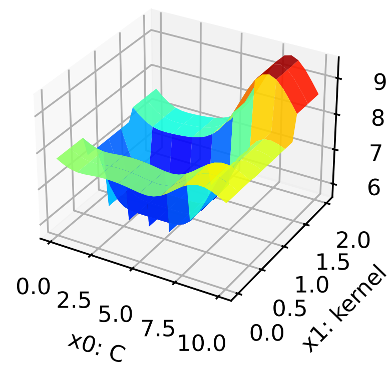
```
(5.691103166702708, 9.485171944504513)
```

## 15.16 Detailed Hyperparameter Plots

```
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
C:  1.1399176173997725
kernel:  100.0
```




## 15.17 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

## 15.18 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 16 HPT: PyTorch With fashionMNIST

In this tutorial, we will show how `spotPython` can be integrated into the `PyTorch` training workflow.

This document refers to the following software versions:

- `python`: 3.10.10
- `torch`: 2.0.1
- `torchvision`: 0.15.0

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                0.2.34
spotRiver                 0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 16.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time, initial design size and the device that is used.

```
MAX_TIME = 1
INIT_SIZE = 5
DEVICE = "cpu" # "cuda:0"
```

```
from spotPython.utils.device import getDevice
DEVICE = getDevice(DEVICE)
print(DEVICE)
```

```
cpu
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '11-torch' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(INIT_SI
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
11-torch_p040025_1min_5init_2023-06-17_11-26-02
```

## 16.2 Step 1: Initialization of the Empty `fun_control` Dictionary

`spotPython` uses a Python dictionary for storing the information required for the hyperparameter tuning process, which was described in Section 21.2.

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/11_spot_hpt_torch_fashion_mnist",
    device=DEVICE)
```

## 16.3 PyTorch Data Loading

## 16.4 Step 2: Load fashionMNIST Data

```
from torchvision import datasets, transforms
from torchvision.transforms import ToTensor
def load_data(data_dir="./data"):
    # Download training data from open datasets.
    training_data = datasets.FashionMNIST(
        root=data_dir,
        train=True,
        download=True,
        transform=ToTensor(),
    )
    # Download test data from open datasets.
    test_data = datasets.FashionMNIST(
        root=data_dir,
        train=False,
        download=True,
        transform=ToTensor(),
    )
    return training_data, test_data
```

```
train, test = load_data()
train.data.shape, test.data.shape
```

```
(torch.Size([60000, 28, 28]), torch.Size([10000, 28, 28]))
```

```
n_samples = len(train)
# add the dataset to the fun_control
fun_control.update({"data": None,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": None})
```

## 16.5 The Model (Algorithm) to be Tuned

## 16.6 Step 3: Specification of the Preprocessing Model

After the training and test data are specified and added to the `fun_control` dictionary, `spotPython` allows the specification of a data preprocessing pipeline, e.g., for the scaling of the data or for the one-hot encoding of categorical variables, see Section 21.4.1. This feature is not used here, so we do not change the default value (which is `None`).

## 16.7 Step 4: Select `algorithm` and `core_model_hyper_dict`

`spotPython` implements a class which is similar to the class described in the PyTorch tutorial. The class is called `Net_fashionMNIST` and is implemented in the file `netfashionMNIST.py`. The class is imported here.

```
from torch import nn
import spotPython.torch.netcore as netcore


class Net_fashionMNIST(netcore.Net_Core):
    def __init__(self, l1, l2, lr_mult, batch_size, epochs, k_folds, patience, optimizer,
        super(Net_fashionMNIST, self).__init__(
            lr_mult=lr_mult,
            batch_size=batch_size,
            epochs=epochs,
            k_folds=k_folds,
            patience=patience,
            optimizer=optimizer,
            sgd_momentum=sgd_momentum,
        )
        self.flatten = nn.Flatten()
        self.linear_relu_stack = nn.Sequential(
            nn.Linear(28 * 28, l1),
            nn.ReLU(),
            nn.Linear(l1, l2),
            nn.ReLU(),
            nn.Linear(l2, 10)
        )

    def forward(self, x):
```

```
        x = self.flatten(x)
        logits = self.linear_relu_stack(x)
        return logits
```

This class inherits from the class `Net_Core` which is implemented in the file `netcore.py`, see Section 21.4.3.

```
from spotPython.data.torch_hyper_dict import TorchHyperDict
from spotPython.torch.netfashionMNIST import Net_fashionMNIST
from spotPython.hyperparameters.values import add_core_model_to_fun_control
fun_control = add_core_model_to_fun_control(core_model=Net_fashionMNIST,
                              fun_control=fun_control,
                              hyper_dict=TorchHyperDict,
                              filename=None)
```

## 16.8 The Search Space

### 16.8.1 Configuring the Search Space With spotPython

#### 16.8.1.1 The `hyper_dict` Hyperparameters for the Selected Algorithm

`spotPython` uses `JSON` files for the specification of the hyperparameters, which were described in Section 21.5.2.

The corresponding entries for the `Net_fashionMNIST` class are shown below.

```
"Net_fashionMNIST":
    {
        "l1": {
            "type": "int",
            "default": 5,
            "transform": "transform_power_2_int",
            "lower": 2,
            "upper": 9},
        "l2": {
            "type": "int",
            "default": 5,
            "transform": "transform_power_2_int",
            "lower": 2,
            "upper": 9},
```

```
        "lr_mult": {
            "type": "float",
            "default": 1.0,
            "transform": "None",
            "lower": 0.1,
            "upper": 10.0},
        "batch_size": {
            "type": "int",
            "default": 4,
            "transform": "transform_power_2_int",
            "lower": 1,
            "upper": 4},
        "epochs": {
                "type": "int",
                "default": 3,
                "transform": "transform_power_2_int",
                "lower": 3,
                "upper": 4},
        "k_folds": {
            "type": "int",
            "default": 1,
            "transform": "None",
            "lower": 1,
            "upper": 1},
        "patience": {
            "type": "int",
            "default": 5,
            "transform": "None",
            "lower": 2,
            "upper": 10
        },
        "optimizer": {
            "levels": ["Adadelta",
                        "Adagrad",
                        "Adam",
                        "AdamW",
                        "SparseAdam",
                        "Adamax",
                        "ASGD",
                        "NAdam",
                        "RAdam",
```

```
                        "RMSprop",
                        "Rprop",
                        "SGD"],
            "type": "factor",
            "default": "SGD",
            "transform": "None",
            "core_model_parameter_type": "str",
            "lower": 0,
            "upper": 12},
        "sgd_momentum": {
            "type": "float",
            "default": 0.0,
            "transform": "None",
            "lower": 0.0,
            "upper": 1.0}
    },
```

## 16.9 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

### 16.9.1 Modify hyperparameter of type numeric and integer (boolean)

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
# fun_control = modify_hyper_parameter_bounds(fun_control, "delta", bounds=[1e-10, 1e-6])
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_split", bounds=[3,
#fun_control = modify_hyper_parameter_bounds(fun_control, "merit_preprune", bounds=[0, 0])
# fun_control["core_model_hyper_dict"]
fun_control = modify_hyper_parameter_bounds(fun_control, "k_folds", bounds=[0, 0])
fun_control = modify_hyper_parameter_bounds(fun_control, "patience", bounds=[2, 2])
fun_control = modify_hyper_parameter_bounds(fun_control, "epochs", bounds=[2, 3])
```

### 16.9.2 Modify hyperparameter of type factor

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
# fun_control = modify_hyper_parameter_levels(fun_control, "leaf_model", ["LinearRegressio
# fun_control["core_model_hyper_dict"]
```

### 16.9.3 Optimizers

Optimizers are described in Section 21.6.

## 16.10 Step 6: Selection of the Objective (Loss) Function

### 16.10.1 Evaluation

The evaluation procedure requires the specification of two elements:

1. the way how the data is split into a train and a test set and
2. the loss function (and a metric).

These are described in Section 26.9.

The key `"loss_function"` specifies the loss function which is used during the optimization, see Section 21.8.

We will use CrossEntropy loss for the multiclass-classification task.

```
from torch.nn import CrossEntropyLoss
loss_function = CrossEntropyLoss()
fun_control.update({
        "loss_function": loss_function,
        "shuffle": True,
        "eval":  "train_hold_out"
        })
```

### 16.10.2 Metric

```
from torchmetrics import Accuracy
metric_torch = Accuracy(task="multiclass", num_classes=10).to(fun_control["device"])
fun_control.update({"metric_torch": metric_torch})
```

## 16.11 Preparing the SPOT Call

The following code passes the information about the parameter ranges and bounds to `spot`.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name         | type   | default   |   lower |   upper | transform             |
|--------------|--------|-----------|---------|---------|-----------------------|
| l1           | int    | 5         |     2   |       9 | transform_power_2_int |
| l2           | int    | 5         |     2   |       9 | transform_power_2_int |
| lr_mult      | float  | 1.0       |     0.1 |      10 | None                  |
| batch_size   | int    | 4         |     1   |       4 | transform_power_2_int |
| epochs       | int    | 3         |     2   |       3 | transform_power_2_int |
| k_folds      | int    | 1         |     0   |       0 | None                  |
| patience     | int    | 5         |     2   |       2 | None                  |
| optimizer    | factor | SGD       |     0   |      12 | None                  |
| sgd_momentum | float  | 0.0       |     0   |       1 | None                  |
```

## 16.12 The Objective Function `fun_torch`

The objective function `fun_torch` is selected next. It implements an interface from `PyTorch`'s training, validation, and testing methods to `spotPython`.

```
from spotPython.fun.hypertorch import HyperTorch
fun = HyperTorch().fun_torch
```

## 16.13 Starting the Hyperparameter Tuning

```
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
                                      "model_fun_evals": 10_000,
                                      "log_level": 50
                                      })
spot_tuner.run(X_start=X_start)
```

```
config: {'l1': 16, 'l2': 32, 'lr_mult': 9.563687451910228, 'batch_size': 8, 'epochs': 8, 'k_
Epoch: 1

Loss on hold-out set: 0.6036816341369413
Accuracy on hold-out set: 0.8116666666666666
MulticlassAccuracy value on hold-out data: 0.8116666674613953
```

```
Epoch: 2

Loss on hold-out set: 0.6637828209282209
Accuracy on hold-out set: 0.8014166666666667
MulticlassAccuracy value on hold-out data: 0.8014166951179504
Epoch: 3

Loss on hold-out set: 0.5263105563688247
Accuracy on hold-out set: 0.82425
MulticlassAccuracy value on hold-out data: 0.8242499828338623
Epoch: 4

Loss on hold-out set: 0.5354919541371055
Accuracy on hold-out set: 0.824625
MulticlassAccuracy value on hold-out data: 0.8246250152587891
Epoch: 5

Loss on hold-out set: 0.5540430189609372
Accuracy on hold-out set: 0.8132083333333333
MulticlassAccuracy value on hold-out data: 0.8132083415985107
Early stopping at epoch 4
Returned to Spot: Validation loss: 0.5540430189609372
----------------------------------------------

config: {'l1': 128, 'l2': 32, 'lr_mult': 6.258012467639852, 'batch_size': 2, 'epochs': 4, 'k
Epoch: 1

Loss on hold-out set: 0.5178951067217543
Accuracy on hold-out set: 0.844875
MulticlassAccuracy value on hold-out data: 0.8448749780654907
Epoch: 2

Loss on hold-out set: 0.5646245991813971
Accuracy on hold-out set: 0.8531666666666666
MulticlassAccuracy value on hold-out data: 0.8531666398048401
Epoch: 3

Loss on hold-out set: 0.5876322446816155
Accuracy on hold-out set: 0.8590833333333333
MulticlassAccuracy value on hold-out data: 0.859083354473114
```

```
Early stopping at epoch 2
Returned to Spot: Validation loss: 0.5876322446816155
----------------------------------------------

config: {'l1': 256, 'l2': 256, 'lr_mult': 0.2437336281201693, 'batch_size': 16, 'epochs': 8,
Epoch: 1

Loss on hold-out set: 0.5070958945155144
Accuracy on hold-out set: 0.8218333333333333
MulticlassAccuracy value on hold-out data: 0.8218333125114441
Epoch: 2

Loss on hold-out set: 0.470326713124911
Accuracy on hold-out set: 0.8344583333333333
MulticlassAccuracy value on hold-out data: 0.8344583511352539
Epoch: 3

Loss on hold-out set: 0.4459075529252489
Accuracy on hold-out set: 0.8414166666666667
MulticlassAccuracy value on hold-out data: 0.8414166569709778
Epoch: 4

Loss on hold-out set: 0.44221022629489504
Accuracy on hold-out set: 0.8434583333333333
MulticlassAccuracy value on hold-out data: 0.843458354473114
Epoch: 5

Loss on hold-out set: 0.426274533290416
Accuracy on hold-out set: 0.850875
MulticlassAccuracy value on hold-out data: 0.8508750200271606
Epoch: 6

Loss on hold-out set: 0.41698824395736056
Accuracy on hold-out set: 0.8516666666666667
MulticlassAccuracy value on hold-out data: 0.8516666889190674
Epoch: 7

Loss on hold-out set: 0.4116738277872403
Accuracy on hold-out set: 0.855125
MulticlassAccuracy value on hold-out data: 0.8551250100135803
Epoch: 8
```

```
Loss on hold-out set: 0.41351523965224624
Accuracy on hold-out set: 0.8545833333333334
MulticlassAccuracy value on hold-out data: 0.8545833230018616
Returned to Spot: Validation loss: 0.41351523965224624
----------------------------------------------

config: {'l1': 64, 'l2': 8, 'lr_mult': 2.906205211581667, 'batch_size': 8, 'epochs': 4, 'k_fo
Epoch: 1

Loss on hold-out set: 1.0309410682519278
Accuracy on hold-out set: 0.6145833333333334
MulticlassAccuracy value on hold-out data: 0.6145833134651184
Epoch: 2

Loss on hold-out set: 0.8048220515474677
Accuracy on hold-out set: 0.69125
MulticlassAccuracy value on hold-out data: 0.6912500262260437
Epoch: 3

Loss on hold-out set: 0.7201188660015663
Accuracy on hold-out set: 0.7283333333333334
MulticlassAccuracy value on hold-out data: 0.7283333539962769
Epoch: 4

Loss on hold-out set: 0.6727624335264166
Accuracy on hold-out set: 0.7634583333333333
MulticlassAccuracy value on hold-out data: 0.7634583115577698
Returned to Spot: Validation loss: 0.6727624335264166
----------------------------------------------

config: {'l1': 4, 'l2': 128, 'lr_mult': 4.224097306355747, 'batch_size': 4, 'epochs': 8, 'k_f
Epoch: 1

Loss on hold-out set: 0.6896910878674595
Accuracy on hold-out set: 0.7760416666666666
MulticlassAccuracy value on hold-out data: 0.7760416865348816
Epoch: 2

Loss on hold-out set: 0.736217575250684
Accuracy on hold-out set: 0.767625
MulticlassAccuracy value on hold-out data: 0.7676249742507935
Epoch: 3
```

```
Loss on hold-out set: 0.6792003887806798
Accuracy on hold-out set: 0.7827083333333333
MulticlassAccuracy value on hold-out data: 0.7827083468437195
Epoch: 4

Loss on hold-out set: 0.6393103414436494
Accuracy on hold-out set: 0.7879583333333333
MulticlassAccuracy value on hold-out data: 0.7879583239555359
Epoch: 5

Loss on hold-out set: 0.7769755123767087
Accuracy on hold-out set: 0.7704583333333334
MulticlassAccuracy value on hold-out data: 0.7704583406448364
Epoch: 6

Loss on hold-out set: 0.6986232720594796
Accuracy on hold-out set: 0.7885833333333333
MulticlassAccuracy value on hold-out data: 0.7885833382606506
Early stopping at epoch 5
Returned to Spot: Validation loss: 0.6986232720594796
----------------------------------------------


config: {'l1': 256, 'l2': 256, 'lr_mult': 0.18907998055276914, 'batch_size': 16, 'epochs': 8
Epoch: 1

Loss on hold-out set: 0.5339325872808695
Accuracy on hold-out set: 0.8122916666666666
MulticlassAccuracy value on hold-out data: 0.81229168176651
Epoch: 2

Loss on hold-out set: 0.47795508443315826
Accuracy on hold-out set: 0.8344166666666667
MulticlassAccuracy value on hold-out data: 0.8344166874885559
Epoch: 3

Loss on hold-out set: 0.4602512670109669
Accuracy on hold-out set: 0.8399583333333334
MulticlassAccuracy value on hold-out data: 0.8399583101272583
Epoch: 4
```

```
Loss on hold-out set: 0.44539840329686803
Accuracy on hold-out set: 0.8453333333333334
MulticlassAccuracy value on hold-out data: 0.8453333377838135
Epoch: 5

Loss on hold-out set: 0.43971184348811704
Accuracy on hold-out set: 0.846375
MulticlassAccuracy value on hold-out data: 0.8463749885559082
Epoch: 6

Loss on hold-out set: 0.4304463624532024
Accuracy on hold-out set: 0.8510416666666667
MulticlassAccuracy value on hold-out data: 0.8510416746139526
Epoch: 7

Loss on hold-out set: 0.42755694181347886
Accuracy on hold-out set: 0.851625
MulticlassAccuracy value on hold-out data: 0.8516250252723694
Epoch: 8

Loss on hold-out set: 0.42188525482763845
Accuracy on hold-out set: 0.8529166666666667
MulticlassAccuracy value on hold-out data: 0.8529166579246521
Returned to Spot: Validation loss: 0.42188525482763845
----------------------------------------------

spotPython tuning: 0.41351523965224624 [#####-----] 50.07%


config: {'l1': 256, 'l2': 256, 'lr_mult': 0.8078848167886729, 'batch_size': 16, 'epochs': 8,
Epoch: 1

Loss on hold-out set: 0.41866066764853893
Accuracy on hold-out set: 0.851875
MulticlassAccuracy value on hold-out data: 0.8518750071525574
Epoch: 2

Loss on hold-out set: 0.3893418207988143
Accuracy on hold-out set: 0.8634166666666667
MulticlassAccuracy value on hold-out data: 0.8634166717529297
Epoch: 3
```

```
Loss on hold-out set: 0.3643297636223336
Accuracy on hold-out set: 0.8724166666666666
MulticlassAccuracy value on hold-out data: 0.8724166750907898
Epoch: 4

Loss on hold-out set: 0.35738026330037975
Accuracy on hold-out set: 0.87525
MulticlassAccuracy value on hold-out data: 0.875249981880188
Epoch: 5

Loss on hold-out set: 0.3467907987255603
Accuracy on hold-out set: 0.8783333333333333
MulticlassAccuracy value on hold-out data: 0.878333330154419
Epoch: 6

Loss on hold-out set: 0.34424078681195774
Accuracy on hold-out set: 0.8805
MulticlassAccuracy value on hold-out data: 0.8805000185966492
Epoch: 7

Loss on hold-out set: 0.34114565353809545
Accuracy on hold-out set: 0.8794166666666666
MulticlassAccuracy value on hold-out data: 0.8794166445732117
Epoch: 8

Loss on hold-out set: 0.3272608193811029
Accuracy on hold-out set: 0.8857083333333333
MulticlassAccuracy value on hold-out data: 0.8857083320617676
Returned to Spot: Validation loss: 0.3272608193811029
----------------------------------------------

spotPython tuning: 0.3272608193811029 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x29c0b2d40>
```

# 17 Tensorboard

The textual output shown in the console (or code cell) can be visualized with Tensorboard as described in Section 21.13.

### 17.0.1 Results

After the hyperparameter tuning run is finished, the results can be analyzed as described in Section 21.14.

```
SAVE = False
LOAD = False

if SAVE:
    result_file_name = "res_" + experiment_name + ".pkl"
    with open(result_file_name, 'wb') as f:
        pickle.dump(spot_tuner, f)

if LOAD:
    result_file_name = "ADD THE NAME here, e.g.: res_ch10-friedman-hpt-0_maans03_60min_20i
    with open(result_file_name, 'rb') as f:
        spot_tuner =  pickle.load(f)
```

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

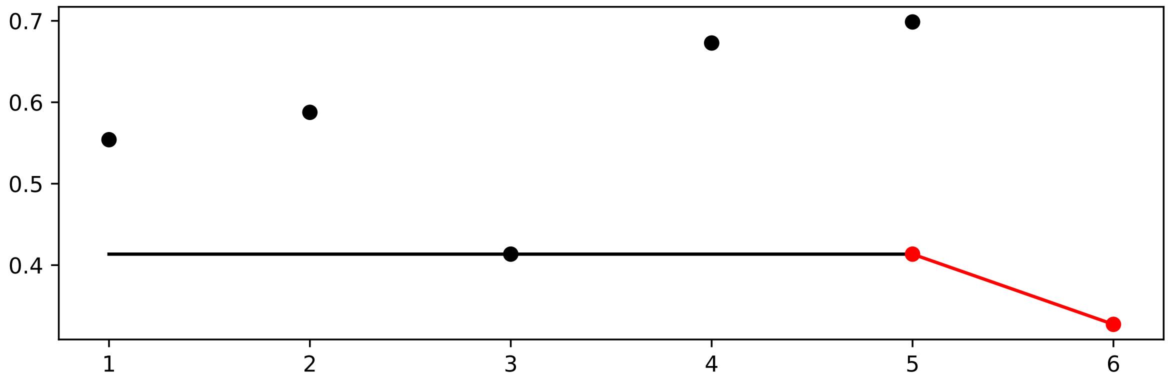



Figure 17.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name         | type   | default    |    lower |    upper |                tuned | transform
|--------------|--------|------------|----------|----------|----------------------|-------------
| l1           | int    | 5          |      2.0 |      9.0 |                  8.0 | transform_pow
| l2           | int    | 5          |      2.0 |      9.0 |                  8.0 | transform_pow
| lr_mult      | float  | 1.0        |      0.1 |     10.0 |   0.8078848167886729 | None
| batch_size   | int    | 4          |      1.0 |      4.0 |                  4.0 | transform_pow
| epochs       | int    | 3          |      2.0 |      3.0 |                  3.0 | transform_pow
| k_folds      | int    | 1          |      0.0 |      0.0 |                  0.0 | None
| patience     | int    | 5          |      2.0 |      2.0 |                  2.0 | None
| optimizer    | factor | SGD        |      0.0 |     12.0 |                  1.0 | None
| sgd_momentum | float  | 0.0        |      0.0 |      1.0 | 0.01020397749406788 | None
```

## 17.1 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

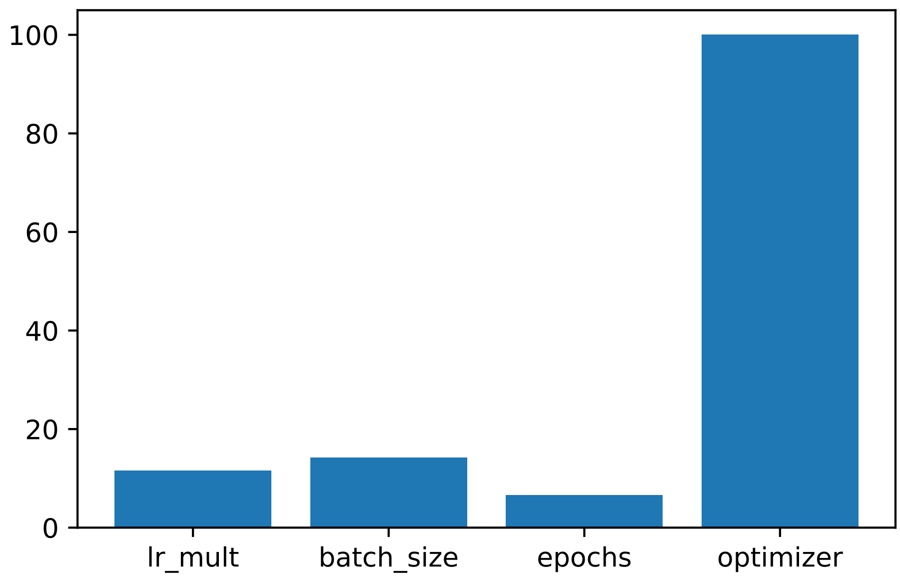



Figure 17.2: Variable importance plot, threshold 0.025.

## 17.2 Get the Tuned Architecture (SPOT Results)

The architecture of the `spotPython` model can be obtained by the following code:

```python
from spotPython.hyperparameters.values import get_one_core_model_from_X
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
model_spot = get_one_core_model_from_X(X, fun_control)
model_spot
```

```
Net_fashionMNIST(
  (flatten): Flatten(start_dim=1, end_dim=-1)
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=784, out_features=256, bias=True)
    (1): ReLU()
    (2): Linear(in_features=256, out_features=256, bias=True)
    (3): ReLU()
    (4): Linear(in_features=256, out_features=10, bias=True)
  )
)
```

## 17.3 Get Default Hyperparameters

```python
fc = fun_control
fc.update({"core_model_hyper_dict":
    hyper_dict[fun_control["core_model"].__name__]})
model_default = get_one_core_model_from_X(X_start, fun_control=fc)
model_default
```

```
Net_fashionMNIST(
  (flatten): Flatten(start_dim=1, end_dim=-1)
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=784, out_features=32, bias=True)
    (1): ReLU()
    (2): Linear(in_features=32, out_features=32, bias=True)
    (3): ReLU()
    (4): Linear(in_features=32, out_features=10, bias=True)
  )
)
```

## 17.4 Evaluation of the Default and the Tuned Architectures

The method `train_tuned` takes a model architecture without trained weights and trains this model with the train data. The train data is split into train and validation data. The validation data is used for early stopping. The trained model weights are saved as a dictionary.

```python
from spotPython.torch.traintest import train_tuned
train_tuned(net=model_default, train_dataset=train, shuffle=True,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        device = fun_control["device"],
        show_batch_interval=1_000_000,
        path=None,
        task=fun_control["task"])
```

```
Epoch: 1

Loss on hold-out set: 2.0102087097962698
Accuracy on hold-out set: 0.39825
MulticlassAccuracy value on hold-out data: 0.398250013589859
Epoch: 2
```

```
Loss on hold-out set: 1.4778107245763143
Accuracy on hold-out set: 0.604125
MulticlassAccuracy value on hold-out data: 0.6041250228881836
Epoch: 3

Loss on hold-out set: 1.187606354912122
Accuracy on hold-out set: 0.6332916666666667
MulticlassAccuracy value on hold-out data: 0.6332916617393494
Epoch: 4

Loss on hold-out set: 1.044139481941859
Accuracy on hold-out set: 0.6559166666666667
MulticlassAccuracy value on hold-out data: 0.655916690826416
Epoch: 5

Loss on hold-out set: 0.9596856433550517
Accuracy on hold-out set: 0.660125
MulticlassAccuracy value on hold-out data: 0.6601250171661377
Epoch: 6

Loss on hold-out set: 0.9023366140127183
Accuracy on hold-out set: 0.668125
MulticlassAccuracy value on hold-out data: 0.6681249737739563
Epoch: 7

Loss on hold-out set: 0.8609944099585215
Accuracy on hold-out set: 0.676375
MulticlassAccuracy value on hold-out data: 0.6763749718666077
Epoch: 8

Loss on hold-out set: 0.82867400487264
Accuracy on hold-out set: 0.6880416666666667
MulticlassAccuracy value on hold-out data: 0.6880416870117188
Returned to Spot: Validation loss: 0.82867400487264
----------------------------------------------
```

```python
from spotPython.torch.traintest import test_tuned
test_tuned(net=model_default, test_dataset=test,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
```

```
        shuffle=False,
        device = fun_control["device"],
        task=fun_control["task"])
```

```
Loss on hold-out set: 0.8409524574756623
Accuracy on hold-out set: 0.6814
MulticlassAccuracy value on hold-out data: 0.6814000010490417
Final evaluation: Validation loss: 0.8409524574756623
Final evaluation: Validation metric: 0.6814000010490417
----------------------------------------------
```

```
(0.8409524574756623, nan, tensor(0.6814))
```

The following code trains the model `model_spot`. If `path` is set to a filename, e.g., `path = "model_spot_trained.pt"`, the weights of the trained model will be saved to this file.

```
train_tuned(net=model_spot, train_dataset=train,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        shuffle=True,
        device = fun_control["device"],
        path=None,
        task=fun_control["task"])
```

```
Epoch: 1

Loss on hold-out set: 0.4163487834079812
Accuracy on hold-out set: 0.8507916666666666
MulticlassAccuracy value on hold-out data: 0.8507916927337646
Epoch: 2

Loss on hold-out set: 0.3855033105872571
Accuracy on hold-out set: 0.863
MulticlassAccuracy value on hold-out data: 0.8629999756813049
Epoch: 3

Loss on hold-out set: 0.3592007557253043
Accuracy on hold-out set: 0.8740833333333333
MulticlassAccuracy value on hold-out data: 0.8740833401679993
Epoch: 4
```

```
Loss on hold-out set: 0.34813339447105923
Accuracy on hold-out set: 0.877375
MulticlassAccuracy value on hold-out data: 0.8773750066757202
Epoch: 5

Loss on hold-out set: 0.35157776687045894
Accuracy on hold-out set: 0.8777916666666666
MulticlassAccuracy value on hold-out data: 0.8777916431427002
Epoch: 6

Loss on hold-out set: 0.33808042569893104
Accuracy on hold-out set: 0.881
MulticlassAccuracy value on hold-out data: 0.8809999823570251
Epoch: 7

Loss on hold-out set: 0.32998394506424666
Accuracy on hold-out set: 0.8822916666666667
MulticlassAccuracy value on hold-out data: 0.8822916746139526
Epoch: 8

Loss on hold-out set: 0.33095782941393553
Accuracy on hold-out set: 0.8827916666666666
MulticlassAccuracy value on hold-out data: 0.8827916383743286
Returned to Spot: Validation loss: 0.33095782941393553
----------------------------------------------
```

```
test_tuned(net=model_spot, test_dataset=test,
            shuffle=False,
            loss_function=fun_control["loss_function"],
            metric=fun_control["metric_torch"],
            device = fun_control["device"],
            task=fun_control["task"])
```

```
Loss on hold-out set: 0.3578525767713785
Accuracy on hold-out set: 0.8759
MulticlassAccuracy value on hold-out data: 0.8758999705314636
Final evaluation: Validation loss: 0.3578525767713785
Final evaluation: Validation metric: 0.8758999705314636
----------------------------------------------
```

```
(0.3578525767713785, nan, tensor(0.8759))
```

## 17.5 Detailed Hyperparameter Plots

```
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
lr_mult:  11.598470160220526
batch_size:  14.229969348708295
epochs:  6.598146295059081
optimizer:  100.0
```

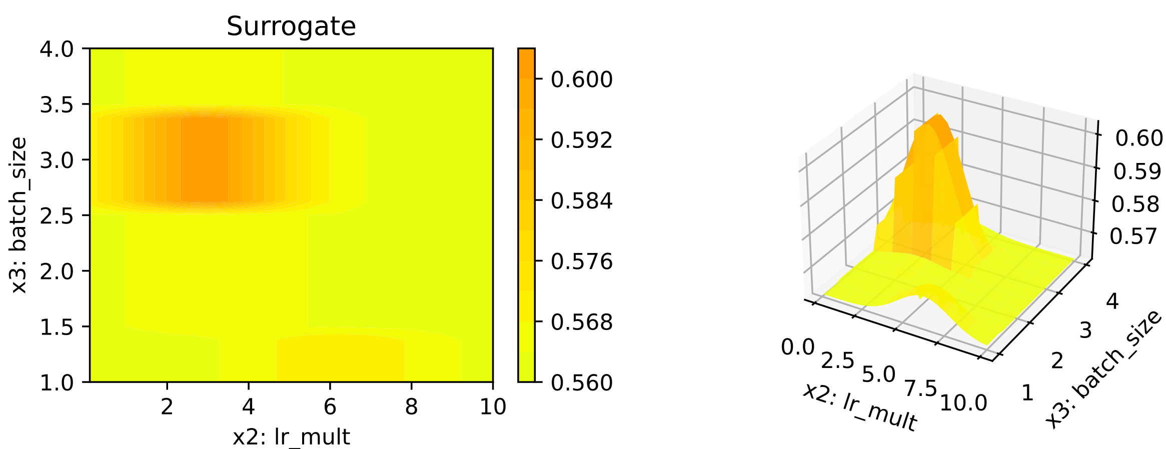
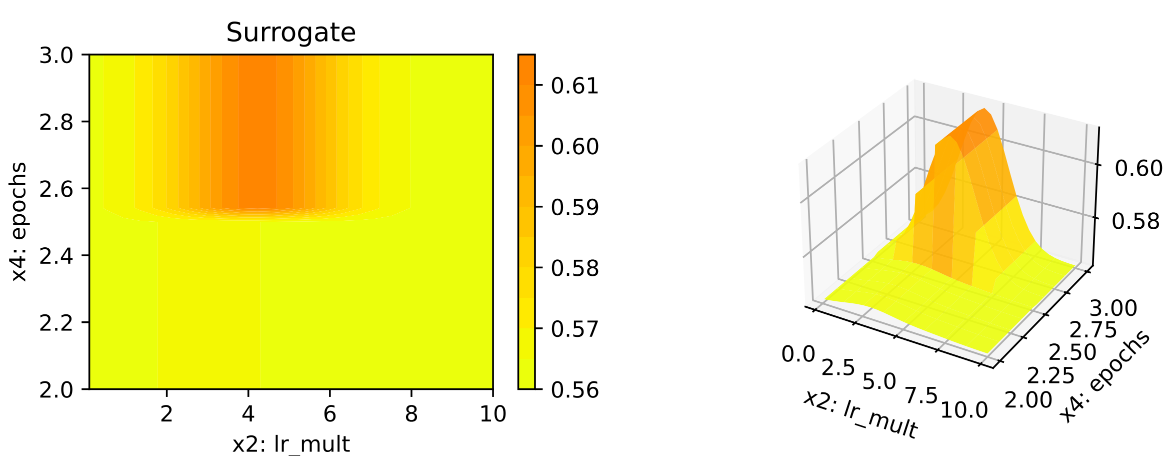
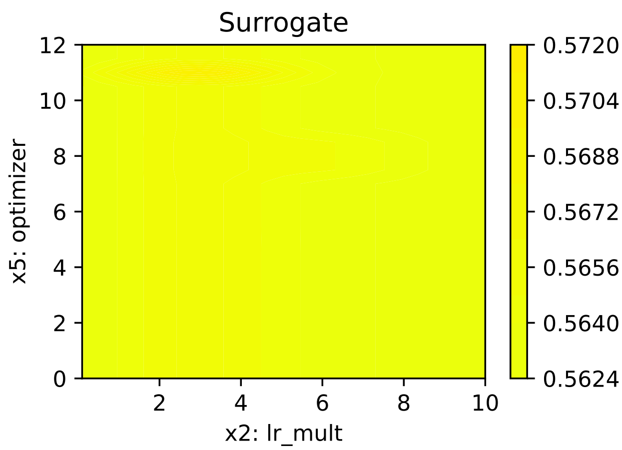
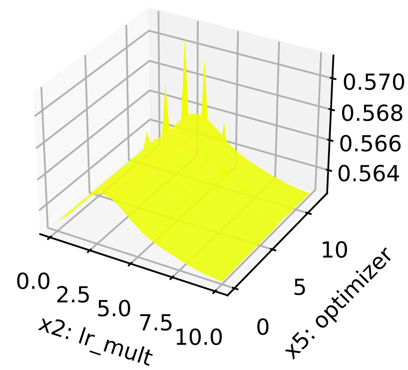
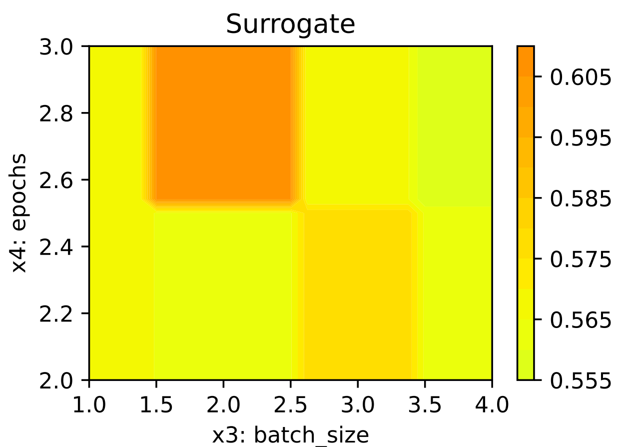


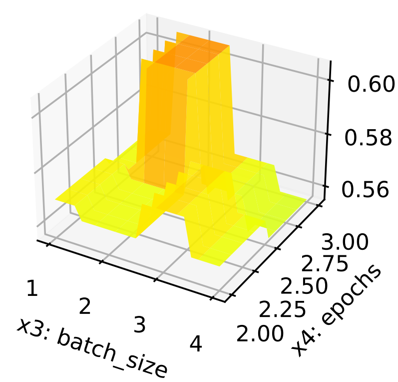

Figure 17.3: Contour plots.

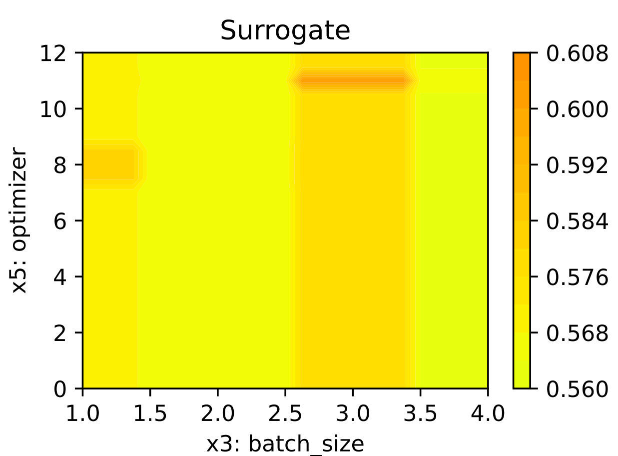


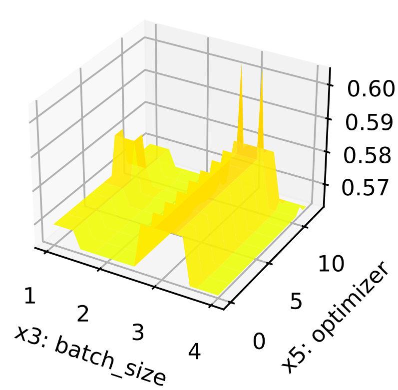

Surrogate
x2: lr_mult
x5: optimizer
0.5720
0.5704
0.5688
0.5672
0.5656
0.5640
0.5624

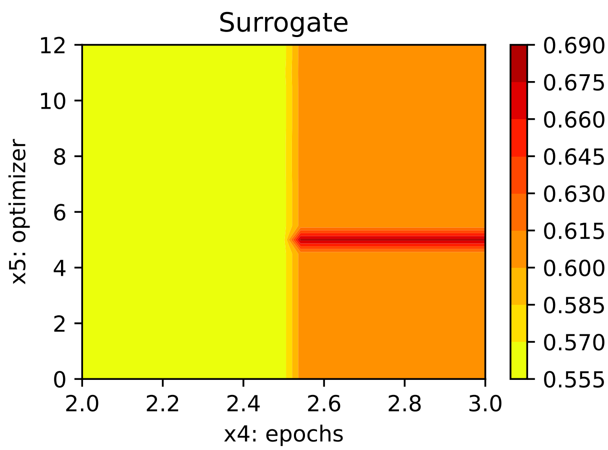

x2: lr_mult
x5: optimizer
0.570
0.568
0.566
0.564

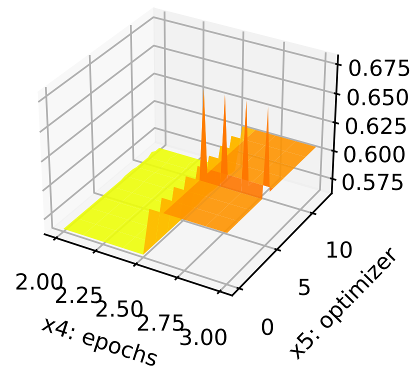

Surrogate
x3: batch_size
x4: epochs
0.605
0.595
0.585
0.575
0.565
0.555


x3: batch_size
x4: epochs
0.60
0.58
0.56


Surrogate
x3: batch_size
x5: optimizer
0.608
0.600
0.592
0.584
0.576
0.568
0.560


x3: batch_size
x5: optimizer
0.60
0.59
0.58
0.57




## 17.6 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

Parallel coordinates plots

```
Unable to display output for mime type(s): text/html
```

## 17.7 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 18 HPT: PyTorch With cifar10 Data

In this tutorial, we will show how `spotPython` can be integrated into the `PyTorch` training workflow.

This document refers to the following software versions:

- `python`: 3.10.10
- `torch`: 2.0.1
- `torchvision`: 0.15.0

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34

spotRiver                     0.0.93

Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 18.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time, initial design size and the device that is used.

```
MAX_TIME = 1
INIT_SIZE = 5
DEVICE = None # "cpu" # "cuda:0"
```

```
from spotPython.utils.device import getDevice
DEVICE = getDevice(DEVICE)
print(DEVICE)
```

```
mps
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '12-torch' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(INIT_SI
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
12-torch_p040025_1min_5init_2023-06-17_13-20-59
```

## 18.2 Initialization of the `fun_control` Dictionary

`spotPython` uses a Python dictionary for storing the information required for the hyperparameter tuning process, which was described in Section 21.2.

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/12_spot_hpt_torch_cifar10",
    device=DEVICE)
```

## 18.3 PyTorch Data Loading

## 18.4 1. Load Data Cifar10 Data

```
from torchvision import datasets, transforms
import torchvision
def load_data(data_dir="./data"):
    transform = transforms.Compose([
        transforms.ToTensor(),
        transforms.Normalize((0.5, 0.5, 0.5), (0.5, 0.5, 0.5))
    ])

    trainset = torchvision.datasets.CIFAR10(
        root=data_dir, train=True, download=True, transform=transform)

    testset = torchvision.datasets.CIFAR10(
        root=data_dir, train=False, download=True, transform=transform)

    return trainset, testset
train, test = load_data()
```

```
Files already downloaded and verified
```

```
Files already downloaded and verified
```

- Since this works fine, we can add the data loading to the `fun_control` dictionary:

```
n_samples = len(train)
# add the dataset to the fun_control
fun_control.update({"data": None, # dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": None})
```

## 18.5 The Model (Algorithm) to be Tuned

## 18.6 Specification of the Preprocessing Model

After the training and test data are specified and added to the `fun_control` dictionary, `spotPython` allows the specification of a data preprocessing pipeline, e.g., for the scaling of the data or for the one-hot encoding of categorical variables, see Section 21.4.1. This feature is not used here, so we do not change the default value (which is `None`).

## 18.7 Step 4: Select `algorithm` and `core_model_hyper_dict`

### 18.7.1 Implementing a Configurable Neural Network With spotPython

`spotPython` includes the `Net_CIFAR10` class which is implemented in the file `netcifar10.py`. The class is imported here.

This class inherits from the class `Net_Core` which is implemented in the file `netcore.py`, see Section 21.4.3.

```
from spotPython.torch.netcifar10 import Net_CIFAR10
from spotPython.data.torch_hyper_dict import TorchHyperDict
from spotPython.hyperparameters.values import add_core_model_to_fun_control
fun_control = add_core_model_to_fun_control(core_model=Net_CIFAR10,
                              fun_control=fun_control,
                              hyper_dict=TorchHyperDict,
                              filename=None)
```

## 18.8 The Search Space

### 18.8.1 Configuring the Search Space With spotPython

#### 18.8.1.1 The `hyper_dict` Hyperparameters for the Selected Algorithm

`spotPython` uses `JSON` files for the specification of the hyperparameters, which were described in Section 21.5.2.

The corresponding entries for the `Net_CIFAR10` class are shown below.

```
    "Net_CIFAR10":
    {
        "l1": {
            "type": "int",
            "default": 5,
            "transform": "transform_power_2_int",
            "lower": 2,
            "upper": 9},
        "l2": {
            "type": "int",
            "default": 5,
            "transform": "transform_power_2_int",
            "lower": 2,
            "upper": 9},
        "lr_mult": {
            "type": "float",
            "default": 1.0,
            "transform": "None",
            "lower": 0.1,
            "upper": 10.0},
        "batch_size": {
            "type": "int",
            "default": 4,
            "transform": "transform_power_2_int",
            "lower": 1,
            "upper": 4},
        "epochs": {
            "type": "int",
            "default": 3,
            "transform": "transform_power_2_int",
            "lower": 3,
            "upper": 4},
        "k_folds": {
            "type": "int",
            "default": 1,
            "transform": "None",
            "lower": 1,
            "upper": 1},
        "patience": {
            "type": "int",
            "default": 5,
```

```
            "transform": "None",
            "lower": 2,
            "upper": 10
        },
        "optimizer": {
            "levels": ["Adadelta",
                       "Adagrad",
                       "Adam",
                       "AdamW",
                       "SparseAdam",
                       "Adamax",
                       "ASGD",
                       "NAdam",
                       "RAdam",
                       "RMSprop",
                       "Rprop",
                       "SGD"],
            "type": "factor",
            "default": "SGD",
            "transform": "None",
            "class_name": "torch.optim",
            "core_model_parameter_type": "str",
            "lower": 0,
            "upper": 12},
        "sgd_momentum": {
            "type": "float",
            "default": 0.0,
            "transform": "None",
            "lower": 0.0,
            "upper": 1.0}
    },
```

## 18.9 Modifying the Hyperparameters

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

### 18.9.1 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

#### 18.9.1.1 Modify Hyperparameters of Type numeric and integer (boolean)

The hyperparameter `k_folds` is not used, it is de-activated here by setting the lower and upper bound to the same value.

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
# fun_control = modify_hyper_parameter_bounds(fun_control, "delta", bounds=[1e-10, 1e-6])
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_split", bounds=[3,
#fun_control = modify_hyper_parameter_bounds(fun_control, "merit_preprune", bounds=[0, 0])
# fun_control["core_model_hyper_dict"]
fun_control = modify_hyper_parameter_bounds(fun_control, "k_folds", bounds=[2, 2])
```

### 18.9.2 Modify hyperparameter of type factor

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
fun_control = modify_hyper_parameter_levels(fun_control, "optimizer", ["Adam"])
# fun_control = modify_hyper_parameter_levels(fun_control, "leaf_model", ["LinearRegressio
# fun_control["core_model_hyper_dict"]
```

### 18.9.3 Optimizers

Optimizers can be selected as described in Section 26.8.2.

Optimizers are described in Section 21.6.

```
fun_control = modify_hyper_parameter_bounds(fun_control,
    "lr_mult", bounds=[1e-3, 1e-3])
fun_control = modify_hyper_parameter_bounds(fun_control,
    "sgd_momentum", bounds=[0.9, 0.9])
```

## 18.10 Evaluation

The evaluation procedure requires the specification of two elements:

1. the way how the data is split into a train and a test set and
2. the loss function (and a metric).

These are described in Section 26.9.

The key `"loss_function"` specifies the loss function which is used during the optimization, see Section 21.8.

We will use CrossEntropy loss for the multiclass-classification task.

```
from torch.nn import CrossEntropyLoss
loss_function = CrossEntropyLoss()
fun_control.update({
        "loss_function": loss_function,
        "shuffle": True,
        "eval":  "train_hold_out"
        })
```

### 18.10.1 Metric

```
import torchmetrics
metric_torch = torchmetrics.Accuracy(task="multiclass",
     num_classes=10).to(fun_control["device"])
fun_control.update({"metric_torch": metric_torch})
```

## 18.11 Preparing the SPOT Call

The following code passes the information about the parameter ranges and bounds to `spot`.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name         | type   | default   |   lower |   upper | transform             |
|--------------|--------|-----------|---------|---------|-----------------------|
| l1           | int    | 5         |   2     |   9     | transform_power_2_int |
| l2           | int    | 5         |   2     |   9     | transform_power_2_int |
| lr_mult      | float  | 1.0       |   0.001 |   0.001 | None                  |
| batch_size   | int    | 4         |   1     |   4     | transform_power_2_int |
| epochs       | int    | 3         |   3     |   4     | transform_power_2_int |
| k_folds      | int    | 1         |   2     |   2     | None                  |
| patience     | int    | 5         |   2     |  10     | None                  |
| optimizer    | factor | SGD       |   0     |   0     | None                  |
| sgd_momentum | float  | 0.0       |   0.9   |   0.9   | None                  |
```

## 18.12 The Objective Function fun_torch

The objective function fun_torch is selected next. It implements an interface from PyTorch's training, validation, and testing methods to spotPython.

```python
from spotPython.fun.hypertorch import HyperTorch
fun = HyperTorch().fun_torch
```

## 18.13 Starting the Hyperparameter Tuning

```python
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
```

```python
                    log_level = 50,
                    show_models= False,
                    show_progress= True,
                    fun_control = fun_control,
                    design_control={"init_size": INIT_SIZE,
                                    "repeats": 1},
                    surrogate_control={"noise": True,
                                       "cod_type": "norm",
                                       "min_theta": -4,
                                       "max_theta": 3,
                                       "n_theta": len(var_name),
                                       "model_fun_evals": 10_000,
                                       "log_level": 50
                                       })
spot_tuner.run(X_start=X_start)
```

```
config: {'l1': 128, 'l2': 8, 'lr_mult': 0.001, 'batch_size': 16, 'epochs': 16, 'k_folds': 2,
Epoch: 1

Loss on hold-out set: 2.316123216819763
Accuracy on hold-out set: 0.10145
MulticlassAccuracy value on hold-out data: 0.10145000368356705
Epoch: 2

Loss on hold-out set: 2.315175532913208
Accuracy on hold-out set: 0.1044
MulticlassAccuracy value on hold-out data: 0.10440000146627426
Epoch: 3

Loss on hold-out set: 2.314146028137207
Accuracy on hold-out set: 0.1061
MulticlassAccuracy value on hold-out data: 0.10610000044107437
Epoch: 4

Loss on hold-out set: 2.312793441772461
Accuracy on hold-out set: 0.10435
MulticlassAccuracy value on hold-out data: 0.1043500006198883
Epoch: 5
```

```
Loss on hold-out set: 2.311161676597595
Accuracy on hold-out set: 0.102
MulticlassAccuracy value on hold-out data: 0.10199999809265137
Epoch: 6

Loss on hold-out set: 2.3093742904663084
Accuracy on hold-out set: 0.1012
MulticlassAccuracy value on hold-out data: 0.10119999945163727
Epoch: 7

Loss on hold-out set: 2.3074346532821655
Accuracy on hold-out set: 0.10095
MulticlassAccuracy value on hold-out data: 0.10095000267028809
Epoch: 8

Loss on hold-out set: 2.305307953262329
Accuracy on hold-out set: 0.1009
MulticlassAccuracy value on hold-out data: 0.10090000182390213
Epoch: 9

Loss on hold-out set: 2.302975860786438
Accuracy on hold-out set: 0.1009
MulticlassAccuracy value on hold-out data: 0.10090000182390213
Epoch: 10

Loss on hold-out set: 2.2967973648071287
Accuracy on hold-out set: 0.10095
MulticlassAccuracy value on hold-out data: 0.10095000267028809
Epoch: 11

Loss on hold-out set: 2.289713087081909
Accuracy on hold-out set: 0.106
MulticlassAccuracy value on hold-out data: 0.10599999874830246
Epoch: 12

Loss on hold-out set: 2.283045128059387
Accuracy on hold-out set: 0.1266
MulticlassAccuracy value on hold-out data: 0.1265999972820282
Epoch: 13
```

```
Loss on hold-out set: 2.2763747188568115
Accuracy on hold-out set: 0.1441
MulticlassAccuracy value on hold-out data: 0.14409999549388885
Epoch: 14

Loss on hold-out set: 2.2697231777191162
Accuracy on hold-out set: 0.1552
MulticlassAccuracy value on hold-out data: 0.15520000457763672
Epoch: 15

Loss on hold-out set: 2.2630849725723268
Accuracy on hold-out set: 0.1588
MulticlassAccuracy value on hold-out data: 0.15880000591278076
Epoch: 16

Loss on hold-out set: 2.2567278566360476
Accuracy on hold-out set: 0.16205
MulticlassAccuracy value on hold-out data: 0.16204999387264252
Returned to Spot: Validation loss: 2.2567278566360476
----------------------------------------------

config: {'l1': 16, 'l2': 16, 'lr_mult': 0.001, 'batch_size': 8, 'epochs': 8, 'k_folds': 2, '
Epoch: 1

Loss on hold-out set: 2.3102197526931763
Accuracy on hold-out set: 0.1008
MulticlassAccuracy value on hold-out data: 0.10080000013113022
Epoch: 2

Loss on hold-out set: 2.3082643251419066
Accuracy on hold-out set: 0.10375
MulticlassAccuracy value on hold-out data: 0.10374999791383743
Epoch: 3

Loss on hold-out set: 2.306570449447632
Accuracy on hold-out set: 0.11205
MulticlassAccuracy value on hold-out data: 0.11204999685287476
Epoch: 4
```

```
Loss on hold-out set: 2.304751749229431
Accuracy on hold-out set: 0.12295
MulticlassAccuracy value on hold-out data: 0.1229500025510788
Epoch: 5

Loss on hold-out set: 2.302857549762726
Accuracy on hold-out set: 0.12665
MulticlassAccuracy value on hold-out data: 0.12665000557899475
Epoch: 6

Loss on hold-out set: 2.3010359693527223
Accuracy on hold-out set: 0.12895
MulticlassAccuracy value on hold-out data: 0.12894999980926514
Epoch: 7

Loss on hold-out set: 2.2993486510276795
Accuracy on hold-out set: 0.1296
MulticlassAccuracy value on hold-out data: 0.12960000336170197
Epoch: 8

Loss on hold-out set: 2.2977550928115846
Accuracy on hold-out set: 0.1297
MulticlassAccuracy value on hold-out data: 0.12970000505447388
Returned to Spot: Validation loss: 2.2977550928115846
----------------------------------------------

config: {'l1': 256, 'l2': 128, 'lr_mult': 0.001, 'batch_size': 2, 'epochs': 16, 'k_folds': 2
Epoch: 1

Loss on hold-out set: 2.2986306455612184
Accuracy on hold-out set: 0.11125
MulticlassAccuracy value on hold-out data: 0.11124999821186066
Epoch: 2

Loss on hold-out set: 2.2815507684469223
Accuracy on hold-out set: 0.18825
MulticlassAccuracy value on hold-out data: 0.18825000524520874
Epoch: 3
```

```
Loss on hold-out set: 2.24039719247818
Accuracy on hold-out set: 0.18945
MulticlassAccuracy value on hold-out data: 0.1894499957561493
Epoch: 4

Loss on hold-out set: 2.173025454711914
Accuracy on hold-out set: 0.22025
MulticlassAccuracy value on hold-out data: 0.2202499955892563
Epoch: 5

Loss on hold-out set: 2.1086123155474663
Accuracy on hold-out set: 0.24915
MulticlassAccuracy value on hold-out data: 0.24914999306201935
Epoch: 6

Loss on hold-out set: 2.0668734232068062
Accuracy on hold-out set: 0.2601
MulticlassAccuracy value on hold-out data: 0.26010000705718994
Epoch: 7

Loss on hold-out set: 2.0331158808350565
Accuracy on hold-out set: 0.2734
MulticlassAccuracy value on hold-out data: 0.2734000086784363
Epoch: 8

Loss on hold-out set: 2.0038821397960187
Accuracy on hold-out set: 0.2847
MulticlassAccuracy value on hold-out data: 0.2847000062465668
Epoch: 9

Loss on hold-out set: 1.9796814930856228
Accuracy on hold-out set: 0.2943
MulticlassAccuracy value on hold-out data: 0.29429998993873596
Epoch: 10

Loss on hold-out set: 1.9531871171295643
Accuracy on hold-out set: 0.30165
MulticlassAccuracy value on hold-out data: 0.3016499876976013
Epoch: 11
```

```
Loss on hold-out set: 1.9317236228048802
Accuracy on hold-out set: 0.30915
MulticlassAccuracy value on hold-out data: 0.30915001034736633
Epoch: 12

Loss on hold-out set: 1.9145926318407058
Accuracy on hold-out set: 0.3136
MulticlassAccuracy value on hold-out data: 0.31360000371932983
Epoch: 13

Loss on hold-out set: 1.9010753717333078
Accuracy on hold-out set: 0.31845
MulticlassAccuracy value on hold-out data: 0.318450003862381
Epoch: 14

Loss on hold-out set: 1.8894450519800186
Accuracy on hold-out set: 0.3204
MulticlassAccuracy value on hold-out data: 0.3203999996185303
Epoch: 15

Loss on hold-out set: 1.8796885427683592
Accuracy on hold-out set: 0.3228
MulticlassAccuracy value on hold-out data: 0.32280001044273376
Epoch: 16

Loss on hold-out set: 1.8698206705272198
Accuracy on hold-out set: 0.3293
MulticlassAccuracy value on hold-out data: 0.3292999863624573
Returned to Spot: Validation loss: 1.8698206705272198
----------------------------------------------

config: {'l1': 8, 'l2': 32, 'lr_mult': 0.001, 'batch_size': 4, 'epochs': 8, 'k_folds': 2, 'pa
Epoch: 1

Loss on hold-out set: 2.3085669312477113
Accuracy on hold-out set: 0.11285
MulticlassAccuracy value on hold-out data: 0.11285000294446945
Epoch: 2
```

```
Loss on hold-out set: 2.3067218083381653
Accuracy on hold-out set: 0.13635
MulticlassAccuracy value on hold-out data: 0.13635000586509705
Epoch: 3

Loss on hold-out set: 2.3042442591667176
Accuracy on hold-out set: 0.14125
MulticlassAccuracy value on hold-out data: 0.14124999940395355
Epoch: 4

Loss on hold-out set: 2.3014075199127197
Accuracy on hold-out set: 0.13815
MulticlassAccuracy value on hold-out data: 0.13815000653266907
Epoch: 5

Loss on hold-out set: 2.2981777039051057
Accuracy on hold-out set: 0.14825
MulticlassAccuracy value on hold-out data: 0.14824999868869781
Epoch: 6

Loss on hold-out set: 2.29417149643898
Accuracy on hold-out set: 0.1624
MulticlassAccuracy value on hold-out data: 0.1624000072479248
Epoch: 7

Loss on hold-out set: 2.28915193567276
Accuracy on hold-out set: 0.1749
MulticlassAccuracy value on hold-out data: 0.17489999532699585
Epoch: 8

Loss on hold-out set: 2.2828350862979887
Accuracy on hold-out set: 0.18005
MulticlassAccuracy value on hold-out data: 0.18005000054836273
Returned to Spot: Validation loss: 2.2828350862979887
----------------------------------------------

config: {'l1': 64, 'l2': 512, 'lr_mult': 0.001, 'batch_size': 8, 'epochs': 16, 'k_folds': 2,
Epoch: 1
```

```
Loss on hold-out set: 2.301959711551666
Accuracy on hold-out set: 0.1036
MulticlassAccuracy value on hold-out data: 0.10360000282526016
Epoch: 2

Loss on hold-out set: 2.2992707778930663
Accuracy on hold-out set: 0.10215
MulticlassAccuracy value on hold-out data: 0.10215000063180923
Epoch: 3

Loss on hold-out set: 2.29497993516922
Accuracy on hold-out set: 0.10385
MulticlassAccuracy value on hold-out data: 0.10384999960660934
Epoch: 4

Loss on hold-out set: 2.2886239996910094
Accuracy on hold-out set: 0.11015
MulticlassAccuracy value on hold-out data: 0.11015000194311142
Epoch: 5

Loss on hold-out set: 2.278608707714081
Accuracy on hold-out set: 0.1237
MulticlassAccuracy value on hold-out data: 0.12370000034570694
Epoch: 6

Loss on hold-out set: 2.2631375685691832
Accuracy on hold-out set: 0.15555
MulticlassAccuracy value on hold-out data: 0.1555500030517578
Epoch: 7

Loss on hold-out set: 2.2409399477005003
Accuracy on hold-out set: 0.1907
MulticlassAccuracy value on hold-out data: 0.1906999945640564
Epoch: 8

Loss on hold-out set: 2.2123201369285583
Accuracy on hold-out set: 0.2109
MulticlassAccuracy value on hold-out data: 0.21089999377727509
Epoch: 9
```

```
Loss on hold-out set: 2.1789593352794645
Accuracy on hold-out set: 0.23265
MulticlassAccuracy value on hold-out data: 0.2326499968767166
Epoch: 10

Loss on hold-out set: 2.1431208488464355
Accuracy on hold-out set: 0.25835
MulticlassAccuracy value on hold-out data: 0.2583500146865845
Epoch: 11

Loss on hold-out set: 2.1073778571128847
Accuracy on hold-out set: 0.2732
MulticlassAccuracy value on hold-out data: 0.27320000529289246
Epoch: 12

Loss on hold-out set: 2.07405280418396
Accuracy on hold-out set: 0.2811
MulticlassAccuracy value on hold-out data: 0.28110000491142273
Epoch: 13

Loss on hold-out set: 2.0444700531005857
Accuracy on hold-out set: 0.2873
MulticlassAccuracy value on hold-out data: 0.2872999906539917
Epoch: 14

Loss on hold-out set: 2.019408536863327
Accuracy on hold-out set: 0.28895
MulticlassAccuracy value on hold-out data: 0.28894999623298645
Epoch: 15

Loss on hold-out set: 1.9982278162956237
Accuracy on hold-out set: 0.294
MulticlassAccuracy value on hold-out data: 0.2939999997615814
Epoch: 16

Loss on hold-out set: 1.9806123357772827
Accuracy on hold-out set: 0.2969
MulticlassAccuracy value on hold-out data: 0.2969000041484833
Returned to Spot: Validation loss: 1.9806123357772827
----------------------------------------------

config: {'l1': 256, 'l2': 128, 'lr_mult': 0.001, 'batch_size': 2, 'epochs': 16, 'k_folds': 2
```

```
Epoch: 1

Loss on hold-out set: 2.2730499152183534
Accuracy on hold-out set: 0.1695
MulticlassAccuracy value on hold-out data: 0.16949999332427979
Epoch: 2

Loss on hold-out set: 2.207008342385292
Accuracy on hold-out set: 0.20495
MulticlassAccuracy value on hold-out data: 0.2049500048160553
Epoch: 3

Loss on hold-out set: 2.1371639948129655
Accuracy on hold-out set: 0.21595
MulticlassAccuracy value on hold-out data: 0.21594999730587006
Epoch: 4

Loss on hold-out set: 2.095948383009434
Accuracy on hold-out set: 0.2303
MulticlassAccuracy value on hold-out data: 0.23029999434947968
Epoch: 5

Loss on hold-out set: 2.0708383491933344
Accuracy on hold-out set: 0.23685
MulticlassAccuracy value on hold-out data: 0.23684999346733093
Epoch: 6

Loss on hold-out set: 2.051491543114185
Accuracy on hold-out set: 0.2473
MulticlassAccuracy value on hold-out data: 0.24729999899864197
Epoch: 7

Loss on hold-out set: 2.035268258553743
Accuracy on hold-out set: 0.2485
MulticlassAccuracy value on hold-out data: 0.2485000044107437
Epoch: 8

Loss on hold-out set: 2.02001898073554
Accuracy on hold-out set: 0.2576
MulticlassAccuracy value on hold-out data: 0.25760000944137573
Epoch: 9
```

```
Loss on hold-out set: 2.00541377376914
Accuracy on hold-out set: 0.26235
MulticlassAccuracy value on hold-out data: 0.2623499929904938
Epoch: 10

Loss on hold-out set: 1.9916269387483596
Accuracy on hold-out set: 0.26755
MulticlassAccuracy value on hold-out data: 0.267549991607666
Epoch: 11

Loss on hold-out set: 1.9782692990362645
Accuracy on hold-out set: 0.27295
MulticlassAccuracy value on hold-out data: 0.2729499936103821
Epoch: 12

Loss on hold-out set: 1.96436498375535
Accuracy on hold-out set: 0.28135
MulticlassAccuracy value on hold-out data: 0.2813499867916107
Epoch: 13

Loss on hold-out set: 1.9508537354171276
Accuracy on hold-out set: 0.28665
MulticlassAccuracy value on hold-out data: 0.28665000200271606
Epoch: 14

Loss on hold-out set: 1.9367634536981582
Accuracy on hold-out set: 0.2936
MulticlassAccuracy value on hold-out data: 0.2935999929904938
Epoch: 15

Loss on hold-out set: 1.9230544898092747
Accuracy on hold-out set: 0.30035
MulticlassAccuracy value on hold-out data: 0.30035001039505005
Epoch: 16

Loss on hold-out set: 1.9098528969079256
Accuracy on hold-out set: 0.30525
MulticlassAccuracy value on hold-out data: 0.30524998903274536
Returned to Spot: Validation loss: 1.9098528969079256
----------------------------------------------
```

```
spotPython tuning: 1.8698206705272198 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x2ae38fb20>
```

# 19 Tensorboard

The textual output shown in the console (or code cell) can be visualized with Tensorboard as described in Section 21.13.

### 19.0.1 Results

After the hyperparameter tuning run is finished, the results can be analyzed as described in Section 21.14.

```
SAVE = False
LOAD = False

if SAVE:
    result_file_name = "res_" + experiment_name + ".pkl"
    with open(result_file_name, 'wb') as f:
        pickle.dump(spot_tuner, f)

if LOAD:
    result_file_name = "ADD THE NAME here, e.g.: res_ch10-friedman-hpt-0_maans03_60min_20i
    with open(result_file_name, 'rb') as f:
        spot_tuner =  pickle.load(f)
```

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

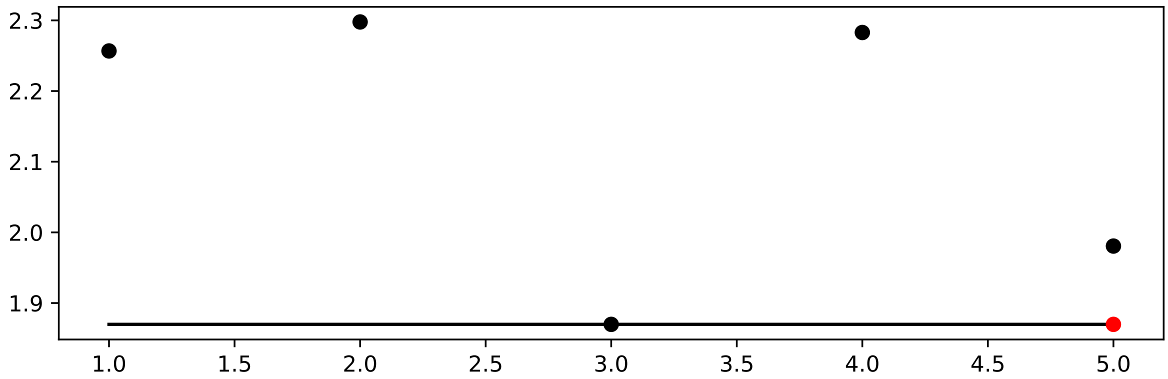



Figure 19.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name         | type   | default   |    lower |    upper |    tuned | transform              |-
|--------------|--------|-----------|----------|----------|----------|------------------------|--
| l1           | int    | 5         |      2.0 |      9.0 |      8.0 | transform_power_2_int |
| l2           | int    | 5         |      2.0 |      9.0 |      7.0 | transform_power_2_int |
| lr_mult      | float  | 1.0       |    0.001 |    0.001 |    0.001 | None                   |
| batch_size   | int    | 4         |      1.0 |      4.0 |      1.0 | transform_power_2_int |
| epochs       | int    | 3         |      3.0 |      4.0 |      4.0 | transform_power_2_int |
| k_folds      | int    | 1         |      2.0 |      2.0 |      2.0 | None                   |
| patience     | int    | 5         |      2.0 |     10.0 |      9.0 | None                   |
| optimizer    | factor | SGD       |      0.0 |      0.0 |      0.0 | None                   |
| sgd_momentum | float  | 0.0       |      0.9 |      0.9 |      0.9 | None                   |
```

## 19.1 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

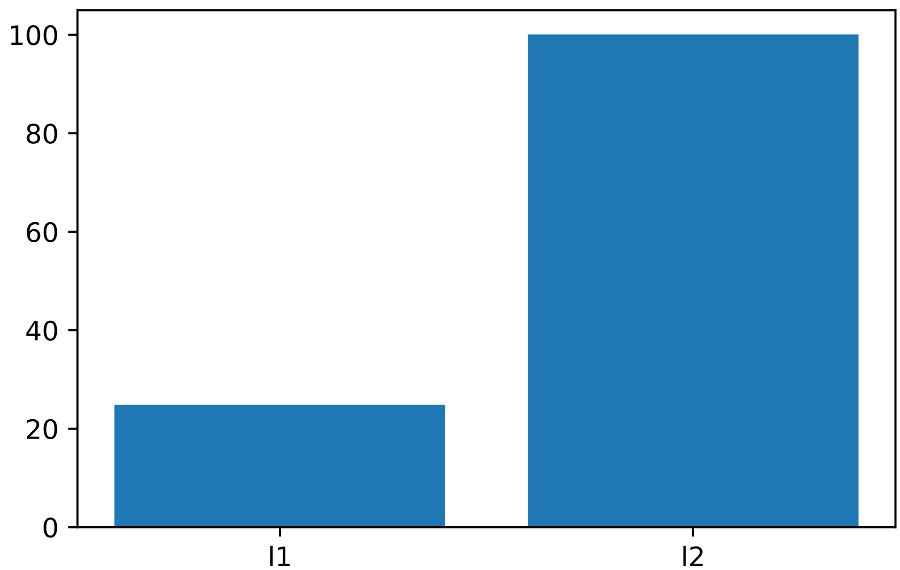



Figure 19.2: Variable importance plot, threshold 0.025.

## 19.2 Get the Tuned Architecture (SPOT Results)

The architecture of the `spotPython` model can be obtained by the following code:

```
from spotPython.hyperparameters.values import get_one_core_model_from_X
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
model_spot = get_one_core_model_from_X(X, fun_control)
model_spot
```

```
Net_CIFAR10(
  (conv1): Conv2d(3, 6, kernel_size=(5, 5), stride=(1, 1))
  (pool): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
  (conv2): Conv2d(6, 16, kernel_size=(5, 5), stride=(1, 1))
  (fc1): Linear(in_features=400, out_features=256, bias=True)
  (fc2): Linear(in_features=256, out_features=128, bias=True)
  (fc3): Linear(in_features=128, out_features=10, bias=True)
)
```

## 19.3 Evaluation of the Tuned Architecture

```
from spotPython.torch.traintest import (
    train_tuned,
    test_tuned,
    )
```

```
train_tuned(net=model_spot, train_dataset=train,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        shuffle=True,
        device = fun_control["device"],
        path=None,
        task=fun_control["task"],)
```

```
Epoch: 1

Batch: 10000. Batch Size: 2. Training Loss (running): 2.302

Loss on hold-out set: 2.295043316912651
Accuracy on hold-out set: 0.1017
MulticlassAccuracy value on hold-out data: 0.10170000046491623
Epoch: 2

Batch: 10000. Batch Size: 2. Training Loss (running): 2.290

Loss on hold-out set: 2.2742282269239427
Accuracy on hold-out set: 0.11345
MulticlassAccuracy value on hold-out data: 0.11344999819993973
Epoch: 3

Batch: 10000. Batch Size: 2. Training Loss (running): 2.263

Loss on hold-out set: 2.234062734937668
Accuracy on hold-out set: 0.1891
MulticlassAccuracy value on hold-out data: 0.1890999972820282
Epoch: 4

Batch: 10000. Batch Size: 2. Training Loss (running): 2.213
```

```
Loss on hold-out set: 2.1722574017763137
Accuracy on hold-out set: 0.2454
MulticlassAccuracy value on hold-out data: 0.24539999663829803
Epoch: 5

Batch: 10000. Batch Size: 2. Training Loss (running): 2.147

Loss on hold-out set: 2.1072573214173316
Accuracy on hold-out set: 0.2526
MulticlassAccuracy value on hold-out data: 0.2526000142097473
Epoch: 6

Batch: 10000. Batch Size: 2. Training Loss (running): 2.083

Loss on hold-out set: 2.056508927512169
Accuracy on hold-out set: 0.26415
MulticlassAccuracy value on hold-out data: 0.2641499936580658
Epoch: 7

Batch: 10000. Batch Size: 2. Training Loss (running): 2.039

Loss on hold-out set: 2.0207617647111418
Accuracy on hold-out set: 0.2682
MulticlassAccuracy value on hold-out data: 0.26820001006126404
Epoch: 8

Batch: 10000. Batch Size: 2. Training Loss (running): 2.006

Loss on hold-out set: 1.9946679057240486
Accuracy on hold-out set: 0.27715
MulticlassAccuracy value on hold-out data: 0.2771500051021576
Epoch: 9

Batch: 10000. Batch Size: 2. Training Loss (running): 1.979

Loss on hold-out set: 1.9749566285431386
Accuracy on hold-out set: 0.284
MulticlassAccuracy value on hold-out data: 0.2840000092983246
Epoch: 10
```

```
Batch: 10000. Batch Size: 2. Training Loss (running): 1.962


Loss on hold-out set: 1.961735676497221
Accuracy on hold-out set: 0.28915
MulticlassAccuracy value on hold-out data: 0.2891499996185303
Epoch: 11

Batch: 10000. Batch Size: 2. Training Loss (running): 1.948


Loss on hold-out set: 1.9488376616954803
Accuracy on hold-out set: 0.29715
MulticlassAccuracy value on hold-out data: 0.29714998602867126
Epoch: 12

Batch: 10000. Batch Size: 2. Training Loss (running): 1.939


Loss on hold-out set: 1.9380441208839416
Accuracy on hold-out set: 0.2993
MulticlassAccuracy value on hold-out data: 0.2992999851703644
Epoch: 13

Batch: 10000. Batch Size: 2. Training Loss (running): 1.931


Loss on hold-out set: 1.9279258598208426
Accuracy on hold-out set: 0.3062
MulticlassAccuracy value on hold-out data: 0.3061999976634979
Epoch: 14

Batch: 10000. Batch Size: 2. Training Loss (running): 1.918


Loss on hold-out set: 1.9194432165831328
Accuracy on hold-out set: 0.30945
MulticlassAccuracy value on hold-out data: 0.3094500005245209
Epoch: 15

Batch: 10000. Batch Size: 2. Training Loss (running): 1.910
```

```
Loss on hold-out set: 1.9116644638806581
Accuracy on hold-out set: 0.31285
MulticlassAccuracy value on hold-out data: 0.3128499984741211
Epoch: 16

Batch: 10000. Batch Size: 2. Training Loss (running): 1.906

Loss on hold-out set: 1.9034361165225506
Accuracy on hold-out set: 0.31695
MulticlassAccuracy value on hold-out data: 0.3169499933719635
Returned to Spot: Validation loss: 1.9034361165225506
----------------------------------------------
```

If `path` is set to a filename, e.g., `path = "model_spot_trained.pt"`, the weights of the trained model will be loaded from this file.

```python
test_tuned(net=model_spot, test_dataset=test,
            shuffle=False,
            loss_function=fun_control["loss_function"],
            metric=fun_control["metric_torch"],
            device = fun_control["device"],
            task=fun_control["task"],)
```

```
Loss on hold-out set: 1.893336629408598
Accuracy on hold-out set: 0.3218
MulticlassAccuracy value on hold-out data: 0.32179999351501465
Final evaluation: Validation loss: 1.893336629408598
Final evaluation: Validation metric: 0.32179999351501465
----------------------------------------------

(1.893336629408598, nan, tensor(0.3218, device='mps:0'))
```

## 19.4 Cross-validated Evaluations

```python
from spotPython.torch.traintest import evaluate_cv
# modify k-kolds:
setattr(model_spot, "k_folds",  10)
df_eval, df_preds, df_metrics = evaluate_cv(net=model_spot,
            dataset=fun_control["data"],
```

```
                loss_function=fun_control["loss_function"],
                metric=fun_control["metric_torch"],
                task=fun_control["task"],
                writer=fun_control["writer"],
                writerId="model_spot_cv",
                device = fun_control["device"])
```

```
Error in Net_Core. Call to evaluate_cv() failed. err=TypeError("Expected sequence or array-li
```

```
metric_name = type(fun_control["metric_torch"]).__name__
print(f"loss: {df_eval}, Cross-validated {metric_name}: {df_metrics}")
```

```
loss: nan, Cross-validated MulticlassAccuracy: nan
```

## 19.5 Detailed Hyperparameter Plots

```
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
l1:  24.837044187757154
l2:  100.0
```

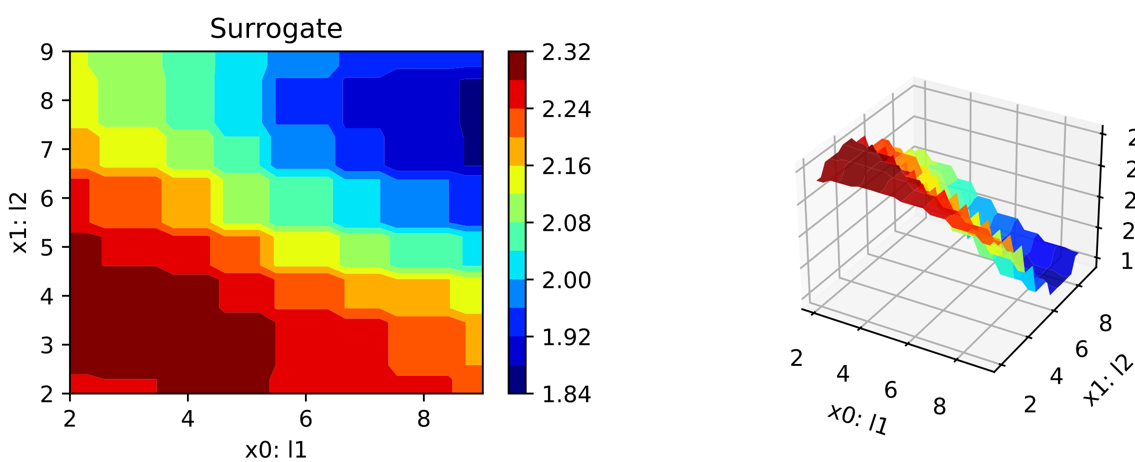



Figure 19.3: Contour plots.

## 19.6 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

Parallel coordinates plots

```
Unable to display output for mime type(s): text/html
```

## 19.7 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 20 HPT: River

River is a Python library for online machine learning (Montiel et al. 2021). It aims to be the most user-friendly library for doing machine learning on streaming data. River is the result of a merger between creme and scikit-multiflow.

# 21 HPT: PyTorch With spotPython and Ray Tune on CIFAR10

In this tutorial, we will show how spotPython can be integrated into the PyTorch training workflow. It is based on the tutorial "Hyperparameter Tuning with Ray Tune" from the PyTorch documentation (PyTorch 2023a), which is an extension of the tutorial "Training a Classifier" (PyTorch 2023b) for training a CIFAR10 image classifier.

This document refers to the following software versions:

- python: 3.10.10
- torch: 2.0.1
- torchvision: 0.15.0

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34

spotRiver                     0.0.93

Note: you may need to restart the kernel to use updated packages.
```

spotPython can be installed via pip[1].

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of spotPython from gitHub.

[1]Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

Results that refer to the `Ray Tune` package are taken from https://PyTorch.org/tutorials/beginner/hyperparameter_tuning_tutorial.html[2].

## 21.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time, initial design size and the device that is used.

```
MAX_TIME = 30
INIT_SIZE = 10
DEVICE = "cpu" # "cuda:0"
```

```
from spotPython.utils.device import getDevice
DEVICE = getDevice(DEVICE)
print(DEVICE)
```

```
cpu
```

```
import os
import copy
import socket
import warnings
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '14-torch' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(INIT_SI
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
warnings.filterwarnings("ignore")
```

```
14-torch_p040025_30min_10init_2023-06-17_16-04-35
```

[2] We were not able to install `Ray Tune` on our system. Therefore, we used the results from the `PyTorch` tutorial.

## 21.2 Initialization of the fun_control Dictionary

spotPython uses a Python dictionary for storing the information required for the hyperparameter tuning process. This dictionary is called fun_control and is initialized with the function fun_control_init. The function fun_control_init returns a skeleton dictionary. The dictionary is filled with the required information for the hyperparameter tuning process. It stores the hyperparameter tuning settings, e.g., the deep learning network architecture that should be tuned, the classification (or regression) problem, and the data that is used for the tuning. The dictionary is used as an input for the SPOT function.

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/14_spot_ray_hpt_torch_cifar10",
    device=DEVICE,)
```

## 21.3 PyTorch Data Loading

The data loading process is implemented in the same manner as described in the Section "Data loaders" in PyTorch (2023a). The data loaders are wrapped into the function load_data_cifar10 which is identical to the function load_data in PyTorch (2023a). A global data directory is used, which allows sharing the data directory between different trials. The method load_data_cifar10 is part of the spotPython package and can be imported from spotPython.data.torchdata.

In the following step, the test and train data are added to the dictionary fun_control.

```
from spotPython.data.torchdata import load_data_cifar10
train, test = load_data_cifar10()
n_samples = len(train)
# add the dataset to the fun_control
fun_control.update({
    "train": train,
    "test": test,
    "n_samples": n_samples})
```

```
Files already downloaded and verified
```

```
Files already downloaded and verified
```

## 21.4 The Model (Algorithm) to be Tuned

### 21.4.1 Specification of the Preprocessing Model

After the training and test data are specified and added to the `fun_control` dictionary, `spotPython` allows the specification of a data preprocessing pipeline, e.g., for the scaling of the data or for the one-hot encoding of categorical variables. The preprocessing model is called `prep_model` ("preparation" or pre-processing) and includes steps that are not subject to the hyperparameter tuning process. The preprocessing model is specified in the `fun_control` dictionary. The preprocessing model can be implemented as a `sklearn` pipeline. The following code shows a typical preprocessing pipeline:

```
categorical_columns = ["cities", "colors"]
one_hot_encoder = OneHotEncoder(handle_unknown="ignore",
                                    sparse_output=False)
prep_model = ColumnTransformer(
        transformers=[
             ("categorical", one_hot_encoder, categorical_columns),
         ],
         remainder=StandardScaler(),
     )
```

Because the Ray Tune (`ray[tune]`) hyperparameter tuning as described in PyTorch (2023a) does not use a preprocessing model, the preprocessing model is set to `None` here.

```
prep_model = None
fun_control.update({"prep_model": prep_model})
```

### 21.4.2 Select `algorithm` and `core_model_hyper_dict`

The same neural network model as implemented in the section "Configurable neural network" of the `PyTorch` tutorial (PyTorch 2023a) is used here. We will show the implementation from PyTorch (2023a) in Section 21.4.2.1 first, before the extended implementation with `spotPython` is shown in Section 21.4.2.2.

#### 21.4.2.1 Implementing a Configurable Neural Network With Ray Tune

We used the same hyperparameters that are implemented as configurable in the `PyTorch` tutorial. We specify the layer sizes, namely `l1` and `l2`, of the fully connected layers:

```python
class Net(nn.Module):
    def __init__(self, l1=120, l2=84):
        super(Net, self).__init__()
        self.conv1 = nn.Conv2d(3, 6, 5)
        self.pool = nn.MaxPool2d(2, 2)
        self.conv2 = nn.Conv2d(6, 16, 5)
        self.fc1 = nn.Linear(16 * 5 * 5, l1)
        self.fc2 = nn.Linear(l1, l2)
        self.fc3 = nn.Linear(l2, 10)

    def forward(self, x):
        x = self.pool(F.relu(self.conv1(x)))
        x = self.pool(F.relu(self.conv2(x)))
        x = x.view(-1, 16 * 5 * 5)
        x = F.relu(self.fc1(x))
        x = F.relu(self.fc2(x))
        x = self.fc3(x)
        return x
```

The learning rate, i.e., `lr`, of the optimizer is made configurable, too:

```python
optimizer = optim.SGD(net.parameters(), lr=config["lr"], momentum=0.9)
```

#### 21.4.2.2 Implementing a Configurable Neural Network With spotPython

`spotPython` implements a class which is similar to the class described in the `PyTorch` tutorial. The class is called `Net_CIFAR10` and is implemented in the file `netcifar10.py`.

```python
from torch import nn
import torch.nn.functional as F
import spotPython.torch.netcore as netcore


class Net_CIFAR10(netcore.Net_Core):
    def __init__(self, l1, l2, lr_mult, batch_size, epochs, k_folds, patience,
    optimizer, sgd_momentum):
        super(Net_CIFAR10, self).__init__(
            lr_mult=lr_mult,
            batch_size=batch_size,
            epochs=epochs,
            k_folds=k_folds,
```

```
            patience=patience,
            optimizer=optimizer,
            sgd_momentum=sgd_momentum,
        )
        self.conv1 = nn.Conv2d(3, 6, 5)
        self.pool = nn.MaxPool2d(2, 2)
        self.conv2 = nn.Conv2d(6, 16, 5)
        self.fc1 = nn.Linear(16 * 5 * 5, l1)
        self.fc2 = nn.Linear(l1, l2)
        self.fc3 = nn.Linear(l2, 10)

    def forward(self, x):
        x = self.pool(F.relu(self.conv1(x)))
        x = self.pool(F.relu(self.conv2(x)))
        x = x.view(-1, 16 * 5 * 5)
        x = F.relu(self.fc1(x))
        x = F.relu(self.fc2(x))
        x = self.fc3(x)
        return x
```

### 21.4.3 The `Net_Core` class

`Net_CIFAR10` inherits from the class `Net_Core` which is implemented in the file `netcore.py`. It implements the additional attributes that are common to all neural network models. The `Net_Core` class is implemented in the file `netcore.py`. It implements hyperparameters as attributes, that are not used by the `core_model`, e.g.:

- optimizer (`optimizer`),
- learning rate (`lr`),
- batch size (`batch_size`),
- epochs (`epochs`),
- k_folds (`k_folds`), and
- early stopping criterion "patience" (`patience`).

Users can add further attributes to the class. The class `Net_Core` is shown below.

```
from torch import nn


class Net_Core(nn.Module):
    def __init__(self, lr_mult, batch_size, epochs, k_folds, patience,
```

```
        optimizer, sgd_momentum):
        super(Net_Core, self).__init__()
        self.lr_mult = lr_mult
        self.batch_size = batch_size
        self.epochs = epochs
        self.k_folds = k_folds
        self.patience = patience
        self.optimizer = optimizer
        self.sgd_momentum = sgd_momentum
```

### 21.4.4 Comparison of the Approach Described in the PyTorch Tutorial With spotPython

Comparing the class `Net` from the `PyTorch` tutorial and the class `Net_CIFAR10` from `spotPython`, we see that the class `Net_CIFAR10` has additional attributes and does not inherit from `nn` directly. It adds an additional class, `Net_core`, that takes care of additional attributes that are common to all neural network models, e.g., the learning rate multiplier `lr_mult` or the batch size `batch_size`.

`spotPython`'s `core_model` implements an instance of the `Net_CIFAR10` class. In addition to the basic neural network model, the `core_model` can use these additional attributes. `spotPython` provides methods for handling these additional attributes to guarantee 100% compatibility with the `PyTorch` classes. The method `add_core_model_to_fun_control` adds the hyperparameters and additional attributes to the `fun_control` dictionary. The method is shown below.

```
from spotPython.torch.netcifar10 import Net_CIFAR10
from spotPython.data.torch_hyper_dict import TorchHyperDict
from spotPython.hyperparameters.values import add_core_model_to_fun_control
core_model = Net_CIFAR10
fun_control = add_core_model_to_fun_control(core_model=core_model,
                              fun_control=fun_control,
                              hyper_dict=TorchHyperDict,
                              filename=None)
```

## 21.5 The Search Space: Hyperparameters

In Section 21.5.1, we first describe how to configure the search space with `ray[tune]` (as shown in PyTorch (2023a)) and then how to configure the search space with `spotPython` in -14.

### 21.5.1 Configuring the Search Space With Ray Tune

Ray Tune's search space can be configured as follows (PyTorch 2023a):

```
config = {
    "l1": tune.sample_from(lambda _: 2**np.random.randint(2, 9)),
    "l2": tune.sample_from(lambda _: 2**np.random.randint(2, 9)),
    "lr": tune.loguniform(1e-4, 1e-1),
    "batch_size": tune.choice([2, 4, 8, 16])
}
```

The `tune.sample_from()` function enables the user to define sample methods to obtain hyperparameters. In this example, the `l1` and `l2` parameters should be powers of 2 between 4 and 256, so either 4, 8, 16, 32, 64, 128, or 256. The `lr` (learning rate) should be uniformly sampled between 0.0001 and 0.1. Lastly, the batch size is a choice between 2, 4, 8, and 16.

At each trial, `ray[tune]` will randomly sample a combination of parameters from these search spaces. It will then train a number of models in parallel and find the best performing one among these. `ray[tune]` uses the `ASHAScheduler` which will terminate bad performing trials early.

### 21.5.2 Configuring the Search Space With spotPython

#### 21.5.2.1 The `hyper_dict` Hyperparameters for the Selected Algorithm

`spotPython` uses `JSON` files for the specification of the hyperparameters. Users can specify their individual `JSON` files, or they can use the `JSON` files provided by `spotPython`. The `JSON` file for the `core_model` is called `torch_hyper_dict.json`.

In contrast to `ray[tune]`, `spotPython` can handle numerical, boolean, and categorical hyperparameters. They can be specified in the `JSON` file in a similar way as the numerical hyperparameters as shown below. Each entry in the `JSON` file represents one hyperparameter with the following structure: `type`, `default`, `transform`, `lower`, and `upper`.

```
"factor_hyperparameter": {
    "levels": ["A", "B", "C"],
    "type": "factor",
    "default": "B",
    "transform": "None",
    "core_model_parameter_type": "str",
    "lower": 0,
    "upper": 2},
```

The corresponding entries for the `Net_CIFAR10` class are shown below.

```
{"Net_CIFAR10":
    {
        "l1": {
            "type": "int",
            "default": 5,
            "transform": "transform_power_2_int",
            "lower": 2,
            "upper": 9},
        "l2": {
            "type": "int",
            "default": 5,
            "transform": "transform_power_2_int",
            "lower": 2,
            "upper": 9},
        "lr_mult": {
            "type": "float",
            "default": 1.0,
            "transform": "None",
            "lower": 0.1,
            "upper": 10},
        "batch_size": {
            "type": "int",
            "default": 4,
            "transform": "transform_power_2_int",
            "lower": 1,
            "upper": 4},
        "epochs": {
            "type": "int",
            "default": 3,
            "transform": "transform_power_2_int",
            "lower": 1,
            "upper": 4},
        "k_folds": {
            "type": "int",
            "default": 2,
            "transform": "None",
            "lower": 2,
            "upper": 3},
        "patience": {
            "type": "int",
```

```
            "default": 5,
            "transform": "None",
            "lower": 2,
            "upper": 10},
        "optimizer": {
            "levels": ["Adadelta",
                       "Adagrad",
                       "Adam",
                       "AdamW",
                       "SparseAdam",
                       "Adamax",
                       "ASGD",
                       "LBFGS",
                       "NAdam",
                       "RAdam",
                       "RMSprop",
                       "Rprop",
                       "SGD"],
            "type": "factor",
            "default": "SGD",
            "transform": "None",
            "class_name": "torch.optim",
            "core_model_parameter_type": "str",
            "lower": 0,
            "upper": 12},
        "sgd_momentum": {
            "type": "float",
            "default": 0.0,
            "transform": "None",
            "lower": 0.0,
            "upper": 1.0}
    }
}
```

### 21.5.3 Modifying the Hyperparameters

Ray tune (PyTorch 2023a) does not provide a way to change the specified hyperparameters without re-compilation. However, `spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions are described in the following.

#### 21.5.3.1 Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

After specifying the model, the corresponding hyperparameters, their types and bounds are loaded from the JSON file `torch_hyper_dict.json`. After loading, the user can modify the hyperparameters, e.g., the bounds. `spotPython` provides a simple rule for de-activating hyperparameters: If the lower and the upper bound are set to identical values, the hyperparameter is de-activated. This is useful for the hyperparameter tuning, because it allows to specify a hyperparameter in the JSON file, but to de-activate it in the `fun_control` dictionary. This is done in the next step.

#### 21.5.3.2 Modify Hyperparameters of Type numeric and integer (boolean)

Since the hyperparameter `k_folds` is not used in the PyTorch tutorial, it is de-activated here by setting the lower and upper bound to the same value. Note, `k_folds` is of type "integer".

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
fun_control = modify_hyper_parameter_bounds(fun_control,
    "batch_size", bounds=[1, 5])
fun_control = modify_hyper_parameter_bounds(fun_control,
    "k_folds", bounds=[0, 0])
fun_control = modify_hyper_parameter_bounds(fun_control,
    "patience", bounds=[3, 3])
```

#### 21.5.3.3 Modify Hyperparameter of Type factor

In a similar manner as for the numerical hyperparameters, the categorical hyperparameters can be modified. New configurations can be chosen by adding or deleting levels. For example, the hyperparameter `optimizer` can be re-configured as follows:

In the following setting, two optimizers (`"SGD"` and `"Adam"`) will be compared during the `spotPython` hyperparameter tuning. The hyperparameter `optimizer` is active.

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
fun_control = modify_hyper_parameter_levels(fun_control,
     "optimizer", ["SGD", "Adam"])
```

The hyperparameter `optimizer` can be de-activated by choosing only one value (level), here: `"SGD"`.

```
fun_control = modify_hyper_parameter_levels(fun_control, "optimizer", ["SGD"])
```

As discussed in Section 21.6, there are some issues with the LBFGS optimizer. Therefore, the usage of the LBFGS optimizer is not deactivated in `spotPython` by default. However, the LBFGS optimizer can be activated by adding it to the list of optimizers. `Rprop` was removed, because it does perform very poorly (as some pre-tests have shown). However, it can also be activated by adding it to the list of optimizers. Since `SparseAdam` does not support dense gradients, `Adam` was used instead. Therefore, there are 10 default optimizers:

```
fun_control = modify_hyper_parameter_levels(fun_control, "optimizer",
    ["Adadelta", "Adagrad", "Adam", "AdamW", "Adamax", "ASGD",
    "NAdam", "RAdam", "RMSprop", "SGD"])
```

## 21.6 Optimizers

Table 21.1 shows some of the optimizers available in `PyTorch`:

$a$ denotes (0.9,0.999), $b$ (0.5,1.2), and $c$ (1e-6, 50), respectively. $R$ denotes `required, but unspecified`. "m" denotes `momentum`, "w_d" `weight_decay`, "d" `dampening`, "n" `nesterov`, "r" `rho`, "l_s" `learning rate for scaling delta`, "l_d" `lr_decay`, "b" `betas`, "l" `lambd`, "a" `alpha`, "m_d" for `momentum_decay`, "e" `etas`, and "s_s" for `step_sizes`.

Table 21.1: Optimizers available in PyTorch (selection). The default values are shown in the table.

| Optimizer | lr | m | w_d | d | n | r | l_s | l_d | b | l | a | m_d | e | s_s |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adadelta | - | - | 0. | - | - | 0.9 | 1. | - | - | - | - | - | - | - |
| Adagrad | 1e-2 | - | 0. | - | - | - | - | 0. | - | - | - | - | - | - |
| Adam | 1e-3 | - | 0. | - | - | - | - | - | $a$ | - | - | - | - | - |
| AdamW | 1e-3 | - | 1e-2 | - | - | - | - | - | $a$ | - | - | - | - | - |
| SparseAdam | 1e-3 | - | - | - | - | - | - | - | $a$ | - | - | - | - | - |
| Adamax | 2e-3 | - | 0. | - | - | - | - | - | $a$ | - | - | - | - | - |
| ASGD | 1e-2 | .9 | 0. | - | F | - | - | - | - | 1e-4 | .75 | - | - | - |
| LBFGS | 1. | - | - | - | - | - | - | - | - | - | - | - | - | - |
| NAdam | 2e-3 | - | 0. | - | - | - | - | - | $a$ | - | - | 0 | - | - |
| RAdam | 1e-3 | - | 0. | - | - | - | - | - | $a$ | - | - | - | - | - |
| RMSprop | 1e-2 | 0. | 0. | - | - | - | - | - | $a$ | - | - | - | - | - |
| Rprop | 1e-2 | - | - | - | - | - | - | - | - | - | $b$ | $c$ | - | - |
| SGD | $R$ | 0. | 0. | 0. | F | - | - | - | - | - | - | - | - | - |

`spotPython` implements an `optimization` handler that maps the optimizer names to the corresponding `PyTorch` optimizers.

**A note on LBFGS**

We recommend deactivating PyTorch's LBFGS optimizer, because it does not perform very well. The PyTorch documentation, see https://pytorch.org/docs/stable/generated/torch.optim.LBFGS.html#torch.optim.LBFGS, states:

> This is a very memory intensive optimizer (it requires additional `param_bytes * (history_size + 1)` bytes). If it doesn't fit in memory try reducing the history size, or use a different algorithm.

Furthermore, the LBFGS optimizer is not compatible with the PyTorch tutorial. The reason is that the LBFGS optimizer requires the `closure` function, which is not implemented in the PyTorch tutorial. Therefore, the `LBFGS` optimizer is recommended here. Since there are ten optimizers in the portfolio, it is not recommended tuning the hyperparameters that effect one single optimizer only.

**A note on the learning rate**

`spotPython` provides a multiplier for the default learning rates, `lr_mult`, because optimizers use different learning rates. Using a multiplier for the learning rates might enable a simultaneous tuning of the learning rates for all optimizers. However, this is not recommended, because the learning rates are not comparable across optimizers. Therefore, we recommend fixing the learning rate for all optimizers if multiple optimizers are used. This can be done by setting the lower and upper bounds of the learning rate multiplier to the same value as shown below.
Thus, the learning rate, which affects the `SGD` optimizer, will be set to a fixed value. We choose the default value of `1e-3` for the learning rate, because it is used in other `PyTorch` examples (it is also the default value used by `spotPython` as defined in the `optimizer_handler()` method). We recommend tuning the learning rate later, when a reduced set of optimizers is fixed. Here, we will demonstrate how to select in a screening phase the optimizers that should be used for the hyperparameter tuning.

For the same reason, we will fix the `sgd_momentum` to `0.9`.

```
fun_control = modify_hyper_parameter_bounds(fun_control,
    "lr_mult", bounds=[1.0, 1.0])
fun_control = modify_hyper_parameter_bounds(fun_control,
    "sgd_momentum", bounds=[0.9, 0.9])
```

## 21.7 Evaluation: Data Splitting

The evaluation procedure requires the specification of the way how the data is split into a train and a test set and the loss function (and a metric). As a default, `spotPython` provides a standard hold-out data split and cross validation.

### 21.7.1 Hold-out Data Split

If a hold-out data split is used, the data will be partitioned into a training, a validation, and a test data set. The split depends on the setting of the `eval` parameter. If `eval` is set to `train_hold_out`, one data set, usually the original training data set, is split into a new training and a validation data set. The training data set is used for training the model. The validation data set is used for the evaluation of the hyperparameter configuration and early stopping to prevent overfitting. In this case, the original test data set is not used.

> **Note**
>
> `spotPython` returns the hyperparameters of the machine learning and deep learning models, e.g., number of layers, learning rate, or optimizer, but not the model weights. Therefore, after the SPOT run is finished, the corresponding model with the optimized architecture has to be trained again with the best hyperparameter configuration. The training is performed on the training data set. The test data set is used for the final evaluation of the model.
> Summarizing, the following splits are performed in the hold-out setting:
>
> 1. Run `spotPython` with `eval` set to `train_hold_out` to determine the best hyperparameter configuration.
> 2. Train the model with the best hyperparameter configuration ("architecture") on the training data set: `train_tuned(model_spot, train, "model_spot.pt")`.
> 3. Test the model on the test data: `test_tuned(model_spot, test, "model_spot.pt")`
>
> These steps will be exemplified in the following sections.

In addition to this `hold-out` setting, `spotPython` provides another hold-out setting, where an explicit test data is specified by the user that will be used as the validation set. To choose this option, the `eval` parameter is set to `test_hold_out`. In this case, the training data set is used for the model training. Then, the explicitly defined test data set is used for the evaluation of the hyperparameter configuration (the validation).

### 21.7.2 Cross-Validation

The cross validation setting is used by setting the `eval` parameter to `train_cv` or `test_cv`. In both cases, the data set is split into $k$ folds. The model is trained on $k-1$ folds and evaluated on the remaining fold. This is repeated $k$ times, so that each fold is used exactly once for evaluation. The final evaluation is performed on the test data set. The cross validation setting is useful for small data sets, because it allows to use all data for training and evaluation. However, it is computationally expensive, because the model has to be trained $k$ times.

> **Note**
>
> Combinations of the above settings are possible, e.g., cross validation can be used for training and hold-out for evaluation or *vice versa*. Also, cross validation can be used for training and testing. Because cross validation is not used in the `PyTorch` tutorial (PyTorch 2023a), it is not considered further here.

### 21.7.3 Overview of the Evaluation Settings

#### 21.7.3.1 Settings for the Hyperparameter Tuning

An overview of the training evaluations is shown in Table 21.2. `"train_cv"` and `"test_cv"` use `sklearn.model_selection.KFold()` internally. More details on the data splitting are provided in Section 30.14 (in the Appendix).

Table 21.2: Overview of the evaluation settings.

| `eval` | `train` | `test` | function | comment |
|---|---|---|---|---|
| `"train_hold_out"` | ✓ | | `train_one_epoch()`, `validate_one_epoch()` for early stopping | splits the `train` data set internally |
| `"test_hold_out"` | ✓ | ✓ | `train_one_epoch()`, `validate_one_epoch()` for early stopping | use the `test data set` for `validate_one_epoch()` |
| `"train_cv"` | ✓ | | `evaluate_cv(net, train)` | CV using the `train` data set |
| `"test_cv"` | | ✓ | `evaluate_cv(net, test)` | CV using the `test` data set . Identical to `"train_cv"`, uses only test data. |

#### 21.7.3.2 Settings for the Final Evaluation of the Tuned Architecture

##### 21.7.3.2.1 Training of the Tuned Architecture

`train_tuned(model, train)`: train the model with the best hyperparameter configuration (or simply the default) on the training data set. It splits the `train`data into new `train` and `validation` sets using `create_train_val_data_loaders()`, which calls `torch.utils.data.random_split()` internally. Currently, 60% of the data is used for training and 40% for validation. The `train` data is used for training the model with `train_hold_out()`. The `validation` data is used for early stopping using `validate_fold_or_hold_out()` on the `validation` data set.

##### 21.7.3.2.2 Testing of the Tuned Architecture

`test_tuned(model, test)`: test the model on the test data set. No data splitting is performed. The (trained) model is evaluated using the `validate_fold_or_hold_out()` function. Note: During training, `"shuffle"` is set to `True`, whereas during testing, `"shuffle"` is set to `False`.

Section 30.14.1.4 describes the final evaluation of the tuned architecture.

```
fun_control.update({
    "eval": "train_hold_out",
    "path": "torch_model.pt",
    "shuffle": True})
```

## 21.8 Evaluation: Loss Functions and Metrics

The key `"loss_function"` specifies the loss function which is used during the optimization. There are several different loss functions under `PyTorch`'s `nn` package. For example, a simple loss is `MSELoss`, which computes the mean-squared error between the output and the target. In this tutorial we will use `CrossEntropyLoss`, because it is also used in the `PyTorch` tutorial.

```
from torch.nn import CrossEntropyLoss
loss_function = CrossEntropyLoss()
fun_control.update({"loss_function": loss_function})
```

In addition to the loss functions, `spotPython` provides access to a large number of metrics.

- The key `"metric_sklearn"` is used for metrics that follow the `scikit-learn` conventions.
- The key `"river_metric"` is used for the river based evaluation (Montiel et al. 2021) via `eval_oml_iter_progressive`, and

- the key "metric_torch" is used for the metrics from TorchMetrics.

TorchMetrics is a collection of more than 90 PyTorch metrics, see https://torchmetrics.readthedocs.io/en/latest/. Because the PyTorch tutorial uses the accuracy as metric, we use the same metric here. Currently, accuracy is computed in the tutorial's example code. We will use TorchMetrics instead, because it offers more flexibilty, e.g., it can be used for regression and classification. Furthermore, TorchMetrics offers the following advantages:

```
* A standardized interface to increase reproducibility
* Reduces Boilerplate
* Distributed-training compatible
* Rigorously tested
* Automatic accumulation over batches
* Automatic synchronization between multiple devices
```

Therefore, we set

```
import torchmetrics
metric_torch = torchmetrics.Accuracy(task="multiclass", num_classes=10).to(fun_control["de
fun_control.update({"metric_torch": metric_torch})
```

## 21.9 Preparing the SPOT Call

The following code passes the information about the parameter ranges and bounds to spot.

```
from spotPython.hyperparameters.values import (
    get_var_type,
    get_var_name,
    get_bound_values
    )
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})

lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

Now, the dictionary fun_control contains all information needed for the hyperparameter tuning. Before the hyperparameter tuning is started, it is recommended to take a look at the experimental design. The method gen_design_table generates a design table as follows:

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name         | type   | default   |   lower |   upper | transform             |
|--------------|--------|-----------|---------|---------|-----------------------|
| l1           | int    | 5         |     2   |     9   | transform_power_2_int |
| l2           | int    | 5         |     2   |     9   | transform_power_2_int |
| lr_mult      | float  | 1.0       |     1   |     1   | None                  |
| batch_size   | int    | 4         |     1   |     5   | transform_power_2_int |
| epochs       | int    | 3         |     3   |     4   | transform_power_2_int |
| k_folds      | int    | 1         |     0   |     0   | None                  |
| patience     | int    | 5         |     3   |     3   | None                  |
| optimizer    | factor | SGD       |     0   |     9   | None                  |
| sgd_momentum | float  | 0.0       |     0.9 |     0.9 | None                  |
```

This allows to check if all information is available and if the information is correct. **?@tbl-design** shows the experimental design for the hyperparameter tuning. The table shows the hyperparameters, their types, default values, lower and upper bounds, and the transformation function. The transformation function is used to transform the hyperparameter values from the unit hypercube to the original domain. The transformation function is applied to the hyperparameter values before the evaluation of the objective function. Hyperparameter transformations are shown in the column "transform", e.g., the `l1` default is `5`, which results in the value $2^5 = 32$ for the network, because the transformation `transform_power_2_int` was selected in the `JSON` file. The default value of the `batch_size` is set to `4`, which results in a batch size of $2^4 = 16$.

## 21.10 The Objective Function `fun_torch`

The objective function `fun_torch` is selected next. It implements an interface from `PyTorch`'s training, validation, and testing methods to `spotPython`.

```
from spotPython.fun.hypertorch import HyperTorch
fun = HyperTorch().fun_torch
```

## 21.11 Using Default Hyperparameters or Results from Previous Runs

We add the default setting to the initial design:

```
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=TorchHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
```

## 21.12 Starting the Hyperparameter Tuning

The `spotPython` hyperparameter tuning is started by calling the `Spot` function. Here, we will run the tuner for approximately 30 minutes (`max_time`). Note: the initial design is always evaluated in the `spotPython` run. As a consequence, the run may take longer than specified by `max_time`, because the evaluation time of initial design (here: `init_size`, 10 points) is performed independently of `max_time`. During the run, results from the training is shown. These results can be visualized with Tensorboard as will be shown in Section 21.13.

```
from spotPython.spot import spot
from math import inf
import numpy as np
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
```

```python
                                        "model_fun_evals": 10_000,
                                        "log_level": 50
                                        })
spot_tuner.run(X_start=X_start)
```

```
config: {'l1': 64, 'l2': 16, 'lr_mult': 1.0, 'batch_size': 16, 'epochs': 16, 'k_folds': 0, '
Epoch: 1

Loss on hold-out set: 1.5219582221984864
Accuracy on hold-out set: 0.449
MulticlassAccuracy value on hold-out data: 0.4490000009536743
Epoch: 2

Loss on hold-out set: 1.3727999521017074
Accuracy on hold-out set: 0.50275
MulticlassAccuracy value on hold-out data: 0.5027499794960022
Epoch: 3

Loss on hold-out set: 1.3048686031341552
Accuracy on hold-out set: 0.53965
MulticlassAccuracy value on hold-out data: 0.539650022983551
Epoch: 4

Loss on hold-out set: 1.253052043557167
Accuracy on hold-out set: 0.5618
MulticlassAccuracy value on hold-out data: 0.5618000030517578
Epoch: 5

Loss on hold-out set: 1.1993524871349335
Accuracy on hold-out set: 0.5808
MulticlassAccuracy value on hold-out data: 0.5807999968528748
Epoch: 6

Loss on hold-out set: 1.1863164348125457
Accuracy on hold-out set: 0.5878
MulticlassAccuracy value on hold-out data: 0.5878000259399414
Epoch: 7
```

```
Loss on hold-out set: 1.2170960848808288
Accuracy on hold-out set: 0.58165
MulticlassAccuracy value on hold-out data: 0.5816500186920166
Epoch: 8

Loss on hold-out set: 1.207920764565468
Accuracy on hold-out set: 0.5852
MulticlassAccuracy value on hold-out data: 0.5852000117301941
Epoch: 9

Loss on hold-out set: 1.202639481830597
Accuracy on hold-out set: 0.58795
MulticlassAccuracy value on hold-out data: 0.5879499912261963
Early stopping at epoch 8
Returned to Spot: Validation loss: 1.202639481830597
----------------------------------------------

config: {'l1': 16, 'l2': 128, 'lr_mult': 1.0, 'batch_size': 4, 'epochs': 16, 'k_folds': 0, 'p
Epoch: 1

Loss on hold-out set: 1.5826375313282013
Accuracy on hold-out set: 0.44295
MulticlassAccuracy value on hold-out data: 0.4429500102996826
Epoch: 2

Loss on hold-out set: 1.4810361552000046
Accuracy on hold-out set: 0.4798
MulticlassAccuracy value on hold-out data: 0.4797999858856201
Epoch: 3

Loss on hold-out set: 1.415360550622642
Accuracy on hold-out set: 0.50445
MulticlassAccuracy value on hold-out data: 0.5044500231742859
Epoch: 4

Loss on hold-out set: 1.406614878088236
Accuracy on hold-out set: 0.51005
MulticlassAccuracy value on hold-out data: 0.5100499987602234
Epoch: 5
```

```
Loss on hold-out set: 1.3943237218216062
Accuracy on hold-out set: 0.52575
MulticlassAccuracy value on hold-out data: 0.5257499814033508
Epoch: 6

Loss on hold-out set: 1.3533527416594326
Accuracy on hold-out set: 0.54115
MulticlassAccuracy value on hold-out data: 0.5411499738693237
Epoch: 7

Loss on hold-out set: 1.3940868198625744
Accuracy on hold-out set: 0.5315
MulticlassAccuracy value on hold-out data: 0.531499981880188
Epoch: 8

Loss on hold-out set: 1.4632197034638375
Accuracy on hold-out set: 0.5321
MulticlassAccuracy value on hold-out data: 0.5321000218391418
Epoch: 9

Loss on hold-out set: 1.3549452826490627
Accuracy on hold-out set: 0.5242
MulticlassAccuracy value on hold-out data: 0.5242000222206116
Early stopping at epoch 8
Returned to Spot: Validation loss: 1.3549452826490627
----------------------------------------------

config: {'l1': 32, 'l2': 8, 'lr_mult': 1.0, 'batch_size': 8, 'epochs': 8, 'k_folds': 0, 'pat
Epoch: 1

Loss on hold-out set: 1.9893493677139282
Accuracy on hold-out set: 0.267
MulticlassAccuracy value on hold-out data: 0.2669999897480011
Epoch: 2

Loss on hold-out set: 1.8320120490550995
Accuracy on hold-out set: 0.3163
MulticlassAccuracy value on hold-out data: 0.31630000472068787
Epoch: 3
```

```
Loss on hold-out set: 1.6894823632240294
Accuracy on hold-out set: 0.37805
MulticlassAccuracy value on hold-out data: 0.3780499994754791
Epoch: 4

Loss on hold-out set: 1.6640148567676545
Accuracy on hold-out set: 0.3804
MulticlassAccuracy value on hold-out data: 0.38040000200271606
Epoch: 5

Loss on hold-out set: 1.5956094424962997
Accuracy on hold-out set: 0.40905
MulticlassAccuracy value on hold-out data: 0.40904998779296875
Epoch: 6

Loss on hold-out set: 1.5541269161224365
Accuracy on hold-out set: 0.4258
MulticlassAccuracy value on hold-out data: 0.42579999566078186
Epoch: 7

Loss on hold-out set: 1.5342247886896134
Accuracy on hold-out set: 0.4367
MulticlassAccuracy value on hold-out data: 0.4366999864578247
Epoch: 8

Loss on hold-out set: 1.5115873582839965
Accuracy on hold-out set: 0.44295
MulticlassAccuracy value on hold-out data: 0.4429500102996826
Returned to Spot: Validation loss: 1.5115873582839965
----------------------------------------------

config: {'l1': 8, 'l2': 64, 'lr_mult': 1.0, 'batch_size': 4, 'epochs': 8, 'k_folds': 0, 'pat
Epoch: 1

Loss on hold-out set: 1.5473761287152767
Accuracy on hold-out set: 0.4305
MulticlassAccuracy value on hold-out data: 0.43050000071525574
Epoch: 2
```

```
Loss on hold-out set: 1.5012669603824615
Accuracy on hold-out set: 0.45375
MulticlassAccuracy value on hold-out data: 0.45375001430511475
Epoch: 3

Loss on hold-out set: 1.378561767217517
Accuracy on hold-out set: 0.49785
MulticlassAccuracy value on hold-out data: 0.4978500008583069
Epoch: 4

Loss on hold-out set: 1.3439899893552065
Accuracy on hold-out set: 0.5168
MulticlassAccuracy value on hold-out data: 0.5167999863624573
Epoch: 5

Loss on hold-out set: 1.2867432553708553
Accuracy on hold-out set: 0.53645
MulticlassAccuracy value on hold-out data: 0.5364500284194946
Epoch: 6

Loss on hold-out set: 1.2939470446698367
Accuracy on hold-out set: 0.54485
MulticlassAccuracy value on hold-out data: 0.5448499917984009
Epoch: 7

Loss on hold-out set: 1.3235716474875807
Accuracy on hold-out set: 0.53955
MulticlassAccuracy value on hold-out data: 0.5395500063896179
Epoch: 8

Loss on hold-out set: 1.2790210461124778
Accuracy on hold-out set: 0.5544
MulticlassAccuracy value on hold-out data: 0.5544000267982483
Returned to Spot: Validation loss: 1.2790210461124778
----------------------------------------------

config: {'l1': 128, 'l2': 32, 'lr_mult': 1.0, 'batch_size': 8, 'epochs': 16, 'k_folds': 0, 'p
Epoch: 1
```

```
Loss on hold-out set: 1.5262402240395545
Accuracy on hold-out set: 0.4446
MulticlassAccuracy value on hold-out data: 0.444599986076355
Epoch: 2

Loss on hold-out set: 1.36971512799263
Accuracy on hold-out set: 0.5072
MulticlassAccuracy value on hold-out data: 0.5072000026702881
Epoch: 3

Loss on hold-out set: 1.3183254519224168
Accuracy on hold-out set: 0.5331
MulticlassAccuracy value on hold-out data: 0.5331000089645386
Epoch: 4

Loss on hold-out set: 1.2582640195667745
Accuracy on hold-out set: 0.55115
MulticlassAccuracy value on hold-out data: 0.5511500239372253
Epoch: 5

Loss on hold-out set: 1.2455605538725854
Accuracy on hold-out set: 0.55915
MulticlassAccuracy value on hold-out data: 0.559149980545044
Epoch: 6

Loss on hold-out set: 1.2151955420553684
Accuracy on hold-out set: 0.57495
MulticlassAccuracy value on hold-out data: 0.5749499797821045
Epoch: 7

Loss on hold-out set: 1.2218167432188989
Accuracy on hold-out set: 0.5754
MulticlassAccuracy value on hold-out data: 0.5753999948501587
Epoch: 8

Loss on hold-out set: 1.1735409120440483
Accuracy on hold-out set: 0.59955
MulticlassAccuracy value on hold-out data: 0.5995500087738037
Epoch: 9
```

```
Loss on hold-out set: 1.196616969561577
Accuracy on hold-out set: 0.5945
MulticlassAccuracy value on hold-out data: 0.5945000052452087
Epoch: 10

Loss on hold-out set: 1.1734407166928054
Accuracy on hold-out set: 0.60295
MulticlassAccuracy value on hold-out data: 0.6029499769210815
Epoch: 11

Loss on hold-out set: 1.1821594884127378
Accuracy on hold-out set: 0.60755
MulticlassAccuracy value on hold-out data: 0.6075500249862671
Epoch: 12

Loss on hold-out set: 1.1719353271067143
Accuracy on hold-out set: 0.61
MulticlassAccuracy value on hold-out data: 0.6100000143051147
Epoch: 13

Loss on hold-out set: 1.1860295499444007
Accuracy on hold-out set: 0.61225
MulticlassAccuracy value on hold-out data: 0.6122499704360962
Epoch: 14

Loss on hold-out set: 1.226845956942439
Accuracy on hold-out set: 0.6073
MulticlassAccuracy value on hold-out data: 0.6072999835014343
Epoch: 15

Loss on hold-out set: 1.3519103231340648
Accuracy on hold-out set: 0.59115
MulticlassAccuracy value on hold-out data: 0.5911499857902527
Early stopping at epoch 14
Returned to Spot: Validation loss: 1.3519103231340648
----------------------------------------------

config: {'l1': 512, 'l2': 16, 'lr_mult': 1.0, 'batch_size': 4, 'epochs': 16, 'k_folds': 0, '
Epoch: 1
```

```
Loss on hold-out set: 2.3109123113155365
Accuracy on hold-out set: 0.0994
MulticlassAccuracy value on hold-out data: 0.09939999878406525
Epoch: 2

Loss on hold-out set: 2.306638641357422
Accuracy on hold-out set: 0.0988
MulticlassAccuracy value on hold-out data: 0.09880000352859497
Epoch: 3

Loss on hold-out set: 2.304519428396225
Accuracy on hold-out set: 0.10155
MulticlassAccuracy value on hold-out data: 0.10154999792575836
Epoch: 4

Loss on hold-out set: 2.3043201933383943
Accuracy on hold-out set: 0.0984
MulticlassAccuracy value on hold-out data: 0.09839999675750732
Epoch: 5

Loss on hold-out set: 2.309128194665909
Accuracy on hold-out set: 0.0985
MulticlassAccuracy value on hold-out data: 0.09849999845027924
Epoch: 6

Loss on hold-out set: 2.3057794860839844
Accuracy on hold-out set: 0.0994
MulticlassAccuracy value on hold-out data: 0.09939999878406525
Epoch: 7

Loss on hold-out set: 2.30558047580719
Accuracy on hold-out set: 0.0999
MulticlassAccuracy value on hold-out data: 0.09989999979734421
Early stopping at epoch 6
Returned to Spot: Validation loss: 2.30558047580719
----------------------------------------------

config: {'l1': 8, 'l2': 8, 'lr_mult': 1.0, 'batch_size': 16, 'epochs': 8, 'k_folds': 0, 'pat
Epoch: 1
```

```
Loss on hold-out set: 1.8480259742736815
Accuracy on hold-out set: 0.26565
MulticlassAccuracy value on hold-out data: 0.2656500041484833
Epoch: 2

Loss on hold-out set: 1.7430640936851503
Accuracy on hold-out set: 0.31845
MulticlassAccuracy value on hold-out data: 0.318450003862381
Epoch: 3

Loss on hold-out set: 1.688589110660553
Accuracy on hold-out set: 0.3466
MulticlassAccuracy value on hold-out data: 0.3465999960899353
Epoch: 4

Loss on hold-out set: 1.6457796052932738
Accuracy on hold-out set: 0.37735
MulticlassAccuracy value on hold-out data: 0.37735000252723694
Epoch: 5

Loss on hold-out set: 1.6170690876960754
Accuracy on hold-out set: 0.3956
MulticlassAccuracy value on hold-out data: 0.39559999108314514
Epoch: 6

Loss on hold-out set: 1.5905068434238434
Accuracy on hold-out set: 0.40955
MulticlassAccuracy value on hold-out data: 0.4095500111579895
Epoch: 7

Loss on hold-out set: 1.5819947251319886
Accuracy on hold-out set: 0.4122
MulticlassAccuracy value on hold-out data: 0.412200003862381
Epoch: 8

Loss on hold-out set: 1.5586501889705657
Accuracy on hold-out set: 0.4239
MulticlassAccuracy value on hold-out data: 0.4239000082015991
Returned to Spot: Validation loss: 1.5586501889705657
----------------------------------------------
```

```
config: {'l1': 256, 'l2': 64, 'lr_mult': 1.0, 'batch_size': 16, 'epochs': 8, 'k_folds': 0, 'p
Epoch: 1

Loss on hold-out set: 2.303136363983154
Accuracy on hold-out set: 0.1027
MulticlassAccuracy value on hold-out data: 0.10270000249147415
Epoch: 2

Loss on hold-out set: 2.3042777353286743
Accuracy on hold-out set: 0.09845
MulticlassAccuracy value on hold-out data: 0.09844999760389328
Epoch: 3

Loss on hold-out set: 2.304166873550415
Accuracy on hold-out set: 0.09965
MulticlassAccuracy value on hold-out data: 0.09965000301599503
Epoch: 4

Loss on hold-out set: 2.305248471832275
Accuracy on hold-out set: 0.09965
MulticlassAccuracy value on hold-out data: 0.09965000301599503
Early stopping at epoch 3
Returned to Spot: Validation loss: 2.305248471832275
----------------------------------------------

config: {'l1': 256, 'l2': 512, 'lr_mult': 1.0, 'batch_size': 2, 'epochs': 8, 'k_folds': 0, 'p
Epoch: 1

Loss on hold-out set: 1.546173004940644
Accuracy on hold-out set: 0.4655
MulticlassAccuracy value on hold-out data: 0.46549999713897705
Epoch: 2

Loss on hold-out set: 1.4121364830534129
Accuracy on hold-out set: 0.5301
MulticlassAccuracy value on hold-out data: 0.5300999879837036
Epoch: 3
```

```
Loss on hold-out set: 1.7027809614705416
Accuracy on hold-out set: 0.46995
MulticlassAccuracy value on hold-out data: 0.46994999051094055
Epoch: 4

Loss on hold-out set: 1.6042585707328223
Accuracy on hold-out set: 0.5364
MulticlassAccuracy value on hold-out data: 0.5364000201225281
Epoch: 5

Loss on hold-out set: 1.4870093726813183
Accuracy on hold-out set: 0.5626
MulticlassAccuracy value on hold-out data: 0.5626000165939331
Early stopping at epoch 4
Returned to Spot: Validation loss: 1.4870093726813183
----------------------------------------------

config: {'l1': 4, 'l2': 256, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0, '
Epoch: 1

Loss on hold-out set: 1.5639358173370361
Accuracy on hold-out set: 0.4181
MulticlassAccuracy value on hold-out data: 0.4180999994277954
Epoch: 2

Loss on hold-out set: 1.4627004611968994
Accuracy on hold-out set: 0.45855
MulticlassAccuracy value on hold-out data: 0.45855000615119934
Epoch: 3

Loss on hold-out set: 1.407848147392273
Accuracy on hold-out set: 0.48045
MulticlassAccuracy value on hold-out data: 0.48045000433921814
Epoch: 4

Loss on hold-out set: 1.3773567038536072
Accuracy on hold-out set: 0.5084
MulticlassAccuracy value on hold-out data: 0.508400022983551
Epoch: 5
```

```
Loss on hold-out set: 1.4203257833480836
Accuracy on hold-out set: 0.49935
MulticlassAccuracy value on hold-out data: 0.49935001134872437
Epoch: 6

Loss on hold-out set: 1.3694352231025695
Accuracy on hold-out set: 0.51365
MulticlassAccuracy value on hold-out data: 0.5136500000953674
Epoch: 7

Loss on hold-out set: 1.4032324273109436
Accuracy on hold-out set: 0.5019
MulticlassAccuracy value on hold-out data: 0.5019000172615051
Epoch: 8

Loss on hold-out set: 1.3774075019836425
Accuracy on hold-out set: 0.50715
MulticlassAccuracy value on hold-out data: 0.5071499943733215
Epoch: 9

Loss on hold-out set: 1.3356633228302002
Accuracy on hold-out set: 0.52275
MulticlassAccuracy value on hold-out data: 0.5227500200271606
Epoch: 10

Loss on hold-out set: 1.3593775232315064
Accuracy on hold-out set: 0.51045
MulticlassAccuracy value on hold-out data: 0.510450005531311
Epoch: 11

Loss on hold-out set: 1.2961927928924561
Accuracy on hold-out set: 0.531
MulticlassAccuracy value on hold-out data: 0.531000018119812
Epoch: 12

Loss on hold-out set: 1.3525038039207458
Accuracy on hold-out set: 0.5237
MulticlassAccuracy value on hold-out data: 0.5236999988555908
Epoch: 13
```

```
Loss on hold-out set: 1.386511409664154
Accuracy on hold-out set: 0.5106
MulticlassAccuracy value on hold-out data: 0.5105999708175659
Epoch: 14

Loss on hold-out set: 1.4165489706993104
Accuracy on hold-out set: 0.5126
MulticlassAccuracy value on hold-out data: 0.5126000046730042
Early stopping at epoch 13
Returned to Spot: Validation loss: 1.4165489706993104
----------------------------------------------


config: {'l1': 512, 'l2': 4, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0, 'p
Epoch: 1

Loss on hold-out set: 1.793743984222412
Accuracy on hold-out set: 0.2966
MulticlassAccuracy value on hold-out data: 0.29660001397132874
Epoch: 2

Loss on hold-out set: 1.5960545024871826
Accuracy on hold-out set: 0.40735
MulticlassAccuracy value on hold-out data: 0.40735000371932983
Epoch: 3

Loss on hold-out set: 1.5165291946411132
Accuracy on hold-out set: 0.44185
MulticlassAccuracy value on hold-out data: 0.4418500065803528
Epoch: 4

Loss on hold-out set: 1.4259245255470276
Accuracy on hold-out set: 0.4996
MulticlassAccuracy value on hold-out data: 0.49959999322891235
Epoch: 5

Loss on hold-out set: 1.3962059812545777
Accuracy on hold-out set: 0.50715
MulticlassAccuracy value on hold-out data: 0.5071499943733215
Epoch: 6
```

```
Loss on hold-out set: 1.4192028886795045
Accuracy on hold-out set: 0.5043
MulticlassAccuracy value on hold-out data: 0.5042999982833862
Epoch: 7

Loss on hold-out set: 1.4076474279403686
Accuracy on hold-out set: 0.51935
MulticlassAccuracy value on hold-out data: 0.519349992275238
Epoch: 8

Loss on hold-out set: 1.4576949935913086
Accuracy on hold-out set: 0.5311
MulticlassAccuracy value on hold-out data: 0.5310999751091003
Early stopping at epoch 7
Returned to Spot: Validation loss: 1.4576949935913086
----------------------------------------------
spotPython tuning: 1.202639481830597 [#---------] 5.14%


config: {'l1': 64, 'l2': 4, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1

Loss on hold-out set: 1.7761971963882446
Accuracy on hold-out set: 0.2903
MulticlassAccuracy value on hold-out data: 0.29030001163482666
Epoch: 2

Loss on hold-out set: 1.6783645782470704
Accuracy on hold-out set: 0.3429
MulticlassAccuracy value on hold-out data: 0.34290000796318054
Epoch: 3

Loss on hold-out set: 1.612242141342163
Accuracy on hold-out set: 0.3915
MulticlassAccuracy value on hold-out data: 0.39149999618530273
Epoch: 4

Loss on hold-out set: 1.4908584526062012
Accuracy on hold-out set: 0.4554
MulticlassAccuracy value on hold-out data: 0.4553999900817871
Epoch: 5
```

```
Loss on hold-out set: 1.4884454937934875
Accuracy on hold-out set: 0.47
MulticlassAccuracy value on hold-out data: 0.4699999988079071
Epoch: 6

Loss on hold-out set: 1.4573547461509704
Accuracy on hold-out set: 0.47625
MulticlassAccuracy value on hold-out data: 0.4762499928474426
Epoch: 7

Loss on hold-out set: 1.421281482219696
Accuracy on hold-out set: 0.49445
MulticlassAccuracy value on hold-out data: 0.49445000290870667
Epoch: 8

Loss on hold-out set: 1.396051072692871
Accuracy on hold-out set: 0.50165
MulticlassAccuracy value on hold-out data: 0.5016499757766724
Epoch: 9

Loss on hold-out set: 1.3485896028518676
Accuracy on hold-out set: 0.5179
MulticlassAccuracy value on hold-out data: 0.5178999900817871
Epoch: 10

Loss on hold-out set: 1.3262115740776061
Accuracy on hold-out set: 0.5288
MulticlassAccuracy value on hold-out data: 0.5288000106811523
Epoch: 11

Loss on hold-out set: 1.324079456615448
Accuracy on hold-out set: 0.53965
MulticlassAccuracy value on hold-out data: 0.539650022983551
Epoch: 12

Loss on hold-out set: 1.3491687876701355
Accuracy on hold-out set: 0.5361
MulticlassAccuracy value on hold-out data: 0.5360999703407288
Epoch: 13
```

```
Loss on hold-out set: 1.3666379673957825
Accuracy on hold-out set: 0.53325
MulticlassAccuracy value on hold-out data: 0.5332499742507935
Epoch: 14

Loss on hold-out set: 1.3567074303627014
Accuracy on hold-out set: 0.5373
MulticlassAccuracy value on hold-out data: 0.5372999906539917
Early stopping at epoch 13
Returned to Spot: Validation loss: 1.3567074303627014
----------------------------------------------
spotPython tuning: 1.202639481830597 [#---------] 13.77%


config: {'l1': 4, 'l2': 8, 'lr_mult': 1.0, 'batch_size': 16, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1

Loss on hold-out set: 1.8103211859703063
Accuracy on hold-out set: 0.30055
MulticlassAccuracy value on hold-out data: 0.30055001378059387
Epoch: 2

Loss on hold-out set: 1.6276292825222016
Accuracy on hold-out set: 0.3908
MulticlassAccuracy value on hold-out data: 0.39079999923706055
Epoch: 3

Loss on hold-out set: 1.5833558003425598
Accuracy on hold-out set: 0.4241
MulticlassAccuracy value on hold-out data: 0.42410001158714294
Epoch: 4

Loss on hold-out set: 1.5078499679088593
Accuracy on hold-out set: 0.4506
MulticlassAccuracy value on hold-out data: 0.4505999982357025
Epoch: 5

Loss on hold-out set: 1.5022262318134307
Accuracy on hold-out set: 0.4415
MulticlassAccuracy value on hold-out data: 0.4415000081062317
Epoch: 6
```

```
Loss on hold-out set: 1.4566400030136109
Accuracy on hold-out set: 0.4704
MulticlassAccuracy value on hold-out data: 0.47040000557899475
Epoch: 7

Loss on hold-out set: 1.4134642950057983
Accuracy on hold-out set: 0.47905
MulticlassAccuracy value on hold-out data: 0.47905001044273376
Epoch: 8

Loss on hold-out set: 1.3903991088867187
Accuracy on hold-out set: 0.488
MulticlassAccuracy value on hold-out data: 0.4880000054836273
Epoch: 9

Loss on hold-out set: 1.3872406478405
Accuracy on hold-out set: 0.4857
MulticlassAccuracy value on hold-out data: 0.48570001125335693
Epoch: 10

Loss on hold-out set: 1.3493319761753082
Accuracy on hold-out set: 0.5042
MulticlassAccuracy value on hold-out data: 0.5041999816894531
Epoch: 11

Loss on hold-out set: 1.3332770479679108
Accuracy on hold-out set: 0.50385
MulticlassAccuracy value on hold-out data: 0.503849983215332
Epoch: 12

Loss on hold-out set: 1.3482616081714631
Accuracy on hold-out set: 0.4982
MulticlassAccuracy value on hold-out data: 0.498199999332428
Epoch: 13

Loss on hold-out set: 1.3689840174198151
Accuracy on hold-out set: 0.5011
MulticlassAccuracy value on hold-out data: 0.5011000037193298
Epoch: 14
```

```
Loss on hold-out set: 1.3042491992473602
Accuracy on hold-out set: 0.52055
MulticlassAccuracy value on hold-out data: 0.520550012588501
Epoch: 15

Loss on hold-out set: 1.3199255063056945
Accuracy on hold-out set: 0.5249
MulticlassAccuracy value on hold-out data: 0.5249000191688538
Epoch: 16

Loss on hold-out set: 1.3108240082740783
Accuracy on hold-out set: 0.52235
MulticlassAccuracy value on hold-out data: 0.522350013256073
Returned to Spot: Validation loss: 1.3108240082740783
----------------------------------------------
spotPython tuning: 1.202639481830597 [###-------] 25.04%


config: {'l1': 8, 'l2': 16, 'lr_mult': 1.0, 'batch_size': 8, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1

Loss on hold-out set: 1.8070437343597412
Accuracy on hold-out set: 0.27365
MulticlassAccuracy value on hold-out data: 0.27364999055862427
Epoch: 2

Loss on hold-out set: 1.6976139913082122
Accuracy on hold-out set: 0.33395
MulticlassAccuracy value on hold-out data: 0.333950012922287
Epoch: 3

Loss on hold-out set: 1.6651862224817275
Accuracy on hold-out set: 0.34595
MulticlassAccuracy value on hold-out data: 0.34595000743865967
Epoch: 4

Loss on hold-out set: 1.6259451935768128
Accuracy on hold-out set: 0.3763
MulticlassAccuracy value on hold-out data: 0.37630000710487366
Epoch: 5
```

```
Loss on hold-out set: 1.5810409898161888
Accuracy on hold-out set: 0.4035
MulticlassAccuracy value on hold-out data: 0.4034999907016754
Epoch: 6

Loss on hold-out set: 1.4838215586662293
Accuracy on hold-out set: 0.44015
MulticlassAccuracy value on hold-out data: 0.4401499927043915
Epoch: 7

Loss on hold-out set: 1.4956743147611617
Accuracy on hold-out set: 0.43975
MulticlassAccuracy value on hold-out data: 0.43974998593330383
Epoch: 8

Loss on hold-out set: 1.4034953966975212
Accuracy on hold-out set: 0.4821
MulticlassAccuracy value on hold-out data: 0.4821000099182129
Epoch: 9

Loss on hold-out set: 1.366302337348461
Accuracy on hold-out set: 0.49685
MulticlassAccuracy value on hold-out data: 0.49685001373291016
Epoch: 10

Loss on hold-out set: 1.3440704543948174
Accuracy on hold-out set: 0.50855
MulticlassAccuracy value on hold-out data: 0.5085499882698059
Epoch: 11

Loss on hold-out set: 1.3559460206508636
Accuracy on hold-out set: 0.5066
MulticlassAccuracy value on hold-out data: 0.506600022315979
Epoch: 12

Loss on hold-out set: 1.3219674251675606
Accuracy on hold-out set: 0.5206
MulticlassAccuracy value on hold-out data: 0.5206000208854675
Epoch: 13
```

```
Loss on hold-out set: 1.3470693740069866
Accuracy on hold-out set: 0.5155
MulticlassAccuracy value on hold-out data: 0.515500009059906
Epoch: 14

Loss on hold-out set: 1.3114336384892464
Accuracy on hold-out set: 0.53095
MulticlassAccuracy value on hold-out data: 0.5309500098228455
Epoch: 15

Loss on hold-out set: 1.2862098707675933
Accuracy on hold-out set: 0.5356
MulticlassAccuracy value on hold-out data: 0.5356000065803528
Epoch: 16

Loss on hold-out set: 1.2964431307971478
Accuracy on hold-out set: 0.5421
MulticlassAccuracy value on hold-out data: 0.5421000123023987
Returned to Spot: Validation loss: 1.2964431307971478
----------------------------------------------

spotPython tuning: 1.202639481830597 [###-------] 33.57%


config: {'l1': 16, 'l2': 4, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1

Loss on hold-out set: 1.7630806728363038
Accuracy on hold-out set: 0.33995
MulticlassAccuracy value on hold-out data: 0.33994999527931213
Epoch: 2

Loss on hold-out set: 1.593512779045105
Accuracy on hold-out set: 0.4041
MulticlassAccuracy value on hold-out data: 0.4041000008583069
Epoch: 3

Loss on hold-out set: 1.4995216064453125
Accuracy on hold-out set: 0.4461
MulticlassAccuracy value on hold-out data: 0.44609999656677246
Epoch: 4
```

```
Loss on hold-out set: 1.4466221963882446
Accuracy on hold-out set: 0.46295
MulticlassAccuracy value on hold-out data: 0.4629499912261963
Epoch: 5

Loss on hold-out set: 1.4267820897102357
Accuracy on hold-out set: 0.47285
MulticlassAccuracy value on hold-out data: 0.4728499948978424
Epoch: 6

Loss on hold-out set: 1.3892252868652344
Accuracy on hold-out set: 0.49475
MulticlassAccuracy value on hold-out data: 0.4947499930858612
Epoch: 7

Loss on hold-out set: 1.3746001750946044
Accuracy on hold-out set: 0.506
MulticlassAccuracy value on hold-out data: 0.5059999823570251
Epoch: 8

Loss on hold-out set: 1.3266783497810364
Accuracy on hold-out set: 0.5161
MulticlassAccuracy value on hold-out data: 0.5160999894142151
Epoch: 9

Loss on hold-out set: 1.2996885578155517
Accuracy on hold-out set: 0.53275
MulticlassAccuracy value on hold-out data: 0.5327500104904175
Epoch: 10

Loss on hold-out set: 1.320478964996338
Accuracy on hold-out set: 0.524
MulticlassAccuracy value on hold-out data: 0.5239999890327454
Epoch: 11

Loss on hold-out set: 1.313703161239624
Accuracy on hold-out set: 0.52515
MulticlassAccuracy value on hold-out data: 0.5251500010490417
Epoch: 12
```

```
Loss on hold-out set: 1.2813459076881408
Accuracy on hold-out set: 0.53905
MulticlassAccuracy value on hold-out data: 0.5390499830245972
Epoch: 13

Loss on hold-out set: 1.2714533507347108
Accuracy on hold-out set: 0.5477
MulticlassAccuracy value on hold-out data: 0.5476999878883362
Epoch: 14

Loss on hold-out set: 1.2757494044303894
Accuracy on hold-out set: 0.54695
MulticlassAccuracy value on hold-out data: 0.5469499826431274
Epoch: 15

Loss on hold-out set: 1.2435948590755463
Accuracy on hold-out set: 0.55555
MulticlassAccuracy value on hold-out data: 0.5555499792098999
Epoch: 16

Loss on hold-out set: 1.2362548210144042
Accuracy on hold-out set: 0.558
MulticlassAccuracy value on hold-out data: 0.5580000281333923
Returned to Spot: Validation loss: 1.2362548210144042
----------------------------------------------

spotPython tuning: 1.202639481830597 [####------] 43.37%


config: {'l1': 8, 'l2': 4, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1

Loss on hold-out set: 1.7532922691345214
Accuracy on hold-out set: 0.33195
MulticlassAccuracy value on hold-out data: 0.33195000886917114
Epoch: 2

Loss on hold-out set: 1.6612108032226562
Accuracy on hold-out set: 0.3802
MulticlassAccuracy value on hold-out data: 0.38019999861717224
Epoch: 3
```

```
Loss on hold-out set: 1.6364377639770509
Accuracy on hold-out set: 0.38615
MulticlassAccuracy value on hold-out data: 0.3861500024795532
Epoch: 4

Loss on hold-out set: 1.6083989900588989
Accuracy on hold-out set: 0.40475
MulticlassAccuracy value on hold-out data: 0.4047499895095825
Epoch: 5

Loss on hold-out set: 1.562745149421692
Accuracy on hold-out set: 0.4195
MulticlassAccuracy value on hold-out data: 0.4194999933242798
Epoch: 6

Loss on hold-out set: 1.548331679534912
Accuracy on hold-out set: 0.4224
MulticlassAccuracy value on hold-out data: 0.42239999771118164
Epoch: 7

Loss on hold-out set: 1.4765480516433716
Accuracy on hold-out set: 0.44605
MulticlassAccuracy value on hold-out data: 0.4460499882698059
Epoch: 8

Loss on hold-out set: 1.4703925687789916
Accuracy on hold-out set: 0.45235
MulticlassAccuracy value on hold-out data: 0.452349990606308
Epoch: 9

Loss on hold-out set: 1.4565853526115418
Accuracy on hold-out set: 0.46035
MulticlassAccuracy value on hold-out data: 0.46035000681877136
Epoch: 10

Loss on hold-out set: 1.4924566791534424
Accuracy on hold-out set: 0.45425
MulticlassAccuracy value on hold-out data: 0.4542500078678131
Epoch: 11
```

```
Loss on hold-out set: 1.3948901494026185
Accuracy on hold-out set: 0.48865
MulticlassAccuracy value on hold-out data: 0.48864999413490295
Epoch: 12

Loss on hold-out set: 1.4048492466926574
Accuracy on hold-out set: 0.4812
MulticlassAccuracy value on hold-out data: 0.4812000095844269
Epoch: 13

Loss on hold-out set: 1.4049164907455445
Accuracy on hold-out set: 0.48655
MulticlassAccuracy value on hold-out data: 0.4865500032901764
Epoch: 14

Loss on hold-out set: 1.356304393672943
Accuracy on hold-out set: 0.50705
MulticlassAccuracy value on hold-out data: 0.5070499777793884
Epoch: 15

Loss on hold-out set: 1.356948748588562
Accuracy on hold-out set: 0.5131
MulticlassAccuracy value on hold-out data: 0.5131000280380249
Epoch: 16

Loss on hold-out set: 1.320544639110565
Accuracy on hold-out set: 0.524
MulticlassAccuracy value on hold-out data: 0.5239999890327454
Returned to Spot: Validation loss: 1.320544639110565
----------------------------------------------
spotPython tuning: 1.202639481830597 [#####-----] 53.25%


config: {'l1': 64, 'l2': 32, 'lr_mult': 1.0, 'batch_size': 16, 'epochs': 16, 'k_folds': 0, '
Epoch: 1

Loss on hold-out set: 1.467204282951355
Accuracy on hold-out set: 0.455
MulticlassAccuracy value on hold-out data: 0.45500001311302185
Epoch: 2
```

```
Loss on hold-out set: 1.4236169402360916
Accuracy on hold-out set: 0.50055
MulticlassAccuracy value on hold-out data: 0.5005499720573425
Epoch: 3

Loss on hold-out set: 1.289088304901123
Accuracy on hold-out set: 0.55025
MulticlassAccuracy value on hold-out data: 0.5502499938011169
Epoch: 4

Loss on hold-out set: 1.2791062786579133
Accuracy on hold-out set: 0.56055
MulticlassAccuracy value on hold-out data: 0.5605499744415283
Epoch: 5

Loss on hold-out set: 1.2440522476673126
Accuracy on hold-out set: 0.5709
MulticlassAccuracy value on hold-out data: 0.570900022983551
Epoch: 6

Loss on hold-out set: 1.2933911822080613
Accuracy on hold-out set: 0.5722
MulticlassAccuracy value on hold-out data: 0.5722000002861023
Epoch: 7

Loss on hold-out set: 1.328475819182396
Accuracy on hold-out set: 0.5637
MulticlassAccuracy value on hold-out data: 0.5637000203132629
Epoch: 8

Loss on hold-out set: 1.3510568744182587
Accuracy on hold-out set: 0.55785
MulticlassAccuracy value on hold-out data: 0.5578500032424927
Early stopping at epoch 7
Returned to Spot: Validation loss: 1.3510568744182587
----------------------------------------------
spotPython tuning: 1.202639481830597 [######----] 59.06%


config: {'l1': 16, 'l2': 32, 'lr_mult': 1.0, 'batch_size': 4, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1
```

```
Loss on hold-out set: 1.545492513602972
Accuracy on hold-out set: 0.4371
MulticlassAccuracy value on hold-out data: 0.43709999322891235
Epoch: 2

Loss on hold-out set: 1.4527968575790524
Accuracy on hold-out set: 0.49035
MulticlassAccuracy value on hold-out data: 0.49035000801086426
Epoch: 3

Loss on hold-out set: 1.331914873278141
Accuracy on hold-out set: 0.53005
MulticlassAccuracy value on hold-out data: 0.5300499796867371
Epoch: 4

Loss on hold-out set: 1.3206381415709854
Accuracy on hold-out set: 0.54105
MulticlassAccuracy value on hold-out data: 0.5410500168800354
Epoch: 5

Loss on hold-out set: 1.2881802764169872
Accuracy on hold-out set: 0.55685
MulticlassAccuracy value on hold-out data: 0.556850016117096
Epoch: 6

Loss on hold-out set: 1.2649830227136611
Accuracy on hold-out set: 0.5628
MulticlassAccuracy value on hold-out data: 0.5627999901771545
Epoch: 7

Loss on hold-out set: 1.2167848710723221
Accuracy on hold-out set: 0.5792
MulticlassAccuracy value on hold-out data: 0.579200029373169
Epoch: 8

Loss on hold-out set: 1.1994577895930036
Accuracy on hold-out set: 0.59075
MulticlassAccuracy value on hold-out data: 0.590749979019165
Epoch: 9
```

```
Loss on hold-out set: 1.228049697136879
Accuracy on hold-out set: 0.58705
MulticlassAccuracy value on hold-out data: 0.5870500206947327
Epoch: 10

Loss on hold-out set: 1.1920824291661383
Accuracy on hold-out set: 0.604
MulticlassAccuracy value on hold-out data: 0.6039999723434448
Epoch: 11

Loss on hold-out set: 1.2346225115897134
Accuracy on hold-out set: 0.59575
MulticlassAccuracy value on hold-out data: 0.5957499742507935
Epoch: 12

Loss on hold-out set: 1.2659276392575354
Accuracy on hold-out set: 0.59535
MulticlassAccuracy value on hold-out data: 0.5953500270843506
Epoch: 13

Loss on hold-out set: 1.2220388488023541
Accuracy on hold-out set: 0.59875
MulticlassAccuracy value on hold-out data: 0.5987499952316284
Early stopping at epoch 12
Returned to Spot: Validation loss: 1.2220388488023541
----------------------------------------------

spotPython tuning: 1.202639481830597 [#######---] 67.98%


config: {'l1': 16, 'l2': 4, 'lr_mult': 1.0, 'batch_size': 4, 'epochs': 16, 'k_folds': 0, 'pa
Epoch: 1

Loss on hold-out set: 1.8019520639896394
Accuracy on hold-out set: 0.3174
MulticlassAccuracy value on hold-out data: 0.3174000084400177
Epoch: 2

Loss on hold-out set: 1.6744934742391109
Accuracy on hold-out set: 0.37485
MulticlassAccuracy value on hold-out data: 0.37485000491142273
Epoch: 3
```

```
Loss on hold-out set: 1.535804140752554
Accuracy on hold-out set: 0.44825
MulticlassAccuracy value on hold-out data: 0.4482499957084656
Epoch: 4

Loss on hold-out set: 1.465215659326315
Accuracy on hold-out set: 0.4816
MulticlassAccuracy value on hold-out data: 0.48159998655319214
Epoch: 5

Loss on hold-out set: 1.4842800035208463
Accuracy on hold-out set: 0.486
MulticlassAccuracy value on hold-out data: 0.4860000014305115
Epoch: 6

Loss on hold-out set: 1.3730079021155834
Accuracy on hold-out set: 0.5195
MulticlassAccuracy value on hold-out data: 0.5195000171661377
Epoch: 7

Loss on hold-out set: 1.3563014519393444
Accuracy on hold-out set: 0.53415
MulticlassAccuracy value on hold-out data: 0.5341500043869019
Epoch: 8

Loss on hold-out set: 1.3620269035495818
Accuracy on hold-out set: 0.53875
MulticlassAccuracy value on hold-out data: 0.5387499928474426
Epoch: 9

Loss on hold-out set: 1.299787348550558
Accuracy on hold-out set: 0.5491
MulticlassAccuracy value on hold-out data: 0.5490999817848206
Epoch: 10

Loss on hold-out set: 1.4237700631994754
Accuracy on hold-out set: 0.53235
MulticlassAccuracy value on hold-out data: 0.5323500037193298
Epoch: 11
```

```
Loss on hold-out set: 1.3089558108635246
Accuracy on hold-out set: 0.5471
MulticlassAccuracy value on hold-out data: 0.5471000075340271
Epoch: 12

Loss on hold-out set: 1.3010633900716901
Accuracy on hold-out set: 0.56045
MulticlassAccuracy value on hold-out data: 0.56045001745224
Early stopping at epoch 11
Returned to Spot: Validation loss: 1.3010633900716901
----------------------------------------------

spotPython tuning: 1.202639481830597 [########--] 76.15%


config: {'l1': 16, 'l2': 512, 'lr_mult': 1.0, 'batch_size': 8, 'epochs': 16, 'k_folds': 0, 'p
Epoch: 1

Loss on hold-out set: 1.6378879925727845
Accuracy on hold-out set: 0.41955
MulticlassAccuracy value on hold-out data: 0.41955000162124634
Epoch: 2

Loss on hold-out set: 1.3335602551221848
Accuracy on hold-out set: 0.5186
MulticlassAccuracy value on hold-out data: 0.5185999870300293
Epoch: 3

Loss on hold-out set: 1.2641369262337685
Accuracy on hold-out set: 0.54855
MulticlassAccuracy value on hold-out data: 0.548550009727478
Epoch: 4

Loss on hold-out set: 1.210939426356554
Accuracy on hold-out set: 0.5711
MulticlassAccuracy value on hold-out data: 0.5710999965667725
Epoch: 5

Loss on hold-out set: 1.2158658728837968
Accuracy on hold-out set: 0.5741
MulticlassAccuracy value on hold-out data: 0.5741000175476074
Epoch: 6
```

```
Loss on hold-out set: 1.1396731701791287
Accuracy on hold-out set: 0.596
MulticlassAccuracy value on hold-out data: 0.5960000157356262
Epoch: 7

Loss on hold-out set: 1.1506663537681103
Accuracy on hold-out set: 0.5992
MulticlassAccuracy value on hold-out data: 0.5992000102996826
Epoch: 8

Loss on hold-out set: 1.1344518176853657
Accuracy on hold-out set: 0.603
MulticlassAccuracy value on hold-out data: 0.6029999852180481
Epoch: 9

Loss on hold-out set: 1.1424700322210788
Accuracy on hold-out set: 0.6039
MulticlassAccuracy value on hold-out data: 0.6039000153541565
Epoch: 10

Loss on hold-out set: 1.1316417773246765
Accuracy on hold-out set: 0.61095
MulticlassAccuracy value on hold-out data: 0.6109499931335449
Epoch: 11

Loss on hold-out set: 1.125610344004631
Accuracy on hold-out set: 0.6105
MulticlassAccuracy value on hold-out data: 0.6104999780654907
Epoch: 12

Loss on hold-out set: 1.1013473339378834
Accuracy on hold-out set: 0.6241
MulticlassAccuracy value on hold-out data: 0.6241000294685364
Epoch: 13

Loss on hold-out set: 1.1313347686082125
Accuracy on hold-out set: 0.6158
MulticlassAccuracy value on hold-out data: 0.6158000230789185
Epoch: 14
```

```
Loss on hold-out set: 1.114631685835123
Accuracy on hold-out set: 0.61385
MulticlassAccuracy value on hold-out data: 0.6138499975204468
Epoch: 15

Loss on hold-out set: 1.11813674415946
Accuracy on hold-out set: 0.61655
MulticlassAccuracy value on hold-out data: 0.6165500283241272
Early stopping at epoch 14
Returned to Spot: Validation loss: 1.11813674415946
----------------------------------------------

spotPython tuning: 1.11813674415946 [########--] 84.39%


config: {'l1': 4, 'l2': 512, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0, '
Epoch: 1

Loss on hold-out set: 1.7452699480056764
Accuracy on hold-out set: 0.3466
MulticlassAccuracy value on hold-out data: 0.3465999960899353
Epoch: 2

Loss on hold-out set: 1.6062601406097412
Accuracy on hold-out set: 0.3877
MulticlassAccuracy value on hold-out data: 0.38769999146461487
Epoch: 3

Loss on hold-out set: 1.5349793363571167
Accuracy on hold-out set: 0.41775
MulticlassAccuracy value on hold-out data: 0.4177500009536743
Epoch: 4

Loss on hold-out set: 1.4938441400527953
Accuracy on hold-out set: 0.44225
MulticlassAccuracy value on hold-out data: 0.44225001335144043
Epoch: 5

Loss on hold-out set: 1.4486610325813294
Accuracy on hold-out set: 0.4519
MulticlassAccuracy value on hold-out data: 0.45190000534057617
Epoch: 6
```

```
Loss on hold-out set: 1.4422160610198975
Accuracy on hold-out set: 0.4625
MulticlassAccuracy value on hold-out data: 0.4625000059604645
Epoch: 7

Loss on hold-out set: 1.4143720396995545
Accuracy on hold-out set: 0.47075
MulticlassAccuracy value on hold-out data: 0.47075000405311584
Epoch: 8

Loss on hold-out set: 1.4111339150428772
Accuracy on hold-out set: 0.4771
MulticlassAccuracy value on hold-out data: 0.4771000146865845
Epoch: 9

Loss on hold-out set: 1.3620494467735291
Accuracy on hold-out set: 0.4987
MulticlassAccuracy value on hold-out data: 0.49869999289512634
Epoch: 10

Loss on hold-out set: 1.3259710597991943
Accuracy on hold-out set: 0.51105
MulticlassAccuracy value on hold-out data: 0.5110499858856201
Epoch: 11

Loss on hold-out set: 1.2921339129447937
Accuracy on hold-out set: 0.52495
MulticlassAccuracy value on hold-out data: 0.5249500274658203
Epoch: 12

Loss on hold-out set: 1.3204376896858214
Accuracy on hold-out set: 0.5141
MulticlassAccuracy value on hold-out data: 0.5141000151634216
Epoch: 13

Loss on hold-out set: 1.2966042384147645
Accuracy on hold-out set: 0.5275
MulticlassAccuracy value on hold-out data: 0.5274999737739563
Epoch: 14
```

```
Loss on hold-out set: 1.270912379360199
Accuracy on hold-out set: 0.5313
MulticlassAccuracy value on hold-out data: 0.5313000082969666
Epoch: 15

Loss on hold-out set: 1.3013971583366395
Accuracy on hold-out set: 0.52695
MulticlassAccuracy value on hold-out data: 0.5269500017166138
Epoch: 16

Loss on hold-out set: 1.2623807074546813
Accuracy on hold-out set: 0.54095
MulticlassAccuracy value on hold-out data: 0.5409500002861023
Returned to Spot: Validation loss: 1.2623807074546813
----------------------------------------------

spotPython tuning: 1.11813674415946 [#########-] 94.29%


config: {'l1': 32, 'l2': 512, 'lr_mult': 1.0, 'batch_size': 32, 'epochs': 16, 'k_folds': 0,
Epoch: 1

Loss on hold-out set: 1.5023722492218017
Accuracy on hold-out set: 0.4434
MulticlassAccuracy value on hold-out data: 0.44339999556541443
Epoch: 2

Loss on hold-out set: 1.386678268623352
Accuracy on hold-out set: 0.4963
MulticlassAccuracy value on hold-out data: 0.49630001187324524
Epoch: 3

Loss on hold-out set: 1.344018244934082
Accuracy on hold-out set: 0.51805
MulticlassAccuracy value on hold-out data: 0.5180500149726868
Epoch: 4

Loss on hold-out set: 1.3250330555915832
Accuracy on hold-out set: 0.52315
MulticlassAccuracy value on hold-out data: 0.5231500267982483
Epoch: 5
```

```
Loss on hold-out set: 1.2969691420555114
Accuracy on hold-out set: 0.5356
MulticlassAccuracy value on hold-out data: 0.5356000065803528
Epoch: 6

Loss on hold-out set: 1.223978764629364
Accuracy on hold-out set: 0.5645
MulticlassAccuracy value on hold-out data: 0.5644999742507935
Epoch: 7

Loss on hold-out set: 1.1927478701591492
Accuracy on hold-out set: 0.57285
MulticlassAccuracy value on hold-out data: 0.5728499889373779
Epoch: 8

Loss on hold-out set: 1.2362130114555359
Accuracy on hold-out set: 0.565
MulticlassAccuracy value on hold-out data: 0.5649999976158142
Epoch: 9

Loss on hold-out set: 1.2456528323173524
Accuracy on hold-out set: 0.5619
MulticlassAccuracy value on hold-out data: 0.5619000196456909
Epoch: 10

Loss on hold-out set: 1.1919959878921509
Accuracy on hold-out set: 0.5799
MulticlassAccuracy value on hold-out data: 0.5799000263214111
Epoch: 11

Loss on hold-out set: 1.1849440072059632
Accuracy on hold-out set: 0.58295
MulticlassAccuracy value on hold-out data: 0.5829499959945679
Epoch: 12

Loss on hold-out set: 1.1521271054267883
Accuracy on hold-out set: 0.5951
MulticlassAccuracy value on hold-out data: 0.5950999855995178
Epoch: 13
```

```
Loss on hold-out set: 1.1370638642311097
Accuracy on hold-out set: 0.59965
MulticlassAccuracy value on hold-out data: 0.5996500253677368
Epoch: 14

Loss on hold-out set: 1.1751175196647643
Accuracy on hold-out set: 0.59065
MulticlassAccuracy value on hold-out data: 0.5906500220298767
Epoch: 15

Loss on hold-out set: 1.1520406333446502
Accuracy on hold-out set: 0.59855
MulticlassAccuracy value on hold-out data: 0.598550021648407
Epoch: 16

Loss on hold-out set: 1.1380208161354064
Accuracy on hold-out set: 0.6061
MulticlassAccuracy value on hold-out data: 0.6061000227928162
Early stopping at epoch 15
Returned to Spot: Validation loss: 1.1380208161354064
----------------------------------------------

spotPython tuning: 1.11813674415946 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x28f423670>
```

## 21.13 Tensorboard

The textual output shown in the console (or code cell) can be visualized with Tensorboard.

### 21.13.1 Tensorboard: Start Tensorboard

Start TensorBoard through the command line to visualize data you logged. Specify the root log directory as used in `fun_control = fun_control_init(task="regression", tensorboard_path="runs/24_spot_torch_regression")` as the `tensorboard_path`. The argument logdir points to directory where TensorBoard will look to find event files that it can display. TensorBoard will recursively walk the directory structure rooted at logdir, looking for *.tfevents.* files.

```
tensorboard --logdir=runs
```

Go to the URL it provides or to http://localhost:6006/. The following figures show some screenshots of Tensorboard.

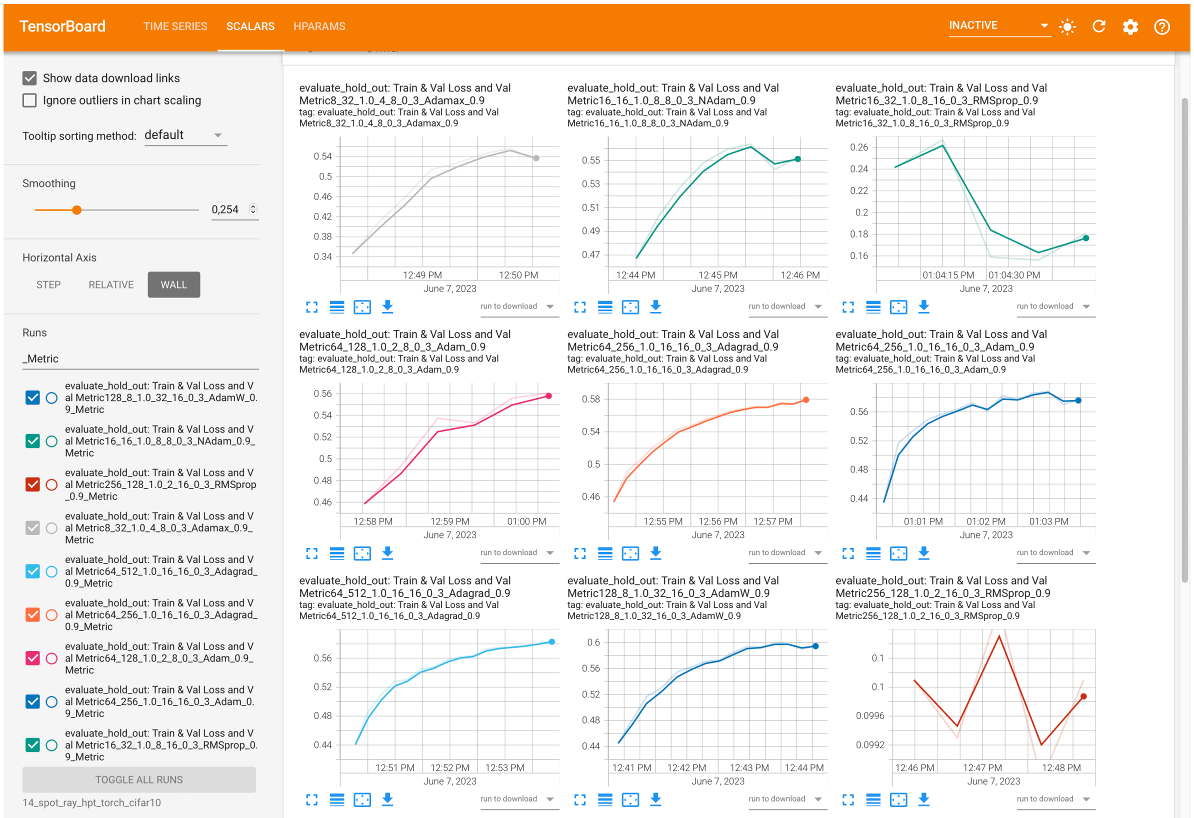



Figure 21.1: Tensorboard

### 21.13.2 Saving the State of the Notebook

The state of the notebook can be saved and reloaded as follows:

```
import pickle
SAVE = False
LOAD = False

if SAVE:
    result_file_name = "res_" + experiment_name + ".pkl"
```


Figure 21.2: Tensorboard

```
    with open(result_file_name, 'wb') as f:
        pickle.dump(spot_tuner, f)

if LOAD:
    result_file_name = "add_the_name_of_the_result_file_here.pkl"
    with open(result_file_name, 'rb') as f:
        spot_tuner =  pickle.load(f)
```

## 21.14 Results

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

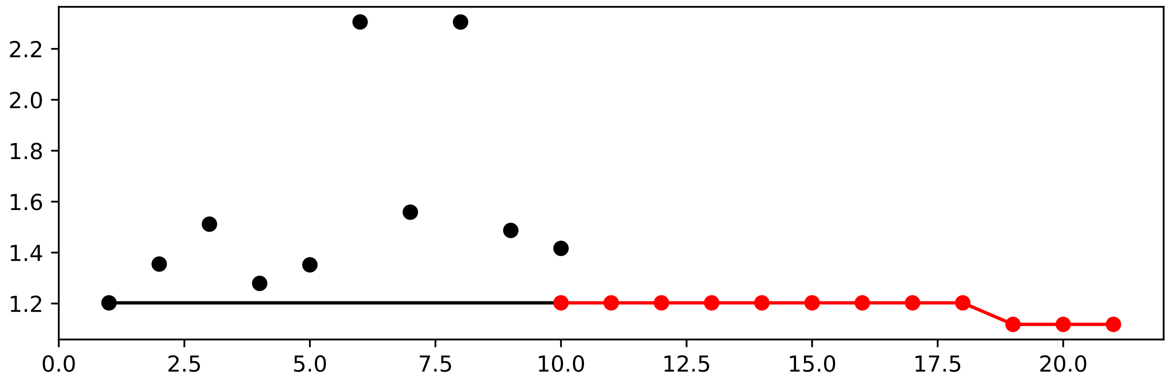



Figure 21.3: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

**?@fig-progress** shows a typical behaviour that can be observed in many hyperparameter studies (Bartz et al. 2022): the largest improvement is obtained during the evaluation of the initial design. The surrogate model based optimization-optimization with the surrogate refines the results. **?@fig-progress** also illustrates one major difference between `ray[tune]` as used in PyTorch (2023a) and `spotPython`: the `ray[tune]` uses a random search and will generate results similar to the *black* dots, whereas `spotPython` uses a surrogate model based optimization and presents results represented by *red* dots in **?@fig-progress**. The surrogate model based optimization is considered to be more efficient than a random search, because the surrogate model guides the search towards promising regions in the hyperparameter space.

In addition to the improved ("optimized") hyperparameter values, `spotPython` allows a statistical analysis, e.g., a sensitivity analysis, of the results. We can print the results of the hyperparameter tuning, see **?@tbl-results**. The table shows the hyperparameters, their types, default values, lower and upper bounds, and the transformation function. The column "tuned" shows the tuned values. The column "importance" shows the importance of the hyperparameters. The column "stars" shows the importance of the hyperparameters in stars. The importance is computed by the SPOT software.

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control=fun_control, spot=spot_tuner))
```

```
| name          | type   | default   |   lower |   upper |   tuned | transform             |
|---------------|--------|-----------|---------|---------|---------|-----------------------|-
| l1            | int    | 5         |     2.0 |     9.0 |     4.0 | transform_power_2_int |
| l2            | int    | 5         |     2.0 |     9.0 |     9.0 | transform_power_2_int |
| lr_mult       | float  | 1.0       |     1.0 |     1.0 |     1.0 | None                  |
| batch_size    | int    | 4         |     1.0 |     5.0 |     3.0 | transform_power_2_int |
```

```
| epochs       | int    | 3          |      3.0 |      4.0 |      4.0 | transform_power_2_int |
| k_folds      | int    | 1          |      0.0 |      0.0 |      0.0 | None                  |
| patience     | int    | 5          |      3.0 |      3.0 |      3.0 | None                  |
| optimizer    | factor | SGD        |      0.0 |      9.0 |      4.0 | None                  |
| sgd_momentum | float  | 0.0        |      0.9 |      0.9 |      0.9 | None                  |
```

To visualize the most important hyperparameters, `spotPython` provides the function `plot_importance`. The following code generates the importance plot from **?@fig-importance**.

```
spot_tuner.plot_importance(threshold=0.025,
    filename="./figures/" + experiment_name+"_importance.png")
```

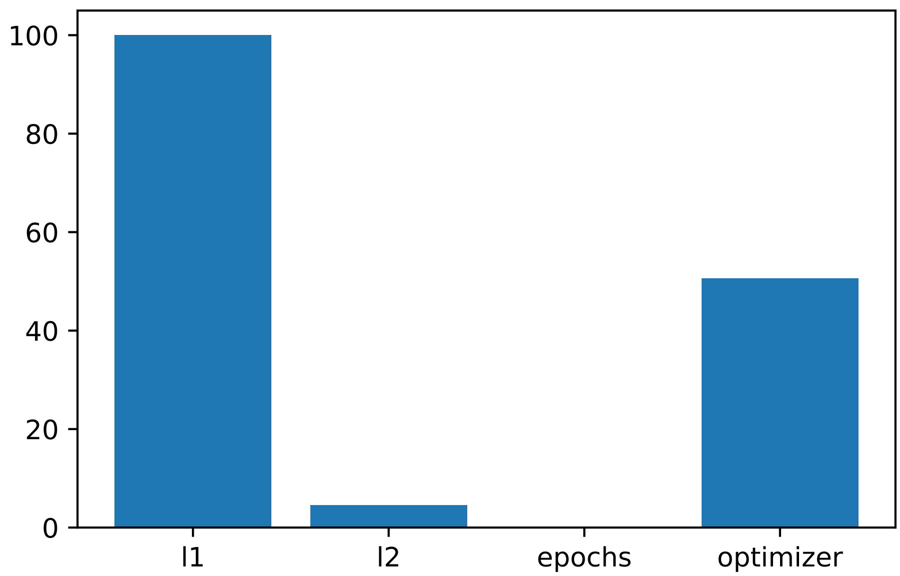



Figure 21.4: Variable importance plot, threshold 0.025.

### 21.14.1 Get the Tuned Architecture (SPOT Results)

The architecture of the `spotPython` model can be obtained as follows. First, the numerical representation of the hyperparameters are obtained, i.e., the numpy array `X` is generated. This array is then used to generate the model `model_spot` by the function `get_one_core_model_from_X`. The model `model_spot` has the following architecture:

```python
from spotPython.hyperparameters.values import get_one_core_model_from_X
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
model_spot = get_one_core_model_from_X(X, fun_control)
model_spot
```

```
Net_CIFAR10(
  (conv1): Conv2d(3, 6, kernel_size=(5, 5), stride=(1, 1))
  (pool): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
  (conv2): Conv2d(6, 16, kernel_size=(5, 5), stride=(1, 1))
  (fc1): Linear(in_features=400, out_features=16, bias=True)
  (fc2): Linear(in_features=16, out_features=512, bias=True)
  (fc3): Linear(in_features=512, out_features=10, bias=True)
)
```

### 21.14.2 Get Default Hyperparameters

In a similar manner as in **?@sec-get-spot-results**, the default hyperparameters can be obtained.

```python
# fun_control was modified, we generate a new one with the original
# default hyperparameters
from spotPython.hyperparameters.values import get_one_core_model_from_X
fc = fun_control
fc.update({"core_model_hyper_dict":
    hyper_dict[fun_control["core_model"].__name__]})
model_default = get_one_core_model_from_X(X_start, fun_control=fc)
model_default
```

```
Net_CIFAR10(
  (conv1): Conv2d(3, 6, kernel_size=(5, 5), stride=(1, 1))
  (pool): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
  (conv2): Conv2d(6, 16, kernel_size=(5, 5), stride=(1, 1))
  (fc1): Linear(in_features=400, out_features=32, bias=True)
  (fc2): Linear(in_features=32, out_features=32, bias=True)
  (fc3): Linear(in_features=32, out_features=10, bias=True)
)
```

### 21.14.3 Evaluation of the Default Architecture

The method **train_tuned** takes a model architecture without trained weights and trains this model with the train data. The train data is split into train and validation data. The validation data is used for early stopping. The trained model weights are saved as a dictionary.

This evaluation is similar to the final evaluation in PyTorch (2023a).

```python
from spotPython.torch.traintest import (
    train_tuned,
    test_tuned,
    )
train_tuned(net=model_default, train_dataset=train, shuffle=True,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        device = fun_control["device"], show_batch_interval=1_000_000,
        path=None,
        task=fun_control["task"],)

test_tuned(net=model_default, test_dataset=test,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        shuffle=False,
        device = fun_control["device"],
        task=fun_control["task"],)
```

```
Epoch: 1

Loss on hold-out set: 2.303734910774231
Accuracy on hold-out set: 0.10195
MulticlassAccuracy value on hold-out data: 0.10194999724626541
Epoch: 2

Loss on hold-out set: 2.300890957260132
Accuracy on hold-out set: 0.10755
MulticlassAccuracy value on hold-out data: 0.1075500026345253
Epoch: 3

Loss on hold-out set: 2.2975561609268187
Accuracy on hold-out set: 0.1443
MulticlassAccuracy value on hold-out data: 0.14429999887943268
Epoch: 4
```

```
Loss on hold-out set: 2.2921482971191405
Accuracy on hold-out set: 0.1501
MulticlassAccuracy value on hold-out data: 0.1500999927520752
Epoch: 5

Loss on hold-out set: 2.280226135444641
Accuracy on hold-out set: 0.16395
MulticlassAccuracy value on hold-out data: 0.16394999623298645
Epoch: 6

Loss on hold-out set: 2.244524569129944
Accuracy on hold-out set: 0.1825
MulticlassAccuracy value on hold-out data: 0.18250000476837158
Epoch: 7

Loss on hold-out set: 2.180144979095459
Accuracy on hold-out set: 0.20065
MulticlassAccuracy value on hold-out data: 0.20065000653266907
Epoch: 8

Loss on hold-out set: 2.140938578224182
Accuracy on hold-out set: 0.2191
MulticlassAccuracy value on hold-out data: 0.2190999984741211
Returned to Spot: Validation loss: 2.140938578224182
----------------------------------------------

Loss on hold-out set: 2.1431055795669556
Accuracy on hold-out set: 0.2194
MulticlassAccuracy value on hold-out data: 0.21940000355243683
Final evaluation: Validation loss: 2.1431055795669556
Final evaluation: Validation metric: 0.21940000355243683
----------------------------------------------

(2.1431055795669556, nan, tensor(0.2194))
```

### 21.14.4 Evaluation of the Tuned Architecture

The following code trains the model `model_spot`.

If `path` is set to a filename, e.g., `path = "model_spot_trained.pt"`, the weights of the trained model will be saved to this file.

If `path` is set to a filename, e.g., `path = "model_spot_trained.pt"`, the weights of the trained model will be loaded from this file.

```
train_tuned(net=model_spot, train_dataset=train,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        shuffle=True,
        device = fun_control["device"],
        path=None,
        task=fun_control["task"],)
test_tuned(net=model_spot, test_dataset=test,
            shuffle=False,
            loss_function=fun_control["loss_function"],
            metric=fun_control["metric_torch"],
            device = fun_control["device"],
            task=fun_control["task"],)
```

```
Epoch: 1

Loss on hold-out set: 1.557007755112648
Accuracy on hold-out set: 0.4303
MulticlassAccuracy value on hold-out data: 0.4302999973297119
Epoch: 2

Loss on hold-out set: 1.416154448747635
Accuracy on hold-out set: 0.4897
MulticlassAccuracy value on hold-out data: 0.48969998955726624
Epoch: 3

Loss on hold-out set: 1.357870229434967
Accuracy on hold-out set: 0.5086
MulticlassAccuracy value on hold-out data: 0.5085999965667725
Epoch: 4
```

```
Loss on hold-out set: 1.3532017847180366
Accuracy on hold-out set: 0.5256
MulticlassAccuracy value on hold-out data: 0.525600016117096
Epoch: 5

Loss on hold-out set: 1.299699307912588
Accuracy on hold-out set: 0.54165
MulticlassAccuracy value on hold-out data: 0.5416499972343445
Epoch: 6

Loss on hold-out set: 1.272576912456751
Accuracy on hold-out set: 0.55595
MulticlassAccuracy value on hold-out data: 0.5559499859809875
Epoch: 7

Loss on hold-out set: 1.2030290097832679
Accuracy on hold-out set: 0.57275
MulticlassAccuracy value on hold-out data: 0.5727499723434448
Epoch: 8

Loss on hold-out set: 1.2175623934090138
Accuracy on hold-out set: 0.57855
MulticlassAccuracy value on hold-out data: 0.5785499811172485
Epoch: 9

Loss on hold-out set: 1.2253897909402847
Accuracy on hold-out set: 0.57335
MulticlassAccuracy value on hold-out data: 0.5733500123023987
Epoch: 10

Loss on hold-out set: 1.225188035851717
Accuracy on hold-out set: 0.5758
MulticlassAccuracy value on hold-out data: 0.5758000016212463
Early stopping at epoch 9
Returned to Spot: Validation loss: 1.225188035851717
----------------------------------------------

Loss on hold-out set: 1.221202143263817
Accuracy on hold-out set: 0.5801
MulticlassAccuracy value on hold-out data: 0.5800999999046326
```

```
Final evaluation: Validation loss: 1.221202143263817
Final evaluation: Validation metric: 0.5800999999046326
----------------------------------------------
```

```
(1.221202143263817, nan, tensor(0.5801))
```

### 21.14.5 Detailed Hyperparameter Plots

The contour plots in this section visualize the interactions of the three most important hyperparameters. Since some of these hyperparameters take fatorial or integer values, sometimes step-like fitness landcapes (or response surfaces) are generated. SPOT draws the interactions of the main hyperparameters by default. It is also possible to visualize all interactions.

```python
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
l1:  100.0
l2:  4.5179663409855095
epochs:  0.1569939243626784
optimizer:  50.56985248927591
```

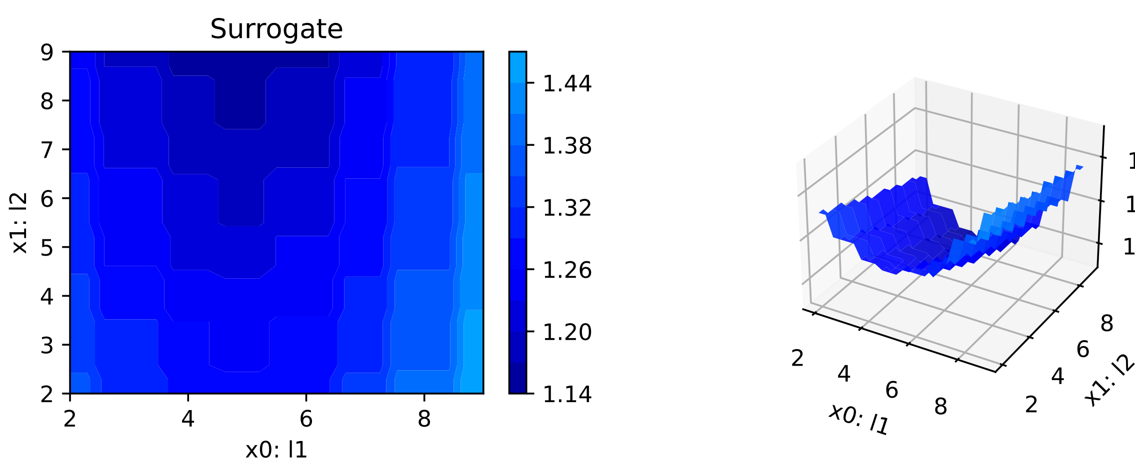
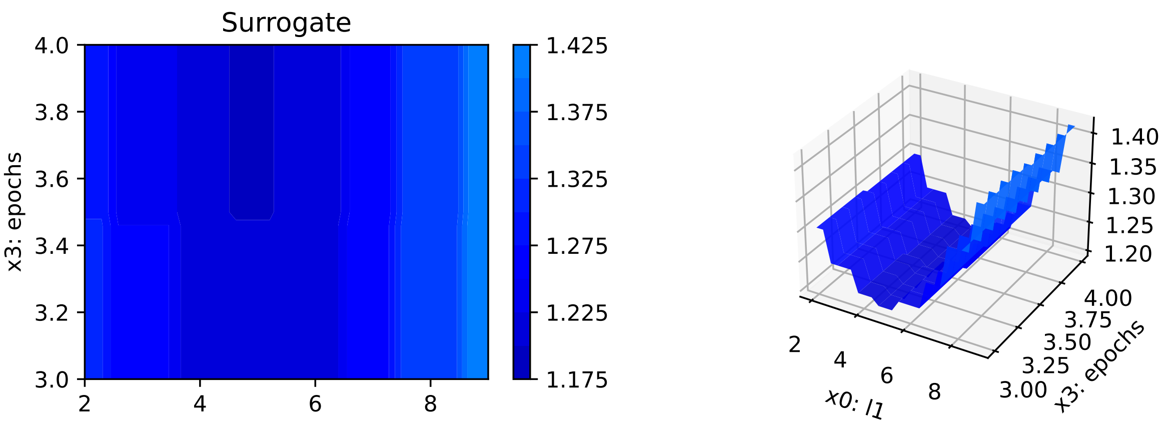
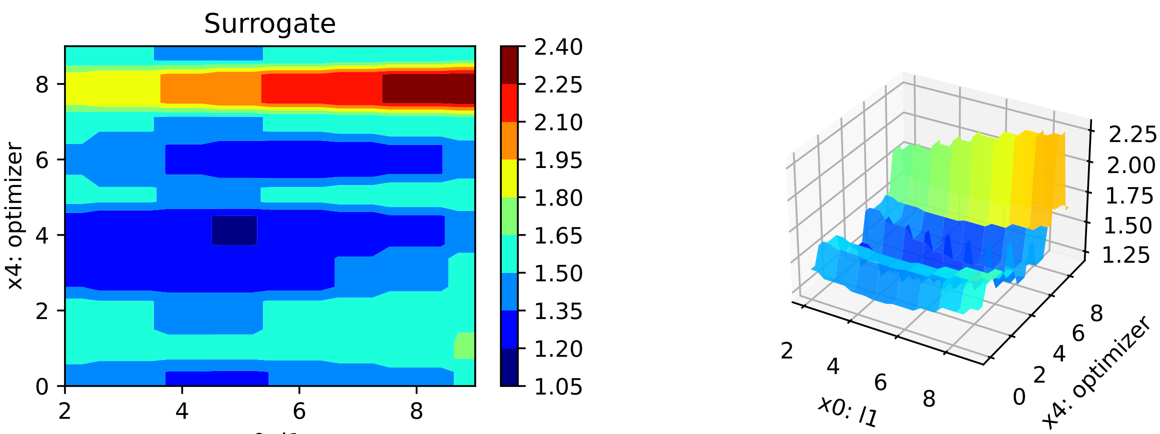
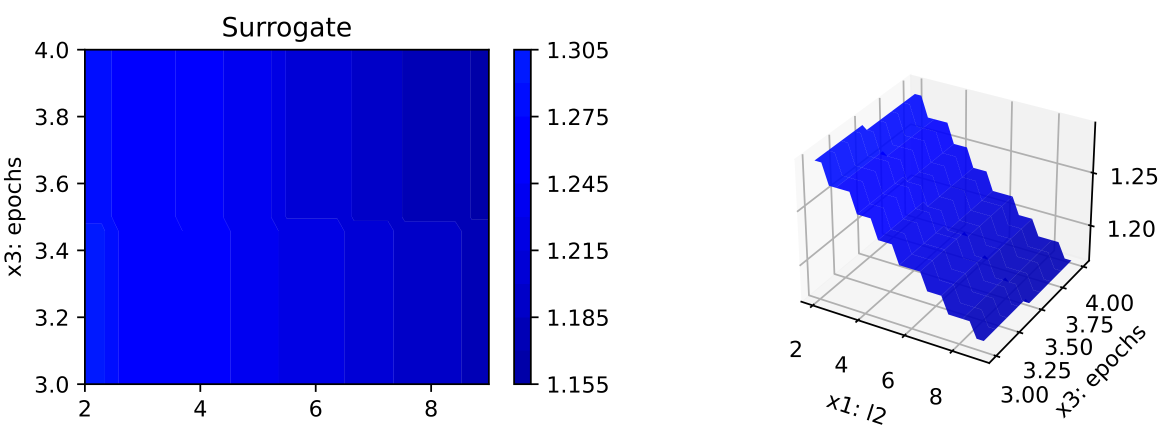
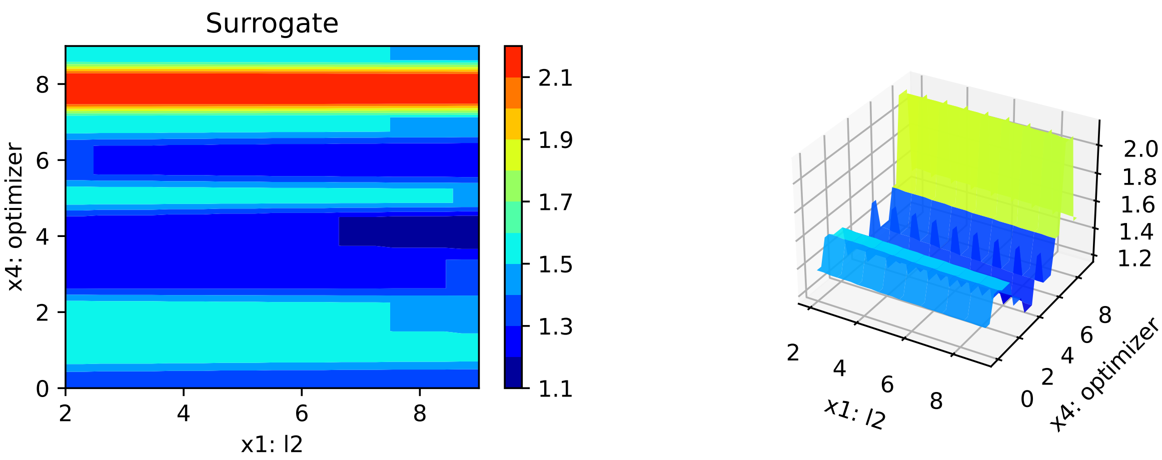


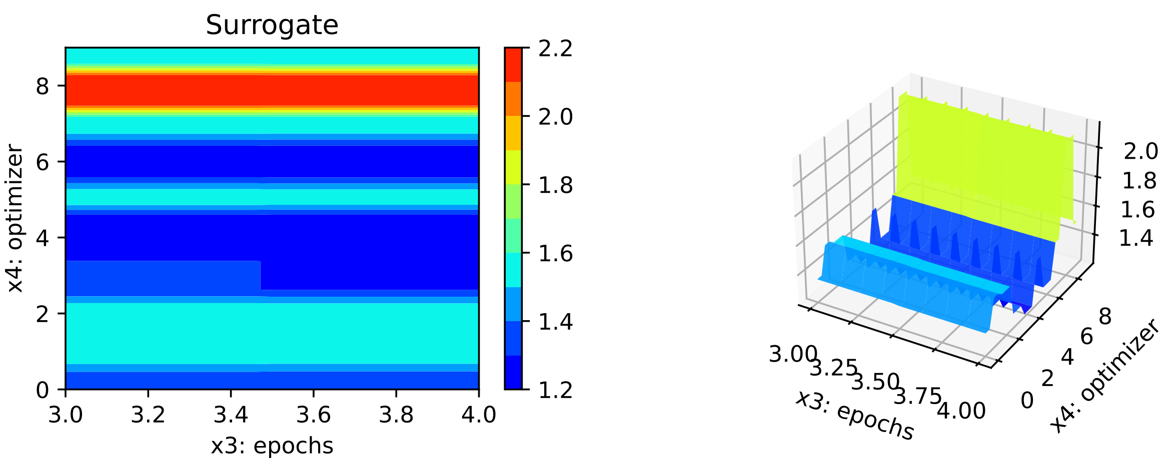

Figure 21.5: Contour plots.


Surrogate
x3: epochs
x0: l1
x3: epochs
x0: l1
1.425
1.375
1.325
1.275
1.225
1.175


Surrogate
x4: optimizer
x0: l1
x4: optimizer
x0: l1
2.40
2.25
2.10
1.95
1.80
1.65
1.50
1.35
1.20
1.05


Surrogate
x3: epochs
x1: l2
x3: epochs
x1: l2
1.305
1.275
1.245
1.215
1.185
1.155




The figures (**?@fig-contour**) show the contour plots of the loss as a function of the hyperparameters. These plots are very helpful for benchmark studies and for understanding neural networks. `spotPython` provides additional tools for a visual inspection of the results and give valuable insights into the hyperparameter tuning process. This is especially useful for model explainability, transparency, and trustworthiness. In addition to the contour plots, **?@fig-parallel** shows the parallel plot of the hyperparameters.

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

Parallel coordinates plots

```
Unable to display output for mime type(s): text/html
```

## 21.15 Summary and Outlook

This tutorial presents the hyperparameter tuning open source software `spotPython` for `PyTorch`. To show its basic features, a comparison with the "official" `PyTorch` hyperparameter tuning tutorial (PyTorch 2023a) is presented. Some of the advantages of `spotPython` are:

- Numerical and categorical hyperparameters.
- Powerful surrogate models.
- Flexible approach and easy to use.
- Simple JSON files for the specification of the hyperparameters.
- Extension of default and user specified network classes.
- Noise handling techniques.
- Interaction with `tensorboard`.

Currently, only rudimentary parallel and distributed neural network training is possible, but these capabilities will be extended in the future. The next version of `spotPython` will also include a more detailed documentation and more examples.

> **! Important**
>
> Important: This tutorial does not present a complete benchmarking study (Bartz-Beielstein et al. 2020). The results are only preliminary and highly dependent on the local configuration (hard- and software). Our goal is to provide a first impression of the performance of the hyperparameter tuning package `spotPython`. To demonstrate its capabilities, a quick comparison with `ray[tune]` was performed. `ray[tune]` was chosen, because it is presented as "an industry standard tool for distributed hyperparameter tuning." The results should be interpreted with care.

## 21.16 Appendix

### 21.16.1 Sample Output From Ray Tune's Run

The output from `ray[tune]` could look like this (PyTorch 2023b):

```
Number of trials: 10 (10 TERMINATED)
------+------+-------------+--------------+---------+------------+--------------------+
|   l1 |   l2 |          lr |   batch_size |    loss |   accuracy | training_iteration |
```

```
+------+------+-------------+--------------+---------+------------+--------------------|
|   64 |    4 | 0.00011629  |            2 | 1.87273 |     0.244  |                  2 |
|   32 |   64 | 0.000339763 |            8 | 1.23603 |     0.567  |                  8 |
|    8 |   16 | 0.00276249  |           16 | 1.1815  |     0.5836 |                 10 |
|    4 |   64 | 0.000648721 |            4 | 1.31131 |     0.5224 |                  8 |
|   32 |   16 | 0.000340753 |            8 | 1.26454 |     0.5444 |                  8 |
|    8 |    4 | 0.000699775 |            8 | 1.99594 |     0.1983 |                  2 |
|  256 |    8 | 0.0839654   |           16 | 2.3119  |     0.0993 |                  1 |
|   16 |  128 | 0.0758154   |           16 | 2.33575 |     0.1327 |                  1 |
|   16 |    8 | 0.0763312   |           16 | 2.31129 |     0.1042 |                  4 |
|  128 |   16 | 0.000124903 |            4 | 2.26917 |     0.1945 |                  1 |
+-----+------+------+------------+-------------+---------+-----------+-----------------
Best trial config: {'l1': 8, 'l2': 16, 'lr': 0.00276249, 'batch_size': 16, 'data_dir': '..
Best trial final validation loss: 1.181501
Best trial final validation accuracy: 0.5836
Best trial test set accuracy: 0.5806
```

# 22 HPT: sklearn RandomForestClassifier VBDP Data

This document refers to the following software versions:

- `python`: 3.10.10

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34
spotRiver                     0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 22.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time and the initial design size.

```
MAX_TIME = 1
INIT_SIZE = 5
ORIGINAL = False
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '16-rf-sklearn' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(IN
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
16-rf-sklearn_p040025_1min_5init_2023-06-17_16-59-16
```

```
import warnings
warnings.filterwarnings("ignore")
```

## 22.2 Step 1: Initialization of the Empty `fun_control` Dictionary

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/16_spot_hpt_sklearn_classification")
```

## 22.3 1. Load Data: Classification

## 22.4 VBDP

```
import pandas as pd
if ORIGINAL == True:
    train_df = pd.read_csv('./data/VBDP/trainn.csv')
    test_df = pd.read_csv('./data/VBDP/testt.csv')
```

```
else:
    train_df = pd.read_csv('./data/VBDP/train.csv')
    # remove the id column
    train_df = train_df.drop(columns=['id'])
```

```
from sklearn.preprocessing import OrdinalEncoder
n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
target_column = "prognosis"
# Encoder our prognosis labels as integers for easier decoding later
enc = OrdinalEncoder()
train_df[target_column] = enc.fit_transform(train_df[[target_column]])
train_df.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train_df.shape)
train_df.head()
```

```
(707, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | ... | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 |
| 3 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 0.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |

The full data set `train_df` 64 features. The target column is labeled as `prognosis`.

## 22.5 Holdout Train and Test Data

We split out a hold-out test set (25% of the data) so we can calculate an example MAP@K

```
import numpy as np
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(train_df.drop(target_column, axis=1),
                                                    random_state=42,
                                                    test_size=0.25,
                                                    stratify=train_df[target_column])
train = pd.DataFrame(np.hstack((X_train, np.array(y_train).reshape(-1, 1))))
```

```
test = pd.DataFrame(np.hstack((X_test, np.array(y_test).reshape(-1, 1))))
train.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
test.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train.shape)
print(test.shape)
train.head()
```

```
(530, 65)
(177, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

```
# add the dataset to the fun_control
fun_control.update({"data": train_df, # full dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column})
```

## 22.6 Step 3: Specification of the Preprocessing Model

Data preprocesssing can be very simple, e.g., you can ignore it. Then you would choose the `prep_model` "None":

```
prep_model = None
fun_control.update({"prep_model": prep_model})
```

A default approach for numerical data is the `StandardScaler` (mean 0, variance 1). This can be selected as follows:

```
# prep_model = StandardScaler()
# fun_control.update({"prep_model": prep_model})
```

Even more complicated pre-processing steps are possible, e.g., the follwing pipeline:

```
# categorical_columns = []
# one_hot_encoder = OneHotEncoder(handle_unknown="ignore", sparse_output=False)
# prep_model = ColumnTransformer(
#         transformers=[
#             ("categorical", one_hot_encoder, categorical_columns),
#         ],
#         remainder=StandardScaler(),
#     )
```

## 22.7 Step 4: Select `algorithm` and `core_model_hyper_dict`

The selection of the algorithm (ML model) that should be tuned is done by specifying the its name from the `sklearn` implementation. For example, the `SVC` support vector machine classifier is selected as follows:

`fun_control = add_core_model_to_fun_control(SVC, fun_control, SklearnHyperDict)`

Other core_models are, e.g.,:

- RidgeCV
- GradientBoostingRegressor
- ElasticNet
- RandomForestClassifier
- LogisticRegression
- KNeighborsClassifier
- RandomForestClassifier
- GradientBoostingClassifier
- HistGradientBoostingClassifier

We will use the `RandomForestClassifier` classifier in this example.

```
from sklearn.linear_model import RidgeCV
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.linear_model import ElasticNet
from spotPython.hyperparameters.values import add_core_model_to_fun_control
```

```python
from spotPython.data.sklearn_hyper_dict import SklearnHyperDict
from spotPython.fun.hypersklearn import HyperSklearn
```

```python
# core_model  = RidgeCV
# core_model = GradientBoostingRegressor
# core_model = ElasticNet
core_model = RandomForestClassifier
# core_model = SVC
# core_model = LogisticRegression
# core_model = KNeighborsClassifier
# core_model = GradientBoostingClassifier
fun_control = add_core_model_to_fun_control(core_model=core_model,
                              fun_control=fun_control,
                              hyper_dict=SklearnHyperDict,
                              filename=None)
```

Now `fun_control` has the information from the JSON file. The available hyperparameters are:

```python
print(*fun_control["core_model_hyper_dict"].keys(), sep="\n")
```

```
n_estimators
criterion
max_depth
min_samples_split
min_samples_leaf
min_weight_fraction_leaf
max_features
max_leaf_nodes
min_impurity_decrease
bootstrap
oob_score
```

## 22.8 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

### 22.8.1 Modify hyperparameter of type numeric and integer (boolean)

Numeric and boolean values can be modified using the `modify_hyper_parameter_bounds` method. For example, to change the `tol` hyperparameter of the `SVC` model to the interval

[1e-3, 1e-2], the following code can be used:

`fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])`

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
# fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_split", bounds=[3,
# fun_control = modify_hyper_parameter_bounds(fun_control, "dual", bounds=[0, 0])
# fun_control = modify_hyper_parameter_bounds(fun_control, "probability", bounds=[1, 1])
# fun_control["core_model_hyper_dict"]["tol"]
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_leaf", bounds=[1,
# fun_control = modify_hyper_parameter_bounds(fun_control, "n_estimators", bounds=[5, 10])
```

### 22.8.2 Modify hyperparameter of type factor

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

Factors can be modified with the `modify_hyper_parameter_levels` function. For example, to exclude the `sigmoid` kernel from the tuning, the `kernel` hyperparameter of the `SVC` model can be modified as follows:

`fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["linear", "rbf"])`

The new setting can be controlled via:

`fun_control["core_model_hyper_dict"]["kernel"]`

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
# XGBoost:
# fun_control = modify_hyper_parameter_levels(fun_control, "loss", ["log_loss"])
```

> **Note: RandomForestClassifier and Out-of-bag Estimation**
>
> Since `oob_score` requires the `bootstrap` hyperparameter to `True`, we set the `oob_score` parameter to `False`. The `oob_score` is later discussed in Section 22.11.1.

```
fun_control = modify_hyper_parameter_bounds(fun_control, "bootstrap", bounds=[0, 1])
fun_control = modify_hyper_parameter_bounds(fun_control, "oob_score", bounds=[0, 0])
```

### 22.8.3 Optimizers

Optimizers are described in Section 21.6.

## 22.9 5. Selection of the Objective: Metric and Loss Functions

- Machine learning models are optimized with respect to a metric, for example, the `accuracy` function.
- Deep learning, e.g., neural networks are optimized with respect to a loss function, for example, the `cross_entropy` function and evaluated with respect to a metric, for example, the `accuracy` function.

## 22.10 Step 6: Selection of the Objective (Loss) Function

The loss function, that is usually used in deep learning for optimizing the weights of the net, is stored in the `fun_control` dictionary as `"loss_function"`.

### 22.10.1 Metric Function

There are two different types of metrics in `spotPython`:

1. `"metric_river"` is used for the river based evaluation via `eval_oml_iter_progressive`.
2. `"metric_sklearn"` is used for the sklearn based evaluation.

We will consider multi-class classification metrics, e.g., `mapk_score` and `top_k_accuracy_score`.

> **Predict Probabilities**
>
> In this multi-class classification example the machine learning algorithm should return the probabilities of the specific classes (`"predict_proba"`) instead of the predicted values.

We set `"predict_proba"` to `True` in the `fun_control` dictionary.

#### 22.10.1.1 The MAPK Metric

To select the MAPK metric, the following two entries can be added to the `fun_control` dictionary:

`"metric_sklearn": mapk_score"`

`"metric_params": {"k": 3}`.

#### 22.10.1.2 Other Metrics

Alternatively, other metrics for multi-class classification can be used, e.g.,: * top_k_accuracy_score or * roc_auc_score

The metric `roc_auc_score` requires the parameter `"multi_class"`, e.g.,

`"multi_class": "ovr"`.

This is set in the `fun_control` dictionary.

> **Weights**
>
> `spotPython` performs a minimization, therefore, metrics that should be maximized have to be multiplied by -1. This is done by setting `"weights"` to `-1`.

- The complete setup for the metric in our example is:

```
from spotPython.utils.metrics import mapk_score
fun_control.update({
               "weights": -1,
               "metric_sklearn": mapk_score,
               "predict_proba": True,
               "metric_params": {"k": 3},
               })
```

## 22.11 Evaluation on Hold-out Data

- The default method for computing the performance is `"eval_holdout"`.
- Alternatively, cross-validation can be used for every machine learning model.
- Specifically for RandomForests, the OOB-score can be used.

```
fun_control.update({
    "eval": "train_hold_out",
})
```

### 22.11.1 OOB Score

Using the OOB-Score is a very efficient way to estimate the performance of a random forest classifier. The OOB-Score is calculated on the training data and does not require a hold-out test set. If the OOB-Score is used, the key "eval" in the `fun_control` dictionary should be set to `"oob_score"` as shown below.

> **OOB-Score**
>
> In addition to setting the key `"eval"` in the `fun_control` dictionary to `"oob_score"`, the keys `"oob_score"` and `"bootstrap"` have to be set to `True`, because the OOB-Score requires the bootstrap method.

- Uncomment the following lines to use the OOB-Score:

```
fun_control.update({
    "eval": "eval_oob_score",
})
fun_control = modify_hyper_parameter_bounds(fun_control, "bootstrap", bounds=[1, 1])
fun_control = modify_hyper_parameter_bounds(fun_control, "oob_score", bounds=[1, 1])
```

#### 22.11.1.1 Cross Validation

Instead of using the OOB-score, the classical cross validation can be used. The number of folds is set by the key `"k_folds"`. For example, to use 5-fold cross validation, the key `"k_folds"` is set to `5`. Uncomment the following line to use cross validation:

```
# fun_control.update({
#      "eval": "train_cv",
#      "k_folds": 10,
# })
```

## 22.12 6. Calling the SPOT Function

## 22.13 Preparing the SPOT Call

- Get types and variable names as well as lower and upper bounds for the hyperparameters.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
```

```python
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```python
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name                     | type   | default   |    lower |    upper | transform
|--------------------------|--------|-----------|----------|----------|------------------------
| n_estimators             | int    | 7         |        5 |   10     | transform_power_2_int
| criterion                | factor | gini      |        0 |    2     | None
| max_depth                | int    | 10        |        1 |   20     | transform_power_2_int
| min_samples_split        | int    | 2         |        2 |  100     | None
| min_samples_leaf         | int    | 1         |        1 |   25     | None
| min_weight_fraction_leaf | float  | 0.0       |        0 |    0.01  | None
| max_features             | factor | sqrt      |        0 |    1     | transform_none_to_None
| max_leaf_nodes           | int    | 10        |        7 |   12     | transform_power_2_int
| min_impurity_decrease    | float  | 0.0       |        0 |    0.01  | None
| bootstrap                | factor | 1         |        1 |    1     | None
| oob_score                | factor | 0         |        1 |    1     | None
```

## 22.14 The Objective Function

The objective function is selected next. It implements an interface from `sklearn`'s training, validation, and testing methods to `spotPython`.

```python
from spotPython.fun.hypersklearn import HyperSklearn
fun = HyperSklearn().fun_sklearn
```

### 22.14.1 Run the `Spot` Optimizer

- Run SPOT for approx. x mins (`max_time`).
- Note: the run takes longer, because the evaluation time of initial design (here: `initi_size`, 20 points) is not considered.

```python
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=SklearnHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
X_start
```

```
array([[ 7.,  0., 10.,  2.,  1.,  0.,  0., 10.,  0.,  1.,  0.]])
```

```python
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
                                      "model_fun_evals": 10_000,
                                      "log_level": 50
                                      })
spot_tuner.run(X_start=X_start)
```

```
spotPython tuning: -0.33301886792452823 [----------] 1.35%
```

```
spotPython tuning: -0.3355345911949686 [----------] 2.98%

spotPython tuning: -0.3355345911949686 [----------] 3.87%

spotPython tuning: -0.3355345911949686 [#---------] 5.12%

spotPython tuning: -0.33867924528301885 [#---------] 6.47%

spotPython tuning: -0.34150943396226413 [#---------] 7.83%

spotPython tuning: -0.34150943396226413 [#---------] 9.18%

spotPython tuning: -0.34150943396226413 [#---------] 9.98%

spotPython tuning: -0.36069182389937104 [#---------] 12.58%

spotPython tuning: -0.36069182389937104 [##--------] 15.10%

spotPython tuning: -0.36069182389937104 [##--------] 17.45%

spotPython tuning: -0.36069182389937104 [##--------] 19.99%

spotPython tuning: -0.36069182389937104 [###-------] 25.42%

spotPython tuning: -0.36069182389937104 [###-------] 30.80%

spotPython tuning: -0.36069182389937104 [####------] 36.31%

spotPython tuning: -0.36069182389937104 [####------] 41.06%

spotPython tuning: -0.36069182389937104 [#####-----] 46.30%

spotPython tuning: -0.36069182389937104 [#####-----] 50.94%

spotPython tuning: -0.36069182389937104 [######----] 55.02%

spotPython tuning: -0.36069182389937104 [######----] 60.80%
```

```
spotPython tuning: -0.36069182389937104 [#######---] 66.46%

spotPython tuning: -0.36069182389937104 [#######---] 71.75%

spotPython tuning: -0.36069182389937104 [########--] 76.20%

spotPython tuning: -0.36069182389937104 [########--] 80.49%

spotPython tuning: -0.36069182389937104 [########--] 84.69%

spotPython tuning: -0.36069182389937104 [#########-] 88.87%

spotPython tuning: -0.36069182389937104 [#########-] 93.08%

spotPython tuning: -0.36069182389937104 [##########] 98.45%

spotPython tuning: -0.36069182389937104 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x15bb2d720>
```

### 22.14.2 Results

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

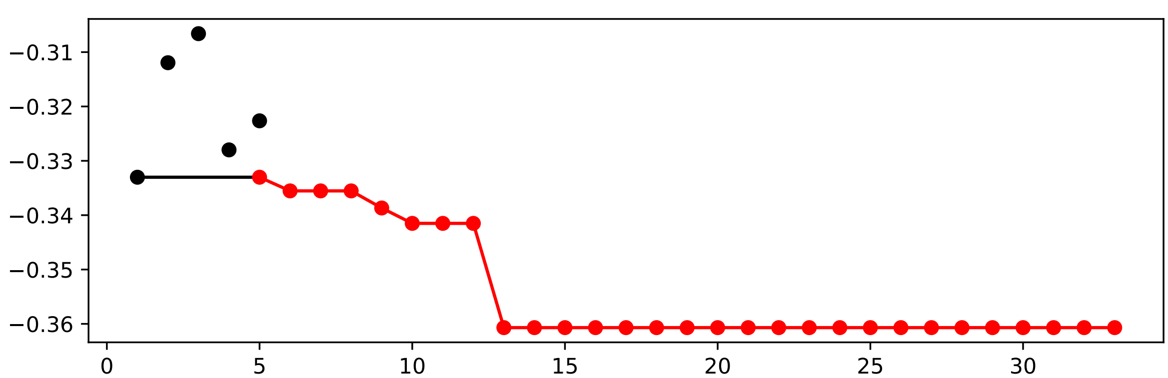



Figure 22.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name                     | type   | default   |   lower |   upper |                 tuned |
|--------------------------|--------|-----------|---------|---------|-----------------------|-
| n_estimators             | int    | 7         |     5.0 |    10.0 |                  10.0 |
| criterion                | factor | gini      |     0.0 |     2.0 |                   2.0 |
| max_depth                | int    | 10        |     1.0 |    20.0 |                  16.0 |
| min_samples_split        | int    | 2         |     2.0 |   100.0 |                   2.0 |
| min_samples_leaf         | int    | 1         |     1.0 |    25.0 |                   2.0 |
| min_weight_fraction_leaf | float  | 0.0       |     0.0 |    0.01 |                  0.01 |
| max_features             | factor | sqrt      |     0.0 |     1.0 |                   1.0 |
| max_leaf_nodes           | int    | 10        |     7.0 |    12.0 |                  10.0 |
| min_impurity_decrease    | float  | 0.0       |     0.0 |    0.01 | 0.004634981698084945 |
| bootstrap                | factor | 1         |     1.0 |     1.0 |                   1.0 |
| oob_score                | factor | 0         |     1.0 |     1.0 |                   1.0 |
```

## 22.15 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

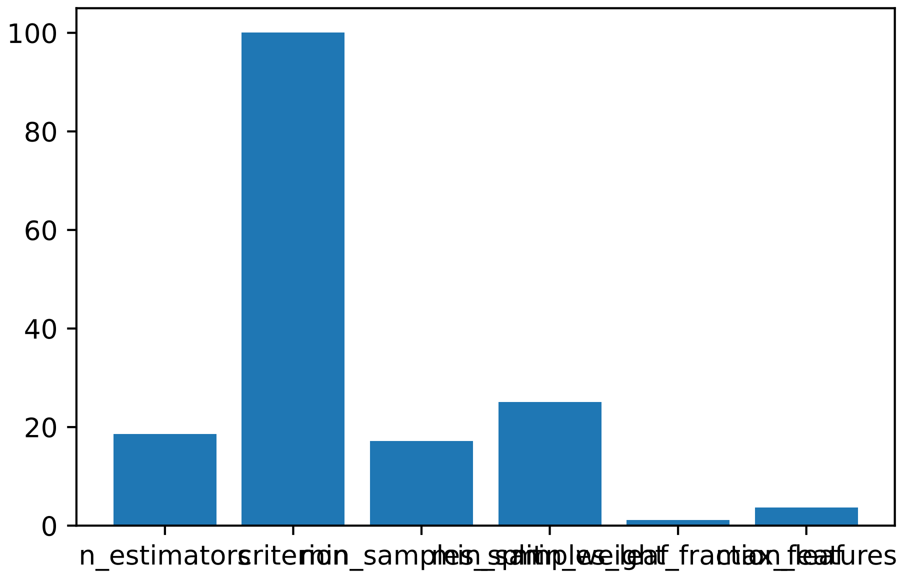



Figure 22.2: Variable importance plot, threshold 0.025.

## 22.16 Get Default Hyperparameters

```
from spotPython.hyperparameters.values import get_default_values, transform_hyper_paramete
values_default = get_default_values(fun_control)
values_default = transform_hyper_parameter_values(fun_control=fun_control, hyper_parameter
values_default
```

```
{'n_estimators': 128,
 'criterion': 'gini',
 'max_depth': 1024,
 'min_samples_split': 2,
 'min_samples_leaf': 1,
 'min_weight_fraction_leaf': 0.0,
 'max_features': 'sqrt',
 'max_leaf_nodes': 1024,
 'min_impurity_decrease': 0.0,
 'bootstrap': 1,
 'oob_score': 0}
```

```
from sklearn.pipeline import make_pipeline
model_default = make_pipeline(fun_control["prep_model"], fun_control["core_model"](**value
model_default
```

```
Pipeline(steps=[('nonetype', None),
                ('randomforestclassifier',
                 RandomForestClassifier(bootstrap=1, max_depth=1024,
                                        max_leaf_nodes=1024, n_estimators=128,
                                        oob_score=0))])
```

## 22.17 Get SPOT Results

```
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
print(X)
```

```
[[1.0000000e+01 2.0000000e+00 1.6000000e+01 2.0000000e+00 2.0000000e+00
  1.0000000e-02 1.0000000e+00 1.0000000e+01 4.6349817e-03 1.0000000e+00
  1.0000000e+00]]
```

```
from spotPython.hyperparameters.values import assign_values, return_conf_list_from_var_dic
v_dict = assign_values(X, fun_control["var_name"])
return_conf_list_from_var_dict(var_dict=v_dict, fun_control=fun_control)
```

```
[{'n_estimators': 1024,
  'criterion': 'log_loss',
  'max_depth': 65536,
  'min_samples_split': 2,
  'min_samples_leaf': 2,
  'min_weight_fraction_leaf': 0.01,
  'max_features': 'log2',
  'max_leaf_nodes': 1024,
  'min_impurity_decrease': 0.004634981698084945,
  'bootstrap': 1,
  'oob_score': 1}]
```

```
from spotPython.hyperparameters.values import get_one_sklearn_model_from_X
model_spot = get_one_sklearn_model_from_X(X, fun_control)
```

```
model_spot
```

```
RandomForestClassifier(bootstrap=1, criterion='log_loss', max_depth=65536,
                       max_features='log2', max_leaf_nodes=1024,
                       min_impurity_decrease=0.004634981698084945,
                       min_samples_leaf=2, min_weight_fraction_leaf=0.01,
                       n_estimators=1024, oob_score=1)
```

## 22.18 Evaluate SPOT Results

- Fetch the data.

```
from spotPython.utils.convert import get_Xy_from_df
X_train, y_train = get_Xy_from_df(fun_control["train"], fun_control["target_column"])
X_test, y_test = get_Xy_from_df(fun_control["test"], fun_control["target_column"])
X_test.shape, y_test.shape
```

```
((177, 64), (177,))
```

- Fit the model with the tuned hyperparameters. This gives one result:

```
model_spot.fit(X_train, y_train)
y_pred = model_spot.predict_proba(X_test)
res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
res
```

```
0.3531073446327684
```

```
def repeated_eval(n, model):
    res_values = []
    for i in range(n):
        model.fit(X_train, y_train)
        y_pred = model.predict_proba(X_test)
        res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
        res_values.append(res)
    mean_res = np.mean(res_values)
    print(f"mean_res: {mean_res}")
    std_res = np.std(res_values)
```

```python
    print(f"std_res: {std_res}")
    min_res = np.min(res_values)
    print(f"min_res: {min_res}")
    max_res = np.max(res_values)
    print(f"max_res: {max_res}")
    median_res = np.median(res_values)
    print(f"median_res: {median_res}")
    return mean_res, std_res, min_res, max_res, median_res
```

### 22.18.1 Handling Non-deterministic Results

- Because the model is non-determinstic, we perform $n = 30$ runs and calculate the mean and standard deviation of the performance metric.

```python
_ = repeated_eval(30, model_spot)
```

```
mean_res: 0.35856873822975516
std_res: 0.006388225603620106
min_res: 0.3474576271186441
max_res: 0.37099811676082856
median_res: 0.35969868173258
```

### 22.18.2 Evalution of the Default Hyperparameters

```python
model_default.fit(X_train, y_train)["randomforestclassifier"]
```

```
RandomForestClassifier(bootstrap=1, max_depth=1024, max_leaf_nodes=1024,
                       n_estimators=128, oob_score=0)
```

- One evaluation of the default hyperparameters is performed on the hold-out test set.

```python
y_pred = model_default.predict_proba(X_test)
mapk_score(y_true=y_test, y_pred=y_pred, k=3)
```

```
0.3672316384180791
```

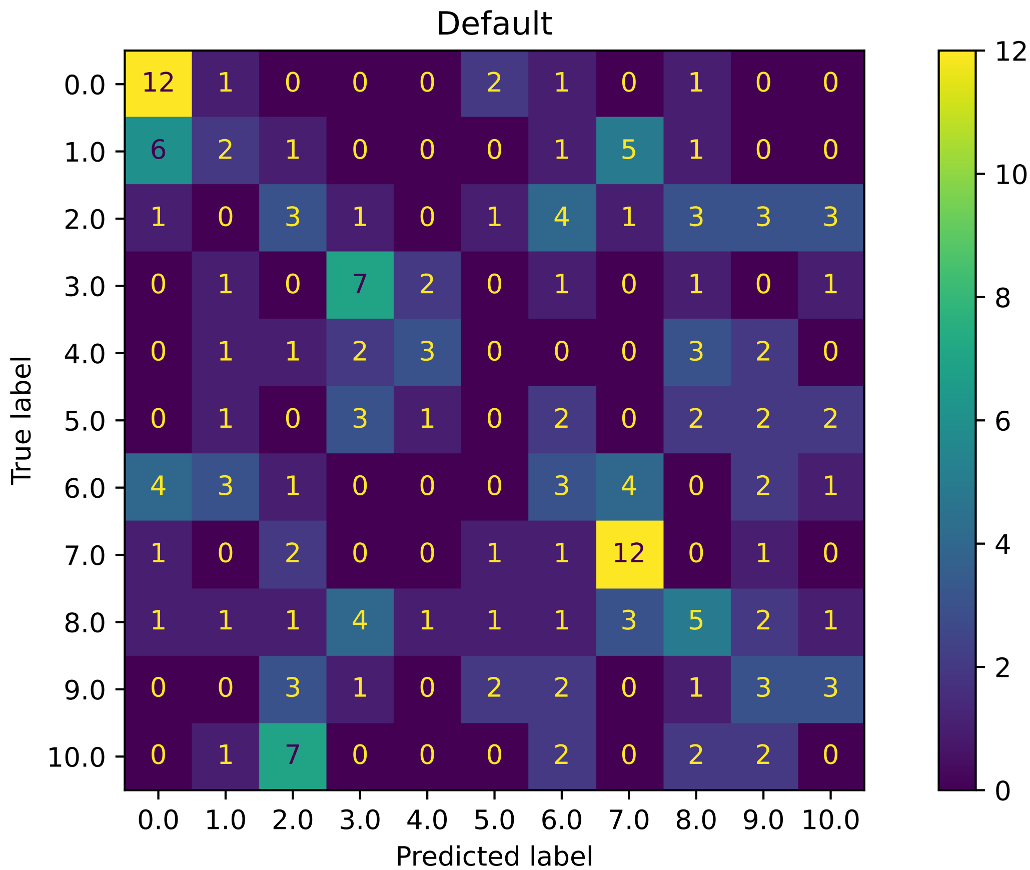
Since one single evaluation is not meaningful, we perform, similar to the evaluation of the SPOT results, $n = 30$ runs of the default setting and and calculate the mean and standard deviation of the performance metric.

```
_ = repeated_eval(30, model_default)
```

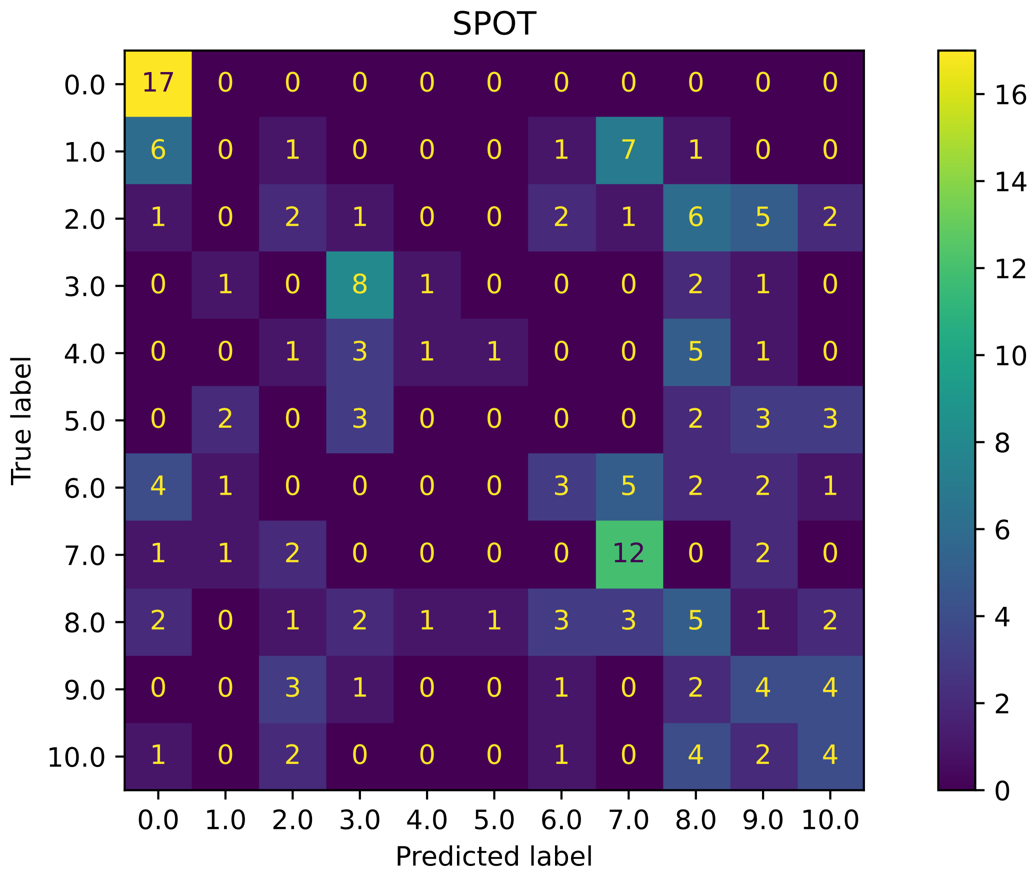
```
mean_res: 0.3431261770244821
std_res: 0.015717997449992718
min_res: 0.3135593220338983
max_res: 0.3728813559322034
median_res: 0.3418079096045198
```

## 22.19 Plot: Compare Predictions

```
from spotPython.plot.validation import plot_confusion_matrix
plot_confusion_matrix(model_default, fun_control, title = "Default")
```




```
plot_confusion_matrix(model_spot, fun_control, title="SPOT")
```




```
min(spot_tuner.y), max(spot_tuner.y)
```

```
(-0.36069182389937104, -0.30660377358490565)
```

## 22.20 Cross-validated Evaluations

```
from spotPython.sklearn.traintest import evaluate_cv
fun_control.update({
     "eval": "train_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.370440251572327, None)
```

```
fun_control.update({
     "eval": "test_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.33257080610021783, None)
```

- This is the evaluation that will be used in the comparison:

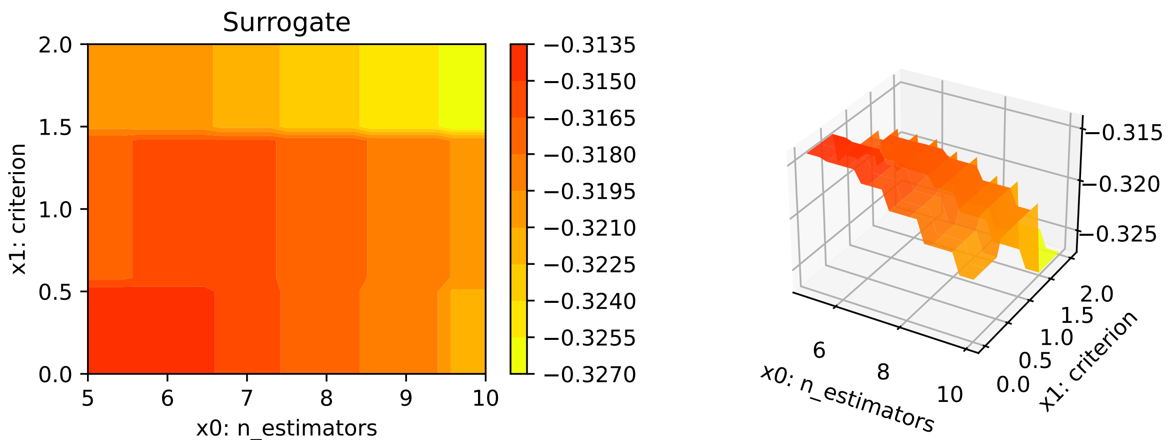
```
fun_control.update({
     "eval": "data_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

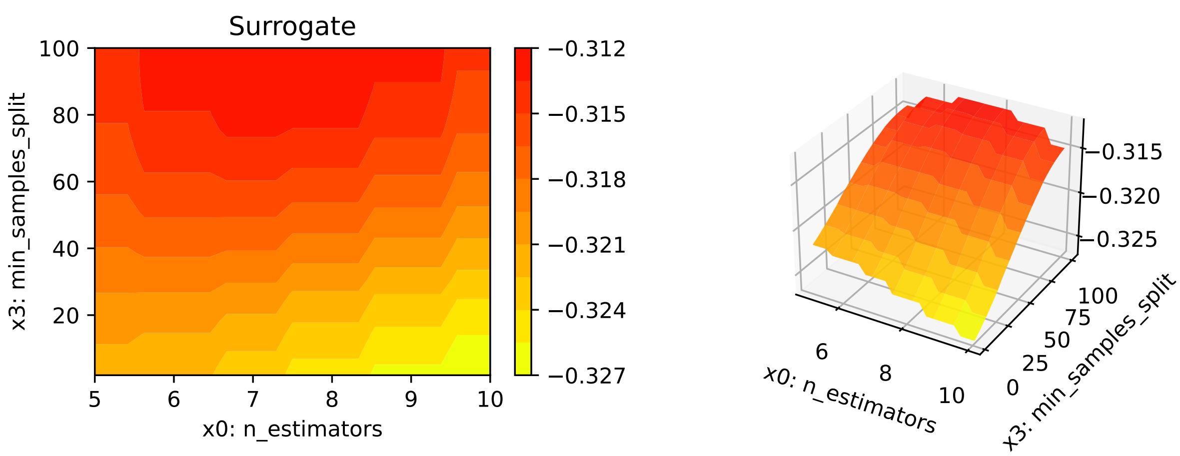
```
(0.3587055667337357, None)
```

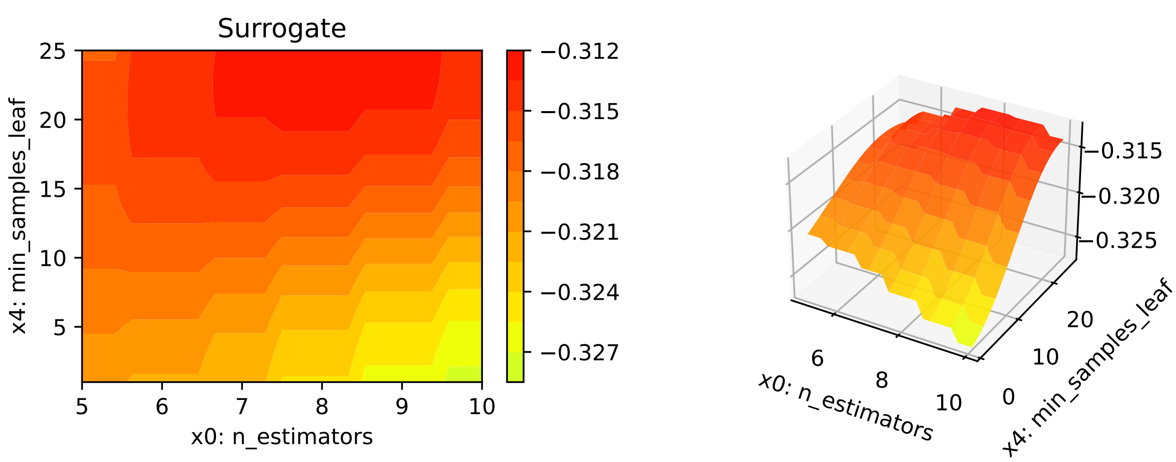
### 22.20.1 Detailed Hyperparameter Plots

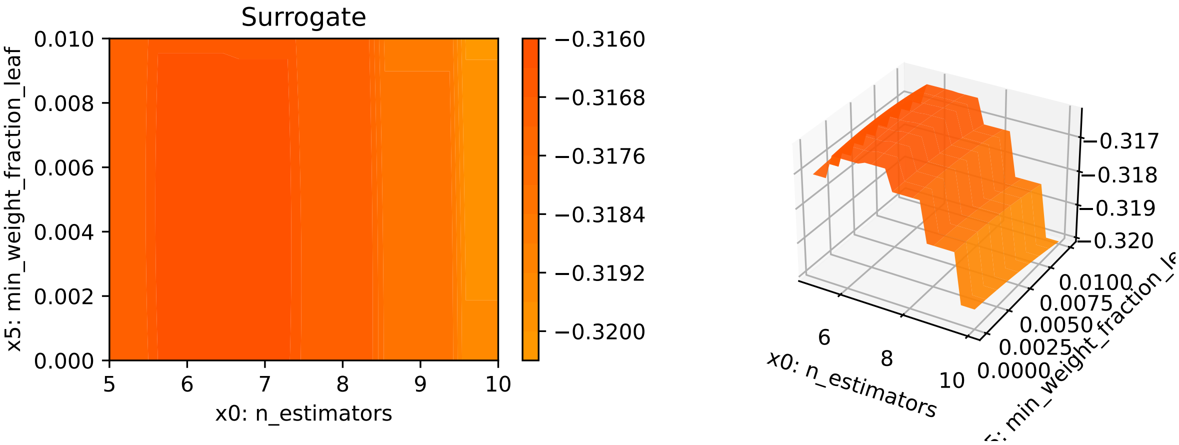
```
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

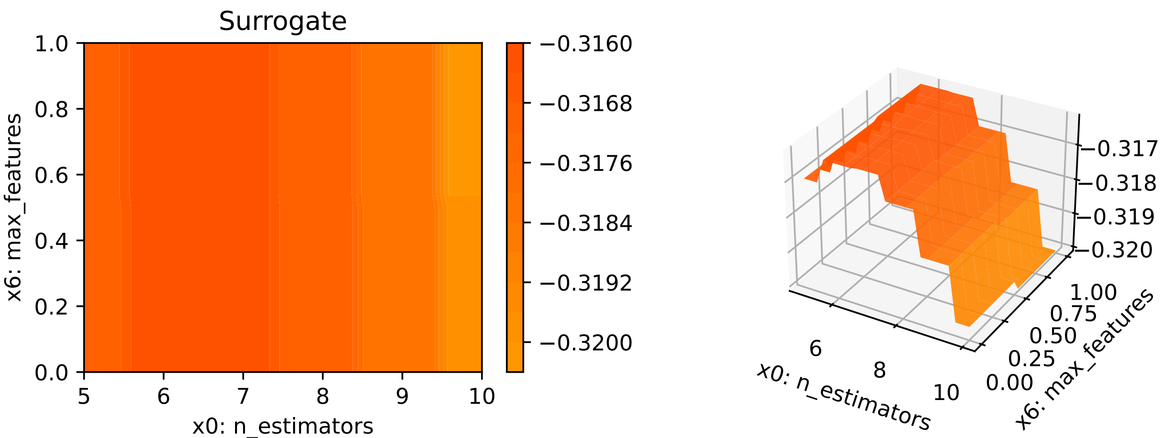
```
n_estimators:  18.543703098896138
criterion:  100.0
min_samples_split:  17.136047563315945
min_samples_leaf:  25.038821231858016
min_weight_fraction_leaf:  1.1165511904152585
max_features:  3.6091305024334175
```

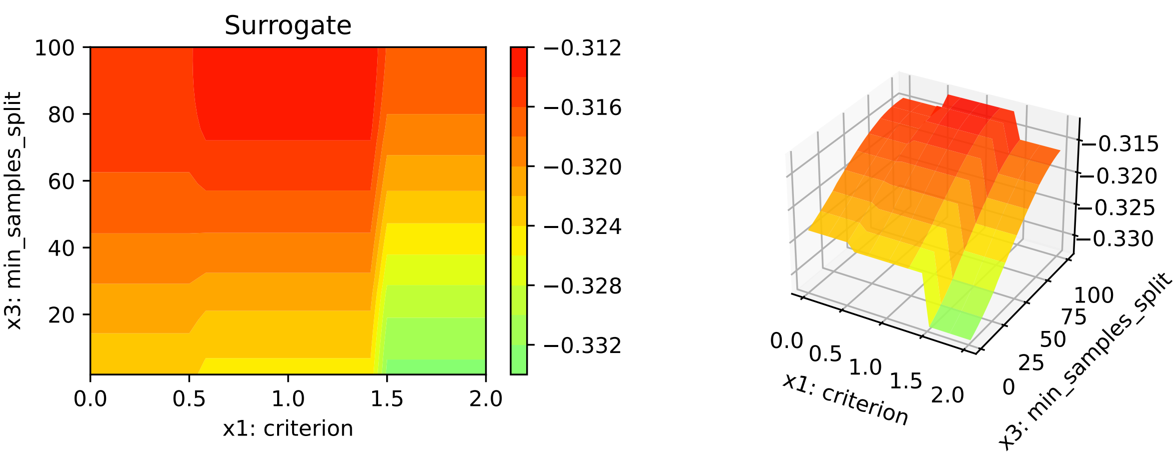

Surrogate
x1: criterion
x0: n_estimators
−0.3135
−0.3150
−0.3165
−0.3180
−0.3195
−0.3210
−0.3225
−0.3240
−0.3255
−0.3270
−0.315
−0.320
−0.325

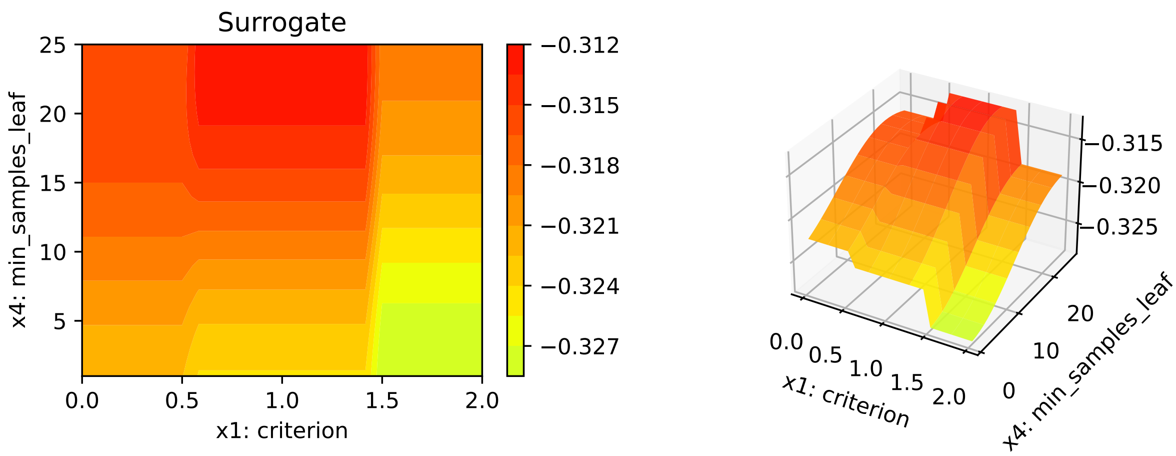

Surrogate
x3: min_samples_split
x0: n_estimators
−0.312
−0.315
−0.318
−0.321
−0.324
−0.327
−0.315
−0.320
−0.325

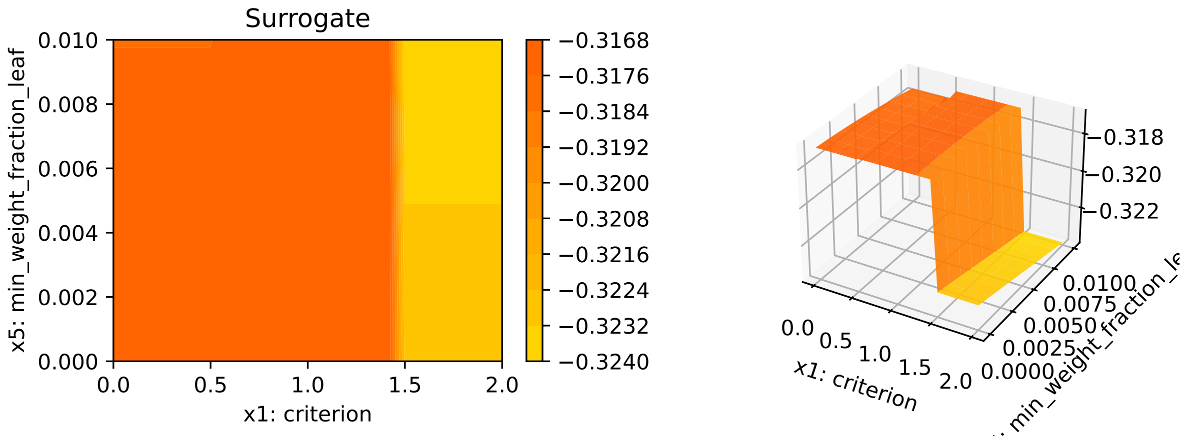

Surrogate
x4: min_samples_leaf
x0: n_estimators
−0.312
−0.315
−0.318
−0.321
−0.324
−0.327
−0.315
−0.320
−0.325

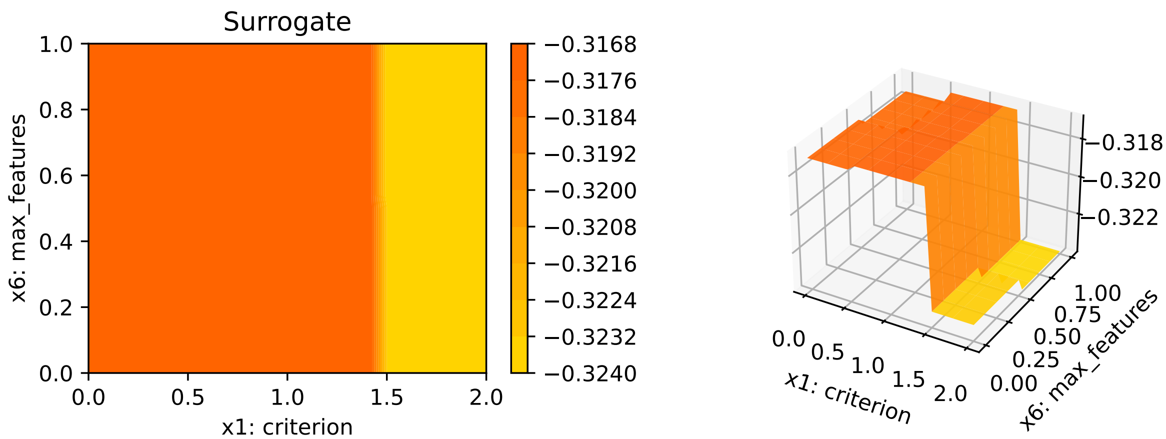

Surrogate
x5: min_weight_fraction_leaf
0.000
0.002
0.004
0.006
0.008
0.010
5
6
7
8
9
10
x0: n_estimators
−0.3160
−0.3168
−0.3176
−0.3184
−0.3192
−0.3200
−0.317
−0.318
−0.319
−0.320
0.0100
0.0075
0.0050
0.0025
0.0000

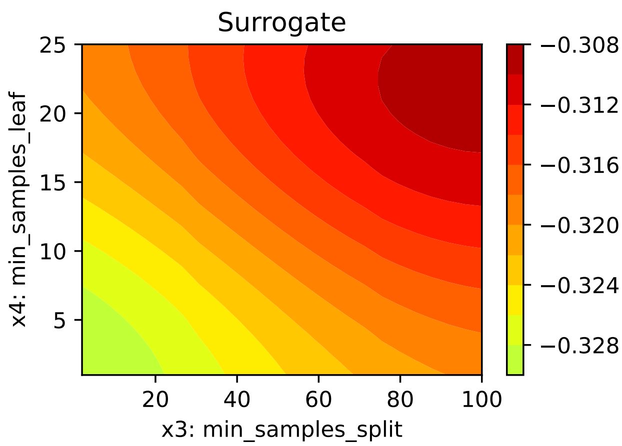

Surrogate
x6: max_features
0.0
0.2
0.4
0.6
0.8
1.0
5
6
7
8
9
10
x0: n_estimators
−0.3160
−0.3168
−0.3176
−0.3184
−0.3192
−0.3200
−0.317
−0.318
−0.319
−0.320
1.00
0.75
0.50
0.25
0.00

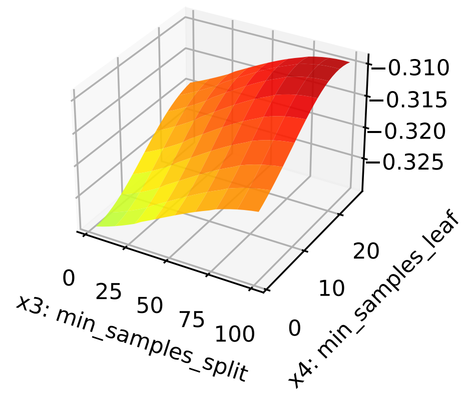

Surrogate
x3: min_samples_split
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
x1: criterion
−0.312
−0.316
−0.320
−0.324
−0.328
−0.332
−0.315
−0.320
−0.325
−0.330
0
25
50
75
100

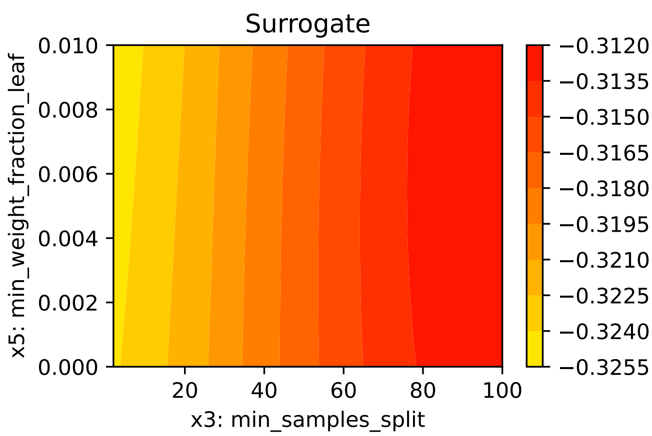

Surrogate
x4: min_samples_leaf
x1: criterion
−0.312
−0.315
−0.318
−0.321
−0.324
−0.327
x4: min_samples_leaf
x1: criterion

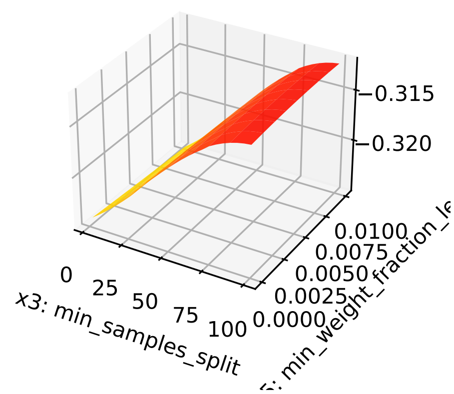

Surrogate
x5: min_weight_fraction_leaf
x1: criterion
−0.3168
−0.3176
−0.3184
−0.3192
−0.3200
−0.3208
−0.3216
−0.3224
−0.3232
−0.3240
x1: criterion

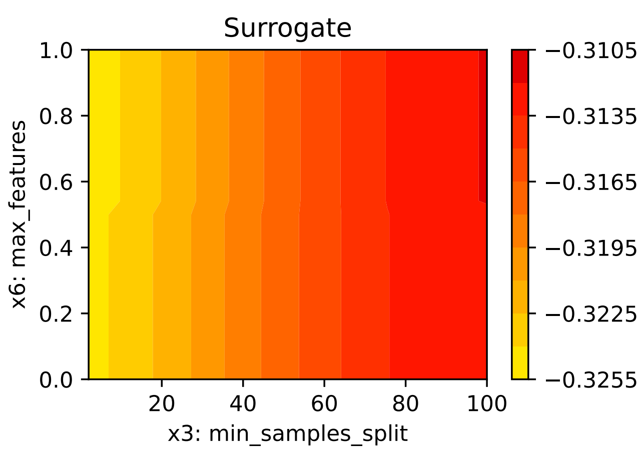

Surrogate
x6: max_features
x1: criterion
−0.3168
−0.3176
−0.3184
−0.3192
−0.3200
−0.3208
−0.3216
−0.3224
−0.3232
−0.3240
x6: max_features
x1: criterion

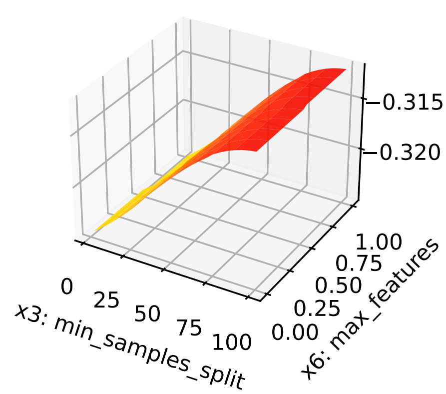

Surrogate
x4: min_samples_leaf
x3: min_samples_split
25
20
15
10
5
20
40
60
80
100
−0.308
−0.312
−0.316
−0.320
−0.324
−0.328

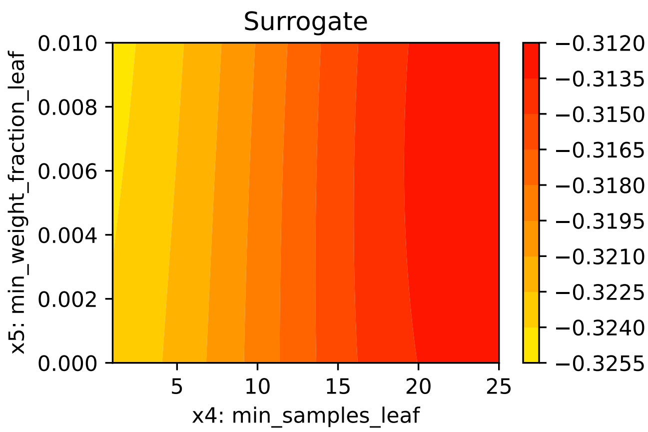
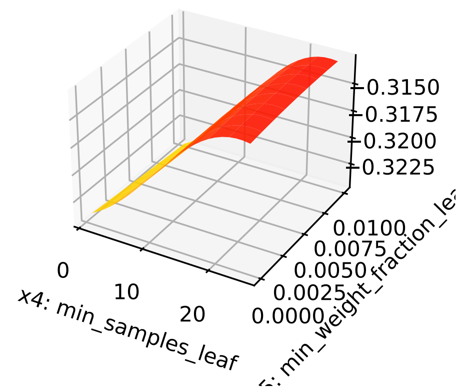
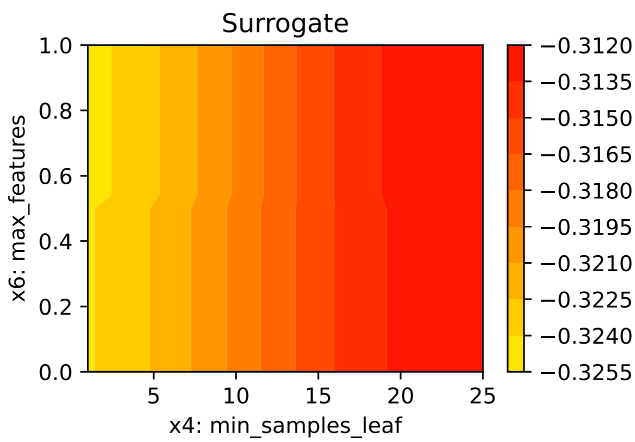
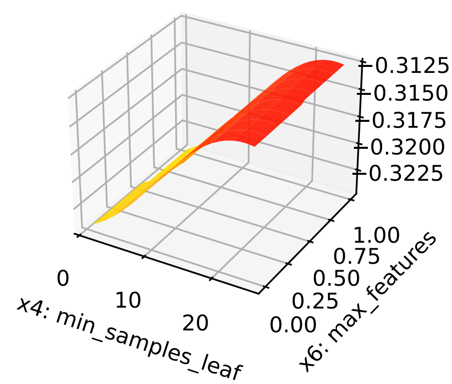
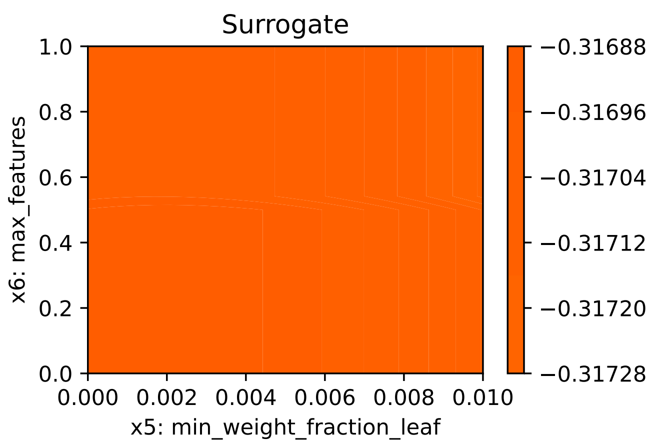
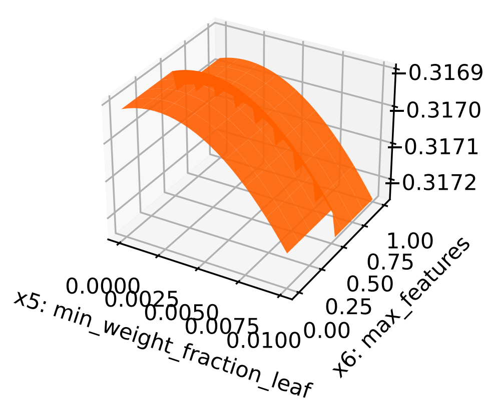

−0.310
−0.315
−0.320
−0.325
0
25
50
75
100
x3: min_samples_split
0
10
20
x4: min_samples_leaf


Surrogate
x5: min_weight_fraction_leaf
x3: min_samples_split
0.010
0.008
0.006
0.004
0.002
0.000
20
40
60
80
100
−0.3120
−0.3135
−0.3150
−0.3165
−0.3180
−0.3195
−0.3210
−0.3225
−0.3240
−0.3255


−0.315
−0.320
0
25
50
75
100
x3: min_samples_split
0.0000
0.0025
0.0050
0.0075
0.0100


Surrogate
x6: max_features
x3: min_samples_split
1.0
0.8
0.6
0.4
0.2
0.0
20
40
60
80
100
−0.3105
−0.3135
−0.3165
−0.3195
−0.3225
−0.3255


−0.315
−0.320
0
25
50
75
100
x3: min_samples_split
0.00
0.25
0.50
0.75
1.00
x6: max_features


Surrogate
x5: min_weight_fraction_leaf
0.000 0.002 0.004 0.006 0.008 0.010
x4: min_samples_leaf
5 10 15 20 25
−0.3120 −0.3135 −0.3150 −0.3165 −0.3180 −0.3195 −0.3210 −0.3225 −0.3240 −0.3255

0.3150 0.3175 0.3200 0.3225
0 10 20
x4: min_samples_leaf
0.0000 0.0025 0.0050 0.0075 0.0100

Surrogate
x6: max_features
0.0 0.2 0.4 0.6 0.8 1.0
x4: min_samples_leaf
5 10 15 20 25
−0.3120 −0.3135 −0.3150 −0.3165 −0.3180 −0.3195 −0.3210 −0.3225 −0.3240 −0.3255

0.3125 0.3150 0.3175 0.3200 0.3225
0 10 20
x4: min_samples_leaf
0.00 0.25 0.50 0.75 1.00
x6: max_features

Surrogate
x6: max_features
0.0 0.2 0.4 0.6 0.8 1.0
x5: min_weight_fraction_leaf
0.000 0.002 0.004 0.006 0.008 0.010
−0.31688 −0.31696 −0.31704 −0.31712 −0.31720 −0.31728

0.3169 0.3170 0.3171 0.3172
x5: min_weight_fraction_leaf
0.00 0.25 0.50 0.75 1.00
x6: max_features

## 22.21 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

## 22.22 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 23 HPT: sklearn XGB Classifier VBDP Data

This document refers to the following software versions:

- python: 3.10.10

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34
spotRiver                     0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

spotPython can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of spotPython from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 23.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time and the initial design size.

```
MAX_TIME = 1
INIT_SIZE = 5
ORIGINAL = False
```

```python
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '17-xgb-sklearn' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(I
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
17-xgb-sklearn_p040025_1min_5init_2023-06-17_17-04-46
```

```python
import warnings
warnings.filterwarnings("ignore")
```

## 23.2 Step 1: Initialization of the Empty `fun_control` Dictionary

```python
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/16_spot_hpt_sklearn_classification")
```

## 23.3 1. Load Data: Classification

## 23.4 VBDP

```python
import pandas as pd
if ORIGINAL == True:
    train_df = pd.read_csv('./data/VBDP/trainn.csv')
    test_df = pd.read_csv('./data/VBDP/testt.csv')
else:
    train_df = pd.read_csv('./data/VBDP/train.csv')
    # remove the id column
    train_df = train_df.drop(columns=['id'])
```

```
from sklearn.preprocessing import OrdinalEncoder
n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
target_column = "prognosis"
# Encoder our prognosis labels as integers for easier decoding later
enc = OrdinalEncoder()
train_df[target_column] = enc.fit_transform(train_df[[target_column]])
train_df.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train_df.shape)
train_df.head()
```

```
(707, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | ... | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 |
| 3 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 0.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |

The full data set `train_df` 64 features. The target column is labeled as `prognosis`.

## 23.5 Holdout Train and Test Data

We split out a hold-out test set (25% of the data) so we can calculate an example MAP@K

```
import numpy as np
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(train_df.drop(target_column, axis=1),
                                                    random_state=42,
                                                    test_size=0.25,
                                                    stratify=train_df[target_column])
train = pd.DataFrame(np.hstack((X_train, np.array(y_train).reshape(-1, 1))))
test = pd.DataFrame(np.hstack((X_test, np.array(y_test).reshape(-1, 1))))
train.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
test.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train.shape)
print(test.shape)
```

```
train.head()
```

```
(530, 65)
(177, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

```
# add the dataset to the fun_control
fun_control.update({"data": train_df, # full dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column})
```

## 23.6 Step 3: Specification of the Preprocessing Model

Data preprocesssing can be very simple, e.g., you can ignore it. Then you would choose the `prep_model` "None":

```
prep_model = None
fun_control.update({"prep_model": prep_model})
```

A default approach for numerical data is the `StandardScaler` (mean 0, variance 1). This can be selected as follows:

```
# prep_model = StandardScaler()
# fun_control.update({"prep_model": prep_model})
```

Even more complicated pre-processing steps are possible, e.g., the follwing pipeline:

```
# categorical_columns = []
# one_hot_encoder = OneHotEncoder(handle_unknown="ignore", sparse_output=False)
# prep_model = ColumnTransformer(
```

```
#         transformers=[
#             ("categorical", one_hot_encoder, categorical_columns),
#         ],
#         remainder=StandardScaler(),
#     )
```

## 23.7 Step 4: Select `algorithm` and `core_model_hyper_dict`

The selection of the algorithm (ML model) that should be tuned is done by specifying the its name from the `sklearn` implementation. For example, the `SVC` support vector machine classifier is selected as follows:

`fun_control = add_core_model_to_fun_control(SVC, fun_control, SklearnHyperDict)`

Other core_models are, e.g.,:

- RidgeCV
- GradientBoostingRegressor
- ElasticNet
- RandomForestClassifier
- LogisticRegression
- KNeighborsClassifier
- RandomForestClassifier
- GradientBoostingClassifier
- HistGradientBoostingClassifier

We will use the `RandomForestClassifier` classifier in this example.

```
from sklearn.linear_model import RidgeCV
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.ensemble import HistGradientBoostingClassifier
from sklearn.linear_model import ElasticNet
from spotPython.hyperparameters.values import add_core_model_to_fun_control
from spotPython.data.sklearn_hyper_dict import SklearnHyperDict
from spotPython.fun.hypersklearn import HyperSklearn
```

```python
# core_model  = RidgeCV
# core_model = GradientBoostingRegressor
# core_model = ElasticNet
core_model = RandomForestClassifier
# core_model = SVC
# core_model = LogisticRegression
# core_model = KNeighborsClassifier
# core_model = GradientBoostingClassifier
core_model = HistGradientBoostingClassifier
fun_control = add_core_model_to_fun_control(core_model=core_model,
                              fun_control=fun_control,
                              hyper_dict=SklearnHyperDict,
                              filename=None)
```

Now `fun_control` has the information from the JSON file. The available hyperparameters are:

```python
print(*fun_control["core_model_hyper_dict"].keys(), sep="\n")
```

```
loss
learning_rate
max_iter
max_leaf_nodes
max_depth
min_samples_leaf
l2_regularization
max_bins
early_stopping
n_iter_no_change
tol
```

## 23.8 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

### 23.8.1 Modify hyperparameter of type numeric and integer (boolean)

Numeric and boolean values can be modified using the `modify_hyper_parameter_bounds` method. For example, to change the `tol` hyperparameter of the `SVC` model to the interval [1e-3, 1e-2], the following code can be used:

fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])

```python
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
# fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_split", bounds=[3,
# fun_control = modify_hyper_parameter_bounds(fun_control, "dual", bounds=[0, 0])
# fun_control = modify_hyper_parameter_bounds(fun_control, "probability", bounds=[1, 1])
# fun_control["core_model_hyper_dict"]["tol"]
# fun_control = modify_hyper_parameter_bounds(fun_control, "min_samples_leaf", bounds=[1,
# fun_control = modify_hyper_parameter_bounds(fun_control, "n_estimators", bounds=[5, 10])
```

### 23.8.2 Modify hyperparameter of type factor

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

Factors can be modified with the `modify_hyper_parameter_levels` function. For example, to exclude the `sigmoid` kernel from the tuning, the `kernel` hyperparameter of the `SVC` model can be modified as follows:

fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["linear", "rbf"])

The new setting can be controlled via:

fun_control["core_model_hyper_dict"]["kernel"]

```python
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
# XGBoost:
fun_control = modify_hyper_parameter_levels(fun_control, "loss", ["log_loss"])
```

### 23.8.3 Optimizers

Optimizers are described in Section 21.6.

## 23.9 5. Selection of the Objective: Metric and Loss Functions

- Machine learning models are optimized with respect to a metric, for example, the `accuracy` function.

- Deep learning, e.g., neural networks are optimized with respect to a loss function, for example, the `cross_entropy` function and evaluated with respect to a metric, for example, the `accuracy` function.

## 23.10 Step 6: Selection of the Objective (Loss) Function

The loss function, that is usually used in deep learning for optimizing the weights of the net, is stored in the `fun_control` dictionary as `"loss_function"`.

### 23.10.1 Metric Function

There are two different types of metrics in `spotPython`:

1. `"metric_river"` is used for the river based evaluation via `eval_oml_iter_progressive`.
2. `"metric_sklearn"` is used for the sklearn based evaluation.

We will consider multi-class classification metrics, e.g., `mapk_score` and `top_k_accuracy_score`.

> **Predict Probabilities**
>
> In this multi-class classification example the machine learning algorithm should return the probabilities of the specific classes (`"predict_proba"`) instead of the predicted values.

We set `"predict_proba"` to `True` in the `fun_control` dictionary.

#### 23.10.1.1 The MAPK Metric

To select the MAPK metric, the following two entries can be added to the `fun_control` dictionary:

`"metric_sklearn": mapk_score"`

`"metric_params": {"k": 3}`.

#### 23.10.1.2 Other Metrics

Alternatively, other metrics for multi-class classification can be used, e.g.,: * top_k_accuracy_score or * roc_auc_score

The metric `roc_auc_score` requires the parameter `"multi_class"`, e.g.,

`"multi_class": "ovr"`.

This is set in the `fun_control` dictionary.

> **Weights**
>
> `spotPython` performs a minimization, therefore, metrics that should be maximized have to be multiplied by -1. This is done by setting `"weights"` to `-1`.

- The complete setup for the metric in our example is:

```python
from spotPython.utils.metrics import mapk_score
fun_control.update({
               "weights": -1,
               "metric_sklearn": mapk_score,
               "predict_proba": True,
               "metric_params": {"k": 3},
               })
```

## 23.11 Evaluation on Hold-out Data

- The default method for computing the performance is `"eval_holdout"`.
- Alternatively, cross-validation can be used for every machine learning model.
- Specifically for RandomForests, the OOB-score can be used.

```python
fun_control.update({
    "eval": "train_hold_out",
})
```

#### 23.11.0.1 Cross Validation

Instead of using the OOB-score, the classical cross validation can be used. The number of folds is set by the key `"k_folds"`. For example, to use 5-fold cross validation, the key `"k_folds"` is set to `5`. Uncomment the following line to use cross validation:

```
# fun_control.update({
#      "eval": "train_cv",
#      "k_folds": 10,
# })
```

## 23.12 6. Calling the SPOT Function

## 23.13 Preparing the SPOT Call

- Get types and variable names as well as lower and upper bounds for the hyperparameters.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name                | type    | default    |   lower |   upper | transform              |
|---------------------|---------|------------|---------|---------|------------------------|
| loss                | factor  | log_loss   |   0     |   0     | None                   |
| learning_rate       | float   | -1.0       |  -5     |   0     | transform_power_10     |
| max_iter            | int     | 7          |   3     |  10     | transform_power_2_int  |
| max_leaf_nodes      | int     | 5          |   1     |  12     | transform_power_2_int  |
| max_depth           | int     | 2          |   1     |  20     | transform_power_2_int  |
| min_samples_leaf    | int     | 4          |   2     |  10     | transform_power_2_int  |
| l2_regularization   | float   | 0.0        |   0     |  10     | None                   |
| max_bins            | int     | 255        | 127     | 255     | None                   |
| early_stopping      | factor  | 1          |   0     |   1     | None                   |
| n_iter_no_change    | int     | 10         |   5     |  20     | None                   |
| tol                 | float   | 0.0001     |   1e-05 |   0.001 | None                   |
```

## 23.14 The Objective Function

The objective function is selected next. It implements an interface from `sklearn`'s training, validation, and testing methods to `spotPython`.

```
from spotPython.fun.hypersklearn import HyperSklearn
fun = HyperSklearn().fun_sklearn
```

### 23.14.1 Run the `Spot` Optimizer

- Run SPOT for approx. x mins (`max_time`).
- Note: the run takes longer, because the evaluation time of initial design (here: `initi_size`, 20 points) is not considered.

```
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=SklearnHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
X_start
```

```
array([[ 0.00e+00, -1.00e+00,  7.00e+00,  5.00e+00,  2.00e+00,  4.00e+00,
         0.00e+00,  2.55e+02,  1.00e+00,  1.00e+01,  1.00e-04]])
```

```
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
```

```python
                     show_progress= True,
                     fun_control = fun_control,
                     design_control={"init_size": INIT_SIZE,
                                     "repeats": 1},
                     surrogate_control={"noise": True,
                                        "cod_type": "norm",
                                        "min_theta": -4,
                                        "max_theta": 3,
                                        "n_theta": len(var_name),
                                        "model_fun_evals": 10_000,
                                        "log_level": 50
                                        })
spot_tuner.run(X_start=X_start)
```

```
spotPython tuning: -0.3596491228070175 [----------] 2.50%

spotPython tuning: -0.3596491228070175 [#---------] 7.37%

spotPython tuning: -0.3596491228070175 [#---------] 9.66%

spotPython tuning: -0.3596491228070175 [#---------] 13.42%

spotPython tuning: -0.3596491228070175 [##--------] 16.99%

spotPython tuning: -0.3596491228070175 [#######---] 69.62%

spotPython tuning: -0.3596491228070175 [#######---] 73.37%

spotPython tuning: -0.3596491228070175 [########--] 75.82%

spotPython tuning: -0.3596491228070175 [########--] 79.38%

spotPython tuning: -0.3596491228070175 [#########-] 92.85%

spotPython tuning: -0.3596491228070175 [#########-] 94.49%

spotPython tuning: -0.36967418546365916 [##########] 97.06%

spotPython tuning: -0.36967418546365916 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x16d3de830>
```

### 23.14.2 Results

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

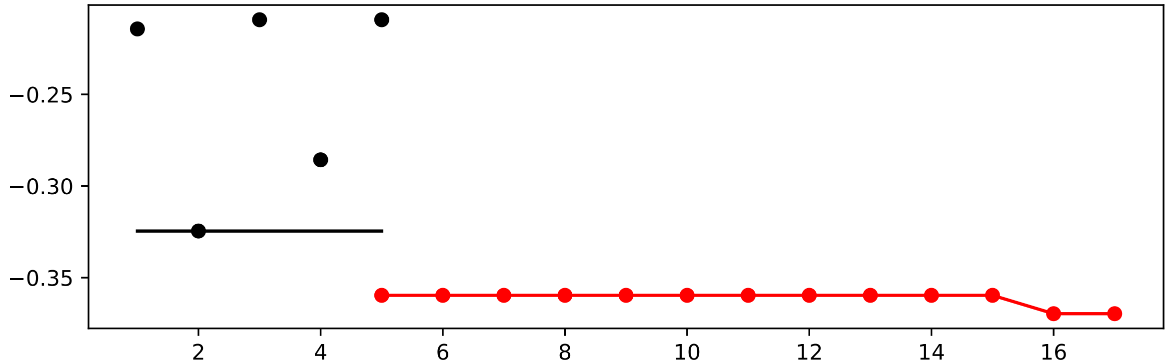



Figure 23.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name                | type    | default   |   lower |   upper |                tuned | transf
|---------------------|---------|-----------|---------|---------|----------------------|-------
| loss                | factor  | log_loss  |     0.0 |     0.0 |                  0.0 | None
| learning_rate       | float   | -1.0      |    -5.0 |     0.0 | -0.38581411447960295 | transf
| max_iter            | int     | 7         |     3.0 |    10.0 |                 10.0 | transf
| max_leaf_nodes      | int     | 5         |     1.0 |    12.0 |                  3.0 | transf
| max_depth           | int     | 2         |     1.0 |    20.0 |                 15.0 | transf
| min_samples_leaf    | int     | 4         |     2.0 |    10.0 |                  5.0 | transf
| l2_regularization   | float   | 0.0       |     0.0 |    10.0 |    3.203252636532734 | None
| max_bins            | int     | 255       |   127.0 |   255.0 |                197.0 | None
| early_stopping      | factor  | 1         |     0.0 |     1.0 |                  1.0 | None
| n_iter_no_change    | int     | 10        |     5.0 |    20.0 |                 19.0 | None
| tol                 | float   | 0.0001    |   1e-05 |   0.001 |                0.001 | None
```

## 23.15 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

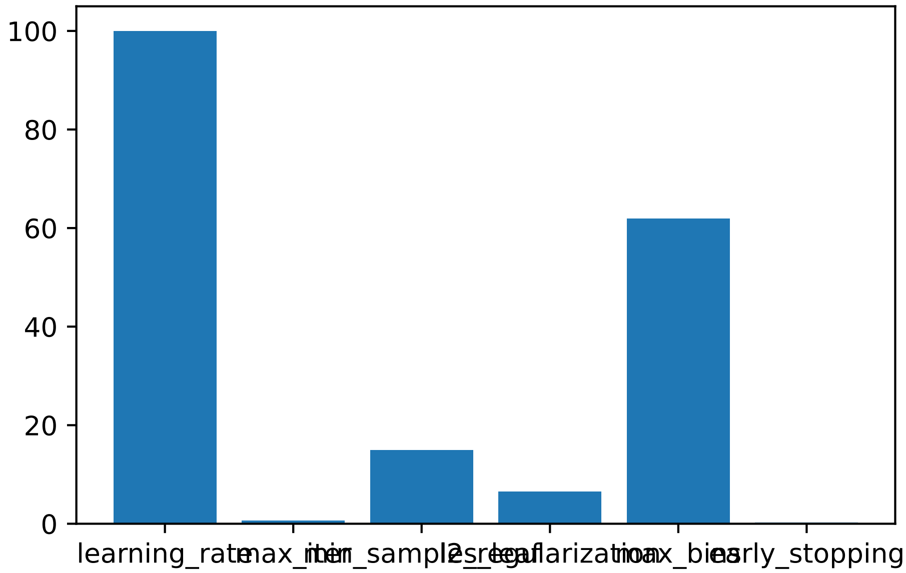



Figure 23.2: Variable importance plot, threshold 0.025.

## 23.16 Get Default Hyperparameters

```
from spotPython.hyperparameters.values import get_default_values, transform_hyper_paramete
values_default = get_default_values(fun_control)
values_default = transform_hyper_parameter_values(fun_control=fun_control, hyper_parameter
values_default
```

```
{'loss': 'log_loss',
 'learning_rate': 0.1,
 'max_iter': 128,
 'max_leaf_nodes': 32,
 'max_depth': 4,
 'min_samples_leaf': 16,
 'l2_regularization': 0.0,
 'max_bins': 255,
```

 'early_stopping': 1,
 'n_iter_no_change': 10,
 'tol': 0.0001}

```python
from sklearn.pipeline import make_pipeline
model_default = make_pipeline(fun_control["prep_model"], fun_control["core_model"](**value
model_default
```

```
Pipeline(steps=[('nonetype', None),
                ('histgradientboostingclassifier',
                 HistGradientBoostingClassifier(early_stopping=1, max_depth=4,
                                                max_iter=128, max_leaf_nodes=32,
                                                min_samples_leaf=16,
                                                tol=0.0001))])
```

## 23.17 Get SPOT Results

```python
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
print(X)
```

```
[[ 0.00000000e+00 -3.85814114e-01  1.00000000e+01  3.00000000e+00
   1.50000000e+01  5.00000000e+00  3.20325264e+00  1.97000000e+02
   1.00000000e+00  1.90000000e+01  1.00000000e-03]]
```

```python
from spotPython.hyperparameters.values import assign_values, return_conf_list_from_var_dic
v_dict = assign_values(X, fun_control["var_name"])
return_conf_list_from_var_dict(var_dict=v_dict, fun_control=fun_control)
```

```
[{'loss': 'log_loss',
  'learning_rate': 0.411325737934984,
  'max_iter': 1024,
  'max_leaf_nodes': 8,
  'max_depth': 32768,
  'min_samples_leaf': 32,
  'l2_regularization': 3.203252636532734,
  'max_bins': 197,
  'early_stopping': 1,
  'n_iter_no_change': 19,
  'tol': 0.001}]
```

```
from spotPython.hyperparameters.values import get_one_sklearn_model_from_X
model_spot = get_one_sklearn_model_from_X(X, fun_control)
model_spot
```

```
HistGradientBoostingClassifier(early_stopping=1,
                               l2_regularization=3.203252636532734,
                               learning_rate=0.411325737934984, max_bins=197,
                               max_depth=32768, max_iter=1024, max_leaf_nodes=8,
                               min_samples_leaf=32, n_iter_no_change=19,
                               tol=0.001)
```

## 23.18 Evaluate SPOT Results

- Fetch the data.

```
from spotPython.utils.convert import get_Xy_from_df
X_train, y_train = get_Xy_from_df(fun_control["train"], fun_control["target_column"])
X_test, y_test = get_Xy_from_df(fun_control["test"], fun_control["target_column"])
X_test.shape, y_test.shape
```

```
((177, 64), (177,))
```

- Fit the model with the tuned hyperparameters. This gives one result:

```
model_spot.fit(X_train, y_train)
y_pred = model_spot.predict_proba(X_test)
res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
res
```

```
0.3248587570621469
```

```
def repeated_eval(n, model):
    res_values = []
    for i in range(n):
        model.fit(X_train, y_train)
        y_pred = model.predict_proba(X_test)
        res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
        res_values.append(res)
```

```python
    mean_res = np.mean(res_values)
    print(f"mean_res: {mean_res}")
    std_res = np.std(res_values)
    print(f"std_res: {std_res}")
    min_res = np.min(res_values)
    print(f"min_res: {min_res}")
    max_res = np.max(res_values)
    print(f"max_res: {max_res}")
    median_res = np.median(res_values)
    print(f"median_res: {median_res}")
    return mean_res, std_res, min_res, max_res, median_res
```

### 23.18.1 Handling Non-deterministic Results

- Because the model is non-determinstic, we perform $n = 30$ runs and calculate the mean and standard deviation of the performance metric.

```python
_ = repeated_eval(30, model_spot)
```

```
mean_res: 0.3299748901443816
std_res: 0.014146630869106886
min_res: 0.3013182674199623
max_res: 0.3549905838041431
median_res: 0.3295668549905838
```

### 23.18.2 Evalution of the Default Hyperparameters

```python
model_default.fit(X_train, y_train)["histgradientboostingclassifier"]
```

```
HistGradientBoostingClassifier(early_stopping=1, max_depth=4, max_iter=128,
                               max_leaf_nodes=32, min_samples_leaf=16,
                               tol=0.0001)
```

- One evaluation of the default hyperparameters is performed on the hold-out test set.

```python
y_pred = model_default.predict_proba(X_test)
mapk_score(y_true=y_test, y_pred=y_pred, k=3)
```

```
0.3540489642184558
```

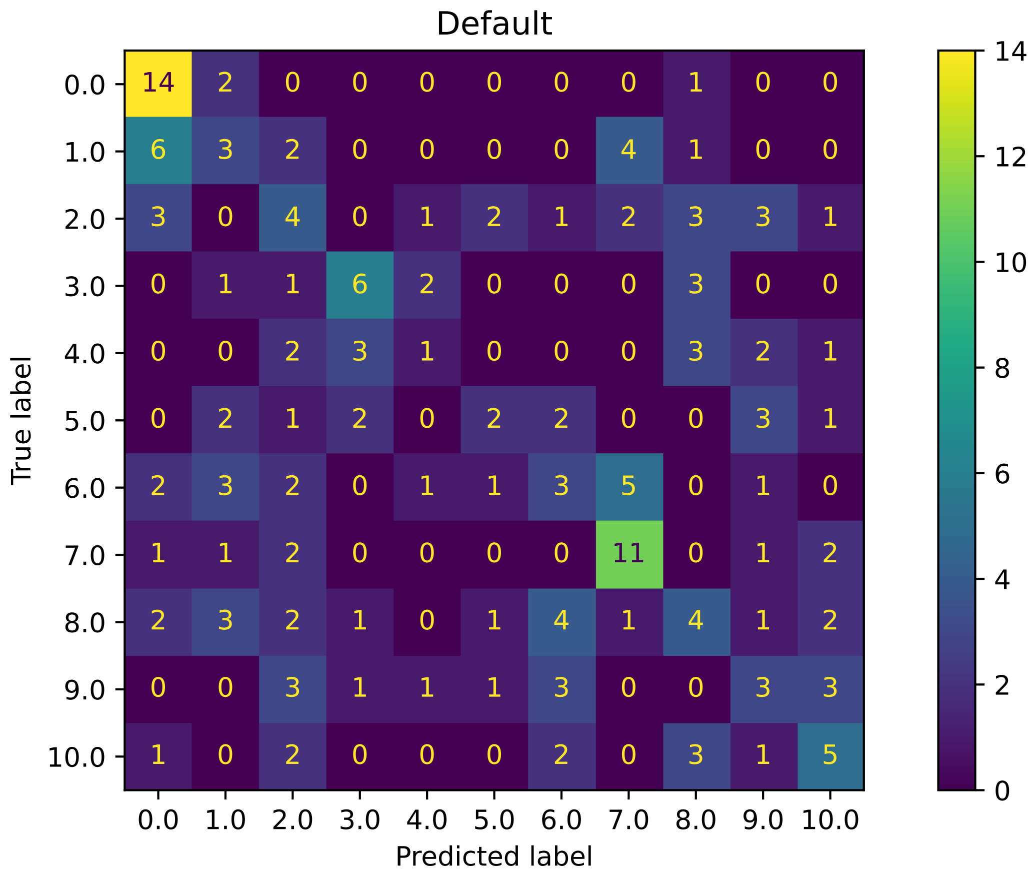
Since one single evaluation is not meaningful, we perform, similar to the evaluation of the SPOT results, $n = 30$ runs of the default setting and and calculate the mean and standard deviation of the performance metric.

```python
_ = repeated_eval(30, model_default)
```

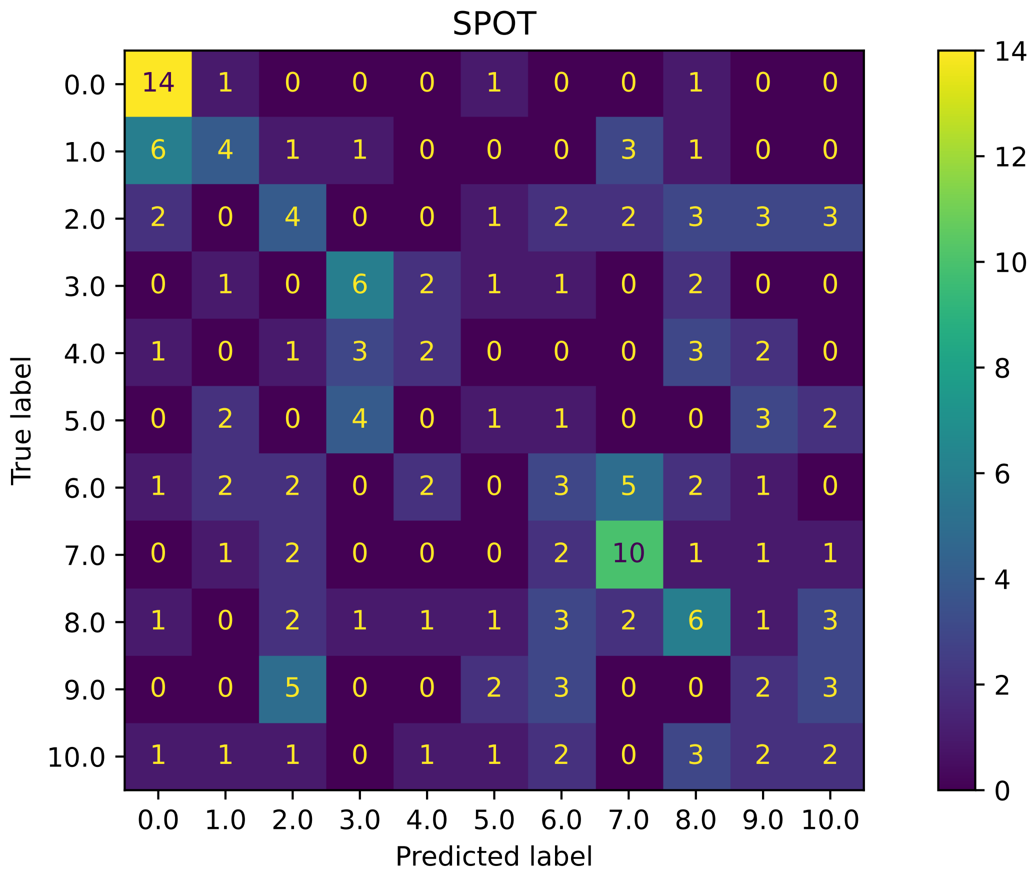
```
mean_res: 0.345323289391086
std_res: 0.017607586877513053
min_res: 0.3069679849340866
max_res: 0.38229755178907726
median_res: 0.34651600753295664
```

## 23.19 Plot: Compare Predictions

```python
from spotPython.plot.validation import plot_confusion_matrix
plot_confusion_matrix(model_default, fun_control, title = "Default")
```




```
plot_confusion_matrix(model_spot, fun_control, title="SPOT")
```




```
min(spot_tuner.y), max(spot_tuner.y)
```

```
(-0.36967418546365916, -0.20927318295739344)
```

## 23.20 Cross-validated Evaluations

```
from spotPython.sklearn.traintest import evaluate_cv
fun_control.update({
     "eval": "train_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.33962264150943394, None)
```

```
fun_control.update({
     "eval": "test_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.2617102396514161, None)
```

- This is the evaluation that will be used in the comparison:

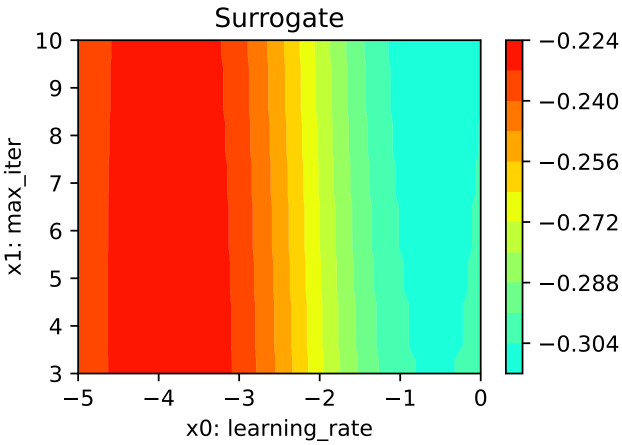
```
fun_control.update({
     "eval": "data_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

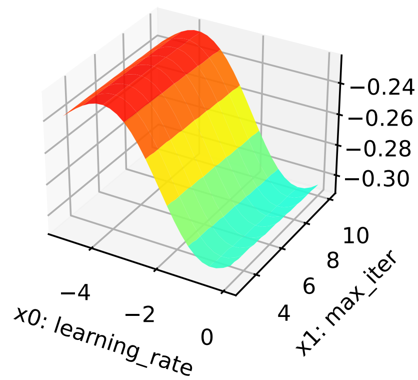
```
(0.34367538564721667, None)
```

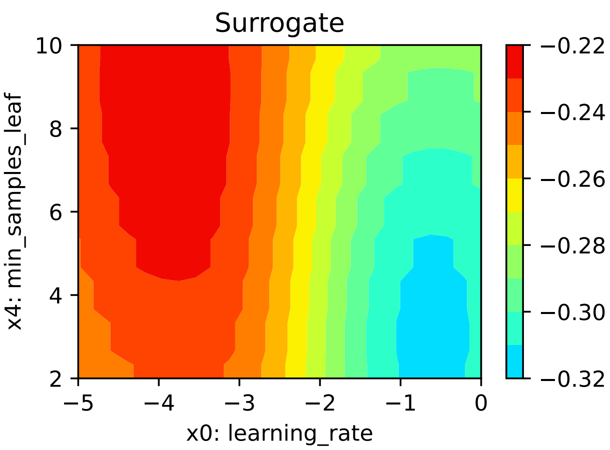
### 23.20.1 Detailed Hyperparameter Plots

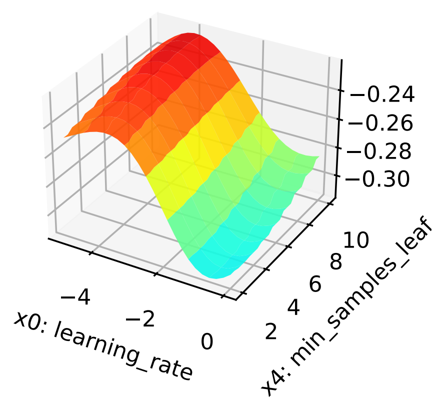
```
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

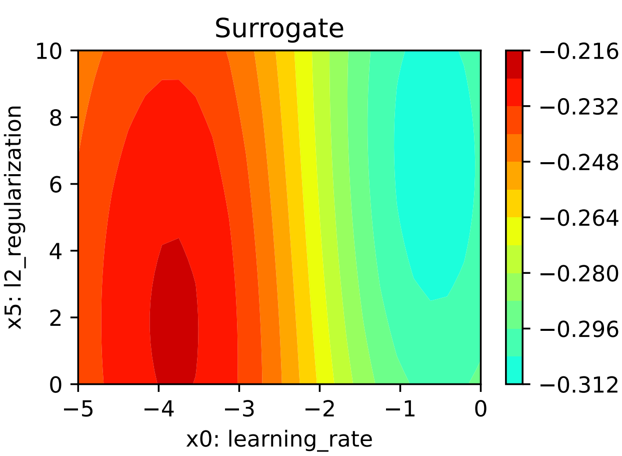
```
learning_rate:  100.0
max_iter:  0.6783097169397524
min_samples_leaf:  14.918659952298887
l2_regularization:  6.496750530767993
max_bins:  61.93957956765709
early_stopping:  0.22426675712238442
```

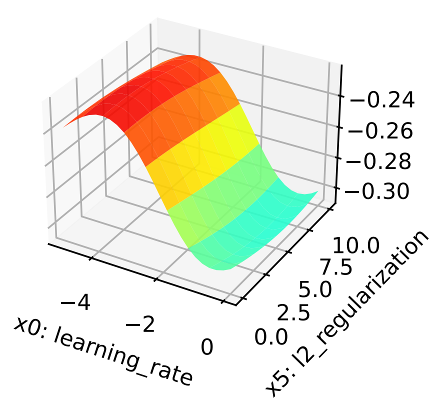

Surrogate
x1: max_iter
x0: learning_rate
−0.224
−0.240
−0.256
−0.272
−0.288
−0.304

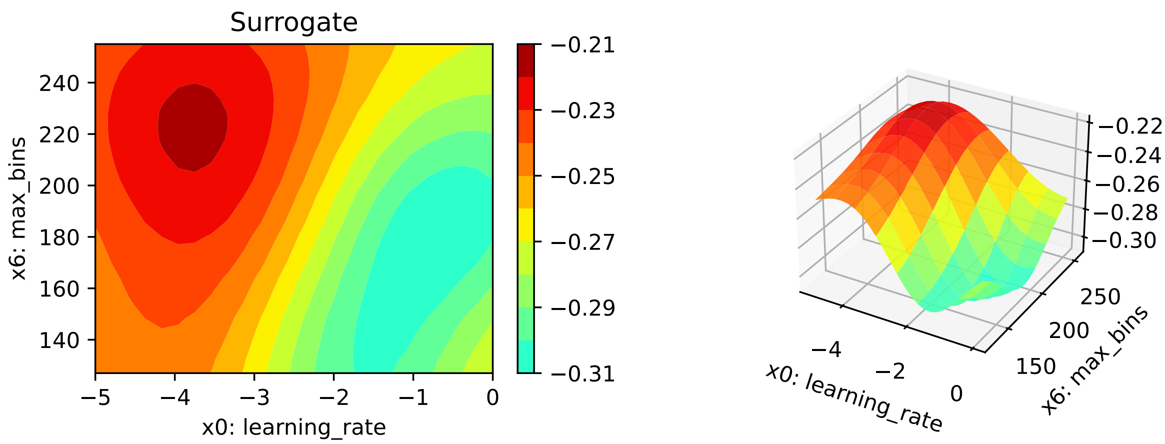

x0: learning_rate
x1: max_iter
−0.24
−0.26
−0.28
−0.30

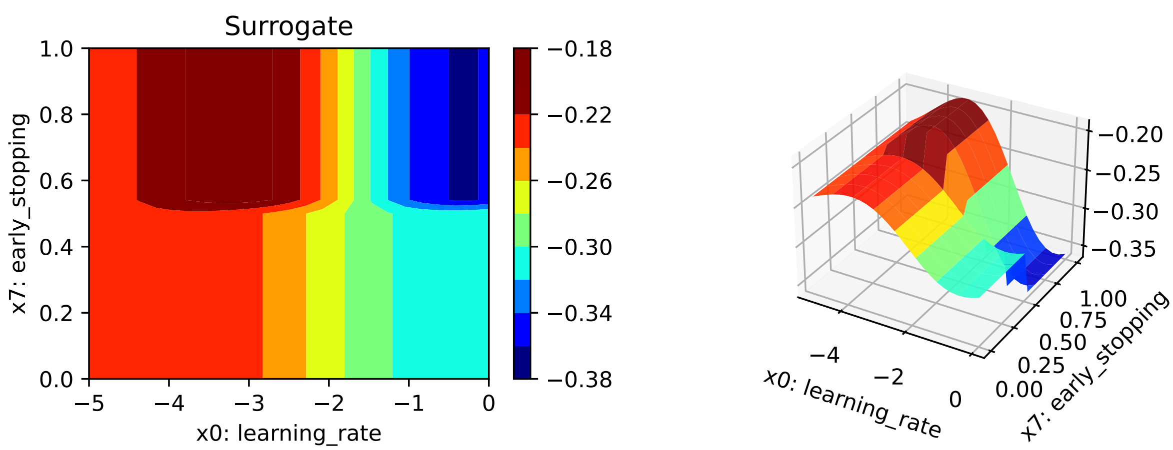

Surrogate
x4: min_samples_leaf
x0: learning_rate
−0.22
−0.24
−0.26
−0.28
−0.30
−0.32

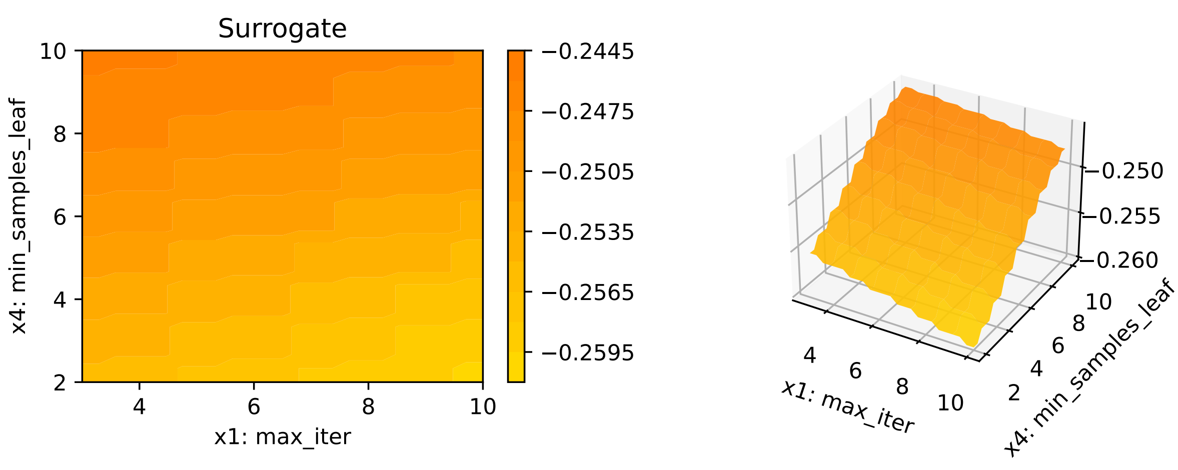

x0: learning_rate
x4: min_samples_leaf
−0.24
−0.26
−0.28
−0.30

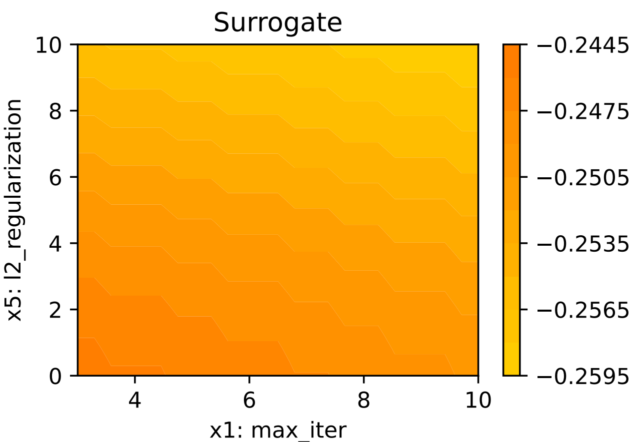

Surrogate
x5: l2_regularization
x0: learning_rate
−0.216
−0.232
−0.248
−0.264
−0.280
−0.296
−0.312

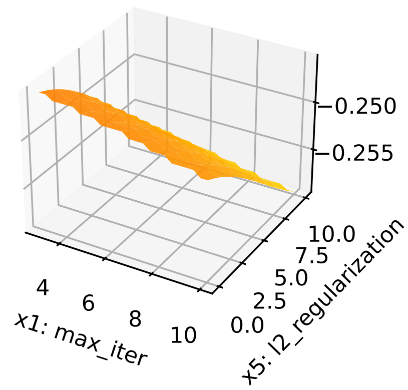

x0: learning_rate
x5: l2_regularization
−0.24
−0.26
−0.28
−0.30

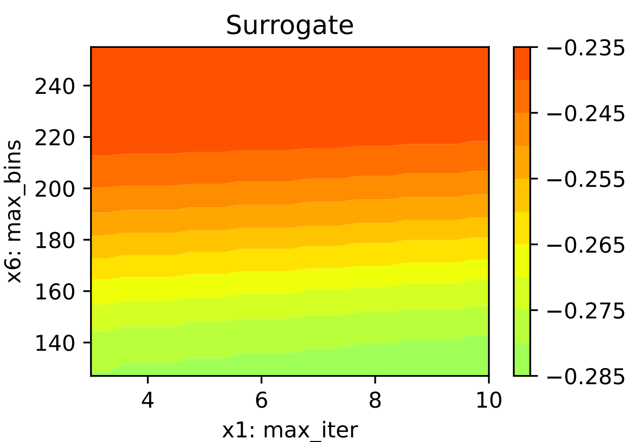

Surrogate
x6: max_bins
x0: learning_rate
−0.21
−0.23
−0.25
−0.27
−0.29
−0.31
x0: learning_rate
x6: max_bins

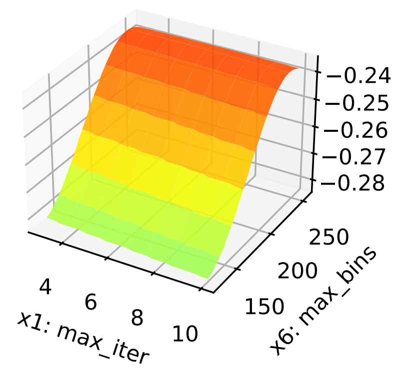

Surrogate
x7: early_stopping
x0: learning_rate
−0.18
−0.22
−0.26
−0.30
−0.34
−0.38
x0: learning_rate
x7: early_stopping

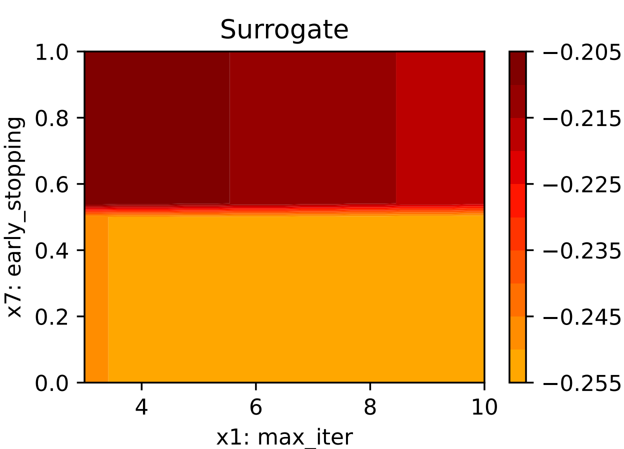

Surrogate
x4: min_samples_leaf
x1: max_iter
−0.2445
−0.2475
−0.2505
−0.2535
−0.2565
−0.2595
x1: max_iter
x4: min_samples_leaf

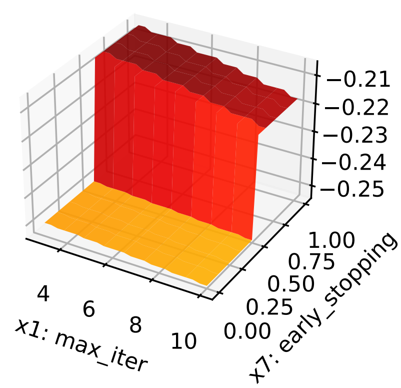

Surrogate
x5: l2_regularization
x1: max_iter
0
2
4
6
8
10
4
6
8
10
−0.2445
−0.2475
−0.2505
−0.2535
−0.2565
−0.2595

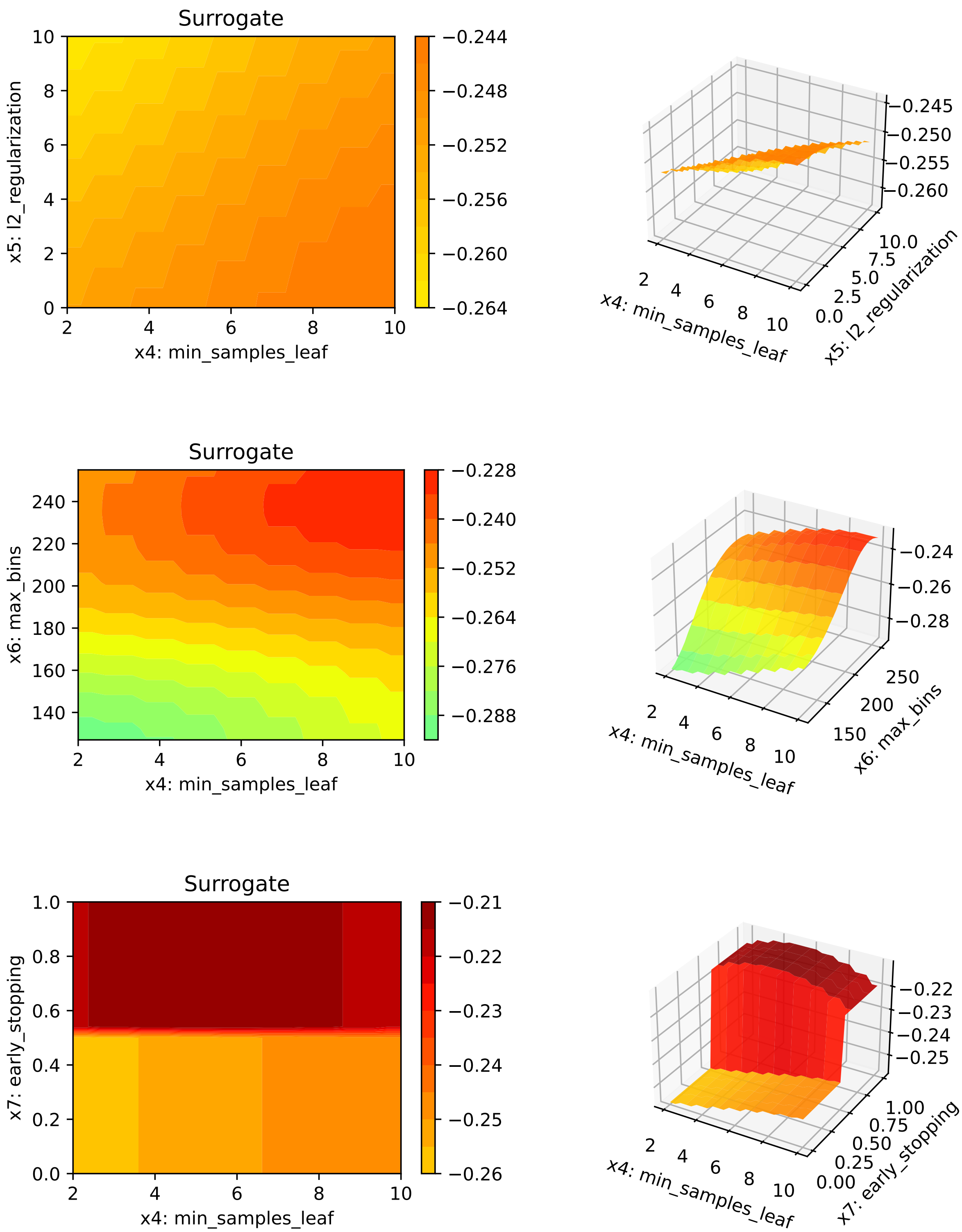

x1: max_iter
x5: l2_regularization
4
6
8
10
0.0
2.5
5.0
7.5
10.0
−0.250
−0.255

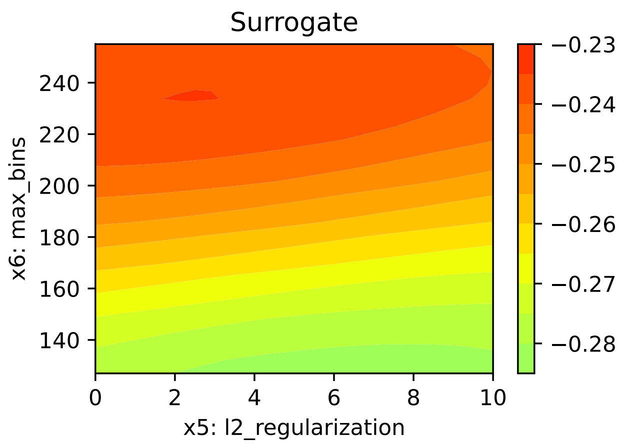

Surrogate
x6: max_bins
x1: max_iter
140
160
180
200
220
240
4
6
8
10
−0.235
−0.245
−0.255
−0.265
−0.275
−0.285

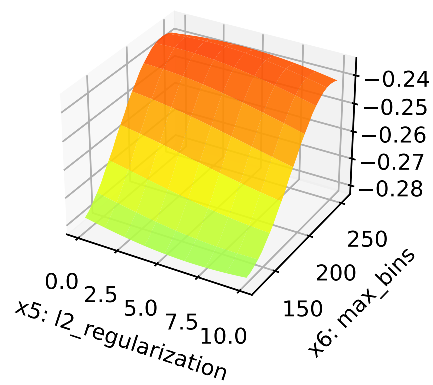

x1: max_iter
x6: max_bins
4
6
8
10
150
200
250
−0.24
−0.25
−0.26
−0.27
−0.28

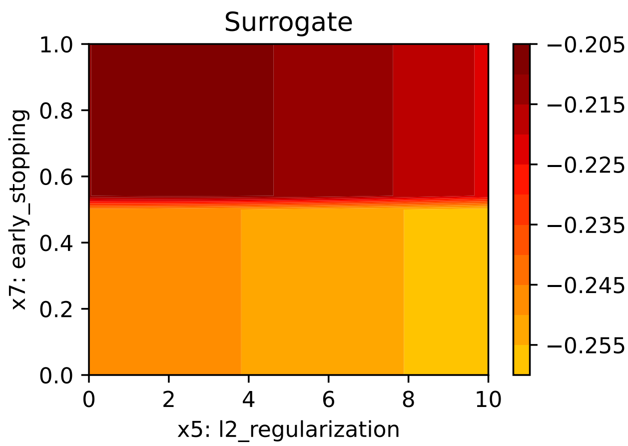

Surrogate
x7: early_stopping
x1: max_iter
0.0
0.2
0.4
0.6
0.8
1.0
4
6
8
10
−0.205
−0.215
−0.225
−0.235
−0.245
−0.255

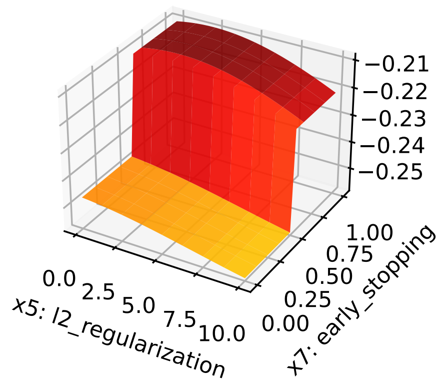

x1: max_iter
x7: early_stopping
4
6
8
10
0.00
0.25
0.50
0.75
1.00
−0.21
−0.22
−0.23
−0.24
−0.25

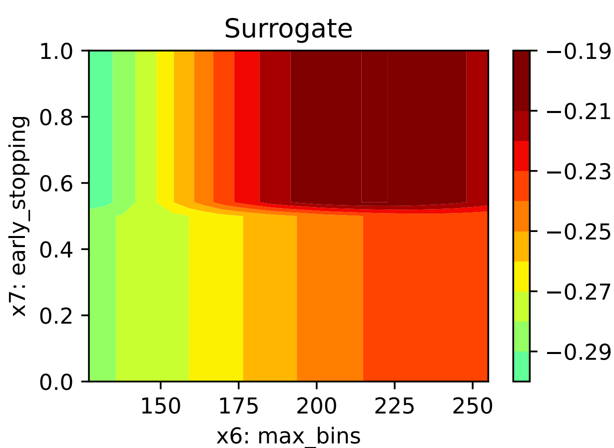

Surrogate
x5: l2_regularization
x4: min_samples_leaf
−0.244
−0.248
−0.252
−0.256
−0.260
−0.264
−0.245
−0.250
−0.255
−0.260
Surrogate
x6: max_bins
x4: min_samples_leaf
−0.228
−0.240
−0.252
−0.264
−0.276
−0.288
−0.24
−0.26
−0.28
Surrogate
x7: early_stopping
x4: min_samples_leaf
−0.21
−0.22
−0.23
−0.24
−0.25
−0.26

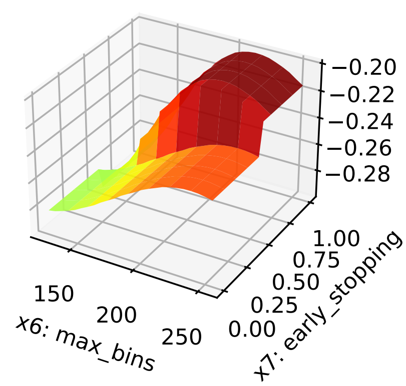

Surrogate
x6: max_bins
x5: l2_regularization
−0.23
−0.24
−0.25
−0.26
−0.27
−0.28


x5: l2_regularization
x6: max_bins


Surrogate
x7: early_stopping
x5: l2_regularization
−0.205
−0.215
−0.225
−0.235
−0.245
−0.255


x5: l2_regularization
x7: early_stopping


Surrogate
x7: early_stopping
x6: max_bins
−0.19
−0.21
−0.23
−0.25
−0.27
−0.29


x6: max_bins
x7: early_stopping

## 23.21 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

## 23.22 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 24 HPT: sklearn SVC VBDP Data

This document refers to the following software versions:

- `python`: 3.10.10

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34
spotRiver                     0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 24.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time and the initial design size.

```
MAX_TIME = 1
INIT_SIZE = 5
ORIGINAL = False
```

```python
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '18-svc-sklearn' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(I
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
18-svc-sklearn_p040025_1min_5init_2023-06-17_17-08-42
```

```python
import warnings
warnings.filterwarnings("ignore")
```

## 24.2 Step 1: Initialization of the Empty `fun_control` Dictionary

```python
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/16_spot_hpt_sklearn_classification")
```

## 24.3 1. Load Data: Classification

## 24.4 VBDP

```python
import pandas as pd
if ORIGINAL == True:
    train_df = pd.read_csv('./data/VBDP/trainn.csv')
    test_df = pd.read_csv('./data/VBDP/testt.csv')
else:
    train_df = pd.read_csv('./data/VBDP/train.csv')
    # remove the id column
    train_df = train_df.drop(columns=['id'])
```

```python
from sklearn.preprocessing import OrdinalEncoder
n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
target_column = "prognosis"
# Encoder our prognosis labels as integers for easier decoding later
enc = OrdinalEncoder()
train_df[target_column] = enc.fit_transform(train_df[[target_column]])
train_df.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train_df.shape)
train_df.head()
```

```
(707, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | ... | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 |
| 3 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 0.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |

The full data set `train_df` 64 features. The target column is labeled as `prognosis`.

## 24.5 Holdout Train and Test Data

We split out a hold-out test set (25% of the data) so we can calculate an example MAP@K

```python
import numpy as np
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(train_df.drop(target_column, axis=1),
                                                    random_state=42,
                                                    test_size=0.25,
                                                    stratify=train_df[target_column])
train = pd.DataFrame(np.hstack((X_train, np.array(y_train).reshape(-1, 1))))
test = pd.DataFrame(np.hstack((X_test, np.array(y_test).reshape(-1, 1))))
train.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
test.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train.shape)
print(test.shape)
```

```
train.head()
```

```
(530, 65)
(177, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

```
# add the dataset to the fun_control
fun_control.update({"data": train_df, # full dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column})
```

## 24.6 Step 3: Specification of the Preprocessing Model

Data preprocesssing can be very simple, e.g., you can ignore it. Then you would choose the `prep_model` "None":

```
prep_model = None
fun_control.update({"prep_model": prep_model})
```

A default approach for numerical data is the `StandardScaler` (mean 0, variance 1). This can be selected as follows:

```
# prep_model = StandardScaler()
# fun_control.update({"prep_model": prep_model})
```

Even more complicated pre-processing steps are possible, e.g., the follwing pipeline:

```
# categorical_columns = []
# one_hot_encoder = OneHotEncoder(handle_unknown="ignore", sparse_output=False)
# prep_model = ColumnTransformer(
```

```
#         transformers=[
#             ("categorical", one_hot_encoder, categorical_columns),
#         ],
#         remainder=StandardScaler(),
#     )
```

## 24.7 Step 4: Select `algorithm` and `core_model_hyper_dict`

The selection of the algorithm (ML model) that should be tuned is done by specifying the its name from the `sklearn` implementation. For example, the `SVC` support vector machine classifier is selected as follows:

`fun_control = add_core_model_to_fun_control(SVC, fun_control, SklearnHyperDict)`

Other core_models are, e.g.,:

- RidgeCV
- GradientBoostingRegressor
- ElasticNet
- RandomForestClassifier
- LogisticRegression
- KNeighborsClassifier
- RandomForestClassifier
- GradientBoostingClassifier
- HistGradientBoostingClassifier

We will use the `RandomForestClassifier` classifier in this example.

```python
from sklearn.linear_model import RidgeCV
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.ensemble import HistGradientBoostingClassifier
from sklearn.linear_model import ElasticNet
from spotPython.hyperparameters.values import add_core_model_to_fun_control
from spotPython.data.sklearn_hyper_dict import SklearnHyperDict
from spotPython.fun.hypersklearn import HyperSklearn
```

```python
# core_model  = RidgeCV
# core_model = GradientBoostingRegressor
# core_model = ElasticNet
# core_model = RandomForestClassifier
core_model = SVC
# core_model = LogisticRegression
# core_model = KNeighborsClassifier
# core_model = GradientBoostingClassifier
# core_model = HistGradientBoostingClassifier
fun_control = add_core_model_to_fun_control(core_model=core_model,
                              fun_control=fun_control,
                              hyper_dict=SklearnHyperDict,
                              filename=None)
```

Now `fun_control` has the information from the JSON file. The available hyperparameters are:

```python
print(*fun_control["core_model_hyper_dict"].keys(), sep="\n")
```

```
C
kernel
degree
gamma
coef0
shrinking
probability
tol
cache_size
break_ties
```

## 24.8 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

### 24.8.1 Modify hyperparameter of type numeric and integer (boolean)

Numeric and boolean values can be modified using the `modify_hyper_parameter_bounds` method. For example, to change the `tol` hyperparameter of the `SVC` model to the interval [1e-3, 1e-2], the following code can be used:

`fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])`

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
fun_control = modify_hyper_parameter_bounds(fun_control, "probability", bounds=[1, 1])
```

### 24.8.2 Modify hyperparameter of type factor

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

Factors can be modified with the `modify_hyper_parameter_levels` function. For example, to exclude the `sigmoid` kernel from the tuning, the `kernel` hyperparameter of the `SVC` model can be modified as follows:

`fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["linear", "rbf"])`

The new setting can be controlled via:

`fun_control["core_model_hyper_dict"]["kernel"]`

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["rbf"])
```

### 24.8.3 Optimizers

Optimizers are described in Section 21.6.

## 24.9 5. Selection of the Objective: Metric and Loss Functions

- Machine learning models are optimized with respect to a metric, for example, the `accuracy` function.
- Deep learning, e.g., neural networks are optimized with respect to a loss function, for example, the `cross_entropy` function and evaluated with respect to a metric, for example, the `accuracy` function.

## 24.10 Step 6: Selection of the Objective (Loss) Function

The loss function, that is usually used in deep learning for optimizing the weights of the net, is stored in the `fun_control` dictionary as `"loss_function"`.

### 24.10.1 Metric Function

There are two different types of metrics in `spotPython`:

1. `"metric_river"` is used for the river based evaluation via `eval_oml_iter_progressive`.
2. `"metric_sklearn"` is used for the sklearn based evaluation.

We will consider multi-class classification metrics, e.g., `mapk_score` and `top_k_accuracy_score`.

> **Predict Probabilities**
>
> In this multi-class classification example the machine learning algorithm should return the probabilities of the specific classes (`"predict_proba"`) instead of the predicted values.

We set `"predict_proba"` to `True` in the `fun_control` dictionary.

#### 24.10.1.1 The MAPK Metric

To select the MAPK metric, the following two entries can be added to the `fun_control` dictionary:

`"metric_sklearn": mapk_score"`

`"metric_params": {"k": 3}`.

#### 24.10.1.2 Other Metrics

Alternatively, other metrics for multi-class classification can be used, e.g.,: * top_k_accuracy_score or * roc_auc_score

The metric `roc_auc_score` requires the parameter `"multi_class"`, e.g.,

`"multi_class": "ovr"`.

This is set in the `fun_control` dictionary.

> **Weights**
>
> `spotPython` performs a minimization, therefore, metrics that should be maximized have to be multiplied by -1. This is done by setting `"weights"` to `-1`.

- The complete setup for the metric in our example is:

```python
from spotPython.utils.metrics import mapk_score
fun_control.update({
               "weights": -1,
               "metric_sklearn": mapk_score,
               "predict_proba": True,
               "metric_params": {"k": 3},
               })
```

## 24.11 Evaluation on Hold-out Data

- The default method for computing the performance is `"eval_holdout"`.
- Alternatively, cross-validation can be used for every machine learning model.
- Specifically for RandomForests, the OOB-score can be used.

```python
fun_control.update({
    "eval": "train_hold_out",
})
```

#### 24.11.0.1 Cross Validation

Instead of using the OOB-score, the classical cross validation can be used. The number of folds is set by the key `"k_folds"`. For example, to use 5-fold cross validation, the key `"k_folds"` is set to `5`. Uncomment the following line to use cross validation:

```python
# fun_control.update({
#      "eval": "train_cv",
#      "k_folds": 10,
# })
```

## 24.12 6. Calling the SPOT Function

## 24.13 Preparing the SPOT Call

- Get types and variable names as well as lower and upper bounds for the hyperparameters.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name        | type   | default   |    lower |   upper | transform   |
|-------------|--------|-----------|----------|---------|-------------|
| C           | float  | 1.0       |   0.1    |   10    | None        |
| kernel      | factor | rbf       |   0      |    0    | None        |
| degree      | int    | 3         |   3      |    3    | None        |
| gamma       | factor | scale     |   0      |    1    | None        |
| coef0       | float  | 0.0       |   0      |    0    | None        |
| shrinking   | factor | 0         |   0      |    1    | None        |
| probability | factor | 0         |   1      |    1    | None        |
| tol         | float  | 0.001     |   0.0001 |    0.01 | None        |
| cache_size  | float  | 200.0     | 100      |  400    | None        |
| break_ties  | factor | 0         |   0      |    1    | None        |
```

## 24.14 The Objective Function

The objective function is selected next. It implements an interface from `sklearn`'s training, validation, and testing methods to `spotPython`.

```
from spotPython.fun.hypersklearn import HyperSklearn
fun = HyperSklearn().fun_sklearn
```

### 24.14.1 Run the `Spot` Optimizer

- Run SPOT for approx. x mins (`max_time`).

- Note: the run takes longer, because the evaluation time of initial design (here: `initi_size`, 20 points) is not considered.

```
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=SklearnHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
X_start
```

```
array([[1.e+00, 2.e+00, 3.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 1.e-03,
        2.e+02, 0.e+00]])
```

```
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
                                      "model_fun_evals": 10_000,
                                      "log_level": 50
                                      })
```

```
spot_tuner.run(X_start=X_start)
```

```
spotPython tuning: -0.38095238095238093 [----------] 0.25%

spotPython tuning: -0.38095238095238093 [----------] 0.63%

spotPython tuning: -0.38095238095238093 [----------] 1.92%

spotPython tuning: -0.38095238095238093 [----------] 2.56%

spotPython tuning: -0.38095238095238093 [----------] 3.04%

spotPython tuning: -0.38095238095238093 [----------] 3.59%

spotPython tuning: -0.38095238095238093 [----------] 4.07%

spotPython tuning: -0.38095238095238093 [----------] 4.53%

spotPython tuning: -0.38847117794486213 [----------] 4.99%

spotPython tuning: -0.39223057644110276 [#---------] 5.49%

spotPython tuning: -0.39348370927318294 [#---------] 5.97%

spotPython tuning: -0.39348370927318294 [#---------] 6.43%

spotPython tuning: -0.39348370927318294 [#---------] 7.41%

spotPython tuning: -0.39348370927318294 [#---------] 9.03%

spotPython tuning: -0.39348370927318294 [#---------] 10.92%

spotPython tuning: -0.39348370927318294 [#---------] 12.24%

spotPython tuning: -0.39348370927318294 [#---------] 13.37%
```

```
spotPython tuning: -0.39348370927318294 [#---------] 14.69%

spotPython tuning: -0.39348370927318294 [##--------] 16.07%

spotPython tuning: -0.39348370927318294 [##--------] 17.81%

spotPython tuning: -0.39348370927318294 [##--------] 19.25%

spotPython tuning: -0.39348370927318294 [##--------] 20.60%

spotPython tuning: -0.39348370927318294 [##--------] 21.94%

spotPython tuning: -0.39348370927318294 [##--------] 23.20%

spotPython tuning: -0.39348370927318294 [##--------] 24.50%

spotPython tuning: -0.39348370927318294 [###-------] 25.74%

spotPython tuning: -0.39348370927318294 [###-------] 27.21%

spotPython tuning: -0.39348370927318294 [###-------] 29.26%

spotPython tuning: -0.39348370927318294 [###-------] 31.38%

spotPython tuning: -0.39348370927318294 [###-------] 33.27%

spotPython tuning: -0.39348370927318294 [####------] 35.38%

spotPython tuning: -0.39348370927318294 [####------] 37.63%

spotPython tuning: -0.39348370927318294 [####------] 40.50%

spotPython tuning: -0.39348370927318294 [####------] 43.63%

spotPython tuning: -0.39348370927318294 [#####-----] 46.39%

spotPython tuning: -0.39348370927318294 [#####-----] 49.59%
```

```
spotPython tuning: -0.39348370927318294 [#####-----] 52.90%

spotPython tuning: -0.39348370927318294 [######----] 55.91%

spotPython tuning: -0.39348370927318294 [######----] 58.56%

spotPython tuning: -0.39348370927318294 [######----] 61.77%

spotPython tuning: -0.39348370927318294 [######----] 64.26%

spotPython tuning: -0.39348370927318294 [#######---] 66.77%

spotPython tuning: -0.39348370927318294 [#######---] 69.50%

spotPython tuning: -0.39348370927318294 [#######---] 72.61%

spotPython tuning: -0.39348370927318294 [########--] 75.63%

spotPython tuning: -0.39348370927318294 [########--] 78.55%

spotPython tuning: -0.39348370927318294 [########--] 81.26%

spotPython tuning: -0.39348370927318294 [########--] 84.87%

spotPython tuning: -0.39348370927318294 [#########-] 87.82%

spotPython tuning: -0.39348370927318294 [#########-] 90.49%

spotPython tuning: -0.39348370927318294 [#########-] 93.44%

spotPython tuning: -0.39348370927318294 [##########] 96.73%

spotPython tuning: -0.39348370927318294 [##########] 99.86%

spotPython tuning: -0.39348370927318294 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x12a8c4fd0>
```

### 24.14.2 Results

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

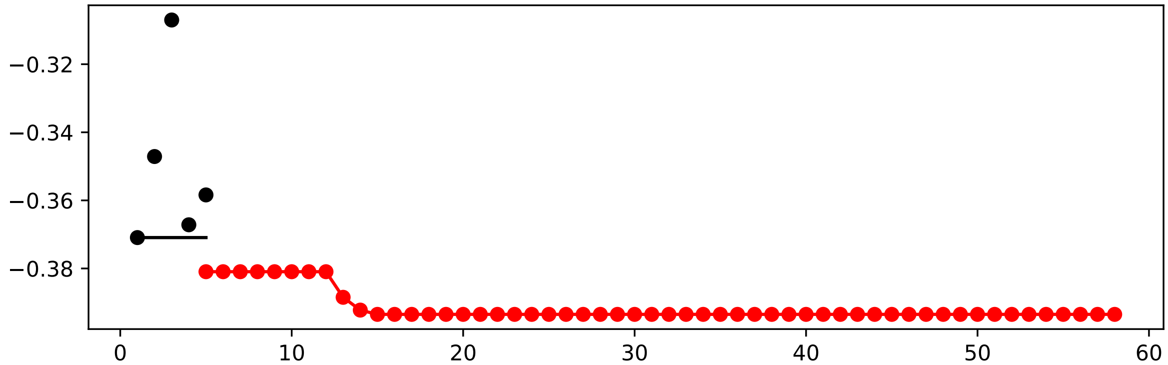


Figure 24.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name        | type   | default   |   lower |   upper |              tuned | transform   |
|-------------|--------|-----------|---------|---------|--------------------|-------------|--
| C           | float  | 1.0       |     0.1 |    10.0 |  2.065611233324793 | None        |
| kernel      | factor | rbf       |     0.0 |     0.0 |                0.0 | None        |
| degree      | int    | 3         |     3.0 |     3.0 |                3.0 | None        |
| gamma       | factor | scale     |     0.0 |     1.0 |                1.0 | None        |
| coef0       | float  | 0.0       |     0.0 |     0.0 |                0.0 | None        |
| shrinking   | factor | 0         |     0.0 |     1.0 |                0.0 | None        |
| probability | factor | 0         |     1.0 |     1.0 |                1.0 | None        |
| tol         | float  | 0.001     |  0.0001 |    0.01 |             0.0001 | None        |
| cache_size  | float  | 200.0     |   100.0 |   400.0 | 267.80382850732275 | None        |
| break_ties  | factor | 0         |     0.0 |     1.0 |                0.0 | None        |
```

## 24.15 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

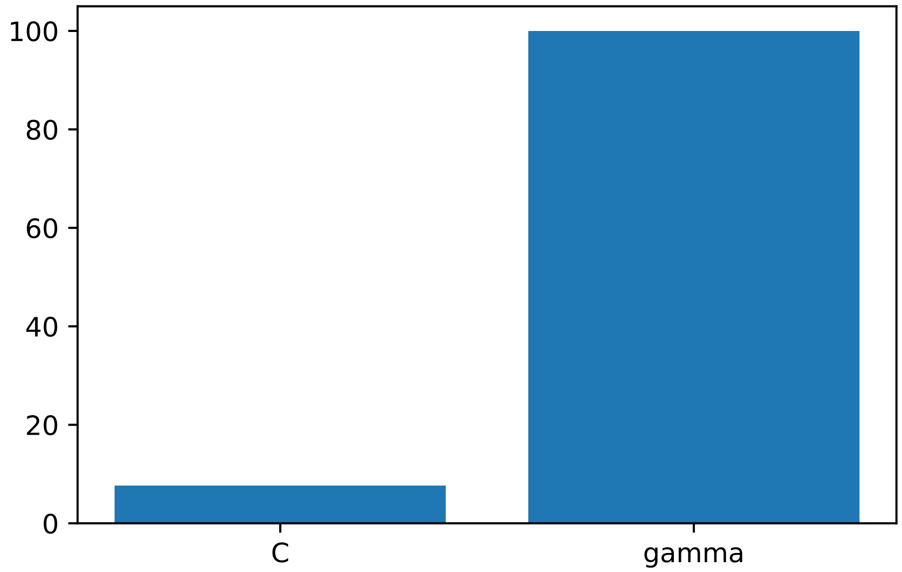



Figure 24.2: Variable importance plot, threshold 0.025.

## 24.16 Get Default Hyperparameters

```
from spotPython.hyperparameters.values import get_default_values, transform_hyper_paramete
values_default = get_default_values(fun_control)
values_default = transform_hyper_parameter_values(fun_control=fun_control, hyper_parameter
values_default
```

```
{'C': 1.0,
 'kernel': 'rbf',
 'degree': 3,
 'gamma': 'scale',
 'coef0': 0.0,
 'shrinking': 0,
 'probability': 0,
 'tol': 0.001,
```

```
 'cache_size': 200.0,
 'break_ties': 0}
```

```
from sklearn.pipeline import make_pipeline
model_default = make_pipeline(fun_control["prep_model"], fun_control["core_model"](**value
model_default
```

```
Pipeline(steps=[('nonetype', None),
                ('svc',
                 SVC(break_ties=0, cache_size=200.0, probability=0,
                     shrinking=0))])
```

> **Note**
>
> - Default value for "probability" is False, but we need it to be True for the metric "mapk_score".
>
> ```
> values_default.update({"probability": 1})
> ```

## 24.17 Get SPOT Results

```
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
print(X)
```

```
[[2.06561123e+00 0.00000000e+00 3.00000000e+00 1.00000000e+00
  0.00000000e+00 0.00000000e+00 1.00000000e+00 1.00000000e-04
  2.67803829e+02 0.00000000e+00]]
```

```
from spotPython.hyperparameters.values import assign_values, return_conf_list_from_var_dic
v_dict = assign_values(X, fun_control["var_name"])
return_conf_list_from_var_dict(var_dict=v_dict, fun_control=fun_control)
```

```
[{'C': 2.065611233324793,
  'kernel': 'rbf',
  'degree': 3,
  'gamma': 'auto',
```

```
'coef0': 0.0,
'shrinking': 0,
'probability': 1,
'tol': 0.0001,
'cache_size': 267.80382850732275,
'break_ties': 0}]
```

```
from spotPython.hyperparameters.values import get_one_sklearn_model_from_X
model_spot = get_one_sklearn_model_from_X(X, fun_control)
model_spot
```

```
SVC(C=2.065611233324793, break_ties=0, cache_size=267.80382850732275,
    gamma='auto', probability=1, shrinking=0, tol=0.0001)
```

## 24.18 Evaluate SPOT Results

- Fetch the data.

```
from spotPython.utils.convert import get_Xy_from_df
X_train, y_train = get_Xy_from_df(fun_control["train"], fun_control["target_column"])
X_test, y_test = get_Xy_from_df(fun_control["test"], fun_control["target_column"])
X_test.shape, y_test.shape
```

```
((177, 64), (177,))
```

- Fit the model with the tuned hyperparameters. This gives one result:

```
model_spot.fit(X_train, y_train)
y_pred = model_spot.predict_proba(X_test)
res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
res
```

```
0.3691148775894538
```

```
def repeated_eval(n, model):
    res_values = []
    for i in range(n):
        model.fit(X_train, y_train)
```

```python
        y_pred = model.predict_proba(X_test)
        res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
        res_values.append(res)
    mean_res = np.mean(res_values)
    print(f"mean_res: {mean_res}")
    std_res = np.std(res_values)
    print(f"std_res: {std_res}")
    min_res = np.min(res_values)
    print(f"min_res: {min_res}")
    max_res = np.max(res_values)
    print(f"max_res: {max_res}")
    median_res = np.median(res_values)
    print(f"median_res: {median_res}")
    return mean_res, std_res, min_res, max_res, median_res
```

### 24.18.1 Handling Non-deterministic Results

- Because the model is non-determinstic, we perform $n = 30$ runs and calculate the mean and standard deviation of the performance metric.

```python
_ = repeated_eval(30, model_spot)
```

```
mean_res: 0.37542372881355593
std_res: 0.0062985365080116045
min_res: 0.36252354048964214
max_res: 0.3907721280602636
median_res: 0.3752354048964219
```

### 24.18.2 Evalution of the Default Hyperparameters

```python
model_default["svc"].probability = True
model_default.fit(X_train, y_train)["svc"]
```

```
SVC(break_ties=0, cache_size=200.0, probability=True, shrinking=0)
```

- One evaluation of the default hyperparameters is performed on the hold-out test set.

```
y_pred = model_default.predict_proba(X_test)
mapk_score(y_true=y_test, y_pred=y_pred, k=3)
```

```
0.3870056497175141
```

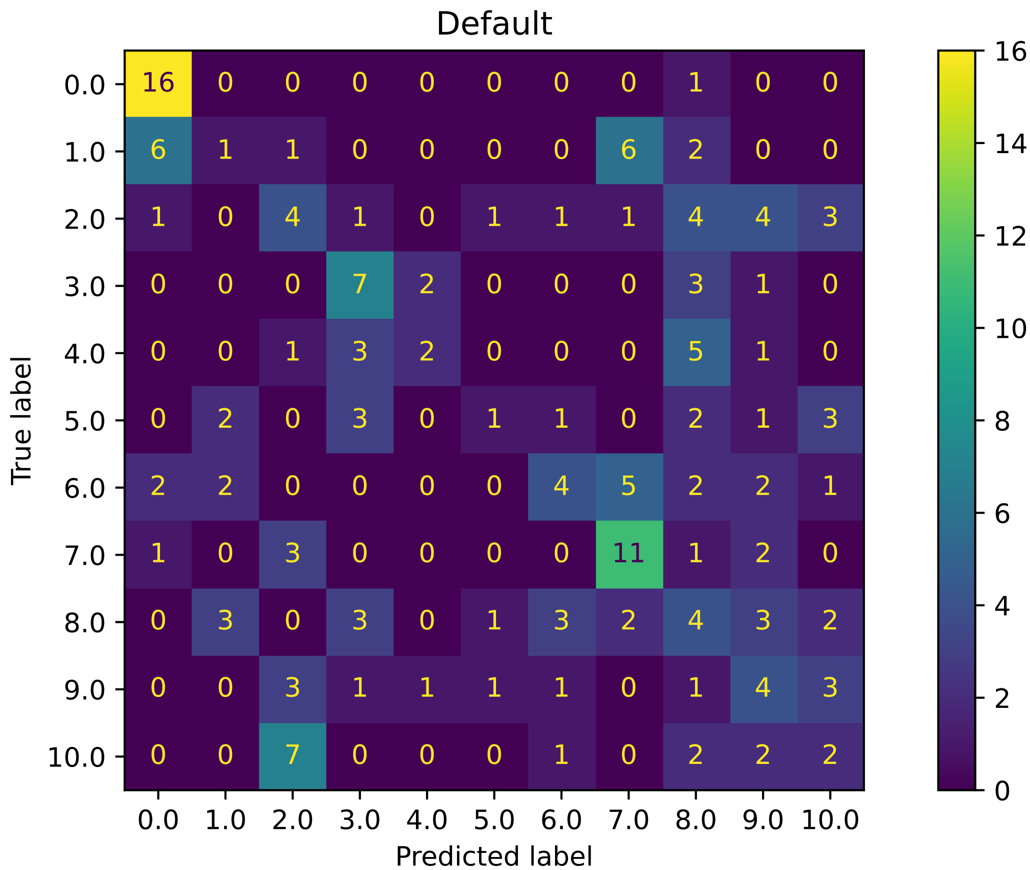
Since one single evaluation is not meaningful, we perform, similar to the evaluation of the SPOT results, $n = 30$ runs of the default setting and and calculate the mean and standard deviation of the performance metric.

```
_ = repeated_eval(30, model_default)
```

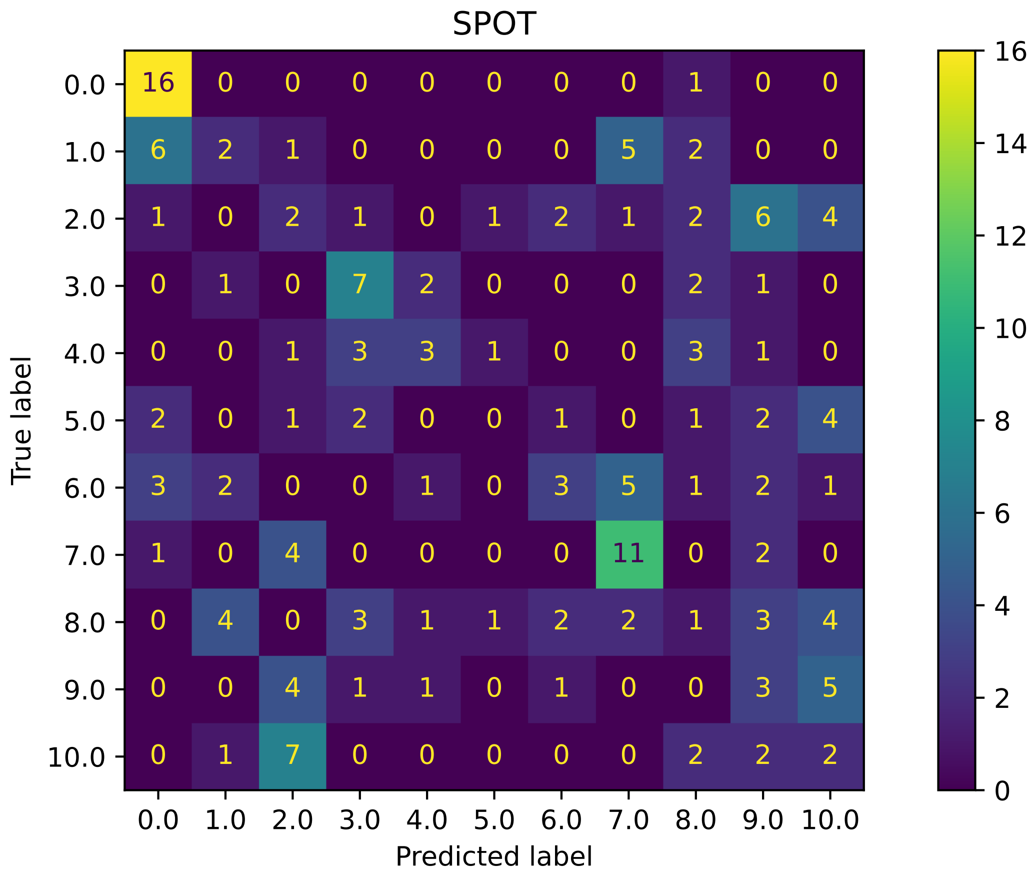
```
mean_res: 0.3839610797237915
std_res: 0.004109342180416669
min_res: 0.3775894538606403
max_res: 0.3935969868173258
median_res: 0.38370998116760824
```

## 24.19 Plot: Compare Predictions

```
from spotPython.plot.validation import plot_confusion_matrix
plot_confusion_matrix(model_default, fun_control, title = "Default")
```




```
plot_confusion_matrix(model_spot, fun_control, title="SPOT")
```




```python
min(spot_tuner.y), max(spot_tuner.y)
```

```
(-0.39348370927318294, -0.3070175438596491)
```

## 24.20 Cross-validated Evaluations

```python
from spotPython.sklearn.traintest import evaluate_cv
fun_control.update({
     "eval": "train_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.3654088050314465, None)
```

```python
fun_control.update({
     "eval": "test_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.3407407407407407, None)
```

- This is the evaluation that will be used in the comparison:

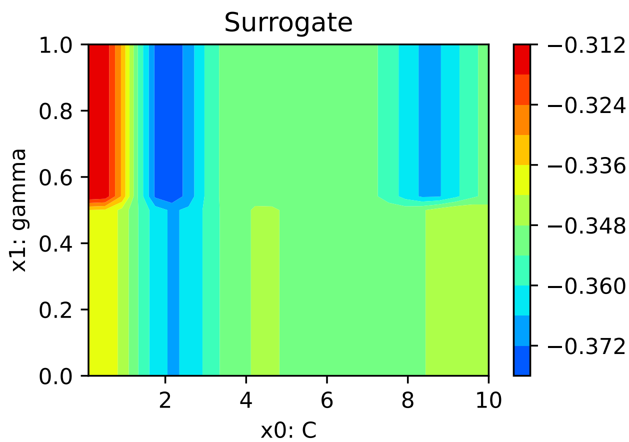
```python
fun_control.update({
     "eval": "data_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

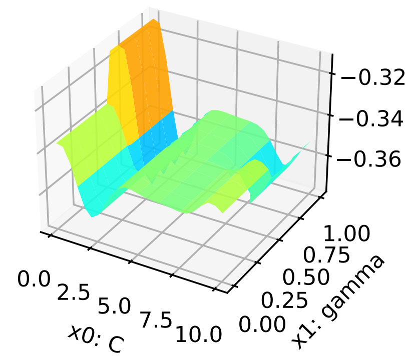
```
(0.36153252850435946, None)
```

### 24.20.1 Detailed Hyperparameter Plots

```python
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
C:  7.630089951040501
gamma:  100.0
```




## 24.21 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

## 24.22 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 25 HPT: sklearn KNN Classifier VBDP Data

This document refers to the following software versions:

- `python`: 3.10.10

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                0.2.34
spotRiver                 0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 25.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time and the initial design size.

```
MAX_TIME = 1
INIT_SIZE = 5
ORIGINAL = False
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '19-knn-sklearn' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(I
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
19-knn-sklearn_p040025_1min_5init_2023-06-17_17-11-07
```

```
import warnings
warnings.filterwarnings("ignore")
```

## 25.2 Step 1: Initialization of the Empty `fun_control` Dictionary

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/16_spot_hpt_sklearn_classification")
```

## 25.3 1. Load Data: Classification

## 25.4 VBDP

```
import pandas as pd
if ORIGINAL == True:
    train_df = pd.read_csv('./data/VBDP/trainn.csv')
    test_df = pd.read_csv('./data/VBDP/testt.csv')
else:
    train_df = pd.read_csv('./data/VBDP/train.csv')
    # remove the id column
    train_df = train_df.drop(columns=['id'])
```

```python
from sklearn.preprocessing import OrdinalEncoder
n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
target_column = "prognosis"
# Encoder our prognosis labels as integers for easier decoding later
enc = OrdinalEncoder()
train_df[target_column] = enc.fit_transform(train_df[[target_column]])
train_df.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train_df.shape)
train_df.head()
```

```
(707, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | ... | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 |
| 3 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 0.0 | 1.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | ... | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |

The full data set `train_df` 64 features. The target column is labeled as `prognosis`.

## 25.5 Holdout Train and Test Data

We split out a hold-out test set (25% of the data) so we can calculate an example MAP@K

```python
import numpy as np
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(train_df.drop(target_column, axis=1),
                                                    random_state=42,
                                                    test_size=0.25,
                                                    stratify=train_df[target_column])
train = pd.DataFrame(np.hstack((X_train, np.array(y_train).reshape(-1, 1))))
test = pd.DataFrame(np.hstack((X_test, np.array(y_test).reshape(-1, 1))))
train.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
test.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train.shape)
print(test.shape)
```

```
train.head()
```

```
(530, 65)
(177, 65)
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x56 | x57 | x58 | x59 | x60 | x61 | x62 | x63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3 | 1.0 | 1.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | ... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

```
# add the dataset to the fun_control
fun_control.update({"data": train_df, # full dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column})
```

## 25.6 Step 3: Specification of the Preprocessing Model

Data preprocesssing can be very simple, e.g., you can ignore it. Then you would choose the `prep_model` “None”:

```
prep_model = None
fun_control.update({"prep_model": prep_model})
```

A default approach for numerical data is the `StandardScaler` (mean 0, variance 1). This can be selected as follows:

```
# prep_model = StandardScaler()
# fun_control.update({"prep_model": prep_model})
```

Even more complicated pre-processing steps are possible, e.g., the follwing pipeline:

```
# categorical_columns = []
# one_hot_encoder = OneHotEncoder(handle_unknown="ignore", sparse_output=False)
# prep_model = ColumnTransformer(
```

```
#         transformers=[
#             ("categorical", one_hot_encoder, categorical_columns),
#         ],
#         remainder=StandardScaler(),
#     )
```

## 25.7 Step 4: Select `algorithm` and `core_model_hyper_dict`

The selection of the algorithm (ML model) that should be tuned is done by specifying the its name from the `sklearn` implementation. For example, the `SVC` support vector machine classifier is selected as follows:

`fun_control = add_core_model_to_fun_control(SVC, fun_control, SklearnHyperDict)`

Other core_models are, e.g.,:

- RidgeCV
- GradientBoostingRegressor
- ElasticNet
- RandomForestClassifier
- LogisticRegression
- KNeighborsClassifier
- RandomForestClassifier
- GradientBoostingClassifier
- HistGradientBoostingClassifier

We will use the `RandomForestClassifier` classifier in this example.

```python
from sklearn.linear_model import RidgeCV
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.ensemble import HistGradientBoostingClassifier
from sklearn.linear_model import ElasticNet
from spotPython.hyperparameters.values import add_core_model_to_fun_control
from spotPython.data.sklearn_hyper_dict import SklearnHyperDict
from spotPython.fun.hypersklearn import HyperSklearn
```

```python
# core_model  = RidgeCV
# core_model = GradientBoostingRegressor
# core_model = ElasticNet
# core_model = RandomForestClassifier
core_model = KNeighborsClassifier
# core_model = LogisticRegression
# core_model = KNeighborsClassifier
# core_model = GradientBoostingClassifier
# core_model = HistGradientBoostingClassifier
fun_control = add_core_model_to_fun_control(core_model=core_model,
                              fun_control=fun_control,
                              hyper_dict=SklearnHyperDict,
                              filename=None)
```

Now `fun_control` has the information from the JSON file. The available hyperparameters are:

```python
print(*fun_control["core_model_hyper_dict"].keys(), sep="\n")
```

```
n_neighbors
weights
algorithm
leaf_size
p
```

## 25.8 Step 5: Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

### 25.8.1 Modify hyperparameter of type numeric and integer (boolean)

Numeric and boolean values can be modified using the `modify_hyper_parameter_bounds` method. For example, to change the `tol` hyperparameter of the `SVC` model to the interval [1e-3, 1e-2], the following code can be used:

`fun_control = modify_hyper_parameter_bounds(fun_control, "tol", bounds=[1e-3, 1e-2])`

```python
# from spotPython.hyperparameters.values import modify_hyper_parameter_bounds
# fun_control = modify_hyper_parameter_bounds(fun_control, "probability", bounds=[1, 1])
```

### 25.8.2 Modify hyperparameter of type factor

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

Factors can be modified with the `modify_hyper_parameter_levels` function. For example, to exclude the `sigmoid` kernel from the tuning, the `kernel` hyperparameter of the `SVC` model can be modified as follows:

`fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["linear", "rbf"])`

The new setting can be controlled via:

`fun_control["core_model_hyper_dict"]["kernel"]`

```
# from spotPython.hyperparameters.values import modify_hyper_parameter_levels
# fun_control = modify_hyper_parameter_levels(fun_control, "kernel", ["rbf"])
```

### 25.8.3 Optimizers

Optimizers are described in Section 21.6.

## 25.9 5. Selection of the Objective: Metric and Loss Functions

- Machine learning models are optimized with respect to a metric, for example, the `accuracy` function.
- Deep learning, e.g., neural networks are optimized with respect to a loss function, for example, the `cross_entropy` function and evaluated with respect to a metric, for example, the `accuracy` function.

## 25.10 Step 6: Selection of the Objective (Loss) Function

The loss function, that is usually used in deep learning for optimizing the weights of the net, is stored in the `fun_control` dictionary as `"loss_function"`.

### 25.10.1 Metric Function

There are two different types of metrics in `spotPython`:

1. `"metric_river"` is used for the river based evaluation via `eval_oml_iter_progressive`.
2. `"metric_sklearn"` is used for the sklearn based evaluation.

We will consider multi-class classification metrics, e.g., `mapk_score` and `top_k_accuracy_score`.

> **Predict Probabilities**
>
> In this multi-class classification example the machine learning algorithm should return the probabilities of the specific classes (`"predict_proba"`) instead of the predicted values.

We set `"predict_proba"` to `True` in the `fun_control` dictionary.

#### 25.10.1.1 The MAPK Metric

To select the MAPK metric, the following two entries can be added to the `fun_control` dictionary:

`"metric_sklearn": mapk_score"`

`"metric_params": {"k": 3}`.

#### 25.10.1.2 Other Metrics

Alternatively, other metrics for multi-class classification can be used, e.g.,: * top_k_accuracy_score or * roc_auc_score

The metric `roc_auc_score` requires the parameter `"multi_class"`, e.g.,

`"multi_class": "ovr"`.

This is set in the `fun_control` dictionary.

> **Weights**
>
> `spotPython` performs a minimization, therefore, metrics that should be maximized have to be multiplied by -1. This is done by setting `"weights"` to `-1`.

- The complete setup for the metric in our example is:

```python
from spotPython.utils.metrics import mapk_score
fun_control.update({
               "weights": -1,
               "metric_sklearn": mapk_score,
               "predict_proba": True,
               "metric_params": {"k": 3},
               })
```

## 25.11 Evaluation on Hold-out Data

- The default method for computing the performance is `"eval_holdout"`.
- Alternatively, cross-validation can be used for every machine learning model.
- Specifically for RandomForests, the OOB-score can be used.

```python
fun_control.update({
    "eval": "train_hold_out",
})
```

#### 25.11.0.1 Cross Validation

Instead of using the OOB-score, the classical cross validation can be used. The number of folds is set by the key `"k_folds"`. For example, to use 5-fold cross validation, the key `"k_folds"` is set to `5`. Uncomment the following line to use cross validation:

```python
# fun_control.update({
#      "eval": "train_cv",
#      "k_folds": 10,
# })
```

## 25.12 6. Calling the SPOT Function

## 25.13 Preparing the SPOT Call

- Get types and variable names as well as lower and upper bounds for the hyperparameters.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name        | type   | default   |   lower |   upper | transform             |
|-------------|--------|-----------|---------|---------|-----------------------|
| n_neighbors | int    | 2         |       1 |       7 | transform_power_2_int |
| weights     | factor | uniform   |       0 |       1 | None                  |
| algorithm   | factor | auto      |       0 |       3 | None                  |
| leaf_size   | int    | 5         |       2 |       7 | transform_power_2_int |
| p           | int    | 2         |       1 |       2 | None                  |
```

## 25.14 The Objective Function

The objective function is selected next. It implements an interface from `sklearn`'s training, validation, and testing methods to `spotPython`.

```
from spotPython.fun.hypersklearn import HyperSklearn
fun = HyperSklearn().fun_sklearn
```

### 25.14.1 Run the `Spot` Optimizer

- Run SPOT for approx. x mins (`max_time`).
- Note: the run takes longer, because the evaluation time of initial design (here: `initi_size`, 20 points) is not considered.

```
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=SklearnHyperDict().load()
```

```python
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
X_start
```

```
array([[2, 0, 0, 5, 2]])
```

```python
import numpy as np
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
                                      "model_fun_evals": 10_000,
                                      "log_level": 50
                                      })
spot_tuner.run(X_start=X_start)
```

```
spotPython tuning: -0.3107769423558897 [----------] 0.25%
```

```
spotPython tuning: -0.3107769423558897 [----------] 0.53%
```

```
spotPython tuning: -0.3107769423558897 [----------] 0.81%

spotPython tuning: -0.3107769423558897 [----------] 1.07%

spotPython tuning: -0.3107769423558897 [----------] 1.32%

spotPython tuning: -0.3107769423558897 [----------] 1.63%

spotPython tuning: -0.3107769423558897 [----------] 2.02%

spotPython tuning: -0.3107769423558897 [----------] 2.35%

spotPython tuning: -0.3107769423558897 [----------] 2.68%

spotPython tuning: -0.3107769423558897 [----------] 2.97%

spotPython tuning: -0.3107769423558897 [----------] 3.26%

spotPython tuning: -0.3107769423558897 [----------] 4.24%

spotPython tuning: -0.3107769423558897 [#---------] 5.27%

spotPython tuning: -0.3107769423558897 [#---------] 6.46%

spotPython tuning: -0.3107769423558897 [#---------] 7.64%

spotPython tuning: -0.3107769423558897 [#---------] 8.88%

spotPython tuning: -0.3107769423558897 [#---------] 10.34%

spotPython tuning: -0.3107769423558897 [#---------] 11.47%

spotPython tuning: -0.3107769423558897 [#---------] 13.42%

spotPython tuning: -0.3107769423558897 [#---------] 14.68%

spotPython tuning: -0.3107769423558897 [##--------] 15.72%
```

```
spotPython tuning: -0.3107769423558897 [##--------] 16.59%

spotPython tuning: -0.3107769423558897 [##--------] 17.57%

spotPython tuning: -0.3107769423558897 [##--------] 18.78%

spotPython tuning: -0.3107769423558897 [##--------] 19.74%

spotPython tuning: -0.3107769423558897 [##--------] 20.95%

spotPython tuning: -0.3107769423558897 [##--------] 22.25%

spotPython tuning: -0.3107769423558897 [##--------] 23.81%

spotPython tuning: -0.3107769423558897 [###-------] 25.51%

spotPython tuning: -0.3107769423558897 [###-------] 27.30%

spotPython tuning: -0.3107769423558897 [###-------] 28.96%

spotPython tuning: -0.3107769423558897 [###-------] 31.35%

spotPython tuning: -0.3107769423558897 [###-------] 33.45%

spotPython tuning: -0.3107769423558897 [####------] 36.02%

spotPython tuning: -0.3107769423558897 [####------] 39.88%

spotPython tuning: -0.3107769423558897 [####------] 42.75%

spotPython tuning: -0.3107769423558897 [#####-----] 45.47%

spotPython tuning: -0.3107769423558897 [#####-----] 48.46%

spotPython tuning: -0.3107769423558897 [#####-----] 51.16%

spotPython tuning: -0.3107769423558897 [#####-----] 53.91%
```

```
spotPython tuning: -0.3107769423558897 [######----] 56.97%

spotPython tuning: -0.3107769423558897 [######----] 59.99%

spotPython tuning: -0.3107769423558897 [######----] 63.25%

spotPython tuning: -0.3107769423558897 [#######---] 66.52%

spotPython tuning: -0.3107769423558897 [#######---] 69.47%

spotPython tuning: -0.3107769423558897 [#######---] 72.57%

spotPython tuning: -0.3107769423558897 [########--] 76.80%

spotPython tuning: -0.3107769423558897 [########--] 80.10%

spotPython tuning: -0.3107769423558897 [########--] 83.46%

spotPython tuning: -0.3107769423558897 [#########-] 87.25%

spotPython tuning: -0.3107769423558897 [#########-] 91.25%

spotPython tuning: -0.3107769423558897 [#########-] 94.59%

spotPython tuning: -0.3107769423558897 [##########] 97.09%

spotPython tuning: -0.3107769423558897 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x140d25e40>
```

### 25.14.2 Results

After the hyperparameter tuning run is finished, the progress of the hyperparameter tuning can be visualized. The following code generates the progress plot from **?@fig-progress**.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

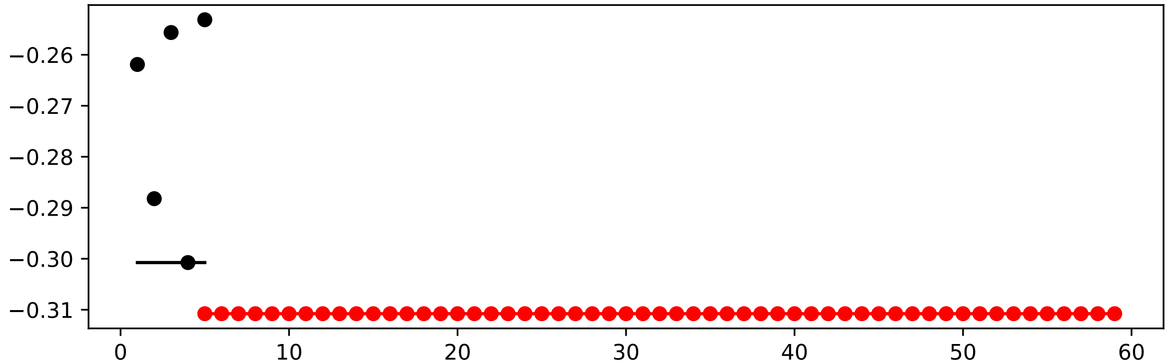



Figure 25.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

- Print the results

```
print(gen_design_table(fun_control=fun_control,
    spot=spot_tuner))
```

```
| name        | type   | default   |   lower |   upper |   tuned | transform             |
|-------------|--------|-----------|---------|---------|---------|-----------------------|---
| n_neighbors | int    | 2         |       1 |       7 |     4.0 | transform_power_2_int |
| weights     | factor | uniform   |       0 |       1 |     1.0 | None                  |
| algorithm   | factor | auto      |       0 |       3 |     2.0 | None                  |
| leaf_size   | int    | 5         |       2 |       7 |     6.0 | transform_power_2_int |
| p           | int    | 2         |       1 |       2 |     1.0 | None                  |
```

## 25.15 Show variable importance

```
spot_tuner.plot_importance(threshold=0.025, filename="./figures/" + experiment_name+"_impo
```

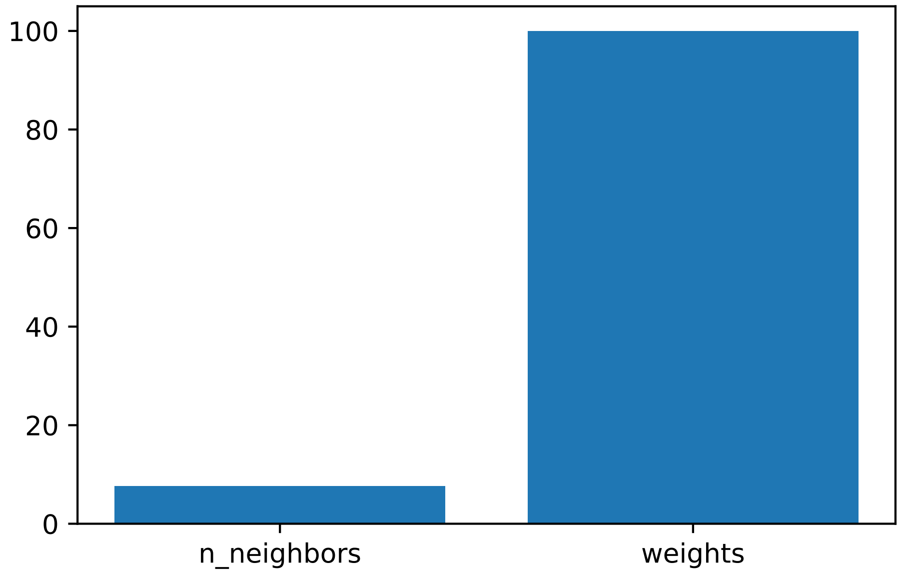



Figure 25.2: Variable importance plot, threshold 0.025.

## 25.16 Get Default Hyperparameters

```
from spotPython.hyperparameters.values import get_default_values, transform_hyper_paramete
values_default = get_default_values(fun_control)
values_default = transform_hyper_parameter_values(fun_control=fun_control, hyper_parameter
values_default
```

```
{'n_neighbors': 4,
 'weights': 'uniform',
 'algorithm': 'auto',
 'leaf_size': 32,
 'p': 2}
```

```python
from sklearn.pipeline import make_pipeline
model_default = make_pipeline(fun_control["prep_model"], fun_control["core_model"](**value
model_default
```

```
Pipeline(steps=[('nonetype', None),
                ('kneighborsclassifier',
                 KNeighborsClassifier(leaf_size=32, n_neighbors=4))])
```

## 25.17 Get SPOT Results

```python
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
print(X)
```

```
[[4. 1. 2. 6. 1.]]
```

```python
from spotPython.hyperparameters.values import assign_values, return_conf_list_from_var_dic
v_dict = assign_values(X, fun_control["var_name"])
return_conf_list_from_var_dict(var_dict=v_dict, fun_control=fun_control)
```

```
[{'n_neighbors': 16,
  'weights': 'distance',
  'algorithm': 'kd_tree',
  'leaf_size': 64,
  'p': 1}]
```

```python
from spotPython.hyperparameters.values import get_one_sklearn_model_from_X
model_spot = get_one_sklearn_model_from_X(X, fun_control)
model_spot
```

```
KNeighborsClassifier(algorithm='kd_tree', leaf_size=64, n_neighbors=16, p=1,
                     weights='distance')
```

## 25.18 Evaluate SPOT Results

- Fetch the data.

```python
from spotPython.utils.convert import get_Xy_from_df
X_train, y_train = get_Xy_from_df(fun_control["train"], fun_control["target_column"])
X_test, y_test = get_Xy_from_df(fun_control["test"], fun_control["target_column"])
X_test.shape, y_test.shape
```

```
((177, 64), (177,))
```

- Fit the model with the tuned hyperparameters. This gives one result:

```python
model_spot.fit(X_train, y_train)
y_pred = model_spot.predict_proba(X_test)
res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
res
```

```
0.3267419962335216
```

```python
def repeated_eval(n, model):
    res_values = []
    for i in range(n):
        model.fit(X_train, y_train)
        y_pred = model.predict_proba(X_test)
        res = mapk_score(y_true=y_test, y_pred=y_pred, k=3)
        res_values.append(res)
    mean_res = np.mean(res_values)
    print(f"mean_res: {mean_res}")
    std_res = np.std(res_values)
    print(f"std_res: {std_res}")
    min_res = np.min(res_values)
    print(f"min_res: {min_res}")
    max_res = np.max(res_values)
    print(f"max_res: {max_res}")
    median_res = np.median(res_values)
    print(f"median_res: {median_res}")
    return mean_res, std_res, min_res, max_res, median_res
```

### 25.18.1 Handling Non-deterministic Results

- Because the model is non-determinstic, we perform $n = 30$ runs and calculate the mean and standard deviation of the performance metric.

```
_ = repeated_eval(30, model_spot)
```

```
mean_res: 0.3267419962335218
std_res: 1.6653345369377348e-16
min_res: 0.3267419962335216
max_res: 0.3267419962335216
median_res: 0.3267419962335216
```

### 25.18.2 Evalution of the Default Hyperparameters

```
model_default.fit(X_train, y_train)["kneighborsclassifier"]
```

```
KNeighborsClassifier(leaf_size=32, n_neighbors=4)
```

- One evaluation of the default hyperparameters is performed on the hold-out test set.

```
y_pred = model_default.predict_proba(X_test)
mapk_score(y_true=y_test, y_pred=y_pred, k=3)
```

```
0.2768361581920904
```

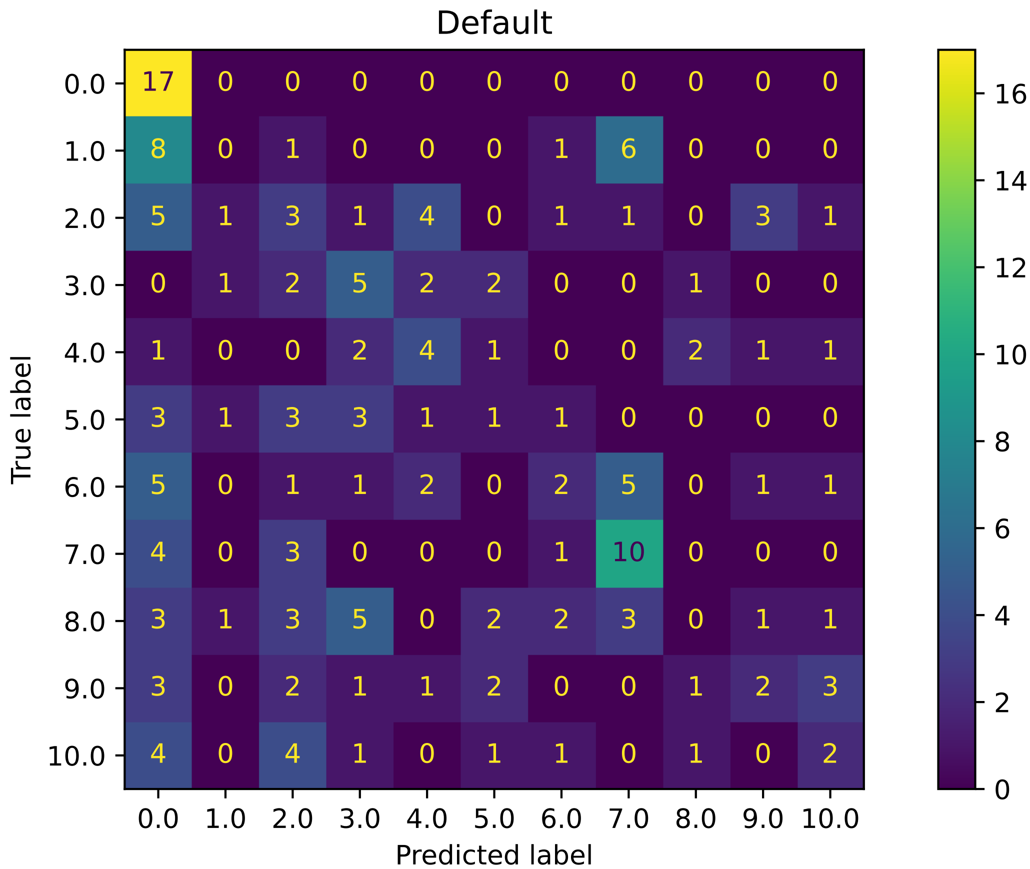
Since one single evaluation is not meaningful, we perform, similar to the evaluation of the SPOT results, $n = 30$ runs of the default setting and and calculate the mean and standard deviation of the performance metric.

```
_ = repeated_eval(30, model_default)
```

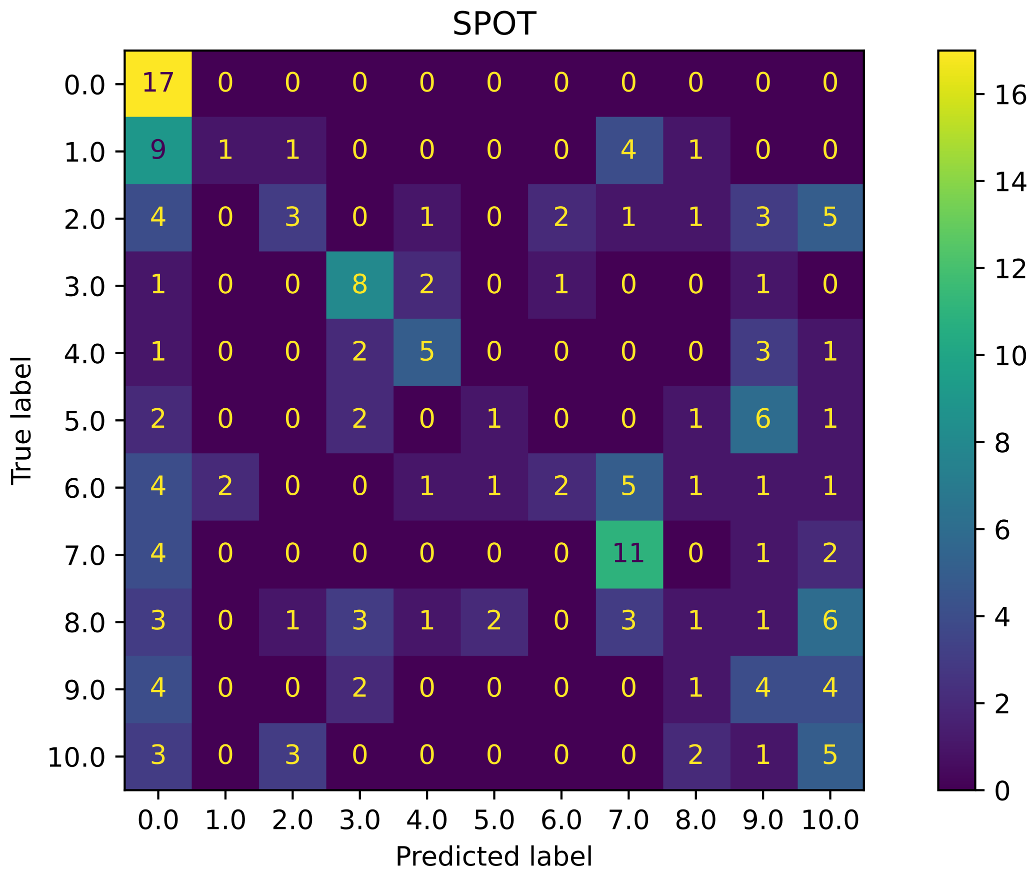
```
mean_res: 0.2768361581920903
std_res: 1.1102230246251565e-16
min_res: 0.2768361581920904
max_res: 0.2768361581920904
median_res: 0.2768361581920904
```

## 25.19 Plot: Compare Predictions

```
from spotPython.plot.validation import plot_confusion_matrix
plot_confusion_matrix(model_default, fun_control, title = "Default")
```




```
plot_confusion_matrix(model_spot, fun_control, title="SPOT")
```




```
min(spot_tuner.y), max(spot_tuner.y)
```

```
(-0.3107769423558897, -0.23558897243107768)
```

## 25.20 Cross-validated Evaluations

```
from spotPython.sklearn.traintest import evaluate_cv
fun_control.update({
     "eval": "train_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.3157232704402516, None)
```

```python
fun_control.update({
     "eval": "test_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

```
(0.2832788671023965, None)
```

- This is the evaluation that will be used in the comparison:

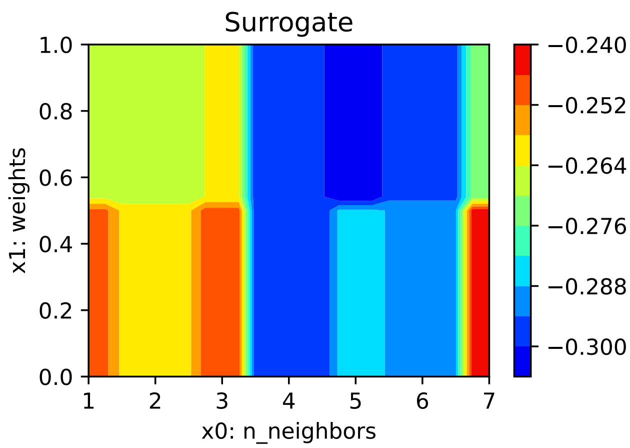
```python
fun_control.update({
     "eval": "data_cv",
     "k_folds": 10,
})
evaluate_cv(model=model_spot, fun_control=fun_control, verbose=0)
```

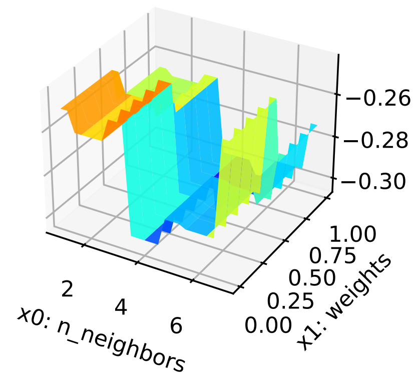
```
(0.3061904761904762, None)
```

### 25.20.1 Detailed Hyperparameter Plots

```python
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
n_neighbors:  7.659298853276286
weights:  100.0
```




## 25.21 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

## 25.22 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 26 HPT PyTorch: Regression

In this tutorial, we will show how `spotPython` can be integrated into the `PyTorch` training workflow for regreession tasks.

This document refers to the following software versions:

- `python`: 3.10.10
- `torch`: 2.0.1
- `torchvision`: 0.15.0

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34
spotRiver                     0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 26.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time, initial design size and the device that is used.

```
MAX_TIME = 1
INIT_SIZE = 5
DEVICE = "cpu" # "cuda:0"
```

```
from spotPython.utils.device import getDevice
DEVICE = getDevice(DEVICE)
print(DEVICE)
```

```
cpu
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '24-torch' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(INIT_SI
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
24-torch_p040025_1min_5init_2023-06-17_17-15-24
```

## 26.2 Initialization of the `fun_control` Dictionary

`spotPython` uses a Python dictionary for storing the information required for the hyperparameter tuning process, which was described in Section 21.2.

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="regression",
 tensorboard_path="runs/24_spot_torch_regression",
 device=DEVICE)
```

## 26.3 PyTorch Data Loading

```python
# Create dataset
import pandas as pd
import numpy as np
from sklearn import datasets as sklearn_datasets
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split
X, y = sklearn_datasets.make_regression(
    n_samples=1000, n_features=10, noise=1, random_state=123)
y = y.reshape(-1, 1)

# Normalize the data
X_scaler = MinMaxScaler()
X_scaled = X_scaler.fit_transform(X)
y_scaler = MinMaxScaler()
y_scaled = y_scaler.fit_transform(y)

# combine the features and target into a single dataframe named train_df
train_df = pd.DataFrame(np.hstack((X_scaled, y_scaled)))

target_column = "y"
n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
train_df.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
X_train, X_test, y_train, y_test = train_test_split(train_df.drop(target_column,
    axis=1),
    train_df[target_column],
    random_state=42,
    test_size=0.25)
trainset = pd.DataFrame(np.hstack((X_train, np.array(y_train).reshape(-1, 1))))
testset = pd.DataFrame(np.hstack((X_test, np.array(y_test).reshape(-1, 1))))
trainset.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
testset.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train_df.shape)
print(trainset.shape)
print(testset.shape)
```

```
(1000, 11)
(750, 11)
(250, 11)
```

```python
import torch
from spotPython.torch.dataframedataset import DataFrameDataset
dtype_x = torch.float32
dtype_y = torch.float32
train_df = DataFrameDataset(train_df, target_column=target_column,
    dtype_x=dtype_x, dtype_y=dtype_y)
train = DataFrameDataset(trainset, target_column=target_column,
    dtype_x=dtype_x, dtype_y=dtype_y)
test = DataFrameDataset(testset, target_column=target_column,
    dtype_x=dtype_x, dtype_y=dtype_y)
n_samples = len(train)
```

- Now we can test the data loading:

```python
from spotPython.torch.traintest import create_train_val_data_loaders
trainloader, testloader = create_train_val_data_loaders(train, 2, True, 0)
for i, data in enumerate(trainloader, 0):
    inputs, labels = data
    print(inputs.shape)
    print(labels.shape)
    print(inputs)
    print(labels)
    break
```

```
torch.Size([2, 10])
torch.Size([2])
tensor([[0.5157, 0.4415, 0.5288, 0.6499, 0.5229, 0.5966, 0.2471, 0.3143, 0.7848,
         0.5442],
        [0.6669, 0.3708, 0.6103, 0.6238, 0.4370, 0.4884, 0.2937, 0.3827, 0.8389,
         0.6200]])
tensor([0.4970, 0.4677])
```

- Since this works fine, we can add the data loading to the `fun_control` dictionary:

```python
# add the dataset to the fun_control
fun_control.update({"data": train_df, # full dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column,})
```

## 26.4 The Model (Algorithm) to be Tuned

## 26.5 Specification of the Preprocessing Model

After the training and test data are specified and added to the `fun_control` dictionary, `spotPython` allows the specification of a data preprocessing pipeline, e.g., for the scaling of the data or for the one-hot encoding of categorical variables, see Section 21.4.1. This feature is not used here, so we do not change the default value (which is `None`).

## 26.6 Select `algorithm` and `core_model_hyper_dict`

### 26.6.1 Implementing a Configurable Neural Network With spotPython

`spotPython` includes the `Net_lin_reg` class which is implemented in the file `netregression.py`.

This class inherits from the class `Net_Core` which is implemented in the file `netcore.py`, see Section 21.4.3.

```
from torch import nn
import spotPython.torch.netcore as netcore


class Net_lin_reg(netcore.Net_Core):
    def __init__(
        self, _L_in, _L_out, l1, dropout_prob, lr_mult,
        batch_size, epochs, k_folds, patience, optimizer,
        sgd_momentum
    ):
        super(Net_lin_reg, self).__init__(
            lr_mult=lr_mult,
            batch_size=batch_size,
            epochs=epochs,
            k_folds=k_folds,
            patience=patience,
            optimizer=optimizer,
            sgd_momentum=sgd_momentum,
        )
        l2 = max(l1 // 2, 4)
        self.fc1 = nn.Linear(_L_in, l1)
        self.fc2 = nn.Linear(l1, l2)
```

```python
        self.fc3 = nn.Linear(l2, _L_out)
        self.relu = nn.ReLU()
        self.softmax = nn.Softmax(dim=1)
        self.dropout1 = nn.Dropout(p=dropout_prob)
        self.dropout2 = nn.Dropout(p=dropout_prob / 2)

    def forward(self, x):
        x = self.fc1(x)
        x = self.relu(x)
        x = self.dropout1(x)
        x = self.fc2(x)
        x = self.relu(x)
        x = self.dropout2(x)
        x = self.fc3(x)
        return x
```

#### 26.6.1.1 The `Net_Core` class

`Net_lin_reg` inherits from the class `Net_Core` which is implemented in the file `netcore.py`. This class was described in Section 21.4.3.

```python
from spotPython.torch.netregression import Net_lin_reg
from spotPython.data.torch_hyper_dict import TorchHyperDict
from spotPython.hyperparameters.values import add_core_model_to_fun_control
fun_control = add_core_model_to_fun_control(core_model=Net_lin_reg,
                              fun_control=fun_control,
                              hyper_dict=TorchHyperDict,
                              filename=None)
```

## 26.7 The Search Space

### 26.7.1 Configuring the Search Space With spotPython

#### 26.7.1.1 The `hyper_dict` Hyperparameters for the Selected Algorithm

`spotPython` uses `JSON` files for the specification of the hyperparameters, which were described in Section 21.5.2.

The corresponding entries for the `Net_lin_reg` class are shown below.

```
"Net_lin_reg":
{
    "_L_in": {
        "type": "int",
        "default": 10,
        "transform": "None",
        "lower": 10,
        "upper": 10},
    "_L_out": {
        "type": "int",
        "default": 1,
        "transform": "None",
        "lower": 1,
        "upper": 1},
    "l1": {
        "type": "int",
        "default": 3,
        "transform": "transform_power_2_int",
        "lower": 3,
        "upper": 8},
    "dropout_prob": {
        "type": "float",
        "default": 0.01,
        "transform": "None",
        "lower": 0.0,
        "upper": 0.9},
    "lr_mult": {
        "type": "float",
        "default": 1.0,
        "transform": "None",
        "lower": 0.1,
        "upper": 10.0},
    "batch_size": {
        "type": "int",
        "default": 4,
        "transform": "transform_power_2_int",
        "lower": 1,
        "upper": 4},
    "epochs": {
        "type": "int",
        "default": 4,
```

```
        "transform": "transform_power_2_int",
        "lower": 4,
        "upper": 9},
    "k_folds": {
        "type": "int",
        "default": 1,
        "transform": "None",
        "lower": 1,
        "upper": 1},
    "patience": {
        "type": "int",
        "default": 2,
        "transform": "transform_power_2_int",
        "lower": 1,
        "upper": 5
    },
    "optimizer": {
        "levels": ["Adadelta",
                   "Adagrad",
                   "Adam",
                   "AdamW",
                   "SparseAdam",
                   "Adamax",
                   "ASGD",
                   "NAdam",
                   "RAdam",
                   "RMSprop",
                   "Rprop",
                   "SGD"],
        "type": "factor",
        "default": "SGD",
        "transform": "None",
        "class_name": "torch.optim",
        "core_model_parameter_type": "str",
        "lower": 0,
        "upper": 12},
    "sgd_momentum": {
        "type": "float",
        "default": 0.0,
        "transform": "None",
        "lower": 0.0,
```

```
            "upper": 1.0}
    },
```

## 26.8 Modifying the Hyperparameters

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

### 26.8.1 Modify `hyper_dict` Hyperparameters for the Selected Algorithm aka `core_model`

#### 26.8.1.1 Modify Hyperparameters of Type numeric and integer (boolean)

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds

fun_control = modify_hyper_parameter_bounds(fun_control, "epochs", bounds=[2, 16])
fun_control = modify_hyper_parameter_bounds(fun_control, "patience", bounds=[3, 7])
```

#### 26.8.1.2 Modify Hyperparameter of Type factor

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
fun_control = modify_hyper_parameter_levels(fun_control, "optimizer",
    ["Adadelta", "Adagrad", "Adam", "AdamW", "Adamax", "ASGD", "NAdam"])


fun_control.update({
               "_L_in": n_features,
               "_L_out": 1,})
```

### 26.8.2 Optimizers

Optimizers are described in Section 21.6.

## 26.9 Evaluation

The evaluation procedure requires the specification of two elements:

1. the way how the data is split into a train and a test set (see Section 21.7)
2. the loss function (and a metric).

### 26.9.1 Loss Functions and Metrics

The key `"loss_function"` specifies the loss function which is used during the optimization, see Section 21.8.

We will use MSE loss for the regression task.

```
from torch.nn import MSELoss
loss_torch = MSELoss()
fun_control.update({"loss_function": loss_torch})
```

### 26.9.2 Metric

```
from torchmetrics import MeanAbsoluteError
metric_torch = MeanAbsoluteError().to(fun_control["device"])
fun_control.update({"metric_torch": metric_torch})
```

## 26.10 Preparing the SPOT Call

The following code passes the information about the parameter ranges and bounds to `spot`.

```
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

```python
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name         | type   | default   |   lower |   upper | transform             |
|--------------|--------|-----------|---------|---------|-----------------------|
| _L_in        | int    | 10        |    10   |    10   | None                  |
| _L_out       | int    | 1         |     1   |     1   | None                  |
| l1           | int    | 3         |     3   |     8   | transform_power_2_int |
| dropout_prob | float  | 0.01      |     0   |     0.9 | None                  |
| lr_mult      | float  | 1.0       |     0.1 |    10   | None                  |
| batch_size   | int    | 4         |     1   |     4   | transform_power_2_int |
| epochs       | int    | 4         |     2   |    16   | transform_power_2_int |
| k_folds      | int    | 1         |     1   |     1   | None                  |
| patience     | int    | 2         |     3   |     7   | transform_power_2_int |
| optimizer    | factor | SGD       |     0   |     6   | None                  |
| sgd_momentum | float  | 0.0       |     0   |     1   | None                  |
```

## 26.11 The Objective Function `fun_torch`

The objective function `fun_torch` is selected next. It implements an interface from `PyTorch`'s training, validation, and testing methods to `spotPython`.

```python
from spotPython.fun.hypertorch import HyperTorch
fun = HyperTorch().fun_torch
```

```python
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=TorchHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
```

## 26.12 Starting the Hyperparameter Tuning

The `spotPython` hyperparameter tuning is started by calling the `Spot` function as described in Section 21.12.

```python
from spotPython.spot import spot
from math import inf
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
```

```
                     upper = upper,
                     fun_evals = inf,
                     fun_repeats = 1,
                     max_time = MAX_TIME,
                     noise = False,
                     tolerance_x = np.sqrt(np.spacing(1)),
                     var_type = var_type,
                     var_name = var_name,
                     infill_criterion = "y",
                     n_points = 1,
                     seed=123,
                     log_level = 50,
                     show_models= False,
                     show_progress= True,
                     fun_control = fun_control,
                     design_control={"init_size": INIT_SIZE,
                                     "repeats": 1},
                     surrogate_control={"noise": True,
                                        "cod_type": "norm",
                                        "min_theta": -4,
                                        "max_theta": 3,
                                        "n_theta": len(var_name),
                                        "model_fun_evals": 10_000,
                                        "log_level": 50
                                        })
spot_tuner.run(X_start=X_start)
```

```
config: {'_L_in': 10, '_L_out': 1, 'l1': 64, 'dropout_prob': 0.7103122166156, 'lr_mult': 3.62
Epoch: 1

Loss on hold-out set: 0.05124847997764224
MeanAbsoluteError value on hold-out data: 0.18463875353336334
Epoch: 2
Loss on hold-out set: 0.0413902588678818
MeanAbsoluteError value on hold-out data: 0.16407173871994019
Epoch: 3
Loss on hold-out set: 0.0359492131116751
MeanAbsoluteError value on hold-out data: 0.15280792117118835
Epoch: 4
Loss on hold-out set: 0.03308462545177654
```

```
MeanAbsoluteError value on hold-out data: 0.14685997366905212
Epoch: 5
Loss on hold-out set: 0.029648005374168094
MeanAbsoluteError value on hold-out data: 0.13910916447639465
Epoch: 6
Loss on hold-out set: 0.027434186409472636
MeanAbsoluteError value on hold-out data: 0.13182179629802704
Epoch: 7
Loss on hold-out set: 0.028866728498159272
MeanAbsoluteError value on hold-out data: 0.13520348072052002
Epoch: 8
Loss on hold-out set: 0.02911795612032476
MeanAbsoluteError value on hold-out data: 0.13549548387527466
Epoch: 9

Loss on hold-out set: 0.02196553870300321
MeanAbsoluteError value on hold-out data: 0.11646810173988342
Epoch: 10

Loss on hold-out set: 0.025017925047952878
MeanAbsoluteError value on hold-out data: 0.12791354954242706
Epoch: 11

Loss on hold-out set: 0.02237258431207585
MeanAbsoluteError value on hold-out data: 0.11958703398704529
Epoch: 12
Loss on hold-out set: 0.02157470490783453
MeanAbsoluteError value on hold-out data: 0.11745011806488037
Epoch: 13
Loss on hold-out set: 0.020393225376641278
MeanAbsoluteError value on hold-out data: 0.11391065269708633
Epoch: 14
Loss on hold-out set: 0.021220962492454993
MeanAbsoluteError value on hold-out data: 0.11578843742609024
Epoch: 15
Loss on hold-out set: 0.01935435913650221
MeanAbsoluteError value on hold-out data: 0.1107984185218811
Epoch: 16
Loss on hold-out set: 0.01996796491776446
MeanAbsoluteError value on hold-out data: 0.11370176821947098
Epoch: 17
Loss on hold-out set: 0.019045713235084947
```

```
MeanAbsoluteError value on hold-out data: 0.10964040458202362
Epoch: 18
Loss on hold-out set: 0.020732289112761225
MeanAbsoluteError value on hold-out data: 0.11564496159553528
Epoch: 19
Loss on hold-out set: 0.01697558560408652
MeanAbsoluteError value on hold-out data: 0.10303089767694473
Epoch: 20

Loss on hold-out set: 0.01736863757679729


MeanAbsoluteError value on hold-out data: 0.10403746366500854
Epoch: 21
Loss on hold-out set: 0.01820789265299314
MeanAbsoluteError value on hold-out data: 0.10686080902814865
Epoch: 22

Loss on hold-out set: 0.01898970713495816
MeanAbsoluteError value on hold-out data: 0.10710354149341583
Epoch: 23
Loss on hold-out set: 0.01771577593478325
MeanAbsoluteError value on hold-out data: 0.10593778640031815
Epoch: 24
Loss on hold-out set: 0.014014983316883445
MeanAbsoluteError value on hold-out data: 0.09109798073768616
Epoch: 25
Loss on hold-out set: 0.0233760487508813
MeanAbsoluteError value on hold-out data: 0.11959344148635864
Epoch: 26
Loss on hold-out set: 0.01700471999662879
MeanAbsoluteError value on hold-out data: 0.10307834297418594
Epoch: 27
Loss on hold-out set: 0.016031273701963455
MeanAbsoluteError value on hold-out data: 0.0993259996175766
Epoch: 28
Loss on hold-out set: 0.015553755844992242
MeanAbsoluteError value on hold-out data: 0.0937018021941185
Epoch: 29
Loss on hold-out set: 0.013818275624592053
MeanAbsoluteError value on hold-out data: 0.09178714454174042
Epoch: 30
```

```
Loss on hold-out set: 0.01403676188477364
MeanAbsoluteError value on hold-out data: 0.09106137603521347
Epoch: 31
Loss on hold-out set: 0.01298080633492454
MeanAbsoluteError value on hold-out data: 0.09046866744756699
Epoch: 32
Loss on hold-out set: 0.01385184103549507
MeanAbsoluteError value on hold-out data: 0.09176404029130936

Epoch: 33
Loss on hold-out set: 0.011891311782069112
MeanAbsoluteError value on hold-out data: 0.08454371243715286
Epoch: 34
Loss on hold-out set: 0.014116326089654314
MeanAbsoluteError value on hold-out data: 0.09481821954250336
Epoch: 35
Loss on hold-out set: 0.011010310459440868
MeanAbsoluteError value on hold-out data: 0.08141487091779709
Epoch: 36
Loss on hold-out set: 0.012714927060235488
MeanAbsoluteError value on hold-out data: 0.08689180761575699
Epoch: 37
Loss on hold-out set: 0.015261190342961958
MeanAbsoluteError value on hold-out data: 0.0981006994843483
Epoch: 38
Loss on hold-out set: 0.011953937098089801
MeanAbsoluteError value on hold-out data: 0.08634082227945328
Epoch: 39
Loss on hold-out set: 0.01052813808813593
MeanAbsoluteError value on hold-out data: 0.08076999336481094
Epoch: 40
Loss on hold-out set: 0.010453678119167881
MeanAbsoluteError value on hold-out data: 0.07897049933671951
Epoch: 41

Loss on hold-out set: 0.010225962593195666
MeanAbsoluteError value on hold-out data: 0.07841142266988754
Epoch: 42
Loss on hold-out set: 0.00999055786278883
MeanAbsoluteError value on hold-out data: 0.07799597084522247
Epoch: 43
```

```
Loss on hold-out set: 0.012026917606003974
MeanAbsoluteError value on hold-out data: 0.08260044455528259
Epoch: 44
Loss on hold-out set: 0.011320322751998901
MeanAbsoluteError value on hold-out data: 0.079743392765522
Epoch: 45
Loss on hold-out set: 0.010475970535097938
MeanAbsoluteError value on hold-out data: 0.0791616216301918
Epoch: 46
Loss on hold-out set: 0.010522928576009642
MeanAbsoluteError value on hold-out data: 0.07948528975248337
Epoch: 47
Loss on hold-out set: 0.01234454084432831
MeanAbsoluteError value on hold-out data: 0.08706151694059372
Epoch: 48
Loss on hold-out set: 0.010706434689621491
MeanAbsoluteError value on hold-out data: 0.07463809847831726
Epoch: 49
Loss on hold-out set: 0.009179026583871363
MeanAbsoluteError value on hold-out data: 0.07341794669628143
Epoch: 50
Loss on hold-out set: 0.01010208645541417
MeanAbsoluteError value on hold-out data: 0.0786900743842125
Epoch: 51

Loss on hold-out set: 0.00970978318946436
MeanAbsoluteError value on hold-out data: 0.07412293553352356
Epoch: 52
Loss on hold-out set: 0.010123260141546396
MeanAbsoluteError value on hold-out data: 0.07511269301176071
Epoch: 53

Loss on hold-out set: 0.00929629175286544
MeanAbsoluteError value on hold-out data: 0.07434546202421188
Epoch: 54
Loss on hold-out set: 0.012046185175054952
MeanAbsoluteError value on hold-out data: 0.08608686923980713
Epoch: 55
Loss on hold-out set: 0.010225081151522892
MeanAbsoluteError value on hold-out data: 0.07680799812078476
Epoch: 56
Loss on hold-out set: 0.008971378651423086
```

```
MeanAbsoluteError value on hold-out data: 0.07320232689380646
Epoch: 57
Loss on hold-out set: 0.009924339338842975
MeanAbsoluteError value on hold-out data: 0.07914730906486511
Epoch: 58
Loss on hold-out set: 0.01007639795027085
MeanAbsoluteError value on hold-out data: 0.07475905120372772
Epoch: 59
Loss on hold-out set: 0.009925851907035778
MeanAbsoluteError value on hold-out data: 0.0765208750963211
Epoch: 60
Loss on hold-out set: 0.010347356523485169
MeanAbsoluteError value on hold-out data: 0.07775337994098663
Epoch: 61
Loss on hold-out set: 0.00887471906179072
MeanAbsoluteError value on hold-out data: 0.07012048363685608
Epoch: 62

Loss on hold-out set: 0.00855493780507363
MeanAbsoluteError value on hold-out data: 0.06821901351213455
Epoch: 63
Loss on hold-out set: 0.009153938910458237
MeanAbsoluteError value on hold-out data: 0.07089095562696457
Epoch: 64

Loss on hold-out set: 0.01058093929589775
MeanAbsoluteError value on hold-out data: 0.07832571119070053
Epoch: 65
Loss on hold-out set: 0.009335154151286636
MeanAbsoluteError value on hold-out data: 0.07337384670972824
Epoch: 66
Loss on hold-out set: 0.00915411412470827
MeanAbsoluteError value on hold-out data: 0.07026026397943497
Epoch: 67
Loss on hold-out set: 0.013236896900803242
MeanAbsoluteError value on hold-out data: 0.08393583446741104
Epoch: 68
Loss on hold-out set: 0.010222992063254902
MeanAbsoluteError value on hold-out data: 0.07596880942583084
Epoch: 69
Loss on hold-out set: 0.008875084812691631
MeanAbsoluteError value on hold-out data: 0.0687321200966835
```

```
Epoch: 70
Loss on hold-out set: 0.009700823881614366
MeanAbsoluteError value on hold-out data: 0.07470055669546127
Epoch: 71
Loss on hold-out set: 0.010111891964793597
MeanAbsoluteError value on hold-out data: 0.07833695411682129
Epoch: 72
Loss on hold-out set: 0.009592513526226148
MeanAbsoluteError value on hold-out data: 0.07540220767259598
Epoch: 73

Loss on hold-out set: 0.011735023023854745
MeanAbsoluteError value on hold-out data: 0.08120422065258026
Epoch: 74
Loss on hold-out set: 0.011491735631256904
MeanAbsoluteError value on hold-out data: 0.08755269646644592
Epoch: 75

Loss on hold-out set: 0.00999821093864739
MeanAbsoluteError value on hold-out data: 0.07746048271656036
Epoch: 76
Loss on hold-out set: 0.008090908436937943
MeanAbsoluteError value on hold-out data: 0.06922077387571335
Epoch: 77
Loss on hold-out set: 0.010746560175903141
MeanAbsoluteError value on hold-out data: 0.08084823936223984
Epoch: 78
Loss on hold-out set: 0.00962978477381464
MeanAbsoluteError value on hold-out data: 0.07010059803724289
Epoch: 79
Loss on hold-out set: 0.00876560397017257
MeanAbsoluteError value on hold-out data: 0.07051770389080048
Epoch: 80
Loss on hold-out set: 0.01200723102144701
MeanAbsoluteError value on hold-out data: 0.07883375138044357
Epoch: 81
Loss on hold-out set: 0.011736286477810753
MeanAbsoluteError value on hold-out data: 0.07745926827192307
Epoch: 82
Loss on hold-out set: 0.012388339670571057
MeanAbsoluteError value on hold-out data: 0.08231493830680847
Epoch: 83
```

```
Loss on hold-out set: 0.010313930817095465
MeanAbsoluteError value on hold-out data: 0.07505254447460175
Epoch: 84

Loss on hold-out set: 0.013027769746258855
MeanAbsoluteError value on hold-out data: 0.0827975943684578
Epoch: 85
Loss on hold-out set: 0.010152790542250793
MeanAbsoluteError value on hold-out data: 0.07731486856937408
Epoch: 86

Loss on hold-out set: 0.010815553311199381
MeanAbsoluteError value on hold-out data: 0.07915482670068741
Epoch: 87
Loss on hold-out set: 0.009766110016866341
MeanAbsoluteError value on hold-out data: 0.07322850078344345
Epoch: 88
Loss on hold-out set: 0.010671947935694143
MeanAbsoluteError value on hold-out data: 0.08331245929002762
Epoch: 89
Loss on hold-out set: 0.012113974313251674
MeanAbsoluteError value on hold-out data: 0.08339647203683853
Epoch: 90
Loss on hold-out set: 0.010356527189479062
MeanAbsoluteError value on hold-out data: 0.07479806989431381
Epoch: 91
Loss on hold-out set: 0.009230098252086654
MeanAbsoluteError value on hold-out data: 0.06787456572055817
Epoch: 92
Loss on hold-out set: 0.010579370752614187
MeanAbsoluteError value on hold-out data: 0.08097023516893387
Early stopping at epoch 91
Returned to Spot: Validation loss: 0.010579370752614187
----------------------------------------------

config: {'_L_in': 10, '_L_out': 1, 'l1': 32, 'dropout_prob': 0.19981931523998656, 'lr_mult':
Epoch: 1
Loss on hold-out set: 0.027056458896320117
MeanAbsoluteError value on hold-out data: 0.12907244265079498
Epoch: 2
Loss on hold-out set: 0.05686182901263237
MeanAbsoluteError value on hold-out data: 0.20012755692005157
```

```
Epoch: 3
Loss on hold-out set: 0.05026999576703498
MeanAbsoluteError value on hold-out data: 0.1885630339384079
Epoch: 4

Loss on hold-out set: 0.06720466147127904
MeanAbsoluteError value on hold-out data: 0.22623616456985474
Epoch: 5
Loss on hold-out set: 0.040163898350376835
MeanAbsoluteError value on hold-out data: 0.16666534543037415
Epoch: 6
Loss on hold-out set: 0.024384137488117342
MeanAbsoluteError value on hold-out data: 0.12570719420909882
Epoch: 7
Loss on hold-out set: 0.033489247833035495
MeanAbsoluteError value on hold-out data: 0.15355663001537323
Epoch: 8

Loss on hold-out set: 0.03164075324802022
MeanAbsoluteError value on hold-out data: 0.14923912286758423
Epoch: 9
Loss on hold-out set: 0.01345205307006836
MeanAbsoluteError value on hold-out data: 0.09227067232131958
Epoch: 10
Loss on hold-out set: 0.027306535085173028
MeanAbsoluteError value on hold-out data: 0.13782896101474762
Epoch: 11
Loss on hold-out set: 0.018223329471718324
MeanAbsoluteError value on hold-out data: 0.10808831453323364
Epoch: 12
Loss on hold-out set: 0.02143183419186818
MeanAbsoluteError value on hold-out data: 0.12208402901887894
Epoch: 13
Loss on hold-out set: 0.02582064074905295
MeanAbsoluteError value on hold-out data: 0.13489456474781036
Epoch: 14
Loss on hold-out set: 0.022199653334131365
MeanAbsoluteError value on hold-out data: 0.12698239088058472
Epoch: 15
Loss on hold-out set: 0.02405809978709409
MeanAbsoluteError value on hold-out data: 0.12982328236103058
Epoch: 16
```

```
Loss on hold-out set: 0.011143703332268879
MeanAbsoluteError value on hold-out data: 0.07961132377386093
Epoch: 17
Loss on hold-out set: 0.013064270765569649
MeanAbsoluteError value on hold-out data: 0.08926033973693848
Epoch: 18
Loss on hold-out set: 0.027373978672058957
MeanAbsoluteError value on hold-out data: 0.140464186668396
Epoch: 19
Loss on hold-out set: 0.009573721363650341
MeanAbsoluteError value on hold-out data: 0.07328081130981445
Epoch: 20
Loss on hold-out set: 0.027391902122058366
MeanAbsoluteError value on hold-out data: 0.14266160130500793
Epoch: 21
Loss on hold-out set: 0.02894573403816474
MeanAbsoluteError value on hold-out data: 0.1467093527317047
Epoch: 22
Loss on hold-out set: 0.008051987578112044
MeanAbsoluteError value on hold-out data: 0.06838327646255493
Epoch: 23

Loss on hold-out set: 0.010430042190771354
MeanAbsoluteError value on hold-out data: 0.07969821989536285
Epoch: 24
Loss on hold-out set: 0.015889225331576246
MeanAbsoluteError value on hold-out data: 0.10232441127300262
Epoch: 25
Loss on hold-out set: 0.015884986612945795
MeanAbsoluteError value on hold-out data: 0.10454598069190979
Epoch: 26
Loss on hold-out set: 0.01572946314454863
MeanAbsoluteError value on hold-out data: 0.10547277331352234
Epoch: 27

Loss on hold-out set: 0.014577527064830065
MeanAbsoluteError value on hold-out data: 0.09790034592151642
Epoch: 28
Loss on hold-out set: 0.007528381213839901
MeanAbsoluteError value on hold-out data: 0.0668400228023529
Epoch: 29
Loss on hold-out set: 0.007779194421968178
```

```
MeanAbsoluteError value on hold-out data: 0.06712119281291962
Epoch: 30
Loss on hold-out set: 0.006522386138768573
MeanAbsoluteError value on hold-out data: 0.05656823515892029
Epoch: 31
Loss on hold-out set: 0.007457676882806577
MeanAbsoluteError value on hold-out data: 0.06481657922267914
Epoch: 32
Loss on hold-out set: 0.00834490978894265
MeanAbsoluteError value on hold-out data: 0.06973674148321152
Epoch: 33
Loss on hold-out set: 0.019296309763663692
MeanAbsoluteError value on hold-out data: 0.116448312997818
Epoch: 34
Loss on hold-out set: 0.006770876567124536
MeanAbsoluteError value on hold-out data: 0.06013916805386543
Epoch: 35
Loss on hold-out set: 0.01824081978319507
MeanAbsoluteError value on hold-out data: 0.11396085470914841
Epoch: 36
Loss on hold-out set: 0.00765696071137331
MeanAbsoluteError value on hold-out data: 0.06411609798669815
Epoch: 37
Loss on hold-out set: 0.006362765672077474
MeanAbsoluteError value on hold-out data: 0.05970890820026398
Epoch: 38
Loss on hold-out set: 0.010438526024747836
MeanAbsoluteError value on hold-out data: 0.0837709903717041
Epoch: 39
Loss on hold-out set: 0.006043744800416262
MeanAbsoluteError value on hold-out data: 0.059262026101350784
Epoch: 40
Loss on hold-out set: 0.006482691258976334
MeanAbsoluteError value on hold-out data: 0.06208304688334465
Epoch: 41
Loss on hold-out set: 0.005038942124596552
MeanAbsoluteError value on hold-out data: 0.05115148797631264
Epoch: 42

Loss on hold-out set: 0.018996470362732287
MeanAbsoluteError value on hold-out data: 0.11857336759567261
Epoch: 43
```

```
Loss on hold-out set: 0.0060971395762049055
MeanAbsoluteError value on hold-out data: 0.05579175800085068
Epoch: 44
Loss on hold-out set: 0.009579258407221028
MeanAbsoluteError value on hold-out data: 0.07595274597406387
Epoch: 45
Loss on hold-out set: 0.006744272700559936
MeanAbsoluteError value on hold-out data: 0.06614743173122406
Epoch: 46


Loss on hold-out set: 0.011589037695605504
MeanAbsoluteError value on hold-out data: 0.09033885598182678
Epoch: 47
Loss on hold-out set: 0.005806184153219587
MeanAbsoluteError value on hold-out data: 0.05115130916237831
Epoch: 48
Loss on hold-out set: 0.00945243690358965
MeanAbsoluteError value on hold-out data: 0.07965869456529617
Epoch: 49
Loss on hold-out set: 0.003444234619995481
MeanAbsoluteError value on hold-out data: 0.04272555559873581
Epoch: 50
Loss on hold-out set: 0.008669377709003655
MeanAbsoluteError value on hold-out data: 0.07186535745859146
Epoch: 51
Loss on hold-out set: 0.00653354141640624
MeanAbsoluteError value on hold-out data: 0.06037190183997154
Epoch: 52
Loss on hold-out set: 0.013368259355621902
MeanAbsoluteError value on hold-out data: 0.09909593313932419
Epoch: 53
Loss on hold-out set: 0.008725342732903204
MeanAbsoluteError value on hold-out data: 0.07263894379138947
Epoch: 54
Loss on hold-out set: 0.0053613179020191495
MeanAbsoluteError value on hold-out data: 0.054424501955509186
Epoch: 55
Loss on hold-out set: 0.0057925644489985545
MeanAbsoluteError value on hold-out data: 0.05864653363823891
Epoch: 56
Loss on hold-out set: 0.003709603107142213
MeanAbsoluteError value on hold-out data: 0.048032667487859726
```

```
Epoch: 57
Loss on hold-out set: 0.00444436583692502
MeanAbsoluteError value on hold-out data: 0.049512073397636414
Epoch: 58
Loss on hold-out set: 0.007952488297106404
MeanAbsoluteError value on hold-out data: 0.07307470589876175
Epoch: 59
Loss on hold-out set: 0.0054583059819905385
MeanAbsoluteError value on hold-out data: 0.05592288821935654
Epoch: 60
Loss on hold-out set: 0.01316229102054709
MeanAbsoluteError value on hold-out data: 0.09789024293422699
Epoch: 61

Loss on hold-out set: 0.0045589269874127284
MeanAbsoluteError value on hold-out data: 0.049232468008995056
Epoch: 62
Loss on hold-out set: 0.0053095694472032945
MeanAbsoluteError value on hold-out data: 0.053498294204473495
Epoch: 63
Loss on hold-out set: 0.005897698354123062
MeanAbsoluteError value on hold-out data: 0.060971710830926895
Epoch: 64
Loss on hold-out set: 0.005721006714003651
MeanAbsoluteError value on hold-out data: 0.058208879083395004
Epoch: 65

Loss on hold-out set: 0.020217723458221083
MeanAbsoluteError value on hold-out data: 0.12955103814601898
Epoch: 66
Loss on hold-out set: 0.003642147106706704
MeanAbsoluteError value on hold-out data: 0.043059706687927246
Epoch: 67
Loss on hold-out set: 0.011526285303070358
MeanAbsoluteError value on hold-out data: 0.09002332389354706
Epoch: 68
Loss on hold-out set: 0.007123249368497024
MeanAbsoluteError value on hold-out data: 0.05843523517251015
Epoch: 69
Loss on hold-out set: 0.002649123927480296
MeanAbsoluteError value on hold-out data: 0.03624875098466873
Epoch: 70
```

```
Loss on hold-out set: 0.005098778000836701
MeanAbsoluteError value on hold-out data: 0.05328012630343437
Epoch: 71
Loss on hold-out set: 0.002973844186942044
MeanAbsoluteError value on hold-out data: 0.04074500501155853
Epoch: 72
Loss on hold-out set: 0.00988490481272732
MeanAbsoluteError value on hold-out data: 0.08188685774803162
Epoch: 73
Loss on hold-out set: 0.005114041391367975
MeanAbsoluteError value on hold-out data: 0.05319233611226082
Epoch: 74
Loss on hold-out set: 0.005691137851068848
MeanAbsoluteError value on hold-out data: 0.05854009464383125
Epoch: 75
Loss on hold-out set: 0.005414119927751783
MeanAbsoluteError value on hold-out data: 0.05552113801240921
Epoch: 76
Loss on hold-out set: 0.006066661107500917
MeanAbsoluteError value on hold-out data: 0.058837153017520905
Epoch: 77
Loss on hold-out set: 0.004018989550930105
MeanAbsoluteError value on hold-out data: 0.04553219676017761
Epoch: 78
Loss on hold-out set: 0.010703503730167685
MeanAbsoluteError value on hold-out data: 0.07536546885967255
Epoch: 79
Loss on hold-out set: 0.004951399800024535
MeanAbsoluteError value on hold-out data: 0.05104116350412369
Epoch: 80

Loss on hold-out set: 0.003661184492030818
MeanAbsoluteError value on hold-out data: 0.044390950351953506
Epoch: 81
Loss on hold-out set: 0.006714773511416034
MeanAbsoluteError value on hold-out data: 0.06461922079324722
Epoch: 82
Loss on hold-out set: 0.008052516091418894
MeanAbsoluteError value on hold-out data: 0.07090683281421661
Epoch: 83
Loss on hold-out set: 0.008936605048610977
MeanAbsoluteError value on hold-out data: 0.07719951122999191
Epoch: 84
```

```
Loss on hold-out set: 0.006484910024722156
MeanAbsoluteError value on hold-out data: 0.06089497730135918
Epoch: 85
Loss on hold-out set: 0.004097975937551574
MeanAbsoluteError value on hold-out data: 0.04576456546783447
Epoch: 86
Loss on hold-out set: 0.006314537304110433
MeanAbsoluteError value on hold-out data: 0.059199728071689606
Epoch: 87
Loss on hold-out set: 0.018731373411260153
MeanAbsoluteError value on hold-out data: 0.12372133880853653
Epoch: 88
Loss on hold-out set: 0.0066746232761560305
MeanAbsoluteError value on hold-out data: 0.06541939079761505
Epoch: 89
Loss on hold-out set: 0.010487193707376719
MeanAbsoluteError value on hold-out data: 0.09052083641290665
Epoch: 90
Loss on hold-out set: 0.027397482508891506
MeanAbsoluteError value on hold-out data: 0.15517672896385193
Epoch: 91
Loss on hold-out set: 0.0031528182781154386
MeanAbsoluteError value on hold-out data: 0.038995061069726944
Epoch: 92
Loss on hold-out set: 0.0067134865706688475
MeanAbsoluteError value on hold-out data: 0.06038244068622589
Epoch: 93
Loss on hold-out set: 0.005560763168001645
MeanAbsoluteError value on hold-out data: 0.05269809439778328
Epoch: 94
Loss on hold-out set: 0.0027275473357325324
MeanAbsoluteError value on hold-out data: 0.03618409484624863
Epoch: 95
Loss on hold-out set: 0.004816522699241575
MeanAbsoluteError value on hold-out data: 0.05320513993501663
Epoch: 96
Loss on hold-out set: 0.0027354979262638247
MeanAbsoluteError value on hold-out data: 0.038655295968055725
Epoch: 97
Loss on hold-out set: 0.003782950145633597
MeanAbsoluteError value on hold-out data: 0.047608841210603714
Epoch: 98
Loss on hold-out set: 0.01013793612487222
```

```
MeanAbsoluteError value on hold-out data: 0.09101821482181549
Epoch: 99

Loss on hold-out set: 0.004169824576054357
MeanAbsoluteError value on hold-out data: 0.04598185420036316
Epoch: 100
Loss on hold-out set: 0.004435850442142079
MeanAbsoluteError value on hold-out data: 0.05380657687783241
Epoch: 101
Loss on hold-out set: 0.004477778572197023
MeanAbsoluteError value on hold-out data: 0.05433148518204689
Early stopping at epoch 100
Returned to Spot: Validation loss: 0.004477778572197023
----------------------------------------------

config: {'_L_in': 10, '_L_out': 1, 'l1': 128, 'dropout_prob': 0.8582565260508446, 'lr_mult':
Epoch: 1

Loss on hold-out set: 0.06504543340027642
MeanAbsoluteError value on hold-out data: 0.19804710149765015
Epoch: 2
Loss on hold-out set: 0.04894331531172308
MeanAbsoluteError value on hold-out data: 0.17811979353427887
Epoch: 3

Loss on hold-out set: 0.04448334265151061
MeanAbsoluteError value on hold-out data: 0.17242513597011566
Epoch: 4

Loss on hold-out set: 0.036879955100933635
MeanAbsoluteError value on hold-out data: 0.14954198896884918
Epoch: 5
Loss on hold-out set: 0.03564276785124093
MeanAbsoluteError value on hold-out data: 0.15132099390029907
Epoch: 6

Loss on hold-out set: 0.031939363283648464
MeanAbsoluteError value on hold-out data: 0.14130337536334991
Epoch: 7
```

```
Loss on hold-out set: 0.030620799841514477
MeanAbsoluteError value on hold-out data: 0.1387050896883011
Epoch: 8
Loss on hold-out set: 0.02933682065360093
MeanAbsoluteError value on hold-out data: 0.13564079999923706
Epoch: 9

Loss on hold-out set: 0.03234226751665119
MeanAbsoluteError value on hold-out data: 0.1440006047487259
Epoch: 10

Loss on hold-out set: 0.031791559923052166
MeanAbsoluteError value on hold-out data: 0.13914074003696442
Epoch: 11
Loss on hold-out set: 0.03107182799906392
MeanAbsoluteError value on hold-out data: 0.14098820090293884
Epoch: 12

Loss on hold-out set: 0.028925507433353537
MeanAbsoluteError value on hold-out data: 0.1343098133802414
Epoch: 13

Loss on hold-out set: 0.029566484938453264
MeanAbsoluteError value on hold-out data: 0.13760456442832947
Epoch: 14
Loss on hold-out set: 0.028824064050374243
MeanAbsoluteError value on hold-out data: 0.13609790802001953
Epoch: 15

Loss on hold-out set: 0.030594835595693344
MeanAbsoluteError value on hold-out data: 0.13788452744483948
Epoch: 16

Loss on hold-out set: 0.028960122810773706
MeanAbsoluteError value on hold-out data: 0.1326959729194641
Epoch: 17
Loss on hold-out set: 0.029863086957387472
MeanAbsoluteError value on hold-out data: 0.13676677644252777
Epoch: 18
```

```
Loss on hold-out set: 0.030344069603209695
MeanAbsoluteError value on hold-out data: 0.13771899044513702
Epoch: 19

Loss on hold-out set: 0.030115371318728042
MeanAbsoluteError value on hold-out data: 0.13879528641700745
Epoch: 20
Loss on hold-out set: 0.029649368763202802
MeanAbsoluteError value on hold-out data: 0.13746409118175507
Epoch: 21

Loss on hold-out set: 0.028972364641134 24
MeanAbsoluteError value on hold-out data: 0.13335947692394257
Epoch: 22

Loss on hold-out set: 0.027597925280182
MeanAbsoluteError value on hold-out data: 0.13021746277809143
Epoch: 23
Loss on hold-out set: 0.02845376821506458
MeanAbsoluteError value on hold-out data: 0.1345987170934677
Epoch: 24

Loss on hold-out set: 0.028431748839405677
MeanAbsoluteError value on hold-out data: 0.13252262771129608
Epoch: 25

Loss on hold-out set: 0.028508333920084016
MeanAbsoluteError value on hold-out data: 0.1327752321958542
Epoch: 26
Loss on hold-out set: 0.028808829589979722
MeanAbsoluteError value on hold-out data: 0.13573841750621796
Epoch: 27

Loss on hold-out set: 0.029747001642463147
MeanAbsoluteError value on hold-out data: 0.13660301268100739
Epoch: 28

Loss on hold-out set: 0.027778710760564 23
MeanAbsoluteError value on hold-out data: 0.13229288160800934
Epoch: 29
```

```
Loss on hold-out set: 0.026726728458161233
MeanAbsoluteError value on hold-out data: 0.13032768666744232
Epoch: 30

Loss on hold-out set: 0.029725941274082287
MeanAbsoluteError value on hold-out data: 0.1357010006904602
Epoch: 31

Loss on hold-out set: 0.02752757048428369
MeanAbsoluteError value on hold-out data: 0.13165053725242615
Epoch: 32
Loss on hold-out set: 0.0300606426759623
MeanAbsoluteError value on hold-out data: 0.1378856897354126
Epoch: 33

Loss on hold-out set: 0.028326466823103448
MeanAbsoluteError value on hold-out data: 0.13287603855133057
Epoch: 34

Loss on hold-out set: 0.029443153856069937
MeanAbsoluteError value on hold-out data: 0.13407732546329498
Epoch: 35
Loss on hold-out set: 0.02999437216654769
MeanAbsoluteError value on hold-out data: 0.135248601436615
Epoch: 36

Loss on hold-out set: 0.02782293292499768
MeanAbsoluteError value on hold-out data: 0.13228373229503632
Epoch: 37

Loss on hold-out set: 0.02804609546108016
MeanAbsoluteError value on hold-out data: 0.13396190106868744
Epoch: 38
Loss on hold-out set: 0.029024921952877775
MeanAbsoluteError value on hold-out data: 0.1331477165222168
Epoch: 39

Loss on hold-out set: 0.028348067835128554
MeanAbsoluteError value on hold-out data: 0.1336670070886612
Epoch: 40
```

```
Loss on hold-out set: 0.028315771989315786
MeanAbsoluteError value on hold-out data: 0.13281777501106262
Epoch: 41
Loss on hold-out set: 0.026990333410988873
MeanAbsoluteError value on hold-out data: 0.13095802068710327
Epoch: 42

Loss on hold-out set: 0.029166251727341053
MeanAbsoluteError value on hold-out data: 0.13679075241088867
Epoch: 43

Loss on hold-out set: 0.028244347091337354
MeanAbsoluteError value on hold-out data: 0.13300660252571106
Epoch: 44
Loss on hold-out set: 0.028781559627580767
MeanAbsoluteError value on hold-out data: 0.1345253437757492
Epoch: 45

Loss on hold-out set: 0.028496291943010874
MeanAbsoluteError value on hold-out data: 0.1327134668827057
Epoch: 46

Loss on hold-out set: 0.02833594830861936
MeanAbsoluteError value on hold-out data: 0.13203367590904236
Epoch: 47
Loss on hold-out set: 0.0278393296256642
MeanAbsoluteError value on hold-out data: 0.13226036727428436
Epoch: 48

Loss on hold-out set: 0.02801499944839937
MeanAbsoluteError value on hold-out data: 0.13418692350387573
Epoch: 49

Loss on hold-out set: 0.02852263007085033
MeanAbsoluteError value on hold-out data: 0.13445840775966644
Epoch: 50
Loss on hold-out set: 0.027546292577365725
MeanAbsoluteError value on hold-out data: 0.1337674856185913
Epoch: 51
```

```
Loss on hold-out set: 0.02885216024587862
MeanAbsoluteError value on hold-out data: 0.13446144759655
Epoch: 52

Loss on hold-out set: 0.027985955451925594
MeanAbsoluteError value on hold-out data: 0.13379204273223877
Epoch: 53
Loss on hold-out set: 0.02796639361806835
MeanAbsoluteError value on hold-out data: 0.13156728446483612
Epoch: 54

Loss on hold-out set: 0.027389533223273855
MeanAbsoluteError value on hold-out data: 0.13059595227241516
Epoch: 55

Loss on hold-out set: 0.028855851304057677
MeanAbsoluteError value on hold-out data: 0.13415442407131195
Epoch: 56
Loss on hold-out set: 0.02729575416005294
MeanAbsoluteError value on hold-out data: 0.1311040073633194
Epoch: 57

Loss on hold-out set: 0.027564992808620445
MeanAbsoluteError value on hold-out data: 0.12886042892932892
Epoch: 58

Loss on hold-out set: 0.026832754059505533
MeanAbsoluteError value on hold-out data: 0.13055245578289032
Epoch: 59
Loss on hold-out set: 0.027282006800111655
MeanAbsoluteError value on hold-out data: 0.1293204426765442
Epoch: 60

Loss on hold-out set: 0.025866742309299296
MeanAbsoluteError value on hold-out data: 0.12620775401592255
Epoch: 61

Loss on hold-out set: 0.027144431561464444
MeanAbsoluteError value on hold-out data: 0.12910711765289307
Epoch: 62
```

```
Loss on hold-out set: 0.027843034329990176
MeanAbsoluteError value on hold-out data: 0.13347910344600677
Epoch: 63

Loss on hold-out set: 0.02718097152518264
MeanAbsoluteError value on hold-out data: 0.1311487853527069
Epoch: 64

Loss on hold-out set: 0.025714294789067935
MeanAbsoluteError value on hold-out data: 0.12794479727745056
Epoch: 65
Loss on hold-out set: 0.02723254198401264
MeanAbsoluteError value on hold-out data: 0.13106438517570496
Epoch: 66

Loss on hold-out set: 0.028028012450037446
MeanAbsoluteError value on hold-out data: 0.1315188705921173
Epoch: 67

Loss on hold-out set: 0.028185743356928774
MeanAbsoluteError value on hold-out data: 0.13184502720832825
Epoch: 68
Loss on hold-out set: 0.027770762917158815
MeanAbsoluteError value on hold-out data: 0.13141481578350067
Epoch: 69

Loss on hold-out set: 0.02750008584019573
MeanAbsoluteError value on hold-out data: 0.1308419108390808
Epoch: 70

Loss on hold-out set: 0.027997340241612014
MeanAbsoluteError value on hold-out data: 0.13107767701148987
Epoch: 71
Loss on hold-out set: 0.026984220592615505
MeanAbsoluteError value on hold-out data: 0.12890765070915222
Epoch: 72

Loss on hold-out set: 0.02799938804101354
MeanAbsoluteError value on hold-out data: 0.1336299628019333
Epoch: 73
```

```
Loss on hold-out set: 0.02874665206899711
MeanAbsoluteError value on hold-out data: 0.13369479775428772
Epoch: 74
Loss on hold-out set: 0.02738790587405674
MeanAbsoluteError value on hold-out data: 0.13160225749015808
Epoch: 75

Loss on hold-out set: 0.025842473322405038
MeanAbsoluteError value on hold-out data: 0.12657946348190308
Epoch: 76

Loss on hold-out set: 0.027465291702131557
MeanAbsoluteError value on hold-out data: 0.1300664246082306
Epoch: 77
Loss on hold-out set: 0.027555108798211828
MeanAbsoluteError value on hold-out data: 0.13264134526252747
Epoch: 78

Loss on hold-out set: 0.026917901750372644
MeanAbsoluteError value on hold-out data: 0.13199520111083984
Epoch: 79

Loss on hold-out set: 0.028638593567787515
MeanAbsoluteError value on hold-out data: 0.13397271931171417
Epoch: 80
Loss on hold-out set: 0.027018363232151992
MeanAbsoluteError value on hold-out data: 0.1304955929517746
Epoch: 81

Loss on hold-out set: 0.02744685832352843
MeanAbsoluteError value on hold-out data: 0.1309013068675995
Epoch: 82

Loss on hold-out set: 0.028391445164646333
MeanAbsoluteError value on hold-out data: 0.1302894502878189
Epoch: 83
Loss on hold-out set: 0.02816052779419503
MeanAbsoluteError value on hold-out data: 0.1325492113828659
Epoch: 84
```

```
Loss on hold-out set: 0.02850953147784215
MeanAbsoluteError value on hold-out data: 0.1337994486093521
Epoch: 85

Loss on hold-out set: 0.02687605666151891
MeanAbsoluteError value on hold-out data: 0.1302754282951355
Epoch: 86
Loss on hold-out set: 0.02694718895945698
MeanAbsoluteError value on hold-out data: 0.13026566803455353
Epoch: 87

Loss on hold-out set: 0.02727929178676277
MeanAbsoluteError value on hold-out data: 0.1290295273065567
Epoch: 88

Loss on hold-out set: 0.02823998855485115
MeanAbsoluteError value on hold-out data: 0.13165396451950073
Epoch: 89
Loss on hold-out set: 0.02781548406307896
MeanAbsoluteError value on hold-out data: 0.13298740983009338
Epoch: 90

Loss on hold-out set: 0.026569664592446203
MeanAbsoluteError value on hold-out data: 0.13062168657779694
Epoch: 91

Loss on hold-out set: 0.02782017905114723
MeanAbsoluteError value on hold-out data: 0.13269896805286407
Epoch: 92
Loss on hold-out set: 0.026580019243992864
MeanAbsoluteError value on hold-out data: 0.1312960535287857
Epoch: 93

Loss on hold-out set: 0.027489750569705696
MeanAbsoluteError value on hold-out data: 0.1319928914308548
Epoch: 94

Loss on hold-out set: 0.02610176345226743
MeanAbsoluteError value on hold-out data: 0.1279689371585846
Epoch: 95
```

```
Loss on hold-out set: 0.026555980538250878
MeanAbsoluteError value on hold-out data: 0.12748640775680542
Epoch: 96

Loss on hold-out set: 0.028741807629024455
MeanAbsoluteError value on hold-out data: 0.13561129570007324
Epoch: 97

Loss on hold-out set: 0.028092953414501
MeanAbsoluteError value on hold-out data: 0.13204489648342133
Epoch: 98
Loss on hold-out set: 0.02640628110675607
MeanAbsoluteError value on hold-out data: 0.1293574422597885
Epoch: 99

Loss on hold-out set: 0.02581503237602495
MeanAbsoluteError value on hold-out data: 0.12594054639339447
Epoch: 100

Loss on hold-out set: 0.02835166461785169
MeanAbsoluteError value on hold-out data: 0.13314904272556305
Epoch: 101
Loss on hold-out set: 0.026742379278875888
MeanAbsoluteError value on hold-out data: 0.12994834780693054
Epoch: 102

Loss on hold-out set: 0.026234078026900535
MeanAbsoluteError value on hold-out data: 0.12824423611164093
Epoch: 103

Loss on hold-out set: 0.02670147565775551
MeanAbsoluteError value on hold-out data: 0.12651395797729492
Epoch: 104
Loss on hold-out set: 0.026215997753703656
MeanAbsoluteError value on hold-out data: 0.13060101866722107
Epoch: 105

Loss on hold-out set: 0.02777599778016641
MeanAbsoluteError value on hold-out data: 0.13091380894184113
Epoch: 106
```

```
Loss on hold-out set: 0.026555915159848762
MeanAbsoluteError value on hold-out data: 0.13006502389907837
Epoch: 107
Loss on hold-out set: 0.025526988980127497
MeanAbsoluteError value on hold-out data: 0.12971562147140503
Epoch: 108

Loss on hold-out set: 0.025358910142385865
MeanAbsoluteError value on hold-out data: 0.12456028163433075
Epoch: 109

Loss on hold-out set: 0.026687645581162846
MeanAbsoluteError value on hold-out data: 0.1295289546251297
Epoch: 110
Loss on hold-out set: 0.028074202423082777
MeanAbsoluteError value on hold-out data: 0.13064315915107727
Epoch: 111

Loss on hold-out set: 0.02692141806396345
MeanAbsoluteError value on hold-out data: 0.12863746285438538
Epoch: 112

Loss on hold-out set: 0.0264830018725479
MeanAbsoluteError value on hold-out data: 0.12827324867248535
Epoch: 113
Loss on hold-out set: 0.027387743808697754
MeanAbsoluteError value on hold-out data: 0.1334698498249054
Epoch: 114

Loss on hold-out set: 0.028628052607236897
MeanAbsoluteError value on hold-out data: 0.13204701244831085
Epoch: 115

Loss on hold-out set: 0.027421347407701736
MeanAbsoluteError value on hold-out data: 0.12992163002490997
Epoch: 116
Loss on hold-out set: 0.02736488651164109
MeanAbsoluteError value on hold-out data: 0.1320263296365738
Epoch: 117
```

```
Loss on hold-out set: 0.027437276903462284
MeanAbsoluteError value on hold-out data: 0.12939871847629547
Epoch: 118

Loss on hold-out set: 0.0263101295513358
MeanAbsoluteError value on hold-out data: 0.1290382444858551
Epoch: 119
Loss on hold-out set: 0.026833762786676138
MeanAbsoluteError value on hold-out data: 0.13019123673439026
Epoch: 120

Loss on hold-out set: 0.025047708507239197
MeanAbsoluteError value on hold-out data: 0.12470583617687225
Epoch: 121

Loss on hold-out set: 0.028539241021110988
MeanAbsoluteError value on hold-out data: 0.1333586424589157
Epoch: 122
Loss on hold-out set: 0.027480989946246457
MeanAbsoluteError value on hold-out data: 0.13154153525829315
Epoch: 123

Loss on hold-out set: 0.025367770221200077
MeanAbsoluteError value on hold-out data: 0.12542542815208435
Epoch: 124

Loss on hold-out set: 0.026001121062727l8
MeanAbsoluteError value on hold-out data: 0.1270054429769516
Epoch: 125
Loss on hold-out set: 0.02641115602348388
MeanAbsoluteError value on hold-out data: 0.12821052968502045
Epoch: 126

Loss on hold-out set: 0.025826484456580753
MeanAbsoluteError value on hold-out data: 0.12692221999168396
Epoch: 127

Loss on hold-out set: 0.025776298492176768
MeanAbsoluteError value on hold-out data: 0.1275041252374649
Epoch: 128
```

```
Loss on hold-out set: 0.026435542035421047
MeanAbsoluteError value on hold-out data: 0.1304405778646469
Epoch: 129

Loss on hold-out set: 0.025787424505494226
MeanAbsoluteError value on hold-out data: 0.12834621965885162
Epoch: 130

Loss on hold-out set: 0.024061331218302562
MeanAbsoluteError value on hold-out data: 0.12449943274259567
Epoch: 131
Loss on hold-out set: 0.026804251496020393
MeanAbsoluteError value on hold-out data: 0.12843140959739685
Epoch: 132

Loss on hold-out set: 0.02731385525786512
MeanAbsoluteError value on hold-out data: 0.13135696947574615
Epoch: 133

Loss on hold-out set: 0.028491637754874923
MeanAbsoluteError value on hold-out data: 0.1345018744468689
Epoch: 134
Loss on hold-out set: 0.025332974769820188
MeanAbsoluteError value on hold-out data: 0.12635426223278046
Epoch: 135

Loss on hold-out set: 0.025444229822508834
MeanAbsoluteError value on hold-out data: 0.1266004741191864
Epoch: 136

Loss on hold-out set: 0.02570643676435187
MeanAbsoluteError value on hold-out data: 0.12756481766700745
Epoch: 137
Loss on hold-out set: 0.028046956300580253
MeanAbsoluteError value on hold-out data: 0.1314086616039276
Epoch: 138

Loss on hold-out set: 0.027178745785198164
MeanAbsoluteError value on hold-out data: 0.13117872178554535
Epoch: 139
```

```
Loss on hold-out set: 0.02756805823786029
MeanAbsoluteError value on hold-out data: 0.13241176307201385
Epoch: 140
Loss on hold-out set: 0.027047096245514695
MeanAbsoluteError value on hold-out data: 0.13061827421188354
Epoch: 141

Loss on hold-out set: 0.025915740919541956
MeanAbsoluteError value on hold-out data: 0.12607139348983765
Epoch: 142

Loss on hold-out set: 0.025739672943697466
MeanAbsoluteError value on hold-out data: 0.12712012231349945
Epoch: 143
Loss on hold-out set: 0.027040308238889945
MeanAbsoluteError value on hold-out data: 0.13119639456272125
Epoch: 144

Loss on hold-out set: 0.025505904050611813
MeanAbsoluteError value on hold-out data: 0.12396354973316193
Epoch: 145

Loss on hold-out set: 0.02538659861274937
MeanAbsoluteError value on hold-out data: 0.12641088664531708
Epoch: 146
Loss on hold-out set: 0.02618157950445796
MeanAbsoluteError value on hold-out data: 0.12815475463867188
Epoch: 147

Loss on hold-out set: 0.02701820415832723
MeanAbsoluteError value on hold-out data: 0.13088425993919373
Epoch: 148

Loss on hold-out set: 0.025027582525799518
MeanAbsoluteError value on hold-out data: 0.12291038781404495
Epoch: 149
Loss on hold-out set: 0.025778885806018177
MeanAbsoluteError value on hold-out data: 0.12705422937870026
Epoch: 150
```

```
Loss on hold-out set: 0.025615799067806318
MeanAbsoluteError value on hold-out data: 0.12655243277549744
Epoch: 151

Loss on hold-out set: 0.02626108719798746
MeanAbsoluteError value on hold-out data: 0.1327965259552002
Epoch: 152
Loss on hold-out set: 0.025657374604488723
MeanAbsoluteError value on hold-out data: 0.12746837735176086
Epoch: 153

Loss on hold-out set: 0.024193023546880188
MeanAbsoluteError value on hold-out data: 0.12076198309659958
Epoch: 154

Loss on hold-out set: 0.025278252266580238
MeanAbsoluteError value on hold-out data: 0.12582965195178986
Epoch: 155
Loss on hold-out set: 0.026369003635966996
MeanAbsoluteError value on hold-out data: 0.1299036592245102
Epoch: 156

Loss on hold-out set: 0.024924169950487945
MeanAbsoluteError value on hold-out data: 0.12653407454490662
Epoch: 157

Loss on hold-out set: 0.025951763192133513
MeanAbsoluteError value on hold-out data: 0.1277024894952774
Epoch: 158
Loss on hold-out set: 0.02565116452945707
MeanAbsoluteError value on hold-out data: 0.1249752789735794
Epoch: 159

Loss on hold-out set: 0.0259152760708821
MeanAbsoluteError value on hold-out data: 0.12671761214733124
Epoch: 160

Loss on hold-out set: 0.024068497358069485
MeanAbsoluteError value on hold-out data: 0.12443631142377853
Epoch: 161
```

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Loss on hold-out set: 0.026337246936163863
MeanAbsoluteError value on hold-out data: 0.12939272820949554
Epoch: 162

Loss on hold-out set: 0.024616773805852667
MeanAbsoluteError value on hold-out data: 0.12605029344558716
Epoch: 163

Loss on hold-out set: 0.025681788180566704
MeanAbsoluteError value on hold-out data: 0.12934429943561554
Epoch: 164
Loss on hold-out set: 0.026620731112877064
MeanAbsoluteError value on hold-out data: 0.12897269427776337
Epoch: 165

Loss on hold-out set: 0.026699087668772943
MeanAbsoluteError value on hold-out data: 0.12754525244235992
Epoch: 166

Loss on hold-out set: 0.025548769745898123
MeanAbsoluteError value on hold-out data: 0.12939324975013733
Epoch: 167
Loss on hold-out set: 0.023937294405768625
MeanAbsoluteError value on hold-out data: 0.12007816135883331
Epoch: 168

Loss on hold-out set: 0.0240982527541928
MeanAbsoluteError value on hold-out data: 0.12425746768712997
Epoch: 169

Loss on hold-out set: 0.024509976708821643
MeanAbsoluteError value on hold-out data: 0.12174433469772339
Epoch: 170
Loss on hold-out set: 0.026787004244051785
MeanAbsoluteError value on hold-out data: 0.12999805808067322
Epoch: 171

Loss on hold-out set: 0.026348331736395874
MeanAbsoluteError value on hold-out data: 0.12761151790618896
Epoch: 172
```

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Loss on hold-out set: 0.023390385002906744
MeanAbsoluteError value on hold-out data: 0.12384741753339767
Epoch: 173
Loss on hold-out set: 0.02571198604341286
MeanAbsoluteError value on hold-out data: 0.12771888077259064
Epoch: 174

Loss on hold-out set: 0.025342129759083037
MeanAbsoluteError value on hold-out data: 0.12374347448348999
Epoch: 175

Loss on hold-out set: 0.02631219107681924
MeanAbsoluteError value on hold-out data: 0.12823456525802612
Epoch: 176
Loss on hold-out set: 0.026131262188325007
MeanAbsoluteError value on hold-out data: 0.12866555154323578
Epoch: 177

Loss on hold-out set: 0.02504993581455589
MeanAbsoluteError value on hold-out data: 0.12354726344347
Epoch: 178

Loss on hold-out set: 0.024593211579485796
MeanAbsoluteError value on hold-out data: 0.12573081254959106
Epoch: 179
Loss on hold-out set: 0.025883751116343775
MeanAbsoluteError value on hold-out data: 0.12837374210357666
Epoch: 180

Loss on hold-out set: 0.024444556803494683
MeanAbsoluteError value on hold-out data: 0.12340698391199112
Epoch: 181

Loss on hold-out set: 0.025429671805080337
MeanAbsoluteError value on hold-out data: 0.12645162642002106
Epoch: 182
Loss on hold-out set: 0.024327150400689182
MeanAbsoluteError value on hold-out data: 0.12451567500829697
Epoch: 183
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Loss on hold-out set: 0.02699874556361465
MeanAbsoluteError value on hold-out data: 0.1290152668952942
Epoch: 184

Loss on hold-out set: 0.024249041860578777
MeanAbsoluteError value on hold-out data: 0.12339159846305847
Epoch: 185
Loss on hold-out set: 0.02439317177919899
MeanAbsoluteError value on hold-out data: 0.12342951446771622
Epoch: 186

Loss on hold-out set: 0.02581193848833209
MeanAbsoluteError value on hold-out data: 0.12716691195964813
Epoch: 187

Loss on hold-out set: 0.02738032142648687
MeanAbsoluteError value on hold-out data: 0.13089486956596375
Epoch: 188
Loss on hold-out set: 0.025130583838326857
MeanAbsoluteError value on hold-out data: 0.12586610019207
Epoch: 189

Loss on hold-out set: 0.023930984943908697
MeanAbsoluteError value on hold-out data: 0.12101571261882782
Epoch: 190

Loss on hold-out set: 0.025054220660046363
MeanAbsoluteError value on hold-out data: 0.12721918523311615
Epoch: 191
Loss on hold-out set: 0.025825092127003398
MeanAbsoluteError value on hold-out data: 0.12599079310894012
Epoch: 192

Loss on hold-out set: 0.02484679838157414
MeanAbsoluteError value on hold-out data: 0.12356464564800262
Epoch: 193

Loss on hold-out set: 0.02382700286398176
MeanAbsoluteError value on hold-out data: 0.12111658602952957
Epoch: 194
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Loss on hold-out set: 0.02504112920013237
MeanAbsoluteError value on hold-out data: 0.12613588571548462
Epoch: 195

Loss on hold-out set: 0.025893131471724094
MeanAbsoluteError value on hold-out data: 0.12819452583789825
Epoch: 196

Loss on hold-out set: 0.02277998678230991
MeanAbsoluteError value on hold-out data: 0.11779435724020004
Epoch: 197
Loss on hold-out set: 0.024228179133860977
MeanAbsoluteError value on hold-out data: 0.12423067539930344
Epoch: 198

Loss on hold-out set: 0.02337868522493712
MeanAbsoluteError value on hold-out data: 0.12148666381835938
Epoch: 199

Loss on hold-out set: 0.024608516400779382
MeanAbsoluteError value on hold-out data: 0.12353499233722687
Epoch: 200
Loss on hold-out set: 0.024734497274524377
MeanAbsoluteError value on hold-out data: 0.12430665642023087
Epoch: 201

Loss on hold-out set: 0.025283973183250055
MeanAbsoluteError value on hold-out data: 0.12595659494400024
Epoch: 202

Loss on hold-out set: 0.023588811503577743
MeanAbsoluteError value on hold-out data: 0.12381535768508911
Epoch: 203
Loss on hold-out set: 0.023928833721244398
MeanAbsoluteError value on hold-out data: 0.12379544228315353
Epoch: 204

Loss on hold-out set: 0.02483839008840732
MeanAbsoluteError value on hold-out data: 0.1250530183315277
Epoch: 205
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Loss on hold-out set: 0.024519272397543923
MeanAbsoluteError value on hold-out data: 0.12107574194669724
Epoch: 206
Loss on hold-out set: 0.023704260202866863
MeanAbsoluteError value on hold-out data: 0.12456972897052765
Epoch: 207

Loss on hold-out set: 0.024621442120793896
MeanAbsoluteError value on hold-out data: 0.12407556176185608
Epoch: 208

Loss on hold-out set: 0.024160873541841283
MeanAbsoluteError value on hold-out data: 0.12315943092107773
Epoch: 209
Loss on hold-out set: 0.022394442543833673
MeanAbsoluteError value on hold-out data: 0.11422239989042282
Epoch: 210

Loss on hold-out set: 0.023282928188837104
MeanAbsoluteError value on hold-out data: 0.12144257873296738
Epoch: 211

Loss on hold-out set: 0.025990921978639867
MeanAbsoluteError value on hold-out data: 0.12730766832828522
Epoch: 212
Loss on hold-out set: 0.02364501278779547
MeanAbsoluteError value on hold-out data: 0.11960245668888092
Epoch: 213

Loss on hold-out set: 0.024659879413335754
MeanAbsoluteError value on hold-out data: 0.12276653200387955
Epoch: 214

Loss on hold-out set: 0.023767451469951385
MeanAbsoluteError value on hold-out data: 0.12162928283214569
Epoch: 215
Loss on hold-out set: 0.02400767979751739
MeanAbsoluteError value on hold-out data: 0.11985800415277481
Epoch: 216
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Loss on hold-out set: 0.02260181413758801
MeanAbsoluteError value on hold-out data: 0.11924664676189423
Epoch: 217

Loss on hold-out set: 0.024801485058948552
MeanAbsoluteError value on hold-out data: 0.12175963073968887
Epoch: 218
Loss on hold-out set: 0.022689889212779236
MeanAbsoluteError value on hold-out data: 0.11891543120145798
Epoch: 219

Loss on hold-out set: 0.025439368438571062
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Epoch: 220

Loss on hold-out set: 0.02582458048425906
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Epoch: 221
Loss on hold-out set: 0.02492744214454433
MeanAbsoluteError value on hold-out data: 0.12627717852592468
Epoch: 222

Loss on hold-out set: 0.023049677925688836
MeanAbsoluteError value on hold-out data: 0.12183837592601776
Epoch: 223

Loss on hold-out set: 0.023908661624785357
MeanAbsoluteError value on hold-out data: 0.12150143831968307
Epoch: 224
Loss on hold-out set: 0.02437711661929825
MeanAbsoluteError value on hold-out data: 0.12169868499040604
Epoch: 225

Loss on hold-out set: 0.025968184485876313
MeanAbsoluteError value on hold-out data: 0.12523864209651947
Epoch: 226

Loss on hold-out set: 0.02516506366567531
MeanAbsoluteError value on hold-out data: 0.12562239170074463
Epoch: 227
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Loss on hold-out set: 0.024368545317168658
MeanAbsoluteError value on hold-out data: 0.12210299074649811
Epoch: 228

Loss on hold-out set: 0.022191627766102708
MeanAbsoluteError value on hold-out data: 0.11784355342388153
Epoch: 229

Loss on hold-out set: 0.022236489625559764
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Epoch: 230
Loss on hold-out set: 0.022853978982790676
MeanAbsoluteError value on hold-out data: 0.12075229734182358
Epoch: 231

Loss on hold-out set: 0.023817323237502328
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Epoch: 232

Loss on hold-out set: 0.02480524116457673
MeanAbsoluteError value on hold-out data: 0.12270881980657578
Epoch: 233
Loss on hold-out set: 0.02557979210117992
MeanAbsoluteError value on hold-out data: 0.12846378982067108
Epoch: 234

Loss on hold-out set: 0.026113498759029123
MeanAbsoluteError value on hold-out data: 0.1299053430557251
Epoch: 235

Loss on hold-out set: 0.022277932752646546
MeanAbsoluteError value on hold-out data: 0.1193196102976799
Epoch: 236
Loss on hold-out set: 0.023426218134506294
MeanAbsoluteError value on hold-out data: 0.12391313910484314
Epoch: 237

Loss on hold-out set: 0.025393747588968837
MeanAbsoluteError value on hold-out data: 0.1264251470565796
Epoch: 238
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Loss on hold-out set: 0.02185949576999216
MeanAbsoluteError value on hold-out data: 0.11464942991733551
Epoch: 239
Loss on hold-out set: 0.022131122489323994
MeanAbsoluteError value on hold-out data: 0.11617086827754974
Epoch: 240

Loss on hold-out set: 0.024050918303934545
MeanAbsoluteError value on hold-out data: 0.11806923151016235
Epoch: 241

Loss on hold-out set: 0.0220621986684273
MeanAbsoluteError value on hold-out data: 0.1156531423330307
Epoch: 242
Loss on hold-out set: 0.025211302824657954
MeanAbsoluteError value on hold-out data: 0.12235067039728165
Epoch: 243

Loss on hold-out set: 0.023781102494879938
MeanAbsoluteError value on hold-out data: 0.12241946905851364
Epoch: 244

Loss on hold-out set: 0.025285574913432356
MeanAbsoluteError value on hold-out data: 0.12307789921760559
Epoch: 245
Loss on hold-out set: 0.02467057205593543
MeanAbsoluteError value on hold-out data: 0.12114990502595901
Epoch: 246

Loss on hold-out set: 0.02268089710890005
MeanAbsoluteError value on hold-out data: 0.12067229300737381
Epoch: 247

Loss on hold-out set: 0.024144174692531425
MeanAbsoluteError value on hold-out data: 0.1216031163930893
Epoch: 248
Loss on hold-out set: 0.024036601106636225
MeanAbsoluteError value on hold-out data: 0.12567758560180664
Epoch: 249
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Loss on hold-out set: 0.0240915108814806455
MeanAbsoluteError value on hold-out data: 0.11914919316768646
Epoch: 250

Loss on hold-out set: 0.02425292797658282
MeanAbsoluteError value on hold-out data: 0.1243034079670906
Epoch: 251
Loss on hold-out set: 0.02423209396705109
MeanAbsoluteError value on hold-out data: 0.1215410977602005
Epoch: 252

Loss on hold-out set: 0.024080540204110244
MeanAbsoluteError value on hold-out data: 0.12181010097265244
Epoch: 253

Loss on hold-out set: 0.025651760396237174
MeanAbsoluteError value on hold-out data: 0.1275702863931656
Epoch: 254
Loss on hold-out set: 0.02200096704410195
MeanAbsoluteError value on hold-out data: 0.1169368103146553
Epoch: 255

Loss on hold-out set: 0.023949232926388505
MeanAbsoluteError value on hold-out data: 0.1217491403222084
Epoch: 256

Loss on hold-out set: 0.024371389558024627
MeanAbsoluteError value on hold-out data: 0.1224072277545929
Epoch: 257
Loss on hold-out set: 0.02323085822184415
MeanAbsoluteError value on hold-out data: 0.11992456018924713
Epoch: 258

Loss on hold-out set: 0.02239132327978344
MeanAbsoluteError value on hold-out data: 0.11687687039375305
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Loss on hold-out set: 0.02249543599357518
MeanAbsoluteError value on hold-out data: 0.11821665614843369
Epoch: 260
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Loss on hold-out set: 0.024295900497818365
MeanAbsoluteError value on hold-out data: 0.11999604851007462
Epoch: 261

Loss on hold-out set: 0.02212027972205154
MeanAbsoluteError value on hold-out data: 0.11570725589990616
Epoch: 262

Loss on hold-out set: 0.024480548813274557
MeanAbsoluteError value on hold-out data: 0.1236884817481041
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Loss on hold-out set: 0.02197278760402696
MeanAbsoluteError value on hold-out data: 0.11550912261009216
Epoch: 264

Loss on hold-out set: 0.025681566171503314
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Epoch: 265

Loss on hold-out set: 0.022654293073743854
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Loss on hold-out set: 0.021086243064488978
MeanAbsoluteError value on hold-out data: 0.11324706673622131
Epoch: 267

Loss on hold-out set: 0.022827637978040608
MeanAbsoluteError value on hold-out data: 0.11944629997015
Epoch: 268

Loss on hold-out set: 0.024200094821329305
MeanAbsoluteError value on hold-out data: 0.12134235352277756
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Loss on hold-out set: 0.023799259160102035
MeanAbsoluteError value on hold-out data: 0.12329389154911041
Epoch: 270

Loss on hold-out set: 0.024092469038587295
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Epoch: 271
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Loss on hold-out set: 0.022941470264243737
MeanAbsoluteError value on hold-out data: 0.12070771306753159
Epoch: 272
Loss on hold-out set: 0.021837386705252964
MeanAbsoluteError value on hold-out data: 0.11713866889476776
Epoch: 273

Loss on hold-out set: 0.023023027314726885
MeanAbsoluteError value on hold-out data: 0.11902447044849396
Epoch: 274

Loss on hold-out set: 0.021718015978791905
MeanAbsoluteError value on hold-out data: 0.11569385230541229
Epoch: 275
Loss on hold-out set: 0.024729261215155323
MeanAbsoluteError value on hold-out data: 0.12451767921447754
Epoch: 276

Loss on hold-out set: 0.023088897073915482
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Epoch: 277

Loss on hold-out set: 0.0232100277866266
MeanAbsoluteError value on hold-out data: 0.12058962136507034
Epoch: 278
Loss on hold-out set: 0.022514623671110408
MeanAbsoluteError value on hold-out data: 0.11817009001970291
Epoch: 279

Loss on hold-out set: 0.02253246997948736
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Epoch: 280

Loss on hold-out set: 0.021356757596319463
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Loss on hold-out set: 0.020698557460176136
MeanAbsoluteError value on hold-out data: 0.11479007452726364
Epoch: 282
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Loss on hold-out set: 0.020833872335691315
MeanAbsoluteError value on hold-out data: 0.1148313358426094
Epoch: 283

Loss on hold-out set: 0.02407255249156151
MeanAbsoluteError value on hold-out data: 0.12359980493783951
Epoch: 284
Loss on hold-out set: 0.02058256767839339
MeanAbsoluteError value on hold-out data: 0.11160976439714432
Epoch: 285

Loss on hold-out set: 0.02375166412750938
MeanAbsoluteError value on hold-out data: 0.12147286534309387
Epoch: 286

Loss on hold-out set: 0.023702204069510725
MeanAbsoluteError value on hold-out data: 0.12222853302955627
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Loss on hold-out set: 0.02203969155952412
MeanAbsoluteError value on hold-out data: 0.11845304816961288
Epoch: 288

Loss on hold-out set: 0.021634784132038475
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Epoch: 289

Loss on hold-out set: 0.023830232696006228
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Loss on hold-out set: 0.023204044387093746
MeanAbsoluteError value on hold-out data: 0.11961713433265686
Epoch: 291

Loss on hold-out set: 0.021366424524991694
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Epoch: 292

Loss on hold-out set: 0.022085753117523078
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Epoch: 293
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Loss on hold-out set: 0.02364497921342263
MeanAbsoluteError value on hold-out data: 0.12170190364122391
Epoch: 294

Loss on hold-out set: 0.021162444205062154
MeanAbsoluteError value on hold-out data: 0.11408944427967072
Epoch: 295

Loss on hold-out set: 0.021003167800954542
MeanAbsoluteError value on hold-out data: 0.11351218074560165
Epoch: 296
Loss on hold-out set: 0.020873056295289037
MeanAbsoluteError value on hold-out data: 0.11447865515947342
Epoch: 297

Loss on hold-out set: 0.020431517042064418
MeanAbsoluteError value on hold-out data: 0.1154855340719223
Epoch: 298

Loss on hold-out set: 0.02042300796902661
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Loss on hold-out set: 0.021206447385290327
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Epoch: 300

Loss on hold-out set: 0.022837139703090845
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Epoch: 301

Loss on hold-out set: 0.022791027321406244
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Epoch: 302
Loss on hold-out set: 0.021803238642557215
MeanAbsoluteError value on hold-out data: 0.1171424612402916
Epoch: 303

Loss on hold-out set: 0.021020984150163714
MeanAbsoluteError value on hold-out data: 0.11381550133228302
Epoch: 304
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Loss on hold-out set: 0.021243872331372888
MeanAbsoluteError value on hold-out data: 0.11489591002464294
Epoch: 305
Loss on hold-out set: 0.022893804096772025
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Epoch: 306

Loss on hold-out set: 0.02165687413723693
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Epoch: 307

Loss on hold-out set: 0.022227635475380036
MeanAbsoluteError value on hold-out data: 0.11572766304016113
Epoch: 308
Loss on hold-out set: 0.023037549135430404
MeanAbsoluteError value on hold-out data: 0.11942251771688461
Epoch: 309

Loss on hold-out set: 0.0220519030844783
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Epoch: 310

Loss on hold-out set: 0.02113137847132748
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Epoch: 311
Loss on hold-out set: 0.02205900866887532
MeanAbsoluteError value on hold-out data: 0.11567768454551697
Epoch: 312

Loss on hold-out set: 0.024069436015755247
MeanAbsoluteError value on hold-out data: 0.12150455266237259
Epoch: 313

Loss on hold-out set: 0.020411272498204198
MeanAbsoluteError value on hold-out data: 0.11305929720401764
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Loss on hold-out set: 0.022469987716467587
MeanAbsoluteError value on hold-out data: 0.11696666479110718
Epoch: 315
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Loss on hold-out set: 0.019813735597781486
MeanAbsoluteError value on hold-out data: 0.10985444486141205
Epoch: 316

Loss on hold-out set: 0.020697029158618534
MeanAbsoluteError value on hold-out data: 0.11319036036729813
Epoch: 317
Loss on hold-out set: 0.021443250956569196
MeanAbsoluteError value on hold-out data: 0.11842725425958633
Epoch: 318

Loss on hold-out set: 0.023299308092973666
MeanAbsoluteError value on hold-out data: 0.12033950537443161
Epoch: 319

Loss on hold-out set: 0.019934521378090722
MeanAbsoluteError value on hold-out data: 0.11051895469427109
Epoch: 320
Loss on hold-out set: 0.02246416219335515
MeanAbsoluteError value on hold-out data: 0.11997026950120926
Epoch: 321

Loss on hold-out set: 0.023182156064819236
MeanAbsoluteError value on hold-out data: 0.12087520956993103
Epoch: 322

Loss on hold-out set: 0.020763961402929756
MeanAbsoluteError value on hold-out data: 0.11221853643655777
Epoch: 323
Loss on hold-out set: 0.021636598854868985
MeanAbsoluteError value on hold-out data: 0.11699633300304413
Epoch: 324

Loss on hold-out set: 0.02124208329555889
MeanAbsoluteError value on hold-out data: 0.11398164182901382
Epoch: 325

Loss on hold-out set: 0.023254581390356178
MeanAbsoluteError value on hold-out data: 0.12173286080360413
Epoch: 326
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Loss on hold-out set: 0.02095136250539023
MeanAbsoluteError value on hold-out data: 0.11447199434041977
Epoch: 327

Loss on hold-out set: 0.022359978497212676
MeanAbsoluteError value on hold-out data: 0.11838633567094803
Epoch: 328

Loss on hold-out set: 0.019905166491128813
MeanAbsoluteError value on hold-out data: 0.10948321223258972
Epoch: 329
Loss on hold-out set: 0.020370172850283173
MeanAbsoluteError value on hold-out data: 0.11623600125312805
Epoch: 330

Loss on hold-out set: 0.021400751228405474
MeanAbsoluteError value on hold-out data: 0.11483628302812576
Epoch: 331

Loss on hold-out set: 0.022426714475732298
MeanAbsoluteError value on hold-out data: 0.12057315558195114
Epoch: 332
Loss on hold-out set: 0.020402513189886427
MeanAbsoluteError value on hold-out data: 0.11162865906953812
Epoch: 333

Loss on hold-out set: 0.02025643226467461
MeanAbsoluteError value on hold-out data: 0.11068279296159744
Epoch: 334

Loss on hold-out set: 0.02077104979870152
MeanAbsoluteError value on hold-out data: 0.11441691219806671
Epoch: 335
Loss on hold-out set: 0.021539134967218463
MeanAbsoluteError value on hold-out data: 0.11542743444442749
Epoch: 336

Loss on hold-out set: 0.02097049009017913
MeanAbsoluteError value on hold-out data: 0.11191848665475845
Epoch: 337
```

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Loss on hold-out set: 0.019621608230639444
MeanAbsoluteError value on hold-out data: 0.11208189278841019
Epoch: 338
Loss on hold-out set: 0.02269253182186124
MeanAbsoluteError value on hold-out data: 0.12008659541606903
Epoch: 339

Loss on hold-out set: 0.021167759466334247
MeanAbsoluteError value on hold-out data: 0.113136887550354
Epoch: 340

Loss on hold-out set: 0.020404831341850997
MeanAbsoluteError value on hold-out data: 0.11313634365797043
Epoch: 341
Loss on hold-out set: 0.021505825923122758
MeanAbsoluteError value on hold-out data: 0.11540063470602036
Epoch: 342

Loss on hold-out set: 0.01974798969410282
MeanAbsoluteError value on hold-out data: 0.10948425531387329
Epoch: 343

Loss on hold-out set: 0.019473475797446252
MeanAbsoluteError value on hold-out data: 0.10918665677309036
Epoch: 344
Loss on hold-out set: 0.021606292447904706
MeanAbsoluteError value on hold-out data: 0.1157565712928772
Epoch: 345

Loss on hold-out set: 0.022881496670367294
MeanAbsoluteError value on hold-out data: 0.11704336851835251
Epoch: 346

Loss on hold-out set: 0.01884675756499443
MeanAbsoluteError value on hold-out data: 0.10877745598554611
Epoch: 347
Loss on hold-out set: 0.020880081586462134
MeanAbsoluteError value on hold-out data: 0.11578369140625
Epoch: 348
```

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Loss on hold-out set: 0.023831520680784403
MeanAbsoluteError value on hold-out data: 0.12155172973871231
Epoch: 349

Loss on hold-out set: 0.022709263404200708
MeanAbsoluteError value on hold-out data: 0.11860815435647964
Epoch: 350
Loss on hold-out set: 0.019465853652218357
MeanAbsoluteError value on hold-out data: 0.1084880605340004
Epoch: 351

Loss on hold-out set: 0.02103663792323156
MeanAbsoluteError value on hold-out data: 0.11154691129922867
Epoch: 352

Loss on hold-out set: 0.019582671335083433
MeanAbsoluteError value on hold-out data: 0.11035429686307907
Epoch: 353
Loss on hold-out set: 0.020735645316211353
MeanAbsoluteError value on hold-out data: 0.11555329710245132
Epoch: 354

Loss on hold-out set: 0.020557387863257948
MeanAbsoluteError value on hold-out data: 0.11100184172391891
Epoch: 355

Loss on hold-out set: 0.018219765097019263
MeanAbsoluteError value on hold-out data: 0.10731782019138336
Epoch: 356
Loss on hold-out set: 0.017791127880627755
MeanAbsoluteError value on hold-out data: 0.10457649827003479
Epoch: 357

Loss on hold-out set: 0.02116479815837617
MeanAbsoluteError value on hold-out data: 0.1145237386226654
Epoch: 358

Loss on hold-out set: 0.020273814508303338
MeanAbsoluteError value on hold-out data: 0.1113862469792366
Epoch: 359
```

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Loss on hold-out set: 0.020997035245333487
MeanAbsoluteError value on hold-out data: 0.11431218683719635
Epoch: 360

Loss on hold-out set: 0.019334347246331162
MeanAbsoluteError value on hold-out data: 0.10844957828521729
Epoch: 361

Loss on hold-out set: 0.020258961889873413
MeanAbsoluteError value on hold-out data: 0.11217205226421356
Epoch: 362
Loss on hold-out set: 0.01928740031376947
MeanAbsoluteError value on hold-out data: 0.11064355075359344
Epoch: 363

Loss on hold-out set: 0.019873240814486052
MeanAbsoluteError value on hold-out data: 0.10935203731060028
Epoch: 364

Loss on hold-out set: 0.022248860704130492
MeanAbsoluteError value on hold-out data: 0.12049878388643265
Epoch: 365
Loss on hold-out set: 0.018879675082474325
MeanAbsoluteError value on hold-out data: 0.10816439241170883
Epoch: 366

Loss on hold-out set: 0.021478957657360145
MeanAbsoluteError value on hold-out data: 0.11612994223833084
Epoch: 367

Loss on hold-out set: 0.020160278999052633
MeanAbsoluteError value on hold-out data: 0.11007896065711975
Epoch: 368
Loss on hold-out set: 0.019981381201817687
MeanAbsoluteError value on hold-out data: 0.11199801415205002
Epoch: 369

Loss on hold-out set: 0.020230751836922235
MeanAbsoluteError value on hold-out data: 0.1122843325138092
Epoch: 370
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Loss on hold-out set: 0.02163783133776936
MeanAbsoluteError value on hold-out data: 0.11239055544137955
Epoch: 371
Loss on hold-out set: 0.02120879809682568
MeanAbsoluteError value on hold-out data: 0.11265455931425095
Epoch: 372

Loss on hold-out set: 0.020512713908295458
MeanAbsoluteError value on hold-out data: 0.11244083195924759
Epoch: 373

Loss on hold-out set: 0.019594149555500203
MeanAbsoluteError value on hold-out data: 0.11046724021434784
Epoch: 374
Loss on hold-out set: 0.01891018024873726
MeanAbsoluteError value on hold-out data: 0.10648008435964584
Epoch: 375

Loss on hold-out set: 0.01926008037723174
MeanAbsoluteError value on hold-out data: 0.10823773592710495
Epoch: 376

Loss on hold-out set: 0.01887514470242119
MeanAbsoluteError value on hold-out data: 0.10426462441682816
Epoch: 377
Loss on hold-out set: 0.018571693257642134
MeanAbsoluteError value on hold-out data: 0.1060851588845253
Epoch: 378

Loss on hold-out set: 0.021824652322975452
MeanAbsoluteError value on hold-out data: 0.11586160212755203
Epoch: 379

Loss on hold-out set: 0.022124218867296198
MeanAbsoluteError value on hold-out data: 0.11598040163516998
Epoch: 380
Loss on hold-out set: 0.022268922457490892
MeanAbsoluteError value on hold-out data: 0.11597215384244919
Epoch: 381
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Loss on hold-out set: 0.019427995385485702
MeanAbsoluteError value on hold-out data: 0.11011605709791183
Epoch: 382

Loss on hold-out set: 0.01939753525465979
MeanAbsoluteError value on hold-out data: 0.1066531389951706
Epoch: 383
Loss on hold-out set: 0.02002174903905446
MeanAbsoluteError value on hold-out data: 0.10918862372636795
Epoch: 384

Loss on hold-out set: 0.01812859997941511
MeanAbsoluteError value on hold-out data: 0.10630206763744354
Epoch: 385

Loss on hold-out set: 0.022242246815682543
MeanAbsoluteError value on hold-out data: 0.11960126459598541
Epoch: 386
Loss on hold-out set: 0.017721381805337538
MeanAbsoluteError value on hold-out data: 0.10227461159229279
Epoch: 387

Loss on hold-out set: 0.02103750542019649
MeanAbsoluteError value on hold-out data: 0.11335862427949905
Epoch: 388

Loss on hold-out set: 0.019762332218233494
MeanAbsoluteError value on hold-out data: 0.1121317446231842
Epoch: 389
Loss on hold-out set: 0.018733417220258463
MeanAbsoluteError value on hold-out data: 0.10639996826648712
Epoch: 390

Loss on hold-out set: 0.020022296751800846
MeanAbsoluteError value on hold-out data: 0.11092034727334976
Epoch: 391

Loss on hold-out set: 0.02018560518117738
MeanAbsoluteError value on hold-out data: 0.11310739815235138
Epoch: 392
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Loss on hold-out set: 0.021572267191392408
MeanAbsoluteError value on hold-out data: 0.11456334590911865
Epoch: 393

Loss on hold-out set: 0.020722085613450267
MeanAbsoluteError value on hold-out data: 0.11238390952348709
Epoch: 394

Loss on hold-out set: 0.01882942502318959
MeanAbsoluteError value on hold-out data: 0.10557031631469727
Epoch: 395
Loss on hold-out set: 0.02059003114234656
MeanAbsoluteError value on hold-out data: 0.11304720491170883
Epoch: 396

Loss on hold-out set: 0.02021746695099864
MeanAbsoluteError value on hold-out data: 0.11180424690246582
Epoch: 397

Loss on hold-out set: 0.018843851232716893
MeanAbsoluteError value on hold-out data: 0.10845580697059631
Epoch: 398
Loss on hold-out set: 0.01980302586685866
MeanAbsoluteError value on hold-out data: 0.11293244361877441
Epoch: 399

Loss on hold-out set: 0.019949391353487347
MeanAbsoluteError value on hold-out data: 0.11192864924669266
Epoch: 400

Loss on hold-out set: 0.018134786325972527
MeanAbsoluteError value on hold-out data: 0.1046563982963562
Epoch: 401
Loss on hold-out set: 0.02061898476795856
MeanAbsoluteError value on hold-out data: 0.11262825131416321
Epoch: 402

Loss on hold-out set: 0.01885326200235189
MeanAbsoluteError value on hold-out data: 0.10796278715133667
Epoch: 403
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Loss on hold-out set: 0.018156849861358845
MeanAbsoluteError value on hold-out data: 0.10918212682008743
Epoch: 404
Loss on hold-out set: 0.020117722382419743
MeanAbsoluteError value on hold-out data: 0.11048512905836105
Epoch: 405

Loss on hold-out set: 0.019722943111143348
MeanAbsoluteError value on hold-out data: 0.10704877227544785
Epoch: 406

Loss on hold-out set: 0.019054624737182165
MeanAbsoluteError value on hold-out data: 0.10618510097265244
Epoch: 407
Loss on hold-out set: 0.020200984611098344
MeanAbsoluteError value on hold-out data: 0.11227423697710037
Epoch: 408

Loss on hold-out set: 0.021835416867785777
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Epoch: 409

Loss on hold-out set: 0.020226048081943494
MeanAbsoluteError value on hold-out data: 0.11209844052791595
Epoch: 410
Loss on hold-out set: 0.021464120807043702
MeanAbsoluteError value on hold-out data: 0.11405723541975021
Epoch: 411

Loss on hold-out set: 0.018625284872638682
MeanAbsoluteError value on hold-out data: 0.1053391620516777
Epoch: 412

Loss on hold-out set: 0.018945074684306746
MeanAbsoluteError value on hold-out data: 0.11089121550321579
Epoch: 413
Loss on hold-out set: 0.021305028750114918
MeanAbsoluteError value on hold-out data: 0.11314230412244797
Epoch: 414
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Loss on hold-out set: 0.019504249422510233
MeanAbsoluteError value on hold-out data: 0.11122055351734161
Epoch: 415

Loss on hold-out set: 0.019629139862566567
MeanAbsoluteError value on hold-out data: 0.11047514528036118
Epoch: 416
Loss on hold-out set: 0.0180489064554907
MeanAbsoluteError value on hold-out data: 0.10685613006353378
Epoch: 417

Loss on hold-out set: 0.021218383946058263
MeanAbsoluteError value on hold-out data: 0.11694611608982086
Epoch: 418

Loss on hold-out set: 0.01997613469158144
MeanAbsoluteError value on hold-out data: 0.11134667694568634
Epoch: 419
Loss on hold-out set: 0.019473407664190746
MeanAbsoluteError value on hold-out data: 0.10907988250255585
Epoch: 420

Loss on hold-out set: 0.017346122138563562
MeanAbsoluteError value on hold-out data: 0.10428309440612793
Epoch: 421

Loss on hold-out set: 0.02018800884038986
MeanAbsoluteError value on hold-out data: 0.11059440672397614
Epoch: 422
Loss on hold-out set: 0.019196155539586
MeanAbsoluteError value on hold-out data: 0.1092204824090004
Epoch: 423

Loss on hold-out set: 0.018972695220782043
MeanAbsoluteError value on hold-out data: 0.10700581967830658
Epoch: 424

Loss on hold-out set: 0.02041291725336729
MeanAbsoluteError value on hold-out data: 0.11158767342567444
Epoch: 425
```

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Loss on hold-out set: 0.019068501449388955
MeanAbsoluteError value on hold-out data: 0.10958698391914368
Epoch: 426

Loss on hold-out set: 0.018861489526364798
MeanAbsoluteError value on hold-out data: 0.10694951564073563
Epoch: 427

Loss on hold-out set: 0.01869828307547626
MeanAbsoluteError value on hold-out data: 0.10581772774457932
Epoch: 428
Loss on hold-out set: 0.02064707429468399
MeanAbsoluteError value on hold-out data: 0.11261976510286331
Epoch: 429

Loss on hold-out set: 0.01841994087367008
MeanAbsoluteError value on hold-out data: 0.10895556211471558
Epoch: 430

Loss on hold-out set: 0.019178047646807195
MeanAbsoluteError value on hold-out data: 0.10913706570863724
Epoch: 431
Loss on hold-out set: 0.017796393739214787
MeanAbsoluteError value on hold-out data: 0.10414369404315948
Epoch: 432

Loss on hold-out set: 0.01799708877442602
MeanAbsoluteError value on hold-out data: 0.1054280698299408
Epoch: 433

Loss on hold-out set: 0.0186504213437244
MeanAbsoluteError value on hold-out data: 0.1048157662153244
Epoch: 434
Loss on hold-out set: 0.02098300076807694
MeanAbsoluteError value on hold-out data: 0.11461257934570312
Epoch: 435

Loss on hold-out set: 0.01866341916326443
MeanAbsoluteError value on hold-out data: 0.10762082785367966
Epoch: 436
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Loss on hold-out set: 0.017798455595107569
MeanAbsoluteError value on hold-out data: 0.10309066623449326
Epoch: 437
Loss on hold-out set: 0.020573002682455505
MeanAbsoluteError value on hold-out data: 0.11154138296842575
Epoch: 438

Loss on hold-out set: 0.017349753112406083
MeanAbsoluteError value on hold-out data: 0.10458260029554367
Epoch: 439

Loss on hold-out set: 0.0175904023295152
MeanAbsoluteError value on hold-out data: 0.10423685610294342
Epoch: 440
Loss on hold-out set: 0.017883513139240678
MeanAbsoluteError value on hold-out data: 0.10518905520439148
Epoch: 441

Loss on hold-out set: 0.017343200766720996
MeanAbsoluteError value on hold-out data: 0.1015293225646019
Epoch: 442

Loss on hold-out set: 0.019394995109081114
MeanAbsoluteError value on hold-out data: 0.107964426279068
Epoch: 443
Loss on hold-out set: 0.016734122876368893
MeanAbsoluteError value on hold-out data: 0.1036766842007637
Epoch: 444

Loss on hold-out set: 0.018269160278359776
MeanAbsoluteError value on hold-out data: 0.10676395148038864
Epoch: 445

Loss on hold-out set: 0.021174221637144608
MeanAbsoluteError value on hold-out data: 0.11432888358831406
Epoch: 446
Loss on hold-out set: 0.01820856694432829
MeanAbsoluteError value on hold-out data: 0.10611812025308609
Epoch: 447
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Loss on hold-out set: 0.019257805327652023
MeanAbsoluteError value on hold-out data: 0.10952481627464294
Epoch: 448

Loss on hold-out set: 0.018845946267295705
MeanAbsoluteError value on hold-out data: 0.10748406499624252
Epoch: 449
Loss on hold-out set: 0.018937545063187525
MeanAbsoluteError value on hold-out data: 0.1087828204035759
Epoch: 450

Loss on hold-out set: 0.01887478470658607
MeanAbsoluteError value on hold-out data: 0.10742570459842682
Epoch: 451

Loss on hold-out set: 0.01694406399454844
MeanAbsoluteError value on hold-out data: 0.10141301900148392
Epoch: 452
Loss on hold-out set: 0.016389130120320866
MeanAbsoluteError value on hold-out data: 0.10462138056755066
Epoch: 453

Loss on hold-out set: 0.017720800743991277
MeanAbsoluteError value on hold-out data: 0.10463392734527588
Epoch: 454

Loss on hold-out set: 0.017045806735016714
MeanAbsoluteError value on hold-out data: 0.10002855211496353
Epoch: 455
Loss on hold-out set: 0.019073901727242628
MeanAbsoluteError value on hold-out data: 0.1043156087398529
Epoch: 456

Loss on hold-out set: 0.017742559928641034
MeanAbsoluteError value on hold-out data: 0.10331559181213379
Epoch: 457

Loss on hold-out set: 0.021040055769796406
MeanAbsoluteError value on hold-out data: 0.11057805269956589
Epoch: 458
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Loss on hold-out set: 0.01692129350536561
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Epoch: 459

Loss on hold-out set: 0.016038744582862516
MeanAbsoluteError value on hold-out data: 0.099942147731781
Epoch: 460

Loss on hold-out set: 0.018667651139645993
MeanAbsoluteError value on hold-out data: 0.10520637780427933
Epoch: 461
Loss on hold-out set: 0.016260894744191318
MeanAbsoluteError value on hold-out data: 0.09989228844642639
Epoch: 462

Loss on hold-out set: 0.018703498135340245
MeanAbsoluteError value on hold-out data: 0.10598146915435791
Epoch: 463

Loss on hold-out set: 0.017775047777880294
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Epoch: 464
Loss on hold-out set: 0.016770736549321253
MeanAbsoluteError value on hold-out data: 0.10324540734291077
Epoch: 465

Loss on hold-out set: 0.017484132436996636
MeanAbsoluteError value on hold-out data: 0.1036999523639679
Epoch: 466

Loss on hold-out set: 0.019211294230917702
MeanAbsoluteError value on hold-out data: 0.11125380545854568
Epoch: 467
Loss on hold-out set: 0.017731307246601016
MeanAbsoluteError value on hold-out data: 0.10531821101903915
Epoch: 468

Loss on hold-out set: 0.016708747077500447
MeanAbsoluteError value on hold-out data: 0.10466187447309494
Epoch: 469
```

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Loss on hold-out set: 0.01758201490333401
MeanAbsoluteError value on hold-out data: 0.10514593124389648
Epoch: 470
Loss on hold-out set: 0.01591934840279767
MeanAbsoluteError value on hold-out data: 0.0961928591132164
Epoch: 471

Loss on hold-out set: 0.015394008797593416
MeanAbsoluteError value on hold-out data: 0.09667612612247467
Epoch: 472

Loss on hold-out set: 0.01798838258352286
MeanAbsoluteError value on hold-out data: 0.10505463182926178
Epoch: 473
Loss on hold-out set: 0.01766466901040985
MeanAbsoluteError value on hold-out data: 0.10494477301836014
Epoch: 474

Loss on hold-out set: 0.017535481269733283
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Epoch: 475

Loss on hold-out set: 0.01710710270500082
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Epoch: 476
Loss on hold-out set: 0.01624806702757875
MeanAbsoluteError value on hold-out data: 0.0965782180428505
Epoch: 477

Loss on hold-out set: 0.017379029342070376
MeanAbsoluteError value on hold-out data: 0.10311944037675858
Epoch: 478

Loss on hold-out set: 0.018015448979034166
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Epoch: 479
Loss on hold-out set: 0.018240202835489376
MeanAbsoluteError value on hold-out data: 0.10625552386045456
Epoch: 480
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Loss on hold-out set: 0.018280586975840077
MeanAbsoluteError value on hold-out data: 0.10700003057718277
Epoch: 481

Loss on hold-out set: 0.016345560506839926
MeanAbsoluteError value on hold-out data: 0.10034633427858353
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Loss on hold-out set: 0.017595020316972902
MeanAbsoluteError value on hold-out data: 0.10140465199947357
Epoch: 483

Loss on hold-out set: 0.01756356373371091
MeanAbsoluteError value on hold-out data: 0.10560804605484009
Epoch: 484

Loss on hold-out set: 0.01872520120610716
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Epoch: 485
Loss on hold-out set: 0.017549052822305386
MeanAbsoluteError value on hold-out data: 0.10210172086954117
Epoch: 486

Loss on hold-out set: 0.016759550348021245
MeanAbsoluteError value on hold-out data: 0.1016378179192543
Epoch: 487

Loss on hold-out set: 0.015010519540519454
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Loss on hold-out set: 0.01892195680527948
MeanAbsoluteError value on hold-out data: 0.10499825328588486
Epoch: 489

Loss on hold-out set: 0.01762818736974926
MeanAbsoluteError value on hold-out data: 0.10264472663402557
Epoch: 490

Loss on hold-out set: 0.01747563900052531
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Epoch: 491
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Loss on hold-out set: 0.015574877274242074
MeanAbsoluteError value on hold-out data: 0.0995033010840416
Epoch: 492

Loss on hold-out set: 0.019457474347630826
MeanAbsoluteError value on hold-out data: 0.10878453403711319
Epoch: 493

Loss on hold-out set: 0.015860158089005077
MeanAbsoluteError value on hold-out data: 0.09620166569948196
Epoch: 494
Loss on hold-out set: 0.01656618322012946
MeanAbsoluteError value on hold-out data: 0.0978485718369484
Epoch: 495

Loss on hold-out set: 0.017339172916399546
MeanAbsoluteError value on hold-out data: 0.10394515842199326
Epoch: 496

Loss on hold-out set: 0.017282679908093998
MeanAbsoluteError value on hold-out data: 0.10303831845521927
Epoch: 497
Loss on hold-out set: 0.018214123843742224
MeanAbsoluteError value on hold-out data: 0.1046106293797493
Epoch: 498

Loss on hold-out set: 0.01595002424912915
MeanAbsoluteError value on hold-out data: 0.10097609460353851
Epoch: 499

Loss on hold-out set: 0.018995751528903686
MeanAbsoluteError value on hold-out data: 0.10355886071920395
Epoch: 500
Loss on hold-out set: 0.015185437526379247
MeanAbsoluteError value on hold-out data: 0.09510454535484314
Epoch: 501

Loss on hold-out set: 0.01694082646671935
MeanAbsoluteError value on hold-out data: 0.10254738479852676
Epoch: 502
```

```
Loss on hold-out set: 0.017884295888814324
MeanAbsoluteError value on hold-out data: 0.1029585599899292
Epoch: 503
Loss on hold-out set: 0.016127304901601747
MeanAbsoluteError value on hold-out data: 0.09975491464138031
Epoch: 504

Loss on hold-out set: 0.01704401295874656
MeanAbsoluteError value on hold-out data: 0.10133769363164902
Epoch: 505

Loss on hold-out set: 0.018282493716736403
MeanAbsoluteError value on hold-out data: 0.10606405884027481
Epoch: 506
Loss on hold-out set: 0.017321006054219955
MeanAbsoluteError value on hold-out data: 0.1029682382941246
Epoch: 507

Loss on hold-out set: 0.016842465934702584
MeanAbsoluteError value on hold-out data: 0.10052017122507095
Epoch: 508

Loss on hold-out set: 0.016743152331522047
MeanAbsoluteError value on hold-out data: 0.10175739228725433
Epoch: 509
Loss on hold-out set: 0.017942279011088733
MeanAbsoluteError value on hold-out data: 0.10302389413118362
Epoch: 510

Loss on hold-out set: 0.017889555391205552
MeanAbsoluteError value on hold-out data: 0.10327038168907166
Epoch: 511

Loss on hold-out set: 0.017010020136561554
MeanAbsoluteError value on hold-out data: 0.10219308733940125
Epoch: 512
Loss on hold-out set: 0.015920525526944403
MeanAbsoluteError value on hold-out data: 0.09811138361692429
Epoch: 513
```

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Loss on hold-out set: 0.01619031418330754
MeanAbsoluteError value on hold-out data: 0.09895649552345276
Epoch: 514

Loss on hold-out set: 0.016598145830794237
MeanAbsoluteError value on hold-out data: 0.10309390723705292
Epoch: 515
Loss on hold-out set: 0.017216778559629043
MeanAbsoluteError value on hold-out data: 0.10154963284730911
Epoch: 516

Loss on hold-out set: 0.01662965468208616
MeanAbsoluteError value on hold-out data: 0.10086042433977127
Epoch: 517

Loss on hold-out set: 0.018369464972250473
MeanAbsoluteError value on hold-out data: 0.10476873070001602
Epoch: 518
Loss on hold-out set: 0.01613451305788961
MeanAbsoluteError value on hold-out data: 0.10027527809143066
Epoch: 519

Loss on hold-out set: 0.017573642082182536
MeanAbsoluteError value on hold-out data: 0.10211104899644852
Epoch: 520

Loss on hold-out set: 0.01755479060705208
MeanAbsoluteError value on hold-out data: 0.10481956601142883
Epoch: 521
Loss on hold-out set: 0.018088572023746866
MeanAbsoluteError value on hold-out data: 0.10406119376420975
Epoch: 522

Loss on hold-out set: 0.017159307207039093
MeanAbsoluteError value on hold-out data: 0.09867119789123535
Epoch: 523

Loss on hold-out set: 0.016779893138542928
MeanAbsoluteError value on hold-out data: 0.09932073950767517
Epoch: 524
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Loss on hold-out set: 0.018235257691703737
MeanAbsoluteError value on hold-out data: 0.1071537509560585
Epoch: 525

Loss on hold-out set: 0.017236698346193104
MeanAbsoluteError value on hold-out data: 0.10074961930513382
Epoch: 526

Loss on hold-out set: 0.017096318748081103
MeanAbsoluteError value on hold-out data: 0.10225022584199905
Epoch: 527
Loss on hold-out set: 0.017000122756144265
MeanAbsoluteError value on hold-out data: 0.10375060886144638
Epoch: 528

Loss on hold-out set: 0.01773022934979963
MeanAbsoluteError value on hold-out data: 0.09909585863351822
Epoch: 529

Loss on hold-out set: 0.015612070125353057
MeanAbsoluteError value on hold-out data: 0.09684610366821289
Epoch: 530
Loss on hold-out set: 0.016745530545595102
MeanAbsoluteError value on hold-out data: 0.0991528257727623
Epoch: 531

Loss on hold-out set: 0.018279680838386412
MeanAbsoluteError value on hold-out data: 0.10554757714271545
Epoch: 532

Loss on hold-out set: 0.01732117756046743
MeanAbsoluteError value on hold-out data: 0.10337546467781067
Epoch: 533
Loss on hold-out set: 0.016633748536396525
MeanAbsoluteError value on hold-out data: 0.10191789269447327
Epoch: 534

Loss on hold-out set: 0.017461063007018916
MeanAbsoluteError value on hold-out data: 0.10149212926626205
Epoch: 535
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Loss on hold-out set: 0.016260755255740757
MeanAbsoluteError value on hold-out data: 0.0994223803281784
Epoch: 536
Loss on hold-out set: 0.016802054677633956
MeanAbsoluteError value on hold-out data: 0.10306103527545929
Epoch: 537

Loss on hold-out set: 0.017813740882556887
MeanAbsoluteError value on hold-out data: 0.10456056147813797
Epoch: 538

Loss on hold-out set: 0.017047114738525125
MeanAbsoluteError value on hold-out data: 0.10185831040143967
Epoch: 539
Loss on hold-out set: 0.015490414881787729
MeanAbsoluteError value on hold-out data: 0.0994693860411644
Epoch: 540

Loss on hold-out set: 0.015018091727979481
MeanAbsoluteError value on hold-out data: 0.09721851348876953
Epoch: 541

Loss on hold-out set: 0.01764886156418167
MeanAbsoluteError value on hold-out data: 0.10185571014881134
Epoch: 542
Loss on hold-out set: 0.018225220529566287
MeanAbsoluteError value on hold-out data: 0.1056797131896019
Epoch: 543

Loss on hold-out set: 0.01730235885392176
MeanAbsoluteError value on hold-out data: 0.10502701252698898
Epoch: 544

Loss on hold-out set: 0.017499150493434475
MeanAbsoluteError value on hold-out data: 0.10292045772075653
Epoch: 545
Loss on hold-out set: 0.01696215196073657
MeanAbsoluteError value on hold-out data: 0.09899839013814926
Epoch: 546
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Loss on hold-out set: 0.016763548120967850
MeanAbsoluteError value on hold-out data: 0.10054029524326324
Epoch: 547

Loss on hold-out set: 0.017755774965771708
MeanAbsoluteError value on hold-out data: 0.10399634391069412
Epoch: 548
Loss on hold-out set: 0.01793324930729189
MeanAbsoluteError value on hold-out data: 0.10206188261508942
Epoch: 549

Loss on hold-out set: 0.014975161204541412
MeanAbsoluteError value on hold-out data: 0.09412303566932678
Epoch: 550

Loss on hold-out set: 0.01618458954365148
MeanAbsoluteError value on hold-out data: 0.10091913491487503
Epoch: 551
Loss on hold-out set: 0.01708110530516327
MeanAbsoluteError value on hold-out data: 0.10179687291383743
Epoch: 552

Loss on hold-out set: 0.015019153415050824
MeanAbsoluteError value on hold-out data: 0.09594553709030151
Epoch: 553

Loss on hold-out set: 0.016747424184383516
MeanAbsoluteError value on hold-out data: 0.1038341224193573
Epoch: 554
Loss on hold-out set: 0.01581528167239109
MeanAbsoluteError value on hold-out data: 0.09726448357105255
Epoch: 555

Loss on hold-out set: 0.015408414508274291
MeanAbsoluteError value on hold-out data: 0.09389436990022659
Epoch: 556

Loss on hold-out set: 0.016959734173724428
MeanAbsoluteError value on hold-out data: 0.09921079128980637
Epoch: 557
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Loss on hold-out set: 0.016457544652075738
MeanAbsoluteError value on hold-out data: 0.09992902725934982
Epoch: 558

Loss on hold-out set: 0.017753024441578114
MeanAbsoluteError value on hold-out data: 0.10500237345695496
Epoch: 559

Loss on hold-out set: 0.015466675329104571
MeanAbsoluteError value on hold-out data: 0.09418579936027527
Epoch: 560
Loss on hold-out set: 0.017778242319861116
MeanAbsoluteError value on hold-out data: 0.10123924911022186
Epoch: 561

Loss on hold-out set: 0.014577725996593169
MeanAbsoluteError value on hold-out data: 0.09131056815385818
Epoch: 562

Loss on hold-out set: 0.015727862451603868
MeanAbsoluteError value on hold-out data: 0.09907560050487518
Epoch: 563
Loss on hold-out set: 0.01630026832271445
MeanAbsoluteError value on hold-out data: 0.10091546177864075
Epoch: 564

Loss on hold-out set: 0.017656444330350497
MeanAbsoluteError value on hold-out data: 0.10347102582454681
Epoch: 565

Loss on hold-out set: 0.016372519017216595
MeanAbsoluteError value on hold-out data: 0.10009893029928207
Epoch: 566
Loss on hold-out set: 0.015278304445479686
MeanAbsoluteError value on hold-out data: 0.09713105857372284
Epoch: 567

Loss on hold-out set: 0.015863275973557998
MeanAbsoluteError value on hold-out data: 0.09615036845207214
Epoch: 568
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Loss on hold-out set: 0.017154798649717123
MeanAbsoluteError value on hold-out data: 0.1021571010351181
Epoch: 569
Loss on hold-out set: 0.014850103142671288
MeanAbsoluteError value on hold-out data: 0.09585054963827133
Epoch: 570

Loss on hold-out set: 0.017416790871745132
MeanAbsoluteError value on hold-out data: 0.10533083230257034
Epoch: 571

Loss on hold-out set: 0.01690358397589686
MeanAbsoluteError value on hold-out data: 0.10106752067804337
Epoch: 572
Loss on hold-out set: 0.016673518497749076
MeanAbsoluteError value on hold-out data: 0.09980639815330505
Epoch: 573

Loss on hold-out set: 0.01693741245738541
MeanAbsoluteError value on hold-out data: 0.1029936820268631
Epoch: 574

Loss on hold-out set: 0.013050261417520232
MeanAbsoluteError value on hold-out data: 0.08878791332244873
Epoch: 575
Loss on hold-out set: 0.01574892166022134
MeanAbsoluteError value on hold-out data: 0.098915234208107
Epoch: 576

Loss on hold-out set: 0.016484279587627194
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Epoch: 577

Loss on hold-out set: 0.01439710346821812
MeanAbsoluteError value on hold-out data: 0.09328129887580872
Epoch: 578
Loss on hold-out set: 0.015058409227009784
MeanAbsoluteError value on hold-out data: 0.09419796615839005
Epoch: 579
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Loss on hold-out set: 0.014841685946800378
MeanAbsoluteError value on hold-out data: 0.092736154794693
Epoch: 580

Loss on hold-out set: 0.014986957530297029
MeanAbsoluteError value on hold-out data: 0.09703875333070755
Epoch: 581
Loss on hold-out set: 0.015914118604996474
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Epoch: 582

Loss on hold-out set: 0.014713636249992609
MeanAbsoluteError value on hold-out data: 0.09517719596624374
Epoch: 583

Loss on hold-out set: 0.016128312042539315
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Epoch: 584
Loss on hold-out set: 0.017014357707648742
MeanAbsoluteError value on hold-out data: 0.0991351380944252
Epoch: 585

Loss on hold-out set: 0.014672828399100885
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Epoch: 586

Loss on hold-out set: 0.014290967727962805
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Epoch: 587
Loss on hold-out set: 0.017653576933626028
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Epoch: 588

Loss on hold-out set: 0.015593218562571565
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Epoch: 589

Loss on hold-out set: 0.016768514680540345
MeanAbsoluteError value on hold-out data: 0.10068351030349731
Epoch: 590
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Loss on hold-out set: 0.014687604239737388
MeanAbsoluteError value on hold-out data: 0.0959344208240509
Epoch: 591

Loss on hold-out set: 0.01486713206358104
MeanAbsoluteError value on hold-out data: 0.0921538844704628
Epoch: 592

Loss on hold-out set: 0.014356099661405703
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Epoch: 593
Loss on hold-out set: 0.014857865278460546
MeanAbsoluteError value on hold-out data: 0.0938226729631424
Epoch: 594

Loss on hold-out set: 0.01642622068466153
MeanAbsoluteError value on hold-out data: 0.09951672703027725
Epoch: 595

Loss on hold-out set: 0.015850497461797203
MeanAbsoluteError value on hold-out data: 0.0977860614657402
Epoch: 596
Loss on hold-out set: 0.015295387044655702
MeanAbsoluteError value on hold-out data: 0.09393303841352463
Epoch: 597

Loss on hold-out set: 0.015677993084827903
MeanAbsoluteError value on hold-out data: 0.09654559195041656
Epoch: 598

Loss on hold-out set: 0.01741658067475934
MeanAbsoluteError value on hold-out data: 0.10021773725748062
Epoch: 599
Loss on hold-out set: 0.015425134680068973
MeanAbsoluteError value on hold-out data: 0.09465335309505463
Epoch: 600

Loss on hold-out set: 0.014772945203294512
MeanAbsoluteError value on hold-out data: 0.09518230706453323
Epoch: 601
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Loss on hold-out set: 0.015602888915906684
MeanAbsoluteError value on hold-out data: 0.09769650548696518
Epoch: 602
Loss on hold-out set: 0.01586041399997157
MeanAbsoluteError value on hold-out data: 0.09748204797506332
Epoch: 603

Loss on hold-out set: 0.015214284422254422
MeanAbsoluteError value on hold-out data: 0.09593123942613602
Epoch: 604

Loss on hold-out set: 0.017983345576964592
MeanAbsoluteError value on hold-out data: 0.1027621477842331
Epoch: 605
Loss on hold-out set: 0.015245737169110119
MeanAbsoluteError value on hold-out data: 0.09341941773891449
Epoch: 606

Loss on hold-out set: 0.013631786917637025
MeanAbsoluteError value on hold-out data: 0.08975102752447128
Epoch: 607

Loss on hold-out set: 0.015532029361299162
MeanAbsoluteError value on hold-out data: 0.09455665946006775
Epoch: 608
Loss on hold-out set: 0.015108933575223395
MeanAbsoluteError value on hold-out data: 0.09530434012413025
Epoch: 609

Loss on hold-out set: 0.014276351199999529
MeanAbsoluteError value on hold-out data: 0.09242288023233414
Epoch: 610

Loss on hold-out set: 0.015204313013006565
MeanAbsoluteError value on hold-out data: 0.09703216701745987
Epoch: 611
Loss on hold-out set: 0.01284400959618021
MeanAbsoluteError value on hold-out data: 0.08663903921842575
Epoch: 612
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Loss on hold-out set: 0.015805157163661838
MeanAbsoluteError value on hold-out data: 0.09575710445642471
Epoch: 613

Loss on hold-out set: 0.015363457379038058
MeanAbsoluteError value on hold-out data: 0.09597591310739517
Epoch: 614
Loss on hold-out set: 0.01582707233460193
MeanAbsoluteError value on hold-out data: 0.09772848337888718
Epoch: 615

Loss on hold-out set: 0.014051923097000932
MeanAbsoluteError value on hold-out data: 0.09554392099380493
Epoch: 616

Loss on hold-out set: 0.014778834961762187
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Epoch: 617
Loss on hold-out set: 0.014704116990997136
MeanAbsoluteError value on hold-out data: 0.09495709091424942
Epoch: 618

Loss on hold-out set: 0.016492553969146683
MeanAbsoluteError value on hold-out data: 0.09816058725118637
Epoch: 619

Loss on hold-out set: 0.014797509552663542
MeanAbsoluteError value on hold-out data: 0.09238187968730927
Epoch: 620
Loss on hold-out set: 0.01622520939039532
MeanAbsoluteError value on hold-out data: 0.09654133021831512
Epoch: 621

Loss on hold-out set: 0.013147827971006337
MeanAbsoluteError value on hold-out data: 0.08865232020616531
Epoch: 622

Loss on hold-out set: 0.014591142912589323
MeanAbsoluteError value on hold-out data: 0.08993467688560486
Epoch: 623
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Loss on hold-out set: 0.014889443799717506
MeanAbsoluteError value on hold-out data: 0.09651318192481995
Epoch: 624

Loss on hold-out set: 0.01664110916062782
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Epoch: 625

Loss on hold-out set: 0.015600989320785933
MeanAbsoluteError value on hold-out data: 0.09883613139390945
Epoch: 626
Loss on hold-out set: 0.014091083838090223
MeanAbsoluteError value on hold-out data: 0.09203816950321198
Epoch: 627

Loss on hold-out set: 0.013963622023972373
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Epoch: 628

Loss on hold-out set: 0.014755156538615968
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Epoch: 629
Loss on hold-out set: 0.014897161884340069
MeanAbsoluteError value on hold-out data: 0.09403469413518906
Epoch: 630

Loss on hold-out set: 0.01429314635276872
MeanAbsoluteError value on hold-out data: 0.09384743124246597
Epoch: 631

Loss on hold-out set: 0.01562590187357273
MeanAbsoluteError value on hold-out data: 0.09731251001358032
Epoch: 632
Loss on hold-out set: 0.015805002079578117
MeanAbsoluteError value on hold-out data: 0.09858272969722748
Epoch: 633

Loss on hold-out set: 0.015579976725081603
MeanAbsoluteError value on hold-out data: 0.09761709719896317
Epoch: 634
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Loss on hold-out set: 0.01546009902342727
MeanAbsoluteError value on hold-out data: 0.09847977012395859
Epoch: 635
Loss on hold-out set: 0.013928198837675154
MeanAbsoluteError value on hold-out data: 0.09322002530097961
Epoch: 636

Loss on hold-out set: 0.01385931118260487
MeanAbsoluteError value on hold-out data: 0.09278406947851181
Epoch: 637

Loss on hold-out set: 0.012641903677188869
MeanAbsoluteError value on hold-out data: 0.08606895804405212
Epoch: 638
Loss on hold-out set: 0.014808637570992383
MeanAbsoluteError value on hold-out data: 0.09557607024908066
Epoch: 639

Loss on hold-out set: 0.013446904134179932
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Epoch: 640

Loss on hold-out set: 0.014436745024577249
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Epoch: 641
Loss on hold-out set: 0.014130904024423217
MeanAbsoluteError value on hold-out data: 0.08909382671117783
Epoch: 642

Loss on hold-out set: 0.016875850336752287
MeanAbsoluteError value on hold-out data: 0.09948161244392395
Epoch: 643

Loss on hold-out set: 0.014956138030878113
MeanAbsoluteError value on hold-out data: 0.09286941587924957
Epoch: 644
Loss on hold-out set: 0.014832610483699682
MeanAbsoluteError value on hold-out data: 0.09169533103704453
Epoch: 645
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Loss on hold-out set: 0.017019944165294874
MeanAbsoluteError value on hold-out data: 0.100210040807724
Epoch: 646

Loss on hold-out set: 0.014459787546569108
MeanAbsoluteError value on hold-out data: 0.09414699673652649
Epoch: 647
Loss on hold-out set: 0.012335937219031621
MeanAbsoluteError value on hold-out data: 0.08699722588062286
Epoch: 648

Loss on hold-out set: 0.01396475842523311
MeanAbsoluteError value on hold-out data: 0.09191715717315674
Epoch: 649

Loss on hold-out set: 0.01406287075060997
MeanAbsoluteError value on hold-out data: 0.0888807624578476
Epoch: 650
Loss on hold-out set: 0.013631080580526032
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Epoch: 651

Loss on hold-out set: 0.014143314840572808
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Epoch: 652

Loss on hold-out set: 0.014796928777553451
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Epoch: 653
Loss on hold-out set: 0.014814472931272273
MeanAbsoluteError value on hold-out data: 0.09640344232320786
Epoch: 654

Loss on hold-out set: 0.013405271421312743
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Epoch: 655

Loss on hold-out set: 0.014903572890325449
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Epoch: 656
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Loss on hold-out set: 0.014127605868755685
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Epoch: 657

Loss on hold-out set: 0.014371493354847189
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Epoch: 658

Loss on hold-out set: 0.013806368538935203
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Loss on hold-out set: 0.01453695696868787
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Epoch: 660

Loss on hold-out set: 0.015336625764951654
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Epoch: 661

Loss on hold-out set: 0.01384781909189769
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Epoch: 662
Loss on hold-out set: 0.016323502705636202
MeanAbsoluteError value on hold-out data: 0.09682215005159378
Epoch: 663

Loss on hold-out set: 0.015042200991835368
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Epoch: 664

Loss on hold-out set: 0.01308262092356017
MeanAbsoluteError value on hold-out data: 0.08626573532819748
Epoch: 665
Loss on hold-out set: 0.015006611121449775
MeanAbsoluteError value on hold-out data: 0.09559845924377441
Epoch: 666

Loss on hold-out set: 0.012952816985149979
MeanAbsoluteError value on hold-out data: 0.08777725696563721
Epoch: 667
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Loss on hold-out set: 0.015810010363347827
MeanAbsoluteError value on hold-out data: 0.09637470543384552
Epoch: 668
Loss on hold-out set: 0.013913742674291522
MeanAbsoluteError value on hold-out data: 0.0893959030508995
Epoch: 669

Loss on hold-out set: 0.013511673761725736
MeanAbsoluteError value on hold-out data: 0.09068416059017181
Epoch: 670

Loss on hold-out set: 0.014373607661127608
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Epoch: 671
Loss on hold-out set: 0.014036560877842325
MeanAbsoluteError value on hold-out data: 0.08968637138605118
Epoch: 672

Loss on hold-out set: 0.015133027684836027
MeanAbsoluteError value on hold-out data: 0.09361463040113449
Epoch: 673

Loss on hold-out set: 0.014067305502928017
MeanAbsoluteError value on hold-out data: 0.09006143361330032
Epoch: 674
Loss on hold-out set: 0.014484234992972536
MeanAbsoluteError value on hold-out data: 0.09088999032974243
Epoch: 675

Loss on hold-out set: 0.012082813934296914
MeanAbsoluteError value on hold-out data: 0.08553196489810944
Epoch: 676

Loss on hold-out set: 0.014242073951972998
MeanAbsoluteError value on hold-out data: 0.09045801311731339
Epoch: 677
Loss on hold-out set: 0.011963148766808445
MeanAbsoluteError value on hold-out data: 0.08677411079406738
Epoch: 678
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Loss on hold-out set: 0.013806285882551492
MeanAbsoluteError value on hold-out data: 0.091395303606987
Epoch: 679

Loss on hold-out set: 0.013325126563916758
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Epoch: 680
Loss on hold-out set: 0.014778845819406949
MeanAbsoluteError value on hold-out data: 0.09199950844049454
Epoch: 681

Loss on hold-out set: 0.012905743272452431
MeanAbsoluteError value on hold-out data: 0.08871453255414963
Epoch: 682

Loss on hold-out set: 0.014963183303916595
MeanAbsoluteError value on hold-out data: 0.09390012174844742
Epoch: 683
Loss on hold-out set: 0.013399562961628059
MeanAbsoluteError value on hold-out data: 0.09029939770698547
Epoch: 684

Loss on hold-out set: 0.012328977490815305
MeanAbsoluteError value on hold-out data: 0.08733698725700378
Epoch: 685

Loss on hold-out set: 0.013042348753321373
MeanAbsoluteError value on hold-out data: 0.08932952582836151
Epoch: 686
Loss on hold-out set: 0.014147632569450555
MeanAbsoluteError value on hold-out data: 0.0928223580121994
Epoch: 687

Loss on hold-out set: 0.014707386810914613
MeanAbsoluteError value on hold-out data: 0.09464887529611588
Epoch: 688

Loss on hold-out set: 0.013440803440268307
MeanAbsoluteError value on hold-out data: 0.09087108820676804
Epoch: 689
```

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Loss on hold-out set: 0.01436214416963594
MeanAbsoluteError value on hold-out data: 0.09467966854572296
Epoch: 690

Loss on hold-out set: 0.012434964532100518
MeanAbsoluteError value on hold-out data: 0.08658277243375778
Epoch: 691

Loss on hold-out set: 0.014464205569432427
MeanAbsoluteError value on hold-out data: 0.08824098855257034
Epoch: 692
Loss on hold-out set: 0.012390097671304829
MeanAbsoluteError value on hold-out data: 0.08774964511394501
Epoch: 693

Loss on hold-out set: 0.013966141587000797
MeanAbsoluteError value on hold-out data: 0.09020981192588806
Epoch: 694

Loss on hold-out set: 0.013294442813203204
MeanAbsoluteError value on hold-out data: 0.0888623595237732
Epoch: 695
Loss on hold-out set: 0.013656145430929124
MeanAbsoluteError value on hold-out data: 0.08936905860900879
Epoch: 696

Loss on hold-out set: 0.01299779258503501
MeanAbsoluteError value on hold-out data: 0.08848785609006882
Epoch: 697

Loss on hold-out set: 0.015913978568448027
MeanAbsoluteError value on hold-out data: 0.09557993710041046
Epoch: 698
Loss on hold-out set: 0.013159186972673827
MeanAbsoluteError value on hold-out data: 0.08807110786437988
Epoch: 699

Loss on hold-out set: 0.011715382759284694
MeanAbsoluteError value on hold-out data: 0.08574588596820831
Epoch: 700
```

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Loss on hold-out set: 0.012943514648747032
MeanAbsoluteError value on hold-out data: 0.08589516580104828
Epoch: 701
Loss on hold-out set: 0.01254609015052362
MeanAbsoluteError value on hold-out data: 0.08773668855428696
Epoch: 702

Loss on hold-out set: 0.013882120810909934
MeanAbsoluteError value on hold-out data: 0.09004565328359604
Epoch: 703

Loss on hold-out set: 0.014596508540366833
MeanAbsoluteError value on hold-out data: 0.0912969708442688
Epoch: 704
Loss on hold-out set: 0.013394804826433149
MeanAbsoluteError value on hold-out data: 0.09075864404439926
Epoch: 705

Loss on hold-out set: 0.012427613158943132
MeanAbsoluteError value on hold-out data: 0.08750679343938828
Epoch: 706

Loss on hold-out set: 0.013928147470481554
MeanAbsoluteError value on hold-out data: 0.09150152653455734
Epoch: 707
Loss on hold-out set: 0.012972803366719745
MeanAbsoluteError value on hold-out data: 0.09039002656936646
Epoch: 708

Loss on hold-out set: 0.014920104849831356
MeanAbsoluteError value on hold-out data: 0.09450224041938782
Epoch: 709

Loss on hold-out set: 0.012418495783883307
MeanAbsoluteError value on hold-out data: 0.08685386925935745
Epoch: 710
Loss on hold-out set: 0.013253461852145846
MeanAbsoluteError value on hold-out data: 0.08621788769960403
Epoch: 711
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Loss on hold-out set: 0.012493615711622018
MeanAbsoluteError value on hold-out data: 0.08833286166191101
Epoch: 712

Loss on hold-out set: 0.014715415194126157
MeanAbsoluteError value on hold-out data: 0.09485936909914017
Epoch: 713
Loss on hold-out set: 0.012210235336776046
MeanAbsoluteError value on hold-out data: 0.08388940244913101
Epoch: 714

Loss on hold-out set: 0.013324995859293268
MeanAbsoluteError value on hold-out data: 0.08766679465770721
Epoch: 715

Loss on hold-out set: 0.013659034546193046
MeanAbsoluteError value on hold-out data: 0.08927009999752045
Epoch: 716
Loss on hold-out set: 0.014563382441186453
MeanAbsoluteError value on hold-out data: 0.09313647449016571
Epoch: 717

Loss on hold-out set: 0.013234700721465444
MeanAbsoluteError value on hold-out data: 0.09045947343111038
Epoch: 718

Loss on hold-out set: 0.015247527454121154
MeanAbsoluteError value on hold-out data: 0.09346253424882889
Epoch: 719
Loss on hold-out set: 0.012917185882397462
MeanAbsoluteError value on hold-out data: 0.08731494098901749
Epoch: 720

Loss on hold-out set: 0.013062470762154893
MeanAbsoluteError value on hold-out data: 0.08769497275352478
Epoch: 721

Loss on hold-out set: 0.014950959588847278
MeanAbsoluteError value on hold-out data: 0.09535210579633713
Epoch: 722
```

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Loss on hold-out set: 0.01213696629672389
MeanAbsoluteError value on hold-out data: 0.08577709645032883
Epoch: 723

Loss on hold-out set: 0.01254315411943632
MeanAbsoluteError value on hold-out data: 0.08700818568468094
Epoch: 724

Loss on hold-out set: 0.013394640761689516
MeanAbsoluteError value on hold-out data: 0.08798687160015106
Epoch: 725
Loss on hold-out set: 0.012840102720171368
MeanAbsoluteError value on hold-out data: 0.09048888087272644
Epoch: 726

Loss on hold-out set: 0.012796422597457422
MeanAbsoluteError value on hold-out data: 0.09059488773345947
Epoch: 727

Loss on hold-out set: 0.013011353800466167
MeanAbsoluteError value on hold-out data: 0.08985647559165955
Epoch: 728
Loss on hold-out set: 0.012599713070036767
MeanAbsoluteError value on hold-out data: 0.08608264476060867
Epoch: 729

Loss on hold-out set: 0.012923803564723736
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Epoch: 730

Loss on hold-out set: 0.012781527825912539
MeanAbsoluteError value on hold-out data: 0.08992448449134827
Epoch: 731
Loss on hold-out set: 0.01240408747306598
MeanAbsoluteError value on hold-out data: 0.08608204871416092
Epoch: 732

Loss on hold-out set: 0.012488693985699987
MeanAbsoluteError value on hold-out data: 0.08581807464361191
Epoch: 733
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Loss on hold-out set: 0.014287451652085678
MeanAbsoluteError value on hold-out data: 0.08936146646738052
Epoch: 734
Loss on hold-out set: 0.013300050987357584
MeanAbsoluteError value on hold-out data: 0.09247277677059174
Epoch: 735

Loss on hold-out set: 0.012117774273368317
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Epoch: 736

Loss on hold-out set: 0.013051976889449483
MeanAbsoluteError value on hold-out data: 0.0863642543554306
Epoch: 737
Loss on hold-out set: 0.012659066951843366
MeanAbsoluteError value on hold-out data: 0.08567964285612106
Epoch: 738

Loss on hold-out set: 0.012401653599760417
MeanAbsoluteError value on hold-out data: 0.08778534084558487
Epoch: 739

Loss on hold-out set: 0.013486481316255473
MeanAbsoluteError value on hold-out data: 0.09065372496843338
Epoch: 740
Loss on hold-out set: 0.013297180784817708
MeanAbsoluteError value on hold-out data: 0.08812738209962845
Epoch: 741

Loss on hold-out set: 0.011081683700698099
MeanAbsoluteError value on hold-out data: 0.0820389911532402
Epoch: 742

Loss on hold-out set: 0.014498968148327549
MeanAbsoluteError value on hold-out data: 0.09166431427001953
Epoch: 743
Loss on hold-out set: 0.012004307961739565
MeanAbsoluteError value on hold-out data: 0.08556034415960312
Epoch: 744
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Loss on hold-out set: 0.012298257524865524
MeanAbsoluteError value on hold-out data: 0.08513786643743515
Epoch: 745

Loss on hold-out set: 0.01234500221030127
MeanAbsoluteError value on hold-out data: 0.08578372746706009
Epoch: 746
Loss on hold-out set: 0.013250754281519525
MeanAbsoluteError value on hold-out data: 0.08576475083827972
Epoch: 747

Loss on hold-out set: 0.014383837640901523
MeanAbsoluteError value on hold-out data: 0.0933515727519989
Epoch: 748

Loss on hold-out set: 0.011682389281486395
MeanAbsoluteError value on hold-out data: 0.08436063677072525
Epoch: 749
Loss on hold-out set: 0.013217612802012203
MeanAbsoluteError value on hold-out data: 0.08851844072341919
Epoch: 750

Loss on hold-out set: 0.012202855711511801
MeanAbsoluteError value on hold-out data: 0.08777448534965515
Epoch: 751

Loss on hold-out set: 0.014809522536112733
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Epoch: 752
Loss on hold-out set: 0.012289979458219023
MeanAbsoluteError value on hold-out data: 0.08415371924638748
Epoch: 753

Loss on hold-out set: 0.01330259214329999
MeanAbsoluteError value on hold-out data: 0.08719613403081894
Epoch: 754

Loss on hold-out set: 0.010971564242575671
MeanAbsoluteError value on hold-out data: 0.08048513531684875
Epoch: 755
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Loss on hold-out set: 0.013255811815179186
MeanAbsoluteError value on hold-out data: 0.0885300412774086
Epoch: 756

Loss on hold-out set: 0.012540422128901507
MeanAbsoluteError value on hold-out data: 0.08737696707248688
Epoch: 757

Loss on hold-out set: 0.011272684366025108
MeanAbsoluteError value on hold-out data: 0.08121666312217712
Epoch: 758
Loss on hold-out set: 0.010420101447962224
MeanAbsoluteError value on hold-out data: 0.07944601774215698
Epoch: 759

Loss on hold-out set: 0.011542216665499533
MeanAbsoluteError value on hold-out data: 0.08100204914808273
Epoch: 760

Loss on hold-out set: 0.014745447751459627
MeanAbsoluteError value on hold-out data: 0.094229556620121
Epoch: 761
Loss on hold-out set: 0.013765559280388213
MeanAbsoluteError value on hold-out data: 0.08987575024366379
Epoch: 762

Loss on hold-out set: 0.010877040042238757
MeanAbsoluteError value on hold-out data: 0.08112354576587677
Epoch: 763

Loss on hold-out set: 0.013752848510897213
MeanAbsoluteError value on hold-out data: 0.08704941719770432
Epoch: 764
Loss on hold-out set: 0.012702742015462717
MeanAbsoluteError value on hold-out data: 0.08859121054410934
Epoch: 765

Loss on hold-out set: 0.013131725610546709
MeanAbsoluteError value on hold-out data: 0.0895613357424736
Epoch: 766
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Loss on hold-out set: 0.014099255339145505
MeanAbsoluteError value on hold-out data: 0.09033515304327011
Epoch: 767
Loss on hold-out set: 0.013866512145080681
MeanAbsoluteError value on hold-out data: 0.09005358815193176
Epoch: 768

Loss on hold-out set: 0.014429769760827185
MeanAbsoluteError value on hold-out data: 0.09369603544473648
Epoch: 769

Loss on hold-out set: 0.012945659571335758
MeanAbsoluteError value on hold-out data: 0.08823759853839874
Epoch: 770
Loss on hold-out set: 0.013780034929277462
MeanAbsoluteError value on hold-out data: 0.08913751691579819
Epoch: 771

Loss on hold-out set: 0.011466153412572263
MeanAbsoluteError value on hold-out data: 0.08380360156297684
Epoch: 772

Loss on hold-out set: 0.010865242594542603
MeanAbsoluteError value on hold-out data: 0.08125536888837814
Epoch: 773
Loss on hold-out set: 0.012063585153033879
MeanAbsoluteError value on hold-out data: 0.08645375072956085
Epoch: 774

Loss on hold-out set: 0.012557071410337812
MeanAbsoluteError value on hold-out data: 0.08652845025062561
Epoch: 775

Loss on hold-out set: 0.012582886240741876
MeanAbsoluteError value on hold-out data: 0.0886656641960144
Epoch: 776
Loss on hold-out set: 0.012613738998382662
MeanAbsoluteError value on hold-out data: 0.08701802045106888
Epoch: 777
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Loss on hold-out set: 0.011854418049406377
MeanAbsoluteError value on hold-out data: 0.08376097679138184
Epoch: 778

Loss on hold-out set: 0.013225335639508557
MeanAbsoluteError value on hold-out data: 0.08797251433134079
Epoch: 779
Loss on hold-out set: 0.014493194278038572
MeanAbsoluteError value on hold-out data: 0.09322711080312729
Epoch: 780

Loss on hold-out set: 0.013539592806312915
MeanAbsoluteError value on hold-out data: 0.087564617395401
Epoch: 781

Loss on hold-out set: 0.012862196340186831
MeanAbsoluteError value on hold-out data: 0.0883142352104187
Epoch: 782
Loss on hold-out set: 0.012905160461523337
MeanAbsoluteError value on hold-out data: 0.08675005286931992
Epoch: 783

Loss on hold-out set: 0.012320867869226882
MeanAbsoluteError value on hold-out data: 0.0861235037446022
Epoch: 784

Loss on hold-out set: 0.012912046967321657
MeanAbsoluteError value on hold-out data: 0.08897195011377335
Epoch: 785
Loss on hold-out set: 0.012611606890617017
MeanAbsoluteError value on hold-out data: 0.08599453419446945
Epoch: 786

Loss on hold-out set: 0.013489087715218678
MeanAbsoluteError value on hold-out data: 0.08628986030817032
Epoch: 787

Loss on hold-out set: 0.011003606583302222
MeanAbsoluteError value on hold-out data: 0.08201957494020462
Epoch: 788
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Loss on hold-out set: 0.01316299422646504
MeanAbsoluteError value on hold-out data: 0.08912172168493271
Epoch: 789

Loss on hold-out set: 0.011234748050956114
MeanAbsoluteError value on hold-out data: 0.08030659705400467
Epoch: 790

Loss on hold-out set: 0.012825328878025176
MeanAbsoluteError value on hold-out data: 0.08685881644487381
Epoch: 791
Loss on hold-out set: 0.012169187244483813
MeanAbsoluteError value on hold-out data: 0.08312933892011642
Epoch: 792

Loss on hold-out set: 0.012880233941553645
MeanAbsoluteError value on hold-out data: 0.08655566722154617
Epoch: 793

Loss on hold-out set: 0.011518646411665638
MeanAbsoluteError value on hold-out data: 0.08333950489759445
Epoch: 794
Loss on hold-out set: 0.012044579439680092
MeanAbsoluteError value on hold-out data: 0.08439572155475616
Epoch: 795

Loss on hold-out set: 0.011399268399327412
MeanAbsoluteError value on hold-out data: 0.08065061271190643
Epoch: 796

Loss on hold-out set: 0.01101413024928964
MeanAbsoluteError value on hold-out data: 0.07901210337877274
Epoch: 797
Loss on hold-out set: 0.012660767116758507
MeanAbsoluteError value on hold-out data: 0.08604847639799118
Epoch: 798

Loss on hold-out set: 0.011298027080641381
MeanAbsoluteError value on hold-out data: 0.08286389708518982
Epoch: 799
```

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Loss on hold-out set: 0.011966136197831172
MeanAbsoluteError value on hold-out data: 0.08495087176561356
Epoch: 800
Loss on hold-out set: 0.011903217412958233
MeanAbsoluteError value on hold-out data: 0.08161348849534988
Epoch: 801

Loss on hold-out set: 0.012502511147079834
MeanAbsoluteError value on hold-out data: 0.08582115173339844
Epoch: 802

Loss on hold-out set: 0.010634892754508959
MeanAbsoluteError value on hold-out data: 0.07653932273387909
Epoch: 803
Loss on hold-out set: 0.011786704736538619
MeanAbsoluteError value on hold-out data: 0.0853421688079834
Epoch: 804

Loss on hold-out set: 0.010227970639049696
MeanAbsoluteError value on hold-out data: 0.07900296896696091
Epoch: 805

Loss on hold-out set: 0.012787459950629151
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Epoch: 806
Loss on hold-out set: 0.012977446117971947
MeanAbsoluteError value on hold-out data: 0.08711539953947067
Epoch: 807

Loss on hold-out set: 0.012314223431555244
MeanAbsoluteError value on hold-out data: 0.08602160960435867
Epoch: 808

Loss on hold-out set: 0.011750221569133525
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Epoch: 809
Loss on hold-out set: 0.01284625275199384
MeanAbsoluteError value on hold-out data: 0.0871041789650917
Epoch: 810
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Loss on hold-out set: 0.011917672090433673
MeanAbsoluteError value on hold-out data: 0.08345631510019302
Epoch: 811

Loss on hold-out set: 0.012236168305292571
MeanAbsoluteError value on hold-out data: 0.08361916989088058
Epoch: 812
Loss on hold-out set: 0.012797713232672928
MeanAbsoluteError value on hold-out data: 0.08926662802696228
Epoch: 813

Loss on hold-out set: 0.013221503255675391
MeanAbsoluteError value on hold-out data: 0.08749480545520782
Epoch: 814

Loss on hold-out set: 0.011668037503501788
MeanAbsoluteError value on hold-out data: 0.081480011343956
Epoch: 815
Loss on hold-out set: 0.011916240363031344
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Epoch: 816

Loss on hold-out set: 0.01287732136384875
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Epoch: 817

Loss on hold-out set: 0.011222653886458525
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Epoch: 818
Loss on hold-out set: 0.01095795239886987
MeanAbsoluteError value on hold-out data: 0.0782802477478981
Epoch: 819

Loss on hold-out set: 0.011556685158661822
MeanAbsoluteError value on hold-out data: 0.08047343045473099
Epoch: 820

Loss on hold-out set: 0.013231195808718137
MeanAbsoluteError value on hold-out data: 0.08875535428524017
Epoch: 821
```

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Loss on hold-out set: 0.011569730804246016
MeanAbsoluteError value on hold-out data: 0.08392524719238281
Epoch: 822

Loss on hold-out set: 0.012887787002012678
MeanAbsoluteError value on hold-out data: 0.0850188285112381
Epoch: 823

Loss on hold-out set: 0.011987273066527753
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Epoch: 824
Loss on hold-out set: 0.012185022134993536
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Epoch: 825

Loss on hold-out set: 0.013105797675040472
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Epoch: 826

Loss on hold-out set: 0.012547226139079916
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Epoch: 827
Loss on hold-out set: 0.01056966872714232
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Epoch: 828

Loss on hold-out set: 0.010979814097251316
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Epoch: 829

Loss on hold-out set: 0.01159674325050825
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Epoch: 830
Loss on hold-out set: 0.012197374358365778
MeanAbsoluteError value on hold-out data: 0.08540560305118561
Epoch: 831

Loss on hold-out set: 0.012233788941448437
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Epoch: 832
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Loss on hold-out set: 0.011708057428283307
MeanAbsoluteError value on hold-out data: 0.08271709084510803
Epoch: 833
Loss on hold-out set: 0.00999993302795095
MeanAbsoluteError value on hold-out data: 0.07351937890052795
Epoch: 834

Loss on hold-out set: 0.011012513510722783
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Epoch: 835

Loss on hold-out set: 0.009727327329940938
MeanAbsoluteError value on hold-out data: 0.0775575339794159
Epoch: 836
Loss on hold-out set: 0.010693620060143683
MeanAbsoluteError value on hold-out data: 0.07975149154663086
Epoch: 837

Loss on hold-out set: 0.011274944093165686
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Epoch: 838

Loss on hold-out set: 0.012331727187047363
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Epoch: 839
Loss on hold-out set: 0.011751612467584589
MeanAbsoluteError value on hold-out data: 0.08476967364549637
Epoch: 840

Loss on hold-out set: 0.011039176020543285
MeanAbsoluteError value on hold-out data: 0.08119075000286102
Epoch: 841

Loss on hold-out set: 0.012603739529537658
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Epoch: 842
Loss on hold-out set: 0.011379192168387817
MeanAbsoluteError value on hold-out data: 0.08204545825719833
Epoch: 843
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Loss on hold-out set: 0.012382628083261503
MeanAbsoluteError value on hold-out data: 0.08434686064720154
Epoch: 844

Loss on hold-out set: 0.011803371763506524
MeanAbsoluteError value on hold-out data: 0.08152630180120468
Epoch: 845
Loss on hold-out set: 0.011973116095092943
MeanAbsoluteError value on hold-out data: 0.08355715125799179
Epoch: 846

Loss on hold-out set: 0.011203969260289643
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Epoch: 847

Loss on hold-out set: 0.010356691547919279
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Epoch: 848
Loss on hold-out set: 0.012999185204537298
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Epoch: 849

Loss on hold-out set: 0.012685120233363704
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Epoch: 850

Loss on hold-out set: 0.012195873224554817
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Epoch: 851
Loss on hold-out set: 0.010521798049570255
MeanAbsoluteError value on hold-out data: 0.07765720784664154
Epoch: 852

Loss on hold-out set: 0.010149949069066981
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Epoch: 853

Loss on hold-out set: 0.010309086672156506
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Epoch: 854
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Loss on hold-out set: 0.013828540953206054
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Epoch: 855

Loss on hold-out set: 0.012179005074625214
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Epoch: 856

Loss on hold-out set: 0.011559491033822227
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Epoch: 857
Loss on hold-out set: 0.011719516097800807
MeanAbsoluteError value on hold-out data: 0.08553624898195267
Epoch: 858

Loss on hold-out set: 0.011833593586488859
MeanAbsoluteError value on hold-out data: 0.08063860982656479
Epoch: 859

Loss on hold-out set: 0.012314861038903472
MeanAbsoluteError value on hold-out data: 0.08701787143945694
Epoch: 860
Loss on hold-out set: 0.012420778518668765
MeanAbsoluteError value on hold-out data: 0.08452712744474411
Epoch: 861

Loss on hold-out set: 0.010866058017491013
MeanAbsoluteError value on hold-out data: 0.07984061539173126
Epoch: 862

Loss on hold-out set: 0.011773949161057923
MeanAbsoluteError value on hold-out data: 0.08380450308322906
Epoch: 863
Loss on hold-out set: 0.012118346250889166
MeanAbsoluteError value on hold-out data: 0.08362431079149246
Epoch: 864

Loss on hold-out set: 0.01114399145488278
MeanAbsoluteError value on hold-out data: 0.0809657871723175
Epoch: 865
```

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Loss on hold-out set: 0.013074248491539037
MeanAbsoluteError value on hold-out data: 0.08711249381303787
Epoch: 866
Loss on hold-out set: 0.011034989908366696
MeanAbsoluteError value on hold-out data: 0.07960832864046097
Epoch: 867

Loss on hold-out set: 0.011583857034541628
MeanAbsoluteError value on hold-out data: 0.08161139488220215
Epoch: 868

Loss on hold-out set: 0.011679561090859351
MeanAbsoluteError value on hold-out data: 0.0806116983294487
Epoch: 869
Loss on hold-out set: 0.011885669369706496
MeanAbsoluteError value on hold-out data: 0.08207166939973831
Epoch: 870

Loss on hold-out set: 0.010490746319046593
MeanAbsoluteError value on hold-out data: 0.07735693454742432
Epoch: 871

Loss on hold-out set: 0.011449706195029042
MeanAbsoluteError value on hold-out data: 0.08316216617822647
Epoch: 872
Loss on hold-out set: 0.01081036621137173
MeanAbsoluteError value on hold-out data: 0.0782940536737442
Epoch: 873

Loss on hold-out set: 0.010253658726578579
MeanAbsoluteError value on hold-out data: 0.07767639309167862
Epoch: 874

Loss on hold-out set: 0.010774910412728787
MeanAbsoluteError value on hold-out data: 0.07838311791419983
Epoch: 875
Loss on hold-out set: 0.012361736799284699
MeanAbsoluteError value on hold-out data: 0.08199021220207214
Epoch: 876
```

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Loss on hold-out set: 0.011166635559178151
MeanAbsoluteError value on hold-out data: 0.08107775449752808
Epoch: 877

Loss on hold-out set: 0.010773989961307961
MeanAbsoluteError value on hold-out data: 0.07762802392244339
Epoch: 878
Loss on hold-out set: 0.011417524360943692
MeanAbsoluteError value on hold-out data: 0.08231185376644135
Epoch: 879

Loss on hold-out set: 0.012504558600485325
MeanAbsoluteError value on hold-out data: 0.0851302221417427
Epoch: 880

Loss on hold-out set: 0.010302138002030005
MeanAbsoluteError value on hold-out data: 0.0763692781329155
Epoch: 881
Loss on hold-out set: 0.01011823073895357
MeanAbsoluteError value on hold-out data: 0.078497514128685
Epoch: 882

Loss on hold-out set: 0.008809455325341938
MeanAbsoluteError value on hold-out data: 0.07341139763593674
Epoch: 883

Loss on hold-out set: 0.010583201446715975
MeanAbsoluteError value on hold-out data: 0.0807344913482666
Epoch: 884
Loss on hold-out set: 0.009521641153260135
MeanAbsoluteError value on hold-out data: 0.07772471010684967
Epoch: 885

Loss on hold-out set: 0.012109597337015051
MeanAbsoluteError value on hold-out data: 0.08610375225543976
Epoch: 886

Loss on hold-out set: 0.013276800554740476
MeanAbsoluteError value on hold-out data: 0.08874280005693436
Epoch: 887
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Loss on hold-out set: 0.011354842010629605
MeanAbsoluteError value on hold-out data: 0.08126760274171829
Epoch: 888

Loss on hold-out set: 0.010060545627687437
MeanAbsoluteError value on hold-out data: 0.07708956301212311
Epoch: 889

Loss on hold-out set: 0.014096580215943202
MeanAbsoluteError value on hold-out data: 0.08530891686677933
Epoch: 890
Loss on hold-out set: 0.010019673141703909
MeanAbsoluteError value on hold-out data: 0.07652898877859116
Epoch: 891

Loss on hold-out set: 0.011228347414750412
MeanAbsoluteError value on hold-out data: 0.08062989264726639
Epoch: 892

Loss on hold-out set: 0.010987446050809618
MeanAbsoluteError value on hold-out data: 0.0799359530210495
Epoch: 893
Loss on hold-out set: 0.011411240062346527
MeanAbsoluteError value on hold-out data: 0.08158528804779053
Epoch: 894

Loss on hold-out set: 0.009327748395929423
MeanAbsoluteError value on hold-out data: 0.07198797911405563
Epoch: 895

Loss on hold-out set: 0.011610429561769706
MeanAbsoluteError value on hold-out data: 0.08396576344966888
Epoch: 896
Loss on hold-out set: 0.010458306091823032
MeanAbsoluteError value on hold-out data: 0.07753241062164307
Epoch: 897

Loss on hold-out set: 0.011539877109729181
MeanAbsoluteError value on hold-out data: 0.08015289902687073
Epoch: 898
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Loss on hold-out set: 0.01074538047464254
MeanAbsoluteError value on hold-out data: 0.0780579149723053
Epoch: 899
Loss on hold-out set: 0.01102365168024941
MeanAbsoluteError value on hold-out data: 0.08161046355962753
Epoch: 900

Loss on hold-out set: 0.011935512032165812
MeanAbsoluteError value on hold-out data: 0.08027300983667374
Epoch: 901

Loss on hold-out set: 0.011290244027477456
MeanAbsoluteError value on hold-out data: 0.08130563050508499
Epoch: 902
Loss on hold-out set: 0.010643738167224607
MeanAbsoluteError value on hold-out data: 0.0800931453704834
Epoch: 903

Loss on hold-out set: 0.010646981720080172
MeanAbsoluteError value on hold-out data: 0.07568778097629547
Epoch: 904

Loss on hold-out set: 0.011804561062478265
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Epoch: 905
Loss on hold-out set: 0.011236394204643148
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Epoch: 906

Loss on hold-out set: 0.011347949898007907
MeanAbsoluteError value on hold-out data: 0.07961191982030869
Epoch: 907

Loss on hold-out set: 0.011608083425696046
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Epoch: 908
Loss on hold-out set: 0.00930810861136706
MeanAbsoluteError value on hold-out data: 0.07398954033851624
Epoch: 909
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Loss on hold-out set: 0.01048808521925821
MeanAbsoluteError value on hold-out data: 0.07576100528240204
Epoch: 910

Loss on hold-out set: 0.012599410609788416
MeanAbsoluteError value on hold-out data: 0.08599673956632614
Epoch: 911
Loss on hold-out set: 0.012723333943880182
MeanAbsoluteError value on hold-out data: 0.08406110107898712
Epoch: 912

Loss on hold-out set: 0.010946798612276326
MeanAbsoluteError value on hold-out data: 0.07819242030382156
Epoch: 913

Loss on hold-out set: 0.011134562056298213
MeanAbsoluteError value on hold-out data: 0.07911656051874161
Epoch: 914
Loss on hold-out set: 0.010702174916865866
MeanAbsoluteError value on hold-out data: 0.07926315814256668
Epoch: 915

Loss on hold-out set: 0.012043784597402312
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Epoch: 916

Loss on hold-out set: 0.010597028440679423
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Epoch: 917
Loss on hold-out set: 0.010065761659025157
MeanAbsoluteError value on hold-out data: 0.07676529884338379
Epoch: 918

Loss on hold-out set: 0.010590971257200484
MeanAbsoluteError value on hold-out data: 0.07762732356786728
Epoch: 919

Loss on hold-out set: 0.009921736753143099
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Epoch: 920
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Loss on hold-out set: 0.011755156469589564
MeanAbsoluteError value on hold-out data: 0.08000563830137253
Epoch: 921

Loss on hold-out set: 0.010017872789103422
MeanAbsoluteError value on hold-out data: 0.07765520364046097
Epoch: 922

Loss on hold-out set: 0.010187324361977517
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Epoch: 923
Loss on hold-out set: 0.010918915775546338
MeanAbsoluteError value on hold-out data: 0.07773898541927338
Epoch: 924

Loss on hold-out set: 0.009151678763349385
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Epoch: 925

Loss on hold-out set: 0.011608575378316648
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Epoch: 926
Loss on hold-out set: 0.011641514778602868
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Epoch: 927

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Epoch: 928

Loss on hold-out set: 0.010016601595416431
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Epoch: 929
Loss on hold-out set: 0.011452099224388803
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Loss on hold-out set: 0.010992966848571087
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Epoch: 931
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Loss on hold-out set: 0.009970115525805644
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Epoch: 932
Loss on hold-out set: 0.010941016647193465
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Epoch: 933

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Epoch: 934

Loss on hold-out set: 0.010521360315809337
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Epoch: 935
Loss on hold-out set: 0.0102611629568734
MeanAbsoluteError value on hold-out data: 0.07803235203027725
Epoch: 936

Loss on hold-out set: 0.009693985331735652
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Epoch: 937

Loss on hold-out set: 0.010287028055754449
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Epoch: 938
Loss on hold-out set: 0.0098126332614144
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Epoch: 939

Loss on hold-out set: 0.011806796934082134
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Epoch: 940

Loss on hold-out set: 0.011164281534923551
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Epoch: 941
Loss on hold-out set: 0.011986554864852223
MeanAbsoluteError value on hold-out data: 0.08139993995428085
Epoch: 942
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Loss on hold-out set: 0.010745925010099503
MeanAbsoluteError value on hold-out data: 0.079677514731884
Epoch: 943

Loss on hold-out set: 0.010061437029401835
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Epoch: 944
Loss on hold-out set: 0.008470388027829661
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Epoch: 945

Loss on hold-out set: 0.011091736005340257
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Epoch: 946

Loss on hold-out set: 0.009374089873066017
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Epoch: 947
Loss on hold-out set: 0.009135785072139697
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Epoch: 948

Loss on hold-out set: 0.012582542896464778
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Epoch: 949

Loss on hold-out set: 0.010609373022646954
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Epoch: 950
Loss on hold-out set: 0.010612795100873882
MeanAbsoluteError value on hold-out data: 0.07795223593711853
Epoch: 951

Loss on hold-out set: 0.011348520122968088
MeanAbsoluteError value on hold-out data: 0.07861150056123734
Epoch: 952

Loss on hold-out set: 0.010752159191021444
MeanAbsoluteError value on hold-out data: 0.07928670942783356
Epoch: 953
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Loss on hold-out set: 0.009279864587515476
MeanAbsoluteError value on hold-out data: 0.07301627844572067
Epoch: 954

Loss on hold-out set: 0.010801987421194401
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Epoch: 955

Loss on hold-out set: 0.010800517366054313
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Epoch: 956
Loss on hold-out set: 0.010814707388732737
MeanAbsoluteError value on hold-out data: 0.0783679410815239
Epoch: 957

Loss on hold-out set: 0.010907863903751907
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Epoch: 958

Loss on hold-out set: 0.010695317236607783
MeanAbsoluteError value on hold-out data: 0.0785730853676796
Epoch: 959
Loss on hold-out set: 0.009649897521400514
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Epoch: 960

Loss on hold-out set: 0.009758063327937331
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Epoch: 961

Loss on hold-out set: 0.011362819174319156
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Epoch: 962
Loss on hold-out set: 0.01012187578145434
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Epoch: 963

Loss on hold-out set: 0.009675966736928483
MeanAbsoluteError value on hold-out data: 0.07340095192193985
Epoch: 964
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Loss on hold-out set: 0.008596564275776472
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Epoch: 965
Loss on hold-out set: 0.010734951059033241
MeanAbsoluteError value on hold-out data: 0.0794455036520958
Epoch: 966

Loss on hold-out set: 0.010989081547498548
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Epoch: 967

Loss on hold-out set: 0.010093551734923191
MeanAbsoluteError value on hold-out data: 0.07517461478710175
Epoch: 968
Loss on hold-out set: 0.009862779062629367
MeanAbsoluteError value on hold-out data: 0.07527989149093628
Epoch: 969

Loss on hold-out set: 0.010663129752780756
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Epoch: 970

Loss on hold-out set: 0.011681407780342852
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Epoch: 971
Loss on hold-out set: 0.012852269617190663
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Epoch: 972

Loss on hold-out set: 0.009970534551466698
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Loss on hold-out set: 0.010197730386425973
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Epoch: 974
Loss on hold-out set: 0.010461253021009422
MeanAbsoluteError value on hold-out data: 0.07828649878501892
Epoch: 975
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Loss on hold-out set: 0.011374720232861363
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Epoch: 976

Loss on hold-out set: 0.009160074894340748
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Epoch: 977
Loss on hold-out set: 0.011426239490004568
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Epoch: 978

Loss on hold-out set: 0.0106707742876218
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Epoch: 979

Loss on hold-out set: 0.010518384694102375
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Epoch: 980
Loss on hold-out set: 0.008740503714458706
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Epoch: 981

Loss on hold-out set: 0.008371226547224069
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Epoch: 982

Loss on hold-out set: 0.012070588615145728
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Epoch: 983
Loss on hold-out set: 0.01022413643799761
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Epoch: 984

Loss on hold-out set: 0.009966299181202582
MeanAbsoluteError value on hold-out data: 0.07420479506254196
Epoch: 985

Loss on hold-out set: 0.010750800433058127
MeanAbsoluteError value on hold-out data: 0.07841484248638153
Epoch: 986
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Loss on hold-out set: 0.009682115190565431
MeanAbsoluteError value on hold-out data: 0.07238572090864182
Epoch: 987

Loss on hold-out set: 0.01044458737897609
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Epoch: 988

Loss on hold-out set: 0.010568551840066599
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Epoch: 989
Loss on hold-out set: 0.00940675403635396
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Epoch: 990

Loss on hold-out set: 0.010067588926890494
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Epoch: 991

Loss on hold-out set: 0.01204001486266255
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Epoch: 992
Loss on hold-out set: 0.01150550565280355
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Epoch: 993

Loss on hold-out set: 0.011092451039585284
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Epoch: 994

Loss on hold-out set: 0.00918206727107948
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Epoch: 995
Loss on hold-out set: 0.009097685527206826
MeanAbsoluteError value on hold-out data: 0.0702088326215744
Epoch: 996

Loss on hold-out set: 0.011394052460673265
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Epoch: 997
```

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Loss on hold-out set: 0.009554313344366771
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Epoch: 998
Loss on hold-out set: 0.012810107403201982
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Epoch: 999

Loss on hold-out set: 0.01000641650010948
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Epoch: 1000

Loss on hold-out set: 0.010251063743732327
MeanAbsoluteError value on hold-out data: 0.07534198462963104
Epoch: 1001
Loss on hold-out set: 0.011154780177118179
MeanAbsoluteError value on hold-out data: 0.08096302300691605
Epoch: 1002

Loss on hold-out set: 0.009785001751903716
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Epoch: 1003

Loss on hold-out set: 0.010916648551839974
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Epoch: 1004
Loss on hold-out set: 0.00887739066633003
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Epoch: 1005

Loss on hold-out set: 0.00902733290417018
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Epoch: 1006

Loss on hold-out set: 0.01141170876682736
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Epoch: 1007
Loss on hold-out set: 0.011031963830052215
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Epoch: 1008
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Loss on hold-out set: 0.009426782943555735
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Epoch: 1009

Loss on hold-out set: 0.010439090663858223
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Epoch: 1010
Loss on hold-out set: 0.008497402566220747
MeanAbsoluteError value on hold-out data: 0.07030630856752396
Epoch: 1011

Loss on hold-out set: 0.01002424575483019
MeanAbsoluteError value on hold-out data: 0.07783900201320648
Epoch: 1012

Loss on hold-out set: 0.00950733119971119
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Epoch: 1013
Loss on hold-out set: 0.010689633707515895
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Epoch: 1014

Loss on hold-out set: 0.008808214781796171
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Epoch: 1015

Loss on hold-out set: 0.009286987050484944
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Epoch: 1016
Loss on hold-out set: 0.0094321503622632
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Epoch: 1017

Loss on hold-out set: 0.009930137067955608
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Epoch: 1018

Loss on hold-out set: 0.008531198053436431
MeanAbsoluteError value on hold-out data: 0.07137885689735413
Epoch: 1019
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Loss on hold-out set: 0.011897541868235445
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Epoch: 1020

Loss on hold-out set: 0.008249589945019882
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Epoch: 1021

Loss on hold-out set: 0.009099445673443066
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Epoch: 1022
Loss on hold-out set: 0.009957133552040129
MeanAbsoluteError value on hold-out data: 0.07236001640558243
Epoch: 1023

Loss on hold-out set: 0.009099459486806153
MeanAbsoluteError value on hold-out data: 0.07170511037111282
Epoch: 1024

Loss on hold-out set: 0.009382981730110866
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Epoch: 1025
Loss on hold-out set: 0.01045179359195269
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Epoch: 1026

Loss on hold-out set: 0.009429450451273927
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Epoch: 1027

Loss on hold-out set: 0.010677084696944804
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Epoch: 1028
Loss on hold-out set: 0.010570601035869914
MeanAbsoluteError value on hold-out data: 0.07641122490167618
Epoch: 1029

Loss on hold-out set: 0.009238935727820112
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Epoch: 1030
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Loss on hold-out set: 0.01027420920358054
MeanAbsoluteError value on hold-out data: 0.07417640089988708
Epoch: 1031
Loss on hold-out set: 0.010837647272007114
MeanAbsoluteError value on hold-out data: 0.0777706727385521
Epoch: 1032

Loss on hold-out set: 0.009267890094294368
MeanAbsoluteError value on hold-out data: 0.07189016044139862
Epoch: 1033

Loss on hold-out set: 0.009534714153063154
MeanAbsoluteError value on hold-out data: 0.07326328754425049
Epoch: 1034
Loss on hold-out set: 0.008616971074370667
MeanAbsoluteError value on hold-out data: 0.07083477079868317
Epoch: 1035

Loss on hold-out set: 0.008842589995947493
MeanAbsoluteError value on hold-out data: 0.06982836127281189
Epoch: 1036

Loss on hold-out set: 0.010658761228599663
MeanAbsoluteError value on hold-out data: 0.07625600695610046
Epoch: 1037
Loss on hold-out set: 0.009181539546892357
MeanAbsoluteError value on hold-out data: 0.0733284130692482
Epoch: 1038

Loss on hold-out set: 0.009647717908452098
MeanAbsoluteError value on hold-out data: 0.07447559386491776
Epoch: 1039

Loss on hold-out set: 0.009958114266701158
MeanAbsoluteError value on hold-out data: 0.0728759691119194
Epoch: 1040
Loss on hold-out set: 0.009659564675694128
MeanAbsoluteError value on hold-out data: 0.07651326805353165
Epoch: 1041
```

```
Loss on hold-out set: 0.011185032179594904
MeanAbsoluteError value on hold-out data: 0.07904951274394989
Epoch: 1042

Loss on hold-out set: 0.010606181750772522
MeanAbsoluteError value on hold-out data: 0.07497604936361313
Epoch: 1043
Loss on hold-out set: 0.010205634290735665
MeanAbsoluteError value on hold-out data: 0.0765485167503357
Epoch: 1044

Loss on hold-out set: 0.008500641528177463
MeanAbsoluteError value on hold-out data: 0.06856707483530045
Epoch: 1045

Loss on hold-out set: 0.00940369462177235
MeanAbsoluteError value on hold-out data: 0.07363234460353851
Epoch: 1046
Loss on hold-out set: 0.009689623220110662
MeanAbsoluteError value on hold-out data: 0.07293952256441116
Epoch: 1047

Loss on hold-out set: 0.00969081997560958
MeanAbsoluteError value on hold-out data: 0.07186213880777359
Epoch: 1048

Loss on hold-out set: 0.00952979956215131
MeanAbsoluteError value on hold-out data: 0.07308032363653183
Epoch: 1049
Loss on hold-out set: 0.009469303936202777
MeanAbsoluteError value on hold-out data: 0.07318081706762314
Epoch: 1050

Loss on hold-out set: 0.010091236728670386
MeanAbsoluteError value on hold-out data: 0.07330258935689926
Epoch: 1051

Loss on hold-out set: 0.010114812581499185
MeanAbsoluteError value on hold-out data: 0.07662609219551086
Epoch: 1052
```

```
Loss on hold-out set: 0.01088768670046799
MeanAbsoluteError value on hold-out data: 0.07695014029741287
Epoch: 1053

Loss on hold-out set: 0.009553444856234515
MeanAbsoluteError value on hold-out data: 0.07296811789274216
Epoch: 1054

Loss on hold-out set: 0.007721602328286584
MeanAbsoluteError value on hold-out data: 0.06401735544204712
Epoch: 1055
Loss on hold-out set: 0.00996585485238029
MeanAbsoluteError value on hold-out data: 0.07451335340738297
Epoch: 1056

Loss on hold-out set: 0.00916524977151615
MeanAbsoluteError value on hold-out data: 0.07118478417396545
Epoch: 1057

Loss on hold-out set: 0.008136906992440344
MeanAbsoluteError value on hold-out data: 0.0697912946343422
Epoch: 1058
Loss on hold-out set: 0.009430330080261532
MeanAbsoluteError value on hold-out data: 0.07078179717063904
Epoch: 1059

Loss on hold-out set: 0.010467029528372222
MeanAbsoluteError value on hold-out data: 0.0772998109459877
Epoch: 1060

Loss on hold-out set: 0.007973103820816807
MeanAbsoluteError value on hold-out data: 0.06540066748857498
Epoch: 1061
Loss on hold-out set: 0.00704076701006367
MeanAbsoluteError value on hold-out data: 0.06530942022800446
Epoch: 1062

Loss on hold-out set: 0.008813880641676708
MeanAbsoluteError value on hold-out data: 0.07065010815858841
Epoch: 1063
```

```
Loss on hold-out set: 0.010179313850506636
MeanAbsoluteError value on hold-out data: 0.07416031509637833
Epoch: 1064
Loss on hold-out set: 0.011171808325331463
MeanAbsoluteError value on hold-out data: 0.0782809853553772
Epoch: 1065

Loss on hold-out set: 0.009322408361567796
MeanAbsoluteError value on hold-out data: 0.07200958579778671
Epoch: 1066

Loss on hold-out set: 0.00992780736071533
MeanAbsoluteError value on hold-out data: 0.0746011883020401
Epoch: 1067
Loss on hold-out set: 0.010014973658301946
MeanAbsoluteError value on hold-out data: 0.07387826591730118
Epoch: 1068

Loss on hold-out set: 0.010437565118481871
MeanAbsoluteError value on hold-out data: 0.07691513746976852
Epoch: 1069

Loss on hold-out set: 0.00806465329490796
MeanAbsoluteError value on hold-out data: 0.0678839460015297
Epoch: 1070
Loss on hold-out set: 0.009200073543603745
MeanAbsoluteError value on hold-out data: 0.07335435599088669
Epoch: 1071

Loss on hold-out set: 0.00933140027448341
MeanAbsoluteError value on hold-out data: 0.07248099148273468
Epoch: 1072

Loss on hold-out set: 0.00902760371468806
MeanAbsoluteError value on hold-out data: 0.07284986227750778
Epoch: 1073
Loss on hold-out set: 0.008090506518055918
MeanAbsoluteError value on hold-out data: 0.06915087252855301
Epoch: 1074
```

```
Loss on hold-out set: 0.00793127828098477
MeanAbsoluteError value on hold-out data: 0.06701178848743439
Epoch: 1075

Loss on hold-out set: 0.00784201715568391
MeanAbsoluteError value on hold-out data: 0.06801345199346542
Epoch: 1076
Loss on hold-out set: 0.009212652517429282
MeanAbsoluteError value on hold-out data: 0.07280600816011429
Epoch: 1077

Loss on hold-out set: 0.010548898418201134
MeanAbsoluteError value on hold-out data: 0.07663603127002716
Epoch: 1078

Loss on hold-out set: 0.010481590681592934
MeanAbsoluteError value on hold-out data: 0.07477033883333206
Epoch: 1079
Loss on hold-out set: 0.009128765937105831
MeanAbsoluteError value on hold-out data: 0.07133360952138901
Epoch: 1080

Loss on hold-out set: 0.008291278120523202
MeanAbsoluteError value on hold-out data: 0.06776850670576096
Epoch: 1081

Loss on hold-out set: 0.009997204961164243
MeanAbsoluteError value on hold-out data: 0.07558555901050568
Epoch: 1082
Loss on hold-out set: 0.010540346823593913
MeanAbsoluteError value on hold-out data: 0.07838406413793564
Epoch: 1083

Loss on hold-out set: 0.009879160913211914
MeanAbsoluteError value on hold-out data: 0.07583922147750854
Epoch: 1084

Loss on hold-out set: 0.009150160379116035
MeanAbsoluteError value on hold-out data: 0.07280943542718887
Epoch: 1085
```

Loss on hold-out set: 0.009076666047767502
MeanAbsoluteError value on hold-out data: 0.07203461229801178
Epoch: 1086

Loss on hold-out set: 0.010286821008521655
MeanAbsoluteError value on hold-out data: 0.07352674752473831
Epoch: 1087

Loss on hold-out set: 0.009022866666637128
MeanAbsoluteError value on hold-out data: 0.07172317802906036
Epoch: 1088
Loss on hold-out set: 0.008006929038248624
MeanAbsoluteError value on hold-out data: 0.06712976843118668
Epoch: 1089

Loss on hold-out set: 0.008482746652831944
MeanAbsoluteError value on hold-out data: 0.07046753168106079
Epoch: 1090

Loss on hold-out set: 0.007723716520667949
MeanAbsoluteError value on hold-out data: 0.06800045818090439
Epoch: 1091
Loss on hold-out set: 0.008946865000471007
MeanAbsoluteError value on hold-out data: 0.07121405750513077
Epoch: 1092

Loss on hold-out set: 0.009840140987053018
MeanAbsoluteError value on hold-out data: 0.07206464558839798
Epoch: 1093

Loss on hold-out set: 0.00876453875969067
MeanAbsoluteError value on hold-out data: 0.07045752555131912
Epoch: 1094
Loss on hold-out set: 0.00947417959466596
MeanAbsoluteError value on hold-out data: 0.0710400864481926
Epoch: 1095

Loss on hold-out set: 0.009867939438821244
MeanAbsoluteError value on hold-out data: 0.07347048074007034
Epoch: 1096

```
Loss on hold-out set: 0.008840701643979022
MeanAbsoluteError value on hold-out data: 0.07132572680711746
Epoch: 1097
Loss on hold-out set: 0.010569360610743388
MeanAbsoluteError value on hold-out data: 0.07831943035125732
Epoch: 1098

Loss on hold-out set: 0.00860217023589333
MeanAbsoluteError value on hold-out data: 0.06970427185297012
Epoch: 1099

Loss on hold-out set: 0.009375464676741102
MeanAbsoluteError value on hold-out data: 0.07157067954540253
Epoch: 1100
Loss on hold-out set: 0.009055025463154986
MeanAbsoluteError value on hold-out data: 0.07107468694448471
Epoch: 1101

Loss on hold-out set: 0.010189876141012064
MeanAbsoluteError value on hold-out data: 0.07647128403186798
Epoch: 1102

Loss on hold-out set: 0.009112089903768113
MeanAbsoluteError value on hold-out data: 0.07437259703874588
Epoch: 1103
Loss on hold-out set: 0.009398118221458087
MeanAbsoluteError value on hold-out data: 0.07122794538736343
Epoch: 1104

Loss on hold-out set: 0.007891756847482915
MeanAbsoluteError value on hold-out data: 0.06978624314069748
Epoch: 1105

Loss on hold-out set: 0.009412117430674698
MeanAbsoluteError value on hold-out data: 0.07022162526845932
Epoch: 1106
Loss on hold-out set: 0.008652096375505304
MeanAbsoluteError value on hold-out data: 0.07086736708879471
Epoch: 1107
```

```
Loss on hold-out set: 0.008957881469565715
MeanAbsoluteError value on hold-out data: 0.0727062076330185
Epoch: 1108

Loss on hold-out set: 0.011791820862078263
MeanAbsoluteError value on hold-out data: 0.08065813779830933
Epoch: 1109
Loss on hold-out set: 0.008167686535495402
MeanAbsoluteError value on hold-out data: 0.06869105994701385
Epoch: 1110

Loss on hold-out set: 0.008082789292335898
MeanAbsoluteError value on hold-out data: 0.0677580013871193
Epoch: 1111

Loss on hold-out set: 0.008597069652023493
MeanAbsoluteError value on hold-out data: 0.06992204487323761
Epoch: 1112
Loss on hold-out set: 0.008634761315952345
MeanAbsoluteError value on hold-out data: 0.06910555064678192
Epoch: 1113

Loss on hold-out set: 0.008072146060294471
MeanAbsoluteError value on hold-out data: 0.06845411658287048
Epoch: 1114

Loss on hold-out set: 0.007549515293582469
MeanAbsoluteError value on hold-out data: 0.06548786163330078
Epoch: 1115
Loss on hold-out set: 0.008483472919482059
MeanAbsoluteError value on hold-out data: 0.0696941539645195
Epoch: 1116

Loss on hold-out set: 0.009316268717528449
MeanAbsoluteError value on hold-out data: 0.07080882042646408
Epoch: 1117

Loss on hold-out set: 0.007834470798431236
MeanAbsoluteError value on hold-out data: 0.06660545617341995
Epoch: 1118
```

```
Loss on hold-out set: 0.007886359367063656
MeanAbsoluteError value on hold-out data: 0.06737709790468216
Epoch: 1119

Loss on hold-out set: 0.009705213471346117
MeanAbsoluteError value on hold-out data: 0.0730283111333847
Epoch: 1120

Loss on hold-out set: 0.009297976082598325
MeanAbsoluteError value on hold-out data: 0.07197529822587967
Epoch: 1121
Loss on hold-out set: 0.009173060146616384
MeanAbsoluteError value on hold-out data: 0.07219615578651428
Epoch: 1122

Loss on hold-out set: 0.009048712904283699
MeanAbsoluteError value on hold-out data: 0.0707484781742096
Epoch: 1123

Loss on hold-out set: 0.008414485141523376
MeanAbsoluteError value on hold-out data: 0.06861355155706406
Epoch: 1124
Loss on hold-out set: 0.008455243290436556
MeanAbsoluteError value on hold-out data: 0.06742150336503983
Epoch: 1125

Loss on hold-out set: 0.007872254676719119
MeanAbsoluteError value on hold-out data: 0.06879782676696777
Epoch: 1126

Loss on hold-out set: 0.008786927458519738
MeanAbsoluteError value on hold-out data: 0.0701141506433487
Epoch: 1127
Loss on hold-out set: 0.009025484222462788
MeanAbsoluteError value on hold-out data: 0.06927936524152756
Epoch: 1128

Loss on hold-out set: 0.00900621933406607
MeanAbsoluteError value on hold-out data: 0.06994282454252243
Epoch: 1129
```

```
Loss on hold-out set: 0.0093354495112726
MeanAbsoluteError value on hold-out data: 0.0696481466293335
Epoch: 1130
Loss on hold-out set: 0.008823307784186909
MeanAbsoluteError value on hold-out data: 0.06687960773706436
Epoch: 1131

Loss on hold-out set: 0.009055525814025411
MeanAbsoluteError value on hold-out data: 0.06903787702322006
Epoch: 1132

Loss on hold-out set: 0.008993574335278632
MeanAbsoluteError value on hold-out data: 0.07119563221931458
Epoch: 1133
Loss on hold-out set: 0.00900572263431968
MeanAbsoluteError value on hold-out data: 0.07049045711755753
Epoch: 1134

Loss on hold-out set: 0.009214896162078124
MeanAbsoluteError value on hold-out data: 0.07253015786409378
Epoch: 1135

Loss on hold-out set: 0.00813484369085927
MeanAbsoluteError value on hold-out data: 0.06809727102518082
Epoch: 1136
Loss on hold-out set: 0.009486410916045619
MeanAbsoluteError value on hold-out data: 0.07355210930109024
Epoch: 1137

Loss on hold-out set: 0.01008275294694613
MeanAbsoluteError value on hold-out data: 0.0730811133980751
Epoch: 1138

Loss on hold-out set: 0.010154273497901158
MeanAbsoluteError value on hold-out data: 0.07128579914569855
Epoch: 1139
Loss on hold-out set: 0.007733079626292844
MeanAbsoluteError value on hold-out data: 0.06658637523651123
Epoch: 1140
```

```
Loss on hold-out set: 0.008112146169842162
MeanAbsoluteError value on hold-out data: 0.06606456637382507
Epoch: 1141

Loss on hold-out set: 0.008986112887747973
MeanAbsoluteError value on hold-out data: 0.07135634869337082
Epoch: 1142
Loss on hold-out set: 0.007798441775596529
MeanAbsoluteError value on hold-out data: 0.06404872983694077
Epoch: 1143

Loss on hold-out set: 0.007909048087215827
MeanAbsoluteError value on hold-out data: 0.06701549887657166
Epoch: 1144

Loss on hold-out set: 0.008310887333621697
MeanAbsoluteError value on hold-out data: 0.06856943666934967
Epoch: 1145
Loss on hold-out set: 0.007392577097113342
MeanAbsoluteError value on hold-out data: 0.06486061215400696
Epoch: 1146

Loss on hold-out set: 0.009309796380394648
MeanAbsoluteError value on hold-out data: 0.07268103957176208
Epoch: 1147

Loss on hold-out set: 0.010063849786771849
MeanAbsoluteError value on hold-out data: 0.07223183661699295
Epoch: 1148
Loss on hold-out set: 0.008944274286004656
MeanAbsoluteError value on hold-out data: 0.06869598478078842
Epoch: 1149

Loss on hold-out set: 0.008641669091145256
MeanAbsoluteError value on hold-out data: 0.06607091426849365
Epoch: 1150

Loss on hold-out set: 0.009212002028968224
MeanAbsoluteError value on hold-out data: 0.07117432355880737
Epoch: 1151
```

```
Loss on hold-out set: 0.009187554753152654
MeanAbsoluteError value on hold-out data: 0.07130670547485352
Epoch: 1152

Loss on hold-out set: 0.009219873945403379
MeanAbsoluteError value on hold-out data: 0.07266250997781754
Epoch: 1153

Loss on hold-out set: 0.010385940670991356
MeanAbsoluteError value on hold-out data: 0.07659441977739334
Epoch: 1154
Loss on hold-out set: 0.009468373442481
MeanAbsoluteError value on hold-out data: 0.07382523268461227
Epoch: 1155

Loss on hold-out set: 0.008499333148165533
MeanAbsoluteError value on hold-out data: 0.06902383267879486
Epoch: 1156

Loss on hold-out set: 0.008271092331851833
MeanAbsoluteError value on hold-out data: 0.06816422939300537
Epoch: 1157
Loss on hold-out set: 0.008791352595938709
MeanAbsoluteError value on hold-out data: 0.06870163232088089
Epoch: 1158

Loss on hold-out set: 0.00862335364765992
MeanAbsoluteError value on hold-out data: 0.07112480700016022
Epoch: 1159

Loss on hold-out set: 0.00883188297477318
MeanAbsoluteError value on hold-out data: 0.07346879690885544
Epoch: 1160
Loss on hold-out set: 0.009708712092869973
MeanAbsoluteError value on hold-out data: 0.0732489824295044
Epoch: 1161

Loss on hold-out set: 0.007966669524833303
MeanAbsoluteError value on hold-out data: 0.06793098896741867
Epoch: 1162
```

```
Loss on hold-out set: 0.010237740828160894
MeanAbsoluteError value on hold-out data: 0.07101470977067947
Epoch: 1163
Loss on hold-out set: 0.008776124947471544
MeanAbsoluteError value on hold-out data: 0.07174880802631378
Epoch: 1164

Loss on hold-out set: 0.008196142166367886
MeanAbsoluteError value on hold-out data: 0.0674140453338623
Epoch: 1165

Loss on hold-out set: 0.009414203695644876
MeanAbsoluteError value on hold-out data: 0.07144362479448318
Epoch: 1166
Loss on hold-out set: 0.008094343690039144
MeanAbsoluteError value on hold-out data: 0.06794548034667969
Epoch: 1167

Loss on hold-out set: 0.009250398949904289
MeanAbsoluteError value on hold-out data: 0.07171531021595001
Epoch: 1168

Loss on hold-out set: 0.00894216843193135
MeanAbsoluteError value on hold-out data: 0.07252272963523865
Epoch: 1169
Loss on hold-out set: 0.008209378103016812
MeanAbsoluteError value on hold-out data: 0.069805808365345
Epoch: 1170

Loss on hold-out set: 0.008213342907116991
MeanAbsoluteError value on hold-out data: 0.06837525963783264
Epoch: 1171

Loss on hold-out set: 0.008342358385355813
MeanAbsoluteError value on hold-out data: 0.06905114650726318
Epoch: 1172
Loss on hold-out set: 0.009907492517935074
MeanAbsoluteError value on hold-out data: 0.07459642738103867
Epoch: 1173
```

```
Loss on hold-out set: 0.010012161371087132
MeanAbsoluteError value on hold-out data: 0.07296283543109894
Epoch: 1174

Loss on hold-out set: 0.010068464582485224
MeanAbsoluteError value on hold-out data: 0.07319335639476776
Epoch: 1175
Loss on hold-out set: 0.009221077072337115
MeanAbsoluteError value on hold-out data: 0.06904277950525284
Epoch: 1176

Loss on hold-out set: 0.008133001869427971
MeanAbsoluteError value on hold-out data: 0.07112175226211548
Epoch: 1177

Loss on hold-out set: 0.007345977558309725
MeanAbsoluteError value on hold-out data: 0.06738515943288803
Epoch: 1178
Loss on hold-out set: 0.007053639883403472
MeanAbsoluteError value on hold-out data: 0.06255277246236801
Epoch: 1179

Loss on hold-out set: 0.008232419423790513
MeanAbsoluteError value on hold-out data: 0.06956759840250015
Epoch: 1180

Loss on hold-out set: 0.009601107704196086
MeanAbsoluteError value on hold-out data: 0.07322686165571213
Epoch: 1181
Loss on hold-out set: 0.008081268749641216
MeanAbsoluteError value on hold-out data: 0.06681330502033234
Epoch: 1182

Loss on hold-out set: 0.008350898385021234
MeanAbsoluteError value on hold-out data: 0.06973090767860413
Epoch: 1183

Loss on hold-out set: 0.008063835034614992
MeanAbsoluteError value on hold-out data: 0.06878930330276489
Epoch: 1184
```

```
Loss on hold-out set: 0.007901755641754183
MeanAbsoluteError value on hold-out data: 0.06656017154455185
Epoch: 1185

Loss on hold-out set: 0.009718892795157596
MeanAbsoluteError value on hold-out data: 0.0697827935218811
Epoch: 1186

Loss on hold-out set: 0.008050839365375092
MeanAbsoluteError value on hold-out data: 0.06715133786201477
Epoch: 1187
Loss on hold-out set: 0.009070073168510741
MeanAbsoluteError value on hold-out data: 0.07122669368982315
Epoch: 1188

Loss on hold-out set: 0.008948393538303208
MeanAbsoluteError value on hold-out data: 0.06858140230178833
Epoch: 1189

Loss on hold-out set: 0.008885734952812 83
MeanAbsoluteError value on hold-out data: 0.06787961721420288
Early stopping at epoch 1188
Returned to Spot: Validation loss: 0.00888573495281283
----------------------------------------------

config: {'_L_in': 10, '_L_out': 1, 'l1': 16, 'dropout_prob': 0.1773189149831582, 'lr_mult': 9
Epoch: 1
Loss on hold-out set: 0.028495822832919657
MeanAbsoluteError value on hold-out data: 0.13525201380252838
Epoch: 2
Loss on hold-out set: 0.02638482462381944
MeanAbsoluteError value on hold-out data: 0.12927834689617157
Epoch: 3
Loss on hold-out set: 0.024423945411108434
MeanAbsoluteError value on hold-out data: 0.1256389617919922
Epoch: 4

Loss on hold-out set: 0.016988728830280405
MeanAbsoluteError value on hold-out data: 0.10201642662286758
Returned to Spot: Validation loss: 0.016988728830280405
----------------------------------------------
```

```
config: {'_L_in': 10, '_L_out': 1, 'l1': 32, 'dropout_prob': 0.3840970624671163, 'lr_mult': 4
Epoch: 1
Loss on hold-out set: 0.05323873563228469
MeanAbsoluteError value on hold-out data: 0.18614044785499573
Epoch: 2
Loss on hold-out set: 0.04104852769523859
MeanAbsoluteError value on hold-out data: 0.16504615545272827
Epoch: 3

Loss on hold-out set: 0.035258072269100105
MeanAbsoluteError value on hold-out data: 0.15027743577957153
Epoch: 4
Loss on hold-out set: 0.0374222510053139
MeanAbsoluteError value on hold-out data: 0.15494711697101593
Epoch: 5
Loss on hold-out set: 0.029913899194645256
MeanAbsoluteError value on hold-out data: 0.13953858613967896
Epoch: 6
Loss on hold-out set: 0.029067572007127302
MeanAbsoluteError value on hold-out data: 0.1363534927368164
Epoch: 7
Loss on hold-out set: 0.022081859581368535
MeanAbsoluteError value on hold-out data: 0.11872783303260803
Epoch: 8
Loss on hold-out set: 0.022864452759294135
MeanAbsoluteError value on hold-out data: 0.1205558255314827
Epoch: 9
Loss on hold-out set: 0.023072635178993408
MeanAbsoluteError value on hold-out data: 0.1212996169924736
Epoch: 10

Loss on hold-out set: 0.017574189791431355
MeanAbsoluteError value on hold-out data: 0.10564598441123962
Epoch: 11
Loss on hold-out set: 0.01650060971855725
MeanAbsoluteError value on hold-out data: 0.1008172258734703
Epoch: 12
Loss on hold-out set: 0.015024805809126088
MeanAbsoluteError value on hold-out data: 0.09356851130723953
Epoch: 13
Loss on hold-out set: 0.014479534002020955
```

```
MeanAbsoluteError value on hold-out data: 0.09605426341295242

Epoch: 14
Loss on hold-out set: 0.012142590430908297
MeanAbsoluteError value on hold-out data: 0.0859205573797226
Epoch: 15
Loss on hold-out set: 0.013324098514491007
MeanAbsoluteError value on hold-out data: 0.09048537909984589
Epoch: 16
Loss on hold-out set: 0.01402485233388449
MeanAbsoluteError value on hold-out data: 0.08935533463954926
Epoch: 17
Loss on hold-out set: 0.01134643559099028
MeanAbsoluteError value on hold-out data: 0.08173924684524536
Epoch: 18
Loss on hold-out set: 0.011713427672236177
MeanAbsoluteError value on hold-out data: 0.08022227883338928
Epoch: 19
Loss on hold-out set: 0.011755482912504752
MeanAbsoluteError value on hold-out data: 0.0836305320262909
Epoch: 20
Loss on hold-out set: 0.010825541633254799
MeanAbsoluteError value on hold-out data: 0.07736793160438538
Epoch: 21

Loss on hold-out set: 0.011633007009023507
MeanAbsoluteError value on hold-out data: 0.08329510688781738
Epoch: 22
Loss on hold-out set: 0.010328074690493705
MeanAbsoluteError value on hold-out data: 0.07678007334470749
Epoch: 23
Loss on hold-out set: 0.011582739880970238
MeanAbsoluteError value on hold-out data: 0.0822281539440155
Epoch: 24

Loss on hold-out set: 0.008596593345588955
MeanAbsoluteError value on hold-out data: 0.06628083437681198
Epoch: 25
Loss on hold-out set: 0.008245468152668573
MeanAbsoluteError value on hold-out data: 0.0662665069103241
Epoch: 26
Loss on hold-out set: 0.00854757100980925
```

```
MeanAbsoluteError value on hold-out data: 0.06904509663581848
Epoch: 27
Loss on hold-out set: 0.010925145547126272
MeanAbsoluteError value on hold-out data: 0.0779813900589943
Epoch: 28
Loss on hold-out set: 0.009140329147492977
MeanAbsoluteError value on hold-out data: 0.0685386210680008
Epoch: 29
Loss on hold-out set: 0.008773078216778996
MeanAbsoluteError value on hold-out data: 0.06649672985076904
Epoch: 30
Loss on hold-out set: 0.009359911767349235
MeanAbsoluteError value on hold-out data: 0.07178555428981781
Epoch: 31
Loss on hold-out set: 0.00989933249289415
MeanAbsoluteError value on hold-out data: 0.0745774433016777
Epoch: 32

Loss on hold-out set: 0.009369878882640287
MeanAbsoluteError value on hold-out data: 0.07161600142717361
Epoch: 33
Loss on hold-out set: 0.009345659970820538
MeanAbsoluteError value on hold-out data: 0.07002965360879898
Epoch: 34
Loss on hold-out set: 0.014045605411458956
MeanAbsoluteError value on hold-out data: 0.099245585501194
Epoch: 35

Loss on hold-out set: 0.00854717748313162
MeanAbsoluteError value on hold-out data: 0.06766332685947418
Epoch: 36
Loss on hold-out set: 0.009729319947502134
MeanAbsoluteError value on hold-out data: 0.07470068335533142
Epoch: 37
Loss on hold-out set: 0.0078098296285852
MeanAbsoluteError value on hold-out data: 0.06400856375694275
Epoch: 38
Loss on hold-out set: 0.011017705767268413
MeanAbsoluteError value on hold-out data: 0.07908523827791214
Epoch: 39
Loss on hold-out set: 0.008441932441201061
MeanAbsoluteError value on hold-out data: 0.06780761480331421
```

```
Epoch: 40
Loss on hold-out set: 0.008115965140811903
MeanAbsoluteError value on hold-out data: 0.06374331563711166
Epoch: 41
Loss on hold-out set: 0.009173605082507589
MeanAbsoluteError value on hold-out data: 0.07273299247026443
Epoch: 42
Loss on hold-out set: 0.007729550462069088
MeanAbsoluteError value on hold-out data: 0.0650750994682312
Epoch: 43

Loss on hold-out set: 0.007910447924299851
MeanAbsoluteError value on hold-out data: 0.06424892693758011
Epoch: 44
Loss on hold-out set: 0.013316529986791704
MeanAbsoluteError value on hold-out data: 0.09215997904539108
Epoch: 45
Loss on hold-out set: 0.008041709241775894
MeanAbsoluteError value on hold-out data: 0.06372641772031784
Epoch: 46

Loss on hold-out set: 0.008840986106262886
MeanAbsoluteError value on hold-out data: 0.06775063276290894
Epoch: 47
Loss on hold-out set: 0.009519637899326258
MeanAbsoluteError value on hold-out data: 0.06942760199308395
Epoch: 48
Loss on hold-out set: 0.00999428559168193
MeanAbsoluteError value on hold-out data: 0.07624474167823792
Epoch: 49
Loss on hold-out set: 0.013572495363309588
MeanAbsoluteError value on hold-out data: 0.09471901506185532
Epoch: 50
Loss on hold-out set: 0.008045758174327938
MeanAbsoluteError value on hold-out data: 0.06685644388198853
Epoch: 51
Loss on hold-out set: 0.00966848695564917
MeanAbsoluteError value on hold-out data: 0.0747053474187851
Epoch: 52
Loss on hold-out set: 0.009101805994042048
MeanAbsoluteError value on hold-out data: 0.06858235597610474
Epoch: 53
```

```
Loss on hold-out set: 0.008458773547317833
MeanAbsoluteError value on hold-out data: 0.06841880828142166
Epoch: 54

Loss on hold-out set: 0.008722373838904068
MeanAbsoluteError value on hold-out data: 0.06767749041318893
Epoch: 55
Loss on hold-out set: 0.013456051620826321
MeanAbsoluteError value on hold-out data: 0.09004881232976913
Epoch: 56
Loss on hold-out set: 0.008204992295328626
MeanAbsoluteError value on hold-out data: 0.06575693190097809
Epoch: 57

Loss on hold-out set: 0.007858880930335113
MeanAbsoluteError value on hold-out data: 0.06296262890100479
Epoch: 58
Loss on hold-out set: 0.008530005612747596
MeanAbsoluteError value on hold-out data: 0.06550723314285278
Epoch: 59
Loss on hold-out set: 0.007758040534099564
MeanAbsoluteError value on hold-out data: 0.06421901285648346
Epoch: 60
Loss on hold-out set: 0.01074646044779863
MeanAbsoluteError value on hold-out data: 0.07697516679763794
Epoch: 61
Loss on hold-out set: 0.008135659739644708
MeanAbsoluteError value on hold-out data: 0.06415408104658127
Epoch: 62
Loss on hold-out set: 0.008447976553150894
MeanAbsoluteError value on hold-out data: 0.06482481956481934
Epoch: 63
Loss on hold-out set: 0.007924069717869554
MeanAbsoluteError value on hold-out data: 0.06497493386268616
Epoch: 64
Loss on hold-out set: 0.009398172707541994
MeanAbsoluteError value on hold-out data: 0.06890507787466049
Epoch: 65

Loss on hold-out set: 0.006786933931595597
MeanAbsoluteError value on hold-out data: 0.05719327926635742
Epoch: 66
```

```
Loss on hold-out set: 0.007877761547110583
MeanAbsoluteError value on hold-out data: 0.06238773465156555
Epoch: 67
Loss on hold-out set: 0.008843542436615712
MeanAbsoluteError value on hold-out data: 0.06769132614135742
Epoch: 68

Loss on hold-out set: 0.007178470835481819
MeanAbsoluteError value on hold-out data: 0.06011362746357918
Epoch: 69
Loss on hold-out set: 0.008095892642526642
MeanAbsoluteError value on hold-out data: 0.06517655402421951
Epoch: 70
Loss on hold-out set: 0.008296450704189115
MeanAbsoluteError value on hold-out data: 0.06374141573905945
Epoch: 71
Loss on hold-out set: 0.009264286830377961
MeanAbsoluteError value on hold-out data: 0.06894386559724808
Epoch: 72
Loss on hold-out set: 0.008134801630053277
MeanAbsoluteError value on hold-out data: 0.0636368989944458
Epoch: 73
Loss on hold-out set: 0.01111744086282622
MeanAbsoluteError value on hold-out data: 0.08159634470939636
Epoch: 74
Loss on hold-out set: 0.00700475278273715
MeanAbsoluteError value on hold-out data: 0.0583784356713295
Epoch: 75
Loss on hold-out set: 0.009772322108466668
MeanAbsoluteError value on hold-out data: 0.07336384803056717
Epoch: 76

Loss on hold-out set: 0.010544944955893842
MeanAbsoluteError value on hold-out data: 0.07931980490684509
Epoch: 77
Loss on hold-out set: 0.008272938007537863
MeanAbsoluteError value on hold-out data: 0.06293366849422455
Epoch: 78
Loss on hold-out set: 0.008006914932354304
MeanAbsoluteError value on hold-out data: 0.0625903457403183
Epoch: 79
```

```
Loss on hold-out set: 0.010672701207161146
MeanAbsoluteError value on hold-out data: 0.0759371742606163
Epoch: 80
Loss on hold-out set: 0.0094334039550679
MeanAbsoluteError value on hold-out data: 0.06932615488767624
Epoch: 81
Loss on hold-out set: 0.007548894678046436
MeanAbsoluteError value on hold-out data: 0.062447063624858856
Epoch: 82
Loss on hold-out set: 0.009530480846909708
MeanAbsoluteError value on hold-out data: 0.07486402243375778
Epoch: 83
Loss on hold-out set: 0.006836220242181106
MeanAbsoluteError value on hold-out data: 0.060025181621313095
Epoch: 84
Loss on hold-out set: 0.008448405822395887
MeanAbsoluteError value on hold-out data: 0.06670445203781128
Epoch: 85
Loss on hold-out set: 0.007239062627042203
MeanAbsoluteError value on hold-out data: 0.060002945363521576
Epoch: 86
Loss on hold-out set: 0.010693348199741817
MeanAbsoluteError value on hold-out data: 0.07281288504600525
Epoch: 87

Loss on hold-out set: 0.008060925496178433
MeanAbsoluteError value on hold-out data: 0.06417036801576614
Epoch: 88
Loss on hold-out set: 0.008198623557722098
MeanAbsoluteError value on hold-out data: 0.06545940041542053
Epoch: 89
Loss on hold-out set: 0.009621118745264156
MeanAbsoluteError value on hold-out data: 0.0688246563076973
Epoch: 90

Loss on hold-out set: 0.009180650317208156
MeanAbsoluteError value on hold-out data: 0.06834898144006729
Epoch: 91
Loss on hold-out set: 0.008187600137285986
MeanAbsoluteError value on hold-out data: 0.0659661516547203
Epoch: 92
Loss on hold-out set: 0.00875327036421942
```

```
MeanAbsoluteError value on hold-out data: 0.06861992925405502
Epoch: 93
Loss on hold-out set: 0.008509444737635357
MeanAbsoluteError value on hold-out data: 0.06554961204528809
Epoch: 94
Loss on hold-out set: 0.008856715395507453
MeanAbsoluteError value on hold-out data: 0.0686911791563034
Epoch: 95
Loss on hold-out set: 0.007783519471750448
MeanAbsoluteError value on hold-out data: 0.06469656527042389
Epoch: 96
Loss on hold-out set: 0.007921787132018883
MeanAbsoluteError value on hold-out data: 0.06583411991596222
Epoch: 97
Loss on hold-out set: 0.0072261382163943426
MeanAbsoluteError value on hold-out data: 0.05838871747255325
Epoch: 98

Loss on hold-out set: 0.008057006811692477
MeanAbsoluteError value on hold-out data: 0.06665470451116562
Epoch: 99
Loss on hold-out set: 0.008434771477416354
MeanAbsoluteError value on hold-out data: 0.06959275156259537
Epoch: 100
Loss on hold-out set: 0.009957695787306875
MeanAbsoluteError value on hold-out data: 0.07251343131065369
Epoch: 101

Loss on hold-out set: 0.012047139345668256
MeanAbsoluteError value on hold-out data: 0.08675013482570648
Epoch: 102
Loss on hold-out set: 0.007775002523742028
MeanAbsoluteError value on hold-out data: 0.0634273886680603
Epoch: 103
Loss on hold-out set: 0.009641812124755234
MeanAbsoluteError value on hold-out data: 0.06833300739526749
Epoch: 104
Loss on hold-out set: 0.008606329698140095
MeanAbsoluteError value on hold-out data: 0.06881167739629745
Epoch: 105
Loss on hold-out set: 0.009637757284125607
MeanAbsoluteError value on hold-out data: 0.06927886605262756
```

```
Epoch: 106
Loss on hold-out set: 0.007647519474726562
MeanAbsoluteError value on hold-out data: 0.06107299029827118
Epoch: 107
Loss on hold-out set: 0.008567879765331255
MeanAbsoluteError value on hold-out data: 0.06884634494781494
Epoch: 108
Loss on hold-out set: 0.00789776303664487
MeanAbsoluteError value on hold-out data: 0.06179400160908699
Epoch: 109

Loss on hold-out set: 0.007763641451387421
MeanAbsoluteError value on hold-out data: 0.0642428919672966
Epoch: 110
Loss on hold-out set: 0.008074445858303653
MeanAbsoluteError value on hold-out data: 0.06365891546010971
Epoch: 111
Loss on hold-out set: 0.0087677663143136
MeanAbsoluteError value on hold-out data: 0.06795167177915573
Epoch: 112

Loss on hold-out set: 0.010763526220168722
MeanAbsoluteError value on hold-out data: 0.07887087017297745
Epoch: 113
Loss on hold-out set: 0.009782916232085737
MeanAbsoluteError value on hold-out data: 0.07180340588092804
Epoch: 114
Loss on hold-out set: 0.007723869602686088
MeanAbsoluteError value on hold-out data: 0.060709621757268906
Epoch: 115
Loss on hold-out set: 0.008387847965901815
MeanAbsoluteError value on hold-out data: 0.0656975656747818
Epoch: 116
Loss on hold-out set: 0.0074563624657457694
MeanAbsoluteError value on hold-out data: 0.061994049698114395
Epoch: 117
Loss on hold-out set: 0.008945551976610563
MeanAbsoluteError value on hold-out data: 0.06837818771600723
Epoch: 118
Loss on hold-out set: 0.008459233073824035
MeanAbsoluteError value on hold-out data: 0.0654476210474968
Epoch: 119
```

```
Loss on hold-out set: 0.00775404167239015
MeanAbsoluteError value on hold-out data: 0.061732418835163116
Epoch: 120

Loss on hold-out set: 0.007984559402470231
MeanAbsoluteError value on hold-out data: 0.06437347084283829
Epoch: 121
Loss on hold-out set: 0.010555001276722913
MeanAbsoluteError value on hold-out data: 0.07661357522010803
Epoch: 122
Loss on hold-out set: 0.007323865064934485
MeanAbsoluteError value on hold-out data: 0.06054489687085152
Epoch: 123

Loss on hold-out set: 0.00813440814243605
MeanAbsoluteError value on hold-out data: 0.06219686567783356
Epoch: 124
Loss on hold-out set: 0.00847606385727168
MeanAbsoluteError value on hold-out data: 0.0649469792842865
Epoch: 125
Loss on hold-out set: 0.008063408411353043
MeanAbsoluteError value on hold-out data: 0.06466244906187057
Epoch: 126
Loss on hold-out set: 0.0084310111399789
MeanAbsoluteError value on hold-out data: 0.0676167905330658
Epoch: 127
Loss on hold-out set: 0.007448142702311375
MeanAbsoluteError value on hold-out data: 0.062021128833293915
Epoch: 128
Loss on hold-out set: 0.008204778558329531
MeanAbsoluteError value on hold-out data: 0.0637044906616211
Epoch: 129
Loss on hold-out set: 0.009221227713983114
MeanAbsoluteError value on hold-out data: 0.07271221280097961
Early stopping at epoch 128
Returned to Spot: Validation loss: 0.009221227713983114
----------------------------------------------


config: {'_L_in': 10, '_L_out': 1, 'l1': 16, 'dropout_prob': 0.167324966785543, 'lr_mult': 7
Epoch: 1
Loss on hold-out set: 0.0993325749510213
```

```
MeanAbsoluteError value on hold-out data: 0.27499154210090637
Epoch: 2
Loss on hold-out set: 0.03090005995411622
MeanAbsoluteError value on hold-out data: 0.13987816870212555
Epoch: 3
Loss on hold-out set: 0.06939689815044403
MeanAbsoluteError value on hold-out data: 0.22423218190670013
Epoch: 4
Loss on hold-out set: 0.03901452296658566
MeanAbsoluteError value on hold-out data: 0.1617082804441452
Epoch: 5
Loss on hold-out set: 0.020502181674696897
MeanAbsoluteError value on hold-out data: 0.1107121929526329
Epoch: 6
Loss on hold-out set: 0.024209444116997093
MeanAbsoluteError value on hold-out data: 0.12323518097400665
Epoch: 7
Loss on hold-out set: 0.01876756686129068
MeanAbsoluteError value on hold-out data: 0.11222819983959198
Epoch: 8
Loss on hold-out set: 0.01928949409997777
MeanAbsoluteError value on hold-out data: 0.11173241585493088
Epoch: 9
Loss on hold-out set: 0.01849421192156641
MeanAbsoluteError value on hold-out data: 0.1039542481303215
Epoch: 10
Loss on hold-out set: 0.01705901383569366
MeanAbsoluteError value on hold-out data: 0.10490208864212036
Epoch: 11
Loss on hold-out set: 0.01877403215162064
MeanAbsoluteError value on hold-out data: 0.11155025660991669
Epoch: 12
Loss on hold-out set: 0.013827593555968059
MeanAbsoluteError value on hold-out data: 0.09050457924604416
Epoch: 13
Loss on hold-out set: 0.014198050098983865
MeanAbsoluteError value on hold-out data: 0.09349779784679413
Epoch: 14
Loss on hold-out set: 0.015669410950259158
MeanAbsoluteError value on hold-out data: 0.09865600615739822
Epoch: 15
Loss on hold-out set: 0.01645879234236322
MeanAbsoluteError value on hold-out data: 0.10236344486474991
```

```
Epoch: 16
Loss on hold-out set: 0.017143474548662965
MeanAbsoluteError value on hold-out data: 0.112118199467659
Epoch: 17
Loss on hold-out set: 0.012858248291243064
MeanAbsoluteError value on hold-out data: 0.08731726557016373
Epoch: 18
Loss on hold-out set: 0.007154203608239952
MeanAbsoluteError value on hold-out data: 0.06478486955165863
Epoch: 19
Loss on hold-out set: 0.007410228448478799
MeanAbsoluteError value on hold-out data: 0.06511983275413513
Epoch: 20
Loss on hold-out set: 0.011369442812314159
MeanAbsoluteError value on hold-out data: 0.07976959645748138
Epoch: 21
```

```
Loss on hold-out set: 0.008602443126667487
MeanAbsoluteError value on hold-out data: 0.07450465112924576
Epoch: 22
Loss on hold-out set: 0.011343218851834536
MeanAbsoluteError value on hold-out data: 0.08495738357305527
Epoch: 23
Loss on hold-out set: 0.0057681082184181404
MeanAbsoluteError value on hold-out data: 0.05679743364453316
Epoch: 24
Loss on hold-out set: 0.010460786864553628
MeanAbsoluteError value on hold-out data: 0.08129746466875076
Epoch: 25
Loss on hold-out set: 0.0148856507516221
MeanAbsoluteError value on hold-out data: 0.10084693878889084
Epoch: 26
Loss on hold-out set: 0.006779809396615938
MeanAbsoluteError value on hold-out data: 0.06249828264117241
Epoch: 27
Loss on hold-out set: 0.015848683879563685
MeanAbsoluteError value on hold-out data: 0.09765991568565369
Epoch: 28
Loss on hold-out set: 0.005409441704518701
MeanAbsoluteError value on hold-out data: 0.05331043526530266
Epoch: 29
Loss on hold-out set: 0.010747451580276615
```

```
MeanAbsoluteError value on hold-out data: 0.0844605416059494
Epoch: 30
Loss on hold-out set: 0.0074913625997540196
MeanAbsoluteError value on hold-out data: 0.0645294263958931
Epoch: 31
Loss on hold-out set: 0.007048589692107941
MeanAbsoluteError value on hold-out data: 0.0630033016204834
Epoch: 32
Loss on hold-out set: 0.01186036835669687
MeanAbsoluteError value on hold-out data: 0.08528776466846466
Epoch: 33
Loss on hold-out set: 0.009405942805307476
MeanAbsoluteError value on hold-out data: 0.0738462507724762
Epoch: 34
Loss on hold-out set: 0.015703930519521236
MeanAbsoluteError value on hold-out data: 0.10838695615530014
Epoch: 35
Loss on hold-out set: 0.012380668844439481
MeanAbsoluteError value on hold-out data: 0.08758008480072021
Epoch: 36
Loss on hold-out set: 0.008986918941924446
MeanAbsoluteError value on hold-out data: 0.07542331516742706
Epoch: 37
Loss on hold-out set: 0.021173327769103804
MeanAbsoluteError value on hold-out data: 0.1333986073732376
Epoch: 38
Loss on hold-out set: 0.004914100024555074
MeanAbsoluteError value on hold-out data: 0.05119321122765541
Epoch: 39
Loss on hold-out set: 0.025047551840543747
MeanAbsoluteError value on hold-out data: 0.146011620759964
Epoch: 40
Loss on hold-out set: 0.005277870713095916
MeanAbsoluteError value on hold-out data: 0.053151242434978485
Epoch: 41
Loss on hold-out set: 0.005658271195563047
MeanAbsoluteError value on hold-out data: 0.05223391205072403

Epoch: 42
Loss on hold-out set: 0.01826318838682614
MeanAbsoluteError value on hold-out data: 0.12147201597690582
Epoch: 43
```

```
Loss on hold-out set: 0.013262240853356687
MeanAbsoluteError value on hold-out data: 0.08915861696004868
Epoch: 44
Loss on hold-out set: 0.004939565753662272
MeanAbsoluteError value on hold-out data: 0.05499092862010002
Epoch: 45
Loss on hold-out set: 0.015116445033958084
MeanAbsoluteError value on hold-out data: 0.10647330433130264
Epoch: 46
Loss on hold-out set: 0.007211875979249415
MeanAbsoluteError value on hold-out data: 0.07155317813158035
Epoch: 47
Loss on hold-out set: 0.010669907211865249
MeanAbsoluteError value on hold-out data: 0.08110005408525467
Epoch: 48
Loss on hold-out set: 0.008893289358208054
MeanAbsoluteError value on hold-out data: 0.07427339255809784
Epoch: 49
Loss on hold-out set: 0.004631854360923171
MeanAbsoluteError value on hold-out data: 0.05428885668516159
Epoch: 50
Loss on hold-out set: 0.00872605220463715
MeanAbsoluteError value on hold-out data: 0.07694882899522781
Epoch: 51
Loss on hold-out set: 0.005414582482588135
MeanAbsoluteError value on hold-out data: 0.05696849897503853
Epoch: 52
Loss on hold-out set: 0.00580767359535553
MeanAbsoluteError value on hold-out data: 0.05942366272211075
Epoch: 53
Loss on hold-out set: 0.012436549007696541
MeanAbsoluteError value on hold-out data: 0.0931730642914772
Epoch: 54
Loss on hold-out set: 0.0038889523191181453
MeanAbsoluteError value on hold-out data: 0.04917079582810402
Epoch: 55
Loss on hold-out set: 0.00810371305009252
MeanAbsoluteError value on hold-out data: 0.07102397829294205
Epoch: 56
Loss on hold-out set: 0.0033691883528311002
MeanAbsoluteError value on hold-out data: 0.041273459792137146
Epoch: 57
Loss on hold-out set: 0.0063330200500786304
```

```
MeanAbsoluteError value on hold-out data: 0.06246565654873848
Epoch: 58
Loss on hold-out set: 0.007871716773431552
MeanAbsoluteError value on hold-out data: 0.06781068444252014
Epoch: 59
Loss on hold-out set: 0.006396719401604251
MeanAbsoluteError value on hold-out data: 0.06582155078649521
Epoch: 60
Loss on hold-out set: 0.011279975333692212
MeanAbsoluteError value on hold-out data: 0.09411153197288513
Epoch: 61
Loss on hold-out set: 0.006704257494819008
MeanAbsoluteError value on hold-out data: 0.06396282464265823
Epoch: 62


Loss on hold-out set: 0.006422166210158091
MeanAbsoluteError value on hold-out data: 0.06515821069478989
Epoch: 63
Loss on hold-out set: 0.007271982337299146
MeanAbsoluteError value on hold-out data: 0.06405244767665863
Epoch: 64
Loss on hold-out set: 0.005403560733324603
MeanAbsoluteError value on hold-out data: 0.0627564787864685
Epoch: 65
Loss on hold-out set: 0.00273121371987815
MeanAbsoluteError value on hold-out data: 0.03631841391324997
Epoch: 66
Loss on hold-out set: 0.0025876309894221393
MeanAbsoluteError value on hold-out data: 0.03473697602748871
Epoch: 67
Loss on hold-out set: 0.002621832499770742
MeanAbsoluteError value on hold-out data: 0.03689627721905708
Epoch: 68
Loss on hold-out set: 0.003220079466700554
MeanAbsoluteError value on hold-out data: 0.0431472584605217
Epoch: 69
Loss on hold-out set: 0.004762119699367567
MeanAbsoluteError value on hold-out data: 0.05055278539657593
Epoch: 70
Loss on hold-out set: 0.005010301884459822
MeanAbsoluteError value on hold-out data: 0.052936237305402756
Epoch: 71
```

```
Loss on hold-out set: 0.0025334913853408865
MeanAbsoluteError value on hold-out data: 0.03665337711572647
Epoch: 72
Loss on hold-out set: 0.0025901642726048044
MeanAbsoluteError value on hold-out data: 0.038137856870889664
Epoch: 73
Loss on hold-out set: 0.0057806664844974875
MeanAbsoluteError value on hold-out data: 0.06232056766748428
Epoch: 74
Loss on hold-out set: 0.007214008021707598
MeanAbsoluteError value on hold-out data: 0.07272358238697052
Epoch: 75
Loss on hold-out set: 0.009472108262247945
MeanAbsoluteError value on hold-out data: 0.07456468790769577
Epoch: 76
Loss on hold-out set: 0.003957813342199906
MeanAbsoluteError value on hold-out data: 0.04826058819890022
Epoch: 77
Loss on hold-out set: 0.003407417147077228
MeanAbsoluteError value on hold-out data: 0.04278990998864174
Epoch: 78
Loss on hold-out set: 0.00541738543880025
MeanAbsoluteError value on hold-out data: 0.05324581265449524
Epoch: 79
Loss on hold-out set: 0.004998409900030023
MeanAbsoluteError value on hold-out data: 0.05515756085515022
Epoch: 80
Loss on hold-out set: 0.0033058646245320376
MeanAbsoluteError value on hold-out data: 0.04088570550084114
Epoch: 81
Loss on hold-out set: 0.0059982179664075375
MeanAbsoluteError value on hold-out data: 0.06314081698656082
Epoch: 82
Loss on hold-out set: 0.0035111566968752364
MeanAbsoluteError value on hold-out data: 0.04692605510354042
Epoch: 83

Loss on hold-out set: 0.006961980430213244
MeanAbsoluteError value on hold-out data: 0.0687888115644455
Epoch: 84
Loss on hold-out set: 0.003739937913211945
MeanAbsoluteError value on hold-out data: 0.0462617352604866
```

```
Epoch: 85
Loss on hold-out set: 0.007573220658263094
MeanAbsoluteError value on hold-out data: 0.06667958945035934
Epoch: 86
Loss on hold-out set: 0.011403106373587721
MeanAbsoluteError value on hold-out data: 0.09353174269199371
Epoch: 87
Loss on hold-out set: 0.008050943406200722
MeanAbsoluteError value on hold-out data: 0.07387831062078476
Epoch: 88
Loss on hold-out set: 0.0036861721401740062
MeanAbsoluteError value on hold-out data: 0.0469672828912735
Epoch: 89
Loss on hold-out set: 0.005781997350583735
MeanAbsoluteError value on hold-out data: 0.06265745311975479
Epoch: 90
Loss on hold-out set: 0.009446824165551286
MeanAbsoluteError value on hold-out data: 0.07676996290683746
Epoch: 91
Loss on hold-out set: 0.00906870869527522
MeanAbsoluteError value on hold-out data: 0.07310188561677933
Epoch: 92
Loss on hold-out set: 0.0023963259759751197
MeanAbsoluteError value on hold-out data: 0.03812062367796898
Epoch: 93
Loss on hold-out set: 0.011734644539262118
MeanAbsoluteError value on hold-out data: 0.09727556258440018
Epoch: 94
Loss on hold-out set: 0.0034832315776791227
MeanAbsoluteError value on hold-out data: 0.042700186371803284
Epoch: 95
Loss on hold-out set: 0.009124329705771646
MeanAbsoluteError value on hold-out data: 0.08658692985773087
Epoch: 96
Loss on hold-out set: 0.002424300574746571
MeanAbsoluteError value on hold-out data: 0.03549009934067726
Epoch: 97
Loss on hold-out set: 0.010586656850615614
MeanAbsoluteError value on hold-out data: 0.08899234235286713
Epoch: 98
Loss on hold-out set: 0.010591776747452585
MeanAbsoluteError value on hold-out data: 0.09307191520929337
Epoch: 99
```

```
Loss on hold-out set: 0.005259300251246283
MeanAbsoluteError value on hold-out data: 0.06237388774752617
Epoch: 100
Loss on hold-out set: 0.006392595529752343
MeanAbsoluteError value on hold-out data: 0.06949056684970856
Epoch: 101
Loss on hold-out set: 0.00910538922701227
MeanAbsoluteError value on hold-out data: 0.07668207585811615
Epoch: 102
Loss on hold-out set: 0.010825903816638808
MeanAbsoluteError value on hold-out data: 0.07914642244577408
Epoch: 103
```

```
Loss on hold-out set: 0.0025402447116855335
MeanAbsoluteError value on hold-out data: 0.03681094944477081
Epoch: 104
Loss on hold-out set: 0.016196708390979392
MeanAbsoluteError value on hold-out data: 0.11713588982820511
Epoch: 105
Loss on hold-out set: 0.00588571404008881
MeanAbsoluteError value on hold-out data: 0.05813723802566528
Epoch: 106
Loss on hold-out set: 0.007490177026116534
MeanAbsoluteError value on hold-out data: 0.06961888819932938
Epoch: 107
Loss on hold-out set: 0.005257421075121353
MeanAbsoluteError value on hold-out data: 0.05634324252605438
Epoch: 108
Loss on hold-out set: 0.0025159740731683805
MeanAbsoluteError value on hold-out data: 0.03387521579861641
Epoch: 109
Loss on hold-out set: 0.005524218713521566
MeanAbsoluteError value on hold-out data: 0.0551508404314518
Epoch: 110
Loss on hold-out set: 0.009536644836005411
MeanAbsoluteError value on hold-out data: 0.0795287936925888
Epoch: 111
Loss on hold-out set: 0.002340251089710938
MeanAbsoluteError value on hold-out data: 0.03748378902673721
Epoch: 112
Loss on hold-out set: 0.0038275641732309993
MeanAbsoluteError value on hold-out data: 0.047365494072437286
```

```
Epoch: 113
Loss on hold-out set: 0.005390898300040709
MeanAbsoluteError value on hold-out data: 0.059588171541690826
Epoch: 114
Loss on hold-out set: 0.006986518280188504
MeanAbsoluteError value on hold-out data: 0.0661153569817543
Epoch: 115
Loss on hold-out set: 0.004116633625112866
MeanAbsoluteError value on hold-out data: 0.053198009729385376
Epoch: 116
Loss on hold-out set: 0.0024825542503477713
MeanAbsoluteError value on hold-out data: 0.035027749836444855
Epoch: 117
Loss on hold-out set: 0.0021887943424333477
MeanAbsoluteError value on hold-out data: 0.0345107726752758
Epoch: 118
Loss on hold-out set: 0.006312179967368904
MeanAbsoluteError value on hold-out data: 0.059028446674346924
Epoch: 119
Loss on hold-out set: 0.007645215839147568
MeanAbsoluteError value on hold-out data: 0.07061195373535156
Epoch: 120
Loss on hold-out set: 0.005191914651444868
MeanAbsoluteError value on hold-out data: 0.06009123474359512
Epoch: 121
Loss on hold-out set: 0.005275641518988107
MeanAbsoluteError value on hold-out data: 0.05561152100563049
Epoch: 122
Loss on hold-out set: 0.002299974681687002
MeanAbsoluteError value on hold-out data: 0.03391976282000542
Epoch: 123
Loss on hold-out set: 0.004285805049891535
MeanAbsoluteError value on hold-out data: 0.056975070387125015
Epoch: 124

Loss on hold-out set: 0.0025856100194352237
MeanAbsoluteError value on hold-out data: 0.04131631180644035
Epoch: 125
Loss on hold-out set: 0.006994777677678748
MeanAbsoluteError value on hold-out data: 0.0744032934308052
Epoch: 126
Loss on hold-out set: 0.0016547034519087326
```

```
MeanAbsoluteError value on hold-out data: 0.02972322702407837
Epoch: 127
Loss on hold-out set: 0.008354742398583576
MeanAbsoluteError value on hold-out data: 0.07626977562904358
Epoch: 128
Loss on hold-out set: 0.0028906206502334066
MeanAbsoluteError value on hold-out data: 0.04072370380163193
Epoch: 129
Loss on hold-out set: 0.005570184341386745
MeanAbsoluteError value on hold-out data: 0.061556555330753326
Epoch: 130
Loss on hold-out set: 0.004584943599949934
MeanAbsoluteError value on hold-out data: 0.05205328390002251
Epoch: 131
Loss on hold-out set: 0.0030010095613665485
MeanAbsoluteError value on hold-out data: 0.03791112080216408
Epoch: 132
Loss on hold-out set: 0.004658191593510932
MeanAbsoluteError value on hold-out data: 0.050864458084106445
Epoch: 133
Loss on hold-out set: 0.003355612236957409
MeanAbsoluteError value on hold-out data: 0.04553000256419182
Epoch: 134
Loss on hold-out set: 0.00817174785525391
MeanAbsoluteError value on hold-out data: 0.0778270736336708
Epoch: 135
Loss on hold-out set: 0.008413730458797593
MeanAbsoluteError value on hold-out data: 0.06935728341341019
Epoch: 136
Loss on hold-out set: 0.003185741781061025
MeanAbsoluteError value on hold-out data: 0.0415896512567997
Epoch: 137
Loss on hold-out set: 0.002638474465225284
MeanAbsoluteError value on hold-out data: 0.03383505716919899
Epoch: 138
Loss on hold-out set: 0.0027224418835861512
MeanAbsoluteError value on hold-out data: 0.0400245375931263
Epoch: 139
Loss on hold-out set: 0.004210732785347653
MeanAbsoluteError value on hold-out data: 0.04925549402832985
Epoch: 140
Loss on hold-out set: 0.0033999289214414986
MeanAbsoluteError value on hold-out data: 0.04080735146999359
```

```
Epoch: 141
Loss on hold-out set: 0.006990268042213039
MeanAbsoluteError value on hold-out data: 0.07243699580430984
Epoch: 142
Loss on hold-out set: 0.0023225342585264067
MeanAbsoluteError value on hold-out data: 0.03192713484168053
Epoch: 143
Loss on hold-out set: 0.004003077316539068
MeanAbsoluteError value on hold-out data: 0.053481146693229675
Epoch: 144
Loss on hold-out set: 0.005438069004173342
MeanAbsoluteError value on hold-out data: 0.061710573732852936
Epoch: 145

Loss on hold-out set: 0.0044332811559893584
MeanAbsoluteError value on hold-out data: 0.049039267003536224
Epoch: 146
Loss on hold-out set: 0.004933945221924468
MeanAbsoluteError value on hold-out data: 0.05682966113090515
Epoch: 147
Loss on hold-out set: 0.011893915992818381
MeanAbsoluteError value on hold-out data: 0.10093658417463303
Epoch: 148
Loss on hold-out set: 0.0020153643440847333
MeanAbsoluteError value on hold-out data: 0.030838049948215485
Epoch: 149
Loss on hold-out set: 0.002013460457275965
MeanAbsoluteError value on hold-out data: 0.030980411916971207
Epoch: 150
Loss on hold-out set: 0.005566254748325599
MeanAbsoluteError value on hold-out data: 0.058875612914562225
Epoch: 151
Loss on hold-out set: 0.0035944642731919885
MeanAbsoluteError value on hold-out data: 0.04187069088220596
Epoch: 152
Loss on hold-out set: 0.005104724967264031
MeanAbsoluteError value on hold-out data: 0.05903788283467293
Epoch: 153
Loss on hold-out set: 0.005053212915204074
MeanAbsoluteError value on hold-out data: 0.05688263103365898
Epoch: 154
Loss on hold-out set: 0.0023959604471823887
```

```
MeanAbsoluteError value on hold-out data: 0.03897247835993767
Epoch: 155
Loss on hold-out set: 0.00478080733630218
MeanAbsoluteError value on hold-out data: 0.05581182613968849
Epoch: 156
Loss on hold-out set: 0.006205137463678655
MeanAbsoluteError value on hold-out data: 0.06250406801700592
Epoch: 157
Loss on hold-out set: 0.004070435368799065
MeanAbsoluteError value on hold-out data: 0.054447416216135025
Epoch: 158
Loss on hold-out set: 0.005747011617610329
MeanAbsoluteError value on hold-out data: 0.05694882571697235
Early stopping at epoch 157
Returned to Spot: Validation loss: 0.005747011617610329
----------------------------------------------

spotPython tuning: 0.004477778572197023 [----------] 3.43%


config: {'_L_in': 10, '_L_out': 1, 'l1': 128, 'dropout_prob': 0.2251925299126734, 'lr_mult':
Epoch: 1
Loss on hold-out set: 0.028014204219767923
MeanAbsoluteError value on hold-out data: 0.13538645207881927
Epoch: 2

Loss on hold-out set: 0.04292857470481019
MeanAbsoluteError value on hold-out data: 0.17143787443637848
Epoch: 3
Loss on hold-out set: 0.024927947376119464
MeanAbsoluteError value on hold-out data: 0.13069148361682892
Epoch: 4
Loss on hold-out set: 0.021459809945602166
MeanAbsoluteError value on hold-out data: 0.11877169460058212
Epoch: 5
Loss on hold-out set: 0.02163721758284067
MeanAbsoluteError value on hold-out data: 0.11982336640357971
Epoch: 6
Loss on hold-out set: 0.015040146113422356
MeanAbsoluteError value on hold-out data: 0.09687220305204391
Epoch: 7
Loss on hold-out set: 0.019187706130507746
```

```
MeanAbsoluteError value on hold-out data: 0.11408598721027374
Epoch: 8
Loss on hold-out set: 0.02077952350832914
MeanAbsoluteError value on hold-out data: 0.11985847353935242
Epoch: 9
Loss on hold-out set: 0.012139195870412024
MeanAbsoluteError value on hold-out data: 0.0876389816403389
Epoch: 10
Loss on hold-out set: 0.016774093340101996
MeanAbsoluteError value on hold-out data: 0.10607129335403442
Epoch: 11
Loss on hold-out set: 0.009675538841340887
MeanAbsoluteError value on hold-out data: 0.07729287445545197
Epoch: 12
Loss on hold-out set: 0.015595648780857263
MeanAbsoluteError value on hold-out data: 0.10260240733623505
Epoch: 13
Loss on hold-out set: 0.012774778431967684
MeanAbsoluteError value on hold-out data: 0.08958809822797775
Epoch: 14
Loss on hold-out set: 0.015480832735958853
MeanAbsoluteError value on hold-out data: 0.10089058429002762
Epoch: 15
Loss on hold-out set: 0.011134645950637366
MeanAbsoluteError value on hold-out data: 0.08235777914524078
Epoch: 16

Loss on hold-out set: 0.01635369653568456
MeanAbsoluteError value on hold-out data: 0.10303983092308044
Epoch: 17
Loss on hold-out set: 0.00686570627026652
MeanAbsoluteError value on hold-out data: 0.06586623191833496
Epoch: 18

Loss on hold-out set: 0.00823785019058146
MeanAbsoluteError value on hold-out data: 0.07307950407266617
Epoch: 19
Loss on hold-out set: 0.019878790321710863
MeanAbsoluteError value on hold-out data: 0.11915340274572372
Epoch: 20
Loss on hold-out set: 0.008558487176503005
MeanAbsoluteError value on hold-out data: 0.07424309104681015
```

```
Epoch: 21
Loss on hold-out set: 0.011152825048683505
MeanAbsoluteError value on hold-out data: 0.09068920463323593
Epoch: 22
Loss on hold-out set: 0.006109392258191579
MeanAbsoluteError value on hold-out data: 0.06086453050374985
Epoch: 23
Loss on hold-out set: 0.004991934720524832
MeanAbsoluteError value on hold-out data: 0.054109860211610794
Epoch: 24
Loss on hold-out set: 0.0074947537413161056
MeanAbsoluteError value on hold-out data: 0.06680932641029358
Epoch: 25
Loss on hold-out set: 0.011661365726276449
MeanAbsoluteError value on hold-out data: 0.08888807892799377
Epoch: 26
Loss on hold-out set: 0.006567858355609994
MeanAbsoluteError value on hold-out data: 0.06501730531454086
Epoch: 27
Loss on hold-out set: 0.013555682313285376
MeanAbsoluteError value on hold-out data: 0.09605178236961365
Epoch: 28
Loss on hold-out set: 0.012284388152980491
MeanAbsoluteError value on hold-out data: 0.0909162387251854
Epoch: 29
Loss on hold-out set: 0.0053490045553955595
MeanAbsoluteError value on hold-out data: 0.05921829119324684
Epoch: 30
Loss on hold-out set: 0.0029566345466791014
MeanAbsoluteError value on hold-out data: 0.04140753298997879
Epoch: 31
Loss on hold-out set: 0.008522744560124059
MeanAbsoluteError value on hold-out data: 0.07868804782629013
Epoch: 32

Loss on hold-out set: 0.011920877046098835
MeanAbsoluteError value on hold-out data: 0.0857522115111351
Epoch: 33
Loss on hold-out set: 0.0055847219926746265
MeanAbsoluteError value on hold-out data: 0.06058249622583389
Epoch: 34

Loss on hold-out set: 0.004486317991426117
```

```
MeanAbsoluteError value on hold-out data: 0.051196396350860596
Epoch: 35
Loss on hold-out set: 0.008440805868686814
MeanAbsoluteError value on hold-out data: 0.07554695755243301
Epoch: 36
Loss on hold-out set: 0.011764290718067633
MeanAbsoluteError value on hold-out data: 0.08932888507843018
Epoch: 37
Loss on hold-out set: 0.011611734639461102
MeanAbsoluteError value on hold-out data: 0.08799745887517929
Epoch: 38
Loss on hold-out set: 0.006800401110300108
MeanAbsoluteError value on hold-out data: 0.0654793307185173
Epoch: 39
Loss on hold-out set: 0.012681608431433377
MeanAbsoluteError value on hold-out data: 0.09063363075256348
Epoch: 40
Loss on hold-out set: 0.012902062900952603
MeanAbsoluteError value on hold-out data: 0.09289942681789398
Epoch: 41
Loss on hold-out set: 0.010728035073139165
MeanAbsoluteError value on hold-out data: 0.09058985114097595
Epoch: 42
Loss on hold-out set: 0.005426736205424133
MeanAbsoluteError value on hold-out data: 0.05898135527968407
Epoch: 43
Loss on hold-out set: 0.004486330944162451
MeanAbsoluteError value on hold-out data: 0.051315318793058395
Epoch: 44
Loss on hold-out set: 0.006618731189519167
MeanAbsoluteError value on hold-out data: 0.0643719807267189
Epoch: 45
Loss on hold-out set: 0.0053412858029141235
MeanAbsoluteError value on hold-out data: 0.0602286159992218
Epoch: 46
Loss on hold-out set: 0.004311898894804089
MeanAbsoluteError value on hold-out data: 0.05086560547351837
Epoch: 47
Loss on hold-out set: 0.0028272006495267546
MeanAbsoluteError value on hold-out data: 0.03823018819093704
Epoch: 48
Loss on hold-out set: 0.0036047031232891115
MeanAbsoluteError value on hold-out data: 0.04755248874425888
```

```
Epoch: 49
Loss on hold-out set: 0.006877505477811945
MeanAbsoluteError value on hold-out data: 0.06782375276088715
Epoch: 50
Loss on hold-out set: 0.003658778168947289
MeanAbsoluteError value on hold-out data: 0.04825012385845184
Epoch: 51
```

```
Loss on hold-out set: 0.010657558634289
MeanAbsoluteError value on hold-out data: 0.08140149712562561
Epoch: 52
Loss on hold-out set: 0.004575789942847271
MeanAbsoluteError value on hold-out data: 0.05418844148516655
Epoch: 53
Loss on hold-out set: 0.00607873493266341
MeanAbsoluteError value on hold-out data: 0.06328269839286804
Epoch: 54
Loss on hold-out set: 0.0057115744872901
MeanAbsoluteError value on hold-out data: 0.059772975742816925
Epoch: 55
Loss on hold-out set: 0.004344648032106067
MeanAbsoluteError value on hold-out data: 0.05309455469250679
Epoch: 56
Loss on hold-out set: 0.0068249004329309654
MeanAbsoluteError value on hold-out data: 0.06747502088546753
Epoch: 57
Loss on hold-out set: 0.002855871601863519
MeanAbsoluteError value on hold-out data: 0.04036467522382736
Epoch: 58
Loss on hold-out set: 0.009780919988100467
MeanAbsoluteError value on hold-out data: 0.08044691383838654
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Loss on hold-out set: 0.0034075832656143526
MeanAbsoluteError value on hold-out data: 0.04452374204993248
Epoch: 60
Loss on hold-out set: 0.004899926636809189
MeanAbsoluteError value on hold-out data: 0.054914411157369614
Epoch: 61
Loss on hold-out set: 0.003928200023150758
MeanAbsoluteError value on hold-out data: 0.046751052141189575
Epoch: 62
Loss on hold-out set: 0.003043503806877293
```

```
MeanAbsoluteError value on hold-out data: 0.04289328306913376
Epoch: 63
Loss on hold-out set: 0.0034545624910510683
MeanAbsoluteError value on hold-out data: 0.044366247951984406
Epoch: 64
Loss on hold-out set: 0.009283248849801327
MeanAbsoluteError value on hold-out data: 0.07598850876092911

Epoch: 65
Loss on hold-out set: 0.010631308743828222
MeanAbsoluteError value on hold-out data: 0.09212643653154373
Epoch: 66
Loss on hold-out set: 0.0038174231058770887
MeanAbsoluteError value on hold-out data: 0.04754910618066788
Epoch: 67

Loss on hold-out set: 0.0023017787944378428
MeanAbsoluteError value on hold-out data: 0.03453842177987099
Epoch: 68
Loss on hold-out set: 0.002928538781002556
MeanAbsoluteError value on hold-out data: 0.040822722017765045
Epoch: 69
Loss on hold-out set: 0.009635394978287973
MeanAbsoluteError value on hold-out data: 0.07767754048109055
Epoch: 70
Loss on hold-out set: 0.0027644198455259597
MeanAbsoluteError value on hold-out data: 0.04013753682374954
Epoch: 71
Loss on hold-out set: 0.003824919609254912
MeanAbsoluteError value on hold-out data: 0.048718441277742386
Epoch: 72
Loss on hold-out set: 0.003717636468967325
MeanAbsoluteError value on hold-out data: 0.04866375774145126
Epoch: 73
Loss on hold-out set: 0.0018692375742830336
MeanAbsoluteError value on hold-out data: 0.03253345936536789
Epoch: 74
Loss on hold-out set: 0.006234734147591026
MeanAbsoluteError value on hold-out data: 0.06965409964323044
Epoch: 75
Loss on hold-out set: 0.006424375515627234
MeanAbsoluteError value on hold-out data: 0.06542912870645523
```

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Epoch: 76
Loss on hold-out set: 0.005091145536617229
MeanAbsoluteError value on hold-out data: 0.05573822557926178
Epoch: 77
Loss on hold-out set: 0.003938955953344703
MeanAbsoluteError value on hold-out data: 0.048941854387521744
Epoch: 78
Loss on hold-out set: 0.0057979576093585864
MeanAbsoluteError value on hold-out data: 0.06154187396168709
Epoch: 79
Loss on hold-out set: 0.0035022880551160165
MeanAbsoluteError value on hold-out data: 0.04560462385416031
Epoch: 80

Loss on hold-out set: 0.00511005196083141
MeanAbsoluteError value on hold-out data: 0.0619702972471714
Epoch: 81
Loss on hold-out set: 0.0029562715820870117
MeanAbsoluteError value on hold-out data: 0.043523043394088745
Epoch: 82
Loss on hold-out set: 0.0037756421983144
MeanAbsoluteError value on hold-out data: 0.049205053597688675
Epoch: 83

Loss on hold-out set: 0.006916084302295195
MeanAbsoluteError value on hold-out data: 0.06776008009910583
Epoch: 84
Loss on hold-out set: 0.002468682758166994
MeanAbsoluteError value on hold-out data: 0.03720599040389061
Epoch: 85
Loss on hold-out set: 0.004447141453917874
MeanAbsoluteError value on hold-out data: 0.050301164388656616
Epoch: 86
Loss on hold-out set: 0.0027752209111656014
MeanAbsoluteError value on hold-out data: 0.04054838791489601
Epoch: 87
Loss on hold-out set: 0.0020811540828282503
MeanAbsoluteError value on hold-out data: 0.03387486934661865
Epoch: 88
Loss on hold-out set: 0.004973755230342871
MeanAbsoluteError value on hold-out data: 0.054964516311883926
Epoch: 89
```

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Loss on hold-out set: 0.004019748594146222
MeanAbsoluteError value on hold-out data: 0.04895571991801262
Epoch: 90
Loss on hold-out set: 0.0030803001350968293
MeanAbsoluteError value on hold-out data: 0.042188532650470734
Epoch: 91
Loss on hold-out set: 0.006475115047865792
MeanAbsoluteError value on hold-out data: 0.06555938720703125
Epoch: 92
Loss on hold-out set: 0.0025297712969691737
MeanAbsoluteError value on hold-out data: 0.03969655930995941
Epoch: 93
Loss on hold-out set: 0.002423317640358092
MeanAbsoluteError value on hold-out data: 0.035634446889162064
Epoch: 94
Loss on hold-out set: 0.003648993767503845
MeanAbsoluteError value on hold-out data: 0.04899945855140686
Epoch: 95
Loss on hold-out set: 0.003950269329116533
MeanAbsoluteError value on hold-out data: 0.05379372835159302
Epoch: 96
Loss on hold-out set: 0.0028297222727958703
MeanAbsoluteError value on hold-out data: 0.04186761751770973
Epoch: 97

Loss on hold-out set: 0.008142058369948676
MeanAbsoluteError value on hold-out data: 0.08225922286510468
Epoch: 98
Loss on hold-out set: 0.0032918828809143682
MeanAbsoluteError value on hold-out data: 0.04425448924303055
Epoch: 99
Loss on hold-out set: 0.005535788062077604
MeanAbsoluteError value on hold-out data: 0.06235134229063988
Epoch: 100

Loss on hold-out set: 0.004591667154607804
MeanAbsoluteError value on hold-out data: 0.05221148207783699
Epoch: 101
Loss on hold-out set: 0.0037628799235742342
MeanAbsoluteError value on hold-out data: 0.046222984790802
Epoch: 102
Loss on hold-out set: 0.002296261633378699
```

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MeanAbsoluteError value on hold-out data: 0.03754450008273125
Epoch: 103
Loss on hold-out set: 0.0024656981358451673
MeanAbsoluteError value on hold-out data: 0.03686734661459923
Epoch: 104
Loss on hold-out set: 0.009551350591018012
MeanAbsoluteError value on hold-out data: 0.07645295560359955
Epoch: 105
Loss on hold-out set: 0.0020567329116410724
MeanAbsoluteError value on hold-out data: 0.03251400217413902
Epoch: 106
Loss on hold-out set: 0.0029199258975782677
MeanAbsoluteError value on hold-out data: 0.041227441281080246
Epoch: 107
Loss on hold-out set: 0.003695086447374993
MeanAbsoluteError value on hold-out data: 0.04777538776397705
Epoch: 108
Loss on hold-out set: 0.004524015539668892
MeanAbsoluteError value on hold-out data: 0.053169261664152145
Epoch: 109
Loss on hold-out set: 0.0016528992380603757
MeanAbsoluteError value on hold-out data: 0.030436573550105095
Epoch: 110
Loss on hold-out set: 0.002533054083438688
MeanAbsoluteError value on hold-out data: 0.03787890821695328
Epoch: 111
Loss on hold-out set: 0.006113888095378091
MeanAbsoluteError value on hold-out data: 0.06474895775318146
Epoch: 112
Loss on hold-out set: 0.004381976286439519
MeanAbsoluteError value on hold-out data: 0.05247491970658302
Epoch: 113

Loss on hold-out set: 0.006837632458068822
MeanAbsoluteError value on hold-out data: 0.0683450996875763
Epoch: 114
Loss on hold-out set: 0.004292221641854236
MeanAbsoluteError value on hold-out data: 0.052674803882837296
Epoch: 115
Loss on hold-out set: 0.0014730429209425654
MeanAbsoluteError value on hold-out data: 0.028783757239580154
Epoch: 116
```

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Loss on hold-out set: 0.005691966642380545
MeanAbsoluteError value on hold-out data: 0.06600134074687958
Epoch: 117
Loss on hold-out set: 0.0028920381262555325
MeanAbsoluteError value on hold-out data: 0.039370737969875336
Epoch: 118
Loss on hold-out set: 0.003674117113022428
MeanAbsoluteError value on hold-out data: 0.04849398508667946
Epoch: 119
Loss on hold-out set: 0.002638182866289035
MeanAbsoluteError value on hold-out data: 0.039462681859731674
Epoch: 120
Loss on hold-out set: 0.001940183785719503
MeanAbsoluteError value on hold-out data: 0.031281422823667526
Epoch: 121
Loss on hold-out set: 0.002581899176890913
MeanAbsoluteError value on hold-out data: 0.03776276856660843
Epoch: 122
Loss on hold-out set: 0.00922260970171345
MeanAbsoluteError value on hold-out data: 0.07862913608551025
Epoch: 123
Loss on hold-out set: 0.005790847267857508
MeanAbsoluteError value on hold-out data: 0.06692838668823242
Epoch: 124
Loss on hold-out set: 0.0020917527512402125
MeanAbsoluteError value on hold-out data: 0.03413825109601021
Epoch: 125
Loss on hold-out set: 0.00355224375073847
MeanAbsoluteError value on hold-out data: 0.04766768217086792
Epoch: 126
Loss on hold-out set: 0.006816716754416886
MeanAbsoluteError value on hold-out data: 0.06363647431135178
Epoch: 127
Loss on hold-out set: 0.0029253165917716138
MeanAbsoluteError value on hold-out data: 0.041845597326755524
Epoch: 128
Loss on hold-out set: 0.003141382929721945
MeanAbsoluteError value on hold-out data: 0.042354028671979904
Epoch: 129
Loss on hold-out set: 0.0023399299519185567
MeanAbsoluteError value on hold-out data: 0.03561525419354439

Epoch: 130
```

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Loss on hold-out set: 0.003510971032818289
MeanAbsoluteError value on hold-out data: 0.04362853989005089
Epoch: 131
Loss on hold-out set: 0.005447583101493747
MeanAbsoluteError value on hold-out data: 0.05653316527605057
Epoch: 132
Loss on hold-out set: 0.0017643898394645045
MeanAbsoluteError value on hold-out data: 0.031246216967701912
Epoch: 133

Loss on hold-out set: 0.0046003524238537805
MeanAbsoluteError value on hold-out data: 0.052344419062137604
Epoch: 134
Loss on hold-out set: 0.0034844844700082354
MeanAbsoluteError value on hold-out data: 0.045544978231191635
Epoch: 135
Loss on hold-out set: 0.002570868929308888
MeanAbsoluteError value on hold-out data: 0.04177400469779968
Epoch: 136
Loss on hold-out set: 0.002025372511094534
MeanAbsoluteError value on hold-out data: 0.0335267037153244
Epoch: 137
Loss on hold-out set: 0.009950768104509303
MeanAbsoluteError value on hold-out data: 0.08809894323348999
Epoch: 138
Loss on hold-out set: 0.002125554387212584
MeanAbsoluteError value on hold-out data: 0.036951422691345215
Epoch: 139
Loss on hold-out set: 0.0029799484059606727
MeanAbsoluteError value on hold-out data: 0.041942015290260315
Epoch: 140
Loss on hold-out set: 0.003684750721348744
MeanAbsoluteError value on hold-out data: 0.04892256483435631
Epoch: 141
Loss on hold-out set: 0.002892029343025857
MeanAbsoluteError value on hold-out data: 0.04112616181373596
Epoch: 142
Loss on hold-out set: 0.005929316283742848
MeanAbsoluteError value on hold-out data: 0.06399604678153992
Epoch: 143
Loss on hold-out set: 0.0025991139823178713
MeanAbsoluteError value on hold-out data: 0.03803189843893051
```

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Epoch: 144
Loss on hold-out set: 0.0015232332271376723
MeanAbsoluteError value on hold-out data: 0.032504837960004807
Epoch: 145
Loss on hold-out set: 0.0017030931623211426
MeanAbsoluteError value on hold-out data: 0.0321100130677232
Epoch: 146

Loss on hold-out set: 0.003118368833766956
MeanAbsoluteError value on hold-out data: 0.04789600521326065
Epoch: 147
Loss on hold-out set: 0.0034950597113684602
MeanAbsoluteError value on hold-out data: 0.04580855369567871
Epoch: 148
Loss on hold-out set: 0.0043838353288408955
MeanAbsoluteError value on hold-out data: 0.05463586002588272
Epoch: 149

Loss on hold-out set: 0.005754000899430953
MeanAbsoluteError value on hold-out data: 0.059900157153606415
Epoch: 150
Loss on hold-out set: 0.005607355729137596
MeanAbsoluteError value on hold-out data: 0.05887420475482941
Epoch: 151
Loss on hold-out set: 0.0043094412448178784
MeanAbsoluteError value on hold-out data: 0.05009407922625542
Epoch: 152
Loss on hold-out set: 0.0026150598239741826
MeanAbsoluteError value on hold-out data: 0.03889704495668411
Epoch: 153
Loss on hold-out set: 0.0033866616186538807
MeanAbsoluteError value on hold-out data: 0.04535006359219551
Epoch: 154
Loss on hold-out set: 0.0016285829172518692
MeanAbsoluteError value on hold-out data: 0.03198099881410599
Epoch: 155
Loss on hold-out set: 0.0012640869490018016
MeanAbsoluteError value on hold-out data: 0.027095919474959373
Epoch: 156
Loss on hold-out set: 0.005872366422983377
MeanAbsoluteError value on hold-out data: 0.06767605245113373
Epoch: 157
```

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Loss on hold-out set: 0.002612013458641932
MeanAbsoluteError value on hold-out data: 0.03942769765853882
Epoch: 158
Loss on hold-out set: 0.001704786842884986
MeanAbsoluteError value on hold-out data: 0.03258112445473671
Epoch: 159
Loss on hold-out set: 0.0033879321509678114
MeanAbsoluteError value on hold-out data: 0.04476376250386238
Epoch: 160
Loss on hold-out set: 0.0016046353297210054
MeanAbsoluteError value on hold-out data: 0.030690336599946022
Epoch: 161
Loss on hold-out set: 0.002954852889831129
MeanAbsoluteError value on hold-out data: 0.042866505682468414
Epoch: 162

Loss on hold-out set: 0.002903084711808907
MeanAbsoluteError value on hold-out data: 0.04435456544160843
Epoch: 163
Loss on hold-out set: 0.0029742085485179957
MeanAbsoluteError value on hold-out data: 0.04351980611681938
Epoch: 164
Loss on hold-out set: 0.002687133156302336
MeanAbsoluteError value on hold-out data: 0.04070974886417389
Epoch: 165

Loss on hold-out set: 0.0022992679702216073
MeanAbsoluteError value on hold-out data: 0.03560996800661087
Epoch: 166
Loss on hold-out set: 0.005049763284133453
MeanAbsoluteError value on hold-out data: 0.058585941791534424
Epoch: 167
Loss on hold-out set: 0.0015283201631207607
MeanAbsoluteError value on hold-out data: 0.031520161777734756
Epoch: 168
Loss on hold-out set: 0.002180995768867433
MeanAbsoluteError value on hold-out data: 0.035721469670534134
Epoch: 169
Loss on hold-out set: 0.0034823403632464377
MeanAbsoluteError value on hold-out data: 0.04873788356781006
Epoch: 170
Loss on hold-out set: 0.0019237832901509184
```

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MeanAbsoluteError value on hold-out data: 0.03108590468764305
Epoch: 171
Loss on hold-out set: 0.0033209957304949824
MeanAbsoluteError value on hold-out data: 0.04501357674598694
Epoch: 172
Loss on hold-out set: 0.004287224238444316
MeanAbsoluteError value on hold-out data: 0.05190526694059372
Epoch: 173
Loss on hold-out set: 0.002893353800142282
MeanAbsoluteError value on hold-out data: 0.04242822155356407
Epoch: 174
Loss on hold-out set: 0.002423361574887837
MeanAbsoluteError value on hold-out data: 0.03904923051595688
Epoch: 175
Loss on hold-out set: 0.0019783548931101044
MeanAbsoluteError value on hold-out data: 0.03231988102197647
Epoch: 176
Loss on hold-out set: 0.0028568630682696636
MeanAbsoluteError value on hold-out data: 0.042942166328430176
Epoch: 177
Loss on hold-out set: 0.005187312790535782
MeanAbsoluteError value on hold-out data: 0.05670253187417984
Epoch: 178

Loss on hold-out set: 0.0036848267650623854
MeanAbsoluteError value on hold-out data: 0.048585984855890274
Epoch: 179
Loss on hold-out set: 0.0037684614745605934
MeanAbsoluteError value on hold-out data: 0.04741281643509865
Epoch: 180
Loss on hold-out set: 0.001983218670111934
MeanAbsoluteError value on hold-out data: 0.03208396956324577
Epoch: 181

Loss on hold-out set: 0.002550064059170453
MeanAbsoluteError value on hold-out data: 0.03823354095220566
Epoch: 182
Loss on hold-out set: 0.002588984887360742
MeanAbsoluteError value on hold-out data: 0.03985410928726196
Epoch: 183
Loss on hold-out set: 0.007061740358997332
MeanAbsoluteError value on hold-out data: 0.07288902997970581
```

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Epoch: 184
Loss on hold-out set: 0.0035707426478007905
MeanAbsoluteError value on hold-out data: 0.04967104271054268
Epoch: 185
Loss on hold-out set: 0.0033489669807941504
MeanAbsoluteError value on hold-out data: 0.04621846228837967
Epoch: 186
Loss on hold-out set: 0.006089928204585847
MeanAbsoluteError value on hold-out data: 0.06436651200056076
Epoch: 187
Loss on hold-out set: 0.0034734100887649937
MeanAbsoluteError value on hold-out data: 0.04966874420642853
Epoch: 188
Loss on hold-out set: 0.002793305397254268
MeanAbsoluteError value on hold-out data: 0.04203532636165619
Epoch: 189
Loss on hold-out set: 0.002397459064683828
MeanAbsoluteError value on hold-out data: 0.03547066077589989
Epoch: 190
Loss on hold-out set: 0.006127413068162768
MeanAbsoluteError value on hold-out data: 0.06133430451154709
Epoch: 191
Loss on hold-out set: 0.003249205575373612
MeanAbsoluteError value on hold-out data: 0.047022439539432526
Epoch: 192
Loss on hold-out set: 0.001654986702640982
MeanAbsoluteError value on hold-out data: 0.02977253682911396
Epoch: 193
Loss on hold-out set: 0.0018984664102869207
MeanAbsoluteError value on hold-out data: 0.03377426043152809
Epoch: 194

Loss on hold-out set: 0.004264437066587179
MeanAbsoluteError value on hold-out data: 0.05270436778664589
Epoch: 195
Loss on hold-out set: 0.010657981038093567
MeanAbsoluteError value on hold-out data: 0.09336055815219879
Epoch: 196
Loss on hold-out set: 0.004509187597585351
MeanAbsoluteError value on hold-out data: 0.05292809009552002
Epoch: 197

Loss on hold-out set: 0.0023344883290854724
```

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MeanAbsoluteError value on hold-out data: 0.03761093690991402
Epoch: 198
Loss on hold-out set: 0.0017566353781148791
MeanAbsoluteError value on hold-out data: 0.031620949506759644
Epoch: 199
Loss on hold-out set: 0.00163847947566721
MeanAbsoluteError value on hold-out data: 0.031010884791612625
Epoch: 200
Loss on hold-out set: 0.003848934803452147
MeanAbsoluteError value on hold-out data: 0.05072920396924019
Epoch: 201
Loss on hold-out set: 0.004214392478675826
MeanAbsoluteError value on hold-out data: 0.04979691281914711
Epoch: 202
Loss on hold-out set: 0.00290395832914663
MeanAbsoluteError value on hold-out data: 0.042832039296627045
Epoch: 203
Loss on hold-out set: 0.0043185331221473845
MeanAbsoluteError value on hold-out data: 0.05539056286215782
Epoch: 204
Loss on hold-out set: 0.0018392133765461807
MeanAbsoluteError value on hold-out data: 0.03129955381155014
Epoch: 205
Loss on hold-out set: 0.0015480753193658433
MeanAbsoluteError value on hold-out data: 0.028429212048649788
Epoch: 206
Loss on hold-out set: 0.002126961774928005
MeanAbsoluteError value on hold-out data: 0.035321690142154694
Epoch: 207
Loss on hold-out set: 0.0013935062620715286
MeanAbsoluteError value on hold-out data: 0.02800609916448593
Epoch: 208
Loss on hold-out set: 0.0026910320494176916
MeanAbsoluteError value on hold-out data: 0.0386786088347435
Epoch: 209
Loss on hold-out set: 0.004573438794499165
MeanAbsoluteError value on hold-out data: 0.053351566195487976
Epoch: 210

Loss on hold-out set: 0.005902237945089215
MeanAbsoluteError value on hold-out data: 0.06310400366783142
Epoch: 211
```

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Loss on hold-out set: 0.002282942522709307
MeanAbsoluteError value on hold-out data: 0.03503711149096489
Epoch: 212
Loss on hold-out set: 0.0019375020760650698
MeanAbsoluteError value on hold-out data: 0.03315872326493263
Epoch: 213


Loss on hold-out set: 0.002549777156673372
MeanAbsoluteError value on hold-out data: 0.04190092533826828
Epoch: 214
Loss on hold-out set: 0.0014595334957304754
MeanAbsoluteError value on hold-out data: 0.028400978073477745
Epoch: 215
Loss on hold-out set: 0.006403703867506824
MeanAbsoluteError value on hold-out data: 0.06177150830626488
Epoch: 216
Loss on hold-out set: 0.0013026230122992082
MeanAbsoluteError value on hold-out data: 0.02765294350683689
Epoch: 217
Loss on hold-out set: 0.0012264922475687375
MeanAbsoluteError value on hold-out data: 0.026704024523496628
Epoch: 218
Loss on hold-out set: 0.0016198023559378558
MeanAbsoluteError value on hold-out data: 0.030728768557310104
Epoch: 219
Loss on hold-out set: 0.0017750299547945982
MeanAbsoluteError value on hold-out data: 0.031113840639591217
Epoch: 220
Loss on hold-out set: 0.005380236568223489
MeanAbsoluteError value on hold-out data: 0.058463916182518005
Epoch: 221
Loss on hold-out set: 0.003696819497762542
MeanAbsoluteError value on hold-out data: 0.051627017557621
Epoch: 222
Loss on hold-out set: 0.0019030959627247955
MeanAbsoluteError value on hold-out data: 0.03201516717672348
Epoch: 223
Loss on hold-out set: 0.0027794521301984787
MeanAbsoluteError value on hold-out data: 0.041391465812921524
Epoch: 224
Loss on hold-out set: 0.0016403403684594913
MeanAbsoluteError value on hold-out data: 0.02934894897043705
```

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Epoch: 225
Loss on hold-out set: 0.007527093599109273
MeanAbsoluteError value on hold-out data: 0.07851707190275192
Epoch: 226

Loss on hold-out set: 0.0019147643715290254
MeanAbsoluteError value on hold-out data: 0.032703086733818054
Epoch: 227
Loss on hold-out set: 0.0023092857414954587
MeanAbsoluteError value on hold-out data: 0.039767228066921234
Epoch: 228
Loss on hold-out set: 0.0016557268436851078
MeanAbsoluteError value on hold-out data: 0.03017326444387436
Epoch: 229

Loss on hold-out set: 0.004646445342682694
MeanAbsoluteError value on hold-out data: 0.0547650083899498
Epoch: 230
Loss on hold-out set: 0.004928936042185677
MeanAbsoluteError value on hold-out data: 0.061851780861616135
Epoch: 231
Loss on hold-out set: 0.002142318319161668
MeanAbsoluteError value on hold-out data: 0.03350142017006874
Epoch: 232
Loss on hold-out set: 0.0026797871718085126
MeanAbsoluteError value on hold-out data: 0.03997039794921875
Epoch: 233
Loss on hold-out set: 0.004836674007636152
MeanAbsoluteError value on hold-out data: 0.05945015698671341
Epoch: 234
Loss on hold-out set: 0.0020616719940383184
MeanAbsoluteError value on hold-out data: 0.03533092886209488
Epoch: 235
Loss on hold-out set: 0.002961942515532045
MeanAbsoluteError value on hold-out data: 0.04341025650501251
Epoch: 236
Loss on hold-out set: 0.008760326811553617
MeanAbsoluteError value on hold-out data: 0.07338525354862213
Epoch: 237
Loss on hold-out set: 0.005394414581946637
MeanAbsoluteError value on hold-out data: 0.06142794340848923
Epoch: 238
```

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Loss on hold-out set: 0.002289791404588246
MeanAbsoluteError value on hold-out data: 0.03659430146217346
Epoch: 239
Loss on hold-out set: 0.0060388224542533096
MeanAbsoluteError value on hold-out data: 0.06258454918861389
Epoch: 240
Loss on hold-out set: 0.0013865573748357985
MeanAbsoluteError value on hold-out data: 0.028452355414628983
Epoch: 241
Loss on hold-out set: 0.0019681273016000263
MeanAbsoluteError value on hold-out data: 0.034224238246679306
Epoch: 242

Loss on hold-out set: 0.0028069814219825752
MeanAbsoluteError value on hold-out data: 0.03974321112036705
Epoch: 243
Loss on hold-out set: 0.001414424231226899
MeanAbsoluteError value on hold-out data: 0.02709980309009552
Epoch: 244
Loss on hold-out set: 0.0014304541890803528
MeanAbsoluteError value on hold-out data: 0.029735691845417023
Epoch: 245

Loss on hold-out set: 0.003205124944399454
MeanAbsoluteError value on hold-out data: 0.042532362043857574
Epoch: 246
Loss on hold-out set: 0.0014589329305300979
MeanAbsoluteError value on hold-out data: 0.028631016612052917
Epoch: 247
Loss on hold-out set: 0.003997447324524585
MeanAbsoluteError value on hold-out data: 0.05025225877761841
Epoch: 248
Loss on hold-out set: 0.0014399557288638071
MeanAbsoluteError value on hold-out data: 0.02740275301039219
Epoch: 249
Loss on hold-out set: 0.002347921797895412
MeanAbsoluteError value on hold-out data: 0.034716494381427765
Epoch: 250
Loss on hold-out set: 0.0032770999854332523
MeanAbsoluteError value on hold-out data: 0.0414552204310894
Epoch: 251
Loss on hold-out set: 0.0022144314808476913
```

```
MeanAbsoluteError value on hold-out data: 0.03681565448641777
Epoch: 252
Loss on hold-out set: 0.005767667641569125
MeanAbsoluteError value on hold-out data: 0.06141423434019089
Epoch: 253
Loss on hold-out set: 0.0016147962550779706
MeanAbsoluteError value on hold-out data: 0.03042692132294178
Epoch: 254
Loss on hold-out set: 0.0029404095655895376
MeanAbsoluteError value on hold-out data: 0.042167626321315765
Epoch: 255
Loss on hold-out set: 0.003942124949964254
MeanAbsoluteError value on hold-out data: 0.05359522998332977
Epoch: 256
Loss on hold-out set: 0.0019089873469630746
MeanAbsoluteError value on hold-out data: 0.033992949873209
Epoch: 257
Loss on hold-out set: 0.004242236333850183
MeanAbsoluteError value on hold-out data: 0.05180143192410469
Epoch: 258

Loss on hold-out set: 0.0026784457731992006
MeanAbsoluteError value on hold-out data: 0.042258165776729584
Epoch: 259
Loss on hold-out set: 0.0016423792143254296
MeanAbsoluteError value on hold-out data: 0.030877307057380676
Epoch: 260
Loss on hold-out set: 0.006714341978199388
MeanAbsoluteError value on hold-out data: 0.06707549095153809
Epoch: 261

Loss on hold-out set: 0.0017797338108434097
MeanAbsoluteError value on hold-out data: 0.03167719021439552
Epoch: 262
Loss on hold-out set: 0.0012018136775096583
MeanAbsoluteError value on hold-out data: 0.025078492239117622
Epoch: 263
Loss on hold-out set: 0.001798223792942927
MeanAbsoluteError value on hold-out data: 0.03082599677145481
Epoch: 264
Loss on hold-out set: 0.00238369018954568
MeanAbsoluteError value on hold-out data: 0.03702816739678383
```

```
Epoch: 265
Loss on hold-out set: 0.0021894719224962358
MeanAbsoluteError value on hold-out data: 0.03342699632048607
Epoch: 266
Loss on hold-out set: 0.0014986913026261487
MeanAbsoluteError value on hold-out data: 0.029923098161816597
Epoch: 267
Loss on hold-out set: 0.001319464149051591
MeanAbsoluteError value on hold-out data: 0.027859468013048172
Epoch: 268
Loss on hold-out set: 0.0009444432017564969
MeanAbsoluteError value on hold-out data: 0.023222852498292923
Epoch: 269
Loss on hold-out set: 0.004725844489018384
MeanAbsoluteError value on hold-out data: 0.05432930588722229
Epoch: 270
Loss on hold-out set: 0.001778148175952466
MeanAbsoluteError value on hold-out data: 0.031843576580286026
Epoch: 271
Loss on hold-out set: 0.003509988591663147
MeanAbsoluteError value on hold-out data: 0.05057934671640396
Epoch: 272
Loss on hold-out set: 0.0014985651451800215
MeanAbsoluteError value on hold-out data: 0.03004205785691738
Epoch: 273
Loss on hold-out set: 0.0012472056183277776
MeanAbsoluteError value on hold-out data: 0.026036012917757034
Epoch: 274

Loss on hold-out set: 0.00253990508836547
MeanAbsoluteError value on hold-out data: 0.040543243288993835
Epoch: 275
Loss on hold-out set: 0.0012339447842494241
MeanAbsoluteError value on hold-out data: 0.025403613224625587
Epoch: 276
Loss on hold-out set: 0.0034927795763666693
MeanAbsoluteError value on hold-out data: 0.04225819185376167
Epoch: 277

Loss on hold-out set: 0.0013458489066627073
MeanAbsoluteError value on hold-out data: 0.02899329550564289
Epoch: 278
```

```
Loss on hold-out set: 0.0016271482178892352
MeanAbsoluteError value on hold-out data: 0.03064260073006153
Epoch: 279
Loss on hold-out set: 0.0017369836415654343
MeanAbsoluteError value on hold-out data: 0.0315508097410202
Epoch: 280
Loss on hold-out set: 0.0012470361114920753
MeanAbsoluteError value on hold-out data: 0.025661449879407883
Epoch: 281
Loss on hold-out set: 0.004491854005640275
MeanAbsoluteError value on hold-out data: 0.057036735117435455
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Loss on hold-out set: 0.0044823699434729
MeanAbsoluteError value on hold-out data: 0.054651036858558655
Epoch: 283
Loss on hold-out set: 0.005508161241825866
MeanAbsoluteError value on hold-out data: 0.062048837542533875
Epoch: 284
Loss on hold-out set: 0.0011734845404709248
MeanAbsoluteError value on hold-out data: 0.025653330609202385
Epoch: 285
Loss on hold-out set: 0.002867063538073317
MeanAbsoluteError value on hold-out data: 0.04435981437563896
Epoch: 286
Loss on hold-out set: 0.0017638593853916973
MeanAbsoluteError value on hold-out data: 0.032703422009944916
Epoch: 287
Loss on hold-out set: 0.0025476712280100115
MeanAbsoluteError value on hold-out data: 0.03996428847312927
Epoch: 288
Loss on hold-out set: 0.0012016702523013872
MeanAbsoluteError value on hold-out data: 0.027157409116625786
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Loss on hold-out set: 0.0019478074483279336
MeanAbsoluteError value on hold-out data: 0.03552405536174774
Epoch: 290

Loss on hold-out set: 0.0015115962994873132
MeanAbsoluteError value on hold-out data: 0.029726266860961914
Epoch: 291
Loss on hold-out set: 0.004022222208349328
MeanAbsoluteError value on hold-out data: 0.05218224599957466
```

```
Epoch: 292
Loss on hold-out set: 0.0013183729330960073
MeanAbsoluteError value on hold-out data: 0.026586897671222687
Epoch: 293


Loss on hold-out set: 0.002733544728375579
MeanAbsoluteError value on hold-out data: 0.040970031172037125
Epoch: 294
Loss on hold-out set: 0.0028024777206347175
MeanAbsoluteError value on hold-out data: 0.04263380914926529
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Loss on hold-out set: 0.002909344957994395
MeanAbsoluteError value on hold-out data: 0.04023011773824692
Epoch: 296
Loss on hold-out set: 0.0027043791671626663
MeanAbsoluteError value on hold-out data: 0.04149119555950165
Epoch: 297
Loss on hold-out set: 0.0010320666448311194
MeanAbsoluteError value on hold-out data: 0.024058839306235313
Epoch: 298
Loss on hold-out set: 0.0013388840368287148
MeanAbsoluteError value on hold-out data: 0.025739695876836777
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Loss on hold-out set: 0.0014935425133444369
MeanAbsoluteError value on hold-out data: 0.030278921127319336
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Loss on hold-out set: 0.0012649364224144894
MeanAbsoluteError value on hold-out data: 0.027525361627340317
Epoch: 301
Loss on hold-out set: 0.001700475931437196
MeanAbsoluteError value on hold-out data: 0.029980871826410294
Epoch: 302
Loss on hold-out set: 0.0024720782009688648
MeanAbsoluteError value on hold-out data: 0.03963863104581833
Epoch: 303
Loss on hold-out set: 0.0030030149378274616
MeanAbsoluteError value on hold-out data: 0.04111657291650772
Epoch: 304
Loss on hold-out set: 0.0013003392071512185
MeanAbsoluteError value on hold-out data: 0.027999643236398697
Epoch: 305
Loss on hold-out set: 0.002286837436258793
```

```
MeanAbsoluteError value on hold-out data: 0.03752651810646057
Epoch: 306

Loss on hold-out set: 0.003958999179303646
MeanAbsoluteError value on hold-out data: 0.05010383203625679
Epoch: 307
Loss on hold-out set: 0.001354640698991716
MeanAbsoluteError value on hold-out data: 0.027283474802970886
Epoch: 308
Loss on hold-out set: 0.001233898948780016
MeanAbsoluteError value on hold-out data: 0.026486283168196678
Epoch: 309

Loss on hold-out set: 0.0014865274271486622
MeanAbsoluteError value on hold-out data: 0.027609802782535553
Epoch: 310
Loss on hold-out set: 0.0031371767338561384
MeanAbsoluteError value on hold-out data: 0.04449407383799553
Epoch: 311
Loss on hold-out set: 0.002012365319962172
MeanAbsoluteError value on hold-out data: 0.033654410392045975
Epoch: 312
Loss on hold-out set: 0.0016744576615134352
MeanAbsoluteError value on hold-out data: 0.029719006270170212
Epoch: 313
Loss on hold-out set: 0.006908283434122016
MeanAbsoluteError value on hold-out data: 0.06780914962291718
Epoch: 314
Loss on hold-out set: 0.0018442412777068583
MeanAbsoluteError value on hold-out data: 0.03161925449967384
Epoch: 315
Loss on hold-out set: 0.0016948292675232025
MeanAbsoluteError value on hold-out data: 0.030522724613547325
Epoch: 316
Loss on hold-out set: 0.0014254352074778197
MeanAbsoluteError value on hold-out data: 0.028005367144942284
Epoch: 317
Loss on hold-out set: 0.0023506939484688794
MeanAbsoluteError value on hold-out data: 0.039292190223932266
Epoch: 318
Loss on hold-out set: 0.0023797518500175917
MeanAbsoluteError value on hold-out data: 0.03632918745279312
```

```
Epoch: 319
Loss on hold-out set: 0.0034099656071415857
MeanAbsoluteError value on hold-out data: 0.044621001929044724
Epoch: 320
Loss on hold-out set: 0.001450102194212377
MeanAbsoluteError value on hold-out data: 0.027997445315122604
Epoch: 321
Loss on hold-out set: 0.001912110855827402
MeanAbsoluteError value on hold-out data: 0.0345819853246212
Epoch: 322

Loss on hold-out set: 0.005073658619566183
MeanAbsoluteError value on hold-out data: 0.05543430149555206
Epoch: 323
Loss on hold-out set: 0.004103546441336603
MeanAbsoluteError value on hold-out data: 0.04755551367998123
Epoch: 324
Loss on hold-out set: 0.005163338917650674
MeanAbsoluteError value on hold-out data: 0.05733993649482727
Epoch: 325

Loss on hold-out set: 0.0024169126378470345
MeanAbsoluteError value on hold-out data: 0.042320385575294495
Epoch: 326
Loss on hold-out set: 0.0011846268332048663
MeanAbsoluteError value on hold-out data: 0.025009483098983765
Epoch: 327
Loss on hold-out set: 0.005237293662503362
MeanAbsoluteError value on hold-out data: 0.062216632068157196
Epoch: 328
Loss on hold-out set: 0.0013626816737661628
MeanAbsoluteError value on hold-out data: 0.02757278084754944
Epoch: 329
Loss on hold-out set: 0.0010635411951960506
MeanAbsoluteError value on hold-out data: 0.02351778745651245
Epoch: 330
Loss on hold-out set: 0.0018959903115357616
MeanAbsoluteError value on hold-out data: 0.035333044826984406
Epoch: 331
Loss on hold-out set: 0.00501993803405448
MeanAbsoluteError value on hold-out data: 0.05690895766019821
Epoch: 332
```

```
Loss on hold-out set: 0.0025107993952635872
MeanAbsoluteError value on hold-out data: 0.039535850286483765
Early stopping at epoch 331
Returned to Spot: Validation loss: 0.0025107993952635872
----------------------------------------------

spotPython tuning: 0.0025107993952635872 [#---------] 11.52%


config: {'_L_in': 10, '_L_out': 1, 'l1': 256, 'dropout_prob': 0.1020832746662752, 'lr_mult':
Epoch: 1
Loss on hold-out set: 0.3002177429826636
MeanAbsoluteError value on hold-out data: 0.5307053327560425
Epoch: 2
Loss on hold-out set: 0.1634236903567063
MeanAbsoluteError value on hold-out data: 0.38703233003616333
Epoch: 3
Loss on hold-out set: 0.10156776599193874
MeanAbsoluteError value on hold-out data: 0.30288180708885193
Epoch: 4
Loss on hold-out set: 0.18950832595950678
MeanAbsoluteError value on hold-out data: 0.4262748956680298
Epoch: 5
Loss on hold-out set: 0.12766680003781067
MeanAbsoluteError value on hold-out data: 0.34745633602142334
Epoch: 6
Loss on hold-out set: 0.1356409137186251
MeanAbsoluteError value on hold-out data: 0.3590982258319855
Epoch: 7
Loss on hold-out set: 0.12961149294125407
MeanAbsoluteError value on hold-out data: 0.34929633140563965
Epoch: 8
Loss on hold-out set: 0.052421986664596354
MeanAbsoluteError value on hold-out data: 0.21509256958961487
Epoch: 9
Loss on hold-out set: 0.0783506627929838
MeanAbsoluteError value on hold-out data: 0.27000558376312256
Epoch: 10
Loss on hold-out set: 0.10313484778529719
MeanAbsoluteError value on hold-out data: 0.3069722354412079
Epoch: 11
Loss on hold-out set: 0.01334885728398436
```

```
MeanAbsoluteError value on hold-out data: 0.09697426110506058
Epoch: 12

Loss on hold-out set: 0.0038479892291912905
MeanAbsoluteError value on hold-out data: 0.048562996089458466
Epoch: 13
Loss on hold-out set: 0.054623598232865334
MeanAbsoluteError value on hold-out data: 0.21693700551986694
Epoch: 14
Loss on hold-out set: 0.04355450013750478
MeanAbsoluteError value on hold-out data: 0.1939861923456192
Epoch: 15
Loss on hold-out set: 0.050837581879214236
MeanAbsoluteError value on hold-out data: 0.20981483161449432
Epoch: 16
Loss on hold-out set: 0.0887770782175817
MeanAbsoluteError value on hold-out data: 0.2853243947029114
Epoch: 17
Loss on hold-out set: 0.003380876561430724
MeanAbsoluteError value on hold-out data: 0.044182244688272476
Epoch: 18
Loss on hold-out set: 0.05515591878640024
MeanAbsoluteError value on hold-out data: 0.21878255903720856
Epoch: 19
Loss on hold-out set: 0.01321122981607914
MeanAbsoluteError value on hold-out data: 0.10378165543079376
Epoch: 20
Loss on hold-out set: 0.032474246170175705
MeanAbsoluteError value on hold-out data: 0.16801291704177856
Epoch: 21
Loss on hold-out set: 0.01579084938490077
MeanAbsoluteError value on hold-out data: 0.11413298547267914
Epoch: 22
Loss on hold-out set: 0.0039719299070144955
MeanAbsoluteError value on hold-out data: 0.04945166036486626
Epoch: 23
Loss on hold-out set: 0.017458217463603144
MeanAbsoluteError value on hold-out data: 0.12022462487220764
Epoch: 24

Loss on hold-out set: 0.012387252584295837
MeanAbsoluteError value on hold-out data: 0.09792596101760864
```

```
Epoch: 25
Loss on hold-out set: 0.00276715543096591
MeanAbsoluteError value on hold-out data: 0.04247059300541878
Epoch: 26
Loss on hold-out set: 0.03472977298262872
MeanAbsoluteError value on hold-out data: 0.17003323137760162
Epoch: 27
Loss on hold-out set: 0.00993519543523067
MeanAbsoluteError value on hold-out data: 0.08867985010147095
Epoch: 28
Loss on hold-out set: 0.030415835545251246
MeanAbsoluteError value on hold-out data: 0.16525693237781525
Epoch: 29
Loss on hold-out set: 0.029258123648009803
MeanAbsoluteError value on hold-out data: 0.15881465375423431
Epoch: 30
Loss on hold-out set: 0.047148538459288444
MeanAbsoluteError value on hold-out data: 0.21153320372104645
Epoch: 31
Loss on hold-out set: 0.003595849137606197
MeanAbsoluteError value on hold-out data: 0.04363520070910454
Epoch: 32
Loss on hold-out set: 0.00180960700871717
MeanAbsoluteError value on hold-out data: 0.03267999738454819
Epoch: 33
Loss on hold-out set: 0.014730869057147126
MeanAbsoluteError value on hold-out data: 0.10724186897277832
Epoch: 34
Loss on hold-out set: 0.0018267104965879728
MeanAbsoluteError value on hold-out data: 0.03208867460489273
Epoch: 35
Loss on hold-out set: 0.008703945327158036
MeanAbsoluteError value on hold-out data: 0.080329529941082
Epoch: 36

Loss on hold-out set: 0.014867419622054226
MeanAbsoluteError value on hold-out data: 0.11228930205106735
Epoch: 37
Loss on hold-out set: 0.01873101519518777
MeanAbsoluteError value on hold-out data: 0.12988273799419403
Epoch: 38
Loss on hold-out set: 0.01425290637110409
```

```
MeanAbsoluteError value on hold-out data: 0.1078311949968338
Epoch: 39
Loss on hold-out set: 0.010225926721958737
MeanAbsoluteError value on hold-out data: 0.08645390719175339
Epoch: 40
Loss on hold-out set: 0.011839769314974546
MeanAbsoluteError value on hold-out data: 0.09523610025644302
Epoch: 41
Loss on hold-out set: 0.005228672960871144
MeanAbsoluteError value on hold-out data: 0.05475805327296257
Epoch: 42
Loss on hold-out set: 0.04296880313440373
MeanAbsoluteError value on hold-out data: 0.19477945566177368
Epoch: 43
Loss on hold-out set: 0.011317861683078502
MeanAbsoluteError value on hold-out data: 0.09391408413648605
Epoch: 44
Loss on hold-out set: 0.01745956910676078
MeanAbsoluteError value on hold-out data: 0.12100061774253845
Epoch: 45
Loss on hold-out set: 0.031606785070739295
MeanAbsoluteError value on hold-out data: 0.1618114858865738
Epoch: 46
Loss on hold-out set: 0.01306483382359147
MeanAbsoluteError value on hold-out data: 0.09357304126024246
Epoch: 47
Loss on hold-out set: 0.003638416406159338
MeanAbsoluteError value on hold-out data: 0.04326207935810089
Epoch: 48

Loss on hold-out set: 0.003929867684890173
MeanAbsoluteError value on hold-out data: 0.052402909845113754
Epoch: 49
Loss on hold-out set: 0.005767343455533448
MeanAbsoluteError value on hold-out data: 0.059893663972616196
Epoch: 50
Loss on hold-out set: 0.017280823158982554
MeanAbsoluteError value on hold-out data: 0.11994700133800507
Epoch: 51
Loss on hold-out set: 0.0031326160839709794
MeanAbsoluteError value on hold-out data: 0.04404158517718315
Epoch: 52
```

```
Loss on hold-out set: 0.002146048465204474
MeanAbsoluteError value on hold-out data: 0.0363253653049469
Epoch: 53
Loss on hold-out set: 0.010485463334541572
MeanAbsoluteError value on hold-out data: 0.09060508012771606
Epoch: 54
Loss on hold-out set: 0.011899575738138274
MeanAbsoluteError value on hold-out data: 0.08991851657629013
Epoch: 55
Loss on hold-out set: 0.007352404847839161
MeanAbsoluteError value on hold-out data: 0.06818775832653046
Epoch: 56
Loss on hold-out set: 0.013602679056164465
MeanAbsoluteError value on hold-out data: 0.10464026033878326
Epoch: 57
Loss on hold-out set: 0.006416108949404014
MeanAbsoluteError value on hold-out data: 0.06588191539049149
Epoch: 58
Loss on hold-out set: 0.018738368231999248
MeanAbsoluteError value on hold-out data: 0.119061179459095
Epoch: 59
Loss on hold-out set: 0.010929131610809188
MeanAbsoluteError value on hold-out data: 0.09017776697874069
Epoch: 60

Loss on hold-out set: 0.014526579823148878
MeanAbsoluteError value on hold-out data: 0.11262290924787521
Epoch: 61
Loss on hold-out set: 0.008535102254858143
MeanAbsoluteError value on hold-out data: 0.07945600897073746
Epoch: 62
Loss on hold-out set: 0.0020609661373064705
MeanAbsoluteError value on hold-out data: 0.03449257090687752
Epoch: 63
Loss on hold-out set: 0.012021489502666028
MeanAbsoluteError value on hold-out data: 0.08880991488695145
Epoch: 64
Loss on hold-out set: 0.005530851929889698
MeanAbsoluteError value on hold-out data: 0.06010906770825386
Epoch: 65
Loss on hold-out set: 0.023251790357263463
MeanAbsoluteError value on hold-out data: 0.13988611102104187
```

```
Epoch: 66
Loss on hold-out set: 0.010363379052202953
MeanAbsoluteError value on hold-out data: 0.08625080436468124
Epoch: 67
Loss on hold-out set: 0.00689694679979431
MeanAbsoluteError value on hold-out data: 0.07373442500829697
Epoch: 68
Loss on hold-out set: 0.014405539455382447
MeanAbsoluteError value on hold-out data: 0.09921692311763763
Epoch: 69
Loss on hold-out set: 0.005568775238077107
MeanAbsoluteError value on hold-out data: 0.0572550967335701
Epoch: 70
Loss on hold-out set: 0.003319443969399129
MeanAbsoluteError value on hold-out data: 0.0452830046415329
Epoch: 71
Loss on hold-out set: 0.0030601211566183913
MeanAbsoluteError value on hold-out data: 0.04008826985955238
Epoch: 72

Loss on hold-out set: 0.009487351304606387
MeanAbsoluteError value on hold-out data: 0.09065365046262741
Epoch: 73
Loss on hold-out set: 0.0021587512823507972
MeanAbsoluteError value on hold-out data: 0.03564586117863655
Epoch: 74
Loss on hold-out set: 0.005397591298740161
MeanAbsoluteError value on hold-out data: 0.061971262097358704
Epoch: 75
Loss on hold-out set: 0.015949372545276817
MeanAbsoluteError value on hold-out data: 0.11827342957258224
Epoch: 76
Loss on hold-out set: 0.007203891456715371
MeanAbsoluteError value on hold-out data: 0.06637145578861237
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Loss on hold-out set: 0.006237489918835069
MeanAbsoluteError value on hold-out data: 0.060167185962200165
Epoch: 78
Loss on hold-out set: 0.0029811629179963156
MeanAbsoluteError value on hold-out data: 0.04191168025135994
Epoch: 79
Loss on hold-out set: 0.004883092760696615
```

```
MeanAbsoluteError value on hold-out data: 0.05316147953271866
Epoch: 80
Loss on hold-out set: 0.01928972560716303
MeanAbsoluteError value on hold-out data: 0.12296602874994278
Epoch: 81
Loss on hold-out set: 0.007071487421758081
MeanAbsoluteError value on hold-out data: 0.06848468631505966
Epoch: 82
Loss on hold-out set: 0.007758786411661851
MeanAbsoluteError value on hold-out data: 0.07610391080379486
Epoch: 83
Loss on hold-out set: 0.014494731728183595
MeanAbsoluteError value on hold-out data: 0.10107529163360596
Epoch: 84

Loss on hold-out set: 0.007089745866036729
MeanAbsoluteError value on hold-out data: 0.06670837104320526
Epoch: 85
Loss on hold-out set: 0.00875416907824968
MeanAbsoluteError value on hold-out data: 0.08127328753471375
Epoch: 86
Loss on hold-out set: 0.0018149691566481795
MeanAbsoluteError value on hold-out data: 0.029235754162073135
Epoch: 87
Loss on hold-out set: 0.06694053584023525
MeanAbsoluteError value on hold-out data: 0.2463686317205429
Epoch: 88
Loss on hold-out set: 0.0015862907518902304
MeanAbsoluteError value on hold-out data: 0.026517100632190704
Epoch: 89
Loss on hold-out set: 0.005074245977754656
MeanAbsoluteError value on hold-out data: 0.05501433089375496
Epoch: 90
Loss on hold-out set: 0.010569710799149777
MeanAbsoluteError value on hold-out data: 0.08456767350435257
Epoch: 91
Loss on hold-out set: 0.00967943433083986
MeanAbsoluteError value on hold-out data: 0.08611159771680832
Epoch: 92
Loss on hold-out set: 0.0062353329389895264
MeanAbsoluteError value on hold-out data: 0.06155494600534439
Epoch: 93
```

```
Loss on hold-out set: 0.01359557590790485
MeanAbsoluteError value on hold-out data: 0.10165966302156448
Epoch: 94
Loss on hold-out set: 0.010215214992824354
MeanAbsoluteError value on hold-out data: 0.08183576911687851
Epoch: 95
Loss on hold-out set: 0.00483055923158597
MeanAbsoluteError value on hold-out data: 0.05534736067056656
Epoch: 96


Loss on hold-out set: 0.016139989718794823
MeanAbsoluteError value on hold-out data: 0.10824550688266754
Epoch: 97
Loss on hold-out set: 0.011024414120536102
MeanAbsoluteError value on hold-out data: 0.08782391250133514
Epoch: 98
Loss on hold-out set: 0.009938703800894712
MeanAbsoluteError value on hold-out data: 0.0885133147239685
Epoch: 99
Loss on hold-out set: 0.003686777524355995
MeanAbsoluteError value on hold-out data: 0.050217218697071075
Epoch: 100
Loss on hold-out set: 0.004265830349667292
MeanAbsoluteError value on hold-out data: 0.047273602336645126
Epoch: 101
Loss on hold-out set: 0.004859434165011503
MeanAbsoluteError value on hold-out data: 0.054649434983730316
Epoch: 102
Loss on hold-out set: 0.0037332634000401747
MeanAbsoluteError value on hold-out data: 0.0462777204811573
Epoch: 103
Loss on hold-out set: 0.002942333635138838
MeanAbsoluteError value on hold-out data: 0.042108677327632904
Epoch: 104
Loss on hold-out set: 0.0016074791048212272
MeanAbsoluteError value on hold-out data: 0.02757539041340351
Epoch: 105
Loss on hold-out set: 0.015947075315604086
MeanAbsoluteError value on hold-out data: 0.1110679879784584
Epoch: 106
Loss on hold-out set: 0.0022488779198427344
MeanAbsoluteError value on hold-out data: 0.033866092562675476
```

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Epoch: 107
Loss on hold-out set: 0.007026828788711052
MeanAbsoluteError value on hold-out data: 0.06288465857505798
Epoch: 108

Loss on hold-out set: 0.001984190590998256
MeanAbsoluteError value on hold-out data: 0.032430779188871384
Epoch: 109
Loss on hold-out set: 0.0030577314502902722
MeanAbsoluteError value on hold-out data: 0.04531450942158699
Epoch: 110
Loss on hold-out set: 0.008189163538382241
MeanAbsoluteError value on hold-out data: 0.07094509899616241
Epoch: 111
Loss on hold-out set: 0.01977751962840557
MeanAbsoluteError value on hold-out data: 0.12284858524799347
Epoch: 112
Loss on hold-out set: 0.007549052200231113
MeanAbsoluteError value on hold-out data: 0.06918471306562424
Epoch: 113
Loss on hold-out set: 0.0037212541302371967
MeanAbsoluteError value on hold-out data: 0.04895804822444916
Epoch: 114
Loss on hold-out set: 0.006952248219596713
MeanAbsoluteError value on hold-out data: 0.07123502343893051
Epoch: 115
Loss on hold-out set: 0.0018721332001548849
MeanAbsoluteError value on hold-out data: 0.03068876639008522
Epoch: 116
Loss on hold-out set: 0.02740895601087495
MeanAbsoluteError value on hold-out data: 0.14886069297790527
Epoch: 117
Loss on hold-out set: 0.004652021863301725
MeanAbsoluteError value on hold-out data: 0.048838354647159576
Epoch: 118
Loss on hold-out set: 0.0058133564889431
MeanAbsoluteError value on hold-out data: 0.06699391454458237
Epoch: 119
Loss on hold-out set: 0.004428756680633677
MeanAbsoluteError value on hold-out data: 0.05181560665369034
Epoch: 120

Loss on hold-out set: 0.004645914807425518
```

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MeanAbsoluteError value on hold-out data: 0.055175572633743286
Epoch: 121
Loss on hold-out set: 0.004829657340642849
MeanAbsoluteError value on hold-out data: 0.051701657474040985
Epoch: 122
Loss on hold-out set: 0.004254515386970812
MeanAbsoluteError value on hold-out data: 0.05179193615913391
Epoch: 123
Loss on hold-out set: 0.007930248988008029
MeanAbsoluteError value on hold-out data: 0.06929769366979599
Epoch: 124
Loss on hold-out set: 0.01777212003147916
MeanAbsoluteError value on hold-out data: 0.10991910099983215
Epoch: 125
Loss on hold-out set: 0.00865594917712243
MeanAbsoluteError value on hold-out data: 0.07562517374753952
Epoch: 126
Loss on hold-out set: 0.0040918104258660035
MeanAbsoluteError value on hold-out data: 0.04916304722428322
Epoch: 127
Loss on hold-out set: 0.0047123390617535305
MeanAbsoluteError value on hold-out data: 0.053313981741666794
Epoch: 128
Loss on hold-out set: 0.02389699068704718
MeanAbsoluteError value on hold-out data: 0.12573030591011047
Epoch: 129
Loss on hold-out set: 0.0062190504671123465
MeanAbsoluteError value on hold-out data: 0.06310766190290451
Epoch: 130
Loss on hold-out set: 0.0025489582361555413
MeanAbsoluteError value on hold-out data: 0.03687738627195358
Epoch: 131
Loss on hold-out set: 0.0026816684342185525
MeanAbsoluteError value on hold-out data: 0.039442192763090134
Epoch: 132

Loss on hold-out set: 0.002527151112812326
MeanAbsoluteError value on hold-out data: 0.033712416887283325
Epoch: 133
Loss on hold-out set: 0.008353375388603462
MeanAbsoluteError value on hold-out data: 0.07148003578186035
Epoch: 134
```

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Loss on hold-out set: 0.005013484642595837
MeanAbsoluteError value on hold-out data: 0.05541340634226799
Epoch: 135
Loss on hold-out set: 0.025523311360494086
MeanAbsoluteError value on hold-out data: 0.1356276124715805
Epoch: 136
Loss on hold-out set: 0.009438044685674342
MeanAbsoluteError value on hold-out data: 0.0862828865647316
Epoch: 137
Loss on hold-out set: 0.0014004495858803
MeanAbsoluteError value on hold-out data: 0.024237386882305145
Epoch: 138
Loss on hold-out set: 0.011756283157554111
MeanAbsoluteError value on hold-out data: 0.09950168430805206
Epoch: 139
Loss on hold-out set: 0.008534802981701336
MeanAbsoluteError value on hold-out data: 0.0793745145201683
Epoch: 140
Loss on hold-out set: 0.0060467105113754145
MeanAbsoluteError value on hold-out data: 0.07293044775724411
Epoch: 141
Loss on hold-out set: 0.007483140479675249
MeanAbsoluteError value on hold-out data: 0.06785883754491806
Epoch: 142
Loss on hold-out set: 0.016353227908870106
MeanAbsoluteError value on hold-out data: 0.10559024661779404
Epoch: 143
Loss on hold-out set: 0.002649476218625511
MeanAbsoluteError value on hold-out data: 0.04233938828110695
Epoch: 144

Loss on hold-out set: 0.009205488757671495
MeanAbsoluteError value on hold-out data: 0.07663287967443466
Epoch: 145
Loss on hold-out set: 0.012160074210872776
MeanAbsoluteError value on hold-out data: 0.08917742222547531
Epoch: 146
Loss on hold-out set: 0.0015349873283412308
MeanAbsoluteError value on hold-out data: 0.025226620957255363
Epoch: 147
Loss on hold-out set: 0.012395695832214858
MeanAbsoluteError value on hold-out data: 0.09022469818592072
```

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Epoch: 148
Loss on hold-out set: 0.009624039337627198
MeanAbsoluteError value on hold-out data: 0.08690763264894485
Epoch: 149
Loss on hold-out set: 0.002895873340189849
MeanAbsoluteError value on hold-out data: 0.0421425886452198
Epoch: 150
Loss on hold-out set: 0.0027554646857376945
MeanAbsoluteError value on hold-out data: 0.04106508940458298
Epoch: 151
Loss on hold-out set: 0.0017336429752360441
MeanAbsoluteError value on hold-out data: 0.030605459585785866
Epoch: 152
Loss on hold-out set: 0.01859181354704656
MeanAbsoluteError value on hold-out data: 0.10882844030857086
Epoch: 153
Loss on hold-out set: 0.008663586659454986
MeanAbsoluteError value on hold-out data: 0.07639673352241516
Epoch: 154
Loss on hold-out set: 0.0015221143916469852
MeanAbsoluteError value on hold-out data: 0.024431690573692322
Epoch: 155
Loss on hold-out set: 0.006045710565032144
MeanAbsoluteError value on hold-out data: 0.06340119987726212
Epoch: 156

Loss on hold-out set: 0.0020543839231035427
MeanAbsoluteError value on hold-out data: 0.035542625933885574
Epoch: 157
Loss on hold-out set: 0.005402528055894531
MeanAbsoluteError value on hold-out data: 0.0591522678732872
Epoch: 158
Loss on hold-out set: 0.0035214310720268834
MeanAbsoluteError value on hold-out data: 0.045205458998680115
Epoch: 159
Loss on hold-out set: 0.004146039063159965
MeanAbsoluteError value on hold-out data: 0.05028948560357094
Epoch: 160
Loss on hold-out set: 0.0020638863084298607
MeanAbsoluteError value on hold-out data: 0.027401437982916832
Epoch: 161
Loss on hold-out set: 0.005313879699985448
```

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MeanAbsoluteError value on hold-out data: 0.06315996497869492
Epoch: 162
Loss on hold-out set: 0.01979286172182152
MeanAbsoluteError value on hold-out data: 0.11989019066095352
Epoch: 163
Loss on hold-out set: 0.004118245830269237
MeanAbsoluteError value on hold-out data: 0.04762891307473183
Epoch: 164
Loss on hold-out set: 0.004693853668868542
MeanAbsoluteError value on hold-out data: 0.055205173790454865
Epoch: 165
Loss on hold-out set: 0.0052476817938058
MeanAbsoluteError value on hold-out data: 0.05756305158138275
Epoch: 166
Loss on hold-out set: 0.007064682982960029
MeanAbsoluteError value on hold-out data: 0.06805075705051422
Epoch: 167
Loss on hold-out set: 0.014178822258193242
MeanAbsoluteError value on hold-out data: 0.1003335639834404
Epoch: 168

Loss on hold-out set: 0.0025779957895314225
MeanAbsoluteError value on hold-out data: 0.040051184594631195
Epoch: 169
Loss on hold-out set: 0.011797839628630563
MeanAbsoluteError value on hold-out data: 0.08488088101148605
Epoch: 170
Loss on hold-out set: 0.007497260690127548
MeanAbsoluteError value on hold-out data: 0.07794319838285446
Epoch: 171
Loss on hold-out set: 0.0036930772169542158
MeanAbsoluteError value on hold-out data: 0.048111122101545334
Epoch: 172
Loss on hold-out set: 0.0021351993047191123
MeanAbsoluteError value on hold-out data: 0.03532236069440842
Epoch: 173
Loss on hold-out set: 0.008902976362916985
MeanAbsoluteError value on hold-out data: 0.07536624372005463
Epoch: 174
Loss on hold-out set: 0.0076633418518069546
MeanAbsoluteError value on hold-out data: 0.06946510076522827
Epoch: 175
```

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Loss on hold-out set: 0.005317402476640909
MeanAbsoluteError value on hold-out data: 0.05553535372018814
Epoch: 176
Loss on hold-out set: 0.0032764416751696877
MeanAbsoluteError value on hold-out data: 0.043261997401714325
Epoch: 177
Loss on hold-out set: 0.023078615434075658
MeanAbsoluteError value on hold-out data: 0.12442932277917862
Epoch: 178
Loss on hold-out set: 0.008627492346261678
MeanAbsoluteError value on hold-out data: 0.07643701136112213
Epoch: 179
Loss on hold-out set: 0.0009318859098895796
MeanAbsoluteError value on hold-out data: 0.02002151869237423
Epoch: 180


Loss on hold-out set: 0.0036223584871837183
MeanAbsoluteError value on hold-out data: 0.049629487097263336
Epoch: 181
Loss on hold-out set: 0.013713025536976363
MeanAbsoluteError value on hold-out data: 0.09362886101007462
Epoch: 182
Loss on hold-out set: 0.0054913217348879885
MeanAbsoluteError value on hold-out data: 0.05876707658171654
Epoch: 183
Loss on hold-out set: 0.0016930826670049054
MeanAbsoluteError value on hold-out data: 0.03093669004738331
Epoch: 184
Loss on hold-out set: 0.03109360638221628
MeanAbsoluteError value on hold-out data: 0.1448163092136383
Epoch: 185
Loss on hold-out set: 0.005035696067161074
MeanAbsoluteError value on hold-out data: 0.053094081580638885
Epoch: 186
Loss on hold-out set: 0.010803556657935443
MeanAbsoluteError value on hold-out data: 0.08297237753868103
Epoch: 187
Loss on hold-out set: 0.007577483860873862
MeanAbsoluteError value on hold-out data: 0.06794735789299011
Epoch: 188
Loss on hold-out set: 0.004264012138408266
MeanAbsoluteError value on hold-out data: 0.045357596129179
```

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Epoch: 189
Loss on hold-out set: 0.03902880053379034
MeanAbsoluteError value on hold-out data: 0.18020451068878174
Epoch: 190
Loss on hold-out set: 0.005304163554683328
MeanAbsoluteError value on hold-out data: 0.05596167966723442
Epoch: 191
Loss on hold-out set: 0.0020273268945809257
MeanAbsoluteError value on hold-out data: 0.030253702774643898
Epoch: 192

Loss on hold-out set: 0.0034562001544001853
MeanAbsoluteError value on hold-out data: 0.04702813923358917
Epoch: 193
Loss on hold-out set: 0.011600196263507792
MeanAbsoluteError value on hold-out data: 0.08653418719768524
Epoch: 194
Loss on hold-out set: 0.0017583200518090866
MeanAbsoluteError value on hold-out data: 0.03408493846654892
Epoch: 195
Loss on hold-out set: 0.008278953940852693
MeanAbsoluteError value on hold-out data: 0.07705491781234741
Epoch: 196
Loss on hold-out set: 0.01075027059567602
MeanAbsoluteError value on hold-out data: 0.08407194167375565
Epoch: 197
Loss on hold-out set: 0.01507320284451309
MeanAbsoluteError value on hold-out data: 0.09559282660484314
Epoch: 198
Loss on hold-out set: 0.012043747438215896
MeanAbsoluteError value on hold-out data: 0.08788425475358963
Epoch: 199
Loss on hold-out set: 0.0063765827860487135
MeanAbsoluteError value on hold-out data: 0.06740277260541916
Epoch: 200
Loss on hold-out set: 0.012787857877188608
MeanAbsoluteError value on hold-out data: 0.09025073796510696
Epoch: 201
Loss on hold-out set: 0.001701507567256493
MeanAbsoluteError value on hold-out data: 0.027892669662833214
Epoch: 202
Loss on hold-out set: 0.0015575096905721647
```

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MeanAbsoluteError value on hold-out data: 0.032491330057382584
Epoch: 203
Loss on hold-out set: 0.028479048492092835
MeanAbsoluteError value on hold-out data: 0.14467816054821014
Epoch: 204

Loss on hold-out set: 0.004568210864243538
MeanAbsoluteError value on hold-out data: 0.05146803334355354
Epoch: 205
Loss on hold-out set: 0.0073762195871064536
MeanAbsoluteError value on hold-out data: 0.0670526921749115
Epoch: 206
Loss on hold-out set: 0.0026803241007177063
MeanAbsoluteError value on hold-out data: 0.03917587921023369
Epoch: 207
Loss on hold-out set: 0.001316265866319698
MeanAbsoluteError value on hold-out data: 0.02497776597738266
Epoch: 208
Loss on hold-out set: 0.008477710432520038
MeanAbsoluteError value on hold-out data: 0.07778560370206833
Epoch: 209
Loss on hold-out set: 0.009260949237566245
MeanAbsoluteError value on hold-out data: 0.07777927815914154
Epoch: 210
Loss on hold-out set: 0.002496843520355852
MeanAbsoluteError value on hold-out data: 0.03677330166101456
Epoch: 211
Loss on hold-out set: 0.0047590974840874736
MeanAbsoluteError value on hold-out data: 0.052713535726070404
Epoch: 212
Loss on hold-out set: 0.009744609706103802
MeanAbsoluteError value on hold-out data: 0.0786350816488266
Epoch: 213
Loss on hold-out set: 0.0015130427874330628
MeanAbsoluteError value on hold-out data: 0.02465406432747841
Epoch: 214
Loss on hold-out set: 0.008683717466498675
MeanAbsoluteError value on hold-out data: 0.07540634274482727
Epoch: 215
Loss on hold-out set: 0.024439315605712563
MeanAbsoluteError value on hold-out data: 0.13026900589466095
Epoch: 216
```

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Loss on hold-out set: 0.00650208515703286
MeanAbsoluteError value on hold-out data: 0.06362198293209076
Epoch: 217
Loss on hold-out set: 0.0011599033329586842
MeanAbsoluteError value on hold-out data: 0.024230612441897392
Epoch: 218
Loss on hold-out set: 0.001918984552551257
MeanAbsoluteError value on hold-out data: 0.03438204154372215
Epoch: 219
Loss on hold-out set: 0.014019487229617019
MeanAbsoluteError value on hold-out data: 0.10218474268913269
Epoch: 220
Loss on hold-out set: 0.0034329272671847753
MeanAbsoluteError value on hold-out data: 0.04616818577051163
Epoch: 221
Loss on hold-out set: 0.02611816297040174
MeanAbsoluteError value on hold-out data: 0.12692537903785706
Epoch: 222
Loss on hold-out set: 0.0077245401120499956
MeanAbsoluteError value on hold-out data: 0.07264374941587448
Epoch: 223
Loss on hold-out set: 0.00596913525001391
MeanAbsoluteError value on hold-out data: 0.06183044612407684
Epoch: 224
Loss on hold-out set: 0.00952963148684878
MeanAbsoluteError value on hold-out data: 0.07930164039134979
Epoch: 225
Loss on hold-out set: 0.0048966827299993604
MeanAbsoluteError value on hold-out data: 0.056369055062532425
Epoch: 226
Loss on hold-out set: 0.02785054319783261
MeanAbsoluteError value on hold-out data: 0.14986726641654968
Epoch: 227
Loss on hold-out set: 0.0078671829358333147
MeanAbsoluteError value on hold-out data: 0.06641843914985657
Epoch: 228

Loss on hold-out set: 0.004408481892345375
MeanAbsoluteError value on hold-out data: 0.049483880400657654
Epoch: 229
Loss on hold-out set: 0.014613300316820019
MeanAbsoluteError value on hold-out data: 0.10688294470310211
```

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Epoch: 230
Loss on hold-out set: 0.016833232862776833
MeanAbsoluteError value on hold-out data: 0.1233583465218544
Epoch: 231
Loss on hold-out set: 0.009075369698142535
MeanAbsoluteError value on hold-out data: 0.07358473539352417
Epoch: 232
Loss on hold-out set: 0.004133357709322713
MeanAbsoluteError value on hold-out data: 0.049354102462530136
Epoch: 233
Loss on hold-out set: 0.002529885558607547
MeanAbsoluteError value on hold-out data: 0.04142481088638306
Epoch: 234
Loss on hold-out set: 0.005083574594831781
MeanAbsoluteError value on hold-out data: 0.06437687575817108
Epoch: 235
Loss on hold-out set: 0.017752577011522493
MeanAbsoluteError value on hold-out data: 0.11666250973939896
Epoch: 236
Loss on hold-out set: 0.003114159035153295
MeanAbsoluteError value on hold-out data: 0.04341129586100578
Epoch: 237
Loss on hold-out set: 0.00709881610237062
MeanAbsoluteError value on hold-out data: 0.0650813952088356
Epoch: 238
Loss on hold-out set: 0.0063363249462686086
MeanAbsoluteError value on hold-out data: 0.06204693019390106
Epoch: 239
Loss on hold-out set: 0.002211748554959501
MeanAbsoluteError value on hold-out data: 0.03684571385383606
Epoch: 240

Loss on hold-out set: 0.006468413740788635
MeanAbsoluteError value on hold-out data: 0.061386141926050186
Epoch: 241
Loss on hold-out set: 0.0024403542843892388
MeanAbsoluteError value on hold-out data: 0.03625621646642685
Epoch: 242
Loss on hold-out set: 0.008708105679895533
MeanAbsoluteError value on hold-out data: 0.0759965255856514
Epoch: 243
Loss on hold-out set: 0.011525075417011976
```

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MeanAbsoluteError value on hold-out data: 0.08530980348587036
Epoch: 244
Loss on hold-out set: 0.0044330021145900615
MeanAbsoluteError value on hold-out data: 0.051236338913440704
Epoch: 245
Loss on hold-out set: 0.002158057272409726
MeanAbsoluteError value on hold-out data: 0.03173772245645523
Epoch: 246
Loss on hold-out set: 0.004653122312830467
MeanAbsoluteError value on hold-out data: 0.05551418289542198
Epoch: 247
Loss on hold-out set: 0.0039678767544070355
MeanAbsoluteError value on hold-out data: 0.051768627017736435
Epoch: 248
Loss on hold-out set: 0.012143432211719062
MeanAbsoluteError value on hold-out data: 0.08608318120241165
Epoch: 249
Loss on hold-out set: 0.02671545292986067
MeanAbsoluteError value on hold-out data: 0.15207025408744812
Epoch: 250
Loss on hold-out set: 0.006026326151760786
MeanAbsoluteError value on hold-out data: 0.0596952885389328
Epoch: 251
Loss on hold-out set: 0.0014299238743995758
MeanAbsoluteError value on hold-out data: 0.027468986809253693
Epoch: 252

Loss on hold-out set: 0.018185041550742954
MeanAbsoluteError value on hold-out data: 0.10734793543815613
Epoch: 253
Loss on hold-out set: 0.010103187376731321
MeanAbsoluteError value on hold-out data: 0.08201126754283905
Epoch: 254
Loss on hold-out set: 0.007918287460741243
MeanAbsoluteError value on hold-out data: 0.07500435411930084
Epoch: 255
Loss on hold-out set: 0.0025386657002136894
MeanAbsoluteError value on hold-out data: 0.0383034311234951
Epoch: 256
Loss on hold-out set: 0.005547640416281004
MeanAbsoluteError value on hold-out data: 0.06064456328749657
Epoch: 257
```

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Loss on hold-out set: 0.013086708262562752
MeanAbsoluteError value on hold-out data: 0.08886433392763138
Epoch: 258
Loss on hold-out set: 0.006587877612266885
MeanAbsoluteError value on hold-out data: 0.06282990425825119
Epoch: 259
Loss on hold-out set: 0.006163873317602433
MeanAbsoluteError value on hold-out data: 0.06805868446826935
Epoch: 260
Loss on hold-out set: 0.015196217812205615
MeanAbsoluteError value on hold-out data: 0.09751147776842117
Epoch: 261
Loss on hold-out set: 0.0023562076323861746
MeanAbsoluteError value on hold-out data: 0.03707648441195488
Epoch: 262
Loss on hold-out set: 0.001861104891807037
MeanAbsoluteError value on hold-out data: 0.033845629543066025
Epoch: 263
Loss on hold-out set: 0.010665835126450187
MeanAbsoluteError value on hold-out data: 0.08675090968608856
Epoch: 264

Loss on hold-out set: 0.009255151558471354
MeanAbsoluteError value on hold-out data: 0.07750383764505386
Epoch: 265
Loss on hold-out set: 0.0011814334108126595
MeanAbsoluteError value on hold-out data: 0.025091715157032013
Epoch: 266
Loss on hold-out set: 0.014885687220253442
MeanAbsoluteError value on hold-out data: 0.11270859092473984
Epoch: 267
Loss on hold-out set: 0.005953608387100853
MeanAbsoluteError value on hold-out data: 0.06120802462100983
Epoch: 268
Loss on hold-out set: 0.004796854906568402
MeanAbsoluteError value on hold-out data: 0.05568653717637062
Epoch: 269
Loss on hold-out set: 0.008153180389567033
MeanAbsoluteError value on hold-out data: 0.07211752980947495
Epoch: 270
Loss on hold-out set: 0.012207973086716313
MeanAbsoluteError value on hold-out data: 0.09700331091880798
```

```
Epoch: 271
Loss on hold-out set: 0.002734593896955056
MeanAbsoluteError value on hold-out data: 0.03919222205877304
Epoch: 272
Loss on hold-out set: 0.008196044431411122
MeanAbsoluteError value on hold-out data: 0.07310159504413605
Epoch: 273
Loss on hold-out set: 0.017184354855041755
MeanAbsoluteError value on hold-out data: 0.10647450387477875
Epoch: 274
Loss on hold-out set: 0.009079144532351117
MeanAbsoluteError value on hold-out data: 0.07632393389940262
Epoch: 275
Loss on hold-out set: 0.003353252100121034
MeanAbsoluteError value on hold-out data: 0.04755551367998123
Epoch: 276
```

```
Loss on hold-out set: 0.005065077205041521
MeanAbsoluteError value on hold-out data: 0.057462017983198166
Epoch: 277
Loss on hold-out set: 0.003684623056630555
MeanAbsoluteError value on hold-out data: 0.046189676970243454
Epoch: 278
Loss on hold-out set: 0.005181419859199147
MeanAbsoluteError value on hold-out data: 0.05506720766425133
Epoch: 279
Loss on hold-out set: 0.0032192891414620376
MeanAbsoluteError value on hold-out data: 0.04428058862686157
Epoch: 280
Loss on hold-out set: 0.016857594349666646
MeanAbsoluteError value on hold-out data: 0.09890463203191757
Epoch: 281
Loss on hold-out set: 0.028474588682384866
MeanAbsoluteError value on hold-out data: 0.14198516309261322
Epoch: 282
Loss on hold-out set: 0.004589666538920842
MeanAbsoluteError value on hold-out data: 0.050542112439870834
Epoch: 283
Loss on hold-out set: 0.008732183248196778
MeanAbsoluteError value on hold-out data: 0.07933732867240906
Epoch: 284
Loss on hold-out set: 0.003206256868954944
```

```
MeanAbsoluteError value on hold-out data: 0.045315954834222794
Epoch: 285
Loss on hold-out set: 0.0061539063279173875
MeanAbsoluteError value on hold-out data: 0.057127825915813446
Epoch: 286
Loss on hold-out set: 0.0037666456528792254
MeanAbsoluteError value on hold-out data: 0.05147695168852806
Epoch: 287
Loss on hold-out set: 0.0023972080885677747
MeanAbsoluteError value on hold-out data: 0.039474278688430786
Epoch: 288

Loss on hold-out set: 0.0315179889531512
MeanAbsoluteError value on hold-out data: 0.155735582113266
Epoch: 289
Loss on hold-out set: 0.007443483759600081
MeanAbsoluteError value on hold-out data: 0.07507573813199997
Epoch: 290
Loss on hold-out set: 0.010617390716154324
MeanAbsoluteError value on hold-out data: 0.08191759884357452
Epoch: 291
Loss on hold-out set: 0.006112612563332445
MeanAbsoluteError value on hold-out data: 0.06305281072854996
Epoch: 292
Loss on hold-out set: 0.009514695597126296
MeanAbsoluteError value on hold-out data: 0.08020910620689392
Epoch: 293
Loss on hold-out set: 0.006282626259091653
MeanAbsoluteError value on hold-out data: 0.07138509303331375
Epoch: 294
Loss on hold-out set: 0.008357893430480831
MeanAbsoluteError value on hold-out data: 0.07238024473190308
Epoch: 295
Loss on hold-out set: 0.001456153261977689
MeanAbsoluteError value on hold-out data: 0.02838488668203354
Epoch: 296
Loss on hold-out set: 0.015753045457562332
MeanAbsoluteError value on hold-out data: 0.09105347841978073
Epoch: 297
Loss on hold-out set: 0.003912089055551118
MeanAbsoluteError value on hold-out data: 0.051720280200242996
Epoch: 298
```

```
Loss on hold-out set: 0.0029849961681879663
MeanAbsoluteError value on hold-out data: 0.042208123952150345
Epoch: 299
Loss on hold-out set: 0.014061214549368933
MeanAbsoluteError value on hold-out data: 0.09629910439252853
Epoch: 300

Loss on hold-out set: 0.01426833936650502
MeanAbsoluteError value on hold-out data: 0.10878083854913712
Epoch: 301
Loss on hold-out set: 0.0032304584747180343
MeanAbsoluteError value on hold-out data: 0.04565182328224182
Epoch: 302
Loss on hold-out set: 0.009322510566562414
MeanAbsoluteError value on hold-out data: 0.07755355536937714
Epoch: 303
Loss on hold-out set: 0.023626059734899747
MeanAbsoluteError value on hold-out data: 0.13959932327270508
Epoch: 304
Loss on hold-out set: 0.008943640847543352
MeanAbsoluteError value on hold-out data: 0.0801270455121994
Epoch: 305
Loss on hold-out set: 0.004939334822426501
MeanAbsoluteError value on hold-out data: 0.05665655806660652
Epoch: 306
Loss on hold-out set: 0.014834257921105936
MeanAbsoluteError value on hold-out data: 0.09802187234163284
Epoch: 307
Loss on hold-out set: 0.0014826075823389385
MeanAbsoluteError value on hold-out data: 0.028576279059052467
Early stopping at epoch 306
Returned to Spot: Validation loss: 0.0014826075823389385
----------------------------------------------

spotPython tuning: 0.0014826075823389385 [##--------] 22.04%

config: {'_L_in': 10, '_L_out': 1, 'l1': 16, 'dropout_prob': 0.0006886408655716325, 'lr_mult

Epoch: 1
```

```
Loss on hold-out set: 0.04827233149032844
MeanAbsoluteError value on hold-out data: 0.18129532039165497
Epoch: 2
Loss on hold-out set: 0.06491918783438833
MeanAbsoluteError value on hold-out data: 0.22349955141544342
Epoch: 3
Loss on hold-out set: 0.06361240246578266
MeanAbsoluteError value on hold-out data: 0.22454024851322174
Epoch: 4
Loss on hold-out set: 0.06754268705844879
MeanAbsoluteError value on hold-out data: 0.23550473153591156
Epoch: 5
Loss on hold-out set: 0.067047027184775
MeanAbsoluteError value on hold-out data: 0.23716232180595398
Epoch: 6
Loss on hold-out set: 0.066375364598475
MeanAbsoluteError value on hold-out data: 0.23743009567260742
Epoch: 7
Loss on hold-out set: 0.06436441446605481
MeanAbsoluteError value on hold-out data: 0.2346949279308319
Epoch: 8
Loss on hold-out set: 0.06169148769817854
MeanAbsoluteError value on hold-out data: 0.23058876395225525
Epoch: 9
Loss on hold-out set: 0.054914831723037516
MeanAbsoluteError value on hold-out data: 0.21781986951828003
Early stopping at epoch 8
Returned to Spot: Validation loss: 0.054914831723037516
----------------------------------------------

spotPython tuning: 0.0014826075823389385 [##--------] 23.32%


config: {'_L_in': 10, '_L_out': 1, 'l1': 256, 'dropout_prob': 0.5533526864143683, 'lr_mult':
Epoch: 1
Loss on hold-out set: 0.08291900471637123
MeanAbsoluteError value on hold-out data: 0.23449058830738068
Epoch: 2
Loss on hold-out set: 0.04795814246723527
MeanAbsoluteError value on hold-out data: 0.17809009552001953
Epoch: 3
Loss on hold-out set: 0.028582732095138022
```

```
MeanAbsoluteError value on hold-out data: 0.13543738424777985
Epoch: 4
Loss on hold-out set: 0.021005682206075443
MeanAbsoluteError value on hold-out data: 0.11537539213895798
Epoch: 5
Loss on hold-out set: 0.06292736883226194
MeanAbsoluteError value on hold-out data: 0.21840520203113556
Epoch: 6
Loss on hold-out set: 0.025113173466371864
MeanAbsoluteError value on hold-out data: 0.12715619802474976
Epoch: 7
Loss on hold-out set: 0.08961919420643856
MeanAbsoluteError value on hold-out data: 0.2690180242061615
Epoch: 8
Loss on hold-out set: 0.02567587993842991
MeanAbsoluteError value on hold-out data: 0.12923564016819
Epoch: 9
Loss on hold-out set: 0.021472077424588957
MeanAbsoluteError value on hold-out data: 0.11544425040483475
Epoch: 10
Loss on hold-out set: 0.02368322808883692
MeanAbsoluteError value on hold-out data: 0.12487803399562836
Epoch: 11
Loss on hold-out set: 0.05148804658337643
MeanAbsoluteError value on hold-out data: 0.199859157204628

Epoch: 12
Loss on hold-out set: 0.022703679915713638
MeanAbsoluteError value on hold-out data: 0.12420501559972763
Early stopping at epoch 11
Returned to Spot: Validation loss: 0.022703679915713638
----------------------------------------------

spotPython tuning: 0.0014826075823389385 [###-------] 25.69%


config: {'_L_in': 10, '_L_out': 1, 'l1': 64, 'dropout_prob': 0.004336414778486056, 'lr_mult'
Epoch: 1
Loss on hold-out set: 0.017939005537252677
MeanAbsoluteError value on hold-out data: 0.10670991241931915
Epoch: 2
Loss on hold-out set: 0.016772364462284667
```

```
MeanAbsoluteError value on hold-out data: 0.10368815064430237
Epoch: 3
Loss on hold-out set: 0.015088533835583612
MeanAbsoluteError value on hold-out data: 0.09913424402475357
Epoch: 4
Loss on hold-out set: 0.013623982643414485
MeanAbsoluteError value on hold-out data: 0.09409154206514359
Epoch: 5
Loss on hold-out set: 0.013621085249867878
MeanAbsoluteError value on hold-out data: 0.09298218041658401
Epoch: 6
Loss on hold-out set: 0.011857655757155857
MeanAbsoluteError value on hold-out data: 0.08719106763601303
Epoch: 7
Loss on hold-out set: 0.01117376265067019
MeanAbsoluteError value on hold-out data: 0.08419278264045715
Epoch: 8
Loss on hold-out set: 0.010251639999057116
MeanAbsoluteError value on hold-out data: 0.0807049423456192
Epoch: 9
Loss on hold-out set: 0.008925335040610088
MeanAbsoluteError value on hold-out data: 0.07590535283088684
Epoch: 10
Loss on hold-out set: 0.00884512549658355
MeanAbsoluteError value on hold-out data: 0.07513673603534698
Epoch: 11
Loss on hold-out set: 0.008080552699730584
MeanAbsoluteError value on hold-out data: 0.07108880579471588
Epoch: 12
Loss on hold-out set: 0.006454704807286984
MeanAbsoluteError value on hold-out data: 0.06381022930145264
Epoch: 13
Loss on hold-out set: 0.006049836605885311
MeanAbsoluteError value on hold-out data: 0.06184912472963333
Epoch: 14
Loss on hold-out set: 0.006439383631866229
MeanAbsoluteError value on hold-out data: 0.0643128976225853
Epoch: 15
Loss on hold-out set: 0.005812859518061343
MeanAbsoluteError value on hold-out data: 0.06014033034443855
Epoch: 16
Loss on hold-out set: 0.006361850194240871
MeanAbsoluteError value on hold-out data: 0.06184951215982437
```

```
Epoch: 17
Loss on hold-out set: 0.005102882566126554
MeanAbsoluteError value on hold-out data: 0.05671108141541481
Epoch: 18
Loss on hold-out set: 0.004878543501131628
MeanAbsoluteError value on hold-out data: 0.056145936250686646
Epoch: 19
```

```
Loss on hold-out set: 0.004660921673731585
MeanAbsoluteError value on hold-out data: 0.05446828901767731
Epoch: 20
Loss on hold-out set: 0.005379429552704096
MeanAbsoluteError value on hold-out data: 0.05864746868610382
Epoch: 21
Loss on hold-out set: 0.005683575609796925
MeanAbsoluteError value on hold-out data: 0.06366966664791107
Epoch: 22
Loss on hold-out set: 0.0031846322266286925
MeanAbsoluteError value on hold-out data: 0.045492056757211685
Epoch: 23
Loss on hold-out set: 0.0038599235826711122
MeanAbsoluteError value on hold-out data: 0.04545463249087334
Epoch: 24
Loss on hold-out set: 0.005136466756659119
MeanAbsoluteError value on hold-out data: 0.060731466859579086
Epoch: 25
Loss on hold-out set: 0.0031934199291036316
MeanAbsoluteError value on hold-out data: 0.04500005394220352
Epoch: 26
Loss on hold-out set: 0.0026753928181470223
MeanAbsoluteError value on hold-out data: 0.0432923249900341
Epoch: 27
Loss on hold-out set: 0.0030688549557357633
MeanAbsoluteError value on hold-out data: 0.04392893612384796
Epoch: 28
Loss on hold-out set: 0.002858975356885869
MeanAbsoluteError value on hold-out data: 0.04458049312233925
Epoch: 29
Loss on hold-out set: 0.0028237696632889935
MeanAbsoluteError value on hold-out data: 0.043463218957185745
Epoch: 30
Loss on hold-out set: 0.0034033291740342975
```

```
MeanAbsoluteError value on hold-out data: 0.04911794140934944
Epoch: 31
Loss on hold-out set: 0.004048937098368218
MeanAbsoluteError value on hold-out data: 0.05417921021580696
Epoch: 32
Loss on hold-out set: 0.0026936574722640216
MeanAbsoluteError value on hold-out data: 0.043587200343608856
Epoch: 33
Loss on hold-out set: 0.0019434197824203263
MeanAbsoluteError value on hold-out data: 0.036125216633081436
Epoch: 34
Loss on hold-out set: 0.0020704819992380706
MeanAbsoluteError value on hold-out data: 0.03659520298242569
Epoch: 35
Loss on hold-out set: 0.0014800035002592363
MeanAbsoluteError value on hold-out data: 0.03217665106058121
Epoch: 36
Loss on hold-out set: 0.003112516819352382
MeanAbsoluteError value on hold-out data: 0.04837525263428688
Epoch: 37
Loss on hold-out set: 0.0029625101688955176
MeanAbsoluteError value on hold-out data: 0.04365080967545509
Epoch: 38

Loss on hold-out set: 0.001737328135947648
MeanAbsoluteError value on hold-out data: 0.03392376750707626
Epoch: 39
Loss on hold-out set: 0.001871264956303333
MeanAbsoluteError value on hold-out data: 0.03044048883020878
Epoch: 40
Loss on hold-out set: 0.010640989915516815
MeanAbsoluteError value on hold-out data: 0.0830087810754776
Epoch: 41
Loss on hold-out set: 0.017348815539949818
MeanAbsoluteError value on hold-out data: 0.12691202759742737
Epoch: 42
Loss on hold-out set: 0.0025443511365569734
MeanAbsoluteError value on hold-out data: 0.04251565411686897
Epoch: 43
Loss on hold-out set: 0.0010546071663204777
MeanAbsoluteError value on hold-out data: 0.02473948709666729
Epoch: 44
```

```
Loss on hold-out set: 0.0018763310631344978
MeanAbsoluteError value on hold-out data: 0.03659626096487045
Epoch: 45
Loss on hold-out set: 0.0010855579672160705
MeanAbsoluteError value on hold-out data: 0.024700764566659927
Epoch: 46
Loss on hold-out set: 0.0015072430649429168
MeanAbsoluteError value on hold-out data: 0.03152346983551979
Epoch: 47
Loss on hold-out set: 0.0015941025906757108
MeanAbsoluteError value on hold-out data: 0.029410649091005325
Epoch: 48
Loss on hold-out set: 0.00138581185417838
MeanAbsoluteError value on hold-out data: 0.028691867366433144
Epoch: 49
Loss on hold-out set: 0.001467295910084718
MeanAbsoluteError value on hold-out data: 0.030404724180698395
Epoch: 50
Loss on hold-out set: 0.000832495446574237
MeanAbsoluteError value on hold-out data: 0.022555120289325714
Epoch: 51
Loss on hold-out set: 0.001040135347897089
MeanAbsoluteError value on hold-out data: 0.02637552097439766
Epoch: 52
Loss on hold-out set: 0.001104135421643916
MeanAbsoluteError value on hold-out data: 0.025679903104901314
Epoch: 53
Loss on hold-out set: 0.005312856458323567
MeanAbsoluteError value on hold-out data: 0.06660236418247223
Epoch: 54
Loss on hold-out set: 0.0020761002087965608
MeanAbsoluteError value on hold-out data: 0.03744861111044884
Epoch: 55
Loss on hold-out set: 0.004353321892650504
MeanAbsoluteError value on hold-out data: 0.05561543256044388
Epoch: 56
Loss on hold-out set: 0.0007779454478479334
MeanAbsoluteError value on hold-out data: 0.02169632539153099
Epoch: 57

Loss on hold-out set: 0.00303975001320635
MeanAbsoluteError value on hold-out data: 0.04564729332923889
```

```
Epoch: 58
Loss on hold-out set: 0.0010453462539436785
MeanAbsoluteError value on hold-out data: 0.022367222234606743
Epoch: 59
Loss on hold-out set: 0.0008080553318569926
MeanAbsoluteError value on hold-out data: 0.02232770249247551
Epoch: 60
Loss on hold-out set: 0.0015351931919882957
MeanAbsoluteError value on hold-out data: 0.032772086560726166
Epoch: 61
Loss on hold-out set: 0.0008148288531964155
MeanAbsoluteError value on hold-out data: 0.022334612905979156
Epoch: 62
Loss on hold-out set: 0.008419854443912444
MeanAbsoluteError value on hold-out data: 0.07495752722024918
Epoch: 63
Loss on hold-out set: 0.0007493480929712716
MeanAbsoluteError value on hold-out data: 0.020822793245315552
Epoch: 64
Loss on hold-out set: 0.002339880625521274
MeanAbsoluteError value on hold-out data: 0.04070455953478813
Epoch: 65
Loss on hold-out set: 0.002100856061779747
MeanAbsoluteError value on hold-out data: 0.03808574751019478
Epoch: 66
Loss on hold-out set: 0.0009543814031578796
MeanAbsoluteError value on hold-out data: 0.02460423856973648
Epoch: 67
Loss on hold-out set: 0.001504765333313691
MeanAbsoluteError value on hold-out data: 0.03203506022691727
Epoch: 68
Loss on hold-out set: 0.0038582327604097756
MeanAbsoluteError value on hold-out data: 0.05611763522028923
Epoch: 69
Loss on hold-out set: 0.0034382191707233063
MeanAbsoluteError value on hold-out data: 0.05347936600446701
Epoch: 70
Loss on hold-out set: 0.0016771090480400936
MeanAbsoluteError value on hold-out data: 0.030972041189670563
Epoch: 71
Loss on hold-out set: 0.014279815025235476
MeanAbsoluteError value on hold-out data: 0.11375840753316879
Epoch: 72
```

```
Loss on hold-out set: 0.0015605685368523393
MeanAbsoluteError value on hold-out data: 0.033017344772815704
Epoch: 73
Loss on hold-out set: 0.002036482463345716
MeanAbsoluteError value on hold-out data: 0.03926723822951317
Epoch: 74
Loss on hold-out set: 0.011370828620305187
MeanAbsoluteError value on hold-out data: 0.08654230087995529
Epoch: 75
Loss on hold-out set: 0.0019503202179054682
MeanAbsoluteError value on hold-out data: 0.03928901255130768
Epoch: 76

Loss on hold-out set: 0.0018421746667866643
MeanAbsoluteError value on hold-out data: 0.038168877363204956
Epoch: 77
Loss on hold-out set: 0.000859991788226915
MeanAbsoluteError value on hold-out data: 0.022726431488990784
Epoch: 78
Loss on hold-out set: 0.00270731919322555
MeanAbsoluteError value on hold-out data: 0.04177716746926308
Epoch: 79
Loss on hold-out set: 0.00171995674578571
MeanAbsoluteError value on hold-out data: 0.03657807409763336
Epoch: 80
Loss on hold-out set: 0.006617381605074594
MeanAbsoluteError value on hold-out data: 0.06396517157554626
Epoch: 81
Loss on hold-out set: 0.0028992166840716414
MeanAbsoluteError value on hold-out data: 0.043807610869407654
Epoch: 82
Loss on hold-out set: 0.010028548367125424
MeanAbsoluteError value on hold-out data: 0.08376999199390411
Epoch: 83
Loss on hold-out set: 0.0009578123786731771
MeanAbsoluteError value on hold-out data: 0.022533860057592392
Epoch: 84
Loss on hold-out set: 0.0020126299810056623
MeanAbsoluteError value on hold-out data: 0.03603578731417656
Epoch: 85
Loss on hold-out set: 0.0007680037248830654
MeanAbsoluteError value on hold-out data: 0.02213570661842823
```

```
Epoch: 86
Loss on hold-out set: 0.005134744961795054
MeanAbsoluteError value on hold-out data: 0.0682600736618042
Epoch: 87
Loss on hold-out set: 0.0034456942965717693
MeanAbsoluteError value on hold-out data: 0.04798894748091698
Epoch: 88
Loss on hold-out set: 0.0017267990440718438
MeanAbsoluteError value on hold-out data: 0.03710180148482323
Epoch: 89
Loss on hold-out set: 0.0005526150160125996
MeanAbsoluteError value on hold-out data: 0.01877390220761299
Epoch: 90
Loss on hold-out set: 0.0030749135797745303
MeanAbsoluteError value on hold-out data: 0.051428865641355515
Epoch: 91
Loss on hold-out set: 0.004099209437538919
MeanAbsoluteError value on hold-out data: 0.05938234180212021
Epoch: 92
Loss on hold-out set: 0.002443982980606195
MeanAbsoluteError value on hold-out data: 0.045615728944540024
Epoch: 93
Loss on hold-out set: 0.0019018181084998343
MeanAbsoluteError value on hold-out data: 0.038601718842983246
Epoch: 94
Loss on hold-out set: 0.001509893566100417
MeanAbsoluteError value on hold-out data: 0.034476347267627716
Epoch: 95

Loss on hold-out set: 0.0010133607950257627
MeanAbsoluteError value on hold-out data: 0.026970719918608665
Epoch: 96
Loss on hold-out set: 0.0012901436819351818
MeanAbsoluteError value on hold-out data: 0.030255811288952827
Epoch: 97
Loss on hold-out set: 0.0018387307033040806
MeanAbsoluteError value on hold-out data: 0.03828229010105133
Epoch: 98
Loss on hold-out set: 0.0022119664292978613
MeanAbsoluteError value on hold-out data: 0.04279083386063576
Epoch: 99
Loss on hold-out set: 0.0014717271214498109
```

```
MeanAbsoluteError value on hold-out data: 0.03191561996936798
Epoch: 100
Loss on hold-out set: 0.0017673489576401679
MeanAbsoluteError value on hold-out data: 0.036343853920698166
Epoch: 101
Loss on hold-out set: 0.0006655267099727338
MeanAbsoluteError value on hold-out data: 0.01868930459022522
Epoch: 102
Loss on hold-out set: 0.001614343007340243
MeanAbsoluteError value on hold-out data: 0.03505096957087517
Epoch: 103
Loss on hold-out set: 0.001984974945356187
MeanAbsoluteError value on hold-out data: 0.03926100581884384
Epoch: 104
Loss on hold-out set: 0.0011589361023844073
MeanAbsoluteError value on hold-out data: 0.02898484468460083
Epoch: 105
Loss on hold-out set: 0.005358434122938074
MeanAbsoluteError value on hold-out data: 0.05923456698656082
Epoch: 106
Loss on hold-out set: 0.0012235467653035333
MeanAbsoluteError value on hold-out data: 0.029305562376976013
Epoch: 107
Loss on hold-out set: 0.001478416416303892
MeanAbsoluteError value on hold-out data: 0.03354179859161377
Epoch: 108
Loss on hold-out set: 0.0004590360170512117
MeanAbsoluteError value on hold-out data: 0.016240732744336128
Epoch: 109
Loss on hold-out set: 0.006192835121366538
MeanAbsoluteError value on hold-out data: 0.07045658677816391
Epoch: 110
Loss on hold-out set: 0.0014566008252777944
MeanAbsoluteError value on hold-out data: 0.03161147981882095
Epoch: 111
Loss on hold-out set: 0.0007515417283253843
MeanAbsoluteError value on hold-out data: 0.022186068817973137
Epoch: 112
Loss on hold-out set: 0.003043597202601009
MeanAbsoluteError value on hold-out data: 0.042085159569978714
Epoch: 113
Loss on hold-out set: 0.0019049869825769413
MeanAbsoluteError value on hold-out data: 0.03678691387176514
```

```
Epoch: 114

Loss on hold-out set: 0.0014304333783097957
MeanAbsoluteError value on hold-out data: 0.03354223445057869
Epoch: 115
Loss on hold-out set: 0.0020432949470552174
MeanAbsoluteError value on hold-out data: 0.04153285548090935
Epoch: 116
Loss on hold-out set: 0.0021242990072718577
MeanAbsoluteError value on hold-out data: 0.041864365339279175
Epoch: 117
Loss on hold-out set: 0.0009458062061304716
MeanAbsoluteError value on hold-out data: 0.025383997708559036
Epoch: 118
Loss on hold-out set: 0.0016383947743298976
MeanAbsoluteError value on hold-out data: 0.03535228222608566
Epoch: 119
Loss on hold-out set: 0.0015323972298861726
MeanAbsoluteError value on hold-out data: 0.03362654894590378
Epoch: 120
Loss on hold-out set: 0.0011129598776613804
MeanAbsoluteError value on hold-out data: 0.02805299125611782
Epoch: 121
Loss on hold-out set: 0.0012695669643825998
MeanAbsoluteError value on hold-out data: 0.03015242889523506
Epoch: 122
Loss on hold-out set: 0.0017547699818877798
MeanAbsoluteError value on hold-out data: 0.036912042647600174
Epoch: 123
Loss on hold-out set: 0.002945720604130704
MeanAbsoluteError value on hold-out data: 0.0415823720395565
Epoch: 124
Loss on hold-out set: 0.0010753495459395804
MeanAbsoluteError value on hold-out data: 0.02874896675348282
Epoch: 125
Loss on hold-out set: 0.001560405445113582
MeanAbsoluteError value on hold-out data: 0.033720288425683975
Epoch: 126
Loss on hold-out set: 0.001918289730766494
MeanAbsoluteError value on hold-out data: 0.03785696253180504
Epoch: 127
Loss on hold-out set: 0.005854651601494927
```

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MeanAbsoluteError value on hold-out data: 0.061386242508888245
Epoch: 128
Loss on hold-out set: 0.0014426778836518917
MeanAbsoluteError value on hold-out data: 0.03309691324830055
Epoch: 129
Loss on hold-out set: 0.0004416895022395214
MeanAbsoluteError value on hold-out data: 0.01641704887151718
Epoch: 130
Loss on hold-out set: 0.004322176774669634 5
MeanAbsoluteError value on hold-out data: 0.05642841383814812
Epoch: 131
Loss on hold-out set: 0.0012274968995418596
MeanAbsoluteError value on hold-out data: 0.02536296844482422
Epoch: 132
Loss on hold-out set: 0.0031787394178345017
MeanAbsoluteError value on hold-out data: 0.045432236045598984
Epoch: 133

Loss on hold-out set: 0.002881689903963553
MeanAbsoluteError value on hold-out data: 0.04201345890760422
Epoch: 134
Loss on hold-out set: 0.0007730831551414571
MeanAbsoluteError value on hold-out data: 0.02116946130990982
Epoch: 135
Loss on hold-out set: 0.0010663212865198914
MeanAbsoluteError value on hold-out data: 0.02544272318482399
Epoch: 136
Loss on hold-out set: 0.0020573226073266645
MeanAbsoluteError value on hold-out data: 0.036421678960323334
Epoch: 137
Loss on hold-out set: 0.0004217820012280227
MeanAbsoluteError value on hold-out data: 0.01568208448588848
Epoch: 138
Loss on hold-out set: 0.0006219697825144976
MeanAbsoluteError value on hold-out data: 0.021527796983718872
Epoch: 139
Loss on hold-out set: 0.0014701303014972883
MeanAbsoluteError value on hold-out data: 0.03235271945595741
Epoch: 140
Loss on hold-out set: 0.007908703783821119
MeanAbsoluteError value on hold-out data: 0.08734022080898285
Epoch: 141
```

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Loss on hold-out set: 0.0011478093679455157
MeanAbsoluteError value on hold-out data: 0.02827463112771511
Epoch: 142
Loss on hold-out set: 0.0004253695553511773
MeanAbsoluteError value on hold-out data: 0.017196662724018097
Epoch: 143
Loss on hold-out set: 0.0005256732570399579
MeanAbsoluteError value on hold-out data: 0.019132232293486595
Epoch: 144
Loss on hold-out set: 0.0016680587738703348
MeanAbsoluteError value on hold-out data: 0.0357532724738121
Epoch: 145
Loss on hold-out set: 0.0016108187326034041
MeanAbsoluteError value on hold-out data: 0.030142927542328835
Epoch: 146
Loss on hold-out set: 0.001387195018316178
MeanAbsoluteError value on hold-out data: 0.03322145715355873
Epoch: 147
Loss on hold-out set: 0.001775826649176643
MeanAbsoluteError value on hold-out data: 0.038410283625125885
Epoch: 148
Loss on hold-out set: 0.0015966035732019105
MeanAbsoluteError value on hold-out data: 0.03013899177312851
Epoch: 149
Loss on hold-out set: 0.0008528574529152952
MeanAbsoluteError value on hold-out data: 0.02435404621064663
Epoch: 150
Loss on hold-out set: 0.0005548234361125843
MeanAbsoluteError value on hold-out data: 0.018075140193104744
Epoch: 151
Loss on hold-out set: 0.000980151994889112
MeanAbsoluteError value on hold-out data: 0.02592439204454422
Epoch: 152

Loss on hold-out set: 0.0020820326416900285
MeanAbsoluteError value on hold-out data: 0.04161695018410683
Epoch: 153
Loss on hold-out set: 0.0007183460233806583
MeanAbsoluteError value on hold-out data: 0.021479414775967598
Epoch: 154
Loss on hold-out set: 0.0014760306864780815
MeanAbsoluteError value on hold-out data: 0.03260445594787598
```

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Epoch: 155
Loss on hold-out set: 0.0006251711977376161
MeanAbsoluteError value on hold-out data: 0.01913169026374817
Epoch: 156
Loss on hold-out set: 0.0033020544184469863
MeanAbsoluteError value on hold-out data: 0.04656919464468956
Epoch: 157
Loss on hold-out set: 0.0006935806212775214
MeanAbsoluteError value on hold-out data: 0.019717862829566002
Epoch: 158
Loss on hold-out set: 0.0014299060230290419
MeanAbsoluteError value on hold-out data: 0.0319732129573822
Epoch: 159
Loss on hold-out set: 0.0007880478454018501
MeanAbsoluteError value on hold-out data: 0.02164469100534916
Epoch: 160
Loss on hold-out set: 0.0013371789062052574
MeanAbsoluteError value on hold-out data: 0.030383097007870674
Epoch: 161
Loss on hold-out set: 0.0015074544353410602
MeanAbsoluteError value on hold-out data: 0.03407998010516167
Epoch: 162
Loss on hold-out set: 0.0021112689037660233
MeanAbsoluteError value on hold-out data: 0.040137019008398056
Epoch: 163
Loss on hold-out set: 0.001951018443306614
MeanAbsoluteError value on hold-out data: 0.039630986750125885
Epoch: 164
Loss on hold-out set: 0.0018375972990485791
MeanAbsoluteError value on hold-out data: 0.03858426585793495
Epoch: 165
Loss on hold-out set: 0.002214024027221297
MeanAbsoluteError value on hold-out data: 0.03917034715414047
Epoch: 166
Loss on hold-out set: 0.0011296075658480589
MeanAbsoluteError value on hold-out data: 0.026490991935133934
Epoch: 167
Loss on hold-out set: 0.0016409182051000627
MeanAbsoluteError value on hold-out data: 0.03343334048986435
Epoch: 168
Loss on hold-out set: 0.0010808654754471622
MeanAbsoluteError value on hold-out data: 0.027268024161458015
Epoch: 169
```

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Loss on hold-out set: 0.0006816993056992559
MeanAbsoluteError value on hold-out data: 0.02197873964905739
Epoch: 170
Loss on hold-out set: 0.0017966085579246283
MeanAbsoluteError value on hold-out data: 0.03610272333025932
Epoch: 171


Loss on hold-out set: 0.0006220317200610513
MeanAbsoluteError value on hold-out data: 0.020537154749035835
Epoch: 172
Loss on hold-out set: 0.0010832735570147634
MeanAbsoluteError value on hold-out data: 0.02727631852030754
Epoch: 173
Loss on hold-out set: 0.0026056261206241814
MeanAbsoluteError value on hold-out data: 0.0475446991622448
Epoch: 174
Loss on hold-out set: 0.0028235928682414325
MeanAbsoluteError value on hold-out data: 0.04961366206407547
Epoch: 175
Loss on hold-out set: 0.0018136980208127123
MeanAbsoluteError value on hold-out data: 0.038622189313173294
Epoch: 176
Loss on hold-out set: 0.002011373075411508
MeanAbsoluteError value on hold-out data: 0.040102001279592514
Epoch: 177
Loss on hold-out set: 0.002165361172764709
MeanAbsoluteError value on hold-out data: 0.04217114672064781
Epoch: 178
Loss on hold-out set: 0.0020750698964356593
MeanAbsoluteError value on hold-out data: 0.04100492224097252
Epoch: 179
Loss on hold-out set: 0.0032147193989275316
MeanAbsoluteError value on hold-out data: 0.05384107679128647
Epoch: 180
Loss on hold-out set: 0.0026206637450836992
MeanAbsoluteError value on hold-out data: 0.04734320566058159
Epoch: 181
Loss on hold-out set: 0.0013986702849108138
MeanAbsoluteError value on hold-out data: 0.030864086002111435
Epoch: 182
Loss on hold-out set: 0.0015407054513496788
MeanAbsoluteError value on hold-out data: 0.02933645248413086
```

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Epoch: 183
Loss on hold-out set: 0.0004220911934297826
MeanAbsoluteError value on hold-out data: 0.016171537339687347
Epoch: 184
Loss on hold-out set: 0.0012243037620608352
MeanAbsoluteError value on hold-out data: 0.028845781460404396
Epoch: 185
Loss on hold-out set: 0.00033846852755615195
MeanAbsoluteError value on hold-out data: 0.014097318984568119
Epoch: 186
Loss on hold-out set: 0.001151931037096993
MeanAbsoluteError value on hold-out data: 0.028111202642321587
Epoch: 187
Loss on hold-out set: 0.0012295283714162284
MeanAbsoluteError value on hold-out data: 0.031583525240421295
Epoch: 188
Loss on hold-out set: 0.0013092518048851115
MeanAbsoluteError value on hold-out data: 0.024889854714274406
Epoch: 189
Loss on hold-out set: 0.0006654618911469649
MeanAbsoluteError value on hold-out data: 0.020610738545656204
Epoch: 190


Loss on hold-out set: 0.0010573814966176685
MeanAbsoluteError value on hold-out data: 0.028259674087166786
Epoch: 191
Loss on hold-out set: 0.0008778422580737816
MeanAbsoluteError value on hold-out data: 0.019049398601055145
Epoch: 192
Loss on hold-out set: 0.0011127007402185547
MeanAbsoluteError value on hold-out data: 0.02795923501253128
Epoch: 193
Loss on hold-out set: 0.0009165445517282933
MeanAbsoluteError value on hold-out data: 0.024866998195648193
Epoch: 194
Loss on hold-out set: 0.0013223615701702471
MeanAbsoluteError value on hold-out data: 0.033729374408721924
Epoch: 195
Loss on hold-out set: 0.0011864553671330214
MeanAbsoluteError value on hold-out data: 0.029744697734713554
Epoch: 196
Loss on hold-out set: 0.0007986688196021868
```

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MeanAbsoluteError value on hold-out data: 0.023052262142300606
Epoch: 197
Loss on hold-out set: 0.00042630697594416375
MeanAbsoluteError value on hold-out data: 0.01676689274609089
Epoch: 198
Loss on hold-out set: 0.0011191189221694674
MeanAbsoluteError value on hold-out data: 0.028267877176404
Epoch: 199
Loss on hold-out set: 0.0009830522926916416
MeanAbsoluteError value on hold-out data: 0.02402046136558056
Epoch: 200
Loss on hold-out set: 0.0007359821312619667
MeanAbsoluteError value on hold-out data: 0.022389352321624756
Epoch: 201
Loss on hold-out set: 0.0007110396415411838
MeanAbsoluteError value on hold-out data: 0.02096845582127571
Epoch: 202
Loss on hold-out set: 0.0013667605694775518
MeanAbsoluteError value on hold-out data: 0.03275926783680916
Epoch: 203
Loss on hold-out set: 0.0011043396294362058
MeanAbsoluteError value on hold-out data: 0.028858903795480728
Epoch: 204
Loss on hold-out set: 0.0013844771923399285
MeanAbsoluteError value on hold-out data: 0.03255543112754822
Epoch: 205
Loss on hold-out set: 0.0016544809209574993
MeanAbsoluteError value on hold-out data: 0.03689544275403023
Epoch: 206
Loss on hold-out set: 0.0018604880897328258
MeanAbsoluteError value on hold-out data: 0.03929775953292847
Epoch: 207
Loss on hold-out set: 0.0017547134591854717
MeanAbsoluteError value on hold-out data: 0.03739924728870392
Epoch: 208
Loss on hold-out set: 0.0019733214469038344
MeanAbsoluteError value on hold-out data: 0.040329400449991226
Epoch: 209

Loss on hold-out set: 0.0019447109600725142
MeanAbsoluteError value on hold-out data: 0.03965756297111511
Epoch: 210
```

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Loss on hold-out set: 0.0022664975901869567
MeanAbsoluteError value on hold-out data: 0.03995290771126747
Epoch: 211
Loss on hold-out set: 0.0021119121290547284
MeanAbsoluteError value on hold-out data: 0.038868121802806854
Epoch: 212
Loss on hold-out set: 0.0016803409763317752
MeanAbsoluteError value on hold-out data: 0.03682205453515053
Epoch: 213
Loss on hold-out set: 0.0015967797034567124
MeanAbsoluteError value on hold-out data: 0.036115121096372604
Epoch: 214
Loss on hold-out set: 0.0009722860275743235
MeanAbsoluteError value on hold-out data: 0.026322489604353905
Epoch: 215
Loss on hold-out set: 0.0005407309386340019
MeanAbsoluteError value on hold-out data: 0.018999231979250908
Epoch: 216
Loss on hold-out set: 0.0012019074852823426
MeanAbsoluteError value on hold-out data: 0.028349589556455612
Epoch: 217
Loss on hold-out set: 0.0016420434541559142
MeanAbsoluteError value on hold-out data: 0.032843202352523804
Epoch: 218
Loss on hold-out set: 0.0021509308257679407
MeanAbsoluteError value on hold-out data: 0.042849503457546234
Epoch: 219
Loss on hold-out set: 0.0010695415303895348
MeanAbsoluteError value on hold-out data: 0.02600959688425064
Epoch: 220
Loss on hold-out set: 0.0006272986877440033
MeanAbsoluteError value on hold-out data: 0.020363913848996162
Epoch: 221
Loss on hold-out set: 0.0006733457542539231
MeanAbsoluteError value on hold-out data: 0.017594676464796066
Epoch: 222
Loss on hold-out set: 0.0006365825737654967
MeanAbsoluteError value on hold-out data: 0.021245870739221573
Epoch: 223
Loss on hold-out set: 0.0004690219341826282
MeanAbsoluteError value on hold-out data: 0.017049092799425125
Epoch: 224
Loss on hold-out set: 0.00092267373111099
```

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MeanAbsoluteError value on hold-out data: 0.025090467184782028
Epoch: 225
Loss on hold-out set: 0.0005630560228478556
MeanAbsoluteError value on hold-out data: 0.020362896844744682
Epoch: 226
Loss on hold-out set: 0.00041272904108106896
MeanAbsoluteError value on hold-out data: 0.016246773302555084
Epoch: 227
Loss on hold-out set: 0.0009803731196658
MeanAbsoluteError value on hold-out data: 0.026049276813864708
Epoch: 228

Loss on hold-out set: 0.0008208081080259657
MeanAbsoluteError value on hold-out data: 0.024460524320602417
Epoch: 229
Loss on hold-out set: 0.0016160643059074094
MeanAbsoluteError value on hold-out data: 0.03726065531373024
Epoch: 230
Loss on hold-out set: 0.0012190093372115179
MeanAbsoluteError value on hold-out data: 0.029847832396626472
Epoch: 231
Loss on hold-out set: 0.0008141730336080256
MeanAbsoluteError value on hold-out data: 0.02322382666170597
Epoch: 232
Loss on hold-out set: 0.0006467961755238081
MeanAbsoluteError value on hold-out data: 0.020851746201515198
Epoch: 233
Loss on hold-out set: 0.0011647083110323077
MeanAbsoluteError value on hold-out data: 0.029868531972169876
Epoch: 234
Loss on hold-out set: 0.0011620118717761024
MeanAbsoluteError value on hold-out data: 0.028573891147971153
Epoch: 235
Loss on hold-out set: 0.0014407776332901496
MeanAbsoluteError value on hold-out data: 0.03142084926366806
Epoch: 236
Loss on hold-out set: 0.0008731525679314999
MeanAbsoluteError value on hold-out data: 0.02432546764612198
Epoch: 237
Loss on hold-out set: 0.0011830440060676712
MeanAbsoluteError value on hold-out data: 0.028506966307759285
Epoch: 238
```

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Loss on hold-out set: 0.000769751434410481
MeanAbsoluteError value on hold-out data: 0.023715922608971596
Epoch: 239
Loss on hold-out set: 0.0007708828917729031
MeanAbsoluteError value on hold-out data: 0.023520605638623238
Epoch: 240
Loss on hold-out set: 0.0006220102276481492
MeanAbsoluteError value on hold-out data: 0.020276831462979317
Epoch: 241
Loss on hold-out set: 0.0009159487794692579
MeanAbsoluteError value on hold-out data: 0.02522936835885048
Epoch: 242
Loss on hold-out set: 0.000401781914804719
MeanAbsoluteError value on hold-out data: 0.015265115536749363
Epoch: 243
Loss on hold-out set: 0.00046403790857814446
MeanAbsoluteError value on hold-out data: 0.01544733066111803
Epoch: 244
Loss on hold-out set: 0.0012653620490853331
MeanAbsoluteError value on hold-out data: 0.031205307692289352
Epoch: 245
Loss on hold-out set: 0.0003617553700582664
MeanAbsoluteError value on hold-out data: 0.015051741153001785
Epoch: 246

Loss on hold-out set: 0.0006429605801761346
MeanAbsoluteError value on hold-out data: 0.020838601514697075
Epoch: 247
Loss on hold-out set: 0.0007649135046736582
MeanAbsoluteError value on hold-out data: 0.022818222641944885
Epoch: 248
Loss on hold-out set: 0.0010718045891017507
MeanAbsoluteError value on hold-out data: 0.028887050226330757
Epoch: 249
Loss on hold-out set: 0.0019062965109601226
MeanAbsoluteError value on hold-out data: 0.03734388202428818
Epoch: 250
Loss on hold-out set: 0.0017793123444885407
MeanAbsoluteError value on hold-out data: 0.03615663945674896
Epoch: 251
Loss on hold-out set: 0.002032129510648941
MeanAbsoluteError value on hold-out data: 0.04141968861222267
```

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Epoch: 252
Loss on hold-out set: 0.0011717074973459699
MeanAbsoluteError value on hold-out data: 0.029225638136267662
Epoch: 253
Loss on hold-out set: 0.0009276508108565682
MeanAbsoluteError value on hold-out data: 0.024825796484947205
Epoch: 254
Loss on hold-out set: 0.0011187679514190869
MeanAbsoluteError value on hold-out data: 0.028040120378136635
Epoch: 255
Loss on hold-out set: 0.001557248972331811
MeanAbsoluteError value on hold-out data: 0.03280521556735039
Epoch: 256
Loss on hold-out set: 0.0021119595039635897
MeanAbsoluteError value on hold-out data: 0.0388147309422493
Epoch: 257
Loss on hold-out set: 0.00150428463300494
MeanAbsoluteError value on hold-out data: 0.034537479281425476
Epoch: 258
Loss on hold-out set: 0.00132838049352071
MeanAbsoluteError value on hold-out data: 0.031190553680062294
Epoch: 259
Loss on hold-out set: 0.002402762802758891
MeanAbsoluteError value on hold-out data: 0.04012657329440117
Epoch: 260
Loss on hold-out set: 0.0016050285439154035
MeanAbsoluteError value on hold-out data: 0.03410853073000908
Epoch: 261
Loss on hold-out set: 0.001287555646788525
MeanAbsoluteError value on hold-out data: 0.03047921136021614
Epoch: 262
Loss on hold-out set: 0.0010337521303690185
MeanAbsoluteError value on hold-out data: 0.02720499597489834
Epoch: 263
Loss on hold-out set: 0.0003502710184731864
MeanAbsoluteError value on hold-out data: 0.015145920217037201
Epoch: 264

Loss on hold-out set: 0.0011623641322857064
MeanAbsoluteError value on hold-out data: 0.031190508976578712
Epoch: 265
Loss on hold-out set: 0.0009387121122256902
```

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MeanAbsoluteError value on hold-out data: 0.0264609195291996
Epoch: 266
Loss on hold-out set: 0.0011044891924891424
MeanAbsoluteError value on hold-out data: 0.027539420872926712
Epoch: 267
Loss on hold-out set: 0.0008271072859459213
MeanAbsoluteError value on hold-out data: 0.022885045036673546
Epoch: 268
Loss on hold-out set: 0.0004963582093631359
MeanAbsoluteError value on hold-out data: 0.01788974739611149
Epoch: 269
Loss on hold-out set: 0.0010800813140935805
MeanAbsoluteError value on hold-out data: 0.026711774989962578
Epoch: 270
Loss on hold-out set: 0.0009867736616318947
MeanAbsoluteError value on hold-out data: 0.02576385997235775
Epoch: 271
Loss on hold-out set: 0.0013034697346340277
MeanAbsoluteError value on hold-out data: 0.0316825695335865
Epoch: 272
Loss on hold-out set: 0.0007350118601032974
MeanAbsoluteError value on hold-out data: 0.022103486582636833
Epoch: 273
Loss on hold-out set: 0.000864462795250706
MeanAbsoluteError value on hold-out data: 0.02560098096728325
Epoch: 274
Loss on hold-out set: 0.0010937353179446962
MeanAbsoluteError value on hold-out data: 0.028933515772223473
Epoch: 275
Loss on hold-out set: 0.0012225770654990093
MeanAbsoluteError value on hold-out data: 0.0307827889919281
Epoch: 276
Loss on hold-out set: 0.0006729136910412068
MeanAbsoluteError value on hold-out data: 0.021144449710845947
Epoch: 277
Loss on hold-out set: 0.0005686960281117967
MeanAbsoluteError value on hold-out data: 0.019487963989377022
Epoch: 278
Loss on hold-out set: 0.0007373289232705965
MeanAbsoluteError value on hold-out data: 0.01990543305873871
Epoch: 279
Loss on hold-out set: 0.000528744768081723
MeanAbsoluteError value on hold-out data: 0.017906809225678444
```

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Epoch: 280
Loss on hold-out set: 0.0009502877303595213
MeanAbsoluteError value on hold-out data: 0.025050783529877663
Epoch: 281
Loss on hold-out set: 0.000646761186592477
MeanAbsoluteError value on hold-out data: 0.020959973335266113
Epoch: 282
Loss on hold-out set: 0.001248660096040878
MeanAbsoluteError value on hold-out data: 0.032162394374608994
Epoch: 283

Loss on hold-out set: 0.0007420171689438192
MeanAbsoluteError value on hold-out data: 0.02240118756890297
Epoch: 284
Loss on hold-out set: 0.0007077878073783052
MeanAbsoluteError value on hold-out data: 0.013107802718877792
Epoch: 285
Loss on hold-out set: 0.0016221070024920138
MeanAbsoluteError value on hold-out data: 0.03399977833032608
Epoch: 286
Loss on hold-out set: 0.0006311844060148456
MeanAbsoluteError value on hold-out data: 0.021011585369706154
Epoch: 287
Loss on hold-out set: 0.00034807993429958036
MeanAbsoluteError value on hold-out data: 0.01463892962783575
Epoch: 288
Loss on hold-out set: 0.0004568911742688598
MeanAbsoluteError value on hold-out data: 0.017357787117362022
Epoch: 289
Loss on hold-out set: 0.0007080037735010448
MeanAbsoluteError value on hold-out data: 0.022519825026392937
Epoch: 290
Loss on hold-out set: 0.0003035530573565905
MeanAbsoluteError value on hold-out data: 0.013688354752957821
Epoch: 291
Loss on hold-out set: 0.0006804586369789353
MeanAbsoluteError value on hold-out data: 0.021319933235645294
Epoch: 292
Loss on hold-out set: 0.00036422192811426754
MeanAbsoluteError value on hold-out data: 0.015053960494697094
Epoch: 293
Loss on hold-out set: 0.0004040572545674973
```

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MeanAbsoluteError value on hold-out data: 0.016653545200824738
Epoch: 294
Loss on hold-out set: 0.0005087346347097896
MeanAbsoluteError value on hold-out data: 0.01778561994433403
Epoch: 295
Loss on hold-out set: 0.0007262405829111996
MeanAbsoluteError value on hold-out data: 0.022084347903728485
Epoch: 296
Loss on hold-out set: 0.0006973276337559678
MeanAbsoluteError value on hold-out data: 0.023383628576993942
Epoch: 297
Loss on hold-out set: 0.0006850260772472737
MeanAbsoluteError value on hold-out data: 0.019633699208498
Epoch: 298
Loss on hold-out set: 0.0006101602339185774
MeanAbsoluteError value on hold-out data: 0.020553477108478546
Epoch: 299
Loss on hold-out set: 0.0010071623684397262
MeanAbsoluteError value on hold-out data: 0.026558062061667442
Epoch: 300
Loss on hold-out set: 0.0007125444841987797
MeanAbsoluteError value on hold-out data: 0.022323425859212875
Epoch: 301
Loss on hold-out set: 0.0009337745447594084
MeanAbsoluteError value on hold-out data: 0.02554655447602272
Epoch: 302

Loss on hold-out set: 0.0005809087735159617
MeanAbsoluteError value on hold-out data: 0.020757107064127922
Epoch: 303
Loss on hold-out set: 0.0014251596049258584
MeanAbsoluteError value on hold-out data: 0.03227246180176735
Epoch: 304
Loss on hold-out set: 0.0010916051932757622
MeanAbsoluteError value on hold-out data: 0.028083261102437973
Epoch: 305
Loss on hold-out set: 0.0007958103149001928
MeanAbsoluteError value on hold-out data: 0.0220554918050766
Epoch: 306
Loss on hold-out set: 0.0023631875305191465
MeanAbsoluteError value on hold-out data: 0.0403025858104229
Epoch: 307
```

```
Loss on hold-out set: 0.0009291440058548592
MeanAbsoluteError value on hold-out data: 0.02287432737648487
Epoch: 308
Loss on hold-out set: 0.0007805605036034984
MeanAbsoluteError value on hold-out data: 0.02308087795972824
Epoch: 309
Loss on hold-out set: 0.0003115328612406493
MeanAbsoluteError value on hold-out data: 0.013811320997774601
Epoch: 310
Loss on hold-out set: 0.000878696948731024
MeanAbsoluteError value on hold-out data: 0.024759557098150253
Epoch: 311
Loss on hold-out set: 0.0006736763998081809
MeanAbsoluteError value on hold-out data: 0.02001303620636463
Epoch: 312
Loss on hold-out set: 0.000608157502842675
MeanAbsoluteError value on hold-out data: 0.020753398537635803
Epoch: 313
Loss on hold-out set: 0.0008558115008973369
MeanAbsoluteError value on hold-out data: 0.0248061902821064
Epoch: 314
Loss on hold-out set: 0.0008337740559670094
MeanAbsoluteError value on hold-out data: 0.02474585920572281
Epoch: 315
Loss on hold-out set: 0.0003325994559992595
MeanAbsoluteError value on hold-out data: 0.015286920592188835
Epoch: 316
Loss on hold-out set: 0.001012917981777144
MeanAbsoluteError value on hold-out data: 0.026758696883916855
Epoch: 317
Loss on hold-out set: 0.0006758515251261231
MeanAbsoluteError value on hold-out data: 0.020899392664432526
Epoch: 318
Loss on hold-out set: 0.001022702383220588
MeanAbsoluteError value on hold-out data: 0.026780862361192703
Epoch: 319
Loss on hold-out set: 0.0006980704125262013
MeanAbsoluteError value on hold-out data: 0.021335778757929802
Epoch: 320
Loss on hold-out set: 0.0007512412419983823
MeanAbsoluteError value on hold-out data: 0.022838372737169266
Epoch: 321
```

```
Loss on hold-out set: 0.0001837729459542683
MeanAbsoluteError value on hold-out data: 0.010872055776417255
Epoch: 322
Loss on hold-out set: 0.000743901283529244
MeanAbsoluteError value on hold-out data: 0.022757457569241524
Epoch: 323
Loss on hold-out set: 0.0004273014676168953
MeanAbsoluteError value on hold-out data: 0.017254235222935677
Epoch: 324
Loss on hold-out set: 0.0006558479094804314
MeanAbsoluteError value on hold-out data: 0.020365238189697266
Epoch: 325
Loss on hold-out set: 0.0003642583109658996
MeanAbsoluteError value on hold-out data: 0.01564253494143486
Epoch: 326
Loss on hold-out set: 0.0003526118334296993
MeanAbsoluteError value on hold-out data: 0.014555994421243668
Epoch: 327
Loss on hold-out set: 0.0014370668336356942
MeanAbsoluteError value on hold-out data: 0.030346231535077095
Epoch: 328
Loss on hold-out set: 0.0007589062596181114
MeanAbsoluteError value on hold-out data: 0.024565907195210457
Epoch: 329
Loss on hold-out set: 0.0006295923391773709
MeanAbsoluteError value on hold-out data: 0.02062518149614334
Epoch: 330
Loss on hold-out set: 0.0007444375108829455
MeanAbsoluteError value on hold-out data: 0.02204081602394581
Epoch: 331
Loss on hold-out set: 0.0005854909541085362
MeanAbsoluteError value on hold-out data: 0.020316481590270996
Epoch: 332
Loss on hold-out set: 0.00024991980975947196
MeanAbsoluteError value on hold-out data: 0.010651887394487858
Epoch: 333
Loss on hold-out set: 0.0002623613235252713
MeanAbsoluteError value on hold-out data: 0.011893372982740402
Epoch: 334
Loss on hold-out set: 0.0002600885782158002
MeanAbsoluteError value on hold-out data: 0.012847869656980038
Epoch: 335
Loss on hold-out set: 0.0005219906651243372
```

```
MeanAbsoluteError value on hold-out data: 0.018947452306747437
Epoch: 336
Loss on hold-out set: 0.0004953116034525202
MeanAbsoluteError value on hold-out data: 0.019357839599251747
Epoch: 337
Loss on hold-out set: 0.0005220881093440479
MeanAbsoluteError value on hold-out data: 0.01827453449368477
Epoch: 338
Loss on hold-out set: 0.00034813072737673983
MeanAbsoluteError value on hold-out data: 0.014274091459810734
Epoch: 339
Loss on hold-out set: 0.00039720828307939594
MeanAbsoluteError value on hold-out data: 0.016047459095716476
Epoch: 340
```

```
Loss on hold-out set: 0.0004115337222557221
MeanAbsoluteError value on hold-out data: 0.015495424158871174
Epoch: 341
Loss on hold-out set: 0.0004859969363008675
MeanAbsoluteError value on hold-out data: 0.018103785812854767
Epoch: 342
Loss on hold-out set: 0.0019630281818344406
MeanAbsoluteError value on hold-out data: 0.02878957986831665
Epoch: 343
Loss on hold-out set: 0.0005265309676025553
MeanAbsoluteError value on hold-out data: 0.016978060826659203
Epoch: 344
Loss on hold-out set: 0.0007912871338990762
MeanAbsoluteError value on hold-out data: 0.02156795747578144
Epoch: 345
Loss on hold-out set: 0.0005514002236611161
MeanAbsoluteError value on hold-out data: 0.017763415351510048
Epoch: 346
Loss on hold-out set: 0.0007803437183611095
MeanAbsoluteError value on hold-out data: 0.024345897138118744
Epoch: 347
Loss on hold-out set: 0.0004996228610827146
MeanAbsoluteError value on hold-out data: 0.018382588401436806
Epoch: 348
Loss on hold-out set: 0.000604889516436838
MeanAbsoluteError value on hold-out data: 0.020262787118554115
Epoch: 349
```

```
Loss on hold-out set: 0.0006309923360516366
MeanAbsoluteError value on hold-out data: 0.020269149914383888
Epoch: 350
Loss on hold-out set: 0.0006732864850690882
MeanAbsoluteError value on hold-out data: 0.02170112542808056
Epoch: 351
Loss on hold-out set: 0.0009705720647042127
MeanAbsoluteError value on hold-out data: 0.02604523114860058
Epoch: 352
Loss on hold-out set: 0.0006065527620529266
MeanAbsoluteError value on hold-out data: 0.02068372815847397
Epoch: 353
Loss on hold-out set: 0.0003867662514829518
MeanAbsoluteError value on hold-out data: 0.0154903968796134
Epoch: 354
Loss on hold-out set: 0.0007465552250658604
MeanAbsoluteError value on hold-out data: 0.020179711282253265
Epoch: 355
Loss on hold-out set: 0.0006617232421903234
MeanAbsoluteError value on hold-out data: 0.02129611186683178
Epoch: 356
Loss on hold-out set: 0.0015150947943574895
MeanAbsoluteError value on hold-out data: 0.03519954904913902
Epoch: 357
Loss on hold-out set: 0.0007283428077291893
MeanAbsoluteError value on hold-out data: 0.02369619719684124
Epoch: 358
Loss on hold-out set: 0.0012654294137303766
MeanAbsoluteError value on hold-out data: 0.02947290986776352
Epoch: 359

Loss on hold-out set: 0.0008040938624425939
MeanAbsoluteError value on hold-out data: 0.024063581600785255
Epoch: 360
Loss on hold-out set: 0.000569297898389203
MeanAbsoluteError value on hold-out data: 0.020436003804206848
Epoch: 361
Loss on hold-out set: 0.0008262088644857469
MeanAbsoluteError value on hold-out data: 0.02487419918179512
Epoch: 362
Loss on hold-out set: 0.0005099199663259481
MeanAbsoluteError value on hold-out data: 0.01918015256524086
```

```
Epoch: 363
Loss on hold-out set: 0.0010043546637079042
MeanAbsoluteError value on hold-out data: 0.02757374197244644
Epoch: 364
Loss on hold-out set: 0.0011310479726250235
MeanAbsoluteError value on hold-out data: 0.029785996302962303
Epoch: 365
Loss on hold-out set: 0.0005715853675562693
MeanAbsoluteError value on hold-out data: 0.018808379769325256
Epoch: 366
Loss on hold-out set: 0.0012425463707921537
MeanAbsoluteError value on hold-out data: 0.030819835141301155
Epoch: 367
Loss on hold-out set: 0.000786559846203186
MeanAbsoluteError value on hold-out data: 0.023697616532444954
Epoch: 368
Loss on hold-out set: 0.0005323933161746122
MeanAbsoluteError value on hold-out data: 0.019227147102355957
Epoch: 369
Loss on hold-out set: 0.0004131111261238785
MeanAbsoluteError value on hold-out data: 0.01683790050446987
Epoch: 370
Loss on hold-out set: 0.0005452045313033619
MeanAbsoluteError value on hold-out data: 0.017521589994430542
Epoch: 371
Loss on hold-out set: 0.0004516395205619598
MeanAbsoluteError value on hold-out data: 0.015906265005469322
Epoch: 372
Loss on hold-out set: 0.0007026123700933041
MeanAbsoluteError value on hold-out data: 0.018865829333662987
Epoch: 373
Loss on hold-out set: 0.0013953694969562715
MeanAbsoluteError value on hold-out data: 0.03139587119221687
Epoch: 374
Loss on hold-out set: 0.0005109567075698195
MeanAbsoluteError value on hold-out data: 0.017779992893338203
Epoch: 375
Loss on hold-out set: 0.0007134385707199966
MeanAbsoluteError value on hold-out data: 0.022357285022735596
Epoch: 376
Loss on hold-out set: 0.00031143147498369217
MeanAbsoluteError value on hold-out data: 0.013902789913117886
Epoch: 377
```

```
Loss on hold-out set: 0.0005879105025853374
MeanAbsoluteError value on hold-out data: 0.019984662532806396
Epoch: 378


Loss on hold-out set: 0.0007494800252300736
MeanAbsoluteError value on hold-out data: 0.02295164205133915
Epoch: 379
Loss on hold-out set: 0.00029924459982124204
MeanAbsoluteError value on hold-out data: 0.01405768096446991
Epoch: 380
Loss on hold-out set: 0.0006001669558157262
MeanAbsoluteError value on hold-out data: 0.020102275535464287
Epoch: 381
Loss on hold-out set: 0.0005962161338079328
MeanAbsoluteError value on hold-out data: 0.020671973004937172
Epoch: 382
Loss on hold-out set: 0.0006896365666761994
MeanAbsoluteError value on hold-out data: 0.022697726264595985
Epoch: 383
Loss on hold-out set: 0.00031213612620424673
MeanAbsoluteError value on hold-out data: 0.01391317043453455
Epoch: 384
Loss on hold-out set: 0.0007636061391646141
MeanAbsoluteError value on hold-out data: 0.023633785545825958
Epoch: 385
Loss on hold-out set: 0.0010436219561501946
MeanAbsoluteError value on hold-out data: 0.018104828894138336
Epoch: 386
Loss on hold-out set: 0.0006003428869390566
MeanAbsoluteError value on hold-out data: 0.02060004696249962
Epoch: 387
Loss on hold-out set: 0.0005847766128442201
MeanAbsoluteError value on hold-out data: 0.01997963897883892
Epoch: 388
Loss on hold-out set: 0.0004727418724398472
MeanAbsoluteError value on hold-out data: 0.018136026337742805
Epoch: 389
Loss on hold-out set: 0.0006187977238656267
MeanAbsoluteError value on hold-out data: 0.020769532769918442
Epoch: 390
Loss on hold-out set: 0.000992340679084392
MeanAbsoluteError value on hold-out data: 0.025656012818217278
```

```
Epoch: 391
Loss on hold-out set: 0.0005023899690346106
MeanAbsoluteError value on hold-out data: 0.01837221346795559
Epoch: 392
Loss on hold-out set: 0.0007308579714797242
MeanAbsoluteError value on hold-out data: 0.022842243313789368
Epoch: 393
Loss on hold-out set: 0.00048485364899725507
MeanAbsoluteError value on hold-out data: 0.017910700291395187
Epoch: 394
Loss on hold-out set: 0.00045130518111890475
MeanAbsoluteError value on hold-out data: 0.017727483063936234
Epoch: 395
Loss on hold-out set: 0.0008242512979593716
MeanAbsoluteError value on hold-out data: 0.02498869225382805
Epoch: 396
Loss on hold-out set: 0.0006939491079384951
MeanAbsoluteError value on hold-out data: 0.021769819781184196
Epoch: 397

Loss on hold-out set: 0.000747650685585349
MeanAbsoluteError value on hold-out data: 0.021874407306313515
Epoch: 398
Loss on hold-out set: 0.0006419138961447109
MeanAbsoluteError value on hold-out data: 0.02132241427898407
Epoch: 399
Loss on hold-out set: 0.0004408703082988627
MeanAbsoluteError value on hold-out data: 0.01584509201347828
Epoch: 400
Loss on hold-out set: 0.0010662229829712917
MeanAbsoluteError value on hold-out data: 0.027510283514857292
Epoch: 401
Loss on hold-out set: 0.0004493804544357485
MeanAbsoluteError value on hold-out data: 0.017056476324796677
Epoch: 402
Loss on hold-out set: 0.00035929534045097073
MeanAbsoluteError value on hold-out data: 0.01555902510881424
Epoch: 403
Loss on hold-out set: 0.0005076587760030586
MeanAbsoluteError value on hold-out data: 0.012926949188113213
Epoch: 404
Loss on hold-out set: 0.0006070934713965183
```

```
MeanAbsoluteError value on hold-out data: 0.020784424617886543
Epoch: 405
Loss on hold-out set: 0.0005837723239030885
MeanAbsoluteError value on hold-out data: 0.01841866783797741
Epoch: 406
Loss on hold-out set: 0.0006536321276431217
MeanAbsoluteError value on hold-out data: 0.016507335007190704
Epoch: 407
Loss on hold-out set: 0.0007028263337959192
MeanAbsoluteError value on hold-out data: 0.021557163447141647
Epoch: 408
Loss on hold-out set: 0.0006997299435744552
MeanAbsoluteError value on hold-out data: 0.020575322210788727
Epoch: 409
Loss on hold-out set: 0.0006440434463959383
MeanAbsoluteError value on hold-out data: 0.019939612597227097
Epoch: 410
Loss on hold-out set: 0.0005109146961905552
MeanAbsoluteError value on hold-out data: 0.016550427302718163
Epoch: 411
Loss on hold-out set: 0.0004715150525474823
MeanAbsoluteError value on hold-out data: 0.01727040484547615
Epoch: 412
Loss on hold-out set: 0.00029191745699407826
MeanAbsoluteError value on hold-out data: 0.01310308463871479
Epoch: 413
Loss on hold-out set: 0.0003503272800069106
MeanAbsoluteError value on hold-out data: 0.015663133934140205
Epoch: 414
Loss on hold-out set: 0.0008012218198640958
MeanAbsoluteError value on hold-out data: 0.023455556482076645
Epoch: 415
Loss on hold-out set: 0.0007382140641933994
MeanAbsoluteError value on hold-out data: 0.021068505942821503
Epoch: 416

Loss on hold-out set: 0.0005112886612646674
MeanAbsoluteError value on hold-out data: 0.01785776950418949
Epoch: 417
Loss on hold-out set: 0.000447535581770353
MeanAbsoluteError value on hold-out data: 0.017292456701397896
Epoch: 418
```

Loss on hold-out set: 0.0004032140798364325
MeanAbsoluteError value on hold-out data: 0.017303884029388428
Epoch: 419
Loss on hold-out set: 0.0005706748511568692
MeanAbsoluteError value on hold-out data: 0.020146898925304413
Epoch: 420
Loss on hold-out set: 0.0006000008219607958
MeanAbsoluteError value on hold-out data: 0.02002616785466671
Epoch: 421
Loss on hold-out set: 0.00027955759019517387
MeanAbsoluteError value on hold-out data: 0.013235354796051979
Epoch: 422
Loss on hold-out set: 0.000828717466088404
MeanAbsoluteError value on hold-out data: 0.022937916219234467
Epoch: 423
Loss on hold-out set: 0.000569945950318422
MeanAbsoluteError value on hold-out data: 0.01951592229306698
Epoch: 424
Loss on hold-out set: 0.0008436242358967368
MeanAbsoluteError value on hold-out data: 0.016565732657909393
Epoch: 425
Loss on hold-out set: 0.0005920579638577214
MeanAbsoluteError value on hold-out data: 0.01943778060376644
Epoch: 426
Loss on hold-out set: 0.00024713451038176
MeanAbsoluteError value on hold-out data: 0.012229363434016705
Epoch: 427
Loss on hold-out set: 0.0004507135147976346
MeanAbsoluteError value on hold-out data: 0.016996536403894424
Epoch: 428
Loss on hold-out set: 0.0008690764455087973
MeanAbsoluteError value on hold-out data: 0.016833307221531868
Epoch: 429
Loss on hold-out set: 0.00045456666205274433
MeanAbsoluteError value on hold-out data: 0.017012622207403183
Epoch: 430
Loss on hold-out set: 0.0006227291887626052
MeanAbsoluteError value on hold-out data: 0.0215094406157732
Epoch: 431
Loss on hold-out set: 0.0008485118864643338
MeanAbsoluteError value on hold-out data: 0.02329062670469284
Epoch: 432
Loss on hold-out set: 0.0008811635611652347

```
MeanAbsoluteError value on hold-out data: 0.02477732114493847
Epoch: 433
Loss on hold-out set: 0.0004971809133789257
MeanAbsoluteError value on hold-out data: 0.018802456557750702
Epoch: 434
Loss on hold-out set: 0.0006753962753512161
MeanAbsoluteError value on hold-out data: 0.022397294640541077
Epoch: 435

Loss on hold-out set: 0.0006449973566065493
MeanAbsoluteError value on hold-out data: 0.020593764260411263
Epoch: 436
Loss on hold-out set: 0.0008330906781147382
MeanAbsoluteError value on hold-out data: 0.020950762555003166
Epoch: 437
Loss on hold-out set: 0.00090782335763307
MeanAbsoluteError value on hold-out data: 0.025689082220196724
Epoch: 438
Loss on hold-out set: 0.00019175376387705145
MeanAbsoluteError value on hold-out data: 0.010997814126312733
Epoch: 439
Loss on hold-out set: 0.0008703375075894751
MeanAbsoluteError value on hold-out data: 0.02532939985394478
Epoch: 440
Loss on hold-out set: 0.0006202954115762719
MeanAbsoluteError value on hold-out data: 0.02009483426809311
Epoch: 441
Loss on hold-out set: 0.0004045171808684245
MeanAbsoluteError value on hold-out data: 0.016730213537812233
Epoch: 442
Loss on hold-out set: 0.0019455215170685399
MeanAbsoluteError value on hold-out data: 0.04184205085039139
Epoch: 443
Loss on hold-out set: 0.0018341434065644677
MeanAbsoluteError value on hold-out data: 0.04077445715665817
Epoch: 444
Loss on hold-out set: 0.0004917865888656754
MeanAbsoluteError value on hold-out data: 0.01886012963950634
Epoch: 445
Loss on hold-out set: 0.0007175314408653465
MeanAbsoluteError value on hold-out data: 0.02237698622047901
Epoch: 446
```

```
Loss on hold-out set: 0.000963165749501633
MeanAbsoluteError value on hold-out data: 0.026460783556103706
Epoch: 447
Loss on hold-out set: 0.0005144722940473768
MeanAbsoluteError value on hold-out data: 0.017885791137814522
Epoch: 448
Loss on hold-out set: 0.00063505312458514
MeanAbsoluteError value on hold-out data: 0.020681090652942657
Epoch: 449
Loss on hold-out set: 0.0006907640766401432
MeanAbsoluteError value on hold-out data: 0.02219667099416256
Early stopping at epoch 448
Returned to Spot: Validation loss: 0.0006907640766401432
----------------------------------------------

spotPython tuning: 0.0006907640766401432 [####------] 35.51%

config: {'_L_in': 10, '_L_out': 1, 'l1': 8, 'dropout_prob': 0.02857159160072684, 'lr_mult': 
Epoch: 1
Loss on hold-out set: 0.03120258793626961
MeanAbsoluteError value on hold-out data: 0.1410081386566162
Epoch: 2
Loss on hold-out set: 0.03590924900613333
MeanAbsoluteError value on hold-out data: 0.15696699917316437
Epoch: 3
Loss on hold-out set: 0.02650238264744219
MeanAbsoluteError value on hold-out data: 0.1281954050064087
Epoch: 4
Loss on hold-out set: 0.0235494659527352
MeanAbsoluteError value on hold-out data: 0.11953633278608322
Returned to Spot: Validation loss: 0.0235494659527352
----------------------------------------------

spotPython tuning: 0.0006907640766401432 [####------] 37.13%

config: {'_L_in': 10, '_L_out': 1, 'l1': 256, 'dropout_prob': 0.0, 'lr_mult': 6.855637843833
Epoch: 1
Loss on hold-out set: 0.04412557086662242
MeanAbsoluteError value on hold-out data: 0.17053337395191193
```

```
Epoch: 2
Loss on hold-out set: 0.02878607368390811
MeanAbsoluteError value on hold-out data: 0.13561248779296875
Epoch: 3
Loss on hold-out set: 0.05423035041282052
MeanAbsoluteError value on hold-out data: 0.19524575769901276
Epoch: 4
Loss on hold-out set: 0.021850295070754856
MeanAbsoluteError value on hold-out data: 0.1184622049331665
Epoch: 5
Loss on hold-out set: 0.033333267820508855
MeanAbsoluteError value on hold-out data: 0.14842668175697327
Epoch: 6
Loss on hold-out set: 0.03035297764367179
MeanAbsoluteError value on hold-out data: 0.14091476798057556
Epoch: 7
Loss on hold-out set: 0.04697571243894728
MeanAbsoluteError value on hold-out data: 0.190818652510643
Epoch: 8
Loss on hold-out set: 0.03983618652350024
MeanAbsoluteError value on hold-out data: 0.17344790697097778
Epoch: 9
Loss on hold-out set: 0.03036082683033065
MeanAbsoluteError value on hold-out data: 0.1461644321680069
Epoch: 10
Loss on hold-out set: 0.028593665479045165
MeanAbsoluteError value on hold-out data: 0.14349611103534698
Epoch: 11
Loss on hold-out set: 0.03705126743175482
MeanAbsoluteError value on hold-out data: 0.16764993965625763
Epoch: 12

Loss on hold-out set: 0.030658485956097905
MeanAbsoluteError value on hold-out data: 0.14539103209972382
Epoch: 13
Loss on hold-out set: 0.02919627716274638
MeanAbsoluteError value on hold-out data: 0.14503638446331024
Epoch: 14
Loss on hold-out set: 0.032862133297481035
MeanAbsoluteError value on hold-out data: 0.1621600240468979
Epoch: 15
Loss on hold-out set: 0.003907259700721816
```

```
MeanAbsoluteError value on hold-out data: 0.05058787390589714
Epoch: 16
Loss on hold-out set: 0.010605283130548503
MeanAbsoluteError value on hold-out data: 0.08726438134908676
Epoch: 17
Loss on hold-out set: 0.023815435112306948
MeanAbsoluteError value on hold-out data: 0.12876984477043152
Epoch: 18
Loss on hold-out set: 0.050393129061711464
MeanAbsoluteError value on hold-out data: 0.21627861261367798
Epoch: 19
Loss on hold-out set: 0.04323715030362731
MeanAbsoluteError value on hold-out data: 0.19805411994457245
Epoch: 20
Loss on hold-out set: 0.040114589329612885
MeanAbsoluteError value on hold-out data: 0.19015273451805115
Epoch: 21
Loss on hold-out set: 0.003621513918532353
MeanAbsoluteError value on hold-out data: 0.04959285259246826
Epoch: 22
Loss on hold-out set: 0.021460230021100295
MeanAbsoluteError value on hold-out data: 0.12794509530067444
Epoch: 23
Loss on hold-out set: 0.012362887249573282
MeanAbsoluteError value on hold-out data: 0.10329115390777588
Epoch: 24
Loss on hold-out set: 0.025020093411991472
MeanAbsoluteError value on hold-out data: 0.14417274296283722
Epoch: 25

Loss on hold-out set: 0.012980763065187554
MeanAbsoluteError value on hold-out data: 0.1007453203201294
Epoch: 26
Loss on hold-out set: 0.021319612566577762
MeanAbsoluteError value on hold-out data: 0.13200312852859497
Epoch: 27
Loss on hold-out set: 0.0014466266546055283
MeanAbsoluteError value on hold-out data: 0.03046562150120735
Epoch: 28
Loss on hold-out set: 0.020148384237759999
MeanAbsoluteError value on hold-out data: 0.12254305183887482
Epoch: 29
```

```
Loss on hold-out set: 0.019043913405192524
MeanAbsoluteError value on hold-out data: 0.13188281655311584
Epoch: 30
Loss on hold-out set: 0.01788123451957577
MeanAbsoluteError value on hold-out data: 0.12754672765731812
Epoch: 31
Loss on hold-out set: 0.016068267047797378
MeanAbsoluteError value on hold-out data: 0.11989026516675949
Epoch: 32
Loss on hold-out set: 0.026206506318167636
MeanAbsoluteError value on hold-out data: 0.15260085463523865
Epoch: 33
Loss on hold-out set: 0.0037551964694438012
MeanAbsoluteError value on hold-out data: 0.05179305747151375
Epoch: 34
Loss on hold-out set: 0.016534037299846347
MeanAbsoluteError value on hold-out data: 0.11454375088214874
Epoch: 35
Loss on hold-out set: 0.021780039134778474
MeanAbsoluteError value on hold-out data: 0.13976705074310303
Epoch: 36
Loss on hold-out set: 0.019360560923814774
MeanAbsoluteError value on hold-out data: 0.12998922169208527
Epoch: 37
Loss on hold-out set: 0.016632108507972015
MeanAbsoluteError value on hold-out data: 0.11236456781625748
Epoch: 38

Loss on hold-out set: 0.009609550482740528
MeanAbsoluteError value on hold-out data: 0.08698062598705292
Epoch: 39
Loss on hold-out set: 0.0026213552949852065
MeanAbsoluteError value on hold-out data: 0.04128136485815048
Epoch: 40
Loss on hold-out set: 0.004545811294136863
MeanAbsoluteError value on hold-out data: 0.05654878541827202
Epoch: 41
Loss on hold-out set: 0.012019734413019921
MeanAbsoluteError value on hold-out data: 0.0911654680967331
Epoch: 42
Loss on hold-out set: 0.0021897068853784156
MeanAbsoluteError value on hold-out data: 0.037805262953042984
```

```
Epoch: 43
Loss on hold-out set: 0.011845799212000872
MeanAbsoluteError value on hold-out data: 0.09676654636859894
Epoch: 44
Loss on hold-out set: 0.0015706488262175729
MeanAbsoluteError value on hold-out data: 0.03098195046186447
Epoch: 45
Loss on hold-out set: 0.011817023550209246
MeanAbsoluteError value on hold-out data: 0.09675181657075882
Epoch: 46
Loss on hold-out set: 0.0036500660567789487
MeanAbsoluteError value on hold-out data: 0.05087704211473465
Epoch: 47
Loss on hold-out set: 0.012054127861598605
MeanAbsoluteError value on hold-out data: 0.0937732458114624
Epoch: 48
Loss on hold-out set: 0.0036632561516997063
MeanAbsoluteError value on hold-out data: 0.051871124655008316
Epoch: 49
Loss on hold-out set: 0.010002700930559322
MeanAbsoluteError value on hold-out data: 0.08836892992258072
Epoch: 50
Loss on hold-out set: 0.0017529685773249519
MeanAbsoluteError value on hold-out data: 0.036038003861904144
Epoch: 51

Loss on hold-out set: 0.012807238503898444
MeanAbsoluteError value on hold-out data: 0.09916795790195465
Epoch: 52
Loss on hold-out set: 0.0014411393295679438
MeanAbsoluteError value on hold-out data: 0.03255988284945488
Epoch: 53
Loss on hold-out set: 0.010020858681711712
MeanAbsoluteError value on hold-out data: 0.08865728974342346
Epoch: 54
Loss on hold-out set: 0.0010967977332735533
MeanAbsoluteError value on hold-out data: 0.027545154094696045
Epoch: 55
Loss on hold-out set: 0.003749086356133615
MeanAbsoluteError value on hold-out data: 0.04715326800942421
Epoch: 56
Loss on hold-out set: 0.0009085094482686959
```

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MeanAbsoluteError value on hold-out data: 0.02372748963534832
Epoch: 57
Loss on hold-out set: 0.004216504356774844
MeanAbsoluteError value on hold-out data: 0.05039704963564873
Epoch: 58
Loss on hold-out set: 0.00113839271331304
MeanAbsoluteError value on hold-out data: 0.02743416465818882
Epoch: 59
Loss on hold-out set: 0.0034651552743621564
MeanAbsoluteError value on hold-out data: 0.043648239225149155
Epoch: 60
Loss on hold-out set: 0.0026478241810477094
MeanAbsoluteError value on hold-out data: 0.04363090917468071
Epoch: 61
Loss on hold-out set: 0.0011494019295481082
MeanAbsoluteError value on hold-out data: 0.025220565497875214
Epoch: 62
Loss on hold-out set: 0.004017053073958347
MeanAbsoluteError value on hold-out data: 0.04654562473297119
Epoch: 63
Loss on hold-out set: 0.00619852814921423
MeanAbsoluteError value on hold-out data: 0.0736108273267746
Epoch: 64

Loss on hold-out set: 0.0009944220272652608
MeanAbsoluteError value on hold-out data: 0.02525477297604084
Epoch: 65
Loss on hold-out set: 0.003932261288068012
MeanAbsoluteError value on hold-out data: 0.04965731129050255
Epoch: 66
Loss on hold-out set: 0.0032196178860766323
MeanAbsoluteError value on hold-out data: 0.05086735263466835
Epoch: 67
Loss on hold-out set: 0.0023863961626040308
MeanAbsoluteError value on hold-out data: 0.040996428579092026
Epoch: 68
Loss on hold-out set: 0.005003591398953607
MeanAbsoluteError value on hold-out data: 0.053333982825279236
Epoch: 69
Loss on hold-out set: 0.001222847185808381
MeanAbsoluteError value on hold-out data: 0.029520569369196892
Epoch: 70
```

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Loss on hold-out set: 0.005184581049865014
MeanAbsoluteError value on hold-out data: 0.0604010708630085
Epoch: 71
Loss on hold-out set: 0.00842072603929984
MeanAbsoluteError value on hold-out data: 0.08705155551433563
Epoch: 72
Loss on hold-out set: 0.0013399173131849814
MeanAbsoluteError value on hold-out data: 0.030982598662376404
Epoch: 73
Loss on hold-out set: 0.00391047563109743
MeanAbsoluteError value on hold-out data: 0.04726013168692589
Epoch: 74
Loss on hold-out set: 0.0017702325406533323
MeanAbsoluteError value on hold-out data: 0.03602517396211624
Epoch: 75
Loss on hold-out set: 0.004121942911297083
MeanAbsoluteError value on hold-out data: 0.04892146587371826
Epoch: 76
Loss on hold-out set: 0.0012593376143884502
MeanAbsoluteError value on hold-out data: 0.027530085295438766
Epoch: 77

Loss on hold-out set: 0.004139133287887824
MeanAbsoluteError value on hold-out data: 0.05176819488406181
Epoch: 78
Loss on hold-out set: 0.008053039519214317
MeanAbsoluteError value on hold-out data: 0.08490050584077835
Epoch: 79
Loss on hold-out set: 0.00441865520061631
MeanAbsoluteError value on hold-out data: 0.0619918555021286
Epoch: 80
Loss on hold-out set: 0.003099089647692285
MeanAbsoluteError value on hold-out data: 0.04806342348456383
Epoch: 81
Loss on hold-out set: 0.004507552366703749
MeanAbsoluteError value on hold-out data: 0.061513468623161316
Epoch: 82
Loss on hold-out set: 0.00911909072218757
MeanAbsoluteError value on hold-out data: 0.09186533838510513
Epoch: 83
Loss on hold-out set: 0.003089140573712556
MeanAbsoluteError value on hold-out data: 0.05053725466132164
```

```
Epoch: 84
Loss on hold-out set: 0.0028555585610631263
MeanAbsoluteError value on hold-out data: 0.042323801666498184
Epoch: 85
Loss on hold-out set: 0.0031955582702434377
MeanAbsoluteError value on hold-out data: 0.045185599476099014
Epoch: 86
Loss on hold-out set: 0.0006028280997844903
MeanAbsoluteError value on hold-out data: 0.019996562972664833
Epoch: 87
Loss on hold-out set: 0.0029721222756626574
MeanAbsoluteError value on hold-out data: 0.042872216552495956
Epoch: 88
Loss on hold-out set: 0.0007681963983678111
MeanAbsoluteError value on hold-out data: 0.021022478118538857
Epoch: 89
Loss on hold-out set: 0.0027529701749843204
MeanAbsoluteError value on hold-out data: 0.04034098982810974
Epoch: 90

Loss on hold-out set: 0.0005700384897768105
MeanAbsoluteError value on hold-out data: 0.018652446568012238
Epoch: 91
Loss on hold-out set: 0.0030860700828366375
MeanAbsoluteError value on hold-out data: 0.04215118661522865
Epoch: 92
Loss on hold-out set: 0.0007704513386431101
MeanAbsoluteError value on hold-out data: 0.021843384951353073
Epoch: 93
Loss on hold-out set: 0.0033416241640225053
MeanAbsoluteError value on hold-out data: 0.04384107142686844
Epoch: 94
Loss on hold-out set: 0.0005475079279245907
MeanAbsoluteError value on hold-out data: 0.018205778673291206
Epoch: 95
Loss on hold-out set: 0.003605642233436045
MeanAbsoluteError value on hold-out data: 0.04555308073759079
Epoch: 96
Loss on hold-out set: 0.0014632143797107826
MeanAbsoluteError value on hold-out data: 0.0325477235019207
Epoch: 97
Loss on hold-out set: 0.003432394783502739
```

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MeanAbsoluteError value on hold-out data: 0.044498641043901443
Epoch: 98
Loss on hold-out set: 0.0007359942453484493
MeanAbsoluteError value on hold-out data: 0.02203724905848503
Epoch: 99
Loss on hold-out set: 0.0033174578933731504
MeanAbsoluteError value on hold-out data: 0.043653927743434906
Epoch: 100
Loss on hold-out set: 0.0007921275621476142
MeanAbsoluteError value on hold-out data: 0.022128727287054062
Epoch: 101
Loss on hold-out set: 0.002907265284049668
MeanAbsoluteError value on hold-out data: 0.04152923822402954
Epoch: 102
Loss on hold-out set: 0.0007401864338470133
MeanAbsoluteError value on hold-out data: 0.020950647071003914
Epoch: 103

Loss on hold-out set: 0.002776808178934612
MeanAbsoluteError value on hold-out data: 0.04023229703307152
Epoch: 104
Loss on hold-out set: 0.0005074247256791415
MeanAbsoluteError value on hold-out data: 0.017418263480067253
Epoch: 105
Loss on hold-out set: 0.0032541346246082532
MeanAbsoluteError value on hold-out data: 0.0437132865190506
Epoch: 106
Loss on hold-out set: 0.0005691613424508097
MeanAbsoluteError value on hold-out data: 0.017795102670788765
Epoch: 107
Loss on hold-out set: 0.0032695094736194925
MeanAbsoluteError value on hold-out data: 0.04430049657821655
Epoch: 108
Loss on hold-out set: 0.0006015645968115056
MeanAbsoluteError value on hold-out data: 0.018935685977339745
Epoch: 109
Loss on hold-out set: 0.00300256771917798
MeanAbsoluteError value on hold-out data: 0.042554281651973724
Epoch: 110
Loss on hold-out set: 0.0006229811528771135
MeanAbsoluteError value on hold-out data: 0.01987539231777191
Epoch: 111
```

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Loss on hold-out set: 0.002707128462038542
MeanAbsoluteError value on hold-out data: 0.03967844322323799
Epoch: 112
Loss on hold-out set: 0.0005739532107805932
MeanAbsoluteError value on hold-out data: 0.019021566957235336
Epoch: 113
Loss on hold-out set: 0.002798207441197806
MeanAbsoluteError value on hold-out data: 0.041023027151823044
Epoch: 114
Loss on hold-out set: 0.0004998204760915158
MeanAbsoluteError value on hold-out data: 0.017166228964924812
Epoch: 115
Loss on hold-out set: 0.0025105145269710767
MeanAbsoluteError value on hold-out data: 0.03926488384604454
Epoch: 116


Loss on hold-out set: 0.0007535651644789859
MeanAbsoluteError value on hold-out data: 0.022010894492268562
Epoch: 117
Loss on hold-out set: 0.0026416818452018654
MeanAbsoluteError value on hold-out data: 0.04086760804057121
Epoch: 118
Loss on hold-out set: 0.0007953153613734207
MeanAbsoluteError value on hold-out data: 0.023303179070353508
Epoch: 119
Loss on hold-out set: 0.0026327035953535847
MeanAbsoluteError value on hold-out data: 0.04036536440253258
Epoch: 120
Loss on hold-out set: 0.00045125857210031857
MeanAbsoluteError value on hold-out data: 0.016486957669258118
Epoch: 121
Loss on hold-out set: 0.002325170495743422
MeanAbsoluteError value on hold-out data: 0.03825153410434723
Epoch: 122
Loss on hold-out set: 0.0006896833579766712
MeanAbsoluteError value on hold-out data: 0.019982807338237762
Epoch: 123
Loss on hold-out set: 0.002895599745802189
MeanAbsoluteError value on hold-out data: 0.04169876500964165
Epoch: 124
Loss on hold-out set: 0.0006856955587863922
MeanAbsoluteError value on hold-out data: 0.019863300025463104
```

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Epoch: 125
Loss on hold-out set: 0.0023915133267445
MeanAbsoluteError value on hold-out data: 0.039929091930389404
Epoch: 126
Loss on hold-out set: 0.00047810800912740986
MeanAbsoluteError value on hold-out data: 0.016787348315119743
Epoch: 127
Loss on hold-out set: 0.0023473023228641403
MeanAbsoluteError value on hold-out data: 0.03916903957724571
Epoch: 128
Loss on hold-out set: 0.0006577014734686696
MeanAbsoluteError value on hold-out data: 0.01928628422319889
Epoch: 129


Loss on hold-out set: 0.0021185949812398143
MeanAbsoluteError value on hold-out data: 0.037366919219493866
Epoch: 130
Loss on hold-out set: 0.0005059972969128898
MeanAbsoluteError value on hold-out data: 0.01758807897567749
Epoch: 131
Loss on hold-out set: 0.011089030702255274
MeanAbsoluteError value on hold-out data: 0.10265344381332397
Epoch: 132
Loss on hold-out set: 0.002191202773246914
MeanAbsoluteError value on hold-out data: 0.03995034843683243
Epoch: 133
Loss on hold-out set: 0.00820708718444956
MeanAbsoluteError value on hold-out data: 0.08789046108722687
Epoch: 134
Loss on hold-out set: 0.0019411947088021982
MeanAbsoluteError value on hold-out data: 0.03795431926846504
Epoch: 135
Loss on hold-out set: 0.006971286879362245
MeanAbsoluteError value on hold-out data: 0.08034688979387283
Epoch: 136
Loss on hold-out set: 0.0030487391264422945
MeanAbsoluteError value on hold-out data: 0.04490363970398903
Epoch: 137
Loss on hold-out set: 0.007260622971348073
MeanAbsoluteError value on hold-out data: 0.0823143795132637
Epoch: 138
Loss on hold-out set: 0.0030047812646156863
```

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MeanAbsoluteError value on hold-out data: 0.04522993788123131
Epoch: 139
Loss on hold-out set: 0.007795230044346107
MeanAbsoluteError value on hold-out data: 0.08562655746936798
Epoch: 140
Loss on hold-out set: 0.002524074675564311
MeanAbsoluteError value on hold-out data: 0.04230862483382225
Epoch: 141
Loss on hold-out set: 0.007318856709293629
MeanAbsoluteError value on hold-out data: 0.08278022706508636
Epoch: 142

Loss on hold-out set: 0.002113406353409549
MeanAbsoluteError value on hold-out data: 0.038896359503269196
Epoch: 143
Loss on hold-out set: 0.006727375408732577
MeanAbsoluteError value on hold-out data: 0.07908408343791962
Epoch: 144
Loss on hold-out set: 0.003176058121760817
MeanAbsoluteError value on hold-out data: 0.046365294605493546
Epoch: 145
Loss on hold-out set: 0.005002076161633197
MeanAbsoluteError value on hold-out data: 0.06748632341623306
Epoch: 146
Loss on hold-out set: 0.0021711377224786894
MeanAbsoluteError value on hold-out data: 0.039236970245838165
Epoch: 147
Loss on hold-out set: 0.007883267428137754
MeanAbsoluteError value on hold-out data: 0.08582033962011337
Epoch: 148
Loss on hold-out set: 0.0015434089551777824
MeanAbsoluteError value on hold-out data: 0.03317975625395775
Epoch: 149
Loss on hold-out set: 0.005069366080294314
MeanAbsoluteError value on hold-out data: 0.06775770336389542
Epoch: 150
Loss on hold-out set: 0.0009390291448461971
MeanAbsoluteError value on hold-out data: 0.02527259849011898
Epoch: 151
Loss on hold-out set: 0.005887867711288364
MeanAbsoluteError value on hold-out data: 0.07354728877544403
Epoch: 152
```

```
Loss on hold-out set: 0.0036251845977906334
MeanAbsoluteError value on hold-out data: 0.05008489638566971
Epoch: 153
Loss on hold-out set: 0.005697794601713356
MeanAbsoluteError value on hold-out data: 0.07142506539821625
Epoch: 154
Loss on hold-out set: 0.0022658957781172113
MeanAbsoluteError value on hold-out data: 0.04094138741493225
Epoch: 155

Loss on hold-out set: 0.004267349655396845
MeanAbsoluteError value on hold-out data: 0.061668142676353455
Epoch: 156
Loss on hold-out set: 0.001942176570944292
MeanAbsoluteError value on hold-out data: 0.038410842418670654
Epoch: 157
Loss on hold-out set: 0.0035494053001074413
MeanAbsoluteError value on hold-out data: 0.05553201213479042
Epoch: 158
Loss on hold-out set: 0.0012850194011422757
MeanAbsoluteError value on hold-out data: 0.030353546142578125
Epoch: 159
Loss on hold-out set: 0.002631845087499211
MeanAbsoluteError value on hold-out data: 0.04736199229955673
Epoch: 160
Loss on hold-out set: 0.0023689887265821823
MeanAbsoluteError value on hold-out data: 0.04170748218894005
Epoch: 161
Loss on hold-out set: 0.004111812670568102
MeanAbsoluteError value on hold-out data: 0.06061776354908943
Epoch: 162
Loss on hold-out set: 0.002813014214074141
MeanAbsoluteError value on hold-out data: 0.04513413459062576
Epoch: 163
Loss on hold-out set: 0.003138844254671743
MeanAbsoluteError value on hold-out data: 0.052076440304517746
Epoch: 164
Loss on hold-out set: 0.0022975384735649355
MeanAbsoluteError value on hold-out data: 0.041134823113679886
Epoch: 165
Loss on hold-out set: 0.004246131247399669
MeanAbsoluteError value on hold-out data: 0.061548881232738495
```

```
Epoch: 166
Loss on hold-out set: 0.002323273903273634
MeanAbsoluteError value on hold-out data: 0.041913654655218124
Epoch: 167
Loss on hold-out set: 0.002380904030839079
MeanAbsoluteError value on hold-out data: 0.044313084334135056
Epoch: 168


Loss on hold-out set: 0.002852016195997988
MeanAbsoluteError value on hold-out data: 0.04452536627650261
Epoch: 169
Loss on hold-out set: 0.0031074541375825278
MeanAbsoluteError value on hold-out data: 0.05190883204340935
Epoch: 170
Loss on hold-out set: 0.004392865028134302
MeanAbsoluteError value on hold-out data: 0.05333080142736435
Epoch: 171
Loss on hold-out set: 0.003581399943581537
MeanAbsoluteError value on hold-out data: 0.05608862638473511
Epoch: 172
Loss on hold-out set: 0.004094847306413085
MeanAbsoluteError value on hold-out data: 0.05185148864984512
Epoch: 173
Loss on hold-out set: 0.0028208044210546895
MeanAbsoluteError value on hold-out data: 0.048705339431762695
Epoch: 174
Loss on hold-out set: 0.002148220147079739
MeanAbsoluteError value on hold-out data: 0.03913868963718414
Epoch: 175
Loss on hold-out set: 0.0017088665626943111
MeanAbsoluteError value on hold-out data: 0.035542212426662445
Epoch: 176
Loss on hold-out set: 0.0028817279687102294
MeanAbsoluteError value on hold-out data: 0.045569710433483124
Epoch: 177
Loss on hold-out set: 0.0004116837693513126
MeanAbsoluteError value on hold-out data: 0.016531504690647125
Epoch: 178
Loss on hold-out set: 0.0031629368344223813
MeanAbsoluteError value on hold-out data: 0.052216775715351105
Epoch: 179
Loss on hold-out set: 0.002284439060052759
```

```
MeanAbsoluteError value on hold-out data: 0.0409570187330246
Epoch: 180
Loss on hold-out set: 0.0017542691202834249
MeanAbsoluteError value on hold-out data: 0.03749581798911095
Epoch: 181

Loss on hold-out set: 0.002133233466577765
MeanAbsoluteError value on hold-out data: 0.03960353508591652
Epoch: 182
Loss on hold-out set: 0.0033818701355669057
MeanAbsoluteError value on hold-out data: 0.05388569459319115
Epoch: 183
Loss on hold-out set: 0.0014932221782050635
MeanAbsoluteError value on hold-out data: 0.03379014506936073
Epoch: 184
Loss on hold-out set: 0.0023789404842414355
MeanAbsoluteError value on hold-out data: 0.04449847713112831
Epoch: 185
Loss on hold-out set: 0.003944454512460844
MeanAbsoluteError value on hold-out data: 0.05338483676314354
Epoch: 186
Loss on hold-out set: 0.003555062043137456
MeanAbsoluteError value on hold-out data: 0.05599358305335045
Epoch: 187
Loss on hold-out set: 0.0021209704297545707
MeanAbsoluteError value on hold-out data: 0.040656425058841705
Epoch: 188
Loss on hold-out set: 0.0020925662676362614
MeanAbsoluteError value on hold-out data: 0.041317667812108994
Epoch: 189
Loss on hold-out set: 0.0042488782200962305
MeanAbsoluteError value on hold-out data: 0.05326073616743088
Epoch: 190
Loss on hold-out set: 0.003461458622232864
MeanAbsoluteError value on hold-out data: 0.05491535738110542
Epoch: 191
Loss on hold-out set: 0.003892453626337412
MeanAbsoluteError value on hold-out data: 0.05161666497588158
Epoch: 192
Loss on hold-out set: 0.0024584897144354486
MeanAbsoluteError value on hold-out data: 0.04512469470500946
Epoch: 193
```

```
Loss on hold-out set: 0.0033760342967549435
MeanAbsoluteError value on hold-out data: 0.04737125337123871
Epoch: 194

Loss on hold-out set: 0.003704440375593932
MeanAbsoluteError value on hold-out data: 0.05672026798129082
Epoch: 195
Loss on hold-out set: 0.004446987675404863
MeanAbsoluteError value on hold-out data: 0.05395789444446564
Epoch: 196
Loss on hold-out set: 0.002201494368675508
MeanAbsoluteError value on hold-out data: 0.042196642607450485
Epoch: 197
Loss on hold-out set: 0.0004432424091072263
MeanAbsoluteError value on hold-out data: 0.016408687457442284
Epoch: 198
Loss on hold-out set: 0.0021490930322263587
MeanAbsoluteError value on hold-out data: 0.040006935596466064
Epoch: 199
Loss on hold-out set: 0.0005613307661597469
MeanAbsoluteError value on hold-out data: 0.02013433538377285
Epoch: 200
Loss on hold-out set: 0.0009404675618402267
MeanAbsoluteError value on hold-out data: 0.02624194510281086
Epoch: 201
Loss on hold-out set: 0.002261796616949141
MeanAbsoluteError value on hold-out data: 0.03891469165682793
Epoch: 202
Loss on hold-out set: 0.003352521171205138
MeanAbsoluteError value on hold-out data: 0.05358816683292389
Epoch: 203
Loss on hold-out set: 0.004650064505097505
MeanAbsoluteError value on hold-out data: 0.05486209690570831
Epoch: 204
Loss on hold-out set: 0.002075837808661163
MeanAbsoluteError value on hold-out data: 0.03973175585269928
Epoch: 205
Loss on hold-out set: 0.0005616421151085218
MeanAbsoluteError value on hold-out data: 0.01974596455693245
Epoch: 206
Loss on hold-out set: 0.0005582586408739811
MeanAbsoluteError value on hold-out data: 0.017721127718687057
Epoch: 207
```

```
Loss on hold-out set: 0.001018411300672022
MeanAbsoluteError value on hold-out data: 0.026562528684735298
Epoch: 208
Loss on hold-out set: 0.003429529355152657
MeanAbsoluteError value on hold-out data: 0.054590046405792236
Epoch: 209
Loss on hold-out set: 0.00039755259441383377
MeanAbsoluteError value on hold-out data: 0.014961153268814087
Epoch: 210
Loss on hold-out set: 0.0021630063420161605
MeanAbsoluteError value on hold-out data: 0.042665645480155945
Epoch: 211
Loss on hold-out set: 0.0008641788215180369
MeanAbsoluteError value on hold-out data: 0.023284820839762688
Epoch: 212
Loss on hold-out set: 0.0035435778677071397
MeanAbsoluteError value on hold-out data: 0.05469316989183426
Epoch: 213
Loss on hold-out set: 0.005045357601423012
MeanAbsoluteError value on hold-out data: 0.05875539034605026
Epoch: 214
Loss on hold-out set: 0.0007287966834969426
MeanAbsoluteError value on hold-out data: 0.02227090485394001
Epoch: 215
Loss on hold-out set: 0.0037877008098324665
MeanAbsoluteError value on hold-out data: 0.05209411680698395
Epoch: 216
Loss on hold-out set: 0.0009889472582328477
MeanAbsoluteError value on hold-out data: 0.025654880329966545
Epoch: 217
Loss on hold-out set: 0.0034926437870844416
MeanAbsoluteError value on hold-out data: 0.048009779304265976
Epoch: 218
Loss on hold-out set: 0.003134902738230793
MeanAbsoluteError value on hold-out data: 0.052258893847465515
Epoch: 219
Loss on hold-out set: 0.003063472551538756
MeanAbsoluteError value on hold-out data: 0.04713156446814537
Epoch: 220

Loss on hold-out set: 0.0013918425109678584
MeanAbsoluteError value on hold-out data: 0.03129615634679794
```

```
Epoch: 221
Loss on hold-out set: 0.0008167923630313261
MeanAbsoluteError value on hold-out data: 0.024150235578417778
Epoch: 222
Loss on hold-out set: 0.0015758552441471501
MeanAbsoluteError value on hold-out data: 0.03511393815279007
Epoch: 223
Loss on hold-out set: 0.0020456450231569378
MeanAbsoluteError value on hold-out data: 0.038738638162612915
Epoch: 224
Loss on hold-out set: 0.0015861193839411594
MeanAbsoluteError value on hold-out data: 0.034156132489442825
Epoch: 225
Loss on hold-out set: 0.0006856832830970617
MeanAbsoluteError value on hold-out data: 0.020812518894672394
Epoch: 226
Loss on hold-out set: 0.0010901321932722471
MeanAbsoluteError value on hold-out data: 0.02905872091650963
Epoch: 227
Loss on hold-out set: 0.0009523460543469378
MeanAbsoluteError value on hold-out data: 0.025817746296525
Epoch: 228
Loss on hold-out set: 0.0023358147407538795
MeanAbsoluteError value on hold-out data: 0.044663768261671066
Epoch: 229
Loss on hold-out set: 0.0005641818156858024
MeanAbsoluteError value on hold-out data: 0.018706226721405983
Epoch: 230
Loss on hold-out set: 0.00317693516415985
MeanAbsoluteError value on hold-out data: 0.04751204699277878
Epoch: 231
Loss on hold-out set: 0.0010868455038258904
MeanAbsoluteError value on hold-out data: 0.028064755722880363
Epoch: 232
Loss on hold-out set: 0.0015869454915733321
MeanAbsoluteError value on hold-out data: 0.033522073179483414
Epoch: 233

Loss on hold-out set: 0.0008235874824765089
MeanAbsoluteError value on hold-out data: 0.023771410807967186
Epoch: 234
Loss on hold-out set: 0.0013457253409892712
```

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MeanAbsoluteError value on hold-out data: 0.03275909274816513
Epoch: 235
Loss on hold-out set: 0.0017035880040279345
MeanAbsoluteError value on hold-out data: 0.034540776163339615
Epoch: 236
Loss on hold-out set: 0.0019032144428868043
MeanAbsoluteError value on hold-out data: 0.03778570890426636
Epoch: 237
Loss on hold-out set: 0.00035585000832246517
MeanAbsoluteError value on hold-out data: 0.014415538869798183
Epoch: 238
Loss on hold-out set: 0.001272139072075094
MeanAbsoluteError value on hold-out data: 0.03050241805613041
Epoch: 239
Loss on hold-out set: 0.0006518830946573105
MeanAbsoluteError value on hold-out data: 0.021270357072353363
Epoch: 240
Loss on hold-out set: 0.0015282328546929516
MeanAbsoluteError value on hold-out data: 0.03433831036090851
Epoch: 241
Loss on hold-out set: 0.0025066857985956105
MeanAbsoluteError value on hold-out data: 0.04145857319235802
Epoch: 242
Loss on hold-out set: 0.001379090067195265
MeanAbsoluteError value on hold-out data: 0.03333864361047745
Epoch: 243
Loss on hold-out set: 0.0010325720435694645
MeanAbsoluteError value on hold-out data: 0.027469901368021965
Epoch: 244
Loss on hold-out set: 0.0012103310835204627
MeanAbsoluteError value on hold-out data: 0.029534686356782913
Epoch: 245
Loss on hold-out set: 0.0002879233836306651
MeanAbsoluteError value on hold-out data: 0.013242877088487148
Epoch: 246

Loss on hold-out set: 0.0009324200126636578
MeanAbsoluteError value on hold-out data: 0.02471594139933586
Epoch: 247
Loss on hold-out set: 0.0015237340060258774
MeanAbsoluteError value on hold-out data: 0.032972972840070724
Epoch: 248
```

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Loss on hold-out set: 0.0009904560130579692
MeanAbsoluteError value on hold-out data: 0.027625633403658867
Epoch: 249
Loss on hold-out set: 0.0017799646256638592
MeanAbsoluteError value on hold-out data: 0.036655765026807785
Epoch: 250
Loss on hold-out set: 0.00019546744174716113
MeanAbsoluteError value on hold-out data: 0.010332364588975906
Epoch: 251
Loss on hold-out set: 0.0002411649429153553
MeanAbsoluteError value on hold-out data: 0.01220589317381382
Epoch: 252
Loss on hold-out set: 0.001518790319096297
MeanAbsoluteError value on hold-out data: 0.033805981278419495
Epoch: 253
Loss on hold-out set: 0.001698311007777719
MeanAbsoluteError value on hold-out data: 0.03823564201593399
Epoch: 254
Loss on hold-out set: 0.001035204760754775
MeanAbsoluteError value on hold-out data: 0.026915794238448143
Epoch: 255
Loss on hold-out set: 0.002233712600029417
MeanAbsoluteError value on hold-out data: 0.039894670248031616
Epoch: 256
Loss on hold-out set: 0.00089574622688815
MeanAbsoluteError value on hold-out data: 0.024029644206166267
Epoch: 257
Loss on hold-out set: 0.0002180363762339479
MeanAbsoluteError value on hold-out data: 0.01096766721457243
Epoch: 258
Loss on hold-out set: 0.0012159152477244405
MeanAbsoluteError value on hold-out data: 0.030926764011383057
Epoch: 259

Loss on hold-out set: 0.0026546520989780362
MeanAbsoluteError value on hold-out data: 0.043387945741415024
Epoch: 260
Loss on hold-out set: 0.00047517795265823796
MeanAbsoluteError value on hold-out data: 0.01677473448216915
Epoch: 261
Loss on hold-out set: 0.0018477466410810226
MeanAbsoluteError value on hold-out data: 0.03729848936200142
```

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Epoch: 262
Loss on hold-out set: 0.0004745881757882767
MeanAbsoluteError value on hold-out data: 0.017003530636429787
Epoch: 263
Loss on hold-out set: 0.0015432367125820172
MeanAbsoluteError value on hold-out data: 0.03521205857396126
Epoch: 264
Loss on hold-out set: 0.0018243595504349
MeanAbsoluteError value on hold-out data: 0.03446503356099129
Epoch: 265
Loss on hold-out set: 0.0023956367022995102
MeanAbsoluteError value on hold-out data: 0.04232276603579521
Epoch: 266
Loss on hold-out set: 0.0011951606873864013
MeanAbsoluteError value on hold-out data: 0.028526032343506813
Epoch: 267
Loss on hold-out set: 0.0010203015990555286
MeanAbsoluteError value on hold-out data: 0.027429400011897087
Epoch: 268
Loss on hold-out set: 0.0007582369159392424
MeanAbsoluteError value on hold-out data: 0.023234352469444275
Epoch: 269
Loss on hold-out set: 0.00230801963909088
MeanAbsoluteError value on hold-out data: 0.0411214716732502
Epoch: 270
Loss on hold-out set: 0.0004987494987864537
MeanAbsoluteError value on hold-out data: 0.017710985615849495
Epoch: 271
Loss on hold-out set: 0.0004948302115448506
MeanAbsoluteError value on hold-out data: 0.017273254692554474
Epoch: 272

Loss on hold-out set: 0.0018695272247944224
MeanAbsoluteError value on hold-out data: 0.0377032496035099
Epoch: 273
Loss on hold-out set: 0.0007733873836083436
MeanAbsoluteError value on hold-out data: 0.023706428706645966
Epoch: 274
Loss on hold-out set: 0.002022886308718865
MeanAbsoluteError value on hold-out data: 0.03753839060664177
Epoch: 275
Loss on hold-out set: 0.0013841862918956107
```

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MeanAbsoluteError value on hold-out data: 0.029733235016465187
Epoch: 276
Loss on hold-out set: 0.001152195937098249
MeanAbsoluteError value on hold-out data: 0.030024327337741852
Epoch: 277
Loss on hold-out set: 0.00212602975692502
MeanAbsoluteError value on hold-out data: 0.039372220635414124
Epoch: 278
Loss on hold-out set: 0.0014037227497043971
MeanAbsoluteError value on hold-out data: 0.03124658204615116
Epoch: 279
Loss on hold-out set: 0.0007967898165684586
MeanAbsoluteError value on hold-out data: 0.024247748777270317
Epoch: 280
Loss on hold-out set: 0.001768996016931181
MeanAbsoluteError value on hold-out data: 0.03616556525230408
Epoch: 281
Loss on hold-out set: 0.0013931380756395427
MeanAbsoluteError value on hold-out data: 0.03303784504532814
Epoch: 282
Loss on hold-out set: 0.00047508283368140266
MeanAbsoluteError value on hold-out data: 0.017539380118250847
Epoch: 283
Loss on hold-out set: 0.001639837910739803
MeanAbsoluteError value on hold-out data: 0.03499840199947357
Epoch: 284

Loss on hold-out set: 0.000719069545371703
MeanAbsoluteError value on hold-out data: 0.01996178738772869
Epoch: 285
Loss on hold-out set: 0.002040464624051789
MeanAbsoluteError value on hold-out data: 0.03978688269853592
Epoch: 286
Loss on hold-out set: 0.00046925981663853715
MeanAbsoluteError value on hold-out data: 0.01596950553357601
Epoch: 287
Loss on hold-out set: 0.0012921032949203724
MeanAbsoluteError value on hold-out data: 0.03173631802201271
Epoch: 288
Loss on hold-out set: 0.0024284242627848136
MeanAbsoluteError value on hold-out data: 0.04157300293445587
Epoch: 289
```

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Loss on hold-out set: 0.0007558993881837906
MeanAbsoluteError value on hold-out data: 0.023141181096434593
Epoch: 290
Loss on hold-out set: 0.0013892660530186013
MeanAbsoluteError value on hold-out data: 0.031041612848639488
Epoch: 291
Loss on hold-out set: 0.0019206775958943915
MeanAbsoluteError value on hold-out data: 0.03822518512606621
Epoch: 292
Loss on hold-out set: 0.00020122603746131063
MeanAbsoluteError value on hold-out data: 0.010988850146532059
Epoch: 293
Loss on hold-out set: 0.002102539715308108
MeanAbsoluteError value on hold-out data: 0.04047783091664314
Epoch: 294
Loss on hold-out set: 0.0008771169783645554
MeanAbsoluteError value on hold-out data: 0.02580428682267666
Epoch: 295
Loss on hold-out set: 0.0012945447570497268
MeanAbsoluteError value on hold-out data: 0.030976898968219757
Epoch: 296

Loss on hold-out set: 0.0009105632412492445
MeanAbsoluteError value on hold-out data: 0.025644049048423767
Epoch: 297
Loss on hold-out set: 0.001685827186233119
MeanAbsoluteError value on hold-out data: 0.034238625317811966
Epoch: 298
Loss on hold-out set: 0.0012435760581865907
MeanAbsoluteError value on hold-out data: 0.03039407730102539
Epoch: 299
Loss on hold-out set: 0.00020781348805604992
MeanAbsoluteError value on hold-out data: 0.011048554442822933
Epoch: 300
Loss on hold-out set: 0.0010677467339280013
MeanAbsoluteError value on hold-out data: 0.02845720201730728
Epoch: 301
Loss on hold-out set: 0.0010623514137573932
MeanAbsoluteError value on hold-out data: 0.027780568227171898
Epoch: 302
Loss on hold-out set: 0.0008803581524836389
MeanAbsoluteError value on hold-out data: 0.025116607546806335
```

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Epoch: 303
Loss on hold-out set: 0.0007627928954255032
MeanAbsoluteError value on hold-out data: 0.02299867384135723
Epoch: 304
Loss on hold-out set: 0.0016157806109588005
MeanAbsoluteError value on hold-out data: 0.03519415110349655
Epoch: 305
Loss on hold-out set: 0.00034110393607988954
MeanAbsoluteError value on hold-out data: 0.014192099682986736
Epoch: 306
Loss on hold-out set: 0.00023954395452930935
MeanAbsoluteError value on hold-out data: 0.012078113853931427
Epoch: 307
Loss on hold-out set: 0.0019338028076545972
MeanAbsoluteError value on hold-out data: 0.037615835666656494
Epoch: 308
Loss on hold-out set: 0.0015330015877751929
MeanAbsoluteError value on hold-out data: 0.03645837679505348
Epoch: 309

Loss on hold-out set: 0.0004334671133332641
MeanAbsoluteError value on hold-out data: 0.016387784853577614
Epoch: 310
Loss on hold-out set: 0.0011026545329705666
MeanAbsoluteError value on hold-out data: 0.028425931930541992
Epoch: 311
Loss on hold-out set: 0.0005969764039802708
MeanAbsoluteError value on hold-out data: 0.018008079379796982
Epoch: 312
Loss on hold-out set: 0.0025838591575034356
MeanAbsoluteError value on hold-out data: 0.04472406953573227
Epoch: 313
Loss on hold-out set: 0.0008008443638621094
MeanAbsoluteError value on hold-out data: 0.021316425874829292
Epoch: 314
Loss on hold-out set: 0.0006951768499627514
MeanAbsoluteError value on hold-out data: 0.021993186324834824
Epoch: 315
Loss on hold-out set: 0.0006343862593272014
MeanAbsoluteError value on hold-out data: 0.021840352565050125
Epoch: 316
Loss on hold-out set: 0.0009948247905796099
```

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MeanAbsoluteError value on hold-out data: 0.027555016800761223
Epoch: 317
Loss on hold-out set: 0.0007124511589369687
MeanAbsoluteError value on hold-out data: 0.020669130608439445
Epoch: 318
Loss on hold-out set: 0.0016193482473394589
MeanAbsoluteError value on hold-out data: 0.03776536509394646
Epoch: 319
Loss on hold-out set: 0.0004022038077604712
MeanAbsoluteError value on hold-out data: 0.015249861404299736
Epoch: 320
Loss on hold-out set: 0.0016397695136746687
MeanAbsoluteError value on hold-out data: 0.03522268682718277
Epoch: 321


Loss on hold-out set: 0.00108217891906143
MeanAbsoluteError value on hold-out data: 0.027653200551867485
Epoch: 322
Loss on hold-out set: 0.0010220338559807523
MeanAbsoluteError value on hold-out data: 0.028256285935640335
Epoch: 323
Loss on hold-out set: 0.0019150680531502555
MeanAbsoluteError value on hold-out data: 0.038212548941373825
Epoch: 324
Loss on hold-out set: 0.0003625995818047637
MeanAbsoluteError value on hold-out data: 0.014881801791489124
Epoch: 325
Loss on hold-out set: 0.0010782565100510653
MeanAbsoluteError value on hold-out data: 0.028872687369585037
Epoch: 326
Loss on hold-out set: 0.0019031929489421217
MeanAbsoluteError value on hold-out data: 0.03747791051864624
Epoch: 327
Loss on hold-out set: 0.0012714785131576814
MeanAbsoluteError value on hold-out data: 0.028039883822202682
Epoch: 328
Loss on hold-out set: 0.0006893530831133065
MeanAbsoluteError value on hold-out data: 0.022050073370337486
Epoch: 329
Loss on hold-out set: 0.0013723137089982629
MeanAbsoluteError value on hold-out data: 0.032180581241846085
Epoch: 330
```

```
Loss on hold-out set: 0.001490290436011396
MeanAbsoluteError value on hold-out data: 0.03202150762081146
Epoch: 331
Loss on hold-out set: 0.001125764677693185
MeanAbsoluteError value on hold-out data: 0.029786501079797745
Epoch: 332
Loss on hold-out set: 0.0009413135810877735
MeanAbsoluteError value on hold-out data: 0.02643689513206482
Epoch: 333

Loss on hold-out set: 0.001486842940242863
MeanAbsoluteError value on hold-out data: 0.030870037153363228
Epoch: 334
Loss on hold-out set: 0.0007472442276163125
MeanAbsoluteError value on hold-out data: 0.023379839956760406
Epoch: 335
Loss on hold-out set: 0.0014396744388106622
MeanAbsoluteError value on hold-out data: 0.03329187259078026
Epoch: 336
Loss on hold-out set: 0.0019952915241255574
MeanAbsoluteError value on hold-out data: 0.038912516087293625
Epoch: 337
Loss on hold-out set: 0.0009952301165628199
MeanAbsoluteError value on hold-out data: 0.02796383947134018
Epoch: 338
Loss on hold-out set: 0.001191308225603088
MeanAbsoluteError value on hold-out data: 0.030401192605495453
Epoch: 339
Loss on hold-out set: 0.001190004977520163
MeanAbsoluteError value on hold-out data: 0.029769273474812508
Epoch: 340
Loss on hold-out set: 0.0006396274440799301
MeanAbsoluteError value on hold-out data: 0.021598858758807182
Epoch: 341
Loss on hold-out set: 0.0019293045870175487
MeanAbsoluteError value on hold-out data: 0.03834064304828644
Epoch: 342
Loss on hold-out set: 0.0004499614917317797
MeanAbsoluteError value on hold-out data: 0.01718553900718689
Epoch: 343
Loss on hold-out set: 0.00046216500968990947
MeanAbsoluteError value on hold-out data: 0.016639217734336853
```

```
Epoch: 344
Loss on hold-out set: 0.0013709196355193853
MeanAbsoluteError value on hold-out data: 0.032148391008377075
Epoch: 345
Loss on hold-out set: 0.0010042237301700209
MeanAbsoluteError value on hold-out data: 0.026964692398905754

Epoch: 346
Loss on hold-out set: 0.0012514405320153425
MeanAbsoluteError value on hold-out data: 0.030747652053833008
Epoch: 347
Loss on hold-out set: 0.001017196670689277
MeanAbsoluteError value on hold-out data: 0.02773817628622055
Epoch: 348
Loss on hold-out set: 0.001118692244697166
MeanAbsoluteError value on hold-out data: 0.028296642005443573
Epoch: 349
Loss on hold-out set: 0.0007665893736932622
MeanAbsoluteError value on hold-out data: 0.02293236181139946
Epoch: 350
Loss on hold-out set: 0.0005700052103125735
MeanAbsoluteError value on hold-out data: 0.020081449300050735
Epoch: 351
Loss on hold-out set: 0.0004762901578368129
MeanAbsoluteError value on hold-out data: 0.01749672181904316
Epoch: 352
Loss on hold-out set: 0.0012440062464999133
MeanAbsoluteError value on hold-out data: 0.030433673411607742
Epoch: 353
Loss on hold-out set: 0.0005670803519406993
MeanAbsoluteError value on hold-out data: 0.020014455541968346
Epoch: 354
Loss on hold-out set: 0.001784439339596582
MeanAbsoluteError value on hold-out data: 0.036298949271440506
Epoch: 355
Loss on hold-out set: 0.0013428189681450788
MeanAbsoluteError value on hold-out data: 0.03070981428027153
Epoch: 356
Loss on hold-out set: 0.0004665537286966451
MeanAbsoluteError value on hold-out data: 0.018086588010191917
Epoch: 357

Loss on hold-out set: 0.0018338899152647507
```

```
MeanAbsoluteError value on hold-out data: 0.03748364746570587
Epoch: 358
Loss on hold-out set: 0.0005134710089279045
MeanAbsoluteError value on hold-out data: 0.018527619540691376
Epoch: 359
Loss on hold-out set: 0.0024310866566865067
MeanAbsoluteError value on hold-out data: 0.043419502675533295
Epoch: 360
Loss on hold-out set: 0.00045366500240848646
MeanAbsoluteError value on hold-out data: 0.017749765887856483
Epoch: 361
Loss on hold-out set: 0.002094366508045871
MeanAbsoluteError value on hold-out data: 0.04023449867963791
Epoch: 362
Loss on hold-out set: 0.00046571459173911105
MeanAbsoluteError value on hold-out data: 0.01799018494784832
Epoch: 363
Loss on hold-out set: 0.002378703401374974
MeanAbsoluteError value on hold-out data: 0.04256667569279671
Epoch: 364
Loss on hold-out set: 0.0005271185724076963
MeanAbsoluteError value on hold-out data: 0.018193218857049942
Epoch: 365
Loss on hold-out set: 0.000284673356968836
MeanAbsoluteError value on hold-out data: 0.0130700021982193
Epoch: 366
Loss on hold-out set: 0.0008051905483865228
MeanAbsoluteError value on hold-out data: 0.024735640734434128
Epoch: 367
Loss on hold-out set: 0.0012870202343420762
MeanAbsoluteError value on hold-out data: 0.02784213051199913
Epoch: 368
Loss on hold-out set: 0.0010284754067757412
MeanAbsoluteError value on hold-out data: 0.028020238503813744
Epoch: 369

Loss on hold-out set: 0.00047118584686694175
MeanAbsoluteError value on hold-out data: 0.016445666551589966
Epoch: 370
Loss on hold-out set: 0.0021130700816253296
MeanAbsoluteError value on hold-out data: 0.040220629423856735
Epoch: 371
```

```
Loss on hold-out set: 0.0007628223232275463
MeanAbsoluteError value on hold-out data: 0.020800121128559113
Epoch: 372
Loss on hold-out set: 0.00039738784605441123
MeanAbsoluteError value on hold-out data: 0.016065221279859543
Epoch: 373
Loss on hold-out set: 0.001659196489000399
MeanAbsoluteError value on hold-out data: 0.0352596640586853
Epoch: 374
Loss on hold-out set: 0.00121707377930809
MeanAbsoluteError value on hold-out data: 0.031607527285814285
Epoch: 375
Loss on hold-out set: 0.0012280799013464467
MeanAbsoluteError value on hold-out data: 0.028919072821736336
Epoch: 376
Loss on hold-out set: 0.0015782440957417222
MeanAbsoluteError value on hold-out data: 0.03464923053979874
Epoch: 377
Loss on hold-out set: 0.0009980830241386827
MeanAbsoluteError value on hold-out data: 0.026683902367949486
Epoch: 378
Loss on hold-out set: 0.00022239663858750932
MeanAbsoluteError value on hold-out data: 0.011745366267859936
Early stopping at epoch 377
Returned to Spot: Validation loss: 0.00022239663858750932
----------------------------------------------

spotPython tuning: 0.00022239663858750932 [#####-----] 49.19%


config: {'_L_in': 10, '_L_out': 1, 'l1': 16, 'dropout_prob': 0.0, 'lr_mult': 6.9311712681307
Epoch: 1
Loss on hold-out set: 0.06277822605089138
MeanAbsoluteError value on hold-out data: 0.21149711310863495
Epoch: 2
Loss on hold-out set: 0.02617754149985941
MeanAbsoluteError value on hold-out data: 0.12615659832954407
Epoch: 3
Loss on hold-out set: 0.026130101594485734
MeanAbsoluteError value on hold-out data: 0.12421233206987381
Epoch: 4
Loss on hold-out set: 0.026283909321615572
```

```
MeanAbsoluteError value on hold-out data: 0.12417825311422348
Epoch: 5
Loss on hold-out set: 0.02600772144567025
MeanAbsoluteError value on hold-out data: 0.12351014465093613
Epoch: 6
Loss on hold-out set: 0.024080964883691387
MeanAbsoluteError value on hold-out data: 0.1182871088385582
Epoch: 7
Loss on hold-out set: 0.02236430734199913
MeanAbsoluteError value on hold-out data: 0.11910071223974228
Epoch: 8
Loss on hold-out set: 0.026151155807862158
MeanAbsoluteError value on hold-out data: 0.1256425976753235
Epoch: 9
Loss on hold-out set: 0.02341969502403548
MeanAbsoluteError value on hold-out data: 0.12163831293582916
Epoch: 10
Loss on hold-out set: 0.011688953755717529
MeanAbsoluteError value on hold-out data: 0.0812191292643547
Epoch: 11
Loss on hold-out set: 0.006895639651798104
MeanAbsoluteError value on hold-out data: 0.06507597863674164
Epoch: 12
Loss on hold-out set: 0.009766923435228435
MeanAbsoluteError value on hold-out data: 0.08520108461380005
Epoch: 13
Loss on hold-out set: 0.010616372707054803
MeanAbsoluteError value on hold-out data: 0.08790752291679382
Epoch: 14
Loss on hold-out set: 0.007835427838328638
MeanAbsoluteError value on hold-out data: 0.07424134016036987
Epoch: 15
Loss on hold-out set: 0.008438444132671544
MeanAbsoluteError value on hold-out data: 0.0793573409318924
Epoch: 16
Loss on hold-out set: 0.007049146279888718
MeanAbsoluteError value on hold-out data: 0.07208503037691116
Epoch: 17
Loss on hold-out set: 0.008086600389919783
MeanAbsoluteError value on hold-out data: 0.08142340183258057
Epoch: 18
Loss on hold-out set: 0.0033889991464093328
MeanAbsoluteError value on hold-out data: 0.0456443727016449
```

```
Epoch: 19
Loss on hold-out set: 0.01623169886634538
MeanAbsoluteError value on hold-out data: 0.12050721794366837
Epoch: 20
Loss on hold-out set: 0.002659834768181961
MeanAbsoluteError value on hold-out data: 0.0419926717877388
Epoch: 21
Loss on hold-out set: 0.014766280784418708
MeanAbsoluteError value on hold-out data: 0.11634135991334915
Epoch: 22

Loss on hold-out set: 0.007288999144772166
MeanAbsoluteError value on hold-out data: 0.07633242756128311
Epoch: 23
Loss on hold-out set: 0.009116352976937043
MeanAbsoluteError value on hold-out data: 0.0912700667977333
Epoch: 24
Loss on hold-out set: 0.0026759128453896232
MeanAbsoluteError value on hold-out data: 0.04245232045650482
Epoch: 25
Loss on hold-out set: 0.010600550002173373
MeanAbsoluteError value on hold-out data: 0.09923664480447769
Epoch: 26
Loss on hold-out set: 0.0063896186061595615
MeanAbsoluteError value on hold-out data: 0.0704018622636795
Epoch: 27
Loss on hold-out set: 0.009897692766236631
MeanAbsoluteError value on hold-out data: 0.09584362059831619
Epoch: 28
Loss on hold-out set: 0.011778360134676882
MeanAbsoluteError value on hold-out data: 0.09990265220403671
Epoch: 29
Loss on hold-out set: 0.007913452646646061
MeanAbsoluteError value on hold-out data: 0.08034766465425491
Epoch: 30
Loss on hold-out set: 0.005549346746288632
MeanAbsoluteError value on hold-out data: 0.0635254830121994
Epoch: 31
Loss on hold-out set: 0.004855656567470808
MeanAbsoluteError value on hold-out data: 0.058604877442121506
Epoch: 32
Loss on hold-out set: 0.005029661139767421
```

```
MeanAbsoluteError value on hold-out data: 0.060053952038288116
Epoch: 33
Loss on hold-out set: 0.0023483062212012315
MeanAbsoluteError value on hold-out data: 0.039032064378261566
Epoch: 34
Loss on hold-out set: 0.002615632581230449
MeanAbsoluteError value on hold-out data: 0.043985139578580856
Epoch: 35
Loss on hold-out set: 0.005901073228175703
MeanAbsoluteError value on hold-out data: 0.07318436354398727
Epoch: 36
Loss on hold-out set: 0.003551222187908072
MeanAbsoluteError value on hold-out data: 0.05393245816230774
Epoch: 37
Loss on hold-out set: 0.0021510389327120626
MeanAbsoluteError value on hold-out data: 0.04088285565376282
Epoch: 38
Loss on hold-out set: 0.0025554250031219502
MeanAbsoluteError value on hold-out data: 0.0453249029815197
Epoch: 39
Loss on hold-out set: 0.006235972684072821
MeanAbsoluteError value on hold-out data: 0.075614795088768
Epoch: 40
Loss on hold-out set: 0.00356777229248301
MeanAbsoluteError value on hold-out data: 0.05184147134423256
Epoch: 41
Loss on hold-out set: 0.003887946754203815
MeanAbsoluteError value on hold-out data: 0.0514778196811676
Epoch: 42
Loss on hold-out set: 0.0013907116433409484
MeanAbsoluteError value on hold-out data: 0.029508281499147415
Epoch: 43
Loss on hold-out set: 0.001229071514803524
MeanAbsoluteError value on hold-out data: 0.028463948518037796
Epoch: 44

Loss on hold-out set: 0.012811940653543723
MeanAbsoluteError value on hold-out data: 0.1098618432879448
Epoch: 45
Loss on hold-out set: 0.0007226912696894846
MeanAbsoluteError value on hold-out data: 0.020797867327928543
Epoch: 46
```

```
Loss on hold-out set: 0.000889794724858611
MeanAbsoluteError value on hold-out data: 0.023326314985752106
Epoch: 47
Loss on hold-out set: 0.0007860846128192191
MeanAbsoluteError value on hold-out data: 0.02220991812646389
Epoch: 48
Loss on hold-out set: 0.0007623828668760037
MeanAbsoluteError value on hold-out data: 0.022065462544560432
Epoch: 49
Loss on hold-out set: 0.0009471428692402122
MeanAbsoluteError value on hold-out data: 0.02460196428000927
Epoch: 50
Loss on hold-out set: 0.0005821649683639407
MeanAbsoluteError value on hold-out data: 0.01964600570499897
Epoch: 51
Loss on hold-out set: 0.0005548431440011451
MeanAbsoluteError value on hold-out data: 0.018975859507918358
Epoch: 52
Loss on hold-out set: 0.0009829413427628185
MeanAbsoluteError value on hold-out data: 0.024841343984007835
Epoch: 53
Loss on hold-out set: 0.00061868467692923
MeanAbsoluteError value on hold-out data: 0.019858116284012794
Epoch: 54
Loss on hold-out set: 0.0007884123172660015
MeanAbsoluteError value on hold-out data: 0.022955531254410744
Epoch: 55
Loss on hold-out set: 0.0010391414750636997
MeanAbsoluteError value on hold-out data: 0.02514631859958172
Epoch: 56
Loss on hold-out set: 0.000899558583593094
MeanAbsoluteError value on hold-out data: 0.024353183805942535
Epoch: 57
Loss on hold-out set: 0.0005684533067611291
MeanAbsoluteError value on hold-out data: 0.019018100574612617
Epoch: 58
Loss on hold-out set: 0.0013857276583286492
MeanAbsoluteError value on hold-out data: 0.03055531531572342
Epoch: 59
Loss on hold-out set: 0.0100755880488769
MeanAbsoluteError value on hold-out data: 0.09387213736772537
Epoch: 60
Loss on hold-out set: 0.0006365499031840285
```

```
MeanAbsoluteError value on hold-out data: 0.020309358835220337
Epoch: 61
Loss on hold-out set: 0.00042712818953747814
MeanAbsoluteError value on hold-out data: 0.016545411199331284
Epoch: 62
Loss on hold-out set: 0.0007410761103720257
MeanAbsoluteError value on hold-out data: 0.02219533547759056
Epoch: 63
Loss on hold-out set: 0.0005247393089934791
MeanAbsoluteError value on hold-out data: 0.01843073219060898
Epoch: 64
Loss on hold-out set: 0.0005136602343746313
MeanAbsoluteError value on hold-out data: 0.01821778528392315
Epoch: 65
Loss on hold-out set: 0.0005835161856865804
MeanAbsoluteError value on hold-out data: 0.01940126344561577
Epoch: 66


Loss on hold-out set: 0.0023316405897371864
MeanAbsoluteError value on hold-out data: 0.04202884063124657
Epoch: 67
Loss on hold-out set: 0.006142386872517436
MeanAbsoluteError value on hold-out data: 0.0758342444896698
Epoch: 68
Loss on hold-out set: 0.0006921587429180937
MeanAbsoluteError value on hold-out data: 0.021848363801836967
Epoch: 69
Loss on hold-out set: 0.0022355032055393644
MeanAbsoluteError value on hold-out data: 0.04182315990328789
Epoch: 70
Loss on hold-out set: 0.00042147992184924846
MeanAbsoluteError value on hold-out data: 0.016474170610308647
Epoch: 71
Loss on hold-out set: 0.000985369417130163
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Epoch: 72
Loss on hold-out set: 0.002680560739367808
MeanAbsoluteError value on hold-out data: 0.04538378864526749
Epoch: 73
Loss on hold-out set: 0.00039765611827054893
MeanAbsoluteError value on hold-out data: 0.016132615506649017
Epoch: 74
```

```
Loss on hold-out set: 0.00061088845311146798
MeanAbsoluteError value on hold-out data: 0.020117176696658134
Epoch: 75
Loss on hold-out set: 0.0012666520870927918
MeanAbsoluteError value on hold-out data: 0.030611973255872726
Epoch: 76
Loss on hold-out set: 0.003631687257438898
MeanAbsoluteError value on hold-out data: 0.05583111569285393
Epoch: 77
Loss on hold-out set: 0.0003783046796390983
MeanAbsoluteError value on hold-out data: 0.015676114708185196
Epoch: 78
Loss on hold-out set: 0.001120158697870609
MeanAbsoluteError value on hold-out data: 0.028651732951402664
Epoch: 79
Loss on hold-out set: 0.002684349090007967
MeanAbsoluteError value on hold-out data: 0.04620976373553276
Epoch: 80
Loss on hold-out set: 0.0006743384123853359
MeanAbsoluteError value on hold-out data: 0.02160358801484108
Epoch: 81
Loss on hold-out set: 0.0010728344174199982
MeanAbsoluteError value on hold-out data: 0.02803201973438263
Epoch: 82
Loss on hold-out set: 0.0005917078248641797
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Epoch: 83
Loss on hold-out set: 0.0018007786037694466
MeanAbsoluteError value on hold-out data: 0.037015046924352646
Epoch: 84
Loss on hold-out set: 0.0029412307960324383
MeanAbsoluteError value on hold-out data: 0.048165563493967056
Epoch: 85
Loss on hold-out set: 0.0057319124768439094
MeanAbsoluteError value on hold-out data: 0.07292068749666214
Epoch: 86
Loss on hold-out set: 0.0007159007731580028
MeanAbsoluteError value on hold-out data: 0.02261580154299736
Epoch: 87
Loss on hold-out set: 0.0040075370527215695
MeanAbsoluteError value on hold-out data: 0.058219291269779205
Epoch: 88
```

```
Loss on hold-out set: 0.0018512557236183631
MeanAbsoluteError value on hold-out data: 0.03823652118444443
Epoch: 89
Loss on hold-out set: 0.004377863124797219
MeanAbsoluteError value on hold-out data: 0.06376750767230988
Epoch: 90
Loss on hold-out set: 0.0005144387832842767
MeanAbsoluteError value on hold-out data: 0.018295759335160255
Epoch: 91
Loss on hold-out set: 0.0031089332616446833
MeanAbsoluteError value on hold-out data: 0.05119576305150986
Epoch: 92
Loss on hold-out set: 0.004319156948967199
MeanAbsoluteError value on hold-out data: 0.06358106434345245
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Loss on hold-out set: 0.00043379257763981034
MeanAbsoluteError value on hold-out data: 0.016240611672401428
Epoch: 94
Loss on hold-out set: 0.0008296934507885261
MeanAbsoluteError value on hold-out data: 0.024726303294301033
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Loss on hold-out set: 0.00481111867549388
MeanAbsoluteError value on hold-out data: 0.06795349717140198
Epoch: 96
Loss on hold-out set: 0.0006206386407077508
MeanAbsoluteError value on hold-out data: 0.01926569640636444
Epoch: 97
Loss on hold-out set: 0.0016496036030156048
MeanAbsoluteError value on hold-out data: 0.036417510360479355
Epoch: 98
Loss on hold-out set: 0.006133716651483586
MeanAbsoluteError value on hold-out data: 0.07744164019823074
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Loss on hold-out set: 0.00035868378702281535
MeanAbsoluteError value on hold-out data: 0.014557215385138988
Epoch: 100
Loss on hold-out set: 0.0015419353118264361
MeanAbsoluteError value on hold-out data: 0.0353311225771904
Epoch: 101
Loss on hold-out set: 0.00034506733170833046
MeanAbsoluteError value on hold-out data: 0.015202484093606472
Epoch: 102
Loss on hold-out set: 0.0006572288938945061
```

```
MeanAbsoluteError value on hold-out data: 0.021525530144572258
Epoch: 103
Loss on hold-out set: 0.005747951542664515
MeanAbsoluteError value on hold-out data: 0.07488231360912323
Epoch: 104
Loss on hold-out set: 0.0007483767082081421
MeanAbsoluteError value on hold-out data: 0.022856025025248528
Epoch: 105
Loss on hold-out set: 0.0016918354055010958
MeanAbsoluteError value on hold-out data: 0.03807324543595314
Epoch: 106
Loss on hold-out set: 0.0011510054311273915
MeanAbsoluteError value on hold-out data: 0.029736779630184174
Epoch: 107
Loss on hold-out set: 0.004140556263002126
MeanAbsoluteError value on hold-out data: 0.06284067779779434
Epoch: 108
Loss on hold-out set: 0.0005069978483094785
MeanAbsoluteError value on hold-out data: 0.017856404185295105
Epoch: 109
Loss on hold-out set: 0.002722577032584109
MeanAbsoluteError value on hold-out data: 0.048626989126205444
Epoch: 110

Loss on hold-out set: 0.005932068403222059
MeanAbsoluteError value on hold-out data: 0.0751461535692215
Epoch: 111
Loss on hold-out set: 0.0005337150436580965
MeanAbsoluteError value on hold-out data: 0.01867280900478363
Epoch: 112
Loss on hold-out set: 0.0011626156445249524
MeanAbsoluteError value on hold-out data: 0.031437646597623825
Epoch: 113
Loss on hold-out set: 0.0005738863516231312
MeanAbsoluteError value on hold-out data: 0.019549334421753883
Epoch: 114
Loss on hold-out set: 0.005779693466856291
MeanAbsoluteError value on hold-out data: 0.07448713481426239
Epoch: 115
Loss on hold-out set: 0.0005626144518732632
MeanAbsoluteError value on hold-out data: 0.019330352544784546
Epoch: 116
```

```
Loss on hold-out set: 0.004463156170554851
MeanAbsoluteError value on hold-out data: 0.0659036636352539
Epoch: 117
Loss on hold-out set: 0.0006749301055127656
MeanAbsoluteError value on hold-out data: 0.021703055128455162
Epoch: 118
Loss on hold-out set: 0.005590383208503849
MeanAbsoluteError value on hold-out data: 0.07330939918756485
Epoch: 119
Loss on hold-out set: 0.0004773827991141987
MeanAbsoluteError value on hold-out data: 0.01733180321753025
Epoch: 120
Loss on hold-out set: 0.00026117466117475967
MeanAbsoluteError value on hold-out data: 0.012949769385159016
Epoch: 121
Loss on hold-out set: 0.0008577704644075742
MeanAbsoluteError value on hold-out data: 0.02548338659107685
Epoch: 122
Loss on hold-out set: 0.00541820725131976
MeanAbsoluteError value on hold-out data: 0.07220938056707382
Epoch: 123
Loss on hold-out set: 0.0004481567065292773
MeanAbsoluteError value on hold-out data: 0.016421355307102203
Epoch: 124
Loss on hold-out set: 0.0044674075355655265
MeanAbsoluteError value on hold-out data: 0.06606481224298477
Epoch: 125
Loss on hold-out set: 0.0004763043107232079
MeanAbsoluteError value on hold-out data: 0.01707296073436737
Epoch: 126
Loss on hold-out set: 0.0049854574823065805
MeanAbsoluteError value on hold-out data: 0.0698368102312088
Epoch: 127
Loss on hold-out set: 0.0005430679662631041
MeanAbsoluteError value on hold-out data: 0.018577981740236282
Epoch: 128
Loss on hold-out set: 0.005264126156505786
MeanAbsoluteError value on hold-out data: 0.0716312825679779
Epoch: 129
Loss on hold-out set: 0.00048712664819935237
MeanAbsoluteError value on hold-out data: 0.017161782830953598
Epoch: 130
Loss on hold-out set: 0.003954354685878283
```

```
MeanAbsoluteError value on hold-out data: 0.06189258396625519
Epoch: 131
Loss on hold-out set: 0.0014037121160838165
MeanAbsoluteError value on hold-out data: 0.0335710309445858
Epoch: 132

Loss on hold-out set: 0.0035562803723702303
MeanAbsoluteError value on hold-out data: 0.05844582989811897
Epoch: 133
Loss on hold-out set: 0.001375794974400809
MeanAbsoluteError value on hold-out data: 0.033091768622398376
Epoch: 134
Loss on hold-out set: 0.0046199638592569455
MeanAbsoluteError value on hold-out data: 0.06612208485603333
Epoch: 135
Loss on hold-out set: 0.0005815994579614582
MeanAbsoluteError value on hold-out data: 0.01946139708161354
Epoch: 136
Loss on hold-out set: 0.0032942069596365877
MeanAbsoluteError value on hold-out data: 0.05613604187965393
Epoch: 137
Loss on hold-out set: 0.0006596637035009304
MeanAbsoluteError value on hold-out data: 0.021160783246159554
Epoch: 138
Loss on hold-out set: 0.004837150268844868
MeanAbsoluteError value on hold-out data: 0.06869412958621979
Epoch: 139
Loss on hold-out set: 0.0006170482527905781
MeanAbsoluteError value on hold-out data: 0.020042667165398598
Epoch: 140
Loss on hold-out set: 0.004637028703368024
MeanAbsoluteError value on hold-out data: 0.06731148064136505
Epoch: 141
Loss on hold-out set: 0.0015583470230922103
MeanAbsoluteError value on hold-out data: 0.035597871989011765
Epoch: 142
Loss on hold-out set: 0.00515184926457311
MeanAbsoluteError value on hold-out data: 0.0709870308637619
Epoch: 143
Loss on hold-out set: 0.0011584683057950123
MeanAbsoluteError value on hold-out data: 0.02976725623011589
Epoch: 144
```

```
Loss on hold-out set: 0.004819389285617753
MeanAbsoluteError value on hold-out data: 0.068508580327034
Epoch: 145
Loss on hold-out set: 0.0011056349765950519
MeanAbsoluteError value on hold-out data: 0.029136748984456062
Epoch: 146
Loss on hold-out set: 0.005307481428118129
MeanAbsoluteError value on hold-out data: 0.07143900543451309
Epoch: 147
Loss on hold-out set: 0.0007288038874608709
MeanAbsoluteError value on hold-out data: 0.022078678011894226
Epoch: 148
Loss on hold-out set: 0.004621879761352351
MeanAbsoluteError value on hold-out data: 0.06712594628334045
Epoch: 149
Loss on hold-out set: 0.001001641074636657
MeanAbsoluteError value on hold-out data: 0.027337990701198578
Epoch: 150
Loss on hold-out set: 0.0050563600257431205
MeanAbsoluteError value on hold-out data: 0.06994795799255371
Epoch: 151
Loss on hold-out set: 0.0010802072540268693
MeanAbsoluteError value on hold-out data: 0.02851264365017414
Epoch: 152
Loss on hold-out set: 0.00474998830376487
MeanAbsoluteError value on hold-out data: 0.06804845482110977
Epoch: 153
Loss on hold-out set: 0.0006956149055009806
MeanAbsoluteError value on hold-out data: 0.021441426128149033
Epoch: 154

Loss on hold-out set: 0.005116631399447981
MeanAbsoluteError value on hold-out data: 0.0705639123916626
Epoch: 155
Loss on hold-out set: 0.0013966240160363285
MeanAbsoluteError value on hold-out data: 0.0332663394510746
Epoch: 156
Loss on hold-out set: 0.004768338397537407
MeanAbsoluteError value on hold-out data: 0.06807796657085419
Epoch: 157
Loss on hold-out set: 0.0013263193755655696
MeanAbsoluteError value on hold-out data: 0.032272208482027054
```

```
Epoch: 158
Loss on hold-out set: 0.004732886329293251
MeanAbsoluteError value on hold-out data: 0.06778407096862793
Epoch: 159
Loss on hold-out set: 0.0013457633751003367
MeanAbsoluteError value on hold-out data: 0.03255188465118408
Epoch: 160
Loss on hold-out set: 0.004649446664476081
MeanAbsoluteError value on hold-out data: 0.06685946136713028
Epoch: 161
Loss on hold-out set: 0.0009204092325250569
MeanAbsoluteError value on hold-out data: 0.02601872757077217
Epoch: 162
Loss on hold-out set: 0.00462600466256079
MeanAbsoluteError value on hold-out data: 0.06688213348388672
Epoch: 163
Loss on hold-out set: 0.0010264513916090916
MeanAbsoluteError value on hold-out data: 0.028064511716365814
Epoch: 164
Loss on hold-out set: 0.0045885186593391395
MeanAbsoluteError value on hold-out data: 0.06687934696674347
Epoch: 165
Loss on hold-out set: 0.0010349398975162522
MeanAbsoluteError value on hold-out data: 0.027839157730340958
Epoch: 166
Loss on hold-out set: 0.0045430715269360105
MeanAbsoluteError value on hold-out data: 0.06621605902910233
Epoch: 167
Loss on hold-out set: 0.0010597425678401794
MeanAbsoluteError value on hold-out data: 0.02865440770983696
Epoch: 168
Loss on hold-out set: 0.004574780940617386
MeanAbsoluteError value on hold-out data: 0.06663458794355392
Epoch: 169
Loss on hold-out set: 0.0010646544641962177
MeanAbsoluteError value on hold-out data: 0.02845081314444542
Epoch: 170
Loss on hold-out set: 0.004164518580134762
MeanAbsoluteError value on hold-out data: 0.06315357983112335
Epoch: 171
Loss on hold-out set: 0.0011601272455759738
MeanAbsoluteError value on hold-out data: 0.03029557876288891
Epoch: 172
```

```
Loss on hold-out set: 0.004593441311858203
MeanAbsoluteError value on hold-out data: 0.06665194779634476
Epoch: 173
Loss on hold-out set: 0.0012304305135713595
MeanAbsoluteError value on hold-out data: 0.031304873526096344
Epoch: 174
Loss on hold-out set: 0.004635961726307869
MeanAbsoluteError value on hold-out data: 0.06700997799634933
Epoch: 175
Loss on hold-out set: 0.0013671588569291327
MeanAbsoluteError value on hold-out data: 0.033167608082294464
Epoch: 176


Loss on hold-out set: 0.00432109101185281
MeanAbsoluteError value on hold-out data: 0.06436647474765778
Epoch: 177
Loss on hold-out set: 0.0010465671565677774
MeanAbsoluteError value on hold-out data: 0.028148103505373
Epoch: 178
Loss on hold-out set: 0.004328177053187238
MeanAbsoluteError value on hold-out data: 0.06452185660600662
Epoch: 179
Loss on hold-out set: 0.000804659146141555
MeanAbsoluteError value on hold-out data: 0.024050746113061905
Epoch: 180
Loss on hold-out set: 0.0043011664559966635
MeanAbsoluteError value on hold-out data: 0.06445789337158203
Epoch: 181
Loss on hold-out set: 0.002051028092146704
MeanAbsoluteError value on hold-out data: 0.04154408350586891
Epoch: 182
Loss on hold-out set: 0.004392516088524931
MeanAbsoluteError value on hold-out data: 0.06494972109794617
Epoch: 183
Loss on hold-out set: 0.0013773488983707992
MeanAbsoluteError value on hold-out data: 0.03318162262439728
Epoch: 184
Loss on hold-out set: 0.004287294822892076
MeanAbsoluteError value on hold-out data: 0.06417164206504822
Epoch: 185
Loss on hold-out set: 0.0015406494371985133
MeanAbsoluteError value on hold-out data: 0.035421207547187805
```

```
Epoch: 186
Loss on hold-out set: 0.004509812208676809
MeanAbsoluteError value on hold-out data: 0.06606593728065491
Epoch: 187
Loss on hold-out set: 0.0013535680114536693
MeanAbsoluteError value on hold-out data: 0.032991353422403336
Epoch: 188
Loss on hold-out set: 0.004263903345226457
MeanAbsoluteError value on hold-out data: 0.06394978612661362
Epoch: 189
Loss on hold-out set: 0.0012008761925818888
MeanAbsoluteError value on hold-out data: 0.030950820073485374
Epoch: 190
Loss on hold-out set: 0.004198095222052775
MeanAbsoluteError value on hold-out data: 0.06371500343084335
Epoch: 191
Loss on hold-out set: 0.0011311873370830558
MeanAbsoluteError value on hold-out data: 0.02983110025525093
Epoch: 192
Loss on hold-out set: 0.004236894390104632
MeanAbsoluteError value on hold-out data: 0.06392408907413483
Epoch: 193
Loss on hold-out set: 0.0009303498663939536
MeanAbsoluteError value on hold-out data: 0.026482298970222473
Epoch: 194
Loss on hold-out set: 0.004127836700430826
MeanAbsoluteError value on hold-out data: 0.0632694661617279
Epoch: 195
Loss on hold-out set: 0.0007881749602108213
MeanAbsoluteError value on hold-out data: 0.02389446645975113
Epoch: 196
Loss on hold-out set: 0.004262157127653298
MeanAbsoluteError value on hold-out data: 0.06436062604188919
Epoch: 197
Loss on hold-out set: 0.0009739780982368087
MeanAbsoluteError value on hold-out data: 0.027211640030145645
Epoch: 198

Loss on hold-out set: 0.0041477759001090336
MeanAbsoluteError value on hold-out data: 0.06343920528888702
Epoch: 199
Loss on hold-out set: 0.0012682324036416646
```

```
MeanAbsoluteError value on hold-out data: 0.03207525610923767
Epoch: 200
Loss on hold-out set: 0.004224857425709304
MeanAbsoluteError value on hold-out data: 0.06399933993816376
Epoch: 201
Loss on hold-out set: 0.0011281279975695437
MeanAbsoluteError value on hold-out data: 0.029992949217557907
Epoch: 202
Loss on hold-out set: 0.004180275222384616
MeanAbsoluteError value on hold-out data: 0.06357410550117493
Epoch: 203
Loss on hold-out set: 0.0016791044954994792
MeanAbsoluteError value on hold-out data: 0.03745472803711891
Epoch: 204
Loss on hold-out set: 0.0041972770551709756
MeanAbsoluteError value on hold-out data: 0.06362397968769073
Epoch: 205
Loss on hold-out set: 0.0010316756700998859
MeanAbsoluteError value on hold-out data: 0.02814350090920925
Epoch: 206
Loss on hold-out set: 0.0042348095264874005
MeanAbsoluteError value on hold-out data: 0.06409996747970581
Epoch: 207
Loss on hold-out set: 0.0016042513674811314
MeanAbsoluteError value on hold-out data: 0.036459796130657196
Epoch: 208
Loss on hold-out set: 0.004273550805488699
MeanAbsoluteError value on hold-out data: 0.06438486278057098
Epoch: 209
Loss on hold-out set: 0.0016987140927659837
MeanAbsoluteError value on hold-out data: 0.03755843639373779
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Loss on hold-out set: 0.004249971703087029
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Loss on hold-out set: 0.0013790404436325556
MeanAbsoluteError value on hold-out data: 0.03339729458093643
Epoch: 212
Loss on hold-out set: 0.0041963114452205205
MeanAbsoluteError value on hold-out data: 0.06355046480894089
Epoch: 213
Loss on hold-out set: 0.0016327259792505127
MeanAbsoluteError value on hold-out data: 0.03689514473080635
```

```
Epoch: 214
Loss on hold-out set: 0.004160638886356824
MeanAbsoluteError value on hold-out data: 0.06322025507688522
Epoch: 215
Loss on hold-out set: 0.001826035606331731
MeanAbsoluteError value on hold-out data: 0.039250582456588745
Epoch: 216
Loss on hold-out set: 0.004096377040504625
MeanAbsoluteError value on hold-out data: 0.06275361031293869
Epoch: 217
Loss on hold-out set: 0.0016558837133312696
MeanAbsoluteError value on hold-out data: 0.03705216199159622
Epoch: 218
Loss on hold-out set: 0.004191381807782148
MeanAbsoluteError value on hold-out data: 0.06340259313583374
Epoch: 219
Loss on hold-out set: 0.0017695210837317926
MeanAbsoluteError value on hold-out data: 0.03846485912799835
Epoch: 220

Loss on hold-out set: 0.004227881295312392
MeanAbsoluteError value on hold-out data: 0.06380300968885422
Epoch: 221
Loss on hold-out set: 0.0010205789401784148
MeanAbsoluteError value on hold-out data: 0.028068721294403076
Epoch: 222
Loss on hold-out set: 0.0042743371480977845
MeanAbsoluteError value on hold-out data: 0.06440198421478271
Epoch: 223
Loss on hold-out set: 0.001870597210271578
MeanAbsoluteError value on hold-out data: 0.03966285288333893
Epoch: 224
Loss on hold-out set: 0.004213196752396853
MeanAbsoluteError value on hold-out data: 0.06365326046943665
Epoch: 225
Loss on hold-out set: 0.0011170700799036574
MeanAbsoluteError value on hold-out data: 0.02962900884449482
Epoch: 226
Loss on hold-out set: 0.004256543752394225
MeanAbsoluteError value on hold-out data: 0.06415361166000366
Epoch: 227
Loss on hold-out set: 0.0011136095854453743
```

```
MeanAbsoluteError value on hold-out data: 0.029606984928250313
Epoch: 228
Loss on hold-out set: 0.00416060091045342
MeanAbsoluteError value on hold-out data: 0.06330938637256622
Epoch: 229
Loss on hold-out set: 0.001303793445817734
MeanAbsoluteError value on hold-out data: 0.03248915821313858
Epoch: 230
Loss on hold-out set: 0.004190869592620354
MeanAbsoluteError value on hold-out data: 0.06356904655694962
Epoch: 231
Loss on hold-out set: 0.0012975460665888693
MeanAbsoluteError value on hold-out data: 0.032412901520729065
Epoch: 232
Loss on hold-out set: 0.004279347381701595
MeanAbsoluteError value on hold-out data: 0.06425677239894867
Epoch: 233
Loss on hold-out set: 0.001293146388458186
MeanAbsoluteError value on hold-out data: 0.032377030700445175
Epoch: 234
Loss on hold-out set: 0.004321728649206068
MeanAbsoluteError value on hold-out data: 0.06462370604276657
Epoch: 235
Loss on hold-out set: 0.0016950315575262433
MeanAbsoluteError value on hold-out data: 0.03775114566087723
Epoch: 236
Loss on hold-out set: 0.004128066381733669
MeanAbsoluteError value on hold-out data: 0.06295940279960632
Epoch: 237
Loss on hold-out set: 0.0018094991836206692
MeanAbsoluteError value on hold-out data: 0.03910627216100693
Epoch: 238
Loss on hold-out set: 0.004261022004740019
MeanAbsoluteError value on hold-out data: 0.06394112855195999
Epoch: 239
Loss on hold-out set: 0.002197119395101541
MeanAbsoluteError value on hold-out data: 0.04360184073448181
Epoch: 240
Loss on hold-out set: 0.004356409704900886
MeanAbsoluteError value on hold-out data: 0.06473594158887863
Epoch: 241
Loss on hold-out set: 0.001771484256574982
MeanAbsoluteError value on hold-out data: 0.03877939656376839
```

```
Epoch: 242

Loss on hold-out set: 0.004332543877688677
MeanAbsoluteError value on hold-out data: 0.06452090293169022
Epoch: 243
Loss on hold-out set: 0.0016573726959330471
MeanAbsoluteError value on hold-out data: 0.03736438229680061
Epoch: 244
Loss on hold-out set: 0.004350013087356561
MeanAbsoluteError value on hold-out data: 0.06466094404459
Epoch: 245
Loss on hold-out set: 0.0017787938459629291
MeanAbsoluteError value on hold-out data: 0.03881772235035896
Epoch: 246
Loss on hold-out set: 0.0043504343637706415
MeanAbsoluteError value on hold-out data: 0.06456152349710464
Epoch: 247
Loss on hold-out set: 0.0022811840570188665
MeanAbsoluteError value on hold-out data: 0.04463282227516174
Epoch: 248
Loss on hold-out set: 0.0043590664128331765
MeanAbsoluteError value on hold-out data: 0.06467986106872559
Early stopping at epoch 247
Returned to Spot: Validation loss: 0.0043590664128331765
----------------------------------------------

spotPython tuning: 0.00022239663858750932 [#####-----] 54.35%


config: {'_L_in': 10, '_L_out': 1, 'l1': 256, 'dropout_prob': 0.013783440755735288, 'lr_mult
Epoch: 1
Loss on hold-out set: 0.05028084694947067
MeanAbsoluteError value on hold-out data: 0.1867147833108902
Epoch: 2
Loss on hold-out set: 0.10281431518102947
MeanAbsoluteError value on hold-out data: 0.2840118706226349
Epoch: 3
Loss on hold-out set: 0.01744624335122736
MeanAbsoluteError value on hold-out data: 0.10381811857223511
Epoch: 4
Loss on hold-out set: 0.018774403847361867
MeanAbsoluteError value on hold-out data: 0.10667451471090317
```

```
Epoch: 5
Loss on hold-out set: 0.017365200641123874
MeanAbsoluteError value on hold-out data: 0.10485254228115082
Epoch: 6
Loss on hold-out set: 0.015509898553749448
MeanAbsoluteError value on hold-out data: 0.09823735803365707
Epoch: 7
Loss on hold-out set: 0.01158504136592934
MeanAbsoluteError value on hold-out data: 0.0843723714351654
Epoch: 8
Loss on hold-out set: 0.013997414124835478
MeanAbsoluteError value on hold-out data: 0.0948055163025856
Epoch: 9
Loss on hold-out set: 0.01017704674679982
MeanAbsoluteError value on hold-out data: 0.07899182289838791
Epoch: 10
Loss on hold-out set: 0.012407463828199789
MeanAbsoluteError value on hold-out data: 0.0881616398692131
Epoch: 11

Loss on hold-out set: 0.017740786222642975
MeanAbsoluteError value on hold-out data: 0.10891290009021759
Epoch: 12
Loss on hold-out set: 0.011009241625862686
MeanAbsoluteError value on hold-out data: 0.08143453299999237
Epoch: 13
Loss on hold-out set: 0.01467668343531458
MeanAbsoluteError value on hold-out data: 0.10299678146839142
Epoch: 14
Loss on hold-out set: 0.008400427643209696
MeanAbsoluteError value on hold-out data: 0.0725247785449028
Epoch: 15
Loss on hold-out set: 0.013245059667449249
MeanAbsoluteError value on hold-out data: 0.09815770387649536
Epoch: 16
Loss on hold-out set: 0.006764891042717193
MeanAbsoluteError value on hold-out data: 0.06507078558206558
Epoch: 17
Loss on hold-out set: 0.006863578014369858
MeanAbsoluteError value on hold-out data: 0.0626007616519928
Epoch: 18
Loss on hold-out set: 0.009368439229499353
```

```
MeanAbsoluteError value on hold-out data: 0.0819806456565857
Epoch: 19
Loss on hold-out set: 0.00904225129143972
MeanAbsoluteError value on hold-out data: 0.07678733021020889
Epoch: 20
Loss on hold-out set: 0.012568712111954627
MeanAbsoluteError value on hold-out data: 0.09383051842451096
Epoch: 21
Loss on hold-out set: 0.010261911408681618
MeanAbsoluteError value on hold-out data: 0.08213324844837189
Epoch: 22
Loss on hold-out set: 0.007303886581212282
MeanAbsoluteError value on hold-out data: 0.07039487361907959
Epoch: 23

Loss on hold-out set: 0.0026702279972500706
MeanAbsoluteError value on hold-out data: 0.041705936193466187
Epoch: 24
Loss on hold-out set: 0.023821990152722912
MeanAbsoluteError value on hold-out data: 0.14544546604156494
Epoch: 25
Loss on hold-out set: 0.007993100885007726
MeanAbsoluteError value on hold-out data: 0.06968703866004944
Epoch: 26
Loss on hold-out set: 0.007350462292762179
MeanAbsoluteError value on hold-out data: 0.06839727610349655
Epoch: 27
Loss on hold-out set: 0.00641228715693088
MeanAbsoluteError value on hold-out data: 0.06562816351652145
Epoch: 28
Loss on hold-out set: 0.0092394210790333
MeanAbsoluteError value on hold-out data: 0.07713039964437485
Epoch: 29
Loss on hold-out set: 0.004634285419199027
MeanAbsoluteError value on hold-out data: 0.05330617353320122
Epoch: 30
Loss on hold-out set: 0.013199913511542897
MeanAbsoluteError value on hold-out data: 0.10075865685939789
Epoch: 31
Loss on hold-out set: 0.0035085592137061453
MeanAbsoluteError value on hold-out data: 0.04542609676718712
Epoch: 32
```

```
Loss on hold-out set: 0.0030507576762159403
MeanAbsoluteError value on hold-out data: 0.04296357184648514
Epoch: 33
Loss on hold-out set: 0.007887181041664198
MeanAbsoluteError value on hold-out data: 0.0766652300953865
Epoch: 34
Loss on hold-out set: 0.0021286429745439243
MeanAbsoluteError value on hold-out data: 0.031078116968274117
Epoch: 35

Loss on hold-out set: 0.005730919258080815
MeanAbsoluteError value on hold-out data: 0.06304209679365158
Epoch: 36
Loss on hold-out set: 0.0033536890619679503
MeanAbsoluteError value on hold-out data: 0.045673515647649765
Epoch: 37
Loss on hold-out set: 0.011475350021531707
MeanAbsoluteError value on hold-out data: 0.0926397368311882
Epoch: 38
Loss on hold-out set: 0.004918077789050968
MeanAbsoluteError value on hold-out data: 0.05505794659256935
Epoch: 39
Loss on hold-out set: 0.0022158083692805745
MeanAbsoluteError value on hold-out data: 0.030729275196790695
Epoch: 40
Loss on hold-out set: 0.006815006208949183
MeanAbsoluteError value on hold-out data: 0.06643082946538925
Epoch: 41
Loss on hold-out set: 0.004106230114733702
MeanAbsoluteError value on hold-out data: 0.05276106297969818
Epoch: 42
Loss on hold-out set: 0.004724902897386959
MeanAbsoluteError value on hold-out data: 0.05518780276179314
Epoch: 43
Loss on hold-out set: 0.0012497982549432077
MeanAbsoluteError value on hold-out data: 0.029195627197623253
Epoch: 44
Loss on hold-out set: 0.0031262346126727366
MeanAbsoluteError value on hold-out data: 0.043621934950351715
Epoch: 45
Loss on hold-out set: 0.002081454805049457
MeanAbsoluteError value on hold-out data: 0.03832503408193588
```

```
Epoch: 46
Loss on hold-out set: 0.005276452345577509
MeanAbsoluteError value on hold-out data: 0.06025804579257965
Epoch: 47

Loss on hold-out set: 0.007339623315553916
MeanAbsoluteError value on hold-out data: 0.0803663581609726
Epoch: 48
Loss on hold-out set: 0.0067459394371038985
MeanAbsoluteError value on hold-out data: 0.06769037246704102
Epoch: 49
Loss on hold-out set: 0.0012018355681855035
MeanAbsoluteError value on hold-out data: 0.023829596117138863
Epoch: 50
Loss on hold-out set: 0.002822397711784824
MeanAbsoluteError value on hold-out data: 0.04273258149623871
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Loss on hold-out set: 0.009007194937255821
MeanAbsoluteError value on hold-out data: 0.07992096245288849
Epoch: 52
Loss on hold-out set: 0.005400789472715635
MeanAbsoluteError value on hold-out data: 0.06159081682562828
Epoch: 53
Loss on hold-out set: 0.005796789547036353
MeanAbsoluteError value on hold-out data: 0.0625811517238617
Epoch: 54
Loss on hold-out set: 0.001004610166235484
MeanAbsoluteError value on hold-out data: 0.02390400320291519
Epoch: 55
Loss on hold-out set: 0.004428179616010503
MeanAbsoluteError value on hold-out data: 0.05206400901079178
Epoch: 56
Loss on hold-out set: 0.005388119944224232
MeanAbsoluteError value on hold-out data: 0.060132946819067
Epoch: 57
Loss on hold-out set: 0.0077964022363487045
MeanAbsoluteError value on hold-out data: 0.07172317802906036
Epoch: 58
Loss on hold-out set: 0.0036989624219897544
MeanAbsoluteError value on hold-out data: 0.050031628459692
Epoch: 59

Loss on hold-out set: 0.005785815969207569
```

```
MeanAbsoluteError value on hold-out data: 0.06843289732933044
Epoch: 60
Loss on hold-out set: 0.004590529776913555
MeanAbsoluteError value on hold-out data: 0.05469706282019615
Epoch: 61
Loss on hold-out set: 0.007865233175260456
MeanAbsoluteError value on hold-out data: 0.07397300750017166
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Loss on hold-out set: 0.00357089308090508
MeanAbsoluteError value on hold-out data: 0.05489068478345871
Epoch: 63
Loss on hold-out set: 0.0020160403372229715
MeanAbsoluteError value on hold-out data: 0.035815659910440445
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Loss on hold-out set: 0.0006834739132931358
MeanAbsoluteError value on hold-out data: 0.019872279837727547
Epoch: 65
Loss on hold-out set: 0.002354728627802902
MeanAbsoluteError value on hold-out data: 0.038024675101041794
Epoch: 66
Loss on hold-out set: 0.0018994078640580962
MeanAbsoluteError value on hold-out data: 0.03555138409137726
Epoch: 67
Loss on hold-out set: 0.005854377449539147
MeanAbsoluteError value on hold-out data: 0.07150068879127502
Epoch: 68
Loss on hold-out set: 0.0029823051483713484
MeanAbsoluteError value on hold-out data: 0.04543453827500343
Epoch: 69
Loss on hold-out set: 0.004540004485629891
MeanAbsoluteError value on hold-out data: 0.06192588806152344
Epoch: 70
Loss on hold-out set: 0.002853628646239246
MeanAbsoluteError value on hold-out data: 0.03966642916202545
Epoch: 71

Loss on hold-out set: 0.002120330672417032
MeanAbsoluteError value on hold-out data: 0.041642751544713974
Epoch: 72
Loss on hold-out set: 0.000802369039248381
MeanAbsoluteError value on hold-out data: 0.02287106029689312
Epoch: 73
```

```
Loss on hold-out set: 0.002230785296935784
MeanAbsoluteError value on hold-out data: 0.038672469556331635
Epoch: 74
Loss on hold-out set: 0.0013479061124503221
MeanAbsoluteError value on hold-out data: 0.031732093542814255
Epoch: 75
Loss on hold-out set: 0.00178888078019219
MeanAbsoluteError value on hold-out data: 0.036730486899614334
Epoch: 76
Loss on hold-out set: 0.003714910120164093
MeanAbsoluteError value on hold-out data: 0.0543869212269783
Epoch: 77
Loss on hold-out set: 0.004007375639814295
MeanAbsoluteError value on hold-out data: 0.05291341245174408
Epoch: 78
Loss on hold-out set: 0.0023499858492103064
MeanAbsoluteError value on hold-out data: 0.04027693346142769
Epoch: 79
Loss on hold-out set: 0.00406641075632682
MeanAbsoluteError value on hold-out data: 0.05006621405482292
Epoch: 80
Loss on hold-out set: 0.007120298025639434
MeanAbsoluteError value on hold-out data: 0.07087557762861252
Epoch: 81
Loss on hold-out set: 0.0026050000451505184
MeanAbsoluteError value on hold-out data: 0.04443903639912605
Epoch: 82
Loss on hold-out set: 0.0015374651840446812
MeanAbsoluteError value on hold-out data: 0.03246794641017914
Epoch: 83

Loss on hold-out set: 0.00525076247408594
MeanAbsoluteError value on hold-out data: 0.06116383895277977
Epoch: 84
Loss on hold-out set: 0.002025432342442831
MeanAbsoluteError value on hold-out data: 0.03188774734735489
Epoch: 85
Loss on hold-out set: 0.005655868297540828
MeanAbsoluteError value on hold-out data: 0.07014322280883789
Epoch: 86
Loss on hold-out set: 0.008688075958113921
MeanAbsoluteError value on hold-out data: 0.08332018554210663
```

```
Epoch: 87
Loss on hold-out set: 0.002836090537082208
MeanAbsoluteError value on hold-out data: 0.04830415919423103
Epoch: 88
Loss on hold-out set: 0.002063989902748481
MeanAbsoluteError value on hold-out data: 0.037709955126047134
Epoch: 89
Loss on hold-out set: 0.0010504035714180454
MeanAbsoluteError value on hold-out data: 0.028381500393152237
Epoch: 90
Loss on hold-out set: 0.0020359784830361605
MeanAbsoluteError value on hold-out data: 0.037063632160425186
Epoch: 91
Loss on hold-out set: 0.0008981066547628296
MeanAbsoluteError value on hold-out data: 0.021207695826888084
Epoch: 92
Loss on hold-out set: 0.0006712400568894258
MeanAbsoluteError value on hold-out data: 0.01920088194310665
Epoch: 93
Loss on hold-out set: 0.0009039409127772638
MeanAbsoluteError value on hold-out data: 0.02342345006763935
Epoch: 94
Loss on hold-out set: 0.0039375300249575
MeanAbsoluteError value on hold-out data: 0.05205502361059189
Epoch: 95

Loss on hold-out set: 0.0012063059931326854
MeanAbsoluteError value on hold-out data: 0.027519045397639275
Epoch: 96
Loss on hold-out set: 0.0019007603282501038
MeanAbsoluteError value on hold-out data: 0.03942328318953514
Epoch: 97
Loss on hold-out set: 0.0033388269550510144
MeanAbsoluteError value on hold-out data: 0.04907175526022911
Epoch: 98
Loss on hold-out set: 0.000753007677543026
MeanAbsoluteError value on hold-out data: 0.02202129364013672
Epoch: 99
Loss on hold-out set: 0.00047911047678146705
MeanAbsoluteError value on hold-out data: 0.01717669703066349
Epoch: 100
Loss on hold-out set: 0.0020097140222787857
```

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MeanAbsoluteError value on hold-out data: 0.03669082373380661
Epoch: 101
Loss on hold-out set: 0.0011940396874897967
MeanAbsoluteError value on hold-out data: 0.027280937880277634
Epoch: 102
Loss on hold-out set: 0.0012488420991423098
MeanAbsoluteError value on hold-out data: 0.02871507965028286
Epoch: 103
Loss on hold-out set: 0.0009274394006321305
MeanAbsoluteError value on hold-out data: 0.022836733609437943
Epoch: 104
Loss on hold-out set: 0.0017430580582616752
MeanAbsoluteError value on hold-out data: 0.0338018499314785
Epoch: 105
Loss on hold-out set: 0.0008619553715872922
MeanAbsoluteError value on hold-out data: 0.02389567531645298
Epoch: 106
Loss on hold-out set: 0.0018469986634476012
MeanAbsoluteError value on hold-out data: 0.03534756228327751
Epoch: 107

Loss on hold-out set: 0.0010090301297359953
MeanAbsoluteError value on hold-out data: 0.026243330910801888
Epoch: 108
Loss on hold-out set: 0.0017953614036454574
MeanAbsoluteError value on hold-out data: 0.03468580171465874
Epoch: 109
Loss on hold-out set: 0.002038401361603878
MeanAbsoluteError value on hold-out data: 0.03337565436959267
Epoch: 110
Loss on hold-out set: 0.005100570851936936
MeanAbsoluteError value on hold-out data: 0.06050548702478409
Epoch: 111
Loss on hold-out set: 0.0009323425995382039
MeanAbsoluteError value on hold-out data: 0.02603212371468544
Epoch: 112
Loss on hold-out set: 0.001814369412482177
MeanAbsoluteError value on hold-out data: 0.03164041042327881
Epoch: 113
Loss on hold-out set: 0.0018129020647488926
MeanAbsoluteError value on hold-out data: 0.03302627429366112
Epoch: 114
```

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Loss on hold-out set: 0.0030124472932105788
MeanAbsoluteError value on hold-out data: 0.04555293917655945
Epoch: 115
Loss on hold-out set: 0.0014697771678727708
MeanAbsoluteError value on hold-out data: 0.03400420770049095
Epoch: 116
Loss on hold-out set: 0.001273688422148361
MeanAbsoluteError value on hold-out data: 0.027354082092642784
Epoch: 117
Loss on hold-out set: 0.0006862196023575962
MeanAbsoluteError value on hold-out data: 0.016976071521639824
Epoch: 118
Loss on hold-out set: 0.0009277739200594002
MeanAbsoluteError value on hold-out data: 0.024312321096658707
Epoch: 119


Loss on hold-out set: 0.001246723689531025
MeanAbsoluteError value on hold-out data: 0.027069702744483948
Epoch: 120
Loss on hold-out set: 0.0006997794614443066
MeanAbsoluteError value on hold-out data: 0.02182493917644024
Epoch: 121
Loss on hold-out set: 0.0013078538008573417
MeanAbsoluteError value on hold-out data: 0.029986800625920296
Epoch: 122
Loss on hold-out set: 0.0018801020403196545
MeanAbsoluteError value on hold-out data: 0.021229922771453857
Epoch: 123
Loss on hold-out set: 0.0013563330821374333
MeanAbsoluteError value on hold-out data: 0.029513273388147354
Epoch: 124
Loss on hold-out set: 0.0023185233524265257
MeanAbsoluteError value on hold-out data: 0.03448003530502319
Epoch: 125
Loss on hold-out set: 0.001020826690364629
MeanAbsoluteError value on hold-out data: 0.02749793976545334
Epoch: 126
Loss on hold-out set: 0.001646618858151334
MeanAbsoluteError value on hold-out data: 0.028036028146743774
Epoch: 127
Loss on hold-out set: 0.0010193971500388887
MeanAbsoluteError value on hold-out data: 0.027383264154195786
```

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Epoch: 128
Loss on hold-out set: 0.0014008695755987183
MeanAbsoluteError value on hold-out data: 0.030664395540952682
Epoch: 129
Loss on hold-out set: 0.0012434775218073475
MeanAbsoluteError value on hold-out data: 0.029604552313685417
Epoch: 130
Loss on hold-out set: 0.0022117234337584754
MeanAbsoluteError value on hold-out data: 0.039313994348049164
Epoch: 131

Loss on hold-out set: 0.0006242439037458481
MeanAbsoluteError value on hold-out data: 0.017120540142059326
Epoch: 132
Loss on hold-out set: 0.0012120554946657073
MeanAbsoluteError value on hold-out data: 0.02774130180478096
Epoch: 133
Loss on hold-out set: 0.0016232252788828
MeanAbsoluteError value on hold-out data: 0.026283282786607742
Epoch: 134
Loss on hold-out set: 0.0015773358050194617
MeanAbsoluteError value on hold-out data: 0.027861591428518295
Epoch: 135
Loss on hold-out set: 0.0010350816239798931
MeanAbsoluteError value on hold-out data: 0.025631865486502647
Epoch: 136
Loss on hold-out set: 0.0010873919006706657
MeanAbsoluteError value on hold-out data: 0.024872981011867523
Epoch: 137
Loss on hold-out set: 0.0010511738824118908
MeanAbsoluteError value on hold-out data: 0.025788556784391403
Epoch: 138
Loss on hold-out set: 0.00044656789395958185
MeanAbsoluteError value on hold-out data: 0.016915353015065193
Epoch: 139
Loss on hold-out set: 0.001243442462414111
MeanAbsoluteError value on hold-out data: 0.0304456427693367
Epoch: 140
Loss on hold-out set: 0.001570957345201781
MeanAbsoluteError value on hold-out data: 0.03168477118015289
Epoch: 141
Loss on hold-out set: 0.001385551791540102
```

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MeanAbsoluteError value on hold-out data: 0.030367329716682434
Epoch: 142
Loss on hold-out set: 0.0014826341005238263
MeanAbsoluteError value on hold-out data: 0.02925586700439453
Epoch: 143

Loss on hold-out set: 0.0027142476694854466
MeanAbsoluteError value on hold-out data: 0.04171914979815483
Epoch: 144
Loss on hold-out set: 0.0015718814684078097
MeanAbsoluteError value on hold-out data: 0.033629409968853
Epoch: 145
Loss on hold-out set: 0.0024709969170783695
MeanAbsoluteError value on hold-out data: 0.04124327749013901
Epoch: 146
Loss on hold-out set: 0.0016081568809520256
MeanAbsoluteError value on hold-out data: 0.033568572252988815
Epoch: 147
Loss on hold-out set: 0.0008131000427774301
MeanAbsoluteError value on hold-out data: 0.022302795201539993
Epoch: 148
Loss on hold-out set: 0.0012896059932628351
MeanAbsoluteError value on hold-out data: 0.026209987699985504
Epoch: 149
Loss on hold-out set: 0.0010039391590429372
MeanAbsoluteError value on hold-out data: 0.021254638209939003
Epoch: 150
Loss on hold-out set: 0.0007984953286052731
MeanAbsoluteError value on hold-out data: 0.0235916581004858
Epoch: 151
Loss on hold-out set: 0.0006408220353095155
MeanAbsoluteError value on hold-out data: 0.020996879786252975
Epoch: 152
Loss on hold-out set: 0.0022929457604492966
MeanAbsoluteError value on hold-out data: 0.043307751417160034
Epoch: 153
Loss on hold-out set: 0.0015612466959282756
MeanAbsoluteError value on hold-out data: 0.03456762060523033
Epoch: 154
Loss on hold-out set: 0.001740336678554549
MeanAbsoluteError value on hold-out data: 0.03432483971118927
Epoch: 155
```

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Loss on hold-out set: 0.0032185094467805406
MeanAbsoluteError value on hold-out data: 0.0458911769092083
Epoch: 156
Loss on hold-out set: 0.0016962603457566154
MeanAbsoluteError value on hold-out data: 0.033260054886341095
Epoch: 157
Loss on hold-out set: 0.0017925274901484187
MeanAbsoluteError value on hold-out data: 0.035842254757881165
Epoch: 158
Loss on hold-out set: 0.0008662807415116971
MeanAbsoluteError value on hold-out data: 0.022779369726777077
Epoch: 159
Loss on hold-out set: 0.0009730899274520772
MeanAbsoluteError value on hold-out data: 0.02462504804134369
Epoch: 160
Loss on hold-out set: 0.001040086785858301
MeanAbsoluteError value on hold-out data: 0.01956811733543873
Epoch: 161
Loss on hold-out set: 0.0011214196764692467
MeanAbsoluteError value on hold-out data: 0.02254372090101242
Epoch: 162
Loss on hold-out set: 0.00223147169392752
MeanAbsoluteError value on hold-out data: 0.03949736803770065
Epoch: 163
Loss on hold-out set: 0.0004501313952986445
MeanAbsoluteError value on hold-out data: 0.015912847593426704
Epoch: 164
Loss on hold-out set: 0.00140578471013884
MeanAbsoluteError value on hold-out data: 0.027103690430521965
Epoch: 165
Loss on hold-out set: 0.0011078359445826592
MeanAbsoluteError value on hold-out data: 0.02882297895848751
Epoch: 166
Loss on hold-out set: 0.0009973276280920561
MeanAbsoluteError value on hold-out data: 0.02038029208779335
Epoch: 167

Loss on hold-out set: 0.0022948298597169157
MeanAbsoluteError value on hold-out data: 0.0411839596927166
Epoch: 168
Loss on hold-out set: 0.0012131804021344962
MeanAbsoluteError value on hold-out data: 0.027346337214112282
```

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Epoch: 169
Loss on hold-out set: 0.0008713321983936782
MeanAbsoluteError value on hold-out data: 0.021894173696637154
Epoch: 170
Loss on hold-out set: 0.0009111095936723837
MeanAbsoluteError value on hold-out data: 0.024179060012102127
Epoch: 171
Loss on hold-out set: 0.0019291539088283714
MeanAbsoluteError value on hold-out data: 0.024504581466317177
Epoch: 172
Loss on hold-out set: 0.0006762708944734186
MeanAbsoluteError value on hold-out data: 0.021854523569345474
Epoch: 173
Loss on hold-out set: 0.0018167521277638642
MeanAbsoluteError value on hold-out data: 0.03404310345649719
Epoch: 174
Loss on hold-out set: 0.00198691296636274
MeanAbsoluteError value on hold-out data: 0.0385410450398922
Epoch: 175
Loss on hold-out set: 0.0010359730375440496
MeanAbsoluteError value on hold-out data: 0.020717307925224304
Epoch: 176
Loss on hold-out set: 0.0014164304838662869
MeanAbsoluteError value on hold-out data: 0.032548483461141586
Epoch: 177
Loss on hold-out set: 0.002866372944002873
MeanAbsoluteError value on hold-out data: 0.039808936417102814
Epoch: 178
Loss on hold-out set: 0.0016515545338686359
MeanAbsoluteError value on hold-out data: 0.0329623781144619
Epoch: 179

Loss on hold-out set: 0.0008784675079177281
MeanAbsoluteError value on hold-out data: 0.022246241569519043
Epoch: 180
Loss on hold-out set: 0.0012682073927288385
MeanAbsoluteError value on hold-out data: 0.028632091358304024
Epoch: 181
Loss on hold-out set: 0.002284677135513017
MeanAbsoluteError value on hold-out data: 0.04001346230506897
Epoch: 182
Loss on hold-out set: 0.001458309174172188
```

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MeanAbsoluteError value on hold-out data: 0.03187168389558792
Epoch: 183
Loss on hold-out set: 0.000746073104796539
MeanAbsoluteError value on hold-out data: 0.021082764491438866
Epoch: 184
Loss on hold-out set: 0.0014997949688940455
MeanAbsoluteError value on hold-out data: 0.02903820015490055
Epoch: 185
Loss on hold-out set: 0.0004576233025689266
MeanAbsoluteError value on hold-out data: 0.016290714964270592
Epoch: 186
Loss on hold-out set: 0.0009001733438038316
MeanAbsoluteError value on hold-out data: 0.019643468782305717
Epoch: 187
Loss on hold-out set: 0.0008090367329331409
MeanAbsoluteError value on hold-out data: 0.022149546071887016
Epoch: 188
Loss on hold-out set: 0.002217202496371771
MeanAbsoluteError value on hold-out data: 0.0426662303507328
Epoch: 189
Loss on hold-out set: 0.0013544256431295683
MeanAbsoluteError value on hold-out data: 0.02754226140677929
Epoch: 190
Loss on hold-out set: 0.0006484475406499481
MeanAbsoluteError value on hold-out data: 0.020638199523091316
Epoch: 191

Loss on hold-out set: 0.0005168816515881764
MeanAbsoluteError value on hold-out data: 0.017714766785502434
Epoch: 192
Loss on hold-out set: 0.0004508190330326263
MeanAbsoluteError value on hold-out data: 0.016223805025219917
Epoch: 193
Loss on hold-out set: 0.0007548467945430035
MeanAbsoluteError value on hold-out data: 0.022009551525115967
Epoch: 194
Loss on hold-out set: 0.0009847603551430726
MeanAbsoluteError value on hold-out data: 0.026892976835370064
Epoch: 195
Loss on hold-out set: 0.0007665834625521185
MeanAbsoluteError value on hold-out data: 0.021869491785764694
Epoch: 196
```

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Loss on hold-out set: 0.002539123433004869
MeanAbsoluteError value on hold-out data: 0.04210870340466499
Epoch: 197
Loss on hold-out set: 0.004592127142179953
MeanAbsoluteError value on hold-out data: 0.06005045399069786
Epoch: 198
Loss on hold-out set: 0.0015581777766592016
MeanAbsoluteError value on hold-out data: 0.03320710361003876
Epoch: 199
Loss on hold-out set: 0.0023609848484691036
MeanAbsoluteError value on hold-out data: 0.040537066757678986
Epoch: 200
Loss on hold-out set: 0.0031548488615570883
MeanAbsoluteError value on hold-out data: 0.049680452793836594
Epoch: 201
Loss on hold-out set: 0.0025874225018349918
MeanAbsoluteError value on hold-out data: 0.04359179362654686
Epoch: 202
Loss on hold-out set: 0.0012216614589928405
MeanAbsoluteError value on hold-out data: 0.024683546274900436
Epoch: 203

Loss on hold-out set: 0.0024353400068847755
MeanAbsoluteError value on hold-out data: 0.04201547056436539
Epoch: 204
Loss on hold-out set: 0.0017182099277545746
MeanAbsoluteError value on hold-out data: 0.03527171537280083
Epoch: 205
Loss on hold-out set: 0.001847391317010318
MeanAbsoluteError value on hold-out data: 0.03896109759807587
Epoch: 206
Loss on hold-out set: 0.0010630265996472812
MeanAbsoluteError value on hold-out data: 0.015686463564634323
Epoch: 207
Loss on hold-out set: 0.0013355825212784111
MeanAbsoluteError value on hold-out data: 0.027191657572984695
Epoch: 208
Loss on hold-out set: 0.000488947498716267
MeanAbsoluteError value on hold-out data: 0.015983473509550095
Epoch: 209
Loss on hold-out set: 0.000769129906793272
MeanAbsoluteError value on hold-out data: 0.022001713514328003
```

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Epoch: 210
Loss on hold-out set: 0.0007839529854735654
MeanAbsoluteError value on hold-out data: 0.02143390290439129
Epoch: 211
Loss on hold-out set: 0.0008811194719256539
MeanAbsoluteError value on hold-out data: 0.025377772748470306
Epoch: 212
Loss on hold-out set: 0.0054647711130153195
MeanAbsoluteError value on hold-out data: 0.06550081819295883
Epoch: 213
Loss on hold-out set: 0.0010789074340688163
MeanAbsoluteError value on hold-out data: 0.02872537635266781
Epoch: 214
Loss on hold-out set: 0.00035163542519225493
MeanAbsoluteError value on hold-out data: 0.015044563449919224
Epoch: 215
```

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Loss on hold-out set: 0.0007873776377987509
MeanAbsoluteError value on hold-out data: 0.01864132098853588
Epoch: 216
Loss on hold-out set: 0.0008929010264661261
MeanAbsoluteError value on hold-out data: 0.015031835064291954
Epoch: 217
Loss on hold-out set: 0.0006028850651713775
MeanAbsoluteError value on hold-out data: 0.0182152409106493
Epoch: 218
Loss on hold-out set: 0.005648682996826737
MeanAbsoluteError value on hold-out data: 0.07216209918260574
Epoch: 219
Loss on hold-out set: 0.0009362168845990183
MeanAbsoluteError value on hold-out data: 0.025830619037151337
Epoch: 220
Loss on hold-out set: 0.0007445031170439171
MeanAbsoluteError value on hold-out data: 0.019851170480251312
Epoch: 221
Loss on hold-out set: 0.0014336044213881618
MeanAbsoluteError value on hold-out data: 0.03150313347578049
Epoch: 222
Loss on hold-out set: 0.002189142274131116
MeanAbsoluteError value on hold-out data: 0.03787285462021828
Epoch: 223
Loss on hold-out set: 0.0017432607342734148
```

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MeanAbsoluteError value on hold-out data: 0.03512212261557579
Epoch: 224
Loss on hold-out set: 0.0024549352605582066
MeanAbsoluteError value on hold-out data: 0.031207211315631866
Epoch: 225
Loss on hold-out set: 0.0018236752519825178
MeanAbsoluteError value on hold-out data: 0.030308417975902557
Epoch: 226
Loss on hold-out set: 0.0009023840554475196
MeanAbsoluteError value on hold-out data: 0.023374119773507118
Epoch: 227

Loss on hold-out set: 0.002280495975068525
MeanAbsoluteError value on hold-out data: 0.034261804074048996
Epoch: 228
Loss on hold-out set: 0.00042964776022065624
MeanAbsoluteError value on hold-out data: 0.01579376682639122
Epoch: 229
Loss on hold-out set: 0.002409547855342297
MeanAbsoluteError value on hold-out data: 0.037281692028045654
Epoch: 230
Loss on hold-out set: 0.0004585645886101319
MeanAbsoluteError value on hold-out data: 0.016080981120467186
Epoch: 231
Loss on hold-out set: 0.0010020559635258426
MeanAbsoluteError value on hold-out data: 0.024571795016527176
Epoch: 232
Loss on hold-out set: 0.0007263866519727009
MeanAbsoluteError value on hold-out data: 0.021462706848978996
Epoch: 233
Loss on hold-out set: 0.0014149649558882964
MeanAbsoluteError value on hold-out data: 0.025268971920013428
Epoch: 234
Loss on hold-out set: 0.0014542804320195788
MeanAbsoluteError value on hold-out data: 0.03315064683556557
Epoch: 235
Loss on hold-out set: 0.0005284036520415133
MeanAbsoluteError value on hold-out data: 0.01875094324350357
Epoch: 236
Loss on hold-out set: 0.0015540681840655836
MeanAbsoluteError value on hold-out data: 0.027197670191526413
Epoch: 237
```

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Loss on hold-out set: 0.0005303485706558843
MeanAbsoluteError value on hold-out data: 0.018198862671852112
Epoch: 238
Loss on hold-out set: 0.0009530506734001009
MeanAbsoluteError value on hold-out data: 0.024104826152324677
Epoch: 239

Loss on hold-out set: 0.001149891243058894
MeanAbsoluteError value on hold-out data: 0.028812367469072342
Epoch: 240
Loss on hold-out set: 0.001291965872760078
MeanAbsoluteError value on hold-out data: 0.03132810443639755
Epoch: 241
Loss on hold-out set: 0.0012402196466849234
MeanAbsoluteError value on hold-out data: 0.02785794623196125
Epoch: 242
Loss on hold-out set: 0.0035289749319322014
MeanAbsoluteError value on hold-out data: 0.0532917195626259
Epoch: 243
Loss on hold-out set: 0.0008358107986982519
MeanAbsoluteError value on hold-out data: 0.02098960056900978
Epoch: 244
Loss on hold-out set: 0.0014099296531639993
MeanAbsoluteError value on hold-out data: 0.02905893325805664
Epoch: 245
Loss on hold-out set: 0.0007351720261412035
MeanAbsoluteError value on hold-out data: 0.021245984360575676
Epoch: 246
Loss on hold-out set: 0.0029521249357218806
MeanAbsoluteError value on hold-out data: 0.04281504452228546
Epoch: 247
Loss on hold-out set: 0.0005304694633722599
MeanAbsoluteError value on hold-out data: 0.017661303281784058
Epoch: 248
Loss on hold-out set: 0.0013674773202326737
MeanAbsoluteError value on hold-out data: 0.03225389122962952
Epoch: 249
Loss on hold-out set: 0.002014193199820032
MeanAbsoluteError value on hold-out data: 0.035638757050037384
Epoch: 250
Loss on hold-out set: 0.0013120041602585268
MeanAbsoluteError value on hold-out data: 0.030210424214601517
Epoch: 251
```

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Loss on hold-out set: 0.0009956561476237287
MeanAbsoluteError value on hold-out data: 0.02556665614247322
Epoch: 252
Loss on hold-out set: 0.001864253635224151
MeanAbsoluteError value on hold-out data: 0.03603110462427139
Epoch: 253
Loss on hold-out set: 0.0011416476458850269
MeanAbsoluteError value on hold-out data: 0.027632372453808784
Epoch: 254
Loss on hold-out set: 0.0005149182214058543
MeanAbsoluteError value on hold-out data: 0.014814498834311962
Epoch: 255
Loss on hold-out set: 0.0009675122717836578
MeanAbsoluteError value on hold-out data: 0.02529926598072052
Epoch: 256
Loss on hold-out set: 0.0006392133333352639
MeanAbsoluteError value on hold-out data: 0.017684118822216988
Epoch: 257
Loss on hold-out set: 0.0008216803038713375
MeanAbsoluteError value on hold-out data: 0.022626658901572227
Epoch: 258
Loss on hold-out set: 0.0006152178807257625
MeanAbsoluteError value on hold-out data: 0.019229404628276825
Epoch: 259
Loss on hold-out set: 0.0005314722465731105
MeanAbsoluteError value on hold-out data: 0.019367603585124016
Epoch: 260
Loss on hold-out set: 0.001729885915808968
MeanAbsoluteError value on hold-out data: 0.03312409669160843
Epoch: 261
Loss on hold-out set: 0.0004650618847287995
MeanAbsoluteError value on hold-out data: 0.016392908990383148
Epoch: 262
Loss on hold-out set: 0.0011743064295794618
MeanAbsoluteError value on hold-out data: 0.02614571712911129
Epoch: 263

Loss on hold-out set: 0.0008088249864828724
MeanAbsoluteError value on hold-out data: 0.01631702296435833
Epoch: 264
Loss on hold-out set: 0.0022727062398763863
MeanAbsoluteError value on hold-out data: 0.03909658268094063
```

```
Epoch: 265
Loss on hold-out set: 0.0015855234048917498
MeanAbsoluteError value on hold-out data: 0.03612593561410904
Epoch: 266
Loss on hold-out set: 0.0004753506838919987
MeanAbsoluteError value on hold-out data: 0.0170646533370018
Epoch: 267
Loss on hold-out set: 0.0012345717833867592
MeanAbsoluteError value on hold-out data: 0.028319817036390305
Epoch: 268
Loss on hold-out set: 0.0011996982809107163
MeanAbsoluteError value on hold-out data: 0.027912095189094543
Epoch: 269
Loss on hold-out set: 0.0014731334629591163
MeanAbsoluteError value on hold-out data: 0.027178484946489334
Epoch: 270
Loss on hold-out set: 0.0006712871177832744
MeanAbsoluteError value on hold-out data: 0.020907646045088768
Epoch: 271
Loss on hold-out set: 0.0013995539691103133
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Epoch: 272
Loss on hold-out set: 0.0019476542335101648
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Epoch: 273
Loss on hold-out set: 0.004327777197192374
MeanAbsoluteError value on hold-out data: 0.06187273561954498
Epoch: 274
Loss on hold-out set: 0.0016436711823763816
MeanAbsoluteError value on hold-out data: 0.035977527499198914
Epoch: 275

Loss on hold-out set: 0.0005277111738809923
MeanAbsoluteError value on hold-out data: 0.0153190353885293
Epoch: 276
Loss on hold-out set: 0.000922952254768461
MeanAbsoluteError value on hold-out data: 0.023066304624080658
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Loss on hold-out set: 0.0006047623066574728
MeanAbsoluteError value on hold-out data: 0.01913582533597946
Epoch: 278
Loss on hold-out set: 0.0004670996162243874
```

```
MeanAbsoluteError value on hold-out data: 0.015839530155062675
Epoch: 279
Loss on hold-out set: 0.001958461637657724
MeanAbsoluteError value on hold-out data: 0.024378815665841103
Epoch: 280
Loss on hold-out set: 0.0011549895433218855
MeanAbsoluteError value on hold-out data: 0.02892700769007206
Epoch: 281
Loss on hold-out set: 0.002555984060132974
MeanAbsoluteError value on hold-out data: 0.04330720752477646
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Loss on hold-out set: 0.0009632871584280542
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Loss on hold-out set: 0.00082581069957661
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Loss on hold-out set: 0.0018347793068785808
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Loss on hold-out set: 0.0005359342934465722
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Loss on hold-out set: 0.0009054640694031198
MeanAbsoluteError value on hold-out data: 0.023375457152724266
Epoch: 287

Loss on hold-out set: 0.002532988339417467
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Loss on hold-out set: 0.0019792035516155394
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Loss on hold-out set: 0.001135744651516066
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Loss on hold-out set: 0.0008455034725269989
MeanAbsoluteError value on hold-out data: 0.02257470041513443
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Loss on hold-out set: 0.0007915039758173455
MeanAbsoluteError value on hold-out data: 0.02026962675154209
Epoch: 292
```

```
Loss on hold-out set: 0.0014603305332313635
MeanAbsoluteError value on hold-out data: 0.0343804694712162
Epoch: 293
Loss on hold-out set: 0.0014949310203327944
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Loss on hold-out set: 0.00035114186711756413
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Loss on hold-out set: 0.00166695413951713
MeanAbsoluteError value on hold-out data: 0.0337597131729126
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Loss on hold-out set: 0.0008865294206005178
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Loss on hold-out set: 0.0009191524295601994
MeanAbsoluteError value on hold-out data: 0.02485072799026966
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Loss on hold-out set: 0.0029132536269332234
MeanAbsoluteError value on hold-out data: 0.050466783344745636
Epoch: 299

Loss on hold-out set: 0.0026877771045914606
MeanAbsoluteError value on hold-out data: 0.047600407153367996
Epoch: 300
Loss on hold-out set: 0.0010633590358530025
MeanAbsoluteError value on hold-out data: 0.021481303498148918
Epoch: 301
Loss on hold-out set: 0.00336518723174537
MeanAbsoluteError value on hold-out data: 0.05391550809144974
Epoch: 302
Loss on hold-out set: 0.0013185129746010429
MeanAbsoluteError value on hold-out data: 0.03213860094547272
Epoch: 303
Loss on hold-out set: 0.0012289601574210745
MeanAbsoluteError value on hold-out data: 0.028774220496416092
Epoch: 304
Loss on hold-out set: 0.0034362454653570525
MeanAbsoluteError value on hold-out data: 0.04994199052453041
Epoch: 305
Loss on hold-out set: 0.0010362528555560857
MeanAbsoluteError value on hold-out data: 0.022570135071873665
```

```
Epoch: 306
Loss on hold-out set: 0.0005949417276209907
MeanAbsoluteError value on hold-out data: 0.019484322518110275
Epoch: 307
Loss on hold-out set: 0.0009555193675240796
MeanAbsoluteError value on hold-out data: 0.025208165869116783
Epoch: 308
Loss on hold-out set: 0.0011212306011370138
MeanAbsoluteError value on hold-out data: 0.029404083266854286
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Loss on hold-out set: 0.0014819740532211175
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Loss on hold-out set: 0.0010088071652908663
MeanAbsoluteError value on hold-out data: 0.023785706609487534
Epoch: 311


Loss on hold-out set: 0.001156796352006495
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Loss on hold-out set: 0.0005511958795403572
MeanAbsoluteError value on hold-out data: 0.015218294225633144
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Loss on hold-out set: 0.0033674255797737523
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Epoch: 314
Loss on hold-out set: 0.00455468204362612
MeanAbsoluteError value on hold-out data: 0.05577627196907997
Epoch: 315
Loss on hold-out set: 0.0034027632546464077
MeanAbsoluteError value on hold-out data: 0.05320630222558975
Epoch: 316
Loss on hold-out set: 0.001970613525420623
MeanAbsoluteError value on hold-out data: 0.03224637359380722
Epoch: 317
Loss on hold-out set: 0.0010171523287059053
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Epoch: 318
Loss on hold-out set: 0.000770194120521314
MeanAbsoluteError value on hold-out data: 0.022036386653780937
Epoch: 319
Loss on hold-out set: 0.0008850224028145405
```

```
MeanAbsoluteError value on hold-out data: 0.023532873019576073
Epoch: 320
Loss on hold-out set: 0.0006248238442870053
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Loss on hold-out set: 0.0018697584440049372
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Epoch: 322
Loss on hold-out set: 0.0008921662979685751
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Epoch: 323

Loss on hold-out set: 0.0016432126362097303
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Loss on hold-out set: 0.002700573887283865
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Epoch: 325
Loss on hold-out set: 0.0005573206458632883
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Loss on hold-out set: 0.0018911873921751976
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Loss on hold-out set: 0.0026875284659725273
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Loss on hold-out set: 0.0005611967644654214
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Loss on hold-out set: 0.0021121877637740815
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Loss on hold-out set: 0.0010419819476450549
MeanAbsoluteError value on hold-out data: 0.02448670193552971
Epoch: 331
Loss on hold-out set: 0.0031278263348595878
MeanAbsoluteError value on hold-out data: 0.04321913793683052
Epoch: 332
Loss on hold-out set: 0.001567688837990557
MeanAbsoluteError value on hold-out data: 0.028074512258172035
Epoch: 333
```

```
Loss on hold-out set: 0.001334966877230296
MeanAbsoluteError value on hold-out data: 0.03258843719959259
Epoch: 334
Loss on hold-out set: 0.0006767077613499408
MeanAbsoluteError value on hold-out data: 0.019803835079073906
Epoch: 335

Loss on hold-out set: 0.001557101955098149
MeanAbsoluteError value on hold-out data: 0.031154410913586617
Epoch: 336
Loss on hold-out set: 0.0005599982763861158
MeanAbsoluteError value on hold-out data: 0.019298341125249863
Epoch: 337
Loss on hold-out set: 0.0010136362061051553
MeanAbsoluteError value on hold-out data: 0.023902790620923042
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Loss on hold-out set: 0.0004686961459044955
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Loss on hold-out set: 0.0014691780555662454
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Loss on hold-out set: 0.0006427429095645877
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Loss on hold-out set: 0.000798401315573995
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Loss on hold-out set: 0.0012433847786221456
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Loss on hold-out set: 0.0012232961813233008
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Loss on hold-out set: 0.0015576319297236439
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Loss on hold-out set: 0.0024588264610716387
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Epoch: 346
Loss on hold-out set: 0.00114024906590777
MeanAbsoluteError value on hold-out data: 0.028958914801478386
Epoch: 347
```

```
Loss on hold-out set: 0.0009866025441289438
MeanAbsoluteError value on hold-out data: 0.01504589058458805
Epoch: 348
Loss on hold-out set: 0.001445193764275724
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Loss on hold-out set: 0.0011380665941703085
MeanAbsoluteError value on hold-out data: 0.027106009423732758
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Loss on hold-out set: 0.0011999217186760354
MeanAbsoluteError value on hold-out data: 0.02861769124865532
Epoch: 351
Loss on hold-out set: 0.0008953562570049575
MeanAbsoluteError value on hold-out data: 0.024657029658555984
Epoch: 352
Loss on hold-out set: 0.0008632917382974961
MeanAbsoluteError value on hold-out data: 0.023440685123205185
Epoch: 353
Loss on hold-out set: 0.002044517663307488
MeanAbsoluteError value on hold-out data: 0.03914405032992363
Epoch: 354
Loss on hold-out set: 0.00045242961679928397
MeanAbsoluteError value on hold-out data: 0.01590581238269806
Epoch: 355
Loss on hold-out set: 0.0016657302683023246
MeanAbsoluteError value on hold-out data: 0.03231023997068405
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Loss on hold-out set: 0.0010383012153110222
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Loss on hold-out set: 0.001300689666286895
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Loss on hold-out set: 0.0004070128427548824
MeanAbsoluteError value on hold-out data: 0.01579359360039234
Epoch: 359

Loss on hold-out set: 0.000805521465065938
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Epoch: 360
Loss on hold-out set: 0.0012583963995750405
MeanAbsoluteError value on hold-out data: 0.0250482726842165
```

```
Epoch: 361
Loss on hold-out set: 0.0008253309612260445
MeanAbsoluteError value on hold-out data: 0.024056004360318184
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Loss on hold-out set: 0.0031662757790304327
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Loss on hold-out set: 0.0010477593076709461
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Loss on hold-out set: 0.0012467277273045558
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Loss on hold-out set: 0.001735597957648631
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Loss on hold-out set: 0.0004506970726652071
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Loss on hold-out set: 0.0019053672287172002
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Loss on hold-out set: 0.0006897041005829937
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Loss on hold-out set: 0.0008833331873910012
MeanAbsoluteError value on hold-out data: 0.02307090349495411
Epoch: 370

Loss on hold-out set: 0.0011683297328234307
MeanAbsoluteError value on hold-out data: 0.024237236008048058
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Loss on hold-out set: 0.0005793978006726032
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Loss on hold-out set: 0.0009306180658505151
MeanAbsoluteError value on hold-out data: 0.02563926763832569
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Loss on hold-out set: 0.0014563260085292552
MeanAbsoluteError value on hold-out data: 0.031767554581165314
Epoch: 374
Loss on hold-out set: 0.0034574178709207396
```

```
MeanAbsoluteError value on hold-out data: 0.052999574691057205
Epoch: 375
Loss on hold-out set: 0.003739355989780865
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Loss on hold-out set: 0.0007784794985414728
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Loss on hold-out set: 0.0013397190395105433
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Loss on hold-out set: 0.001916699283021061
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Loss on hold-out set: 0.0015996304910482937
MeanAbsoluteError value on hold-out data: 0.024289114400744438
Epoch: 382

Loss on hold-out set: 0.0012177855349268373
MeanAbsoluteError value on hold-out data: 0.020888930186629295
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Loss on hold-out set: 0.0008223748882301152
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Loss on hold-out set: 0.0006033358229998205
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Loss on hold-out set: 0.0014592801729266189
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Loss on hold-out set: 0.003050682490299407
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Loss on hold-out set: 0.002775705094743324
MeanAbsoluteError value on hold-out data: 0.047818735241889954
Epoch: 388
```

```
Loss on hold-out set: 0.0010363687393500616
MeanAbsoluteError value on hold-out data: 0.0215753260999918
Epoch: 389
Loss on hold-out set: 0.0005914337671129033
MeanAbsoluteError value on hold-out data: 0.01678004302084446
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Loss on hold-out set: 0.0006818837343751894
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Loss on hold-out set: 0.000979586305268305
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Loss on hold-out set: 0.002194079588853607
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Epoch: 394

Loss on hold-out set: 0.0012561428807920923
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Loss on hold-out set: 0.0012552092835233595
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Loss on hold-out set: 0.0012053254575125482
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Loss on hold-out set: 0.0013111985325323123
MeanAbsoluteError value on hold-out data: 0.02918822318315506
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Loss on hold-out set: 0.0006772530997343557
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Loss on hold-out set: 0.0004646396532495457
MeanAbsoluteError value on hold-out data: 0.016058865934610367
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Loss on hold-out set: 0.0016906379697550285
MeanAbsoluteError value on hold-out data: 0.03646869584918022
Epoch: 401
Loss on hold-out set: 0.0025324552062604773
MeanAbsoluteError value on hold-out data: 0.044036198407411575
```

```
Epoch: 402
Loss on hold-out set: 0.002267936557090204
MeanAbsoluteError value on hold-out data: 0.04261808097362518
Epoch: 403
Loss on hold-out set: 0.002704329292387947
MeanAbsoluteError value on hold-out data: 0.03935534507036209
Epoch: 404
Loss on hold-out set: 0.0012690013360330149
MeanAbsoluteError value on hold-out data: 0.03218313679099083
Epoch: 405
Loss on hold-out set: 0.0021298949386140235
MeanAbsoluteError value on hold-out data: 0.035652145743370056
Epoch: 406

Loss on hold-out set: 0.0016961516199731513
MeanAbsoluteError value on hold-out data: 0.03570466488599777
Epoch: 407
Loss on hold-out set: 0.0021668631326113093
MeanAbsoluteError value on hold-out data: 0.04258720949292183
Epoch: 408
Loss on hold-out set: 0.0007251540879032722
MeanAbsoluteError value on hold-out data: 0.017194192856550217
Epoch: 409
Loss on hold-out set: 0.0006437865438209357
MeanAbsoluteError value on hold-out data: 0.01802693121135235
Epoch: 410
Loss on hold-out set: 0.0014135809676525625
MeanAbsoluteError value on hold-out data: 0.021352194249629974
Epoch: 411
Loss on hold-out set: 0.0011891018734068463
MeanAbsoluteError value on hold-out data: 0.02101130411028862
Epoch: 412
Loss on hold-out set: 0.0011577068247501494
MeanAbsoluteError value on hold-out data: 0.01747857965528965
Epoch: 413
Loss on hold-out set: 0.0004188041087840439
MeanAbsoluteError value on hold-out data: 0.014955178834497929
Epoch: 414
Loss on hold-out set: 0.001022875324308284
MeanAbsoluteError value on hold-out data: 0.0269469041377306
Epoch: 415
Loss on hold-out set: 0.0009087641481432671
```

```
MeanAbsoluteError value on hold-out data: 0.01862121932208538
Epoch: 416
Loss on hold-out set: 0.0009087907796799156
MeanAbsoluteError value on hold-out data: 0.020246097818017006
Epoch: 417
Loss on hold-out set: 0.0014463230097470315
MeanAbsoluteError value on hold-out data: 0.031941141933202744
Epoch: 418

Loss on hold-out set: 0.002267690694057628
MeanAbsoluteError value on hold-out data: 0.043973907828330994
Epoch: 419
Loss on hold-out set: 0.0026218292952858305
MeanAbsoluteError value on hold-out data: 0.0477440245449543
Epoch: 420
Loss on hold-out set: 0.0008579678006323153
MeanAbsoluteError value on hold-out data: 0.025170354172587395
Epoch: 421
Loss on hold-out set: 0.001058352772624379
MeanAbsoluteError value on hold-out data: 0.02092081680893898
Epoch: 422
Loss on hold-out set: 0.000564732769577715
MeanAbsoluteError value on hold-out data: 0.01696457341313362
Early stopping at epoch 421
Returned to Spot: Validation loss: 0.000564732769577715
----------------------------------------------

spotPython tuning: 0.00022239663858750932 [#######---] 68.59%


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Loss on hold-out set: 0.3016386549723776
MeanAbsoluteError value on hold-out data: 0.54080730676651
Epoch: 2
Loss on hold-out set: 0.03895349310416924
MeanAbsoluteError value on hold-out data: 0.17068657279014587
Epoch: 3
Loss on hold-out set: 0.03517686232532326
MeanAbsoluteError value on hold-out data: 0.16219864785671234
Epoch: 4
Loss on hold-out set: 0.0383488508431535
```

```
MeanAbsoluteError value on hold-out data: 0.17409363389015198
Epoch: 5
Loss on hold-out set: 0.06462481363039267
MeanAbsoluteError value on hold-out data: 0.24055606126785278
Epoch: 6
Loss on hold-out set: 0.10018021378077958
MeanAbsoluteError value on hold-out data: 0.30852195620536804
Epoch: 7
Loss on hold-out set: 0.12698784470558167
MeanAbsoluteError value on hold-out data: 0.35082703828811646
Epoch: 8
Loss on hold-out set: 0.13893414210332067
MeanAbsoluteError value on hold-out data: 0.367451936006546
Epoch: 9
Loss on hold-out set: 0.024302491526070395
MeanAbsoluteError value on hold-out data: 0.14050798118114471
Epoch: 10
Loss on hold-out set: 0.060682234403334166
MeanAbsoluteError value on hold-out data: 0.23984219133853912
Epoch: 11
Loss on hold-out set: 0.08270835366688277
MeanAbsoluteError value on hold-out data: 0.2830686569213867
Epoch: 12
Loss on hold-out set: 0.08823052911381972
MeanAbsoluteError value on hold-out data: 0.2923072278499603
Epoch: 13
Loss on hold-out set: 0.019802447702539593
MeanAbsoluteError value on hold-out data: 0.13225464522838593
Epoch: 14
Loss on hold-out set: 0.0060338167179571954
MeanAbsoluteError value on hold-out data: 0.06092226132750511
Epoch: 15
Loss on hold-out set: 0.07553041608710039
MeanAbsoluteError value on hold-out data: 0.27181941270828247
Epoch: 16

Loss on hold-out set: 0.03412693640903423
MeanAbsoluteError value on hold-out data: 0.18003112077713013
Epoch: 17
Loss on hold-out set: 0.012505668019385715
MeanAbsoluteError value on hold-out data: 0.10441140830516815
Epoch: 18
```

```
Loss on hold-out set: 0.005750358276265233
MeanAbsoluteError value on hold-out data: 0.059903502464294434
Epoch: 19
Loss on hold-out set: 0.0057323634575464225
MeanAbsoluteError value on hold-out data: 0.06497999280691147
Epoch: 20
Loss on hold-out set: 0.050206326928577925
MeanAbsoluteError value on hold-out data: 0.22063997387886047
Epoch: 21
Loss on hold-out set: 0.026475292777544575
MeanAbsoluteError value on hold-out data: 0.15883518755435944
Epoch: 22
Loss on hold-out set: 0.004864779644106564
MeanAbsoluteError value on hold-out data: 0.05612839385867119
Epoch: 23
Loss on hold-out set: 0.049997898897058086
MeanAbsoluteError value on hold-out data: 0.220232293009758
Epoch: 24
Loss on hold-out set: 0.01691154934661953
MeanAbsoluteError value on hold-out data: 0.12463181465864182
Epoch: 25
Loss on hold-out set: 0.0052955253049731255
MeanAbsoluteError value on hold-out data: 0.05832045152783394
Epoch: 26
Loss on hold-out set: 0.017698505697281736
MeanAbsoluteError value on hold-out data: 0.1280338615179062
Epoch: 27
Loss on hold-out set: 0.022160795174146954
MeanAbsoluteError value on hold-out data: 0.14469289779663086
Epoch: 28
Loss on hold-out set: 0.026532429123395367
MeanAbsoluteError value on hold-out data: 0.15946805477142334
Epoch: 29
Loss on hold-out set: 0.006377807671302243
MeanAbsoluteError value on hold-out data: 0.06597491353750229
Epoch: 30
Loss on hold-out set: 0.018844061433092543
MeanAbsoluteError value on hold-out data: 0.13271567225456238
Epoch: 31
Loss on hold-out set: 0.004703929537515107
MeanAbsoluteError value on hold-out data: 0.05498165637254715
Epoch: 32
```

```
Loss on hold-out set: 0.019265737433574702
MeanAbsoluteError value on hold-out data: 0.13463494181632996
Epoch: 33
Loss on hold-out set: 0.012579735662592085
MeanAbsoluteError value on hold-out data: 0.09053157269954681
Epoch: 34
Loss on hold-out set: 0.03338380461852802
MeanAbsoluteError value on hold-out data: 0.17961877584457397
Epoch: 35
Loss on hold-out set: 0.01314976105564519
MeanAbsoluteError value on hold-out data: 0.10166218131780624
Epoch: 36
Loss on hold-out set: 0.030324220167178857
MeanAbsoluteError value on hold-out data: 0.17150458693504333
Epoch: 37
Loss on hold-out set: 0.003930852969030016
MeanAbsoluteError value on hold-out data: 0.0504012256860733
Epoch: 38
Loss on hold-out set: 0.031479967463957634
MeanAbsoluteError value on hold-out data: 0.17430640757083893
Epoch: 39
Loss on hold-out set: 0.011142100133982143
MeanAbsoluteError value on hold-out data: 0.08544446527957916
Epoch: 40
Loss on hold-out set: 0.024675453964032625
MeanAbsoluteError value on hold-out data: 0.15429167449474335
Epoch: 41
Loss on hold-out set: 0.003950751962532338
MeanAbsoluteError value on hold-out data: 0.050957635045051575
Epoch: 42
Loss on hold-out set: 0.02996016980001801
MeanAbsoluteError value on hold-out data: 0.16995270550251007
Epoch: 43
Loss on hold-out set: 0.004961074648523017
MeanAbsoluteError value on hold-out data: 0.05566302686929703
Epoch: 44
Loss on hold-out set: 0.019454477452918104
MeanAbsoluteError value on hold-out data: 0.1358112096786499
Epoch: 45
Loss on hold-out set: 0.011602362568833326
MeanAbsoluteError value on hold-out data: 0.09344065934419632
Epoch: 46
Loss on hold-out set: 0.02431189690373446
```

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MeanAbsoluteError value on hold-out data: 0.15229085087776184
Epoch: 47
Loss on hold-out set: 0.0041025729825426085
MeanAbsoluteError value on hold-out data: 0.05041544884443283
Epoch: 48
Loss on hold-out set: 0.028623396432713458
MeanAbsoluteError value on hold-out data: 0.16578592360019684


Epoch: 49
Loss on hold-out set: 0.015748752967307444
MeanAbsoluteError value on hold-out data: 0.12130700796842575
Epoch: 50
Loss on hold-out set: 0.004315967953420784
MeanAbsoluteError value on hold-out data: 0.051995426416397095
Epoch: 51
Loss on hold-out set: 0.018638169000807562
MeanAbsoluteError value on hold-out data: 0.13248692452907562
Epoch: 52
Loss on hold-out set: 0.003951035495112209
MeanAbsoluteError value on hold-out data: 0.0495474599301815
Epoch: 53
Loss on hold-out set: 0.01842415465140029
MeanAbsoluteError value on hold-out data: 0.13175977766513824
Epoch: 54
Loss on hold-out set: 0.00955431442707777
MeanAbsoluteError value on hold-out data: 0.07805664837360382
Epoch: 55
Loss on hold-out set: 0.01761499125706522
MeanAbsoluteError value on hold-out data: 0.12989608943462372
Epoch: 56
Loss on hold-out set: 0.0029796693216715205
MeanAbsoluteError value on hold-out data: 0.04350341856479645
Epoch: 57
Loss on hold-out set: 0.01890065913137637
MeanAbsoluteError value on hold-out data: 0.1341584473848343
Epoch: 58
Loss on hold-out set: 0.009792565956319632
MeanAbsoluteError value on hold-out data: 0.08775413781404495
Epoch: 59
Loss on hold-out set: 0.017640141133022934
MeanAbsoluteError value on hold-out data: 0.1294422745704651
Epoch: 60
```

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Loss on hold-out set: 0.0068312708263922675
MeanAbsoluteError value on hold-out data: 0.06375540047883987
Epoch: 61
Loss on hold-out set: 0.019728014931867
MeanAbsoluteError value on hold-out data: 0.13700832426548004
Epoch: 62
Loss on hold-out set: 0.004208656812184735
MeanAbsoluteError value on hold-out data: 0.051076557487249374
Epoch: 63
Loss on hold-out set: 0.022865305605687593
MeanAbsoluteError value on hold-out data: 0.147657111287117
Epoch: 64


Loss on hold-out set: 0.006978811818714205
MeanAbsoluteError value on hold-out data: 0.0784192755818367
Epoch: 65
Loss on hold-out set: 0.004673824657833106
MeanAbsoluteError value on hold-out data: 0.054121289402246475
Epoch: 66
Loss on hold-out set: 0.010639412034499017
MeanAbsoluteError value on hold-out data: 0.09876718372106552
Epoch: 67
Loss on hold-out set: 0.005343651938203134
MeanAbsoluteError value on hold-out data: 0.058341383934020996
Epoch: 68
Loss on hold-out set: 0.021968107670545578
MeanAbsoluteError value on hold-out data: 0.1446257084608078
Epoch: 69
Loss on hold-out set: 0.004157866964018659
MeanAbsoluteError value on hold-out data: 0.050999924540519714
Epoch: 70
Loss on hold-out set: 0.01770435322664286
MeanAbsoluteError value on hold-out data: 0.12898266315460205
Epoch: 71
Loss on hold-out set: 0.0047815898188242785
MeanAbsoluteError value on hold-out data: 0.056055642664432526
Epoch: 72
Loss on hold-out set: 0.006660916327841972
MeanAbsoluteError value on hold-out data: 0.07651825249195099
Epoch: 73
Loss on hold-out set: 0.008562253616554173
MeanAbsoluteError value on hold-out data: 0.074795201420784
```

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Epoch: 74
Loss on hold-out set: 0.005657483406953122
MeanAbsoluteError value on hold-out data: 0.07030181586742401
Epoch: 75
Loss on hold-out set: 0.00445030367394027
MeanAbsoluteError value on hold-out data: 0.05338270962238312
Epoch: 76
Loss on hold-out set: 0.015316953539456191
MeanAbsoluteError value on hold-out data: 0.11883397400379181
Epoch: 77
Loss on hold-out set: 0.004363363192073609
MeanAbsoluteError value on hold-out data: 0.05346034839749336
Epoch: 78
Loss on hold-out set: 0.008839451952984459
MeanAbsoluteError value on hold-out data: 0.0900271087884903
Epoch: 79
Loss on hold-out set: 0.006863976019973818
MeanAbsoluteError value on hold-out data: 0.06454396992921829
Epoch: 80

Loss on hold-out set: 0.006497128719561978
MeanAbsoluteError value on hold-out data: 0.0757850855588913
Epoch: 81
Loss on hold-out set: 0.006466741661394113
MeanAbsoluteError value on hold-out data: 0.06358496844768524
Epoch: 82
Loss on hold-out set: 0.010393321023959862
MeanAbsoluteError value on hold-out data: 0.09831926226615906
Epoch: 83
Loss on hold-out set: 0.005745873578186882
MeanAbsoluteError value on hold-out data: 0.0621495246887207
Epoch: 84
Loss on hold-out set: 0.009504302821465228
MeanAbsoluteError value on hold-out data: 0.09300268441438675
Epoch: 85
Loss on hold-out set: 0.005171560461779958
MeanAbsoluteError value on hold-out data: 0.05729668214917183
Epoch: 86
Loss on hold-out set: 0.0100195728928635
MeanAbsoluteError value on hold-out data: 0.09538668394088745
Epoch: 87
Loss on hold-out set: 0.005743483877985885
```

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MeanAbsoluteError value on hold-out data: 0.06079307571053505
Epoch: 88
Loss on hold-out set: 0.009592196806088873
MeanAbsoluteError value on hold-out data: 0.09444732218980789
Epoch: 89
Loss on hold-out set: 0.005729503047309424
MeanAbsoluteError value on hold-out data: 0.0583837516605854
Epoch: 90
Loss on hold-out set: 0.007624769191208638
MeanAbsoluteError value on hold-out data: 0.08367743343114853
Epoch: 91
Loss on hold-out set: 0.006731670423361816
MeanAbsoluteError value on hold-out data: 0.06587406247854233
Epoch: 92
Loss on hold-out set: 0.005287180642450326
MeanAbsoluteError value on hold-out data: 0.06847889721393585
Epoch: 93
Loss on hold-out set: 0.005171066787289946
MeanAbsoluteError value on hold-out data: 0.05642271786928177
Epoch: 94
Loss on hold-out set: 0.0067197481709483425
MeanAbsoluteError value on hold-out data: 0.0777042806148529
Epoch: 95
Loss on hold-out set: 0.005812035996074739
MeanAbsoluteError value on hold-out data: 0.06307479739189148
Epoch: 96
Loss on hold-out set: 0.012653335977933909
MeanAbsoluteError value on hold-out data: 0.10679548978805542


Epoch: 97
Loss on hold-out set: 0.007595404786498923
MeanAbsoluteError value on hold-out data: 0.08261631429195404
Epoch: 98
Loss on hold-out set: 0.007461987558360163
MeanAbsoluteError value on hold-out data: 0.06630454957485199
Epoch: 99
Loss on hold-out set: 0.006086676160951978
MeanAbsoluteError value on hold-out data: 0.07435718178749084
Epoch: 100
Loss on hold-out set: 0.006504849236654608
MeanAbsoluteError value on hold-out data: 0.06519244611263275
Epoch: 101
```

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Loss on hold-out set: 0.004879166506917069
MeanAbsoluteError value on hold-out data: 0.06602755188941956
Epoch: 102
Loss on hold-out set: 0.006219435238132351
MeanAbsoluteError value on hold-out data: 0.06443029642105103
Epoch: 103
Loss on hold-out set: 0.005664528764196132
MeanAbsoluteError value on hold-out data: 0.0716342180967331
Epoch: 104
Loss on hold-out set: 0.0056830333717363445
MeanAbsoluteError value on hold-out data: 0.06204694136977196
Epoch: 105
Loss on hold-out set: 0.008652344787199246
MeanAbsoluteError value on hold-out data: 0.08871609717607498
Epoch: 106
Loss on hold-out set: 0.005466499390374673
MeanAbsoluteError value on hold-out data: 0.05929919704794884
Epoch: 107
Loss on hold-out set: 0.0091559247750985
MeanAbsoluteError value on hold-out data: 0.09126012027263641
Epoch: 108
Loss on hold-out set: 0.005273603944500026
MeanAbsoluteError value on hold-out data: 0.05669889599084854
Epoch: 109
Loss on hold-out set: 0.008255947234207079
MeanAbsoluteError value on hold-out data: 0.08690368384122849
Epoch: 110
Loss on hold-out set: 0.004848926193325927
MeanAbsoluteError value on hold-out data: 0.05586833134293556
Epoch: 111
Loss on hold-out set: 0.004296671599149704
MeanAbsoluteError value on hold-out data: 0.06214085966348648
Epoch: 112
Loss on hold-out set: 0.004993529475637172
MeanAbsoluteError value on hold-out data: 0.057343125343322754
Epoch: 113

Loss on hold-out set: 0.005283346301630924
MeanAbsoluteError value on hold-out data: 0.06868462264537811
Epoch: 114
Loss on hold-out set: 0.004248183367675857
MeanAbsoluteError value on hold-out data: 0.05267046019434929
```

```
Epoch: 115
Loss on hold-out set: 0.006977439490392O2
MeanAbsoluteError value on hold-out data: 0.07969023287296295
Epoch: 116
Loss on hold-out set: 0.005098083779509915
MeanAbsoluteError value on hold-out data: 0.05693330243229866
Epoch: 117
Loss on hold-out set: 0.008777739038985027
MeanAbsoluteError value on hold-out data: 0.08935488760471344
Epoch: 118
Loss on hold-out set: 0.006336033368777288
MeanAbsoluteError value on hold-out data: 0.06100514158606529
Epoch: 119
Loss on hold-out set: 0.006150561678958566
MeanAbsoluteError value on hold-out data: 0.07460286468267441
Epoch: 120
Loss on hold-out set: 0.005524871834112625
MeanAbsoluteError value on hold-out data: 0.05689530074596405
Epoch: 121
Loss on hold-out set: 0.006248710186857926
MeanAbsoluteError value on hold-out data: 0.07488750666379929
Epoch: 122
Loss on hold-out set: 0.00633965829681409
MeanAbsoluteError value on hold-out data: 0.06123489513993263
Epoch: 123
Loss on hold-out set: 0.006809682242180172
MeanAbsoluteError value on hold-out data: 0.07855884730815887
Epoch: 124
Loss on hold-out set: 0.004858977259381821
MeanAbsoluteError value on hold-out data: 0.05442589893937111
Epoch: 125
Loss on hold-out set: 0.019258687860871617
MeanAbsoluteError value on hold-out data: 0.13453523814678192
Epoch: 126
Loss on hold-out set: 0.0010325030429827933
MeanAbsoluteError value on hold-out data: 0.02839653380215168
Epoch: 127
Loss on hold-out set: 0.0024712358625899804
MeanAbsoluteError value on hold-out data: 0.04549740254878998
Epoch: 128
Loss on hold-out set: 0.005876220897526333
MeanAbsoluteError value on hold-out data: 0.06056883558630943
Epoch: 129
```

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Loss on hold-out set: 0.0022154743170463725
MeanAbsoluteError value on hold-out data: 0.043231356889009476
Epoch: 130

Loss on hold-out set: 0.0049897995654885705
MeanAbsoluteError value on hold-out data: 0.05543224513530731
Epoch: 131
Loss on hold-out set: 0.00717592523678353
MeanAbsoluteError value on hold-out data: 0.08102720230817795
Epoch: 132
Loss on hold-out set: 0.004727606539075312
MeanAbsoluteError value on hold-out data: 0.054514892399311066
Epoch: 133
Loss on hold-out set: 0.007242660528342975
MeanAbsoluteError value on hold-out data: 0.08098674565553665
Epoch: 134
Loss on hold-out set: 0.004707589157317814
MeanAbsoluteError value on hold-out data: 0.05312897637486458
Epoch: 135
Loss on hold-out set: 0.006535679886215611
MeanAbsoluteError value on hold-out data: 0.07671300321817398
Epoch: 136
Loss on hold-out set: 0.005188590136209601
MeanAbsoluteError value on hold-out data: 0.056456077843904495
Epoch: 137
Loss on hold-out set: 0.00711258395427936
MeanAbsoluteError value on hold-out data: 0.080455482006073
Epoch: 138
Loss on hold-out set: 0.004542466498127109
MeanAbsoluteError value on hold-out data: 0.05315347760915756
Epoch: 139
Loss on hold-out set: 0.006682428408806261
MeanAbsoluteError value on hold-out data: 0.07774375379085541
Epoch: 140
Loss on hold-out set: 0.005675827986315677
MeanAbsoluteError value on hold-out data: 0.05764847621321678
Epoch: 141
Loss on hold-out set: 0.006860413882685335
MeanAbsoluteError value on hold-out data: 0.07870090752840042
Epoch: 142
Loss on hold-out set: 0.004444544681494958
MeanAbsoluteError value on hold-out data: 0.05245053768157959
```

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Epoch: 143
Loss on hold-out set: 0.007231981787634523
MeanAbsoluteError value on hold-out data: 0.08072420209646225
Epoch: 144
Loss on hold-out set: 0.0049473075686316745
MeanAbsoluteError value on hold-out data: 0.05435000732541084
Epoch: 145
Loss on hold-out set: 0.007490284740924835
MeanAbsoluteError value on hold-out data: 0.08284659683704376
Epoch: 146
Loss on hold-out set: 0.005061948892513388
MeanAbsoluteError value on hold-out data: 0.055007204413414


Epoch: 147
Loss on hold-out set: 0.010633259227401331
MeanAbsoluteError value on hold-out data: 0.09822620451450348
Epoch: 148
Loss on hold-out set: 0.0049702600747542946
MeanAbsoluteError value on hold-out data: 0.05286206677556038
Epoch: 149
Loss on hold-out set: 0.008773072279597583
MeanAbsoluteError value on hold-out data: 0.08957795053720474
Epoch: 150
Loss on hold-out set: 0.004906441342379702
MeanAbsoluteError value on hold-out data: 0.053337547928094864
Epoch: 151
Loss on hold-out set: 0.009684064131426183
MeanAbsoluteError value on hold-out data: 0.09386129677295685
Epoch: 152
Loss on hold-out set: 0.004173140923835729
MeanAbsoluteError value on hold-out data: 0.047400955110788345
Epoch: 153
Loss on hold-out set: 0.007859142007012116
MeanAbsoluteError value on hold-out data: 0.08437608182430267
Epoch: 154
Loss on hold-out set: 0.004889806659009896
MeanAbsoluteError value on hold-out data: 0.052366528660058975
Epoch: 155
Loss on hold-out set: 0.007673806535374177
MeanAbsoluteError value on hold-out data: 0.08302382379770279
Epoch: 156
Loss on hold-out set: 0.0053000814330420995
```

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MeanAbsoluteError value on hold-out data: 0.05415777862071991
Epoch: 157
Loss on hold-out set: 0.010218781026962557
MeanAbsoluteError value on hold-out data: 0.0965796634554863
Epoch: 158
Loss on hold-out set: 0.00528417695558777
MeanAbsoluteError value on hold-out data: 0.055093567818403244
Epoch: 159
Loss on hold-out set: 0.007725197797347056
MeanAbsoluteError value on hold-out data: 0.0832943543791771
Epoch: 160
Loss on hold-out set: 0.004022058430372884
MeanAbsoluteError value on hold-out data: 0.04772673174738884
Epoch: 161
Loss on hold-out set: 0.006824779103657133
MeanAbsoluteError value on hold-out data: 0.07833914458751678
Epoch: 162

Loss on hold-out set: 0.0047083788820983545
MeanAbsoluteError value on hold-out data: 0.0508972629904747
Epoch: 163
Loss on hold-out set: 0.0067447925378617485
MeanAbsoluteError value on hold-out data: 0.07664771378040314
Epoch: 164
Loss on hold-out set: 0.005131003275317581
MeanAbsoluteError value on hold-out data: 0.053191181272268295
Epoch: 165
Loss on hold-out set: 0.007084147538989782
MeanAbsoluteError value on hold-out data: 0.07871245592832565
Epoch: 166
Loss on hold-out set: 0.005678316406709583
MeanAbsoluteError value on hold-out data: 0.055455487221479416
Epoch: 167
Loss on hold-out set: 0.008633525502917013
MeanAbsoluteError value on hold-out data: 0.08873289078474045
Epoch: 168
Loss on hold-out set: 0.004753164260795242
MeanAbsoluteError value on hold-out data: 0.05104586482048035
Epoch: 169
Loss on hold-out set: 0.006996015503414367
MeanAbsoluteError value on hold-out data: 0.07833610475063324
Epoch: 170
```

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Loss on hold-out set: 0.00614127105003909
MeanAbsoluteError value on hold-out data: 0.057548604905605316
Epoch: 171
Loss on hold-out set: 0.0069482562769400446
MeanAbsoluteError value on hold-out data: 0.07836902886629105
Epoch: 172
Loss on hold-out set: 0.005402608872636368
MeanAbsoluteError value on hold-out data: 0.054362550377845764
Epoch: 173
Loss on hold-out set: 0.0062335610977913205
MeanAbsoluteError value on hold-out data: 0.0740780383348465
Epoch: 174
Loss on hold-out set: 0.00439420004228228
MeanAbsoluteError value on hold-out data: 0.04872724413871765
Epoch: 175
Loss on hold-out set: 0.006701791708014514
MeanAbsoluteError value on hold-out data: 0.07628169655799866
Epoch: 176
Loss on hold-out set: 0.005512258540348787
MeanAbsoluteError value on hold-out data: 0.05444933474063873
Epoch: 177
Loss on hold-out set: 0.00599991169905192
MeanAbsoluteError value on hold-out data: 0.07276291400194168
Epoch: 178
Loss on hold-out set: 0.005601543896390419
MeanAbsoluteError value on hold-out data: 0.055888716131448746
Epoch: 179

Loss on hold-out set: 0.007069129153693977
MeanAbsoluteError value on hold-out data: 0.0780210867524147
Epoch: 180
Loss on hold-out set: 0.004300125813307731
MeanAbsoluteError value on hold-out data: 0.048161063343286514
Epoch: 181
Loss on hold-out set: 0.007742931061473332
MeanAbsoluteError value on hold-out data: 0.08267244696617126
Epoch: 182
Loss on hold-out set: 0.003656152684829737
MeanAbsoluteError value on hold-out data: 0.04551452770829201
Epoch: 183
Loss on hold-out set: 0.005903821291500016
MeanAbsoluteError value on hold-out data: 0.07191664725542068
```

```
Epoch: 184
Loss on hold-out set: 0.004539953091328866
MeanAbsoluteError value on hold-out data: 0.0498649962246418
Epoch: 185
Loss on hold-out set: 0.005959552075517805
MeanAbsoluteError value on hold-out data: 0.07105699181556702
Epoch: 186
Loss on hold-out set: 0.0042189454022598894
MeanAbsoluteError value on hold-out data: 0.04967100918292999
Epoch: 187
Loss on hold-out set: 0.006456605795966952
MeanAbsoluteError value on hold-out data: 0.0740426778793335
Epoch: 188
Loss on hold-out set: 0.005455316363000556
MeanAbsoluteError value on hold-out data: 0.053673069924116135
Epoch: 189
Loss on hold-out set: 0.004040090232401302
MeanAbsoluteError value on hold-out data: 0.057823341339826584
Epoch: 190
Loss on hold-out set: 0.004674596172806464
MeanAbsoluteError value on hold-out data: 0.05239325389266014
Epoch: 191
Loss on hold-out set: 0.009128267068023744
MeanAbsoluteError value on hold-out data: 0.0876806303858757
Epoch: 192
Loss on hold-out set: 0.005303709816775824
MeanAbsoluteError value on hold-out data: 0.06663258373737335
Epoch: 193
Loss on hold-out set: 0.006221669824107697
MeanAbsoluteError value on hold-out data: 0.058963578194379807
Epoch: 194
Loss on hold-out set: 0.00611302594801313
MeanAbsoluteError value on hold-out data: 0.07219445705413818
Epoch: 195
Loss on hold-out set: 0.004395942338497231
MeanAbsoluteError value on hold-out data: 0.05054892227053642

Epoch: 196
Loss on hold-out set: 0.009575447116635348
MeanAbsoluteError value on hold-out data: 0.09102673828601837
Epoch: 197
Loss on hold-out set: 0.0014900917977731872
```

```
MeanAbsoluteError value on hold-out data: 0.03380889073014259
Epoch: 198
Loss on hold-out set: 0.005336865341584934
MeanAbsoluteError value on hold-out data: 0.05705227702856064
Epoch: 199
Loss on hold-out set: 0.004690899979323149
MeanAbsoluteError value on hold-out data: 0.06084714084863663
Epoch: 200
Loss on hold-out set: 0.004472021993837859
MeanAbsoluteError value on hold-out data: 0.05094842240214348
Epoch: 201
Loss on hold-out set: 0.008553422007121537
MeanAbsoluteError value on hold-out data: 0.08510881662368774
Epoch: 202
Loss on hold-out set: 0.0013087102316172892
MeanAbsoluteError value on hold-out data: 0.031073348596692085
Epoch: 203
Loss on hold-out set: 0.005165073113810075
MeanAbsoluteError value on hold-out data: 0.06579414755105972
Epoch: 204
Loss on hold-out set: 0.004804271040484309
MeanAbsoluteError value on hold-out data: 0.055729541927576065
Epoch: 205
Loss on hold-out set: 0.005148188725702073
MeanAbsoluteError value on hold-out data: 0.06560742110013962
Epoch: 206
Loss on hold-out set: 0.006359016890392492
MeanAbsoluteError value on hold-out data: 0.06436994671821594
Epoch: 207
Loss on hold-out set: 0.005774613812957939
MeanAbsoluteError value on hold-out data: 0.06866816431283951
Epoch: 208
Loss on hold-out set: 0.0032238274641138943
MeanAbsoluteError value on hold-out data: 0.044123511761426926
Epoch: 209
Loss on hold-out set: 0.006250371984941394
MeanAbsoluteError value on hold-out data: 0.07319582253694534
Epoch: 210
Loss on hold-out set: 0.008241500509412665
MeanAbsoluteError value on hold-out data: 0.07282209396362305
Epoch: 211
Loss on hold-out set: 0.003559886771989496
MeanAbsoluteError value on hold-out data: 0.053396061062812805
```

Epoch: 212

Loss on hold-out set: 0.002273603262820918
MeanAbsoluteError value on hold-out data: 0.03777066990733147
Epoch: 213
Loss on hold-out set: 0.004924622437867679
MeanAbsoluteError value on hold-out data: 0.06359311193227768
Epoch: 214
Loss on hold-out set: 0.004840073187982566
MeanAbsoluteError value on hold-out data: 0.05692513659596443
Epoch: 215
Loss on hold-out set: 0.0062490756329345075
MeanAbsoluteError value on hold-out data: 0.07114914059638977
Epoch: 216
Loss on hold-out set: 0.007327815787376542
MeanAbsoluteError value on hold-out data: 0.07080387324094772
Epoch: 217
Loss on hold-out set: 0.0048775778054014635
MeanAbsoluteError value on hold-out data: 0.06306054443120956
Epoch: 218
Loss on hold-out set: 0.005689770252885003
MeanAbsoluteError value on hold-out data: 0.06100140139460564
Epoch: 219
Loss on hold-out set: 0.010469764127935233
MeanAbsoluteError value on hold-out data: 0.09470130503177643
Epoch: 220
Loss on hold-out set: 0.00234362265511759
MeanAbsoluteError value on hold-out data: 0.03730038180947304
Epoch: 221
Loss on hold-out set: 0.003831936181277821
MeanAbsoluteError value on hold-out data: 0.05667009949684143
Epoch: 222
Loss on hold-out set: 0.00349565307413669
MeanAbsoluteError value on hold-out data: 0.04739832505583763
Epoch: 223
Loss on hold-out set: 0.0040986327773058105
MeanAbsoluteError value on hold-out data: 0.05765073001384735
Epoch: 224
Loss on hold-out set: 0.004798519388331394
MeanAbsoluteError value on hold-out data: 0.05544343218207359
Epoch: 225
Loss on hold-out set: 0.005674145208965791

MeanAbsoluteError value on hold-out data: 0.06776708364486694
Epoch: 226
Loss on hold-out set: 0.0019161936912783666
MeanAbsoluteError value on hold-out data: 0.03776136413216591
Epoch: 227
Loss on hold-out set: 0.0008250922715217856
MeanAbsoluteError value on hold-out data: 0.021573856472969055
Epoch: 228
Loss on hold-out set: 0.0007738694472017846
MeanAbsoluteError value on hold-out data: 0.02035074308514595

Epoch: 229
Loss on hold-out set: 0.0014665701034429826
MeanAbsoluteError value on hold-out data: 0.03253522887825966
Epoch: 230
Loss on hold-out set: 0.004979611129352921
MeanAbsoluteError value on hold-out data: 0.056231506168842316
Epoch: 231
Loss on hold-out set: 0.0013632286940456222
MeanAbsoluteError value on hold-out data: 0.03300812467932701
Epoch: 232
Loss on hold-out set: 0.004075167467817664
MeanAbsoluteError value on hold-out data: 0.05158606544137001
Epoch: 233
Loss on hold-out set: 0.005360098678226534
MeanAbsoluteError value on hold-out data: 0.06669033318758011
Epoch: 234
Loss on hold-out set: 0.007728476542979479
MeanAbsoluteError value on hold-out data: 0.0731094479560852
Epoch: 235
Loss on hold-out set: 0.0033019682343461013
MeanAbsoluteError value on hold-out data: 0.05233307182788849
Epoch: 236
Loss on hold-out set: 0.004272526657012732
MeanAbsoluteError value on hold-out data: 0.05434032529592514
Epoch: 237
Loss on hold-out set: 0.0039002313523700365
MeanAbsoluteError value on hold-out data: 0.05630440264940262
Epoch: 238
Loss on hold-out set: 0.005915638181920114
MeanAbsoluteError value on hold-out data: 0.06343720108270645
Epoch: 239

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Loss on hold-out set: 0.0038653980989597344
MeanAbsoluteError value on hold-out data: 0.055810585618019104
Epoch: 240
Loss on hold-out set: 0.001939129402959033
MeanAbsoluteError value on hold-out data: 0.03580979257822037
Epoch: 241
Loss on hold-out set: 0.002909308054337376
MeanAbsoluteError value on hold-out data: 0.048247989267110825
Epoch: 242
Loss on hold-out set: 0.002159247389308324
MeanAbsoluteError value on hold-out data: 0.03902657702565193
Epoch: 243
Loss on hold-out set: 0.0029196037212386727
MeanAbsoluteError value on hold-out data: 0.04560162127017975
Epoch: 244

Loss on hold-out set: 0.00550594856031239
MeanAbsoluteError value on hold-out data: 0.060890037566423416
Epoch: 245
Loss on hold-out set: 0.0010723642649521168
MeanAbsoluteError value on hold-out data: 0.028703749179840088
Epoch: 246
Loss on hold-out set: 0.00474202207681772
MeanAbsoluteError value on hold-out data: 0.056370265781879425
Epoch: 247
Loss on hold-out set: 0.0016749936499093707
MeanAbsoluteError value on hold-out data: 0.03601149842143059
Epoch: 248
Loss on hold-out set: 0.006129816971033027
MeanAbsoluteError value on hold-out data: 0.06401341408491135
Epoch: 249
Loss on hold-out set: 0.0022114111527212358
MeanAbsoluteError value on hold-out data: 0.04209556058049202
Epoch: 250
Loss on hold-out set: 0.006703884389839675
MeanAbsoluteError value on hold-out data: 0.0665314719080925
Epoch: 251
Loss on hold-out set: 0.006387387059236828
MeanAbsoluteError value on hold-out data: 0.0736025795340538
Epoch: 252
Loss on hold-out set: 0.006662338702498298
MeanAbsoluteError value on hold-out data: 0.06722712516784668
```

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Epoch: 253
Loss on hold-out set: 0.004158360062559184
MeanAbsoluteError value on hold-out data: 0.05976324900984764
Epoch: 254
Loss on hold-out set: 0.0035849780113877436
MeanAbsoluteError value on hold-out data: 0.049400679767131805
Epoch: 255
Loss on hold-out set: 0.0009617845368522563
MeanAbsoluteError value on hold-out data: 0.02724335342645645
Epoch: 256
Loss on hold-out set: 0.003950661097310092
MeanAbsoluteError value on hold-out data: 0.050881095230579376
Epoch: 257
Loss on hold-out set: 0.004684129533799071
MeanAbsoluteError value on hold-out data: 0.06217901408672333
Epoch: 258
Loss on hold-out set: 0.0020274614032946133
MeanAbsoluteError value on hold-out data: 0.03592189401388168
Epoch: 259
Loss on hold-out set: 0.009054136977187897
MeanAbsoluteError value on hold-out data: 0.08809886127710342
Epoch: 260


Loss on hold-out set: 0.004604701038548036
MeanAbsoluteError value on hold-out data: 0.056491293013095856
Epoch: 261
Loss on hold-out set: 0.002714686009934858
MeanAbsoluteError value on hold-out data: 0.047769103199243546
Epoch: 262
Loss on hold-out set: 0.003876982538617755
MeanAbsoluteError value on hold-out data: 0.05101865157485008
Epoch: 263
Loss on hold-out set: 0.004463352606092629
MeanAbsoluteError value on hold-out data: 0.061936721205711365
Epoch: 264
Loss on hold-out set: 0.00527100491729614
MeanAbsoluteError value on hold-out data: 0.05897537246346474
Epoch: 265
Loss on hold-out set: 0.0037113408876681014
MeanAbsoluteError value on hold-out data: 0.055967796593904495
Epoch: 266
Loss on hold-out set: 0.004259477847402817
```

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MeanAbsoluteError value on hold-out data: 0.05319467931985855
Epoch: 267
Loss on hold-out set: 0.0034740711072165716
MeanAbsoluteError value on hold-out data: 0.05318151414394379
Epoch: 268
Loss on hold-out set: 0.006600622700429277
MeanAbsoluteError value on hold-out data: 0.06637069582939148
Epoch: 269
Loss on hold-out set: 0.0037553982784677494
MeanAbsoluteError value on hold-out data: 0.0561399981379509
Epoch: 270
Loss on hold-out set: 0.006747042294591665
MeanAbsoluteError value on hold-out data: 0.06669113039970398
Epoch: 271
Loss on hold-out set: 0.00208405518634735
MeanAbsoluteError value on hold-out data: 0.04167395830154419
Epoch: 272
Loss on hold-out set: 0.006183552653773835
MeanAbsoluteError value on hold-out data: 0.06545265763998032
Epoch: 273
Loss on hold-out set: 0.0020638539847966874
MeanAbsoluteError value on hold-out data: 0.04174400120973587
Epoch: 274
Loss on hold-out set: 0.006061051580074586
MeanAbsoluteError value on hold-out data: 0.06292705982923508
Epoch: 275
Loss on hold-out set: 0.005526148346497824
MeanAbsoluteError value on hold-out data: 0.0685223862528801
Epoch: 276

Loss on hold-out set: 0.002424068626408514
MeanAbsoluteError value on hold-out data: 0.03958969563245773
Epoch: 277
Loss on hold-out set: 0.008483874341963153
MeanAbsoluteError value on hold-out data: 0.0859699472784996
Epoch: 278
Loss on hold-out set: 0.002062769625090847
MeanAbsoluteError value on hold-out data: 0.03599504008889198
Epoch: 279
Loss on hold-out set: 0.009373705000861696
MeanAbsoluteError value on hold-out data: 0.09100635349750519
Epoch: 280
```

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Loss on hold-out set: 0.004487322557619528
MeanAbsoluteError value on hold-out data: 0.055480360984802246
Epoch: 281
Loss on hold-out set: 0.0016783011746347735
MeanAbsoluteError value on hold-out data: 0.03733661398291588
Epoch: 282
Loss on hold-out set: 0.006202614547586755
MeanAbsoluteError value on hold-out data: 0.06464999914169312
Epoch: 283
Loss on hold-out set: 0.002626443208244286
MeanAbsoluteError value on hold-out data: 0.04702103137969971
Epoch: 284
Loss on hold-out set: 0.00748065508607971
MeanAbsoluteError value on hold-out data: 0.06852570921182632
Epoch: 285
Loss on hold-out set: 0.002691948590309996
MeanAbsoluteError value on hold-out data: 0.047891221940517426
Epoch: 286
Loss on hold-out set: 0.0053721221016817975
MeanAbsoluteError value on hold-out data: 0.06002672761678696
Epoch: 287
Loss on hold-out set: 0.003995895888166208
MeanAbsoluteError value on hold-out data: 0.05812002718448639
Epoch: 288
Loss on hold-out set: 0.0032724019041971155
MeanAbsoluteError value on hold-out data: 0.05236370489001274
Epoch: 289
Loss on hold-out set: 0.0005471102279108507
MeanAbsoluteError value on hold-out data: 0.017775626853108406
Epoch: 290
Loss on hold-out set: 0.0003430257899086236
MeanAbsoluteError value on hold-out data: 0.01501564309000969
Epoch: 291
Loss on hold-out set: 0.007711622643431551
MeanAbsoluteError value on hold-out data: 0.07139737904071808
Epoch: 292

Loss on hold-out set: 0.004345541954726765
MeanAbsoluteError value on hold-out data: 0.060966022312641144
Epoch: 293
Loss on hold-out set: 0.005058895600469489
MeanAbsoluteError value on hold-out data: 0.05860112980008125
```

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Epoch: 294
Loss on hold-out set: 0.0013051990811762057
MeanAbsoluteError value on hold-out data: 0.031290579587221146
Epoch: 295
Loss on hold-out set: 0.0034008816644353302
MeanAbsoluteError value on hold-out data: 0.04932345077395439
Epoch: 296
Loss on hold-out set: 0.004096678041509892
MeanAbsoluteError value on hold-out data: 0.057401664555072784
Epoch: 297
Loss on hold-out set: 0.004053515663958694
MeanAbsoluteError value on hold-out data: 0.05138052627444267
Epoch: 298
Loss on hold-out set: 0.004249458311517772
MeanAbsoluteError value on hold-out data: 0.06003232300281525
Epoch: 299
Loss on hold-out set: 0.007508402053070695
MeanAbsoluteError value on hold-out data: 0.07083152234554291
Epoch: 300
Loss on hold-out set: 0.0024751337049038788
MeanAbsoluteError value on hold-out data: 0.04602387920022011
Epoch: 301
Loss on hold-out set: 0.007960157885559295
MeanAbsoluteError value on hold-out data: 0.07376236468553543
Epoch: 302
Loss on hold-out set: 0.0021627936879859157
MeanAbsoluteError value on hold-out data: 0.04327324405312538
Epoch: 303
Loss on hold-out set: 0.004532473933833994
MeanAbsoluteError value on hold-out data: 0.055994320660829544
Epoch: 304
Loss on hold-out set: 0.0029745815125735184
MeanAbsoluteError value on hold-out data: 0.0501207560300827
Epoch: 305
Loss on hold-out set: 0.007983340171018713
MeanAbsoluteError value on hold-out data: 0.07200194150209427
Epoch: 306
Loss on hold-out set: 0.004185587437333245
MeanAbsoluteError value on hold-out data: 0.06043066084384918
Epoch: 307
Loss on hold-out set: 0.007610580957445659
MeanAbsoluteError value on hold-out data: 0.07172594964504242
Epoch: 308
```

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Loss on hold-out set: 0.008264220148128899
MeanAbsoluteError value on hold-out data: 0.08588233590126038
Epoch: 309
Loss on hold-out set: 0.0013063237389647647
MeanAbsoluteError value on hold-out data: 0.028877360746264458
Epoch: 310
Loss on hold-out set: 0.005265127622375363
MeanAbsoluteError value on hold-out data: 0.06726863235235214
Epoch: 311
Loss on hold-out set: 0.0011505773536076667
MeanAbsoluteError value on hold-out data: 0.028808075934648514
Epoch: 312
Loss on hold-out set: 0.002307279574635782
MeanAbsoluteError value on hold-out data: 0.04465143382549286
Epoch: 313
Loss on hold-out set: 0.005550966916703864
MeanAbsoluteError value on hold-out data: 0.06159023195505142
Epoch: 314
Loss on hold-out set: 0.003886218403318995
MeanAbsoluteError value on hold-out data: 0.0576772578060627
Epoch: 315
Loss on hold-out set: 0.0009635252920959733
MeanAbsoluteError value on hold-out data: 0.02393174357712269
Epoch: 316
Loss on hold-out set: 0.004701047057383939
MeanAbsoluteError value on hold-out data: 0.06460961699485779
Epoch: 317
Loss on hold-out set: 0.007836768722259685
MeanAbsoluteError value on hold-out data: 0.07343368977308273
Epoch: 318
Loss on hold-out set: 0.003266588931805209
MeanAbsoluteError value on hold-out data: 0.0535346083343029
Epoch: 319
Loss on hold-out set: 0.006339816989279107
MeanAbsoluteError value on hold-out data: 0.06575454026460648
Epoch: 320
Loss on hold-out set: 0.004213153727744755
MeanAbsoluteError value on hold-out data: 0.06128725782036781
Epoch: 321
Loss on hold-out set: 0.005574056756143507
MeanAbsoluteError value on hold-out data: 0.06205020099878311
Epoch: 322
Loss on hold-out set: 0.0060512062015109945
```

MeanAbsoluteError value on hold-out data: 0.07223344594240189
Epoch: 323
Loss on hold-out set: 0.00244742051673759
MeanAbsoluteError value on hold-out data: 0.04112734645605087
Epoch: 324

Loss on hold-out set: 0.002600595465322074
MeanAbsoluteError value on hold-out data: 0.04171479493379593
Epoch: 325
Loss on hold-out set: 0.011186884275000347
MeanAbsoluteError value on hold-out data: 0.09890133887529373
Epoch: 326
Loss on hold-out set: 0.004026337514484399
MeanAbsoluteError value on hold-out data: 0.05230775475502014
Epoch: 327
Loss on hold-out set: 0.001031684162291257
MeanAbsoluteError value on hold-out data: 0.026769552379846573
Epoch: 328
Loss on hold-out set: 0.008244692102858895
MeanAbsoluteError value on hold-out data: 0.08367299288511276
Epoch: 329
Loss on hold-out set: 0.0017387384156647482
MeanAbsoluteError value on hold-out data: 0.03455283120274544
Epoch: 330
Loss on hold-out set: 0.005304769110424738
MeanAbsoluteError value on hold-out data: 0.06055423617362976
Epoch: 331
Loss on hold-out set: 0.0005810173369306875
MeanAbsoluteError value on hold-out data: 0.0192827470600605
Epoch: 332
Loss on hold-out set: 0.00536294477550607
MeanAbsoluteError value on hold-out data: 0.06517109274864197
Epoch: 333
Loss on hold-out set: 0.004173590103164315
MeanAbsoluteError value on hold-out data: 0.05967019498348236
Epoch: 334
Loss on hold-out set: 0.0036976539627893977
MeanAbsoluteError value on hold-out data: 0.057374510914087296
Epoch: 335
Loss on hold-out set: 0.007875228202656695
MeanAbsoluteError value on hold-out data: 0.07219374924898148
Epoch: 336

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Loss on hold-out set: 0.002899670875386188
MeanAbsoluteError value on hold-out data: 0.049921002238988876
Epoch: 337
Loss on hold-out set: 0.006050214195918096
MeanAbsoluteError value on hold-out data: 0.06574330478906631
Epoch: 338
Loss on hold-out set: 0.0026673429008377226
MeanAbsoluteError value on hold-out data: 0.047657813876867294
Epoch: 339
Loss on hold-out set: 0.004756016129823892
MeanAbsoluteError value on hold-out data: 0.05728766694664955
Epoch: 340


Loss on hold-out set: 0.004353746869846394
MeanAbsoluteError value on hold-out data: 0.061729636043310165
Epoch: 341
Loss on hold-out set: 0.00757163118473009
MeanAbsoluteError value on hold-out data: 0.06991813331842422
Epoch: 342
Loss on hold-out set: 0.0038248669282582247
MeanAbsoluteError value on hold-out data: 0.05744803696870804
Epoch: 343
Loss on hold-out set: 0.006458195244991465
MeanAbsoluteError value on hold-out data: 0.06673845648765564
Epoch: 344
Loss on hold-out set: 0.005249604043599807
MeanAbsoluteError value on hold-out data: 0.06756746768951416
Epoch: 345
Loss on hold-out set: 0.005266760377899597
MeanAbsoluteError value on hold-out data: 0.06049029529094696
Epoch: 346
Loss on hold-out set: 0.005144792094238494
MeanAbsoluteError value on hold-out data: 0.06531054526567459
Epoch: 347
Loss on hold-out set: 0.002213114805176462
MeanAbsoluteError value on hold-out data: 0.04016086459159851
Epoch: 348
Loss on hold-out set: 0.004637740625950851
MeanAbsoluteError value on hold-out data: 0.06208163499832153
Epoch: 349
Loss on hold-out set: 0.003151980498315472
MeanAbsoluteError value on hold-out data: 0.046920035034418106
```

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Epoch: 350
Loss on hold-out set: 0.006012039455144029
MeanAbsoluteError value on hold-out data: 0.07157142460346222
Epoch: 351
Loss on hold-out set: 0.005051377609274105
MeanAbsoluteError value on hold-out data: 0.060101211071014404
Epoch: 352
Loss on hold-out set: 0.0016186308961263613
MeanAbsoluteError value on hold-out data: 0.0341726653277874
Epoch: 353
Loss on hold-out set: 0.006097247946615282
MeanAbsoluteError value on hold-out data: 0.07306040823459625
Epoch: 354
Loss on hold-out set: 0.008060852972496497
MeanAbsoluteError value on hold-out data: 0.07437199354171753
Epoch: 355


Loss on hold-out set: 0.007158562541007996
MeanAbsoluteError value on hold-out data: 0.07904302328824997
Epoch: 356
Loss on hold-out set: 0.00211892161199725
MeanAbsoluteError value on hold-out data: 0.03795810788869858
Epoch: 357
Loss on hold-out set: 0.003382755541487744
MeanAbsoluteError value on hold-out data: 0.04763340204954147
Epoch: 358
Loss on hold-out set: 0.006458944714579143
MeanAbsoluteError value on hold-out data: 0.06475479155778885
Epoch: 359
Loss on hold-out set: 0.0009262837089696213
MeanAbsoluteError value on hold-out data: 0.02456646040081978
Epoch: 360
Loss on hold-out set: 0.003295983886346221
MeanAbsoluteError value on hold-out data: 0.04789431020617485
Epoch: 361
Loss on hold-out set: 0.002476162215890853
MeanAbsoluteError value on hold-out data: 0.04658539593219757
Epoch: 362
Loss on hold-out set: 0.006814120876553811
MeanAbsoluteError value on hold-out data: 0.06796619296073914
Epoch: 363
Loss on hold-out set: 0.007570516538659209
```

```
MeanAbsoluteError value on hold-out data: 0.0807439535856247
Epoch: 364
Loss on hold-out set: 0.0010381644395621198
MeanAbsoluteError value on hold-out data: 0.026553524658083916
Epoch: 365
Loss on hold-out set: 0.004776220572622199
MeanAbsoluteError value on hold-out data: 0.06322634965181351
Epoch: 366
Loss on hold-out set: 0.006753367445382632
MeanAbsoluteError value on hold-out data: 0.06956750899553299
Epoch: 367
Loss on hold-out set: 0.0062638623394856326
MeanAbsoluteError value on hold-out data: 0.07384234666824341
Epoch: 368
Loss on hold-out set: 0.0010375625080134916
MeanAbsoluteError value on hold-out data: 0.02716660499572754
Epoch: 369
Loss on hold-out set: 0.0004889197252372181
MeanAbsoluteError value on hold-out data: 0.01945015974342823
Epoch: 370
Loss on hold-out set: 0.0004235758678987622
MeanAbsoluteError value on hold-out data: 0.016902457922697067
Epoch: 371

Loss on hold-out set: 0.0013538124652481393
MeanAbsoluteError value on hold-out data: 0.03392408415675163
Epoch: 372
Loss on hold-out set: 0.007229543217506848
MeanAbsoluteError value on hold-out data: 0.06941511482000351
Epoch: 373
Loss on hold-out set: 0.0033972122412371008
MeanAbsoluteError value on hold-out data: 0.05434712767601013
Epoch: 374
Loss on hold-out set: 0.002625464253421677
MeanAbsoluteError value on hold-out data: 0.043912410736083984
Epoch: 375
Loss on hold-out set: 0.0036395755719001357
MeanAbsoluteError value on hold-out data: 0.05537731200456619
Epoch: 376
Loss on hold-out set: 0.0028167330096230694
MeanAbsoluteError value on hold-out data: 0.04265331104397774
Epoch: 377
```

```
Loss on hold-out set: 0.0006958616646251789
MeanAbsoluteError value on hold-out data: 0.020936982706189156
Epoch: 378
Loss on hold-out set: 0.0073245902741818055
MeanAbsoluteError value on hold-out data: 0.07965719699859619
Epoch: 379
Loss on hold-out set: 0.004684123137083493
MeanAbsoluteError value on hold-out data: 0.05642184615135193
Epoch: 380
Loss on hold-out set: 0.005068734827402391
MeanAbsoluteError value on hold-out data: 0.05821799114346504
Epoch: 381
Loss on hold-out set: 0.00013212612535234687
MeanAbsoluteError value on hold-out data: 0.009231079369783401
Epoch: 382
Loss on hold-out set: 0.0008910831376469057
MeanAbsoluteError value on hold-out data: 0.02392967976629734
Epoch: 383
Loss on hold-out set: 0.0011960308888534967
MeanAbsoluteError value on hold-out data: 0.027567459270358086
Epoch: 384
Loss on hold-out set: 0.002160887754718332
MeanAbsoluteError value on hold-out data: 0.04340057075023651
Epoch: 385
Loss on hold-out set: 0.004053602558805754
MeanAbsoluteError value on hold-out data: 0.058942776173353195
Epoch: 386
Loss on hold-out set: 0.0007266488728897744
MeanAbsoluteError value on hold-out data: 0.021264873445034027
Epoch: 387

Loss on hold-out set: 0.006549564876446598
MeanAbsoluteError value on hold-out data: 0.0748041421175003
Epoch: 388
Loss on hold-out set: 0.004569946518658023
MeanAbsoluteError value on hold-out data: 0.05509933456778526
Epoch: 389
Loss on hold-out set: 0.005421305124304797
MeanAbsoluteError value on hold-out data: 0.06772668659687042
Epoch: 390
Loss on hold-out set: 0.005258287597251565
MeanAbsoluteError value on hold-out data: 0.061249420046806335
```

```
Epoch: 391
Loss on hold-out set: 0.003717364032605761
MeanAbsoluteError value on hold-out data: 0.04998808726668358
Epoch: 392
Loss on hold-out set: 0.004456664472328205
MeanAbsoluteError value on hold-out data: 0.05384320020675659
Epoch: 393
Loss on hold-out set: 0.007970501497191819
MeanAbsoluteError value on hold-out data: 0.08372072875499725
Epoch: 394
Loss on hold-out set: 0.005375172918368327
MeanAbsoluteError value on hold-out data: 0.059880033135414124
Epoch: 395
Loss on hold-out set: 0.001940216856861585
MeanAbsoluteError value on hold-out data: 0.036196112632751465
Epoch: 396
Loss on hold-out set: 0.004840810464597062
MeanAbsoluteError value on hold-out data: 0.06531631201505661
Epoch: 397
Loss on hold-out set: 0.006735626166980518
MeanAbsoluteError value on hold-out data: 0.06762342154979706
Epoch: 398
Loss on hold-out set: 0.006997753057236734
MeanAbsoluteError value on hold-out data: 0.07736893743276596
Epoch: 399
Loss on hold-out set: 0.003171770245228943
MeanAbsoluteError value on hold-out data: 0.04740723967552185
Epoch: 400
Loss on hold-out set: 0.005605281232611129
MeanAbsoluteError value on hold-out data: 0.06893975287675858
Epoch: 401
Loss on hold-out set: 0.0034320489625985686
MeanAbsoluteError value on hold-out data: 0.049729183316230774
Epoch: 402
Loss on hold-out set: 0.004973189121014194
MeanAbsoluteError value on hold-out data: 0.06559694558382034
Epoch: 403

Loss on hold-out set: 0.0049597518518567085
MeanAbsoluteError value on hold-out data: 0.06007413938641548
Epoch: 404
Loss on hold-out set: 0.001702012383918229
```

```
MeanAbsoluteError value on hold-out data: 0.03740047290921211
Epoch: 405
Loss on hold-out set: 0.0010656383053987827
MeanAbsoluteError value on hold-out data: 0.027456900104880333
Epoch: 406
Loss on hold-out set: 0.003379260741272255
MeanAbsoluteError value on hold-out data: 0.05357933044433594
Epoch: 407
Loss on hold-out set: 0.009071973569102977
MeanAbsoluteError value on hold-out data: 0.08179159462451935
Epoch: 408
Loss on hold-out set: 0.0028676882533258514
MeanAbsoluteError value on hold-out data: 0.049756646156311035
Epoch: 409
Loss on hold-out set: 0.006309610889538338
MeanAbsoluteError value on hold-out data: 0.06764953583478928
Epoch: 410
Loss on hold-out set: 0.006781514979114658
MeanAbsoluteError value on hold-out data: 0.07693425565958023
Epoch: 411
Loss on hold-out set: 0.0010632113247227512
MeanAbsoluteError value on hold-out data: 0.028317738324403763
Epoch: 412
Loss on hold-out set: 0.0010729259198629542
MeanAbsoluteError value on hold-out data: 0.02987527847290039
Epoch: 413
Loss on hold-out set: 0.0002971821400263396
MeanAbsoluteError value on hold-out data: 0.013821840286254883
Epoch: 414
Loss on hold-out set: 0.0011795171793844354
MeanAbsoluteError value on hold-out data: 0.030778786167502403
Epoch: 415
Loss on hold-out set: 0.006386259154073502
MeanAbsoluteError value on hold-out data: 0.0669078603386879
Epoch: 416
Loss on hold-out set: 0.001702263136394322
MeanAbsoluteError value on hold-out data: 0.036899466067552567
Epoch: 417
Loss on hold-out set: 0.0005320939863419259
MeanAbsoluteError value on hold-out data: 0.018952341750264168
Epoch: 418
Loss on hold-out set: 0.0015033138241912973
MeanAbsoluteError value on hold-out data: 0.03373369947075844
```

```
Epoch: 419

Loss on hold-out set: 0.0022574288427437608
MeanAbsoluteError value on hold-out data: 0.04008845239877701
Epoch: 420
Loss on hold-out set: 0.0007368637184538928
MeanAbsoluteError value on hold-out data: 0.024658823385834694
Epoch: 421
Loss on hold-out set: 0.004558616820232649
MeanAbsoluteError value on hold-out data: 0.05615620315074921
Epoch: 422
Loss on hold-out set: 0.0016001245975004214
MeanAbsoluteError value on hold-out data: 0.03586876392364502
Epoch: 423
Loss on hold-out set: 0.00504612112662902
MeanAbsoluteError value on hold-out data: 0.06025117263197899
Epoch: 424
Loss on hold-out set: 0.00413777490489577
MeanAbsoluteError value on hold-out data: 0.0589095801115036
Epoch: 425
Loss on hold-out set: 0.0028047210438863226
MeanAbsoluteError value on hold-out data: 0.04468492791056633
Epoch: 426
Loss on hold-out set: 0.0025748132335904395
MeanAbsoluteError value on hold-out data: 0.04625657945871353
Epoch: 427
Loss on hold-out set: 0.007377003662680325
MeanAbsoluteError value on hold-out data: 0.07359261065721512
Epoch: 428
Loss on hold-out set: 0.00440655023741879
MeanAbsoluteError value on hold-out data: 0.062005314975976944
Epoch: 429
Loss on hold-out set: 0.005152314117080287
MeanAbsoluteError value on hold-out data: 0.061661649495363235
Epoch: 430
Loss on hold-out set: 0.0046174655619420505
MeanAbsoluteError value on hold-out data: 0.06344606727361679
Epoch: 431
Loss on hold-out set: 0.006176744342634552
MeanAbsoluteError value on hold-out data: 0.06706345826387405
Epoch: 432
Loss on hold-out set: 0.003047213522031119
```

```
MeanAbsoluteError value on hold-out data: 0.05001375824213028
Epoch: 433
Loss on hold-out set: 0.0057596550568153985
MeanAbsoluteError value on hold-out data: 0.06615281105041504
Epoch: 434
Loss on hold-out set: 0.005186255187972596
MeanAbsoluteError value on hold-out data: 0.06750481575727463
Epoch: 435

Loss on hold-out set: 0.00015502447250152103
MeanAbsoluteError value on hold-out data: 0.009398632682859898
Epoch: 436
Loss on hold-out set: 0.0031636184032418227
MeanAbsoluteError value on hold-out data: 0.052444152534008026
Epoch: 437
Loss on hold-out set: 0.008967870870899213
MeanAbsoluteError value on hold-out data: 0.07770225405693054
Epoch: 438
Loss on hold-out set: 0.007366592285076254
MeanAbsoluteError value on hold-out data: 0.08068357408046722
Epoch: 439
Loss on hold-out set: 0.0011271037541231827
MeanAbsoluteError value on hold-out data: 0.02621033415198326
Epoch: 440
Loss on hold-out set: 0.007064226818712134
MeanAbsoluteError value on hold-out data: 0.07897534966468811
Epoch: 441
Loss on hold-out set: 0.006163584019400571
MeanAbsoluteError value on hold-out data: 0.06540866196155548
Epoch: 442
Loss on hold-out set: 0.0002780591327648022
MeanAbsoluteError value on hold-out data: 0.012815464287996292
Epoch: 443
Loss on hold-out set: 0.0001883347684174384
MeanAbsoluteError value on hold-out data: 0.011126616038382053
Epoch: 444
Loss on hold-out set: 0.003644633253938273
MeanAbsoluteError value on hold-out data: 0.0507533960044384
Epoch: 445
Loss on hold-out set: 0.002973108907769385
MeanAbsoluteError value on hold-out data: 0.05087832733988762
Epoch: 446
```

```
Loss on hold-out set: 0.006499783675137319
MeanAbsoluteError value on hold-out data: 0.0666937604546547
Epoch: 447
Loss on hold-out set: 0.006648040989315824
MeanAbsoluteError value on hold-out data: 0.07611200958490372
Epoch: 448
Loss on hold-out set: 0.0010820916810955264
MeanAbsoluteError value on hold-out data: 0.02642137184739113
Epoch: 449
Loss on hold-out set: 0.0014694848183640524
MeanAbsoluteError value on hold-out data: 0.0348149798810482
Epoch: 450
Loss on hold-out set: 0.002051843042289348
MeanAbsoluteError value on hold-out data: 0.038406502455472946
Epoch: 451


Loss on hold-out set: 0.0031510663194287765
MeanAbsoluteError value on hold-out data: 0.051702216267585754
Epoch: 452
Loss on hold-out set: 0.008125025999585265
MeanAbsoluteError value on hold-out data: 0.07605831325054169
Epoch: 453
Loss on hold-out set: 0.004275235751839845
MeanAbsoluteError value on hold-out data: 0.06070250645279884
Epoch: 454
Loss on hold-out set: 0.0026647116817337902
MeanAbsoluteError value on hold-out data: 0.04472833499312401
Epoch: 455
Loss on hold-out set: 0.002707349491844836
MeanAbsoluteError value on hold-out data: 0.04771961271762848
Epoch: 456
Loss on hold-out set: 0.0025996352962561345
MeanAbsoluteError value on hold-out data: 0.04400148615241051
Epoch: 457
Loss on hold-out set: 0.0035581350154978665
MeanAbsoluteError value on hold-out data: 0.054679401218891144
Epoch: 458
Loss on hold-out set: 0.004517085445848734
MeanAbsoluteError value on hold-out data: 0.057485371828079224
Epoch: 459
Loss on hold-out set: 0.0042822027309356555
MeanAbsoluteError value on hold-out data: 0.05701892077922821
```

```
Epoch: 460
Loss on hold-out set: 0.00352003188852809
MeanAbsoluteError value on hold-out data: 0.05073869973421097
Epoch: 461
Loss on hold-out set: 0.004152909656496425
MeanAbsoluteError value on hold-out data: 0.059810277074575424
Epoch: 462
Loss on hold-out set: 0.004129995947311583
MeanAbsoluteError value on hold-out data: 0.05494684353470802
Epoch: 463
Loss on hold-out set: 0.0043656062089691035
MeanAbsoluteError value on hold-out data: 0.06103377044200897
Epoch: 464
Loss on hold-out set: 0.0029140866459592394
MeanAbsoluteError value on hold-out data: 0.04615895450115204
Epoch: 465
Loss on hold-out set: 0.0038230556651557748
MeanAbsoluteError value on hold-out data: 0.057989299297332764
Epoch: 466
Loss on hold-out set: 0.006213799315063577
MeanAbsoluteError value on hold-out data: 0.06677056103944778
Epoch: 467
```

```
Loss on hold-out set: 0.003525852495314259
MeanAbsoluteError value on hold-out data: 0.05529659241437912
Epoch: 468
Loss on hold-out set: 0.002180490036200928
MeanAbsoluteError value on hold-out data: 0.03366965427994728
Epoch: 469
Loss on hold-out set: 0.0020312088370127114
MeanAbsoluteError value on hold-out data: 0.04158227518200874
Epoch: 470
Loss on hold-out set: 0.004149735120958404
MeanAbsoluteError value on hold-out data: 0.05434373766183853
Epoch: 471
Loss on hold-out set: 0.003520294484731398
MeanAbsoluteError value on hold-out data: 0.054840151220560074
Epoch: 472
Loss on hold-out set: 0.004815907168545221
MeanAbsoluteError value on hold-out data: 0.05905218794941902
Epoch: 473
Loss on hold-out set: 0.004664583131670952
```

```
MeanAbsoluteError value on hold-out data: 0.06360391527414322
Epoch: 474
Loss on hold-out set: 0.0003495390456488454
MeanAbsoluteError value on hold-out data: 0.015516942366957664
Epoch: 475
Loss on hold-out set: 0.0018705898638520587
MeanAbsoluteError value on hold-out data: 0.03314477577805519
Epoch: 476
Loss on hold-out set: 0.0069990018137583605
MeanAbsoluteError value on hold-out data: 0.066584013402462
Epoch: 477
Loss on hold-out set: 0.004713420278245681
MeanAbsoluteError value on hold-out data: 0.055474452674388885
Epoch: 478
Loss on hold-out set: 0.00850588225416447
MeanAbsoluteError value on hold-out data: 0.0868750736117363
Epoch: 479
Loss on hold-out set: 0.00035868151156280776
MeanAbsoluteError value on hold-out data: 0.016446707770228386
Epoch: 480
Loss on hold-out set: 0.008395834164203782
MeanAbsoluteError value on hold-out data: 0.07412998378276825
Epoch: 481
Loss on hold-out set: 0.0045662782351045235
MeanAbsoluteError value on hold-out data: 0.06317297369241714
Epoch: 482
Loss on hold-out set: 0.0016720004955698784
MeanAbsoluteError value on hold-out data: 0.036661483347415924
Epoch: 483

Loss on hold-out set: 0.008316858990215942
MeanAbsoluteError value on hold-out data: 0.07657201588153839
Epoch: 484
Loss on hold-out set: 0.0037327368841751627
MeanAbsoluteError value on hold-out data: 0.05651964992284775
Epoch: 485
Loss on hold-out set: 0.0012989405567120564
MeanAbsoluteError value on hold-out data: 0.03253360092639923
Epoch: 486
Loss on hold-out set: 0.006250327771627589
MeanAbsoluteError value on hold-out data: 0.06585648655891418
Epoch: 487
```

```
Loss on hold-out set: 0.0025939234581432843
MeanAbsoluteError value on hold-out data: 0.046688590198755264
Epoch: 488
Loss on hold-out set: 0.0024617555747298817
MeanAbsoluteError value on hold-out data: 0.04109114781022072
Epoch: 489
Loss on hold-out set: 0.005229449022169176
MeanAbsoluteError value on hold-out data: 0.06664752960205078
Epoch: 490
Loss on hold-out set: 0.002757660045876707
MeanAbsoluteError value on hold-out data: 0.043936584144830704
Epoch: 491
Loss on hold-out set: 0.000503799614594563
MeanAbsoluteError value on hold-out data: 0.018777836114168167
Epoch: 492
Loss on hold-out set: 0.0013500420977116416
MeanAbsoluteError value on hold-out data: 0.03147279471158981
Epoch: 493
Loss on hold-out set: 0.004109089029952884
MeanAbsoluteError value on hold-out data: 0.059025757014751434
Epoch: 494
Loss on hold-out set: 0.0038629345914446994
MeanAbsoluteError value on hold-out data: 0.05199310928583145
Epoch: 495
Loss on hold-out set: 0.002011515622909524
MeanAbsoluteError value on hold-out data: 0.04036007449030876
Epoch: 496
Loss on hold-out set: 0.0023210960513863122
MeanAbsoluteError value on hold-out data: 0.04015837609767914
Epoch: 497
Loss on hold-out set: 0.0047080514119251776
MeanAbsoluteError value on hold-out data: 0.0634855329990387
Epoch: 498
Loss on hold-out set: 0.0035155975308857465
MeanAbsoluteError value on hold-out data: 0.05012661963701248
Epoch: 499

Loss on hold-out set: 0.0025092891392935264
MeanAbsoluteError value on hold-out data: 0.04577212780714035
Epoch: 500
Loss on hold-out set: 0.0020037638452394227
MeanAbsoluteError value on hold-out data: 0.03702685609459877
```

```
Epoch: 501
Loss on hold-out set: 0.0031400226595762527
MeanAbsoluteError value on hold-out data: 0.05215893313288689
Epoch: 502
Loss on hold-out set: 0.004364776804945187
MeanAbsoluteError value on hold-out data: 0.05626850947737694
Epoch: 503
Loss on hold-out set: 0.004457397839838737
MeanAbsoluteError value on hold-out data: 0.06176603212952614
Epoch: 504
Loss on hold-out set: 0.0070374937924115285
MeanAbsoluteError value on hold-out data: 0.07188643515110016
Epoch: 505
Loss on hold-out set: 0.0021879388154239245
MeanAbsoluteError value on hold-out data: 0.043273381888866425
Epoch: 506
Loss on hold-out set: 0.004696793327304094
MeanAbsoluteError value on hold-out data: 0.05788499116897583
Epoch: 507
Loss on hold-out set: 0.00205807658034916
MeanAbsoluteError value on hold-out data: 0.04161255061626434
Epoch: 508
Loss on hold-out set: 0.0044921820027459605
MeanAbsoluteError value on hold-out data: 0.055761437863111496
Epoch: 509
Loss on hold-out set: 0.0024784912698363
MeanAbsoluteError value on hold-out data: 0.04635242000222206
Early stopping at epoch 508
Returned to Spot: Validation loss: 0.0024784912698363
----------------------------------------------

spotPython tuning: 0.00022239663858750932 [########--] 81.03%


config: {'_L_in': 10, '_L_out': 1, 'l1': 256, 'dropout_prob': 0.1781765401545034, 'lr_mult':
Epoch: 1
Loss on hold-out set: 0.02866863861287895
MeanAbsoluteError value on hold-out data: 0.1360698640346527
Epoch: 2
Loss on hold-out set: 0.023652340040395136
MeanAbsoluteError value on hold-out data: 0.12276539951562881
Epoch: 3
```

```
Loss on hold-out set: 0.019542481505164976
MeanAbsoluteError value on hold-out data: 0.11250853538513184
Epoch: 4
Loss on hold-out set: 0.015069107230948774
MeanAbsoluteError value on hold-out data: 0.09724103659391403
Epoch: 5
Loss on hold-out set: 0.01632510995688407
MeanAbsoluteError value on hold-out data: 0.10031311959028244
Epoch: 6
Loss on hold-out set: 0.011787718186449064
MeanAbsoluteError value on hold-out data: 0.0842735692858696
Epoch: 7
Loss on hold-out set: 0.01395116572415358
MeanAbsoluteError value on hold-out data: 0.0927601084113121
Epoch: 8
Loss on hold-out set: 0.00965961438946818
MeanAbsoluteError value on hold-out data: 0.07830315083265305
Epoch: 9
Loss on hold-out set: 0.006777730831680329
MeanAbsoluteError value on hold-out data: 0.06368102133274078
Epoch: 10
Loss on hold-out set: 0.009585194559277673
MeanAbsoluteError value on hold-out data: 0.0770416408777237
Epoch: 11
Loss on hold-out set: 0.017000492980801744
MeanAbsoluteError value on hold-out data: 0.10976967215538025

Epoch: 12
Loss on hold-out set: 0.007383710888557528
MeanAbsoluteError value on hold-out data: 0.06672365218400955
Epoch: 13
Loss on hold-out set: 0.010177927434836564
MeanAbsoluteError value on hold-out data: 0.0817730724811554
Epoch: 14
Loss on hold-out set: 0.012493730547200693
MeanAbsoluteError value on hold-out data: 0.0905618667602539
Epoch: 15
Loss on hold-out set: 0.013106031759985183
MeanAbsoluteError value on hold-out data: 0.08833860605955124
Epoch: 16
Loss on hold-out set: 0.006626582483908064
MeanAbsoluteError value on hold-out data: 0.06391242891550064
```

```
Epoch: 17
Loss on hold-out set: 0.008445411724479575
MeanAbsoluteError value on hold-out data: 0.07245226949453354
Epoch: 18
Loss on hold-out set: 0.00680623992689346
MeanAbsoluteError value on hold-out data: 0.06508548557758331
Epoch: 19
Loss on hold-out set: 0.005771567787680971
MeanAbsoluteError value on hold-out data: 0.0587698295712471
Epoch: 20
Loss on hold-out set: 0.0048666081244224
MeanAbsoluteError value on hold-out data: 0.052674300968647
Epoch: 21
Loss on hold-out set: 0.020015111585196695
MeanAbsoluteError value on hold-out data: 0.12852224707603455
Epoch: 22
Loss on hold-out set: 0.010417039163018527
MeanAbsoluteError value on hold-out data: 0.08583752810955048
Epoch: 23

Loss on hold-out set: 0.003911997308023274
MeanAbsoluteError value on hold-out data: 0.04959265887737274
Epoch: 24
Loss on hold-out set: 0.004723720191242664
MeanAbsoluteError value on hold-out data: 0.05421845242381096
Epoch: 25
Loss on hold-out set: 0.005281955261077536
MeanAbsoluteError value on hold-out data: 0.0550275556743145
Epoch: 26
Loss on hold-out set: 0.004416259526471167
MeanAbsoluteError value on hold-out data: 0.04534098133444786
Epoch: 27
Loss on hold-out set: 0.0045870659921906495
MeanAbsoluteError value on hold-out data: 0.050080593675374985
Epoch: 28
Loss on hold-out set: 0.004528495023566249
MeanAbsoluteError value on hold-out data: 0.05071651190519333
Epoch: 29
Loss on hold-out set: 0.005800590017124226
MeanAbsoluteError value on hold-out data: 0.06270181387662888
Epoch: 30
Loss on hold-out set: 0.0035790344884030914
```

```
MeanAbsoluteError value on hold-out data: 0.04523409903049469
Epoch: 31
Loss on hold-out set: 0.0024549880916693886
MeanAbsoluteError value on hold-out data: 0.03706410899758339
Epoch: 32
Loss on hold-out set: 0.0032509499057931336
MeanAbsoluteError value on hold-out data: 0.04353359341621399
Epoch: 33
Loss on hold-out set: 0.016540206135495714
MeanAbsoluteError value on hold-out data: 0.11329025030136108
Epoch: 34
Loss on hold-out set: 0.029679545348412113
MeanAbsoluteError value on hold-out data: 0.15393511950969696
Epoch: 35

Loss on hold-out set: 0.0036852670416824126
MeanAbsoluteError value on hold-out data: 0.04540763795375824
Epoch: 36
Loss on hold-out set: 0.0028650401662544986
MeanAbsoluteError value on hold-out data: 0.039359621703624725
Epoch: 37
Loss on hold-out set: 0.007439783749807822
MeanAbsoluteError value on hold-out data: 0.07532281428575516
Epoch: 38
Loss on hold-out set: 0.0022262001508160643
MeanAbsoluteError value on hold-out data: 0.03626390919089317
Epoch: 39
Loss on hold-out set: 0.005270773973806124
MeanAbsoluteError value on hold-out data: 0.056768354028463364
Epoch: 40
Loss on hold-out set: 0.014168120675573223
MeanAbsoluteError value on hold-out data: 0.10529784858226776
Epoch: 41
Loss on hold-out set: 0.003142802957690468
MeanAbsoluteError value on hold-out data: 0.04129650816321373
Epoch: 42
Loss on hold-out set: 0.0034990090521444615
MeanAbsoluteError value on hold-out data: 0.04165251553058624
Epoch: 43
Loss on hold-out set: 0.002810485275021117
MeanAbsoluteError value on hold-out data: 0.03981805965304375
Epoch: 44
```

```
Loss on hold-out set: 0.002044998412633217
MeanAbsoluteError value on hold-out data: 0.033961620181798935
Epoch: 45
Loss on hold-out set: 0.0092158470743973
MeanAbsoluteError value on hold-out data: 0.08315262943506241
Epoch: 46
Loss on hold-out set: 0.00496583815517002
MeanAbsoluteError value on hold-out data: 0.060755614191293716
Epoch: 47

Loss on hold-out set: 0.003761644946950439
MeanAbsoluteError value on hold-out data: 0.04900530353188515
Epoch: 48
Loss on hold-out set: 0.014139110369509772
MeanAbsoluteError value on hold-out data: 0.10358528047800064
Epoch: 49
Loss on hold-out set: 0.01175416133513576
MeanAbsoluteError value on hold-out data: 0.10000170022249222
Epoch: 50
Loss on hold-out set: 0.0042918944412744355
MeanAbsoluteError value on hold-out data: 0.0545651949942112
Epoch: 51
Loss on hold-out set: 0.008268763458258227
MeanAbsoluteError value on hold-out data: 0.07457773387432098
Epoch: 52
Loss on hold-out set: 0.004440440624756248
MeanAbsoluteError value on hold-out data: 0.05030663684010506
Epoch: 53
Loss on hold-out set: 0.004304423499362249
MeanAbsoluteError value on hold-out data: 0.05458829179406166
Epoch: 54
Loss on hold-out set: 0.0044742873502208996
MeanAbsoluteError value on hold-out data: 0.05231122300028801
Epoch: 55
Loss on hold-out set: 0.0021212762037880325
MeanAbsoluteError value on hold-out data: 0.0349222831428051
Epoch: 56
Loss on hold-out set: 0.0018004540470428765
MeanAbsoluteError value on hold-out data: 0.031517162919044495
Epoch: 57
Loss on hold-out set: 0.0025887182411296586
MeanAbsoluteError value on hold-out data: 0.038528796285390854
```

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Epoch: 58
Loss on hold-out set: 0.0060585844085404746
MeanAbsoluteError value on hold-out data: 0.0637786015868187
Epoch: 59

Loss on hold-out set: 0.005314978476809828
MeanAbsoluteError value on hold-out data: 0.05863436311483383
Epoch: 60
Loss on hold-out set: 0.0021230656849710564
MeanAbsoluteError value on hold-out data: 0.03360341861844063
Epoch: 61
Loss on hold-out set: 0.004067212220673498
MeanAbsoluteError value on hold-out data: 0.0510176457464695
Epoch: 62
Loss on hold-out set: 0.0025000382079987935
MeanAbsoluteError value on hold-out data: 0.039526086300611496
Epoch: 63
Loss on hold-out set: 0.0036513737500890307
MeanAbsoluteError value on hold-out data: 0.044601548463106155
Epoch: 64
Loss on hold-out set: 0.0014986597755188612
MeanAbsoluteError value on hold-out data: 0.027805296704173088
Epoch: 65
Loss on hold-out set: 0.003392544605671183
MeanAbsoluteError value on hold-out data: 0.04435528442263603
Epoch: 66
Loss on hold-out set: 0.00385403464009103
MeanAbsoluteError value on hold-out data: 0.05212675780057907
Epoch: 67
Loss on hold-out set: 0.002513798376496293
MeanAbsoluteError value on hold-out data: 0.036026060581207275
Epoch: 68
Loss on hold-out set: 0.0020995184190963443
MeanAbsoluteError value on hold-out data: 0.034093715250492096
Epoch: 69
Loss on hold-out set: 0.008717144116465198
MeanAbsoluteError value on hold-out data: 0.07205070555210114
Epoch: 70
Loss on hold-out set: 0.01246187894752151
MeanAbsoluteError value on hold-out data: 0.10082190483808517
Epoch: 71

Loss on hold-out set: 0.0016256551699418771
```

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MeanAbsoluteError value on hold-out data: 0.028102250769734383
Epoch: 72
Loss on hold-out set: 0.0026621793482550665
MeanAbsoluteError value on hold-out data: 0.03759248927235603
Epoch: 73
Loss on hold-out set: 0.006981065754141463
MeanAbsoluteError value on hold-out data: 0.07184864580631256
Epoch: 74
Loss on hold-out set: 0.014583556030533816
MeanAbsoluteError value on hold-out data: 0.10921420902013779
Epoch: 75
Loss on hold-out set: 0.007560776583360214
MeanAbsoluteError value on hold-out data: 0.07302234321832657
Epoch: 76
Loss on hold-out set: 0.003586535801571843
MeanAbsoluteError value on hold-out data: 0.04987795650959015
Epoch: 77
Loss on hold-out set: 0.005677577916924891
MeanAbsoluteError value on hold-out data: 0.06844596564769745
Epoch: 78
Loss on hold-out set: 0.002211663954719705
MeanAbsoluteError value on hold-out data: 0.03533720225095749
Epoch: 79
Loss on hold-out set: 0.007807551392991292
MeanAbsoluteError value on hold-out data: 0.06914900243282318
Epoch: 80
Loss on hold-out set: 0.01135143544524908
MeanAbsoluteError value on hold-out data: 0.09711786359548569
Epoch: 81
Loss on hold-out set: 0.0020421779772732407
MeanAbsoluteError value on hold-out data: 0.029910266399383545
Epoch: 82
Loss on hold-out set: 0.009519956748638498
MeanAbsoluteError value on hold-out data: 0.07480048388242722
Epoch: 83

Loss on hold-out set: 0.007105810959872447
MeanAbsoluteError value on hold-out data: 0.06929730623960495
Epoch: 84
Loss on hold-out set: 0.003993272144151361
MeanAbsoluteError value on hold-out data: 0.053052689880132675
Epoch: 85
```

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Loss on hold-out set: 0.007368908704895722
MeanAbsoluteError value on hold-out data: 0.07775066047906876
Epoch: 86
Loss on hold-out set: 0.0025078319993458295
MeanAbsoluteError value on hold-out data: 0.037853728979825974
Epoch: 87
Loss on hold-out set: 0.002115760620462855
MeanAbsoluteError value on hold-out data: 0.036566007882356644
Epoch: 88
Loss on hold-out set: 0.006277103222122318
MeanAbsoluteError value on hold-out data: 0.06726305931806564
Epoch: 89
Loss on hold-out set: 0.00391107472885204
MeanAbsoluteError value on hold-out data: 0.05348563566803932
Epoch: 90
Loss on hold-out set: 0.0037553281167914208
MeanAbsoluteError value on hold-out data: 0.05018482357263565
Epoch: 91
Loss on hold-out set: 0.0023209631816778135
MeanAbsoluteError value on hold-out data: 0.035518862307071686
Epoch: 92
Loss on hold-out set: 0.0053711594817669765
MeanAbsoluteError value on hold-out data: 0.06354732811450958
Epoch: 93
Loss on hold-out set: 0.0018915259830751701
MeanAbsoluteError value on hold-out data: 0.029043547809123993
Epoch: 94
Loss on hold-out set: 0.006601325040192981
MeanAbsoluteError value on hold-out data: 0.060577310621738434
Epoch: 95

Loss on hold-out set: 0.007891955515859942
MeanAbsoluteError value on hold-out data: 0.07960175722837448
Epoch: 96
Loss on hold-out set: 0.0020167198258844252
MeanAbsoluteError value on hold-out data: 0.03056769073009491
Epoch: 97
Loss on hold-out set: 0.003543933761600209
MeanAbsoluteError value on hold-out data: 0.04513116180896759
Epoch: 98
Loss on hold-out set: 0.007517437524113216
MeanAbsoluteError value on hold-out data: 0.0727960541844368
```

```
Epoch: 99
Loss on hold-out set: 0.0038851440124409763
MeanAbsoluteError value on hold-out data: 0.05258508026599884
Epoch: 100
Loss on hold-out set: 0.0017036965015760966
MeanAbsoluteError value on hold-out data: 0.028466710820794106
Epoch: 101
Loss on hold-out set: 0.005999464799012793
MeanAbsoluteError value on hold-out data: 0.061991430819034576
Epoch: 102
Loss on hold-out set: 0.0031220198020731147
MeanAbsoluteError value on hold-out data: 0.046889957040548325
Epoch: 103
Loss on hold-out set: 0.0023892706376500428
MeanAbsoluteError value on hold-out data: 0.03755804896354675
Epoch: 104
Loss on hold-out set: 0.0022028984002597433
MeanAbsoluteError value on hold-out data: 0.03340731933712959
Epoch: 105
Loss on hold-out set: 0.004657490883561734
MeanAbsoluteError value on hold-out data: 0.05312548577785492
Epoch: 106
Loss on hold-out set: 0.0020953724589688996
MeanAbsoluteError value on hold-out data: 0.03275400027632713
Epoch: 107

Loss on hold-out set: 0.0018294498318267103
MeanAbsoluteError value on hold-out data: 0.02899100072681904
Epoch: 108
Loss on hold-out set: 0.0018214573838600987
MeanAbsoluteError value on hold-out data: 0.032213035970926285
Epoch: 109
Loss on hold-out set: 0.0028904715528417575
MeanAbsoluteError value on hold-out data: 0.0411391519010067
Epoch: 110
Loss on hold-out set: 0.002388373985396404
MeanAbsoluteError value on hold-out data: 0.037739671766757965
Epoch: 111
Loss on hold-out set: 0.004701167161233331
MeanAbsoluteError value on hold-out data: 0.0548260435461998
Epoch: 112
Loss on hold-out set: 0.0019154956895171811
```

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MeanAbsoluteError value on hold-out data: 0.033862560987472534
Epoch: 113
Loss on hold-out set: 0.0032487611200562433
MeanAbsoluteError value on hold-out data: 0.038729872554540634
Epoch: 114
Loss on hold-out set: 0.004219814117899851
MeanAbsoluteError value on hold-out data: 0.05559156462550163
Epoch: 115
Loss on hold-out set: 0.004953440009175162
MeanAbsoluteError value on hold-out data: 0.05460813641548157
Epoch: 116
Loss on hold-out set: 0.002224446280467275
MeanAbsoluteError value on hold-out data: 0.03267720714211464
Epoch: 117
Loss on hold-out set: 0.0092619246999292
MeanAbsoluteError value on hold-out data: 0.0764637440443039
Epoch: 118

Loss on hold-out set: 0.002196410511571326
MeanAbsoluteError value on hold-out data: 0.03381258249282837
Epoch: 119
Loss on hold-out set: 0.00296849441273432
MeanAbsoluteError value on hold-out data: 0.0444008968770504
Epoch: 120
Loss on hold-out set: 0.0028986175924441532
MeanAbsoluteError value on hold-out data: 0.03765105456113815
Epoch: 121
Loss on hold-out set: 0.003763314079199182
MeanAbsoluteError value on hold-out data: 0.04386775568127632
Epoch: 122
Loss on hold-out set: 0.009552227627289923
MeanAbsoluteError value on hold-out data: 0.08603011816740036
Epoch: 123
Loss on hold-out set: 0.0030928828851564936
MeanAbsoluteError value on hold-out data: 0.04507409781217575
Epoch: 124
Loss on hold-out set: 0.0016431506603686629
MeanAbsoluteError value on hold-out data: 0.027826398611068726
Epoch: 125
Loss on hold-out set: 0.004259222266754429
MeanAbsoluteError value on hold-out data: 0.0500945970416069
Epoch: 126
```

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Loss on hold-out set: 0.0032818610044686417
MeanAbsoluteError value on hold-out data: 0.041500598192214966
Epoch: 127
Loss on hold-out set: 0.001995395795491181
MeanAbsoluteError value on hold-out data: 0.03422306478023529
Epoch: 128
Loss on hold-out set: 0.0017294742038326436
MeanAbsoluteError value on hold-out data: 0.03136126324534416
Epoch: 129
Loss on hold-out set: 0.0015242707940112603
MeanAbsoluteError value on hold-out data: 0.03010968118906021
Epoch: 130
```

```
Loss on hold-out set: 0.005996577944116373
MeanAbsoluteError value on hold-out data: 0.05627550184726715
Epoch: 131
Loss on hold-out set: 0.002107815761854382
MeanAbsoluteError value on hold-out data: 0.03407607600092888
Epoch: 132
Loss on hold-out set: 0.0024975482496972148
MeanAbsoluteError value on hold-out data: 0.03908208757638931
Epoch: 133
Loss on hold-out set: 0.006571694938956122
MeanAbsoluteError value on hold-out data: 0.0739884153008461
Epoch: 134
Loss on hold-out set: 0.004318314175562639
MeanAbsoluteError value on hold-out data: 0.05098457261919975
Epoch: 135
Loss on hold-out set: 0.002073228264252018
MeanAbsoluteError value on hold-out data: 0.033859387040138245
Epoch: 136
Loss on hold-out set: 0.0014086690483198158
MeanAbsoluteError value on hold-out data: 0.02917349897325039
Epoch: 137
Loss on hold-out set: 0.00378964086504359
MeanAbsoluteError value on hold-out data: 0.05277325585484505
Epoch: 138
Loss on hold-out set: 0.002329977547847911
MeanAbsoluteError value on hold-out data: 0.03300396725535393
Epoch: 139
Loss on hold-out set: 0.004638772102464971
MeanAbsoluteError value on hold-out data: 0.05745258182287216
```

```
Epoch: 140
Loss on hold-out set: 0.001580088059295361
MeanAbsoluteError value on hold-out data: 0.0289277583360672
Epoch: 141
Loss on hold-out set: 0.005380756491305013
MeanAbsoluteError value on hold-out data: 0.05661517009139061

Epoch: 142
Loss on hold-out set: 0.003233704489263657
MeanAbsoluteError value on hold-out data: 0.04292917251586914
Epoch: 143
Loss on hold-out set: 0.005394796007557919
MeanAbsoluteError value on hold-out data: 0.05827042832970619
Epoch: 144
Loss on hold-out set: 0.004442081841836243
MeanAbsoluteError value on hold-out data: 0.04928833246231079
Epoch: 145
Loss on hold-out set: 0.0037865318713317577
MeanAbsoluteError value on hold-out data: 0.04706132411956787
Epoch: 146
Loss on hold-out set: 0.0037164173432086643
MeanAbsoluteError value on hold-out data: 0.046059079468250275
Epoch: 147
Loss on hold-out set: 0.002181786253411127
MeanAbsoluteError value on hold-out data: 0.036073893308639526
Epoch: 148
Loss on hold-out set: 0.0022444213789544606
MeanAbsoluteError value on hold-out data: 0.03422524407505989
Epoch: 149
Loss on hold-out set: 0.005097935049745597
MeanAbsoluteError value on hold-out data: 0.054669156670570374
Epoch: 150
Loss on hold-out set: 0.0019549863768349354
MeanAbsoluteError value on hold-out data: 0.031810931861400604
Epoch: 151
Loss on hold-out set: 0.0029686287560157084
MeanAbsoluteError value on hold-out data: 0.04484783485531807
Epoch: 152
Loss on hold-out set: 0.005298684081552844
MeanAbsoluteError value on hold-out data: 0.06055785343050957
Epoch: 153

Loss on hold-out set: 0.0015672720772655386
```

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MeanAbsoluteError value on hold-out data: 0.026932483538985252
Epoch: 154
Loss on hold-out set: 0.0021677849275109017
MeanAbsoluteError value on hold-out data: 0.034002240747213364
Epoch: 155
Loss on hold-out set: 0.003446989178069328
MeanAbsoluteError value on hold-out data: 0.04580848664045334
Epoch: 156
Loss on hold-out set: 0.0020736863738612123
MeanAbsoluteError value on hold-out data: 0.03627985715866089
Epoch: 157
Loss on hold-out set: 0.0026665728808821817
MeanAbsoluteError value on hold-out data: 0.03722745552659035
Epoch: 158
Loss on hold-out set: 0.0012590648869885818
MeanAbsoluteError value on hold-out data: 0.026411723345518112
Epoch: 159
Loss on hold-out set: 0.0033922171722607394
MeanAbsoluteError value on hold-out data: 0.045285191386938095
Epoch: 160
Loss on hold-out set: 0.00599957350641489
MeanAbsoluteError value on hold-out data: 0.06739241629838943
Epoch: 161
Loss on hold-out set: 0.0020061370236554034
MeanAbsoluteError value on hold-out data: 0.03161776065826416
Epoch: 162
Loss on hold-out set: 0.0038315662930376434
MeanAbsoluteError value on hold-out data: 0.049554742872714996
Epoch: 163
Loss on hold-out set: 0.0021765603604236325
MeanAbsoluteError value on hold-out data: 0.03374328836798668
Epoch: 164
Loss on hold-out set: 0.002306546427701649
MeanAbsoluteError value on hold-out data: 0.03517433628439903
Epoch: 165

Loss on hold-out set: 0.004675464042903562
MeanAbsoluteError value on hold-out data: 0.058088526129722595
Epoch: 166
Loss on hold-out set: 0.0018304371164719526
MeanAbsoluteError value on hold-out data: 0.032346002757549286
Epoch: 167
```

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Loss on hold-out set: 0.0032280736455791875
MeanAbsoluteError value on hold-out data: 0.04403908923268318
Epoch: 168
Loss on hold-out set: 0.002321216528990159
MeanAbsoluteError value on hold-out data: 0.03918607905507088
Epoch: 169
Loss on hold-out set: 0.001591355352981114
MeanAbsoluteError value on hold-out data: 0.027146507054567337
Epoch: 170
Loss on hold-out set: 0.0026917182534050787
MeanAbsoluteError value on hold-out data: 0.040495581924915314
Epoch: 171
Loss on hold-out set: 0.0027440364080432212
MeanAbsoluteError value on hold-out data: 0.04124048724770546
Epoch: 172
Loss on hold-out set: 0.003247401554529604
MeanAbsoluteError value on hold-out data: 0.045168131589889526
Epoch: 173
Loss on hold-out set: 0.004382339036582332
MeanAbsoluteError value on hold-out data: 0.05610811710357666
Epoch: 174
Loss on hold-out set: 0.0019188705788876273
MeanAbsoluteError value on hold-out data: 0.03597763553261757
Epoch: 175
Loss on hold-out set: 0.001888257534071607
MeanAbsoluteError value on hold-out data: 0.032208435237407684
Epoch: 176

Loss on hold-out set: 0.010200172858802896
MeanAbsoluteError value on hold-out data: 0.09100834280252457
Epoch: 177
Loss on hold-out set: 0.0014420014631468803
MeanAbsoluteError value on hold-out data: 0.02809843048453331
Epoch: 178
Loss on hold-out set: 0.0018132294430152367
MeanAbsoluteError value on hold-out data: 0.03381088748574257
Epoch: 179
Loss on hold-out set: 0.003868275763172852
MeanAbsoluteError value on hold-out data: 0.054242026060819626
Epoch: 180
Loss on hold-out set: 0.0013915836461819708
MeanAbsoluteError value on hold-out data: 0.02843320555984974
```

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Epoch: 181
Loss on hold-out set: 0.004299483225239735
MeanAbsoluteError value on hold-out data: 0.05047036334872246
Epoch: 182
Loss on hold-out set: 0.0018257212604543096
MeanAbsoluteError value on hold-out data: 0.030888671055436134
Epoch: 183
Loss on hold-out set: 0.004218423720694294
MeanAbsoluteError value on hold-out data: 0.0492033027112484
Epoch: 184
Loss on hold-out set: 0.0026239887627429867
MeanAbsoluteError value on hold-out data: 0.03859032317996025
Epoch: 185
Loss on hold-out set: 0.0112478316418443445
MeanAbsoluteError value on hold-out data: 0.09733368456363678
Epoch: 186
Loss on hold-out set: 0.0023454134107420317
MeanAbsoluteError value on hold-out data: 0.03871284797787666
Epoch: 187
Loss on hold-out set: 0.0029162962455302477
MeanAbsoluteError value on hold-out data: 0.04145445674657822
Epoch: 188

Loss on hold-out set: 0.0029968958850459834
MeanAbsoluteError value on hold-out data: 0.04457095265388489
Epoch: 189
Loss on hold-out set: 0.003934230612541892
MeanAbsoluteError value on hold-out data: 0.04666084423661232
Epoch: 190
Loss on hold-out set: 0.0031962186637285507
MeanAbsoluteError value on hold-out data: 0.04784400388598442
Epoch: 191
Loss on hold-out set: 0.003571021364462611
MeanAbsoluteError value on hold-out data: 0.04782179370522499
Epoch: 192
Loss on hold-out set: 0.004177760675941643
MeanAbsoluteError value on hold-out data: 0.052306968718767166
Epoch: 193
Loss on hold-out set: 0.003412078735173533
MeanAbsoluteError value on hold-out data: 0.04644784331321716
Epoch: 194
Loss on hold-out set: 0.0030879466916973655
```

```
MeanAbsoluteError value on hold-out data: 0.040766436606645584
Epoch: 195
Loss on hold-out set: 0.004175858327040547
MeanAbsoluteError value on hold-out data: 0.050175778567790985
Epoch: 196
Loss on hold-out set: 0.0015706506735449167
MeanAbsoluteError value on hold-out data: 0.03128570318222046
Epoch: 197
Loss on hold-out set: 0.0018455638568603287
MeanAbsoluteError value on hold-out data: 0.03192334249615669
Epoch: 198
Loss on hold-out set: 0.0018015333671907061
MeanAbsoluteError value on hold-out data: 0.03401483595371246
Epoch: 199


Loss on hold-out set: 0.0023792030191735216
MeanAbsoluteError value on hold-out data: 0.040400583297014236
Epoch: 200
Loss on hold-out set: 0.0036610544438620933
MeanAbsoluteError value on hold-out data: 0.05144001170992851
Epoch: 201
Loss on hold-out set: 0.003548411290945583
MeanAbsoluteError value on hold-out data: 0.04576191306114197
Epoch: 202
Loss on hold-out set: 0.007680252145387624
MeanAbsoluteError value on hold-out data: 0.07646965980529785
Epoch: 203
Loss on hold-out set: 0.0033851193362160734
MeanAbsoluteError value on hold-out data: 0.04571421816945076
Epoch: 204
Loss on hold-out set: 0.002544974424190035
MeanAbsoluteError value on hold-out data: 0.037323832511901855
Epoch: 205
Loss on hold-out set: 0.001767605589090013
MeanAbsoluteError value on hold-out data: 0.029696909710764885
Epoch: 206
Loss on hold-out set: 0.0033481721276123273
MeanAbsoluteError value on hold-out data: 0.044618334621191025
Epoch: 207
Loss on hold-out set: 0.0025492236018180847
MeanAbsoluteError value on hold-out data: 0.041566696017980576
Epoch: 208
```

```
Loss on hold-out set: 0.0025288133060951765
MeanAbsoluteError value on hold-out data: 0.037756696343421936
Epoch: 209
Loss on hold-out set: 0.005056456454392327
MeanAbsoluteError value on hold-out data: 0.06303998082876205
Epoch: 210
Loss on hold-out set: 0.0011882160431827958
MeanAbsoluteError value on hold-out data: 0.023813746869564056
Epoch: 211

Loss on hold-out set: 0.002689375695282299
MeanAbsoluteError value on hold-out data: 0.03857738897204399
Epoch: 212
Loss on hold-out set: 0.006340002996454898
MeanAbsoluteError value on hold-out data: 0.06351286917924881
Epoch: 213
Loss on hold-out set: 0.0013372955175949947
MeanAbsoluteError value on hold-out data: 0.02566547691822052
Epoch: 214
Loss on hold-out set: 0.002385686222145236
MeanAbsoluteError value on hold-out data: 0.032736968249082565
Epoch: 215
Loss on hold-out set: 0.0031017226988057558
MeanAbsoluteError value on hold-out data: 0.044811852276325226
Epoch: 216
Loss on hold-out set: 0.004154373021600277
MeanAbsoluteError value on hold-out data: 0.053045183420181274
Epoch: 217
Loss on hold-out set: 0.003433205426278475
MeanAbsoluteError value on hold-out data: 0.047727297991514206
Epoch: 218
Loss on hold-out set: 0.0014307674045037281
MeanAbsoluteError value on hold-out data: 0.028529953211545944
Epoch: 219
Loss on hold-out set: 0.0057356076707181175
MeanAbsoluteError value on hold-out data: 0.06643455475568771
Epoch: 220
Loss on hold-out set: 0.0042232828778459835
MeanAbsoluteError value on hold-out data: 0.05054563283920288
Epoch: 221
Loss on hold-out set: 0.0012503478394233082
MeanAbsoluteError value on hold-out data: 0.02796180360019207
```

```
Epoch: 222
Loss on hold-out set: 0.0014319314259888703
MeanAbsoluteError value on hold-out data: 0.02738574706017971
Epoch: 223

Loss on hold-out set: 0.003534145971858188
MeanAbsoluteError value on hold-out data: 0.04705516993999481
Epoch: 224
Loss on hold-out set: 0.0017170969543880538
MeanAbsoluteError value on hold-out data: 0.03270421177148819
Epoch: 225
Loss on hold-out set: 0.005635866932080765
MeanAbsoluteError value on hold-out data: 0.05830966308712959
Epoch: 226
Loss on hold-out set: 0.004682342828202404
MeanAbsoluteError value on hold-out data: 0.06024404987692833
Epoch: 227
Loss on hold-out set: 0.001429868423943653
MeanAbsoluteError value on hold-out data: 0.029543228447437286
Epoch: 228
Loss on hold-out set: 0.0014536316770030872
MeanAbsoluteError value on hold-out data: 0.03019626997411251
Epoch: 229
Loss on hold-out set: 0.0022923269272340755
MeanAbsoluteError value on hold-out data: 0.03876862674951553
Epoch: 230
Loss on hold-out set: 0.0018344393128676242
MeanAbsoluteError value on hold-out data: 0.03153953701257706
Epoch: 231
Loss on hold-out set: 0.0015266826192505266
MeanAbsoluteError value on hold-out data: 0.02702716737985611
Epoch: 232
Loss on hold-out set: 0.0016744714659197551
MeanAbsoluteError value on hold-out data: 0.030839335173368454
Epoch: 233
Loss on hold-out set: 0.0021447135307090847
MeanAbsoluteError value on hold-out data: 0.03722406178712845
Epoch: 234
Loss on hold-out set: 0.0013296022876410892
MeanAbsoluteError value on hold-out data: 0.027281321585178375

Epoch: 235
```

```
Loss on hold-out set: 0.0021664249453399527
MeanAbsoluteError value on hold-out data: 0.03674906864762306
Epoch: 236
Loss on hold-out set: 0.004073276110973798
MeanAbsoluteError value on hold-out data: 0.054459571838378906
Epoch: 237
Loss on hold-out set: 0.0013420602182649371
MeanAbsoluteError value on hold-out data: 0.026292214170098305
Epoch: 238
Loss on hold-out set: 0.0018740311436551181
MeanAbsoluteError value on hold-out data: 0.03235766664147377
Epoch: 239
Loss on hold-out set: 0.0015201542946191406
MeanAbsoluteError value on hold-out data: 0.027294663712382317
Epoch: 240
Loss on hold-out set: 0.005954784721038059
MeanAbsoluteError value on hold-out data: 0.062296442687511444
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Loss on hold-out set: 0.0016789006338895935
MeanAbsoluteError value on hold-out data: 0.028102096170186996
Epoch: 242
Loss on hold-out set: 0.0018687273320545884
MeanAbsoluteError value on hold-out data: 0.03335804119706154
Epoch: 243
Loss on hold-out set: 0.0011315009048159577
MeanAbsoluteError value on hold-out data: 0.025893684476614
Epoch: 244
Loss on hold-out set: 0.0021869473857805133
MeanAbsoluteError value on hold-out data: 0.03530968353152275
Epoch: 245
Loss on hold-out set: 0.003287242002491104
MeanAbsoluteError value on hold-out data: 0.04661795124411583
Epoch: 246

Loss on hold-out set: 0.0010024013861670699
MeanAbsoluteError value on hold-out data: 0.02323775924742222
Epoch: 247
Loss on hold-out set: 0.005652520572766662
MeanAbsoluteError value on hold-out data: 0.059895724058151245
Epoch: 248
Loss on hold-out set: 0.0013959312652188696
MeanAbsoluteError value on hold-out data: 0.028004007413983345
```

```
Epoch: 249
Loss on hold-out set: 0.001607366580221998
MeanAbsoluteError value on hold-out data: 0.029778413474559784
Epoch: 250
Loss on hold-out set: 0.004401580522474097
MeanAbsoluteError value on hold-out data: 0.05197694152593613
Epoch: 251
Loss on hold-out set: 0.003563957141810342
MeanAbsoluteError value on hold-out data: 0.050073012709617615
Epoch: 252
Loss on hold-out set: 0.0035141942851049336
MeanAbsoluteError value on hold-out data: 0.049096692353487015
Epoch: 253
Loss on hold-out set: 0.0028908693317421957
MeanAbsoluteError value on hold-out data: 0.04540032148361206
Epoch: 254
Loss on hold-out set: 0.006385677714685076
MeanAbsoluteError value on hold-out data: 0.07045891135931015
Epoch: 255
Loss on hold-out set: 0.004426136784451573
MeanAbsoluteError value on hold-out data: 0.05780652537941933
Epoch: 256
Loss on hold-out set: 0.00216037482268324
MeanAbsoluteError value on hold-out data: 0.0356186106801033
Epoch: 257

Loss on hold-out set: 0.0020061205447602427
MeanAbsoluteError value on hold-out data: 0.031751278787851334
Epoch: 258
Loss on hold-out set: 0.001181636554017467
MeanAbsoluteError value on hold-out data: 0.023486364632844925
Epoch: 259
Loss on hold-out set: 0.0014180722738322067
MeanAbsoluteError value on hold-out data: 0.027561821043491364
Epoch: 260
Loss on hold-out set: 0.0020530663038554942
MeanAbsoluteError value on hold-out data: 0.03568734601140022
Epoch: 261
Loss on hold-out set: 0.004862131036229823
MeanAbsoluteError value on hold-out data: 0.05545475706458092
Epoch: 262
Loss on hold-out set: 0.0010751893722427714
```

```
MeanAbsoluteError value on hold-out data: 0.022052517160773277
Epoch: 263
Loss on hold-out set: 0.001788595253234043
MeanAbsoluteError value on hold-out data: 0.029895255342125893
Epoch: 264
Loss on hold-out set: 0.002456856352326117
MeanAbsoluteError value on hold-out data: 0.0409269779920578
Epoch: 265
Loss on hold-out set: 0.002280150393122121
MeanAbsoluteError value on hold-out data: 0.03676539286971092
Epoch: 266
Loss on hold-out set: 0.0023732968011723928
MeanAbsoluteError value on hold-out data: 0.039801619946956635
Epoch: 267
Loss on hold-out set: 0.002538060450828389
MeanAbsoluteError value on hold-out data: 0.03394915163516998
Epoch: 268
Loss on hold-out set: 0.001518472456250732
MeanAbsoluteError value on hold-out data: 0.02893035300076008
Epoch: 269

Loss on hold-out set: 0.0013820989636434732
MeanAbsoluteError value on hold-out data: 0.026898501440882683
Epoch: 270
Loss on hold-out set: 0.0017596527499048726
MeanAbsoluteError value on hold-out data: 0.03384983539581299
Epoch: 271
Loss on hold-out set: 0.0015353635474304227
MeanAbsoluteError value on hold-out data: 0.031028591096401215
Epoch: 272
Loss on hold-out set: 0.0011146287127446971
MeanAbsoluteError value on hold-out data: 0.023409532383084297
Epoch: 273
Loss on hold-out set: 0.0012448235372032382
MeanAbsoluteError value on hold-out data: 0.02528703771531582
Epoch: 274
Loss on hold-out set: 0.0038341006484666935
MeanAbsoluteError value on hold-out data: 0.05318676307797432
Epoch: 275
Loss on hold-out set: 0.002113959990980986
MeanAbsoluteError value on hold-out data: 0.0330885648727417
Epoch: 276
```

```
Loss on hold-out set: 0.002489744134149269
MeanAbsoluteError value on hold-out data: 0.04038447514176369
Epoch: 277
Loss on hold-out set: 0.001462979766074568
MeanAbsoluteError value on hold-out data: 0.02826886810362339
Epoch: 278
Loss on hold-out set: 0.0018831672802518465
MeanAbsoluteError value on hold-out data: 0.032050058245658875
Epoch: 279
Loss on hold-out set: 0.003282250236033609
MeanAbsoluteError value on hold-out data: 0.043974440544843674
Epoch: 280
Loss on hold-out set: 0.0016001875077276246
MeanAbsoluteError value on hold-out data: 0.029523493722081184
Epoch: 281


Loss on hold-out set: 0.005902344924642851
MeanAbsoluteError value on hold-out data: 0.05827769637107849
Epoch: 282
Loss on hold-out set: 0.003182759122481864
MeanAbsoluteError value on hold-out data: 0.044205132871866226
Epoch: 283
Loss on hold-out set: 0.001460249079268818
MeanAbsoluteError value on hold-out data: 0.029331769794225693
Epoch: 284
Loss on hold-out set: 0.002104935536504184
MeanAbsoluteError value on hold-out data: 0.03515271097421646
Epoch: 285
Loss on hold-out set: 0.0022509659297372166
MeanAbsoluteError value on hold-out data: 0.03750951588153839
Epoch: 286
Loss on hold-out set: 0.004781490436902172
MeanAbsoluteError value on hold-out data: 0.05803334712982178
Epoch: 287
Loss on hold-out set: 0.0020914074787134794
MeanAbsoluteError value on hold-out data: 0.03628934547305107
Epoch: 288
Loss on hold-out set: 0.0032667347695678473
MeanAbsoluteError value on hold-out data: 0.04571842774748802
Epoch: 289
Loss on hold-out set: 0.0027539459927203623
MeanAbsoluteError value on hold-out data: 0.041247304528951645
```

```
Epoch: 290
Loss on hold-out set: 0.0037586747080479797
MeanAbsoluteError value on hold-out data: 0.049058135598897934
Epoch: 291
Loss on hold-out set: 0.001856689196613029
MeanAbsoluteError value on hold-out data: 0.0294040460139513
Epoch: 292
Loss on hold-out set: 0.0021417375935829782
MeanAbsoluteError value on hold-out data: 0.03186533600091934
Epoch: 293

Loss on hold-out set: 0.002575389670183588
MeanAbsoluteError value on hold-out data: 0.03886277973651886
Epoch: 294
Loss on hold-out set: 0.0033230529914266968
MeanAbsoluteError value on hold-out data: 0.043895021080970764
Epoch: 295
Loss on hold-out set: 0.0023411073305300975
MeanAbsoluteError value on hold-out data: 0.03900039941072464
Epoch: 296
Loss on hold-out set: 0.0013038516710941238
MeanAbsoluteError value on hold-out data: 0.026543788611888885
Epoch: 297
Loss on hold-out set: 0.0015418988906802905
MeanAbsoluteError value on hold-out data: 0.029551047831773758
Epoch: 298
Loss on hold-out set: 0.0020368381244081414
MeanAbsoluteError value on hold-out data: 0.03501307964324951
Epoch: 299
Loss on hold-out set: 0.0012114849232602865
MeanAbsoluteError value on hold-out data: 0.024950861930847168
Epoch: 300
Loss on hold-out set: 0.0031048196711038287
MeanAbsoluteError value on hold-out data: 0.0405106246471405
Epoch: 301
Loss on hold-out set: 0.0013177900094122283
MeanAbsoluteError value on hold-out data: 0.026125799864530563
Epoch: 302
Loss on hold-out set: 0.0017695606128606749
MeanAbsoluteError value on hold-out data: 0.031741805374622345
Epoch: 303
Loss on hold-out set: 0.00459605548530817
```

```
MeanAbsoluteError value on hold-out data: 0.05316033214330673
Epoch: 304
Loss on hold-out set: 0.002004399543358503
MeanAbsoluteError value on hold-out data: 0.032212939113378525
Epoch: 305

Loss on hold-out set: 0.001496752834339675
MeanAbsoluteError value on hold-out data: 0.026009870693087578
Epoch: 306
Loss on hold-out set: 0.002972865397551734
MeanAbsoluteError value on hold-out data: 0.04407278075814247
Epoch: 307
Loss on hold-out set: 0.001085835607036164
MeanAbsoluteError value on hold-out data: 0.02576133981347084
Epoch: 308
Loss on hold-out set: 0.0019555134778401176
MeanAbsoluteError value on hold-out data: 0.03455667942762375
Epoch: 309
Loss on hold-out set: 0.0059739550158969664
MeanAbsoluteError value on hold-out data: 0.06689082831144333
Epoch: 310
Loss on hold-out set: 0.0018699501922942307
MeanAbsoluteError value on hold-out data: 0.03480001166462898
Epoch: 311
Loss on hold-out set: 0.0015397896671569661
MeanAbsoluteError value on hold-out data: 0.02600538171827793
Epoch: 312
Loss on hold-out set: 0.003613551373985645
MeanAbsoluteError value on hold-out data: 0.046549007296562195
Epoch: 313
Loss on hold-out set: 0.00373737512793588
MeanAbsoluteError value on hold-out data: 0.04899217188358307
Epoch: 314
Loss on hold-out set: 0.0016799127793331679
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Epoch: 315
Loss on hold-out set: 0.0015617169464301121
MeanAbsoluteError value on hold-out data: 0.029022149741649628
Epoch: 316
Loss on hold-out set: 0.001480291297316159
MeanAbsoluteError value on hold-out data: 0.029263855889439583
Epoch: 317
```

```
Loss on hold-out set: 0.0027351697208359838
MeanAbsoluteError value on hold-out data: 0.03999605029821396
Epoch: 318
Loss on hold-out set: 0.0026219461395062113
MeanAbsoluteError value on hold-out data: 0.041220419108867645
Epoch: 319
Loss on hold-out set: 0.006455354968478021
MeanAbsoluteError value on hold-out data: 0.05931292101740837
Epoch: 320
Loss on hold-out set: 0.0027783103562940502
MeanAbsoluteError value on hold-out data: 0.040048375725746155
Epoch: 321
Loss on hold-out set: 0.0037621927178023676
MeanAbsoluteError value on hold-out data: 0.047271933406591415
Epoch: 322
Loss on hold-out set: 0.004487387235521486
MeanAbsoluteError value on hold-out data: 0.05511639267206192
Epoch: 323
Loss on hold-out set: 0.002473588591735614
MeanAbsoluteError value on hold-out data: 0.03754280135035515
Epoch: 324
Loss on hold-out set: 0.004166501709014962
MeanAbsoluteError value on hold-out data: 0.05446965992450714
Epoch: 325
Loss on hold-out set: 0.0019009791921186995
MeanAbsoluteError value on hold-out data: 0.031225057318806648
Epoch: 326
Loss on hold-out set: 0.005446418139495347
MeanAbsoluteError value on hold-out data: 0.057012349367141724
Epoch: 327
Loss on hold-out set: 0.0026266275228025685
MeanAbsoluteError value on hold-out data: 0.03685294836759567
Epoch: 328
Loss on hold-out set: 0.0035582855772717218
MeanAbsoluteError value on hold-out data: 0.04610595479607582
Epoch: 329

Loss on hold-out set: 0.0025037886317525256
MeanAbsoluteError value on hold-out data: 0.033992037177085876
Epoch: 330
Loss on hold-out set: 0.004561408533175525
MeanAbsoluteError value on hold-out data: 0.055840205401182175
```

```
Epoch: 331
Loss on hold-out set: 0.0020732161968848423
MeanAbsoluteError value on hold-out data: 0.03625049814581871
Epoch: 332
Loss on hold-out set: 0.0013938846133992467
MeanAbsoluteError value on hold-out data: 0.03032694198191166
Epoch: 333
Loss on hold-out set: 0.0016395170410090174
MeanAbsoluteError value on hold-out data: 0.030138082802295685
Epoch: 334
Loss on hold-out set: 0.0024492371594533324
MeanAbsoluteError value on hold-out data: 0.035911086946725845
Epoch: 335
Loss on hold-out set: 0.001976033323444426
MeanAbsoluteError value on hold-out data: 0.0334346704185009
Epoch: 336
Loss on hold-out set: 0.004577259998768568
MeanAbsoluteError value on hold-out data: 0.054927509278059006
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Loss on hold-out set: 0.0022963438256594693
MeanAbsoluteError value on hold-out data: 0.03680245578289032
Epoch: 338
Loss on hold-out set: 0.004404342108357109
MeanAbsoluteError value on hold-out data: 0.054341498762369156
Epoch: 339
Loss on hold-out set: 0.0022719538966683964
MeanAbsoluteError value on hold-out data: 0.035500623285770416
Epoch: 340
Loss on hold-out set: 0.0030532799857227425
MeanAbsoluteError value on hold-out data: 0.04259311407804489
Epoch: 341

Loss on hold-out set: 0.004931168667481918
MeanAbsoluteError value on hold-out data: 0.05383606627583504
Epoch: 342
Loss on hold-out set: 0.003962191275173896
MeanAbsoluteError value on hold-out data: 0.05377248674631119
Epoch: 343
Loss on hold-out set: 0.001841130499470685
MeanAbsoluteError value on hold-out data: 0.03193084895610809
Epoch: 344
Loss on hold-out set: 0.006931160184505738
```

```
MeanAbsoluteError value on hold-out data: 0.073978953063488
Epoch: 345
Loss on hold-out set: 0.001987464964928988
MeanAbsoluteError value on hold-out data: 0.036890722811222076
Epoch: 346
Loss on hold-out set: 0.0015619166354697786
MeanAbsoluteError value on hold-out data: 0.026181424036622047
Epoch: 347
Loss on hold-out set: 0.0016195972535857244
MeanAbsoluteError value on hold-out data: 0.030479660257697105
Epoch: 348
Loss on hold-out set: 0.006620898058539943
MeanAbsoluteError value on hold-out data: 0.06980966031551361
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Loss on hold-out set: 0.001750107013657199
MeanAbsoluteError value on hold-out data: 0.030946727842092514
Epoch: 350
Loss on hold-out set: 0.0026920692333461424
MeanAbsoluteError value on hold-out data: 0.04471065104007721
Epoch: 351
Loss on hold-out set: 0.0017688698319130037
MeanAbsoluteError value on hold-out data: 0.03289932757616043
Epoch: 352

Loss on hold-out set: 0.002751347357652297
MeanAbsoluteError value on hold-out data: 0.04121576249599457
Epoch: 353
Loss on hold-out set: 0.001795930398848692
MeanAbsoluteError value on hold-out data: 0.03199959918856621
Epoch: 354
Loss on hold-out set: 0.0026091744902690776
MeanAbsoluteError value on hold-out data: 0.04014456272125244
Epoch: 355
Loss on hold-out set: 0.0013529263432198939
MeanAbsoluteError value on hold-out data: 0.026455029845237732
Epoch: 356
Loss on hold-out set: 0.002628532299575837
MeanAbsoluteError value on hold-out data: 0.04140558838844299
Epoch: 357
Loss on hold-out set: 0.0036413025993265605
MeanAbsoluteError value on hold-out data: 0.05251304805278778
Epoch: 358
```

```
Loss on hold-out set: 0.005109886546913385
MeanAbsoluteError value on hold-out data: 0.05579904466867447
Epoch: 359
Loss on hold-out set: 0.003370838877009718
MeanAbsoluteError value on hold-out data: 0.04572253301739693
Epoch: 360
Loss on hold-out set: 0.0011257215029265928
MeanAbsoluteError value on hold-out data: 0.023943033069372177
Epoch: 361
Loss on hold-out set: 0.0010943481955971372
MeanAbsoluteError value on hold-out data: 0.024649042636156082
Epoch: 362
Loss on hold-out set: 0.0022947318380159374
MeanAbsoluteError value on hold-out data: 0.036600153893232346
Epoch: 363
Loss on hold-out set: 0.002154965235508586
MeanAbsoluteError value on hold-out data: 0.03395489603281021


Epoch: 364
Loss on hold-out set: 0.002202973897127729
MeanAbsoluteError value on hold-out data: 0.03664002940058708
Epoch: 365
Loss on hold-out set: 0.0032516629864020566
MeanAbsoluteError value on hold-out data: 0.04189334437251091
Epoch: 366
Loss on hold-out set: 0.0013603180460019136
MeanAbsoluteError value on hold-out data: 0.027018187567591667
Epoch: 367
Loss on hold-out set: 0.0016125074869609978
MeanAbsoluteError value on hold-out data: 0.030797341838479042
Epoch: 368
Loss on hold-out set: 0.0016291866333248389
MeanAbsoluteError value on hold-out data: 0.027337681502103806
Epoch: 369
Loss on hold-out set: 0.001615983835347977
MeanAbsoluteError value on hold-out data: 0.029224300757050514
Epoch: 370
Loss on hold-out set: 0.001688626741892413
MeanAbsoluteError value on hold-out data: 0.03161964192986488
Epoch: 371
Loss on hold-out set: 0.001275877413143845
MeanAbsoluteError value on hold-out data: 0.026542488485574722
```

```
Epoch: 372
Loss on hold-out set: 0.003117432964867667
MeanAbsoluteError value on hold-out data: 0.04766428843140602
Epoch: 373
Loss on hold-out set: 0.006240152067651874
MeanAbsoluteError value on hold-out data: 0.06923195719718933
Epoch: 374
Loss on hold-out set: 0.0022384403120285193
MeanAbsoluteError value on hold-out data: 0.03667527809739113
Early stopping at epoch 373
Returned to Spot: Validation loss: 0.0022384403120285193
----------------------------------------------

spotPython tuning: 0.00022239663858750932 [#########-] 93.59%


config: {'_L_in': 10, '_L_out': 1, 'l1': 256, 'dropout_prob': 0.013863933137096385, 'lr_mult
Epoch: 1
Loss on hold-out set: 0.03771516749341237
MeanAbsoluteError value on hold-out data: 0.15630874037742615
Epoch: 2
Loss on hold-out set: 0.042979427074131216
MeanAbsoluteError value on hold-out data: 0.17528365552425385
Epoch: 3
Loss on hold-out set: 0.03443896662639944
MeanAbsoluteError value on hold-out data: 0.15449978411197662
Epoch: 4
Loss on hold-out set: 0.02589259987795039
MeanAbsoluteError value on hold-out data: 0.1318667232990265
Epoch: 5
Loss on hold-out set: 0.0246793653227781
MeanAbsoluteError value on hold-out data: 0.1307855099439621
Epoch: 6
Loss on hold-out set: 0.02141253096296599
MeanAbsoluteError value on hold-out data: 0.12225354462862015
Epoch: 7
Loss on hold-out set: 0.015943881467376884
MeanAbsoluteError value on hold-out data: 0.10221405327320099
Epoch: 8
Loss on hold-out set: 0.01846420862957051
MeanAbsoluteError value on hold-out data: 0.11551669985055923
Epoch: 9
```

```
Loss on hold-out set: 0.01052573011992009
MeanAbsoluteError value on hold-out data: 0.07835457473993301
Epoch: 10
Loss on hold-out set: 0.018576302026447496
MeanAbsoluteError value on hold-out data: 0.1175643801689148
Epoch: 11
Loss on hold-out set: 0.007985889090617237
MeanAbsoluteError value on hold-out data: 0.06874512881040573

Epoch: 12
Loss on hold-out set: 0.008608022839517185
MeanAbsoluteError value on hold-out data: 0.07315477728843689
Epoch: 13
Loss on hold-out set: 0.0060437534764213
MeanAbsoluteError value on hold-out data: 0.05927206203341484
Epoch: 14
Loss on hold-out set: 0.007609466973103975
MeanAbsoluteError value on hold-out data: 0.07102556526660919
Epoch: 15
Loss on hold-out set: 0.004381959718701087
MeanAbsoluteError value on hold-out data: 0.05146514251828194
Epoch: 16
Loss on hold-out set: 0.004901322903797815
MeanAbsoluteError value on hold-out data: 0.05541318282485008
Epoch: 17
Loss on hold-out set: 0.004142104623545157
MeanAbsoluteError value on hold-out data: 0.05045683681964874
Epoch: 18
Loss on hold-out set: 0.00800541118032446
MeanAbsoluteError value on hold-out data: 0.07126501202583313
Epoch: 19
Loss on hold-out set: 0.007464307850520862
MeanAbsoluteError value on hold-out data: 0.07510867714881897
Epoch: 20
Loss on hold-out set: 0.002929375549827359
MeanAbsoluteError value on hold-out data: 0.03992673382163048
Epoch: 21
Loss on hold-out set: 0.013182677769739377
MeanAbsoluteError value on hold-out data: 0.1003246083855629
Epoch: 22
Loss on hold-out set: 0.01464705176553444
MeanAbsoluteError value on hold-out data: 0.10019265860319138
Epoch: 23
```

```
Loss on hold-out set: 0.007804280784177153
MeanAbsoluteError value on hold-out data: 0.07808926701545715
Epoch: 24
Loss on hold-out set: 0.0033691920199137378
MeanAbsoluteError value on hold-out data: 0.042600132524967194
Epoch: 25
Loss on hold-out set: 0.0016498258199518251
MeanAbsoluteError value on hold-out data: 0.029796654358506203
Epoch: 26
Loss on hold-out set: 0.001834292408985723
MeanAbsoluteError value on hold-out data: 0.03356155753135681
Epoch: 27
Loss on hold-out set: 0.0038144466173099844
MeanAbsoluteError value on hold-out data: 0.051718223839998245
Epoch: 28
Loss on hold-out set: 0.009588065508164857
MeanAbsoluteError value on hold-out data: 0.0869806706905365
Epoch: 29
Loss on hold-out set: 0.0026899250622495615
MeanAbsoluteError value on hold-out data: 0.039717789739370346
Epoch: 30
Loss on hold-out set: 0.0073903872092303475
MeanAbsoluteError value on hold-out data: 0.07746998965740204
Epoch: 31
Loss on hold-out set: 0.0023263578033564905
MeanAbsoluteError value on hold-out data: 0.03821985796093941
Epoch: 32
Loss on hold-out set: 0.005783287943095753
MeanAbsoluteError value on hold-out data: 0.06399451196193695
Epoch: 33
Loss on hold-out set: 0.0077885548878265055
MeanAbsoluteError value on hold-out data: 0.07171452045440674
Epoch: 34
Loss on hold-out set: 0.012226877488980168
MeanAbsoluteError value on hold-out data: 0.1016676276922226
Epoch: 35

Loss on hold-out set: 0.0022643108080190265
MeanAbsoluteError value on hold-out data: 0.03665868937969208
Epoch: 36
Loss on hold-out set: 0.007549624497953214
MeanAbsoluteError value on hold-out data: 0.06839962303638458
```

```
Epoch: 37
Loss on hold-out set: 0.0024416169556053845
MeanAbsoluteError value on hold-out data: 0.03847839683294296
Epoch: 38
Loss on hold-out set: 0.009283224659922876
MeanAbsoluteError value on hold-out data: 0.07936426997184753
Epoch: 39
Loss on hold-out set: 0.005141232573231192
MeanAbsoluteError value on hold-out data: 0.055311042815446854
Epoch: 40
Loss on hold-out set: 0.0022216286957509033
MeanAbsoluteError value on hold-out data: 0.035660453140735626
Epoch: 41
Loss on hold-out set: 0.003831963627721722
MeanAbsoluteError value on hold-out data: 0.04669225588440895
Epoch: 42
Loss on hold-out set: 0.0035326684714834158
MeanAbsoluteError value on hold-out data: 0.0463530533015728
Epoch: 43
Loss on hold-out set: 0.011111913542998465
MeanAbsoluteError value on hold-out data: 0.09479515999555588
Epoch: 44
Loss on hold-out set: 0.00448585734212477
MeanAbsoluteError value on hold-out data: 0.05207962170243263
Epoch: 45
Loss on hold-out set: 0.012457712749509435
MeanAbsoluteError value on hold-out data: 0.10245511680841446
Epoch: 46
Loss on hold-out set: 0.002461501734184199
MeanAbsoluteError value on hold-out data: 0.03637690469622612
Epoch: 47

Loss on hold-out set: 0.002919386594409221
MeanAbsoluteError value on hold-out data: 0.040486935526132584
Epoch: 48
Loss on hold-out set: 0.00316673211483775
MeanAbsoluteError value on hold-out data: 0.04754837602376938
Epoch: 49
Loss on hold-out set: 0.006356769173994269
MeanAbsoluteError value on hold-out data: 0.061835430562496185
Epoch: 50
Loss on hold-out set: 0.004274493389713921
```

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MeanAbsoluteError value on hold-out data: 0.05200386047363281
Epoch: 51
Loss on hold-out set: 0.0047380287004144565
MeanAbsoluteError value on hold-out data: 0.05449628829956055
Epoch: 52
Loss on hold-out set: 0.0034282115459638206
MeanAbsoluteError value on hold-out data: 0.049141060560941696
Epoch: 53
Loss on hold-out set: 0.004770328646133605
MeanAbsoluteError value on hold-out data: 0.05233784392476082
Epoch: 54
Loss on hold-out set: 0.0068335807882249355
MeanAbsoluteError value on hold-out data: 0.0673467367887497
Epoch: 55
Loss on hold-out set: 0.00227272425667922
MeanAbsoluteError value on hold-out data: 0.03933842107653618
Epoch: 56
Loss on hold-out set: 0.001103711420192236
MeanAbsoluteError value on hold-out data: 0.025349648669362068
Epoch: 57
Loss on hold-out set: 0.003637334932328055
MeanAbsoluteError value on hold-out data: 0.04535700008273125
Epoch: 58
Loss on hold-out set: 0.002326298860440913
MeanAbsoluteError value on hold-out data: 0.038864511996507645
Epoch: 59

Loss on hold-out set: 0.0014527812293779693
MeanAbsoluteError value on hold-out data: 0.02787032164633274
Epoch: 60
Loss on hold-out set: 0.004852616289434464
MeanAbsoluteError value on hold-out data: 0.05458706617355347
Epoch: 61
Loss on hold-out set: 0.001108593793009947
MeanAbsoluteError value on hold-out data: 0.025041155517101288
Epoch: 62
Loss on hold-out set: 0.0017096239561827755
MeanAbsoluteError value on hold-out data: 0.029635412618517876
Epoch: 63
Loss on hold-out set: 0.0059414569067915805
MeanAbsoluteError value on hold-out data: 0.06171155348420143
Epoch: 64
```

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Loss on hold-out set: 0.0016943624451462376
MeanAbsoluteError value on hold-out data: 0.025036241859197617
Epoch: 65
Loss on hold-out set: 0.0010833253128159988
MeanAbsoluteError value on hold-out data: 0.025508327409625053
Epoch: 66
Loss on hold-out set: 0.0011811176664195955
MeanAbsoluteError value on hold-out data: 0.027253326028585434
Epoch: 67
Loss on hold-out set: 0.0012509561186705373
MeanAbsoluteError value on hold-out data: 0.02750658616423607
Epoch: 68
Loss on hold-out set: 0.007660176127070659
MeanAbsoluteError value on hold-out data: 0.06987278163433075
Epoch: 69
Loss on hold-out set: 0.0011775259443215634
MeanAbsoluteError value on hold-out data: 0.026568764820694923
Epoch: 70
Loss on hold-out set: 0.004213094668413855
MeanAbsoluteError value on hold-out data: 0.0501025915145874
Epoch: 71

Loss on hold-out set: 0.0013170160481853312
MeanAbsoluteError value on hold-out data: 0.02804933302104473
Epoch: 72
Loss on hold-out set: 0.004754513293798817
MeanAbsoluteError value on hold-out data: 0.05978457257151604
Epoch: 73
Loss on hold-out set: 0.001965841008840423
MeanAbsoluteError value on hold-out data: 0.035686884075403214
Epoch: 74
Loss on hold-out set: 0.0073688389659908255
MeanAbsoluteError value on hold-out data: 0.07017990946769714
Epoch: 75
Loss on hold-out set: 0.004220190353838629
MeanAbsoluteError value on hold-out data: 0.05133094638586044
Epoch: 76
Loss on hold-out set: 0.0011984534702557874
MeanAbsoluteError value on hold-out data: 0.027861731126904488
Epoch: 77
Loss on hold-out set: 0.00411888086972268
MeanAbsoluteError value on hold-out data: 0.051149602979421616
```

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Epoch: 78
Loss on hold-out set: 0.011203621072988761
MeanAbsoluteError value on hold-out data: 0.10118240863084793
Epoch: 79
Loss on hold-out set: 0.0062052534868646606
MeanAbsoluteError value on hold-out data: 0.06627974659204483
Epoch: 80
Loss on hold-out set: 0.006236439117377526
MeanAbsoluteError value on hold-out data: 0.06489399075508118
Epoch: 81
Loss on hold-out set: 0.0033166686802073137
MeanAbsoluteError value on hold-out data: 0.041111934930086136
Epoch: 82
Loss on hold-out set: 0.001847457692125126
MeanAbsoluteError value on hold-out data: 0.03323138505220413
Epoch: 83

Loss on hold-out set: 0.0029842368829505225
MeanAbsoluteError value on hold-out data: 0.04263733699917793
Epoch: 84
Loss on hold-out set: 0.0051563819870352745
MeanAbsoluteError value on hold-out data: 0.05599737912416458
Epoch: 85
Loss on hold-out set: 0.002353403132139264
MeanAbsoluteError value on hold-out data: 0.035269539803266525
Epoch: 86
Loss on hold-out set: 0.0034638296040755356
MeanAbsoluteError value on hold-out data: 0.04079373925924301
Epoch: 87
Loss on hold-out set: 0.00763209977824437
MeanAbsoluteError value on hold-out data: 0.07823332399129868
Epoch: 88
Loss on hold-out set: 0.003239439573678139
MeanAbsoluteError value on hold-out data: 0.04477955773472786
Epoch: 89
Loss on hold-out set: 0.0006380363997059727
MeanAbsoluteError value on hold-out data: 0.02017710916697979
Epoch: 90
Loss on hold-out set: 0.0046456744526758
MeanAbsoluteError value on hold-out data: 0.0550311915576458
Epoch: 91
Loss on hold-out set: 0.001099917081821906
```

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MeanAbsoluteError value on hold-out data: 0.021610047668218613
Epoch: 92
Loss on hold-out set: 0.006229492394547714
MeanAbsoluteError value on hold-out data: 0.06395736336708069
Epoch: 93
Loss on hold-out set: 0.0034917988079158882
MeanAbsoluteError value on hold-out data: 0.053455621004104614
Epoch: 94
Loss on hold-out set: 0.006147200499024046
MeanAbsoluteError value on hold-out data: 0.06279458105564117
Epoch: 95

Loss on hold-out set: 0.0016659567083575223
MeanAbsoluteError value on hold-out data: 0.02509916014969349
Epoch: 96
Loss on hold-out set: 0.005348890566414124
MeanAbsoluteError value on hold-out data: 0.06693988293409348
Epoch: 97
Loss on hold-out set: 0.0029207278000141835
MeanAbsoluteError value on hold-out data: 0.04214656725525856
Epoch: 98
Loss on hold-out set: 0.00587319158703873
MeanAbsoluteError value on hold-out data: 0.06226971372961998
Epoch: 99
Loss on hold-out set: 0.0010012416383496632
MeanAbsoluteError value on hold-out data: 0.02536712773144245
Epoch: 100
Loss on hold-out set: 0.006147290175584586
MeanAbsoluteError value on hold-out data: 0.06417190283536911
Epoch: 101
Loss on hold-out set: 0.0006272522548801805
MeanAbsoluteError value on hold-out data: 0.018612993881106377
Epoch: 102
Loss on hold-out set: 0.0006331395852612332
MeanAbsoluteError value on hold-out data: 0.019496044144034386
Epoch: 103
Loss on hold-out set: 0.004668171174432102
MeanAbsoluteError value on hold-out data: 0.05760851502418518
Epoch: 104
Loss on hold-out set: 0.002599993968799122
MeanAbsoluteError value on hold-out data: 0.0379447378218174
Epoch: 105
```

```
Loss on hold-out set: 0.0011036981534408895
MeanAbsoluteError value on hold-out data: 0.020189832895994186
Epoch: 106
Loss on hold-out set: 0.004511487535446098
MeanAbsoluteError value on hold-out data: 0.054834745824337006
Epoch: 107

Loss on hold-out set: 0.003664964197301551
MeanAbsoluteError value on hold-out data: 0.04653025418519974
Epoch: 108
Loss on hold-out set: 0.0034462449655524993
MeanAbsoluteError value on hold-out data: 0.046581242233514786
Epoch: 109
Loss on hold-out set: 0.00274148011751669
MeanAbsoluteError value on hold-out data: 0.036865971982479095
Epoch: 110
Loss on hold-out set: 0.00106123584555462
MeanAbsoluteError value on hold-out data: 0.021607229486107826
Epoch: 111
Loss on hold-out set: 0.005821842271344442
MeanAbsoluteError value on hold-out data: 0.06152110546827316
Epoch: 112
Loss on hold-out set: 0.0032108837652853445
MeanAbsoluteError value on hold-out data: 0.04534104838967323
Epoch: 113
Loss on hold-out set: 0.002524947275799748
MeanAbsoluteError value on hold-out data: 0.03606489673256874
Epoch: 114
Loss on hold-out set: 0.0007637914493802542
MeanAbsoluteError value on hold-out data: 0.021516697481274605
Epoch: 115
Loss on hold-out set: 0.004182048990562754
MeanAbsoluteError value on hold-out data: 0.04638843610882759
Epoch: 116
Loss on hold-out set: 0.008075019442721418
MeanAbsoluteError value on hold-out data: 0.08178707212209702
Epoch: 117
Loss on hold-out set: 0.0057694747137199895
MeanAbsoluteError value on hold-out data: 0.06152388080954552
Epoch: 118
Loss on hold-out set: 0.0012693044708085883
MeanAbsoluteError value on hold-out data: 0.0276737492531538
Epoch: 119
```

```
Loss on hold-out set: 0.005256718355476072
MeanAbsoluteError value on hold-out data: 0.059206873178482056
Epoch: 120
Loss on hold-out set: 0.002834903646113449
MeanAbsoluteError value on hold-out data: 0.046917110681533813
Epoch: 121
Loss on hold-out set: 0.006091521170578505
MeanAbsoluteError value on hold-out data: 0.06448835879564285
Epoch: 122
Loss on hold-out set: 0.004424793149442657
MeanAbsoluteError value on hold-out data: 0.054214153438806534
Epoch: 123
Loss on hold-out set: 0.0009988519718478386
MeanAbsoluteError value on hold-out data: 0.025191616266965866
Epoch: 124
Loss on hold-out set: 0.004723242196058364
MeanAbsoluteError value on hold-out data: 0.05465184524655342
Epoch: 125
Loss on hold-out set: 0.001956239661299869
MeanAbsoluteError value on hold-out data: 0.035717252641916275
Epoch: 126
Loss on hold-out set: 0.0059786423011437845
MeanAbsoluteError value on hold-out data: 0.06418266892433167
Epoch: 127
Loss on hold-out set: 0.0009900444496643583
MeanAbsoluteError value on hold-out data: 0.02149009145796299
Epoch: 128
Loss on hold-out set: 0.0050667404001088516
MeanAbsoluteError value on hold-out data: 0.05523648113012314
Epoch: 129
Loss on hold-out set: 0.0006803371215937659
MeanAbsoluteError value on hold-out data: 0.01864073984324932
Epoch: 130
Loss on hold-out set: 0.004743849999565435
MeanAbsoluteError value on hold-out data: 0.05701874941587448
Epoch: 131

Loss on hold-out set: 0.0005787868867628276
MeanAbsoluteError value on hold-out data: 0.019276415929198265
Epoch: 132
Loss on hold-out set: 0.0012286770966296132
MeanAbsoluteError value on hold-out data: 0.020256558433175087
```

```
Epoch: 133
Loss on hold-out set: 0.0005198837913523771
MeanAbsoluteError value on hold-out data: 0.01822233386337757
Epoch: 134
Loss on hold-out set: 0.007453889132624394
MeanAbsoluteError value on hold-out data: 0.07021164149045944
Epoch: 135
Loss on hold-out set: 0.004537717923276911
MeanAbsoluteError value on hold-out data: 0.05458556488156319
Epoch: 136
Loss on hold-out set: 0.0008774922822148687
MeanAbsoluteError value on hold-out data: 0.02023516222834587
Epoch: 137
Loss on hold-out set: 0.000699393780546655
MeanAbsoluteError value on hold-out data: 0.020669899880886078
Epoch: 138
Loss on hold-out set: 0.00947418821191317
MeanAbsoluteError value on hold-out data: 0.07873532921075821
Epoch: 139
Loss on hold-out set: 0.002612949113091944
MeanAbsoluteError value on hold-out data: 0.04010983929038048
Epoch: 140
Loss on hold-out set: 0.0008591380962905916
MeanAbsoluteError value on hold-out data: 0.022727299481630325
Epoch: 141
Loss on hold-out set: 0.0012484082713183995
MeanAbsoluteError value on hold-out data: 0.03013394959270954
Epoch: 142
Loss on hold-out set: 0.006037143524736166
MeanAbsoluteError value on hold-out data: 0.0617496632039547
Epoch: 143

Loss on hold-out set: 0.0008520600370646111
MeanAbsoluteError value on hold-out data: 0.02274731546640396
Epoch: 144
Loss on hold-out set: 0.005324915357816376
MeanAbsoluteError value on hold-out data: 0.06000485271215439
Epoch: 145
Loss on hold-out set: 0.0010624952372286077
MeanAbsoluteError value on hold-out data: 0.02021367847919464
Epoch: 146
Loss on hold-out set: 0.008067397535533496
```

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MeanAbsoluteError value on hold-out data: 0.0713508129119873
Epoch: 147
Loss on hold-out set: 0.0028848634775433886
MeanAbsoluteError value on hold-out data: 0.04164467379450798
Epoch: 148
Loss on hold-out set: 0.0009817588510678003
MeanAbsoluteError value on hold-out data: 0.023825716227293015
Epoch: 149
Loss on hold-out set: 0.0062752928780881985
MeanAbsoluteError value on hold-out data: 0.06340024620294571
Epoch: 150
Loss on hold-out set: 0.0024986982063733435
MeanAbsoluteError value on hold-out data: 0.04469343647360802
Epoch: 151
Loss on hold-out set: 0.005928167178736706
MeanAbsoluteError value on hold-out data: 0.06253420561552048
Epoch: 152
Loss on hold-out set: 0.0010149342063079147
MeanAbsoluteError value on hold-out data: 0.024020589888095856
Epoch: 153
Loss on hold-out set: 0.005495274684538967
MeanAbsoluteError value on hold-out data: 0.056850615888834
Epoch: 154
Loss on hold-out set: 0.003033524520057989
MeanAbsoluteError value on hold-out data: 0.04266994073987007
Epoch: 155

Loss on hold-out set: 0.001522393413133135
MeanAbsoluteError value on hold-out data: 0.03101595863699913
Epoch: 156
Loss on hold-out set: 0.009279524270249041
MeanAbsoluteError value on hold-out data: 0.07746024429798126
Epoch: 157
Loss on hold-out set: 0.0037078321053597486
MeanAbsoluteError value on hold-out data: 0.04842697083950043
Epoch: 158
Loss on hold-out set: 0.0009399475529789925
MeanAbsoluteError value on hold-out data: 0.023319600149989128
Epoch: 159
Loss on hold-out set: 0.004140515058105321
MeanAbsoluteError value on hold-out data: 0.05192304030060768
Epoch: 160
```

```
Loss on hold-out set: 0.0011102515425974208
MeanAbsoluteError value on hold-out data: 0.0266020018607378
Epoch: 161
Loss on hold-out set: 0.0054690154685981965
MeanAbsoluteError value on hold-out data: 0.05772731825709343
Epoch: 162
Loss on hold-out set: 0.00071758416551778
MeanAbsoluteError value on hold-out data: 0.01810195855796337
Epoch: 163
Loss on hold-out set: 0.005478590138648686
MeanAbsoluteError value on hold-out data: 0.06057325378060341
Epoch: 164
Loss on hold-out set: 0.002162624251612119
MeanAbsoluteError value on hold-out data: 0.03638570010662079
Epoch: 165
Loss on hold-out set: 0.0025539876905416974
MeanAbsoluteError value on hold-out data: 0.03520451858639717
Epoch: 166
Loss on hold-out set: 0.001808145273427822
MeanAbsoluteError value on hold-out data: 0.034244611859321594
Epoch: 167

Loss on hold-out set: 0.006851371769842349
MeanAbsoluteError value on hold-out data: 0.06352340430021286
Epoch: 168
Loss on hold-out set: 0.003666123197610049
MeanAbsoluteError value on hold-out data: 0.04851832613348961
Epoch: 169
Loss on hold-out set: 0.004039698268139833
MeanAbsoluteError value on hold-out data: 0.05189047381281853
Epoch: 170
Loss on hold-out set: 0.0017283199214082408
MeanAbsoluteError value on hold-out data: 0.030181922018527985
Epoch: 171
Loss on hold-out set: 0.004411909661843981
MeanAbsoluteError value on hold-out data: 0.053700752556324005
Epoch: 172
Loss on hold-out set: 0.0009673363069611552
MeanAbsoluteError value on hold-out data: 0.02476409636437893
Epoch: 173
Loss on hold-out set: 0.0049958566179204925
MeanAbsoluteError value on hold-out data: 0.056806012988090515
```

```
Epoch: 174
Loss on hold-out set: 0.001194582967161152
MeanAbsoluteError value on hold-out data: 0.023886285722255707
Epoch: 175
Loss on hold-out set: 0.00514286294530489
MeanAbsoluteError value on hold-out data: 0.05396080017089844
Epoch: 176
Loss on hold-out set: 0.0013106652661104147
MeanAbsoluteError value on hold-out data: 0.027828006073832512
Epoch: 177
Loss on hold-out set: 0.006590270510825671
MeanAbsoluteError value on hold-out data: 0.06389376521110535
Epoch: 178
Loss on hold-out set: 0.00305885669015544
MeanAbsoluteError value on hold-out data: 0.04119280353188515
Epoch: 179


Loss on hold-out set: 0.0008602906830339251
MeanAbsoluteError value on hold-out data: 0.022094080224633217
Epoch: 180
Loss on hold-out set: 0.003897261168611677
MeanAbsoluteError value on hold-out data: 0.049757521599531174
Epoch: 181
Loss on hold-out set: 0.0010005123469071758
MeanAbsoluteError value on hold-out data: 0.02648734487593174
Epoch: 182
Loss on hold-out set: 0.004661839375713546
MeanAbsoluteError value on hold-out data: 0.053945593535900116
Epoch: 183
Loss on hold-out set: 0.0011709890830771702
MeanAbsoluteError value on hold-out data: 0.027076365426182747
Epoch: 184
Loss on hold-out set: 0.005786839272140672
MeanAbsoluteError value on hold-out data: 0.06078988313674927
Epoch: 185
Loss on hold-out set: 0.0021549996147912586
MeanAbsoluteError value on hold-out data: 0.036664705723524094
Epoch: 186
Loss on hold-out set: 0.0027838228760581267
MeanAbsoluteError value on hold-out data: 0.04102426394820213
Epoch: 187
Loss on hold-out set: 0.004770418604541766
```

```
MeanAbsoluteError value on hold-out data: 0.05487391725182533
Epoch: 188
Loss on hold-out set: 0.0005867061830174766
MeanAbsoluteError value on hold-out data: 0.01907615177333355
Epoch: 189
Loss on hold-out set: 0.005881414074744833
MeanAbsoluteError value on hold-out data: 0.061299171298742294
Epoch: 190
Loss on hold-out set: 0.0026883226206624194
MeanAbsoluteError value on hold-out data: 0.04683733358979225
Epoch: 191

Loss on hold-out set: 0.0033220694657709253
MeanAbsoluteError value on hold-out data: 0.044827528297901154
Epoch: 192
Loss on hold-out set: 0.001822798733452433
MeanAbsoluteError value on hold-out data: 0.02649948000907898
Epoch: 193
Loss on hold-out set: 0.006615182041729751
MeanAbsoluteError value on hold-out data: 0.06479218602180481
Epoch: 194
Loss on hold-out set: 0.0016424410492426862
MeanAbsoluteError value on hold-out data: 0.028328683227300644
Epoch: 195
Loss on hold-out set: 0.001963459044131205
MeanAbsoluteError value on hold-out data: 0.03430689126253128
Epoch: 196
Loss on hold-out set: 0.003825311714440192
MeanAbsoluteError value on hold-out data: 0.050670523196458817
Epoch: 197
Loss on hold-out set: 0.0008480905311635548
MeanAbsoluteError value on hold-out data: 0.022985950112342834
Epoch: 198
Loss on hold-out set: 0.0020725446275288335
MeanAbsoluteError value on hold-out data: 0.03379113972187042
Epoch: 199
Loss on hold-out set: 0.0027292814706207104
MeanAbsoluteError value on hold-out data: 0.04285755008459091
Epoch: 200
Loss on hold-out set: 0.004558569488213642
MeanAbsoluteError value on hold-out data: 0.052647173404693604
Epoch: 201
```

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Loss on hold-out set: 0.0015074977923895379
MeanAbsoluteError value on hold-out data: 0.0290856771171093
Epoch: 202
Loss on hold-out set: 0.004805060483417229
MeanAbsoluteError value on hold-out data: 0.055793844163417816
Epoch: 203

Loss on hold-out set: 0.0020198081068596558
MeanAbsoluteError value on hold-out data: 0.031567491590976715
Epoch: 204
Loss on hold-out set: 0.005282582267873774
MeanAbsoluteError value on hold-out data: 0.05272313952445984
Epoch: 205
Loss on hold-out set: 0.001083494785952529
MeanAbsoluteError value on hold-out data: 0.02627783641219139
Epoch: 206
Loss on hold-out set: 0.0006389544639540347
MeanAbsoluteError value on hold-out data: 0.020224815234541893
Epoch: 207
Loss on hold-out set: 0.005259396643132756
MeanAbsoluteError value on hold-out data: 0.05900141969323158
Epoch: 208
Loss on hold-out set: 0.0035409673398948812
MeanAbsoluteError value on hold-out data: 0.048726629465818405
Epoch: 209
Loss on hold-out set: 0.0034260631318351158
MeanAbsoluteError value on hold-out data: 0.0471489392220974
Epoch: 210
Loss on hold-out set: 0.001466799512088887
MeanAbsoluteError value on hold-out data: 0.03242907300591469
Epoch: 211
Loss on hold-out set: 0.0032196403419795004
MeanAbsoluteError value on hold-out data: 0.044872671365737915
Epoch: 212
Loss on hold-out set: 0.0011464170743956377
MeanAbsoluteError value on hold-out data: 0.028199007734656334
Epoch: 213
Loss on hold-out set: 0.0018538323439363587
MeanAbsoluteError value on hold-out data: 0.03627210482954979
Epoch: 214
Loss on hold-out set: 0.0012584986903484126
MeanAbsoluteError value on hold-out data: 0.025316141545772552
Epoch: 215
```

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Loss on hold-out set: 0.0013173321050616276
MeanAbsoluteError value on hold-out data: 0.023044507950544357
Epoch: 216
Loss on hold-out set: 0.0060897721712918655
MeanAbsoluteError value on hold-out data: 0.06172899156808853
Epoch: 217
Loss on hold-out set: 0.005125803885197169
MeanAbsoluteError value on hold-out data: 0.0580347441136837
Epoch: 218
Loss on hold-out set: 0.0016163485553605777
MeanAbsoluteError value on hold-out data: 0.03293886408209801
Epoch: 219
Loss on hold-out set: 0.005065877885116558
MeanAbsoluteError value on hold-out data: 0.05648273974657059
Epoch: 220
Loss on hold-out set: 0.0018323090809740517
MeanAbsoluteError value on hold-out data: 0.03258098289370537
Epoch: 221
Loss on hold-out set: 0.002092672787655733
MeanAbsoluteError value on hold-out data: 0.037277158349752426
Epoch: 222
Loss on hold-out set: 0.000872958947806374
MeanAbsoluteError value on hold-out data: 0.019892532378435135
Epoch: 223
Loss on hold-out set: 0.004480517910499322
MeanAbsoluteError value on hold-out data: 0.05545423552393913
Epoch: 224
Loss on hold-out set: 0.0020156453369724516
MeanAbsoluteError value on hold-out data: 0.036134324967861176
Epoch: 225
Loss on hold-out set: 0.001691922557687289
MeanAbsoluteError value on hold-out data: 0.035481058061122894
Epoch: 226

Loss on hold-out set: 0.0031847642170951553
MeanAbsoluteError value on hold-out data: 0.04537156969308853
Epoch: 227
Loss on hold-out set: 0.000763464882957602
MeanAbsoluteError value on hold-out data: 0.02146795019507408
Epoch: 228
Loss on hold-out set: 0.0029117059526278786
MeanAbsoluteError value on hold-out data: 0.040032416582107544
```

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Epoch: 229
Loss on hold-out set: 0.00041755747148080875
MeanAbsoluteError value on hold-out data: 0.015595607459545135
Epoch: 230
Loss on hold-out set: 0.005024709849079188
MeanAbsoluteError value on hold-out data: 0.05471848323941231
Epoch: 231
Loss on hold-out set: 0.002301108208484947
MeanAbsoluteError value on hold-out data: 0.03734629973769188
Epoch: 232
Loss on hold-out set: 0.002219631832926289
MeanAbsoluteError value on hold-out data: 0.0368766263127327
Epoch: 233
Loss on hold-out set: 0.0017196602604695056
MeanAbsoluteError value on hold-out data: 0.03339506685733795
Epoch: 234
Loss on hold-out set: 0.0015713852572892058
MeanAbsoluteError value on hold-out data: 0.031471747905015945
Epoch: 235
Loss on hold-out set: 0.0026012215898127146
MeanAbsoluteError value on hold-out data: 0.04097840562462807
Epoch: 236
Loss on hold-out set: 0.0009838492199043302
MeanAbsoluteError value on hold-out data: 0.023909054696559906
Epoch: 237
Loss on hold-out set: 0.0033363359919013945
MeanAbsoluteError value on hold-out data: 0.04729590192437172
Epoch: 238

Loss on hold-out set: 0.0015961323270427161
MeanAbsoluteError value on hold-out data: 0.033937856554985046
Epoch: 239
Loss on hold-out set: 0.0007559479915806534
MeanAbsoluteError value on hold-out data: 0.021228039637207985
Epoch: 240
Loss on hold-out set: 0.006291561956076245
MeanAbsoluteError value on hold-out data: 0.06522905081510544
Epoch: 241
Loss on hold-out set: 0.0013654075967344014
MeanAbsoluteError value on hold-out data: 0.02960946410894394
Epoch: 242
Loss on hold-out set: 0.0012918769314542021
```

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MeanAbsoluteError value on hold-out data: 0.028428420424461365
Epoch: 243
Loss on hold-out set: 0.000825179486510981
MeanAbsoluteError value on hold-out data: 0.02204929292201996
Epoch: 244
Loss on hold-out set: 0.0017716839639960152
MeanAbsoluteError value on hold-out data: 0.03591824322938919
Epoch: 245
Loss on hold-out set: 0.005225032371909995
MeanAbsoluteError value on hold-out data: 0.05832109600305557
Epoch: 246
Loss on hold-out set: 0.0009216842330428527
MeanAbsoluteError value on hold-out data: 0.023358240723609924
Epoch: 247
Loss on hold-out set: 0.005890979603128998
MeanAbsoluteError value on hold-out data: 0.05946812778711319
Epoch: 248
Loss on hold-out set: 0.0019073346323382697
MeanAbsoluteError value on hold-out data: 0.03519131615757942
Epoch: 249
Loss on hold-out set: 0.0014346036860890883
MeanAbsoluteError value on hold-out data: 0.028188396245241165
Epoch: 250
```

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Loss on hold-out set: 0.001593228797183225
MeanAbsoluteError value on hold-out data: 0.03154478222131729
Epoch: 251
Loss on hold-out set: 0.0045490869762081845
MeanAbsoluteError value on hold-out data: 0.056256745010614395
Epoch: 252
Loss on hold-out set: 0.001194245597090278
MeanAbsoluteError value on hold-out data: 0.025774352252483368
Epoch: 253
Loss on hold-out set: 0.003633728612361378
MeanAbsoluteError value on hold-out data: 0.047591663897037506
Epoch: 254
Loss on hold-out set: 0.002499678472400104
MeanAbsoluteError value on hold-out data: 0.03976232931017876
Epoch: 255
Loss on hold-out set: 0.0011381092833624663
MeanAbsoluteError value on hold-out data: 0.025987422093749046
Epoch: 256
```

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Loss on hold-out set: 0.003086355710892301
MeanAbsoluteError value on hold-out data: 0.04336729645729065
Epoch: 257
Loss on hold-out set: 0.0036030289300374293
MeanAbsoluteError value on hold-out data: 0.05242372304201126
Epoch: 258
Loss on hold-out set: 0.0030596316546985976
MeanAbsoluteError value on hold-out data: 0.04383474215865135
Epoch: 259
Loss on hold-out set: 0.0006225663191320276
MeanAbsoluteError value on hold-out data: 0.017931468784809113
Epoch: 260
Loss on hold-out set: 0.004673012654836241
MeanAbsoluteError value on hold-out data: 0.0558701828122139
Epoch: 261


Loss on hold-out set: 0.0031463530919465577
MeanAbsoluteError value on hold-out data: 0.04536689072847366
Epoch: 262
Loss on hold-out set: 0.0015762085186954784
MeanAbsoluteError value on hold-out data: 0.03163638338446617
Epoch: 263
Loss on hold-out set: 0.0016990014486701081
MeanAbsoluteError value on hold-out data: 0.030782807618379593
Epoch: 264
Loss on hold-out set: 0.0012890797990717385
MeanAbsoluteError value on hold-out data: 0.028925521299242973
Epoch: 265
Loss on hold-out set: 0.002734695787933704
MeanAbsoluteError value on hold-out data: 0.042014677077531815
Epoch: 266
Loss on hold-out set: 0.0027603158837576445
MeanAbsoluteError value on hold-out data: 0.0455397330224514
Epoch: 267
Loss on hold-out set: 0.0037321332768586123
MeanAbsoluteError value on hold-out data: 0.04938613623380661
Epoch: 268
Loss on hold-out set: 0.0008841495421764098
MeanAbsoluteError value on hold-out data: 0.019354060292243958
Epoch: 269
Loss on hold-out set: 0.001868498318608066
MeanAbsoluteError value on hold-out data: 0.03344663232564926
```

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Epoch: 270
Loss on hold-out set: 0.0008383736008239028
MeanAbsoluteError value on hold-out data: 0.022878535091876984
Epoch: 271
Loss on hold-out set: 0.005597805359253758
MeanAbsoluteError value on hold-out data: 0.06001636013388634
Epoch: 272
Loss on hold-out set: 0.0009156573260521615
MeanAbsoluteError value on hold-out data: 0.022476255893707275
Epoch: 273

Loss on hold-out set: 0.0018980248622890365
MeanAbsoluteError value on hold-out data: 0.032287582755088806
Epoch: 274
Loss on hold-out set: 0.0020175907319705737
MeanAbsoluteError value on hold-out data: 0.03833942487835884
Epoch: 275
Loss on hold-out set: 0.004556718411071128
MeanAbsoluteError value on hold-out data: 0.05599639192223549
Epoch: 276
Loss on hold-out set: 0.0032653395625713622
MeanAbsoluteError value on hold-out data: 0.05006185173988342
Epoch: 277
Loss on hold-out set: 0.0005534769673096506
MeanAbsoluteError value on hold-out data: 0.019093621522188187
Epoch: 278
Loss on hold-out set: 0.0012479978429741766
MeanAbsoluteError value on hold-out data: 0.029111165553331375
Epoch: 279
Loss on hold-out set: 0.004681535163208058
MeanAbsoluteError value on hold-out data: 0.055237043648958206
Epoch: 280
Loss on hold-out set: 0.001045419761028729
MeanAbsoluteError value on hold-out data: 0.02373998425900936
Epoch: 281
Loss on hold-out set: 0.003549768497530175
MeanAbsoluteError value on hold-out data: 0.05067950487136841
Epoch: 282
Loss on hold-out set: 0.0027288212747264063
MeanAbsoluteError value on hold-out data: 0.04103974625468254
Epoch: 283
Loss on hold-out set: 0.0033470721559991177
```

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MeanAbsoluteError value on hold-out data: 0.0462455116212368
Epoch: 284
Loss on hold-out set: 0.002981358498800546
MeanAbsoluteError value on hold-out data: 0.039370156824588776
Epoch: 285


Loss on hold-out set: 0.005761037102753394 4
MeanAbsoluteError value on hold-out data: 0.07057669758796692
Epoch: 286
Loss on hold-out set: 0.0013360886460807371
MeanAbsoluteError value on hold-out data: 0.026523368433117867
Epoch: 287
Loss on hold-out set: 0.004309822045462697
MeanAbsoluteError value on hold-out data: 0.05453174561262131
Epoch: 288
Loss on hold-out set: 0.0015695010048435314
MeanAbsoluteError value on hold-out data: 0.03127735108137131
Epoch: 289
Loss on hold-out set: 0.0027092150780127235
MeanAbsoluteError value on hold-out data: 0.04157545790076256
Epoch: 290
Loss on hold-out set: 0.0012837113202917145
MeanAbsoluteError value on hold-out data: 0.019554123282432556
Epoch: 291
Loss on hold-out set: 0.004794009471018063
MeanAbsoluteError value on hold-out data: 0.05545728653669357
Epoch: 292
Loss on hold-out set: 0.002025989337677234
MeanAbsoluteError value on hold-out data: 0.034670062363147736
Epoch: 293
Loss on hold-out set: 0.002338368028990532
MeanAbsoluteError value on hold-out data: 0.04090745374560356
Epoch: 294
Loss on hold-out set: 0.0030214167383842564
MeanAbsoluteError value on hold-out data: 0.05036867782473564
Epoch: 295
Loss on hold-out set: 0.0007337256982665215
MeanAbsoluteError value on hold-out data: 0.020969334989786148
Epoch: 296
Loss on hold-out set: 0.0029747351440355964
MeanAbsoluteError value on hold-out data: 0.04505707323551178
Epoch: 297
```

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Loss on hold-out set: 0.0012950153047169902
MeanAbsoluteError value on hold-out data: 0.027953077107667923
Epoch: 298
Loss on hold-out set: 0.004346978826154219
MeanAbsoluteError value on hold-out data: 0.05331246554851532
Epoch: 299
Loss on hold-out set: 0.004371225123146647
MeanAbsoluteError value on hold-out data: 0.053741760551929474
Epoch: 300
Loss on hold-out set: 0.0019022023495237686
MeanAbsoluteError value on hold-out data: 0.03394655883312225
Epoch: 301
Loss on hold-out set: 0.001942541309338259
MeanAbsoluteError value on hold-out data: 0.0356159582734108
Epoch: 302
Loss on hold-out set: 0.0010813658039918856
MeanAbsoluteError value on hold-out data: 0.024825429543852806
Epoch: 303
Loss on hold-out set: 0.001422094692794704
MeanAbsoluteError value on hold-out data: 0.02983315847814083
Epoch: 304
Loss on hold-out set: 0.0033527966650006803
MeanAbsoluteError value on hold-out data: 0.045309677720069885
Epoch: 305
Loss on hold-out set: 0.0008860885864123702
MeanAbsoluteError value on hold-out data: 0.02404070273041725
Epoch: 306
Loss on hold-out set: 0.002677409039614232
MeanAbsoluteError value on hold-out data: 0.042248137295246124
Epoch: 307
Loss on hold-out set: 0.004491908653443189
MeanAbsoluteError value on hold-out data: 0.05349564924836159
Epoch: 308
Loss on hold-out set: 0.0025354900617936722
MeanAbsoluteError value on hold-out data: 0.037304457277059555
Epoch: 309

Loss on hold-out set: 0.0009119252300527142
MeanAbsoluteError value on hold-out data: 0.022016899660229683
Epoch: 310
Loss on hold-out set: 0.0035346470111490866
MeanAbsoluteError value on hold-out data: 0.04707672819495201
```

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Epoch: 311
Loss on hold-out set: 0.0019199384780796734
MeanAbsoluteError value on hold-out data: 0.0350477360188961
Epoch: 312
Loss on hold-out set: 0.000826569283258562
MeanAbsoluteError value on hold-out data: 0.021394575014710426
Epoch: 313
Loss on hold-out set: 0.0011441717720835616
MeanAbsoluteError value on hold-out data: 0.02686857245862484
Epoch: 314
Loss on hold-out set: 0.004204528461406498
MeanAbsoluteError value on hold-out data: 0.053021565079689026
Epoch: 315
Loss on hold-out set: 0.0022448246538835136
MeanAbsoluteError value on hold-out data: 0.03787161409854889
Epoch: 316
Loss on hold-out set: 0.0019475265994275872
MeanAbsoluteError value on hold-out data: 0.037082575261592865
Epoch: 317
Loss on hold-out set: 0.0037098279235100277
MeanAbsoluteError value on hold-out data: 0.04893685132265091
Epoch: 318
Loss on hold-out set: 0.0010545732067456764
MeanAbsoluteError value on hold-out data: 0.025670843198895454
Epoch: 319
Loss on hold-out set: 0.0009302436282221032
MeanAbsoluteError value on hold-out data: 0.020876744762063026
Epoch: 320

Loss on hold-out set: 0.0014635168397370236
MeanAbsoluteError value on hold-out data: 0.02642303705215454
Epoch: 321
Loss on hold-out set: 0.0038856988846275365
MeanAbsoluteError value on hold-out data: 0.04765673354268074
Epoch: 322
Loss on hold-out set: 0.0006778902277705799
MeanAbsoluteError value on hold-out data: 0.017944976687431335
Epoch: 323
Loss on hold-out set: 0.0016473568776793975
MeanAbsoluteError value on hold-out data: 0.03256633132696152
Epoch: 324
Loss on hold-out set: 0.0009203835552876914
```

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MeanAbsoluteError value on hold-out data: 0.023015080019831657
Epoch: 325
Loss on hold-out set: 0.0011291941306186153
MeanAbsoluteError value on hold-out data: 0.02593187615275383
Epoch: 326
Loss on hold-out set: 0.0026618012251626503
MeanAbsoluteError value on hold-out data: 0.04339674487709999
Epoch: 327
Loss on hold-out set: 0.003240635900415088
MeanAbsoluteError value on hold-out data: 0.0438762903213501
Epoch: 328
Loss on hold-out set: 0.00166080775057995
MeanAbsoluteError value on hold-out data: 0.031399909406900406
Epoch: 329
Loss on hold-out set: 0.003303145603766959
MeanAbsoluteError value on hold-out data: 0.04483674466609955
Epoch: 330
Loss on hold-out set: 0.002927324480352629
MeanAbsoluteError value on hold-out data: 0.041361596435308456
Epoch: 331

Loss on hold-out set: 0.0006540071749201927
MeanAbsoluteError value on hold-out data: 0.02099684067070484
Epoch: 332
Loss on hold-out set: 0.005344407657455457
MeanAbsoluteError value on hold-out data: 0.06345534324645996
Epoch: 333
Loss on hold-out set: 0.003591654515874229
MeanAbsoluteError value on hold-out data: 0.04569089412689209
Epoch: 334
Loss on hold-out set: 0.002262011685065533
MeanAbsoluteError value on hold-out data: 0.03853131830692291
Epoch: 335
Loss on hold-out set: 0.0009476963865668758
MeanAbsoluteError value on hold-out data: 0.018297066912055016
Epoch: 336
Loss on hold-out set: 0.002057185583429313
MeanAbsoluteError value on hold-out data: 0.035594262182712555
Epoch: 337
Loss on hold-out set: 0.0012628314342643869
MeanAbsoluteError value on hold-out data: 0.02730216272175312
Epoch: 338
```

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Loss on hold-out set: 0.0023701044295816437
MeanAbsoluteError value on hold-out data: 0.04025418311357498
Epoch: 339
Loss on hold-out set: 0.0008048063563795662
MeanAbsoluteError value on hold-out data: 0.022278714925050735
Epoch: 340
Loss on hold-out set: 0.0013102741764956399
MeanAbsoluteError value on hold-out data: 0.029287712648510933
Epoch: 341
Loss on hold-out set: 0.0027189609337303984
MeanAbsoluteError value on hold-out data: 0.04178011417388916
Epoch: 342
Loss on hold-out set: 0.0018452975966379438
MeanAbsoluteError value on hold-out data: 0.03167049214243889
Epoch: 343

Loss on hold-out set: 0.004520612535998225
MeanAbsoluteError value on hold-out data: 0.053814053535461426
Epoch: 344
Loss on hold-out set: 0.0017359773475235623
MeanAbsoluteError value on hold-out data: 0.030617058277130127
Epoch: 345
Loss on hold-out set: 0.0009284129911592524
MeanAbsoluteError value on hold-out data: 0.02243240922689438
Epoch: 346
Loss on hold-out set: 0.0023512017275942
MeanAbsoluteError value on hold-out data: 0.04015851765871048
Epoch: 347
Loss on hold-out set: 0.0016334674437530339
MeanAbsoluteError value on hold-out data: 0.03143692761659622
Epoch: 348
Loss on hold-out set: 0.002557557318237071
MeanAbsoluteError value on hold-out data: 0.0385296605527401
Epoch: 349
Loss on hold-out set: 0.00046747163440542
MeanAbsoluteError value on hold-out data: 0.01600779965519905
Epoch: 350
Loss on hold-out set: 0.0023943486280347172
MeanAbsoluteError value on hold-out data: 0.03935590013861656
Epoch: 351
Loss on hold-out set: 0.001122066337541726
MeanAbsoluteError value on hold-out data: 0.022564221173524857
```

```
Epoch: 352
Loss on hold-out set: 0.0014858232094220032
MeanAbsoluteError value on hold-out data: 0.024815896525979042
Epoch: 353
Loss on hold-out set: 0.0013020586338825524
MeanAbsoluteError value on hold-out data: 0.02765980176627636
Epoch: 354
Loss on hold-out set: 0.0018905832946888711
MeanAbsoluteError value on hold-out data: 0.03498785197734833
Epoch: 355

Loss on hold-out set: 0.0030269292458940888
MeanAbsoluteError value on hold-out data: 0.045765217393636703
Epoch: 356
Loss on hold-out set: 0.0007475260292841611
MeanAbsoluteError value on hold-out data: 0.022312073037028313
Epoch: 357
Loss on hold-out set: 0.004471476336843089
MeanAbsoluteError value on hold-out data: 0.053121890872716904
Early stopping at epoch 356
Returned to Spot: Validation loss: 0.004471476336843089
----------------------------------------------
```

```
spotPython tuning: 0.00022239663858750932 [##########] 100.00% Done...
```

```
<spotPython.spot.spot.Spot at 0x1692d7f70>
```

## 26.13 Tensorboard

The textual output shown in the console (or code cell) can be visualized with Tensorboard as described in Section 21.13.

## 26.14 Results

After the hyperparameter tuning run is finished, the results can be analyzed as described in Section 21.14.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

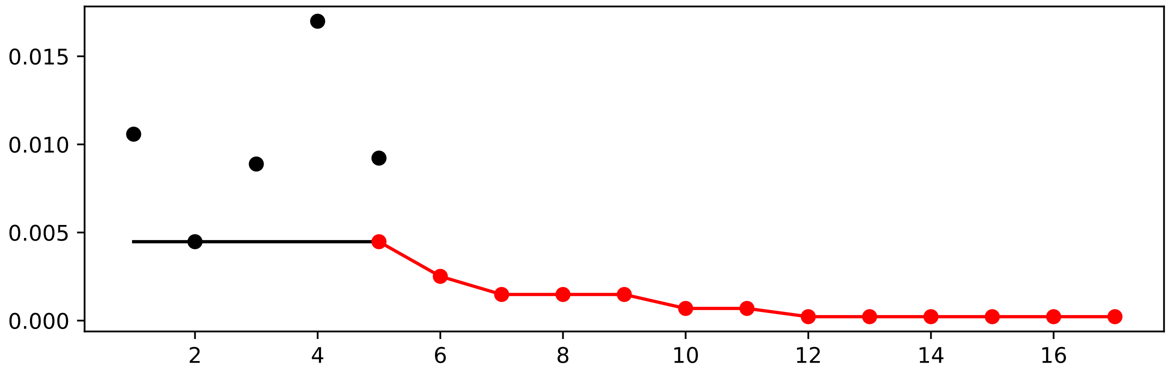


Figure 26.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

```
print(gen_design_table(fun_control=fun_control, spot=spot_tuner))
```

```
| name         | type   | default   |   lower |   upper |             tuned | transform
|--------------|--------|-----------|---------|---------|-------------------|----------------
| _L_in        | int    | 10        |    10.0 |    10.0 |              10.0 | None
| _L_out       | int    | 1         |     1.0 |     1.0 |               1.0 | None
| l1           | int    | 3         |     3.0 |     8.0 |               8.0 | transform_powe
| dropout_prob | float  | 0.01      |     0.0 |     0.9 |               0.0 | None
| lr_mult      | float  | 1.0       |     0.1 |    10.0 | 6.855637843833871 | None
| batch_size   | int    | 4         |     1.0 |     4.0 |               4.0 | transform_powe
| epochs       | int    | 4         |     2.0 |    16.0 |              15.0 | transform_powe
| k_folds      | int    | 1         |     1.0 |     1.0 |               1.0 | None
| patience     | int    | 2         |     3.0 |     7.0 |               7.0 | transform_powe
| optimizer    | factor | SGD       |     0.0 |     6.0 |               0.0 | None
| sgd_momentum | float  | 0.0       |     0.0 |     1.0 |               1.0 | None
```

```
spot_tuner.plot_importance(threshold=0.025,
    filename="./figures/" + experiment_name+"_importance.png")
```

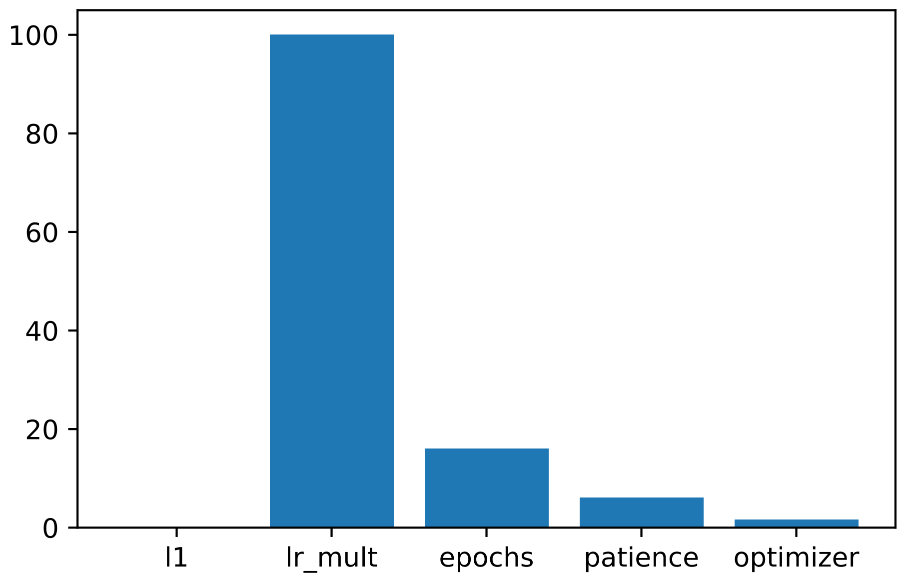


Figure 26.2: Variable importance plot, threshold 0.025.

## 26.15 Get the Tuned Architecture (SPOT Results)

```
from spotPython.hyperparameters.values import get_one_core_model_from_X
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
model_spot = get_one_core_model_from_X(X, fun_control)
model_spot
```

```
Net_lin_reg(
  (fc1): Linear(in_features=10, out_features=256, bias=True)
  (fc2): Linear(in_features=256, out_features=128, bias=True)
  (fc3): Linear(in_features=128, out_features=1, bias=True)
  (relu): ReLU()
  (softmax): Softmax(dim=1)
  (dropout1): Dropout(p=0.0, inplace=False)
  (dropout2): Dropout(p=0.0, inplace=False)
)
```

## 26.16 Evaluation of the Tuned Architecture

```
from spotPython.torch.traintest import (
    train_tuned,
    test_tuned,
    )
```

```
train_tuned(net=model_spot, train_dataset=train,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        shuffle=True,
        device = fun_control["device"],
        path=None,
        task=fun_control["task"],)
```

```
Epoch: 1
Loss on hold-out set: 0.04480068248353506
MeanAbsoluteError value on hold-out data: 0.17708082497119904
Epoch: 2
Loss on hold-out set: 0.01964939282716889
MeanAbsoluteError value on hold-out data: 0.11383228003978729
Epoch: 3

Loss on hold-out set: 0.03560472191556504
MeanAbsoluteError value on hold-out data: 0.16329583525657654
Epoch: 4
Loss on hold-out set: 0.01729781153660856
MeanAbsoluteError value on hold-out data: 0.10783328860998154
Epoch: 5
Loss on hold-out set: 0.010294924514662279
MeanAbsoluteError value on hold-out data: 0.08316002041101456
Epoch: 6
Loss on hold-out set: 0.027886043890918557
MeanAbsoluteError value on hold-out data: 0.14102454483509064
Epoch: 7
Loss on hold-out set: 0.010972405195628343
MeanAbsoluteError value on hold-out data: 0.08298376202583313
Epoch: 8
Loss on hold-out set: 0.006976695008281814
MeanAbsoluteError value on hold-out data: 0.06788483262062073
Epoch: 9
```

```
Loss on hold-out set: 0.030145346726241865
MeanAbsoluteError value on hold-out data: 0.16678762435913086
Epoch: 10
Loss on hold-out set: 0.036561818989483935
MeanAbsoluteError value on hold-out data: 0.17402979731559753
Epoch: 11
Loss on hold-out set: 0.014231291795639615
MeanAbsoluteError value on hold-out data: 0.10736069828271866
Epoch: 12

Loss on hold-out set: 0.008237784017661684
MeanAbsoluteError value on hold-out data: 0.07273975014686584
Epoch: 13
Loss on hold-out set: 0.021827671431789274
MeanAbsoluteError value on hold-out data: 0.13421817123889923
Epoch: 14
Loss on hold-out set: 0.016509702821311197
MeanAbsoluteError value on hold-out data: 0.12121940404176712
Epoch: 15

Loss on hold-out set: 0.006000425078366932
MeanAbsoluteError value on hold-out data: 0.06234827637672424
Epoch: 16
Loss on hold-out set: 0.0037924130937378657
MeanAbsoluteError value on hold-out data: 0.049324240535497665
Epoch: 17
Loss on hold-out set: 0.013985667524761275
MeanAbsoluteError value on hold-out data: 0.10705429315567017
Epoch: 18
Loss on hold-out set: 0.00184545350432592
MeanAbsoluteError value on hold-out data: 0.03563898056745529
Epoch: 19
Loss on hold-out set: 0.01237799298312319
MeanAbsoluteError value on hold-out data: 0.10165302455425262
Epoch: 20
Loss on hold-out set: 0.006957407158456351
MeanAbsoluteError value on hold-out data: 0.06726929545402527
Epoch: 21
Loss on hold-out set: 0.007495280759605138
MeanAbsoluteError value on hold-out data: 0.07064791023731232
Epoch: 22
Loss on hold-out set: 0.002844249060696089
```

```
MeanAbsoluteError value on hold-out data: 0.04327692836523056
Epoch: 23
Loss on hold-out set: 0.011289780469317185
MeanAbsoluteError value on hold-out data: 0.09768135100603104
Epoch: 24

Loss on hold-out set: 0.0019899883466821754
MeanAbsoluteError value on hold-out data: 0.035342052578926086
Epoch: 25
Loss on hold-out set: 0.013568309282785967
MeanAbsoluteError value on hold-out data: 0.11329470574855804
Epoch: 26
Loss on hold-out set: 0.001986882367514466
MeanAbsoluteError value on hold-out data: 0.034678783267736435
Epoch: 27

Loss on hold-out set: 0.008183145601498453
MeanAbsoluteError value on hold-out data: 0.0793512761592865
Epoch: 28
Loss on hold-out set: 0.0052591609082331785
MeanAbsoluteError value on hold-out data: 0.06333071738481522
Epoch: 29
Loss on hold-out set: 0.0028720027276952016
MeanAbsoluteError value on hold-out data: 0.043597325682640076
Epoch: 30
Loss on hold-out set: 0.006890321321981518
MeanAbsoluteError value on hold-out data: 0.067889504134655
Epoch: 31
Loss on hold-out set: 0.005275974368774577
MeanAbsoluteError value on hold-out data: 0.06869789958000183
Epoch: 32
Loss on hold-out set: 0.0035647754251074636
MeanAbsoluteError value on hold-out data: 0.051836591213941574
Epoch: 33
Loss on hold-out set: 0.008983829132232227
MeanAbsoluteError value on hold-out data: 0.08701355010271072
Epoch: 34
Loss on hold-out set: 0.0010001704274480673
MeanAbsoluteError value on hold-out data: 0.0268538985401392
Epoch: 35
Loss on hold-out set: 0.0037195647907394326
MeanAbsoluteError value on hold-out data: 0.048109021037817
```

```
Epoch: 36

Loss on hold-out set: 0.028972301436097997
MeanAbsoluteError value on hold-out data: 0.16500572860240936
Epoch: 37
Loss on hold-out set: 0.002833001579059974
MeanAbsoluteError value on hold-out data: 0.04942376911640167
Epoch: 38
Loss on hold-out set: 0.0006330200657861209
MeanAbsoluteError value on hold-out data: 0.01921704038977623
Epoch: 39

Loss on hold-out set: 0.005379836761245602
MeanAbsoluteError value on hold-out data: 0.06142975389957428
Epoch: 40
Loss on hold-out set: 0.014473047891729757
MeanAbsoluteError value on hold-out data: 0.11606746912002563
Epoch: 41
Loss on hold-out set: 0.0010247312357502157
MeanAbsoluteError value on hold-out data: 0.027241162955760956
Epoch: 42
Loss on hold-out set: 0.0028530076991668657
MeanAbsoluteError value on hold-out data: 0.041957370936870575
Epoch: 43
Loss on hold-out set: 0.005250455897399469
MeanAbsoluteError value on hold-out data: 0.06072992831468582
Epoch: 44
Loss on hold-out set: 0.0161281805485487
MeanAbsoluteError value on hold-out data: 0.11305133998394012
Epoch: 45
Loss on hold-out set: 0.0034626113116054944
MeanAbsoluteError value on hold-out data: 0.047866616398096085
Epoch: 46
Loss on hold-out set: 0.003434842262466095
MeanAbsoluteError value on hold-out data: 0.04411111772060394
Epoch: 47
Loss on hold-out set: 0.008977591133627453
MeanAbsoluteError value on hold-out data: 0.08861257880926132
Epoch: 48

Loss on hold-out set: 0.001244176856983502
MeanAbsoluteError value on hold-out data: 0.026880476623773575
```

```
Epoch: 49
Loss on hold-out set: 0.014145129654360445
MeanAbsoluteError value on hold-out data: 0.11120156943798065
Epoch: 50
Loss on hold-out set: 0.009093006264026227
MeanAbsoluteError value on hold-out data: 0.08058466762304306
Epoch: 51

Loss on hold-out set: 0.01212956126485216
MeanAbsoluteError value on hold-out data: 0.09240437299013138
Epoch: 52
Loss on hold-out set: 0.010087821657132161
MeanAbsoluteError value on hold-out data: 0.08894267678260803
Epoch: 53
Loss on hold-out set: 0.0012622828301238386
MeanAbsoluteError value on hold-out data: 0.028785578906536102
Epoch: 54
Loss on hold-out set: 0.007243658121871321
MeanAbsoluteError value on hold-out data: 0.07519668340682983
Epoch: 55
Loss on hold-out set: 0.01747259458428935
MeanAbsoluteError value on hold-out data: 0.1222987100481987
Epoch: 56
Loss on hold-out set: 0.0009680986940542138
MeanAbsoluteError value on hold-out data: 0.02502485178411007
Epoch: 57
Loss on hold-out set: 0.0006453551223354512
MeanAbsoluteError value on hold-out data: 0.019318226724863052
Epoch: 58
Loss on hold-out set: 0.004710249909150757
MeanAbsoluteError value on hold-out data: 0.05077791213989258
Epoch: 59
Loss on hold-out set: 0.0014890938182361424
MeanAbsoluteError value on hold-out data: 0.029789501801133156
Epoch: 60

Loss on hold-out set: 0.008165996656508037
MeanAbsoluteError value on hold-out data: 0.07324434816837311
Epoch: 61
Loss on hold-out set: 0.00045983628048193887
MeanAbsoluteError value on hold-out data: 0.016661353409290314
Epoch: 62
```

```
Loss on hold-out set: 0.002166990708486226
MeanAbsoluteError value on hold-out data: 0.037275686860084534
Epoch: 63


Loss on hold-out set: 0.002416374379352323
MeanAbsoluteError value on hold-out data: 0.03908639773726463
Epoch: 64
Loss on hold-out set: 0.006425561181171552
MeanAbsoluteError value on hold-out data: 0.05868419632315636
Epoch: 65
Loss on hold-out set: 0.0034565163506685118
MeanAbsoluteError value on hold-out data: 0.05153324827551842
Epoch: 66
Loss on hold-out set: 0.010900212402798627
MeanAbsoluteError value on hold-out data: 0.09814740717411041
Epoch: 67
Loss on hold-out set: 0.0024485710922530607
MeanAbsoluteError value on hold-out data: 0.04629071429371834
Epoch: 68
Loss on hold-out set: 0.007588379501708244
MeanAbsoluteError value on hold-out data: 0.08243294060230255
Epoch: 69
Loss on hold-out set: 0.0009307709467401238
MeanAbsoluteError value on hold-out data: 0.027295691892504692
Epoch: 70
Loss on hold-out set: 0.0003560052236456326
MeanAbsoluteError value on hold-out data: 0.015416473150253296
Epoch: 71
Loss on hold-out set: 0.009277526338241603
MeanAbsoluteError value on hold-out data: 0.08028066903352737
Epoch: 72


Loss on hold-out set: 0.0058089115803963256
MeanAbsoluteError value on hold-out data: 0.06275832653045654
Epoch: 73
Loss on hold-out set: 0.0032619504061968704
MeanAbsoluteError value on hold-out data: 0.044869281351566315
Epoch: 74
Loss on hold-out set: 0.003207641849784475
MeanAbsoluteError value on hold-out data: 0.041109390556812286
Epoch: 75
Loss on hold-out set: 0.002499848619520076
```

```
MeanAbsoluteError value on hold-out data: 0.040436625480651855
Epoch: 76

Loss on hold-out set: 0.0013572995115904824
MeanAbsoluteError value on hold-out data: 0.029923245310783386
Epoch: 77
Loss on hold-out set: 0.0006296278351280643
MeanAbsoluteError value on hold-out data: 0.018714867532253265
Epoch: 78
Loss on hold-out set: 0.008935919423636637
MeanAbsoluteError value on hold-out data: 0.07767868787050247
Epoch: 79
Loss on hold-out set: 0.0009907182814602397
MeanAbsoluteError value on hold-out data: 0.023499084636569023
Epoch: 80
Loss on hold-out set: 0.007404879764898827
MeanAbsoluteError value on hold-out data: 0.07168665528297424
Epoch: 81
Loss on hold-out set: 0.004864130977933344
MeanAbsoluteError value on hold-out data: 0.05591556057333946
Epoch: 82
Loss on hold-out set: 0.00974094823591019
MeanAbsoluteError value on hold-out data: 0.09437808394432068
Epoch: 83
Loss on hold-out set: 0.003525327137475343
MeanAbsoluteError value on hold-out data: 0.04915495589375496
Epoch: 84
Loss on hold-out set: 0.004893672934390213
MeanAbsoluteError value on hold-out data: 0.06296239793300629
Epoch: 85

Loss on hold-out set: 0.002045025800869457
MeanAbsoluteError value on hold-out data: 0.035965871065855026
Epoch: 86
Loss on hold-out set: 0.0003407658721124263
MeanAbsoluteError value on hold-out data: 0.013917284086346626
Epoch: 87
Loss on hold-out set: 0.0024395177055052237
MeanAbsoluteError value on hold-out data: 0.04246516525745392
Epoch: 88
Loss on hold-out set: 0.006968646800439609
MeanAbsoluteError value on hold-out data: 0.07939504086971283
```

```
Epoch: 89

Loss on hold-out set: 0.0005994622509828524
MeanAbsoluteError value on hold-out data: 0.019148673862218857
Epoch: 90
Loss on hold-out set: 0.003358705735177194
MeanAbsoluteError value on hold-out data: 0.04386626183986664
Epoch: 91
Loss on hold-out set: 0.0020912243788571735
MeanAbsoluteError value on hold-out data: 0.040933284908533096
Epoch: 92
Loss on hold-out set: 0.002366389215335642
MeanAbsoluteError value on hold-out data: 0.04438981041312218
Epoch: 93
Loss on hold-out set: 0.0013531983928068687
MeanAbsoluteError value on hold-out data: 0.03353460133075714
Epoch: 94
Loss on hold-out set: 0.009321985472189752
MeanAbsoluteError value on hold-out data: 0.09226740896701813
Epoch: 95
Loss on hold-out set: 0.010549804832982389
MeanAbsoluteError value on hold-out data: 0.09740259498357773
Epoch: 96
Loss on hold-out set: 0.003610352409611407
MeanAbsoluteError value on hold-out data: 0.04422501102089882
Epoch: 97

Loss on hold-out set: 0.005928249465987871
MeanAbsoluteError value on hold-out data: 0.07509468495845795
Epoch: 98
Loss on hold-out set: 0.005216153424331232
MeanAbsoluteError value on hold-out data: 0.06006840243935585
Epoch: 99
Loss on hold-out set: 0.012932497272758107
MeanAbsoluteError value on hold-out data: 0.10595688223838806
Epoch: 100
Loss on hold-out set: 0.0018251632450540598
MeanAbsoluteError value on hold-out data: 0.03995228931307793
Epoch: 101

Loss on hold-out set: 0.004961559303889149
MeanAbsoluteError value on hold-out data: 0.05858030170202255
```

```
Epoch: 102
Loss on hold-out set: 0.003998726765674196
MeanAbsoluteError value on hold-out data: 0.058921605348587036
Epoch: 103
Loss on hold-out set: 0.0003494148105873089
MeanAbsoluteError value on hold-out data: 0.015518792904913425
Epoch: 104
Loss on hold-out set: 0.0005934172927242655
MeanAbsoluteError value on hold-out data: 0.017923299223184586
Epoch: 105
Loss on hold-out set: 0.000639070056709706
MeanAbsoluteError value on hold-out data: 0.020225681364536285
Epoch: 106
Loss on hold-out set: 0.0015252216314700874
MeanAbsoluteError value on hold-out data: 0.035890597850084305
Epoch: 107
Loss on hold-out set: 0.003991306563349147
MeanAbsoluteError value on hold-out data: 0.051565807312726974
Epoch: 108
Loss on hold-out set: 0.00430060904105439
MeanAbsoluteError value on hold-out data: 0.04825099557638168
Epoch: 109
Loss on hold-out set: 0.0033282203673336065
MeanAbsoluteError value on hold-out data: 0.055769264698028564
Epoch: 110

Loss on hold-out set: 0.005326185645045419
MeanAbsoluteError value on hold-out data: 0.07106410712003708
Epoch: 111
Loss on hold-out set: 0.004844498808348649
MeanAbsoluteError value on hold-out data: 0.05213756859302521
Epoch: 112
Loss on hold-out set: 0.006441925296952066
MeanAbsoluteError value on hold-out data: 0.07262205332517624
Epoch: 113
Loss on hold-out set: 0.0013878740351892223
MeanAbsoluteError value on hold-out data: 0.0319049172103405
Epoch: 114

Loss on hold-out set: 0.0021740772461175525
MeanAbsoluteError value on hold-out data: 0.037599753588438034
Epoch: 115
```

```
Loss on hold-out set: 0.0006236255086198645
MeanAbsoluteError value on hold-out data: 0.021512841805815697
Epoch: 116
Loss on hold-out set: 0.005333977359298028
MeanAbsoluteError value on hold-out data: 0.0648210197687149
Epoch: 117
Loss on hold-out set: 0.001004839081648051
MeanAbsoluteError value on hold-out data: 0.02505587972700596
Epoch: 118
Loss on hold-out set: 0.00027299275634026055
MeanAbsoluteError value on hold-out data: 0.0129987932741642
Epoch: 119
Loss on hold-out set: 0.006232141149475386
MeanAbsoluteError value on hold-out data: 0.07449737936258316
Epoch: 120
Loss on hold-out set: 0.004409623638677754
MeanAbsoluteError value on hold-out data: 0.06033756211400032
Epoch: 121
Loss on hold-out set: 0.007286582877369304
MeanAbsoluteError value on hold-out data: 0.08218801766633987
Epoch: 122
Loss on hold-out set: 0.00029040872591155534
MeanAbsoluteError value on hold-out data: 0.013175745494663715
Epoch: 123

Loss on hold-out set: 0.00032092374519714594
MeanAbsoluteError value on hold-out data: 0.013827238231897354
Epoch: 124
Loss on hold-out set: 0.001525446763384695
MeanAbsoluteError value on hold-out data: 0.03417449817061424
Epoch: 125
Loss on hold-out set: 0.005942835166168056
MeanAbsoluteError value on hold-out data: 0.06352216750383377
Epoch: 126
Loss on hold-out set: 0.0019882013040937877
MeanAbsoluteError value on hold-out data: 0.037928178906440735
Epoch: 127

Loss on hold-out set: 0.004434625140244239
MeanAbsoluteError value on hold-out data: 0.05475345626473427
Epoch: 128
Loss on hold-out set: 0.0028501849339686728
```

```
MeanAbsoluteError value on hold-out data: 0.0402275025844574
Epoch: 129
Loss on hold-out set: 0.011800312976303854
MeanAbsoluteError value on hold-out data: 0.10750608891248703
Epoch: 130
Loss on hold-out set: 0.0009782099452997116
MeanAbsoluteError value on hold-out data: 0.025869179517030716
Epoch: 131
Loss on hold-out set: 0.0015806870375710883
MeanAbsoluteError value on hold-out data: 0.03082292154431343
Epoch: 132
Loss on hold-out set: 0.007504187352759273
MeanAbsoluteError value on hold-out data: 0.07079911231994629
Epoch: 133
Loss on hold-out set: 0.0096153602445204
MeanAbsoluteError value on hold-out data: 0.09278673678636551
Epoch: 134
Loss on hold-out set: 0.003473930367219605
MeanAbsoluteError value on hold-out data: 0.04964461922645569
Epoch: 135
Loss on hold-out set: 0.0007992190750021683
MeanAbsoluteError value on hold-out data: 0.024632403627038002
Epoch: 136

Loss on hold-out set: 0.0018281944335046176
MeanAbsoluteError value on hold-out data: 0.03194599971175194
Epoch: 137
Loss on hold-out set: 0.010332092495733186
MeanAbsoluteError value on hold-out data: 0.08214332908391953
Epoch: 138
Loss on hold-out set: 0.006067481749740086
MeanAbsoluteError value on hold-out data: 0.07203270494937897
Epoch: 139
Loss on hold-out set: 0.00042521545593014086
MeanAbsoluteError value on hold-out data: 0.016464674845337868
Epoch: 140

Loss on hold-out set: 0.00299378121149187
MeanAbsoluteError value on hold-out data: 0.04605070874094963
Epoch: 141
Loss on hold-out set: 0.005708146374672651
MeanAbsoluteError value on hold-out data: 0.0722288265824318
```

```
Epoch: 142
Loss on hold-out set: 0.0008944655649094401
MeanAbsoluteError value on hold-out data: 0.022917890921235085
Epoch: 143
Loss on hold-out set: 0.0038324588493100905
MeanAbsoluteError value on hold-out data: 0.05254213511943817
Epoch: 144
Loss on hold-out set: 0.0012707316230884508
MeanAbsoluteError value on hold-out data: 0.03115515410900116
Epoch: 145
Loss on hold-out set: 0.0015355856954365184
MeanAbsoluteError value on hold-out data: 0.03650175407528877
Epoch: 146
Loss on hold-out set: 0.0008485834328702799
MeanAbsoluteError value on hold-out data: 0.02638752944767475
Epoch: 147
Loss on hold-out set: 0.004401890475204901
MeanAbsoluteError value on hold-out data: 0.05987296998500824
Epoch: 148
Loss on hold-out set: 0.0006945853712845986
MeanAbsoluteError value on hold-out data: 0.021401356905698776
Epoch: 149

Loss on hold-out set: 0.005393897746934702
MeanAbsoluteError value on hold-out data: 0.06956484913825989
Epoch: 150
Loss on hold-out set: 0.004290059319158134
MeanAbsoluteError value on hold-out data: 0.055151283740997314
Epoch: 151
Loss on hold-out set: 0.0023257656966483124
MeanAbsoluteError value on hold-out data: 0.03931581228971481
Epoch: 152
Loss on hold-out set: 0.004593271700861423
MeanAbsoluteError value on hold-out data: 0.058204058557748795
Epoch: 153

Loss on hold-out set: 0.0003662423030044393
MeanAbsoluteError value on hold-out data: 0.01494686771184206
Epoch: 154
Loss on hold-out set: 0.00030679719776870976
MeanAbsoluteError value on hold-out data: 0.014324894174933434
Epoch: 155
```

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Loss on hold-out set: 0.0007287232851683113
MeanAbsoluteError value on hold-out data: 0.022243475541472435
Epoch: 156
Loss on hold-out set: 0.017531114973519977
MeanAbsoluteError value on hold-out data: 0.12595807015895844
Epoch: 157
Loss on hold-out set: 0.002199950707635205
MeanAbsoluteError value on hold-out data: 0.041581492871046066
Epoch: 158
Loss on hold-out set: 0.003958284180905474
MeanAbsoluteError value on hold-out data: 0.06172100827097893
Epoch: 159
Loss on hold-out set: 0.004556623765414483
MeanAbsoluteError value on hold-out data: 0.06359805166721344
Epoch: 160
Loss on hold-out set: 0.001979392365013298
MeanAbsoluteError value on hold-out data: 0.03525421395897865
Epoch: 161
Loss on hold-out set: 0.000767571140864962
MeanAbsoluteError value on hold-out data: 0.024572204798460007
Epoch: 162

Loss on hold-out set: 0.004911314267174978
MeanAbsoluteError value on hold-out data: 0.05893909931182861
Epoch: 163
Loss on hold-out set: 0.002753678255861527
MeanAbsoluteError value on hold-out data: 0.04528689384460449
Epoch: 164
Loss on hold-out set: 0.0021033683105518945
MeanAbsoluteError value on hold-out data: 0.04234093055129051
Epoch: 165
Loss on hold-out set: 0.002365301277390436
MeanAbsoluteError value on hold-out data: 0.03817513585090637
Epoch: 166

Loss on hold-out set: 0.0006924606905637407
MeanAbsoluteError value on hold-out data: 0.023553747683763504
Epoch: 167
Loss on hold-out set: 0.0004385729966758701
MeanAbsoluteError value on hold-out data: 0.017406916245818138
Epoch: 168
Loss on hold-out set: 0.002268550880743485
```

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MeanAbsoluteError value on hold-out data: 0.03619169071316719
Epoch: 169
Loss on hold-out set: 0.001180227652902862
MeanAbsoluteError value on hold-out data: 0.029585378244519234
Epoch: 170
Loss on hold-out set: 0.0012204921344834332
MeanAbsoluteError value on hold-out data: 0.029625050723552704
Epoch: 171
Loss on hold-out set: 0.013579756364618478
MeanAbsoluteError value on hold-out data: 0.11167485266923904
Epoch: 172
Loss on hold-out set: 0.005990153007013233
MeanAbsoluteError value on hold-out data: 0.07220468670129776
Epoch: 173
Loss on hold-out set: 0.002870940517536119
MeanAbsoluteError value on hold-out data: 0.04342779144644737
Epoch: 174

Loss on hold-out set: 0.0006474670800870578
MeanAbsoluteError value on hold-out data: 0.02253551408648491
Epoch: 175
Loss on hold-out set: 0.008146273217311031
MeanAbsoluteError value on hold-out data: 0.08268817514181137
Epoch: 176
Loss on hold-out set: 0.007131213910485569
MeanAbsoluteError value on hold-out data: 0.0797516256570816
Epoch: 177
Loss on hold-out set: 0.005671444728872494
MeanAbsoluteError value on hold-out data: 0.0690140500664711
Epoch: 178

Loss on hold-out set: 0.0001667875997219725
MeanAbsoluteError value on hold-out data: 0.01023884117603302
Epoch: 179
Loss on hold-out set: 0.0031120545769992626
MeanAbsoluteError value on hold-out data: 0.04638556391000748
Epoch: 180
Loss on hold-out set: 0.0021571140417731122
MeanAbsoluteError value on hold-out data: 0.03968872129917145
Epoch: 181
Loss on hold-out set: 0.0060316060032499464
MeanAbsoluteError value on hold-out data: 0.07308855652809143
```

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Epoch: 182
Loss on hold-out set: 0.002548360106486239
MeanAbsoluteError value on hold-out data: 0.04507166147232056
Epoch: 183
Loss on hold-out set: 0.0005803806508131521
MeanAbsoluteError value on hold-out data: 0.01982901245355606
Epoch: 184
Loss on hold-out set: 0.0025388320883441913
MeanAbsoluteError value on hold-out data: 0.04233910143375397
Epoch: 185
Loss on hold-out set: 0.0020734871933726887
MeanAbsoluteError value on hold-out data: 0.037939175963401794
Epoch: 186
Loss on hold-out set: 0.00041127978673964545
MeanAbsoluteError value on hold-out data: 0.01695067062973976
Epoch: 187

Loss on hold-out set: 0.003601004332794171
MeanAbsoluteError value on hold-out data: 0.05827833339571953
Epoch: 188
Loss on hold-out set: 0.003329767931350752
MeanAbsoluteError value on hold-out data: 0.054478421807289124
Epoch: 189
Loss on hold-out set: 0.011084995330556444
MeanAbsoluteError value on hold-out data: 0.09360449761152267
Epoch: 190
Loss on hold-out set: 0.00031622718808265696
MeanAbsoluteError value on hold-out data: 0.01422325149178505
Epoch: 191

Loss on hold-out set: 0.00930989717476462
MeanAbsoluteError value on hold-out data: 0.08011819422245026
Epoch: 192
Loss on hold-out set: 0.0006627114397767736
MeanAbsoluteError value on hold-out data: 0.02314925380051136
Epoch: 193
Loss on hold-out set: 0.003032593644763294
MeanAbsoluteError value on hold-out data: 0.0513184629380703
Epoch: 194
Loss on hold-out set: 0.00612871475076597
MeanAbsoluteError value on hold-out data: 0.06581136584281921
Epoch: 195
```

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Loss on hold-out set: 0.017997489604902894
MeanAbsoluteError value on hold-out data: 0.12946948409080505
Epoch: 196
Loss on hold-out set: 0.0005649840719630255
MeanAbsoluteError value on hold-out data: 0.02120324596762657
Epoch: 197
Loss on hold-out set: 0.0030577412904485277
MeanAbsoluteError value on hold-out data: 0.052229996770620346
Epoch: 198
Loss on hold-out set: 0.006180815778574661
MeanAbsoluteError value on hold-out data: 0.05613187700510025
Epoch: 199
Loss on hold-out set: 0.0017367058102727721
MeanAbsoluteError value on hold-out data: 0.03788669407367706
Epoch: 200

Loss on hold-out set: 0.009248557255456322
MeanAbsoluteError value on hold-out data: 0.09499147534370422
Epoch: 201
Loss on hold-out set: 0.0006252639516452817
MeanAbsoluteError value on hold-out data: 0.021083831787109375
Epoch: 202
Loss on hold-out set: 0.0019636278494114152
MeanAbsoluteError value on hold-out data: 0.042594097554683685
Epoch: 203
Loss on hold-out set: 0.0033717356426151176
MeanAbsoluteError value on hold-out data: 0.051771923899650574
Epoch: 204

Loss on hold-out set: 0.00013403550187113548
MeanAbsoluteError value on hold-out data: 0.009245619177818298
Epoch: 205
Loss on hold-out set: 0.0002170829937217365
MeanAbsoluteError value on hold-out data: 0.012018437497317791
Epoch: 206
Loss on hold-out set: 0.006166538664777028
MeanAbsoluteError value on hold-out data: 0.07031542807817459
Epoch: 207
Loss on hold-out set: 0.008138516660485613
MeanAbsoluteError value on hold-out data: 0.06595755368471146
Epoch: 208
Loss on hold-out set: 0.008291068413343868
```

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MeanAbsoluteError value on hold-out data: 0.08257696777582169
Epoch: 209
Loss on hold-out set: 0.0016240597776088276
MeanAbsoluteError value on hold-out data: 0.03519769012928009
Epoch: 210
Loss on hold-out set: 0.0056017959171808076
MeanAbsoluteError value on hold-out data: 0.06381262093782425
Epoch: 211
Loss on hold-out set: 0.005326536778164537
MeanAbsoluteError value on hold-out data: 0.06725656241178513
Epoch: 212
Loss on hold-out set: 0.00035176325074740147
MeanAbsoluteError value on hold-out data: 0.01641904190182686
Epoch: 213

Loss on hold-out set: 0.008853571881589136
MeanAbsoluteError value on hold-out data: 0.08700268715620041
Epoch: 214
Loss on hold-out set: 0.0024018367556364914
MeanAbsoluteError value on hold-out data: 0.03940995782613754
Epoch: 215
Loss on hold-out set: 0.00042827404257351244
MeanAbsoluteError value on hold-out data: 0.01756390370428562
Epoch: 216
Loss on hold-out set: 0.0006678507825678313
MeanAbsoluteError value on hold-out data: 0.021171195432543755
Epoch: 217

Loss on hold-out set: 0.0016525826772282783
MeanAbsoluteError value on hold-out data: 0.03718447685241699
Epoch: 218
Loss on hold-out set: 0.00012312750416305405
MeanAbsoluteError value on hold-out data: 0.009106106124818325
Epoch: 219
Loss on hold-out set: 0.001050752722413132
MeanAbsoluteError value on hold-out data: 0.026017460972070694
Epoch: 220
Loss on hold-out set: 0.00018144370245097794
MeanAbsoluteError value on hold-out data: 0.010696389712393284
Epoch: 221
Loss on hold-out set: 0.0018251268438210613
MeanAbsoluteError value on hold-out data: 0.04059901088476181
```

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Epoch: 222
Loss on hold-out set: 0.0008489156439042601
MeanAbsoluteError value on hold-out data: 0.02432183176279068
Epoch: 223
Loss on hold-out set: 0.002316324634624547
MeanAbsoluteError value on hold-out data: 0.04257987067103386
Epoch: 224
Loss on hold-out set: 0.001323303152610989
MeanAbsoluteError value on hold-out data: 0.030663805082440376
Epoch: 225
Loss on hold-out set: 0.0014181773692957666
MeanAbsoluteError value on hold-out data: 0.032662276178598404
Epoch: 226

Loss on hold-out set: 0.007247469804592822
MeanAbsoluteError value on hold-out data: 0.07376231998205185
Epoch: 227
Loss on hold-out set: 0.00032419635068723247
MeanAbsoluteError value on hold-out data: 0.014539098367094994
Epoch: 228
Loss on hold-out set: 0.003858965870581175
MeanAbsoluteError value on hold-out data: 0.05916985124349594
Epoch: 229
Loss on hold-out set: 0.00043346962238980557
MeanAbsoluteError value on hold-out data: 0.017715340480208397
Epoch: 230

Loss on hold-out set: 0.0034078549054500306
MeanAbsoluteError value on hold-out data: 0.049879539757966995
Epoch: 231
Loss on hold-out set: 0.004127458926584376
MeanAbsoluteError value on hold-out data: 0.04879900440573692
Epoch: 232
Loss on hold-out set: 0.0003022933225637596
MeanAbsoluteError value on hold-out data: 0.013874843716621399
Epoch: 233
Loss on hold-out set: 0.0017101355693548133
MeanAbsoluteError value on hold-out data: 0.0355190671980381
Epoch: 234
Loss on hold-out set: 0.003400149240501617
MeanAbsoluteError value on hold-out data: 0.050471093505620956
Epoch: 235
```

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Loss on hold-out set: 0.0016335768220750125
MeanAbsoluteError value on hold-out data: 0.030644429847598076
Epoch: 236
Loss on hold-out set: 0.001341990605731936
MeanAbsoluteError value on hold-out data: 0.03242048621177673
Epoch: 237
Loss on hold-out set: 0.00423300382681191
MeanAbsoluteError value on hold-out data: 0.04577554762363434
Epoch: 238
Loss on hold-out set: 0.0007978867782328866
MeanAbsoluteError value on hold-out data: 0.023180296644568443
Epoch: 239

Loss on hold-out set: 0.0015348904876430567
MeanAbsoluteError value on hold-out data: 0.03727773204445839
Epoch: 240
Loss on hold-out set: 0.0019916776677985724
MeanAbsoluteError value on hold-out data: 0.03709865361452103
Epoch: 241
Loss on hold-out set: 0.0021602505401365065
MeanAbsoluteError value on hold-out data: 0.03829579055309296
Epoch: 242
Loss on hold-out set: 0.0031631574659657324
MeanAbsoluteError value on hold-out data: 0.04411211609840393
Epoch: 243

Loss on hold-out set: 0.004247422428115418
MeanAbsoluteError value on hold-out data: 0.049464643001556396
Epoch: 244
Loss on hold-out set: 0.004787968324595376
MeanAbsoluteError value on hold-out data: 0.06682310998439789
Epoch: 245
Loss on hold-out set: 0.00019378043783179142
MeanAbsoluteError value on hold-out data: 0.011150358244776726
Epoch: 246
Loss on hold-out set: 0.004636195451511364
MeanAbsoluteError value on hold-out data: 0.06009833514690399
Epoch: 247
Loss on hold-out set: 0.0033023364253734287
MeanAbsoluteError value on hold-out data: 0.05174969881772995
Epoch: 248
Loss on hold-out set: 0.0013170012389309704
```

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MeanAbsoluteError value on hold-out data: 0.028705552220344543
Epoch: 249
Loss on hold-out set: 0.002095379425506843
MeanAbsoluteError value on hold-out data: 0.03742474317550659
Epoch: 250
Loss on hold-out set: 0.00016826438743584347
MeanAbsoluteError value on hold-out data: 0.01069517619907856
Epoch: 251
Loss on hold-out set: 0.0027376877536114896
MeanAbsoluteError value on hold-out data: 0.05054602026939392
Epoch: 252

Loss on hold-out set: 0.0037644415064469763
MeanAbsoluteError value on hold-out data: 0.05409400165081024
Epoch: 253
Loss on hold-out set: 0.0012073171858087573
MeanAbsoluteError value on hold-out data: 0.029439188539981842
Epoch: 254
Loss on hold-out set: 0.000292362530384899
MeanAbsoluteError value on hold-out data: 0.014799815602600574
Epoch: 255
Loss on hold-out set: 0.00020137244964165516
MeanAbsoluteError value on hold-out data: 0.01074137445539236
Epoch: 256

Loss on hold-out set: 0.005930528853480753
MeanAbsoluteError value on hold-out data: 0.07452763617038727
Epoch: 257
Loss on hold-out set: 0.001431595157268212
MeanAbsoluteError value on hold-out data: 0.034331489354372025
Epoch: 258
Loss on hold-out set: 0.0051746875366294074
MeanAbsoluteError value on hold-out data: 0.059072982519865036
Epoch: 259
Loss on hold-out set: 0.006199844916792293
MeanAbsoluteError value on hold-out data: 0.07212506979703903
Epoch: 260
Loss on hold-out set: 0.0004078622311537497
MeanAbsoluteError value on hold-out data: 0.01643388345837593
Epoch: 261
Loss on hold-out set: 0.006921561655441397
MeanAbsoluteError value on hold-out data: 0.06699013710021973
```

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Epoch: 262
Loss on hold-out set: 0.004086246530182268
MeanAbsoluteError value on hold-out data: 0.05113476142287254
Epoch: 263
Loss on hold-out set: 0.0005029015331896708
MeanAbsoluteError value on hold-out data: 0.018723532557487488
Epoch: 264
Loss on hold-out set: 0.004626965383067727
MeanAbsoluteError value on hold-out data: 0.06509251892566681
Epoch: 265

Loss on hold-out set: 0.002420462168581588
MeanAbsoluteError value on hold-out data: 0.041548680514097214
Epoch: 266
Loss on hold-out set: 0.00043175792732079953
MeanAbsoluteError value on hold-out data: 0.01739521510899067
Epoch: 267
Loss on hold-out set: 8.999817356724586e-05
MeanAbsoluteError value on hold-out data: 0.007763532921671867
Epoch: 268
Loss on hold-out set: 0.0027731285969677722
MeanAbsoluteError value on hold-out data: 0.040822096168994904
Epoch: 269

Loss on hold-out set: 0.006286377332320339
MeanAbsoluteError value on hold-out data: 0.06148908659815788
Epoch: 270
Loss on hold-out set: 0.0005918344893296691
MeanAbsoluteError value on hold-out data: 0.02177283726632595
Epoch: 271
Loss on hold-out set: 0.0006515033570681943
MeanAbsoluteError value on hold-out data: 0.021498631685972214
Epoch: 272
Loss on hold-out set: 0.0028749036382099517
MeanAbsoluteError value on hold-out data: 0.049133479595184326
Epoch: 273
Loss on hold-out set: 0.00030236324528232217
MeanAbsoluteError value on hold-out data: 0.013712773099541664
Epoch: 274
Loss on hold-out set: 0.000963666920525659
MeanAbsoluteError value on hold-out data: 0.026034852489829063
Epoch: 275
```

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Loss on hold-out set: 0.002368429182464943
MeanAbsoluteError value on hold-out data: 0.04047691822052002
Epoch: 276
Loss on hold-out set: 0.0034375737274163647
MeanAbsoluteError value on hold-out data: 0.050482816994190216
Epoch: 277
Loss on hold-out set: 0.0045882102138803975
MeanAbsoluteError value on hold-out data: 0.05731451138854027
Epoch: 278

Loss on hold-out set: 0.00019828410892698325
MeanAbsoluteError value on hold-out data: 0.011450953781604767
Epoch: 279
Loss on hold-out set: 0.0009276231591540732
MeanAbsoluteError value on hold-out data: 0.02833552099764347
Epoch: 280
Loss on hold-out set: 0.0013456277941402636
MeanAbsoluteError value on hold-out data: 0.030916186049580574
Epoch: 281
Loss on hold-out set: 0.0022420806160784864
MeanAbsoluteError value on hold-out data: 0.04294201731681824
Epoch: 282

Loss on hold-out set: 0.00031218593128295123
MeanAbsoluteError value on hold-out data: 0.014988452196121216
Epoch: 283
Loss on hold-out set: 0.0005387092701551554
MeanAbsoluteError value on hold-out data: 0.01895495504140854
Epoch: 284
Loss on hold-out set: 0.000603149963640853
MeanAbsoluteError value on hold-out data: 0.01785845123231411
Epoch: 285
Loss on hold-out set: 0.0016342112411573332
MeanAbsoluteError value on hold-out data: 0.028315268456935883
Epoch: 286
Loss on hold-out set: 0.009656373631993407
MeanAbsoluteError value on hold-out data: 0.07610277831554413
Epoch: 287
Loss on hold-out set: 0.004237209679558873
MeanAbsoluteError value on hold-out data: 0.05971672758460045
Epoch: 288
Loss on hold-out set: 0.00046518012057181055
```

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MeanAbsoluteError value on hold-out data: 0.01774052157998085
Epoch: 289
Loss on hold-out set: 0.0002818720792052581
MeanAbsoluteError value on hold-out data: 0.013447138480842113
Epoch: 290

Loss on hold-out set: 0.004497795635344167
MeanAbsoluteError value on hold-out data: 0.06322510540485382
Epoch: 291
Loss on hold-out set: 0.003444830850256901
MeanAbsoluteError value on hold-out data: 0.05398329347372055
Epoch: 292
Loss on hold-out set: 0.0010219630693379593
MeanAbsoluteError value on hold-out data: 0.025899400934576988
Epoch: 293
Loss on hold-out set: 0.0006411653425618026
MeanAbsoluteError value on hold-out data: 0.019889287650585175
Epoch: 294

Loss on hold-out set: 0.0010088822975950805
MeanAbsoluteError value on hold-out data: 0.028069743886590004
Epoch: 295
Loss on hold-out set: 0.0010351965381567808
MeanAbsoluteError value on hold-out data: 0.02734479494392872
Epoch: 296
Loss on hold-out set: 0.0010670845911494996
MeanAbsoluteError value on hold-out data: 0.02844722382724285
Epoch: 297
Loss on hold-out set: 0.0026992077657364702
MeanAbsoluteError value on hold-out data: 0.042634718120098114
Epoch: 298
Loss on hold-out set: 0.00044477474952337186
MeanAbsoluteError value on hold-out data: 0.01831820420920849
Epoch: 299
Loss on hold-out set: 0.0041515263973882326
MeanAbsoluteError value on hold-out data: 0.05126648768782616
Epoch: 300
Loss on hold-out set: 0.008950131283582826
MeanAbsoluteError value on hold-out data: 0.08704257756471634
Epoch: 301
Loss on hold-out set: 0.0001429190555140131
MeanAbsoluteError value on hold-out data: 0.009914622642099857
```

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Epoch: 302

Loss on hold-out set: 0.00224283391511754
MeanAbsoluteError value on hold-out data: 0.04577052593231201
Epoch: 303
Loss on hold-out set: 0.0007464111427237329
MeanAbsoluteError value on hold-out data: 0.0226089209318161
Epoch: 304
Loss on hold-out set: 0.005012087088911549
MeanAbsoluteError value on hold-out data: 0.05033339560031891
Epoch: 305
Loss on hold-out set: 0.0017363620970986392
MeanAbsoluteError value on hold-out data: 0.03706216812133789
Epoch: 306

Loss on hold-out set: 0.001397235625374474
MeanAbsoluteError value on hold-out data: 0.032754816114902496
Epoch: 307
Loss on hold-out set: 0.0004081152483673864
MeanAbsoluteError value on hold-out data: 0.01714215986430645
Epoch: 308
Loss on hold-out set: 0.0006520883394650331
MeanAbsoluteError value on hold-out data: 0.02236798033118248
Epoch: 309
Loss on hold-out set: 0.010537280480524427
MeanAbsoluteError value on hold-out data: 0.09736410528421402
Epoch: 310
Loss on hold-out set: 0.00013863129195095482
MeanAbsoluteError value on hold-out data: 0.009395317174494267
Epoch: 311
Loss on hold-out set: 0.0003702146641444415
MeanAbsoluteError value on hold-out data: 0.015702789649367332
Epoch: 312
Loss on hold-out set: 0.00525402843854145
MeanAbsoluteError value on hold-out data: 0.059458211064338684
Epoch: 313
Loss on hold-out set: 0.0011527671901460149
MeanAbsoluteError value on hold-out data: 0.026197010651230812
Epoch: 314

Loss on hold-out set: 0.0005239578420418854
MeanAbsoluteError value on hold-out data: 0.019145838916301727
```

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Epoch: 315
Loss on hold-out set: 0.004681308202347473
MeanAbsoluteError value on hold-out data: 0.05555211380124092
Epoch: 316
Loss on hold-out set: 0.0006810430158542371
MeanAbsoluteError value on hold-out data: 0.0218398068100214
Epoch: 317
Loss on hold-out set: 0.001956488575639301
MeanAbsoluteError value on hold-out data: 0.03654119372367859
Epoch: 318

Loss on hold-out set: 0.0042787050877354646
MeanAbsoluteError value on hold-out data: 0.05727345868945122
Epoch: 319
Loss on hold-out set: 0.0009092671802806619
MeanAbsoluteError value on hold-out data: 0.02732297219336033
Epoch: 320
Loss on hold-out set: 0.006444868141491162
MeanAbsoluteError value on hold-out data: 0.07408785820007324
Epoch: 321
Loss on hold-out set: 0.004347527877574689
MeanAbsoluteError value on hold-out data: 0.05526161193847656
Epoch: 322
Loss on hold-out set: 0.004130766292004601
MeanAbsoluteError value on hold-out data: 0.04429314658045769
Epoch: 323
Loss on hold-out set: 0.0013034782390796433
MeanAbsoluteError value on hold-out data: 0.029196972027420998
Epoch: 324
Loss on hold-out set: 0.0049701349956816744
MeanAbsoluteError value on hold-out data: 0.058259956538677216
Epoch: 325
Loss on hold-out set: 0.00012146225938187471
MeanAbsoluteError value on hold-out data: 0.008815348148345947
Epoch: 326

Loss on hold-out set: 0.005116137345076392
MeanAbsoluteError value on hold-out data: 0.06911741942167282
Epoch: 327
Loss on hold-out set: 0.0021409405468914068
MeanAbsoluteError value on hold-out data: 0.03888586536049843
Epoch: 328
```

```
Loss on hold-out set: 0.001870106047901668
MeanAbsoluteError value on hold-out data: 0.03586369752883911
Epoch: 329
Loss on hold-out set: 0.012286283860081121
MeanAbsoluteError value on hold-out data: 0.09704602509737015
Epoch: 330

Loss on hold-out set: 0.0027514979806973748
MeanAbsoluteError value on hold-out data: 0.04711177945137024
Epoch: 331
Loss on hold-out set: 0.0005478041283296127
MeanAbsoluteError value on hold-out data: 0.02101588249206543
Epoch: 332
Loss on hold-out set: 0.0027812854999578313
MeanAbsoluteError value on hold-out data: 0.044362135231494904
Epoch: 333
Loss on hold-out set: 0.002704014388942405
MeanAbsoluteError value on hold-out data: 0.04516393318772316
Epoch: 334
Loss on hold-out set: 0.0001966681256338856
MeanAbsoluteError value on hold-out data: 0.010735099203884602
Epoch: 335
Loss on hold-out set: 0.001590090846691869
MeanAbsoluteError value on hold-out data: 0.03790096193552017
Epoch: 336
Loss on hold-out set: 0.005090063780938324
MeanAbsoluteError value on hold-out data: 0.0677659884095192
Epoch: 337
Loss on hold-out set: 0.0013792239631967324
MeanAbsoluteError value on hold-out data: 0.035714540630578995
Epoch: 338

Loss on hold-out set: 0.003978579237714018
MeanAbsoluteError value on hold-out data: 0.04773080721497536
Epoch: 339
Loss on hold-out set: 0.002232163384752838
MeanAbsoluteError value on hold-out data: 0.03831811621785164
Epoch: 340
Loss on hold-out set: 0.0004657993987692814
MeanAbsoluteError value on hold-out data: 0.01906239427626133
Epoch: 341
Loss on hold-out set: 0.002885265006242614
```

```
MeanAbsoluteError value on hold-out data: 0.05154906585812569
Epoch: 342

Loss on hold-out set: 0.00034660552735562975
MeanAbsoluteError value on hold-out data: 0.015319230034947395
Epoch: 343
Loss on hold-out set: 0.0016698188387396697
MeanAbsoluteError value on hold-out data: 0.033184610307216644
Epoch: 344
Loss on hold-out set: 0.0020378445471195797
MeanAbsoluteError value on hold-out data: 0.04180515184998512
Epoch: 345
Loss on hold-out set: 0.006525529487254589
MeanAbsoluteError value on hold-out data: 0.05734807252883911
Epoch: 346
Loss on hold-out set: 0.0005198688181974974
MeanAbsoluteError value on hold-out data: 0.018320754170417786
Epoch: 347
Loss on hold-out set: 0.0006792320698303612
MeanAbsoluteError value on hold-out data: 0.019521215930581093
Epoch: 348
Loss on hold-out set: 0.0021946930608369017
MeanAbsoluteError value on hold-out data: 0.044500384479761124
Epoch: 349
Loss on hold-out set: 0.0016447590590503655
MeanAbsoluteError value on hold-out data: 0.0360819511115551
Epoch: 350

Loss on hold-out set: 0.001780940158488719
MeanAbsoluteError value on hold-out data: 0.03373103588819504
Epoch: 351
Loss on hold-out set: 0.002797096465273123
MeanAbsoluteError value on hold-out data: 0.04711758345365524
Epoch: 352
Loss on hold-out set: 0.0015602956072574383
MeanAbsoluteError value on hold-out data: 0.036085084080696106
Epoch: 353
Loss on hold-out set: 0.00020617205308027273
MeanAbsoluteError value on hold-out data: 0.011221685446798801
Epoch: 354

Loss on hold-out set: 0.0010699023627430985
```

```
MeanAbsoluteError value on hold-out data: 0.028346188366413116
Epoch: 355
Loss on hold-out set: 0.0005089784283068423
MeanAbsoluteError value on hold-out data: 0.01993686519563198
Epoch: 356
Loss on hold-out set: 0.0007451148060346512
MeanAbsoluteError value on hold-out data: 0.024219492450356483
Epoch: 357
Loss on hold-out set: 0.016331248818651625
MeanAbsoluteError value on hold-out data: 0.10959625244140625
Epoch: 358
Loss on hold-out set: 0.0005214907639463874
MeanAbsoluteError value on hold-out data: 0.019279804080724716
Epoch: 359
Loss on hold-out set: 0.0018706642961325614
MeanAbsoluteError value on hold-out data: 0.03762982413172722
Epoch: 360
Loss on hold-out set: 0.0012717397889661555
MeanAbsoluteError value on hold-out data: 0.030168794095516205
Epoch: 361
Loss on hold-out set: 0.00958688569402224
MeanAbsoluteError value on hold-out data: 0.08345048874616623
Epoch: 362

Loss on hold-out set: 0.0016141434653515095
MeanAbsoluteError value on hold-out data: 0.03789449483156204
Epoch: 363
Loss on hold-out set: 0.0007188908424914667
MeanAbsoluteError value on hold-out data: 0.021218324080109596
Epoch: 364
Loss on hold-out set: 0.001966634360877307
MeanAbsoluteError value on hold-out data: 0.03565700724720955
Epoch: 365
Loss on hold-out set: 0.00017788523530869402
MeanAbsoluteError value on hold-out data: 0.01088748499751091
Epoch: 366

Loss on hold-out set: 0.00159929779750344
MeanAbsoluteError value on hold-out data: 0.032539889216423035
Epoch: 367
Loss on hold-out set: 0.0005795871149626022
MeanAbsoluteError value on hold-out data: 0.022092174738645554
```

```
Epoch: 368
Loss on hold-out set: 0.001189746033081687
MeanAbsoluteError value on hold-out data: 0.03267679736018181
Epoch: 369
Loss on hold-out set: 0.002249645191783968
MeanAbsoluteError value on hold-out data: 0.04513852298259735
Epoch: 370
Loss on hold-out set: 0.0002865885938885377
MeanAbsoluteError value on hold-out data: 0.0130779929459095
Epoch: 371
Loss on hold-out set: 0.0018955456938496546
MeanAbsoluteError value on hold-out data: 0.037107013165950775
Epoch: 372
Loss on hold-out set: 0.0011399970221406732
MeanAbsoluteError value on hold-out data: 0.026240549981594086
Epoch: 373
Loss on hold-out set: 0.003250797518136862
MeanAbsoluteError value on hold-out data: 0.04490898177027702
Epoch: 374

Loss on hold-out set: 0.0026023815520793982
MeanAbsoluteError value on hold-out data: 0.04122011363506317
Epoch: 375
Loss on hold-out set: 0.00033601808766099185
MeanAbsoluteError value on hold-out data: 0.014921353198587894
Epoch: 376
Loss on hold-out set: 0.0004813534860180593
MeanAbsoluteError value on hold-out data: 0.01891890913248062
Epoch: 377
Loss on hold-out set: 0.001303314203764067
MeanAbsoluteError value on hold-out data: 0.03207454830408096
Epoch: 378

Loss on hold-out set: 0.003225652262029287
MeanAbsoluteError value on hold-out data: 0.04685552045702934
Epoch: 379
Loss on hold-out set: 0.004248681588490543
MeanAbsoluteError value on hold-out data: 0.060166213661432266
Epoch: 380
Loss on hold-out set: 0.0023590443827407924
MeanAbsoluteError value on hold-out data: 0.04236375540494919
Epoch: 381
```

```
Loss on hold-out set: 0.0025952258269841735
MeanAbsoluteError value on hold-out data: 0.04843918979167938
Epoch: 382
Loss on hold-out set: 0.0003626383795084334
MeanAbsoluteError value on hold-out data: 0.016212090849876404
Epoch: 383
Loss on hold-out set: 0.00039504326291774447
MeanAbsoluteError value on hold-out data: 0.01649075746536255
Epoch: 384
Loss on hold-out set: 0.0016469051632540005
MeanAbsoluteError value on hold-out data: 0.031374119222164154
Epoch: 385
Loss on hold-out set: 0.0005993031097061344
MeanAbsoluteError value on hold-out data: 0.02057776413857937
Epoch: 386

Loss on hold-out set: 0.001245430685996421
MeanAbsoluteError value on hold-out data: 0.02921428345143795
Epoch: 387
Loss on hold-out set: 0.00241418692013739
MeanAbsoluteError value on hold-out data: 0.039100997149944305
Epoch: 388
Loss on hold-out set: 0.008264587873494938
MeanAbsoluteError value on hold-out data: 0.07686910778284073
Epoch: 389
Loss on hold-out set: 0.0010138112043741306
MeanAbsoluteError value on hold-out data: 0.026425441727042198
Epoch: 390

Loss on hold-out set: 0.00024054141862219885
MeanAbsoluteError value on hold-out data: 0.012053768150508404
Epoch: 391
Loss on hold-out set: 0.0018022613550879453
MeanAbsoluteError value on hold-out data: 0.03747191280126572
Epoch: 392
Loss on hold-out set: 0.001411186414770782
MeanAbsoluteError value on hold-out data: 0.032850250601768494
Epoch: 393
Loss on hold-out set: 0.0019111398509458492
MeanAbsoluteError value on hold-out data: 0.03454729542136192
Epoch: 394
Loss on hold-out set: 0.00026684615754914517
```

```
MeanAbsoluteError value on hold-out data: 0.013745218515396118
Epoch: 395
Loss on hold-out set: 0.002727712351387661
MeanAbsoluteError value on hold-out data: 0.04763827472925186
Early stopping at epoch 394
Returned to Spot: Validation loss: 0.002727712351387661
----------------------------------------------
```

If `path` is set to a filename, e.g., `path = "model_spot_trained.pt"`, the weights of the trained model will be loaded from this file.

```
test_tuned(net=model_spot, test_dataset=test,
            shuffle=False,
            loss_function=fun_control["loss_function"],
            metric=fun_control["metric_torch"],
            device = fun_control["device"],
            task=fun_control["task"],)
```

```
Loss on hold-out set: 0.0028985949466004968
MeanAbsoluteError value on hold-out data: 0.049063295125961304
Final evaluation: Validation loss: 0.0028985949466004968
Final evaluation: Validation metric: 0.049063295125961304
----------------------------------------------
```

```
(0.0028985949466004968, nan, tensor(0.0491))
```

## 26.17 Cross-validated Evaluations

- This is the evaluation that will be used in the comparison (evaluatecv has to be updated before, to get metric vlaues!):

```
from spotPython.torch.traintest import evaluate_cv
# modify k-kolds:
setattr(model_spot, "k_folds",  10)
df_eval, df_preds, df_metrics = evaluate_cv(net=model_spot,
            dataset=fun_control["data"],
            loss_function=fun_control["loss_function"],
            metric=fun_control["metric_torch"],
            task=fun_control["task"],
            writer=fun_control["writer"],
```

```python
                writerId="model_spot_cv",
                device = fun_control["device"])
```

```
Fold: 1
Epoch: 1
Loss on hold-out set: 0.016480940660195693
MeanAbsoluteError value on hold-out data: 0.10963477194309235
Epoch: 2

Loss on hold-out set: 0.023461326025426388
MeanAbsoluteError value on hold-out data: 0.12974919378757477
Epoch: 3
Loss on hold-out set: 0.012803474175078529
MeanAbsoluteError value on hold-out data: 0.09014832228422165
Epoch: 4

Loss on hold-out set: 0.004612047491329057
MeanAbsoluteError value on hold-out data: 0.055803194642066956
Epoch: 5
Loss on hold-out set: 0.011183090108845915
MeanAbsoluteError value on hold-out data: 0.08272109180688858
Epoch: 6
Loss on hold-out set: 0.023076306762439863
MeanAbsoluteError value on hold-out data: 0.13066862523555756
Epoch: 7

Loss on hold-out set: 0.016807455436645961
MeanAbsoluteError value on hold-out data: 0.10163907706737518
Epoch: 8
Loss on hold-out set: 0.005816058455301183
MeanAbsoluteError value on hold-out data: 0.06152691692113876
Epoch: 9

Loss on hold-out set: 0.007093212434222372
MeanAbsoluteError value on hold-out data: 0.07173656672239304
Epoch: 10
Loss on hold-out set: 0.008022157009691
MeanAbsoluteError value on hold-out data: 0.07543879747390747
Epoch: 11
```

```
Loss on hold-out set: 0.004485924894522343
MeanAbsoluteError value on hold-out data: 0.055777408182621
Epoch: 12
Loss on hold-out set: 0.0060521006983305725
MeanAbsoluteError value on hold-out data: 0.06592585891485214
Epoch: 13
Loss on hold-out set: 0.006618460241172995
MeanAbsoluteError value on hold-out data: 0.07416550815105438
Epoch: 14

Loss on hold-out set: 0.000883226000171687
MeanAbsoluteError value on hold-out data: 0.02430378645658493
Epoch: 15
Loss on hold-out set: 0.01418584571885211
MeanAbsoluteError value on hold-out data: 0.10727688670158386
Epoch: 16

Loss on hold-out set: 0.0038270136075360434
MeanAbsoluteError value on hold-out data: 0.05762846767902374
Epoch: 17
Loss on hold-out set: 0.006381085674677577
MeanAbsoluteError value on hold-out data: 0.07347682118415833
Epoch: 18

Loss on hold-out set: 0.014582383845533644
MeanAbsoluteError value on hold-out data: 0.111467644572258
Epoch: 19
Loss on hold-out set: 0.013112463190087251
MeanAbsoluteError value on hold-out data: 0.11056899279356003
Epoch: 20
Loss on hold-out set: 0.007056649109082562
MeanAbsoluteError value on hold-out data: 0.072241872549057
Epoch: 21

Loss on hold-out set: 0.0034335384012332986
MeanAbsoluteError value on hold-out data: 0.04608355835080147
Epoch: 22
Loss on hold-out set: 0.0038249472355736153
MeanAbsoluteError value on hold-out data: 0.04819437116384506
Epoch: 23
```

```
Loss on hold-out set: 0.0006170105438546411
MeanAbsoluteError value on hold-out data: 0.019709179177880287
Epoch: 24
Loss on hold-out set: 0.007627667992242745
MeanAbsoluteError value on hold-out data: 0.0686238706111908
Epoch: 25

Loss on hold-out set: 0.006984390451439789
MeanAbsoluteError value on hold-out data: 0.0830947682261467
Epoch: 26
Loss on hold-out set: 0.005240475991740823
MeanAbsoluteError value on hold-out data: 0.06808987259864807
Epoch: 27
Loss on hold-out set: 0.012159466610423155
MeanAbsoluteError value on hold-out data: 0.10680097341537476
Epoch: 28

Loss on hold-out set: 0.005370905423270804
MeanAbsoluteError value on hold-out data: 0.0642501711845398
Epoch: 29
Loss on hold-out set: 0.00044608015533802766
MeanAbsoluteError value on hold-out data: 0.018077408894896507
Epoch: 30

Loss on hold-out set: 0.002038933685980737
MeanAbsoluteError value on hold-out data: 0.0427398681640625
Epoch: 31
Loss on hold-out set: 0.012330176840935434
MeanAbsoluteError value on hold-out data: 0.09135061502456665
Epoch: 32

Loss on hold-out set: 0.005111474743379014
MeanAbsoluteError value on hold-out data: 0.06232286989688873
Epoch: 33
Loss on hold-out set: 0.0025188553013971876
MeanAbsoluteError value on hold-out data: 0.04007646441459656
Epoch: 34
Loss on hold-out set: 0.01867426186800003
MeanAbsoluteError value on hold-out data: 0.13311830163002014
Epoch: 35
```

```
Loss on hold-out set: 0.012085297810179847
MeanAbsoluteError value on hold-out data: 0.10379047691822052
Epoch: 36
Loss on hold-out set: 0.0038642636500298977
MeanAbsoluteError value on hold-out data: 0.05288718640804291
Epoch: 37

Loss on hold-out set: 0.0017827352941302316
MeanAbsoluteError value on hold-out data: 0.036884456872940063
Epoch: 38
Loss on hold-out set: 0.00468036492488214
MeanAbsoluteError value on hold-out data: 0.05791004002094269
Epoch: 39

Loss on hold-out set: 0.0055359116356287685
MeanAbsoluteError value on hold-out data: 0.07103050500154495
Epoch: 40
Loss on hold-out set: 0.014493853385959352
MeanAbsoluteError value on hold-out data: 0.11223234236240387
Epoch: 41
Loss on hold-out set: 0.002678483225671308
MeanAbsoluteError value on hold-out data: 0.04391404241323471
Epoch: 42

Loss on hold-out set: 0.00039102769889203567
MeanAbsoluteError value on hold-out data: 0.015912313014268875
Epoch: 43
Loss on hold-out set: 0.0037844280512737377
MeanAbsoluteError value on hold-out data: 0.04902840778231621
Epoch: 44

Loss on hold-out set: 0.001580103999003768
MeanAbsoluteError value on hold-out data: 0.036468178033828735
Epoch: 45
Loss on hold-out set: 0.0003470205379666628
MeanAbsoluteError value on hold-out data: 0.01638738624751568
Epoch: 46

Loss on hold-out set: 0.004128526031438794
MeanAbsoluteError value on hold-out data: 0.04940808191895485
Epoch: 47
```

```
Loss on hold-out set: 0.0023002003685438205
MeanAbsoluteError value on hold-out data: 0.04609735310077667
Epoch: 48
Loss on hold-out set: 0.0093874242156744
MeanAbsoluteError value on hold-out data: 0.09298163652420044
Epoch: 49

Loss on hold-out set: 0.004572553360568625
MeanAbsoluteError value on hold-out data: 0.05498742684721947
Epoch: 50
Loss on hold-out set: 0.0016089029543633973
MeanAbsoluteError value on hold-out data: 0.03642817959189415
Epoch: 51

Loss on hold-out set: 0.006659391352773777
MeanAbsoluteError value on hold-out data: 0.06740724295377731
Epoch: 52
Loss on hold-out set: 0.004687351108129535
MeanAbsoluteError value on hold-out data: 0.060431305319070816
Epoch: 53

Loss on hold-out set: 0.0012537229506831085
MeanAbsoluteError value on hold-out data: 0.03371800482273102
Epoch: 54
Loss on hold-out set: 0.0002505048697847607
MeanAbsoluteError value on hold-out data: 0.010815683752298355
Epoch: 55
Loss on hold-out set: 0.0027747228242723005
MeanAbsoluteError value on hold-out data: 0.042646512389183044
Epoch: 56

Loss on hold-out set: 0.00041528394129792493
MeanAbsoluteError value on hold-out data: 0.017648490145802498
Epoch: 57
Loss on hold-out set: 0.0003642399221592184
MeanAbsoluteError value on hold-out data: 0.015338413417339325
Epoch: 58

Loss on hold-out set: 0.0010538737738638052
MeanAbsoluteError value on hold-out data: 0.03134796768426895
Epoch: 59
```

```
Loss on hold-out set: 0.0020067710928352816
MeanAbsoluteError value on hold-out data: 0.03978777304291725
Epoch: 60

Loss on hold-out set: 0.004592395653682095
MeanAbsoluteError value on hold-out data: 0.06676751375198364
Epoch: 61
Loss on hold-out set: 0.003050553928395467
MeanAbsoluteError value on hold-out data: 0.043319977819919586
Epoch: 62
Loss on hold-out set: 0.004823574064565557
MeanAbsoluteError value on hold-out data: 0.06691917032003403
Epoch: 63

Loss on hold-out set: 0.008079218811222486
MeanAbsoluteError value on hold-out data: 0.06788761913776398
Epoch: 64
Loss on hold-out set: 0.0008063527555870158
MeanAbsoluteError value on hold-out data: 0.02368730865418911
Epoch: 65

Loss on hold-out set: 0.0008452184016018041
MeanAbsoluteError value on hold-out data: 0.027722753584384918
Epoch: 66
Loss on hold-out set: 0.0050609081517905
MeanAbsoluteError value on hold-out data: 0.06377885490655899
Epoch: 67

Loss on hold-out set: 0.001648278790526092
MeanAbsoluteError value on hold-out data: 0.036975763738155365
Epoch: 68
Loss on hold-out set: 0.00018264333110502257
MeanAbsoluteError value on hold-out data: 0.010338111780583858
Epoch: 69
Loss on hold-out set: 0.0011616009536997548
MeanAbsoluteError value on hold-out data: 0.02511649765074253
Epoch: 70

Loss on hold-out set: 0.0014264346349851362
MeanAbsoluteError value on hold-out data: 0.030963223427534103
Epoch: 71
```

```
Loss on hold-out set: 0.001818579322259341
MeanAbsoluteError value on hold-out data: 0.03428257629275322
Epoch: 72

Loss on hold-out set: 0.0019560237248827305
MeanAbsoluteError value on hold-out data: 0.03976429998874664
Epoch: 73
Loss on hold-out set: 0.0001588017922975788
MeanAbsoluteError value on hold-out data: 0.010544671677052975
Epoch: 74

Loss on hold-out set: 0.007299546817583697
MeanAbsoluteError value on hold-out data: 0.08168049901723862
Epoch: 75
Loss on hold-out set: 0.002851527583386217
MeanAbsoluteError value on hold-out data: 0.04074859246611595
Epoch: 76
Loss on hold-out set: 0.017312118517501012
MeanAbsoluteError value on hold-out data: 0.1298884153366089
Epoch: 77

Loss on hold-out set: 0.0043503540634576765
MeanAbsoluteError value on hold-out data: 0.06170688569545746
Epoch: 78
Loss on hold-out set: 0.0037915803092931
MeanAbsoluteError value on hold-out data: 0.06084801256656647
Epoch: 79

Loss on hold-out set: 0.0015010976265849812
MeanAbsoluteError value on hold-out data: 0.03706299886107445
Epoch: 80
Loss on hold-out set: 0.004446406649159533
MeanAbsoluteError value on hold-out data: 0.06486150622367859
Epoch: 81

Loss on hold-out set: 0.002584082506863134
MeanAbsoluteError value on hold-out data: 0.04917803406715393
Epoch: 82
Loss on hold-out set: 0.0008546631434001029
MeanAbsoluteError value on hold-out data: 0.024716828018426895
Epoch: 83
```

```
Loss on hold-out set: 0.003988343024892467
MeanAbsoluteError value on hold-out data: 0.060641419142484665
Epoch: 84

Loss on hold-out set: 0.00027032613849899335
MeanAbsoluteError value on hold-out data: 0.012980149127542973
Epoch: 85
Loss on hold-out set: 0.0024531884617837413
MeanAbsoluteError value on hold-out data: 0.04688497632741928
Epoch: 86

Loss on hold-out set: 0.0021187039092183113
MeanAbsoluteError value on hold-out data: 0.03979026898741722
Epoch: 87
Loss on hold-out set: 0.0007014723128772207
MeanAbsoluteError value on hold-out data: 0.02297261171042919
Epoch: 88

Loss on hold-out set: 0.0043581262164350066
MeanAbsoluteError value on hold-out data: 0.06395091116428375
Epoch: 89
Loss on hold-out set: 0.007263329478779009
MeanAbsoluteError value on hold-out data: 0.08084174990653992
Epoch: 90
Loss on hold-out set: 0.000255884461304439
MeanAbsoluteError value on hold-out data: 0.013970721513032913
Epoch: 91

Loss on hold-out set: 0.0013125763008637087
MeanAbsoluteError value on hold-out data: 0.034868549555540085
Epoch: 92
Loss on hold-out set: 0.0018960423434951476
MeanAbsoluteError value on hold-out data: 0.03592858836054802
Epoch: 93

Loss on hold-out set: 0.0016258680511132947
MeanAbsoluteError value on hold-out data: 0.03388945758342743
Epoch: 94
Loss on hold-out set: 0.0019359925562249763
MeanAbsoluteError value on hold-out data: 0.03737907484173775
Epoch: 95
```

```
Loss on hold-out set: 0.0036214532530201332
MeanAbsoluteError value on hold-out data: 0.0524483285844326
Epoch: 96
Loss on hold-out set: 0.0005199141118542425
MeanAbsoluteError value on hold-out data: 0.018959539011120796
Epoch: 97
Loss on hold-out set: 0.00044785813744446
MeanAbsoluteError value on hold-out data: 0.017644869163632393
Epoch: 98

Loss on hold-out set: 0.003224152173580868
MeanAbsoluteError value on hold-out data: 0.049372974783182144
Epoch: 99
Loss on hold-out set: 0.0006169664515514991
MeanAbsoluteError value on hold-out data: 0.021656641736626625
Epoch: 100

Loss on hold-out set: 0.00684427998826972
MeanAbsoluteError value on hold-out data: 0.07742352783679962
Epoch: 101
Loss on hold-out set: 0.004237750511882561
MeanAbsoluteError value on hold-out data: 0.058291591703891754
Epoch: 102

Loss on hold-out set: 0.0002905744394021375
MeanAbsoluteError value on hold-out data: 0.014938585460186005
Epoch: 103
Loss on hold-out set: 0.009700357248740537
MeanAbsoluteError value on hold-out data: 0.09383637458086014
Epoch: 104
Loss on hold-out set: 0.002586015500128269
MeanAbsoluteError value on hold-out data: 0.04446568340063095
Epoch: 105

Loss on hold-out set: 0.002811403579211661
MeanAbsoluteError value on hold-out data: 0.04821218177676201
Epoch: 106
Loss on hold-out set: 0.004513146522055779
MeanAbsoluteError value on hold-out data: 0.059387680143117905
Epoch: 107
```

```
Loss on hold-out set: 0.0016231662760089552
MeanAbsoluteError value on hold-out data: 0.03509664162993431
Epoch: 108
Loss on hold-out set: 6.837518958491273e-05
MeanAbsoluteError value on hold-out data: 0.006442576181143522
Epoch: 109

Loss on hold-out set: 0.00044261838775128126
MeanAbsoluteError value on hold-out data: 0.018704192712903023
Epoch: 110
Loss on hold-out set: 0.003623001610061952
MeanAbsoluteError value on hold-out data: 0.055657561868429184
Epoch: 111
Loss on hold-out set: 0.002528779740844454
MeanAbsoluteError value on hold-out data: 0.04832036793231964
Epoch: 112

Loss on hold-out set: 0.004337594378739595
MeanAbsoluteError value on hold-out data: 0.060811132192611694
Epoch: 113
Loss on hold-out set: 0.0020177633435066256
MeanAbsoluteError value on hold-out data: 0.037549544125795364
Epoch: 114

Loss on hold-out set: 0.0018496481768254722
MeanAbsoluteError value on hold-out data: 0.03582156077027321
Epoch: 115
Loss on hold-out set: 0.0016032465833372303
MeanAbsoluteError value on hold-out data: 0.03783171996474266
Epoch: 116

Loss on hold-out set: 0.0014047471340745687
MeanAbsoluteError value on hold-out data: 0.036010924726724625
Epoch: 117
Loss on hold-out set: 0.002372727746010891
MeanAbsoluteError value on hold-out data: 0.04807918146252632
Epoch: 118
Loss on hold-out set: 0.0008443183781179998
MeanAbsoluteError value on hold-out data: 0.02412501722574234
Epoch: 119
```

```
Loss on hold-out set: 0.003098742204851338
MeanAbsoluteError value on hold-out data: 0.049113284796476364
Epoch: 120
Loss on hold-out set: 0.0007360723476657378
MeanAbsoluteError value on hold-out data: 0.022997748106718063
Epoch: 121

Loss on hold-out set: 0.0038045165461621116
MeanAbsoluteError value on hold-out data: 0.051698241382837296
Epoch: 122
Loss on hold-out set: 0.0005898938314723117
MeanAbsoluteError value on hold-out data: 0.022418586537241936
Epoch: 123

Loss on hold-out set: 0.001539887527802161
MeanAbsoluteError value on hold-out data: 0.0374184213578701
Epoch: 124
Loss on hold-out set: 0.003062504277165447
MeanAbsoluteError value on hold-out data: 0.053395748138427734
Epoch: 125
Loss on hold-out set: 0.0008165457360779069
MeanAbsoluteError value on hold-out data: 0.02580832503736019
Epoch: 126

Loss on hold-out set: 0.002517837432346174
MeanAbsoluteError value on hold-out data: 0.04576485976576805
Epoch: 127
Loss on hold-out set: 0.002584744444383042
MeanAbsoluteError value on hold-out data: 0.04089824855327606
Epoch: 128

Loss on hold-out set: 0.0009791855783467846
MeanAbsoluteError value on hold-out data: 0.028928766027092934
Epoch: 129
Loss on hold-out set: 0.001882970133530242
MeanAbsoluteError value on hold-out data: 0.040326524525880814
Epoch: 130

Loss on hold-out set: 0.0013123886726264442
MeanAbsoluteError value on hold-out data: 0.032308053225278854
Epoch: 131
```

```
Loss on hold-out set: 0.00048114595535610406
MeanAbsoluteError value on hold-out data: 0.01934809423983097
Epoch: 132
Loss on hold-out set: 0.0004414404226866152
MeanAbsoluteError value on hold-out data: 0.019601989537477493
Epoch: 133

Loss on hold-out set: 0.0023597265992845807
MeanAbsoluteError value on hold-out data: 0.03994756564497948
Epoch: 134
Loss on hold-out set: 0.00044519739458337426
MeanAbsoluteError value on hold-out data: 0.017370129004120827
Epoch: 135

Loss on hold-out set: 0.0003607853390609047
MeanAbsoluteError value on hold-out data: 0.01648571901023388
Epoch: 136
Loss on hold-out set: 0.0007262502081825265
MeanAbsoluteError value on hold-out data: 0.02431982010602951
Epoch: 137

Loss on hold-out set: 0.0005055218976589718
MeanAbsoluteError value on hold-out data: 0.01703309267759323
Epoch: 138
Loss on hold-out set: 0.0030278608069888185
MeanAbsoluteError value on hold-out data: 0.04906047508120537
Epoch: 139
Loss on hold-out set: 0.00010728594030037389
MeanAbsoluteError value on hold-out data: 0.007675488013774157
Epoch: 140

Loss on hold-out set: 0.0008682878313785684
MeanAbsoluteError value on hold-out data: 0.02641034685075283
Epoch: 141
Loss on hold-out set: 0.0021480843923719867
MeanAbsoluteError value on hold-out data: 0.044411249458789825
Epoch: 142

Loss on hold-out set: 0.00034313276825871853
MeanAbsoluteError value on hold-out data: 0.016873616725206375
Epoch: 143
```

```
Loss on hold-out set: 0.016753442053283964
MeanAbsoluteError value on hold-out data: 0.10004540532827377
Epoch: 144

Loss on hold-out set: 0.0015420818817801774
MeanAbsoluteError value on hold-out data: 0.030568959191441536
Epoch: 145
Loss on hold-out set: 0.00011423310102795117
MeanAbsoluteError value on hold-out data: 0.008928876370191574
Epoch: 146
Loss on hold-out set: 0.002950001840612718
MeanAbsoluteError value on hold-out data: 0.04273908585309982
Epoch: 147

Loss on hold-out set: 0.003307519281016929
MeanAbsoluteError value on hold-out data: 0.05745952948927879
Epoch: 148
Loss on hold-out set: 0.00043015796732756177
MeanAbsoluteError value on hold-out data: 0.014783023856580257
Epoch: 149

Loss on hold-out set: 0.012257809484643596
MeanAbsoluteError value on hold-out data: 0.1024349182844162
Epoch: 150
Loss on hold-out set: 0.002609019467074956
MeanAbsoluteError value on hold-out data: 0.04969044029712677
Epoch: 151

Loss on hold-out set: 0.0029287773982754777
MeanAbsoluteError value on hold-out data: 0.0529036708176136
Epoch: 152
Loss on hold-out set: 0.0022720990236848593
MeanAbsoluteError value on hold-out data: 0.04640131816267967
Epoch: 153
Loss on hold-out set: 0.0005842437302427632
MeanAbsoluteError value on hold-out data: 0.020630095154047012
Epoch: 154

Loss on hold-out set: 0.0010298418679407664
MeanAbsoluteError value on hold-out data: 0.026950230821967125
Epoch: 155
```

```
Loss on hold-out set: 0.0010649564626094485
MeanAbsoluteError value on hold-out data: 0.03005564771592617
Epoch: 156

Loss on hold-out set: 0.0005289074573998473
MeanAbsoluteError value on hold-out data: 0.021575039252638817
Epoch: 157
Loss on hold-out set: 0.0011238298445407832
MeanAbsoluteError value on hold-out data: 0.029164621606469154
Epoch: 158

Loss on hold-out set: 0.0007587866940801698
MeanAbsoluteError value on hold-out data: 0.022770285606384277
Epoch: 159
Loss on hold-out set: 0.0011599898654302315
MeanAbsoluteError value on hold-out data: 0.03311730921268463
Epoch: 160
Loss on hold-out set: 0.005539391788520983
MeanAbsoluteError value on hold-out data: 0.06504813581705093
Epoch: 161

Loss on hold-out set: 0.0027284169503088507
MeanAbsoluteError value on hold-out data: 0.049497995525598526
Epoch: 162
Loss on hold-out set: 0.0006872756930533797
MeanAbsoluteError value on hold-out data: 0.022610630840063095
Epoch: 163

Loss on hold-out set: 0.00014498926793748979
MeanAbsoluteError value on hold-out data: 0.009752234444022179
Epoch: 164
Loss on hold-out set: 0.0015776134678162634
MeanAbsoluteError value on hold-out data: 0.03019210323691368
Epoch: 165

Loss on hold-out set: 0.00034941469909556745
MeanAbsoluteError value on hold-out data: 0.017516331747174263
Epoch: 166
Loss on hold-out set: 0.0017988806856530054
MeanAbsoluteError value on hold-out data: 0.04041542112827301
Epoch: 167
```

```
Loss on hold-out set: 0.002803573534557862
MeanAbsoluteError value on hold-out data: 0.0432584173977375
Epoch: 168

Loss on hold-out set: 8.176139817805961e-05
MeanAbsoluteError value on hold-out data: 0.006809933111071587
Epoch: 169
Loss on hold-out set: 0.0041816803028008765
MeanAbsoluteError value on hold-out data: 0.0634380504488945
Epoch: 170

Loss on hold-out set: 0.005684369310204472
MeanAbsoluteError value on hold-out data: 0.07277024537324905
Epoch: 171
Loss on hold-out set: 0.0010410766533043767
MeanAbsoluteError value on hold-out data: 0.02817021869122982
Epoch: 172

Loss on hold-out set: 0.0016678726034505026
MeanAbsoluteError value on hold-out data: 0.036071937531232834
Epoch: 173
Loss on hold-out set: 0.0006410851534123399
MeanAbsoluteError value on hold-out data: 0.020533867180347443
Epoch: 174
Loss on hold-out set: 0.0006102047378330358
MeanAbsoluteError value on hold-out data: 0.021680885925889015
Epoch: 175

Loss on hold-out set: 0.006319582329264709
MeanAbsoluteError value on hold-out data: 0.07208888232707977
Epoch: 176
Loss on hold-out set: 0.0026858082772897823
MeanAbsoluteError value on hold-out data: 0.04991433769464493
Epoch: 177

Loss on hold-out set: 0.001426599595496165
MeanAbsoluteError value on hold-out data: 0.03433683514595032
Epoch: 178
Loss on hold-out set: 0.0003184024618738996
MeanAbsoluteError value on hold-out data: 0.015270126052200794
Epoch: 179
```

```
Loss on hold-out set: 0.00203189774349864
MeanAbsoluteError value on hold-out data: 0.0441545806825161
Epoch: 180
Loss on hold-out set: 0.008161071089229413
MeanAbsoluteError value on hold-out data: 0.08433301746845245
Epoch: 181
Loss on hold-out set: 0.0015380321336644037
MeanAbsoluteError value on hold-out data: 0.02872598171234131
Epoch: 182

Loss on hold-out set: 0.00027942996114558937
MeanAbsoluteError value on hold-out data: 0.013291170820593834
Epoch: 183
Loss on hold-out set: 0.00447686984469848
MeanAbsoluteError value on hold-out data: 0.0646350234746933
Epoch: 184

Loss on hold-out set: 0.0002948939290945418
MeanAbsoluteError value on hold-out data: 0.015115146525204182
Epoch: 185
Loss on hold-out set: 0.003743270561764283
MeanAbsoluteError value on hold-out data: 0.05416441336274147
Epoch: 186

Loss on hold-out set: 0.0002869375935655886
MeanAbsoluteError value on hold-out data: 0.013950174674391747
Epoch: 187
Loss on hold-out set: 0.0015390630079699413
MeanAbsoluteError value on hold-out data: 0.03789331763982773
Epoch: 188
Loss on hold-out set: 0.005274215713143349
MeanAbsoluteError value on hold-out data: 0.06827367842197418
Epoch: 189

Loss on hold-out set: 0.00412148712868137
MeanAbsoluteError value on hold-out data: 0.05533938854932785
Epoch: 190
Loss on hold-out set: 0.0015306756499090365
MeanAbsoluteError value on hold-out data: 0.03545574098825455
Epoch: 191
```

```
Loss on hold-out set: 0.0021396218799054623
MeanAbsoluteError value on hold-out data: 0.043894752860069275
Epoch: 192
Loss on hold-out set: 0.0015783449135986821
MeanAbsoluteError value on hold-out data: 0.03831979259848595
Epoch: 193

Loss on hold-out set: 0.0007885609936368253
MeanAbsoluteError value on hold-out data: 0.022834504023194313
Epoch: 194
Loss on hold-out set: 0.0001876609811526058
MeanAbsoluteError value on hold-out data: 0.011331222951412201
Epoch: 195
Loss on hold-out set: 0.0036223111674189568
MeanAbsoluteError value on hold-out data: 0.050489526242017746
Epoch: 196

Loss on hold-out set: 0.00017906230745471215
MeanAbsoluteError value on hold-out data: 0.011523489840328693
Epoch: 197
Loss on hold-out set: 0.00043321913108229637
MeanAbsoluteError value on hold-out data: 0.018992627039551735
Epoch: 198

Loss on hold-out set: 0.0017233647106747543
MeanAbsoluteError value on hold-out data: 0.03835291787981987
Epoch: 199
Loss on hold-out set: 0.00216180195898882
MeanAbsoluteError value on hold-out data: 0.044513363391160965
Epoch: 200

Loss on hold-out set: 0.0011918970350442188
MeanAbsoluteError value on hold-out data: 0.026841454207897186
Epoch: 201
Loss on hold-out set: 0.0034560188983700107
MeanAbsoluteError value on hold-out data: 0.05303322151303291
Epoch: 202
Loss on hold-out set: 0.0005300250029124852
MeanAbsoluteError value on hold-out data: 0.020877335220575333
Epoch: 203
```

```
Loss on hold-out set: 0.0005643701546692423
MeanAbsoluteError value on hold-out data: 0.020399803295731544
Epoch: 204
Loss on hold-out set: 0.0022109986914853963
MeanAbsoluteError value on hold-out data: 0.04121401906013489
Epoch: 205

Loss on hold-out set: 0.0031429286380963667
MeanAbsoluteError value on hold-out data: 0.054922331124544144
Epoch: 206
Loss on hold-out set: 0.0035686990179653677
MeanAbsoluteError value on hold-out data: 0.051032792776823044
Epoch: 207

Loss on hold-out set: 0.0016046173903825028
MeanAbsoluteError value on hold-out data: 0.03208246827125549
Epoch: 208
Loss on hold-out set: 0.0036965168214270045
MeanAbsoluteError value on hold-out data: 0.05840003117918968
Epoch: 209
Loss on hold-out set: 0.002292497150067772
MeanAbsoluteError value on hold-out data: 0.046879205852746964
Epoch: 210

Loss on hold-out set: 0.007784886751323938
MeanAbsoluteError value on hold-out data: 0.08693704754114151
Epoch: 211
Loss on hold-out set: 0.0007085945274281714
MeanAbsoluteError value on hold-out data: 0.025044715031981468
Epoch: 212

Loss on hold-out set: 0.004240953629570348
MeanAbsoluteError value on hold-out data: 0.06453700363636017
Epoch: 213
Loss on hold-out set: 0.0006905721841446523
MeanAbsoluteError value on hold-out data: 0.02240782231092453
Epoch: 214

Loss on hold-out set: 0.005921503861567804
MeanAbsoluteError value on hold-out data: 0.058484479784965515
Epoch: 215
```

```
Loss on hold-out set: 0.007381289731711149
MeanAbsoluteError value on hold-out data: 0.06435792148113251
Epoch: 216
Loss on hold-out set: 0.004656093760526606
MeanAbsoluteError value on hold-out data: 0.05981405824422836
Epoch: 217

Loss on hold-out set: 0.009140834012734038
MeanAbsoluteError value on hold-out data: 0.08208870142698288
Epoch: 218
Loss on hold-out set: 0.0014033226096736534
MeanAbsoluteError value on hold-out data: 0.02994951233267784
Epoch: 219

Loss on hold-out set: 0.00841196978996907
MeanAbsoluteError value on hold-out data: 0.0688072070479393
Epoch: 220
Loss on hold-out set: 0.001608750903480021
MeanAbsoluteError value on hold-out data: 0.03370751813054085
Epoch: 221

Loss on hold-out set: 0.00017322927098056034
MeanAbsoluteError value on hold-out data: 0.011216726154088974
Epoch: 222
Loss on hold-out set: 0.0030861621988671167
MeanAbsoluteError value on hold-out data: 0.05483676865696907
Epoch: 223
Loss on hold-out set: 0.0010928811887944384
MeanAbsoluteError value on hold-out data: 0.0255816001445055
Epoch: 224

Loss on hold-out set: 0.0011077375300893827
MeanAbsoluteError value on hold-out data: 0.0319865420460701
Epoch: 225
Loss on hold-out set: 0.0004734509961313701
MeanAbsoluteError value on hold-out data: 0.01987048052251339
Epoch: 226

Loss on hold-out set: 0.0007534610922448337
MeanAbsoluteError value on hold-out data: 0.02323152869939804
Epoch: 227
```

```
Loss on hold-out set: 0.0024928494822233915
MeanAbsoluteError value on hold-out data: 0.04762747883796692
Epoch: 228

Loss on hold-out set: 0.0009150200224082385
MeanAbsoluteError value on hold-out data: 0.025342652574181557
Epoch: 229
Loss on hold-out set: 0.00013418394311364473
MeanAbsoluteError value on hold-out data: 0.009780415333807468
Epoch: 230
Loss on hold-out set: 0.0016774522456606583
MeanAbsoluteError value on hold-out data: 0.03830639272928238
Epoch: 231

Loss on hold-out set: 0.007595736333834273
MeanAbsoluteError value on hold-out data: 0.07489932328462601
Epoch: 232
Loss on hold-out set: 0.0035631307234455433
MeanAbsoluteError value on hold-out data: 0.04145288094878197
Epoch: 233

Loss on hold-out set: 0.005201347804229174
MeanAbsoluteError value on hold-out data: 0.05984779819846153
Epoch: 234
Loss on hold-out set: 0.0027624195541388224
MeanAbsoluteError value on hold-out data: 0.04377107694745064
Epoch: 235

Loss on hold-out set: 0.0020738281475912246
MeanAbsoluteError value on hold-out data: 0.04407824948430061
Epoch: 236
Loss on hold-out set: 0.0013020648122099893
MeanAbsoluteError value on hold-out data: 0.030273709446191788
Early stopping at epoch 235
Fold: 2
Epoch: 1
Loss on hold-out set: 0.016272499758218015
MeanAbsoluteError value on hold-out data: 0.1033690944314003
Epoch: 2
```

```
Loss on hold-out set: 0.02308406454644033
MeanAbsoluteError value on hold-out data: 0.10953335464000702
Epoch: 3
Loss on hold-out set: 0.04117264811481748
MeanAbsoluteError value on hold-out data: 0.18150392174720764
Epoch: 4

Loss on hold-out set: 0.00730580510571599
MeanAbsoluteError value on hold-out data: 0.06103996932506561
Epoch: 5
Loss on hold-out set: 0.019949580010558878
MeanAbsoluteError value on hold-out data: 0.12382546067237854
Epoch: 6

Loss on hold-out set: 0.004494727722236088
MeanAbsoluteError value on hold-out data: 0.05681869015097618
Epoch: 7
Loss on hold-out set: 0.07254937823329653
MeanAbsoluteError value on hold-out data: 0.26671943068504333
Epoch: 8
Loss on hold-out set: 0.03722128538148744
MeanAbsoluteError value on hold-out data: 0.16820579767227173
Epoch: 9

Loss on hold-out set: 0.007299731751637799
MeanAbsoluteError value on hold-out data: 0.06640680134296417
Epoch: 10
Loss on hold-out set: 0.007328339519777468
MeanAbsoluteError value on hold-out data: 0.08075080811977386
Epoch: 11

Loss on hold-out set: 0.005624608968251518
MeanAbsoluteError value on hold-out data: 0.058783650398254395
Epoch: 12
Loss on hold-out set: 0.007547112913536174
MeanAbsoluteError value on hold-out data: 0.075757697224617
Epoch: 13

Loss on hold-out set: 0.002132530224376491
MeanAbsoluteError value on hold-out data: 0.03650568425655365
Epoch: 14
```

```
Loss on hold-out set: 0.004709040413477591
MeanAbsoluteError value on hold-out data: 0.055141206830739975
Epoch: 15
Loss on hold-out set: 0.008319401514849492
MeanAbsoluteError value on hold-out data: 0.08335120975971222
Epoch: 16

Loss on hold-out set: 0.020903600912008966
MeanAbsoluteError value on hold-out data: 0.13946586847305298
Epoch: 17
Loss on hold-out set: 0.01766694669744798
MeanAbsoluteError value on hold-out data: 0.12997326254844666
Epoch: 18

Loss on hold-out set: 0.0018265827924811415
MeanAbsoluteError value on hold-out data: 0.034854136407375336
Epoch: 19
Loss on hold-out set: 0.017531574038522586
MeanAbsoluteError value on hold-out data: 0.1174481213092804
Epoch: 20

Loss on hold-out set: 0.0010515074786131404
MeanAbsoluteError value on hold-out data: 0.024005627259612083
Epoch: 21
Loss on hold-out set: 0.0023688367967094693
MeanAbsoluteError value on hold-out data: 0.04430462419986725
Epoch: 22
Loss on hold-out set: 0.0010748863403153206
MeanAbsoluteError value on hold-out data: 0.027691569179296494
Epoch: 23

Loss on hold-out set: 0.00574285164475441
MeanAbsoluteError value on hold-out data: 0.06714120507240295
Epoch: 24
Loss on hold-out set: 0.008198576513677835
MeanAbsoluteError value on hold-out data: 0.08310184627771378
Epoch: 25

Loss on hold-out set: 0.012386206271392959
MeanAbsoluteError value on hold-out data: 0.10764346271753311
Epoch: 26
```

```
Loss on hold-out set: 0.014259082930428641
MeanAbsoluteError value on hold-out data: 0.11776930838823318
Epoch: 27

Loss on hold-out set: 0.007456779746072633
MeanAbsoluteError value on hold-out data: 0.08487242460250854
Epoch: 28
Loss on hold-out set: 0.002341112870323871
MeanAbsoluteError value on hold-out data: 0.0432545505464077
Epoch: 29
Loss on hold-out set: 0.010806851089000702
MeanAbsoluteError value on hold-out data: 0.10076957941055298
Epoch: 30

Loss on hold-out set: 0.0027959589414032443
MeanAbsoluteError value on hold-out data: 0.03973209112882614
Epoch: 31
Loss on hold-out set: 0.000623342938654657
MeanAbsoluteError value on hold-out data: 0.02022884041070938
Epoch: 32

Loss on hold-out set: 0.00034208223223686622
MeanAbsoluteError value on hold-out data: 0.0139009365811944
Epoch: 33
Loss on hold-out set: 0.0027746445765452726
MeanAbsoluteError value on hold-out data: 0.04805342108011246
Epoch: 34

Loss on hold-out set: 0.00039766458004513349
MeanAbsoluteError value on hold-out data: 0.016867201775312424
Epoch: 35
Loss on hold-out set: 0.001592465875936406
MeanAbsoluteError value on hold-out data: 0.03359740599989891
Epoch: 36
Loss on hold-out set: 0.0011107751384510525
MeanAbsoluteError value on hold-out data: 0.028107840567827225
Epoch: 37

Loss on hold-out set: 0.0010852907351883395
MeanAbsoluteError value on hold-out data: 0.02791757509112358
Epoch: 38
```

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Loss on hold-out set: 0.00271271588280797
MeanAbsoluteError value on hold-out data: 0.04416373372077942
Epoch: 39

Loss on hold-out set: 0.010061539909137147
MeanAbsoluteError value on hold-out data: 0.09924539923667908
Epoch: 40
Loss on hold-out set: 0.0067678906156548434
MeanAbsoluteError value on hold-out data: 0.07649549096822739
Epoch: 41

Loss on hold-out set: 0.0050597419030964375
MeanAbsoluteError value on hold-out data: 0.06505419313907623
Epoch: 42
Loss on hold-out set: 0.007479534883584295
MeanAbsoluteError value on hold-out data: 0.08339415490627289
Epoch: 43
Loss on hold-out set: 0.0023676404796008554
MeanAbsoluteError value on hold-out data: 0.040567632764577866
Epoch: 44

Loss on hold-out set: 0.005091044852244002
MeanAbsoluteError value on hold-out data: 0.06795480102300644
Epoch: 45
Loss on hold-out set: 0.0019401659124663898
MeanAbsoluteError value on hold-out data: 0.03547688573598862
Epoch: 46

Loss on hold-out set: 0.00216099081028785
MeanAbsoluteError value on hold-out data: 0.0407114140689373
Epoch: 47
Loss on hold-out set: 0.0008500546433164605
MeanAbsoluteError value on hold-out data: 0.026109352707862854
Epoch: 48

Loss on hold-out set: 0.0017645866111186998
MeanAbsoluteError value on hold-out data: 0.039046913385391235
Epoch: 49
Loss on hold-out set: 0.009740399063697882
MeanAbsoluteError value on hold-out data: 0.09429263323545456
Epoch: 50
```

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Loss on hold-out set: 0.00016276755923172466
MeanAbsoluteError value on hold-out data: 0.010501192882657051
Epoch: 51

Loss on hold-out set: 0.0015365615420575654
MeanAbsoluteError value on hold-out data: 0.031193923205137253
Epoch: 52
Loss on hold-out set: 0.005710073946309941
MeanAbsoluteError value on hold-out data: 0.07123827189207077
Epoch: 53

Loss on hold-out set: 0.004811061679252556
MeanAbsoluteError value on hold-out data: 0.06509965658187866
Epoch: 54
Loss on hold-out set: 0.010278262064925261
MeanAbsoluteError value on hold-out data: 0.07746836543083191
Epoch: 55

Loss on hold-out set: 0.003243518028674381
MeanAbsoluteError value on hold-out data: 0.04684091731905937
Epoch: 56
Loss on hold-out set: 0.004865269376231092
MeanAbsoluteError value on hold-out data: 0.0659710243344307
Epoch: 57
Loss on hold-out set: 0.017780738483582224
MeanAbsoluteError value on hold-out data: 0.1320318728685379
Epoch: 58

Loss on hold-out set: 0.003061292925849557
MeanAbsoluteError value on hold-out data: 0.04901851341128349
Epoch: 59
Loss on hold-out set: 0.0066495706726397786
MeanAbsoluteError value on hold-out data: 0.0656738355755806
Epoch: 60

Loss on hold-out set: 0.007402737026235887
MeanAbsoluteError value on hold-out data: 0.08393560349941254
Epoch: 61
Loss on hold-out set: 0.004715333825775555
MeanAbsoluteError value on hold-out data: 0.05643589794635773
Epoch: 62
```

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Loss on hold-out set: 0.0007911636535676994
MeanAbsoluteError value on hold-out data: 0.02444317564368248
Epoch: 63
Loss on hold-out set: 0.00011225962173609463
MeanAbsoluteError value on hold-out data: 0.00838166568428278
Epoch: 64
Loss on hold-out set: 0.0003726097222949777
MeanAbsoluteError value on hold-out data: 0.016764145344495773
Epoch: 65

Loss on hold-out set: 0.014808725166533674
MeanAbsoluteError value on hold-out data: 0.10783177614212036
Epoch: 66
Loss on hold-out set: 0.0018058879816505527
MeanAbsoluteError value on hold-out data: 0.03324528783559799
Epoch: 67

Loss on hold-out set: 0.001440729363821447
MeanAbsoluteError value on hold-out data: 0.033276546746492386
Epoch: 68
Loss on hold-out set: 0.005567891656288079
MeanAbsoluteError value on hold-out data: 0.07175184041261673
Epoch: 69

Loss on hold-out set: 0.0012635279895870813
MeanAbsoluteError value on hold-out data: 0.03263350948691368
Epoch: 70
Loss on hold-out set: 0.02235365313078676
MeanAbsoluteError value on hold-out data: 0.132416769862175
Epoch: 71
Loss on hold-out set: 0.001327115177576031
MeanAbsoluteError value on hold-out data: 0.0282258503139019
Epoch: 72

Loss on hold-out set: 0.0011367018450982869
MeanAbsoluteError value on hold-out data: 0.02985691837966442
Epoch: 73
Loss on hold-out set: 0.0013120932271704078
MeanAbsoluteError value on hold-out data: 0.030779356136918068
Epoch: 74
```

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Loss on hold-out set: 0.0034245551297707216
MeanAbsoluteError value on hold-out data: 0.05635259300470352
Epoch: 75
Loss on hold-out set: 0.00011961268787022814
MeanAbsoluteError value on hold-out data: 0.00842073280364275
Epoch: 76

Loss on hold-out set: 0.004276809415646962
MeanAbsoluteError value on hold-out data: 0.06341283023357391
Epoch: 77
Loss on hold-out set: 0.002025808606828962
MeanAbsoluteError value on hold-out data: 0.035807233303785324
Epoch: 78
Loss on hold-out set: 0.004258363341380443
MeanAbsoluteError value on hold-out data: 0.05400249361991882
Epoch: 79

Loss on hold-out set: 0.001540204044431448
MeanAbsoluteError value on hold-out data: 0.03763441741466522
Epoch: 80
Loss on hold-out set: 0.001607796094114227
MeanAbsoluteError value on hold-out data: 0.03464575856924057
Epoch: 81

Loss on hold-out set: 0.004514495276712945
MeanAbsoluteError value on hold-out data: 0.06523516774177551
Epoch: 82
Loss on hold-out set: 0.0001858121675987994
MeanAbsoluteError value on hold-out data: 0.010217909701168537
Epoch: 83

Loss on hold-out set: 0.002129605472353952
MeanAbsoluteError value on hold-out data: 0.03636924922466278
Epoch: 84
Loss on hold-out set: 0.0006313295244971025
MeanAbsoluteError value on hold-out data: 0.021167593076825142
Epoch: 85
Loss on hold-out set: 0.005110454531469648
MeanAbsoluteError value on hold-out data: 0.058130521327257156
Epoch: 86
```

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Loss on hold-out set: 0.00308632428225662
MeanAbsoluteError value on hold-out data: 0.042607687413692474
Epoch: 87
Loss on hold-out set: 0.0030096457672438453
MeanAbsoluteError value on hold-out data: 0.05417082831263542
Epoch: 88

Loss on hold-out set: 0.004654444354985442
MeanAbsoluteError value on hold-out data: 0.06689967215061188
Epoch: 89
Loss on hold-out set: 0.00023829536387763386
MeanAbsoluteError value on hold-out data: 0.01402297057211399
Epoch: 90

Loss on hold-out set: 0.009879200852343015
MeanAbsoluteError value on hold-out data: 0.09333671629428864
Epoch: 91
Loss on hold-out set: 0.00031111644680744836
MeanAbsoluteError value on hold-out data: 0.015655843541026115
Epoch: 92
Loss on hold-out set: 0.0013092124635087593
MeanAbsoluteError value on hold-out data: 0.0311422161757946
Epoch: 93

Loss on hold-out set: 0.0009397156619732934
MeanAbsoluteError value on hold-out data: 0.028292443603277206
Epoch: 94
Loss on hold-out set: 0.002474479177700622
MeanAbsoluteError value on hold-out data: 0.04442012682557106
Epoch: 95

Loss on hold-out set: 0.0001929353831136333
MeanAbsoluteError value on hold-out data: 0.010084884241223335
Epoch: 96
Loss on hold-out set: 0.001401347274492894
MeanAbsoluteError value on hold-out data: 0.03296278789639473
Epoch: 97

Loss on hold-out set: 0.0023793622219402876
MeanAbsoluteError value on hold-out data: 0.039562828838825226
Epoch: 98
```

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Loss on hold-out set: 0.0010805310531785445
MeanAbsoluteError value on hold-out data: 0.030145516619086266
Epoch: 99
Loss on hold-out set: 0.006260655986677323
MeanAbsoluteError value on hold-out data: 0.06647975742816925
Epoch: 100

Loss on hold-out set: 0.00505779217928648
MeanAbsoluteError value on hold-out data: 0.05424089357256889
Epoch: 101
Loss on hold-out set: 0.0015917149721644819
MeanAbsoluteError value on hold-out data: 0.03659197315573692
Epoch: 102

Loss on hold-out set: 0.0001570998439482147
MeanAbsoluteError value on hold-out data: 0.009901100769639015
Epoch: 103
Loss on hold-out set: 0.00025704696184090735
MeanAbsoluteError value on hold-out data: 0.013877231627702713
Epoch: 104

Loss on hold-out set: 0.0014483712646844132
MeanAbsoluteError value on hold-out data: 0.03501510247588158
Epoch: 105
Loss on hold-out set: 9.023672464536503e-05
MeanAbsoluteError value on hold-out data: 0.006661791820079088
Epoch: 106
Loss on hold-out set: 0.0030694604294175015
MeanAbsoluteError value on hold-out data: 0.044470928609371185
Epoch: 107

Loss on hold-out set: 0.001660547501939748
MeanAbsoluteError value on hold-out data: 0.03906097263097763
Epoch: 108
Loss on hold-out set: 0.0011941057247375803
MeanAbsoluteError value on hold-out data: 0.03250749409198761
Epoch: 109

Loss on hold-out set: 0.0006964392793763961
MeanAbsoluteError value on hold-out data: 0.02396598644554615
Epoch: 110
```

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Loss on hold-out set: 0.0013542022123666747
MeanAbsoluteError value on hold-out data: 0.033139489591121674
Epoch: 111

Loss on hold-out set: 0.0007431929615060133
MeanAbsoluteError value on hold-out data: 0.024173296988010406
Epoch: 112
Loss on hold-out set: 0.0003262256733640762
MeanAbsoluteError value on hold-out data: 0.015486901625990868
Epoch: 113
Loss on hold-out set: 0.003925984858402184
MeanAbsoluteError value on hold-out data: 0.06077732890844345
Epoch: 114

Loss on hold-out set: 0.00030718144677978543
MeanAbsoluteError value on hold-out data: 0.015364306978881359
Epoch: 115
Loss on hold-out set: 0.0021732394816353917
MeanAbsoluteError value on hold-out data: 0.04043187201023102
Epoch: 116

Loss on hold-out set: 0.0007863108268273729
MeanAbsoluteError value on hold-out data: 0.022448036819696426
Epoch: 117
Loss on hold-out set: 0.0016360146193099873
MeanAbsoluteError value on hold-out data: 0.03151611611247063
Epoch: 118

Loss on hold-out set: 0.0032989506144076586
MeanAbsoluteError value on hold-out data: 0.05508596822619438
Epoch: 119
Loss on hold-out set: 0.000480042995020215
MeanAbsoluteError value on hold-out data: 0.018459178507328033
Epoch: 120
Loss on hold-out set: 0.0020063212640317424
MeanAbsoluteError value on hold-out data: 0.042375560849905014
Epoch: 121

Loss on hold-out set: 0.00034640076669997403
MeanAbsoluteError value on hold-out data: 0.016044989228248596
Epoch: 122
```

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Loss on hold-out set: 0.0014058167497361346
MeanAbsoluteError value on hold-out data: 0.02976740151643753
Epoch: 123

Loss on hold-out set: 0.0002154249679214055
MeanAbsoluteError value on hold-out data: 0.009781046770513058
Epoch: 124
Loss on hold-out set: 0.004411335801705718
MeanAbsoluteError value on hold-out data: 0.055591125041246414
Epoch: 125

Loss on hold-out set: 0.0038041360343673398
MeanAbsoluteError value on hold-out data: 0.057716142386198044
Epoch: 126
Loss on hold-out set: 0.0018754411222679274
MeanAbsoluteError value on hold-out data: 0.03372034803032875
Epoch: 127
Loss on hold-out set: 0.006829331296363047
MeanAbsoluteError value on hold-out data: 0.07609342038631439
Epoch: 128

Loss on hold-out set: 0.0026325947671596494
MeanAbsoluteError value on hold-out data: 0.04901932179927826
Epoch: 129
Loss on hold-out set: 0.0012174004056890095
MeanAbsoluteError value on hold-out data: 0.03167486563324928
Epoch: 130

Loss on hold-out set: 0.005657640817974295
MeanAbsoluteError value on hold-out data: 0.055607642978429794
Epoch: 131
Loss on hold-out set: 0.0036768849074308363
MeanAbsoluteError value on hold-out data: 0.059093765914440155
Epoch: 132

Loss on hold-out set: 0.0006508170751788254
MeanAbsoluteError value on hold-out data: 0.023524779826402664
Epoch: 133
Loss on hold-out set: 0.0023533424994509134
MeanAbsoluteError value on hold-out data: 0.043161217123270035
Epoch: 134
```

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Loss on hold-out set: 0.00023679941244024252
MeanAbsoluteError value on hold-out data: 0.011071315966546535
Epoch: 135

Loss on hold-out set: 0.0014996759460440703
MeanAbsoluteError value on hold-out data: 0.030555732548236847
Epoch: 136
Loss on hold-out set: 0.00018149971375740797
MeanAbsoluteError value on hold-out data: 0.011245821602642536
Epoch: 137

Loss on hold-out set: 0.001253311040012964
MeanAbsoluteError value on hold-out data: 0.028772521764039993
Epoch: 138
Loss on hold-out set: 0.006495360783966524
MeanAbsoluteError value on hold-out data: 0.05604599416255951
Epoch: 139

Loss on hold-out set: 0.0011768593436240085
MeanAbsoluteError value on hold-out data: 0.028098292648792267
Epoch: 140
Loss on hold-out set: 0.0013754786091989704
MeanAbsoluteError value on hold-out data: 0.030087947845458984
Epoch: 141
Loss on hold-out set: 0.002861174538598529
MeanAbsoluteError value on hold-out data: 0.04921962693333626
Epoch: 142

Loss on hold-out set: 0.006448619666376284
MeanAbsoluteError value on hold-out data: 0.07953525334596634
Epoch: 143
Loss on hold-out set: 0.0007870086743163743
MeanAbsoluteError value on hold-out data: 0.023225216194987297
Epoch: 144

Loss on hold-out set: 0.0004956358212179371
MeanAbsoluteError value on hold-out data: 0.019395215436816216
Epoch: 145
Loss on hold-out set: 0.013169316841023309
MeanAbsoluteError value on hold-out data: 0.11291525512933731
Epoch: 146
```

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Loss on hold-out set: 0.008282752374985389
MeanAbsoluteError value on hold-out data: 0.08844266086816788
Epoch: 147
Loss on hold-out set: 0.00025384687926686766
MeanAbsoluteError value on hold-out data: 0.013506016694009304
Epoch: 148
Loss on hold-out set: 0.0009943927372140543
MeanAbsoluteError value on hold-out data: 0.03020698018372059
Epoch: 149

Loss on hold-out set: 0.0033922173481966767
MeanAbsoluteError value on hold-out data: 0.04869779199361801
Epoch: 150
Loss on hold-out set: 0.0002228412070378129
MeanAbsoluteError value on hold-out data: 0.012076723389327526
Epoch: 151

Loss on hold-out set: 0.0030147321771697272
MeanAbsoluteError value on hold-out data: 0.049403801560401917
Epoch: 152
Loss on hold-out set: 0.005861125320994428
MeanAbsoluteError value on hold-out data: 0.0709085613489151
Epoch: 153

Loss on hold-out set: 0.000690686670298289
MeanAbsoluteError value on hold-out data: 0.023583589121699333
Epoch: 154
Loss on hold-out set: 0.0005957359348290733
MeanAbsoluteError value on hold-out data: 0.021024463698267937
Epoch: 155
Loss on hold-out set: 0.00017622426691689595
MeanAbsoluteError value on hold-out data: 0.011447317898273468
Epoch: 156

Loss on hold-out set: 0.002708879000108157
MeanAbsoluteError value on hold-out data: 0.05132351815700531
Epoch: 157
Loss on hold-out set: 0.004843880954597678
MeanAbsoluteError value on hold-out data: 0.0666881874203682
Epoch: 158
```

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Loss on hold-out set: 0.0012153462074430926
MeanAbsoluteError value on hold-out data: 0.033193111419677734
Epoch: 159
Loss on hold-out set: 0.0013363614977736557
MeanAbsoluteError value on hold-out data: 0.03444679453969002
Epoch: 160

Loss on hold-out set: 0.0067979427985847
MeanAbsoluteError value on hold-out data: 0.07711127400398254
Epoch: 161
Loss on hold-out set: 0.0007647428096139006
MeanAbsoluteError value on hold-out data: 0.023608746007084846
Epoch: 162
Loss on hold-out set: 0.0008439849729516677
MeanAbsoluteError value on hold-out data: 0.023458190262317657
Epoch: 163

Loss on hold-out set: 0.00012465030470463847
MeanAbsoluteError value on hold-out data: 0.008611373603343964
Epoch: 164
Loss on hold-out set: 7.912203623813443e-05
MeanAbsoluteError value on hold-out data: 0.007266951724886894
Epoch: 165

Loss on hold-out set: 0.0005967890860379807
MeanAbsoluteError value on hold-out data: 0.021546676754951477
Epoch: 166
Loss on hold-out set: 0.0014030338165217213
MeanAbsoluteError value on hold-out data: 0.03612181544303894
Epoch: 167

Loss on hold-out set: 0.0011051834361361606
MeanAbsoluteError value on hold-out data: 0.03175213932991028
Epoch: 168
Loss on hold-out set: 0.008289739356509276
MeanAbsoluteError value on hold-out data: 0.08922068774700165
Epoch: 169
Loss on hold-out set: 0.0022755875418494853
MeanAbsoluteError value on hold-out data: 0.04321898892521858
Epoch: 170
```

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Loss on hold-out set: 0.0030589908960142304
MeanAbsoluteError value on hold-out data: 0.04794839024543762
Epoch: 171
Loss on hold-out set: 0.001982414479633527
MeanAbsoluteError value on hold-out data: 0.036668043583631516
Epoch: 172

Loss on hold-out set: 0.0002810055344265753
MeanAbsoluteError value on hold-out data: 0.015746204182505608
Epoch: 173
Loss on hold-out set: 0.0005068969247596604
MeanAbsoluteError value on hold-out data: 0.020683083683252335
Epoch: 174

Loss on hold-out set: 0.000977547697922481
MeanAbsoluteError value on hold-out data: 0.02790527604520321
Epoch: 175
Loss on hold-out set: 0.00021210025339054743
MeanAbsoluteError value on hold-out data: 0.013229558244347572
Epoch: 176
Loss on hold-out set: 0.0008720383422249662
MeanAbsoluteError value on hold-out data: 0.022739021107554436
Epoch: 177

Loss on hold-out set: 0.0022052647047010915
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Epoch: 178
Loss on hold-out set: 0.0013811145909130573
MeanAbsoluteError value on hold-out data: 0.03579152002930641
Epoch: 179

Loss on hold-out set: 0.0007162328526776816
MeanAbsoluteError value on hold-out data: 0.02390303835272789
Epoch: 180
Loss on hold-out set: 0.002421974886341819
MeanAbsoluteError value on hold-out data: 0.038425263017416
Epoch: 181

Loss on hold-out set: 0.0023090941997777137
MeanAbsoluteError value on hold-out data: 0.04570751264691353
Epoch: 182
```

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Loss on hold-out set: 0.00019222710346054685
MeanAbsoluteError value on hold-out data: 0.010271064005792141
Epoch: 183
Loss on hold-out set: 0.0035501756106636356
MeanAbsoluteError value on hold-out data: 0.058637041598558426
Epoch: 184

Loss on hold-out set: 0.001304686809557357
MeanAbsoluteError value on hold-out data: 0.03316045179963112
Epoch: 185
Loss on hold-out set: 0.0029661954447094884
MeanAbsoluteError value on hold-out data: 0.05105285346508026
Epoch: 186

Loss on hold-out set: 0.00013497446967189068
MeanAbsoluteError value on hold-out data: 0.009093117900192738
Epoch: 187
Loss on hold-out set: 0.00021092555627027260
MeanAbsoluteError value on hold-out data: 0.01130178477615118
Epoch: 188

Loss on hold-out set: 0.0037041376677474807
MeanAbsoluteError value on hold-out data: 0.05867652967572212
Epoch: 189
Loss on hold-out set: 0.0008601008531903582
MeanAbsoluteError value on hold-out data: 0.024652838706970215
Epoch: 190
Loss on hold-out set: 0.0006794132142593819
MeanAbsoluteError value on hold-out data: 0.023301906883716583
Epoch: 191

Loss on hold-out set: 0.000399617212159293
MeanAbsoluteError value on hold-out data: 0.01738152466714382
Epoch: 192
Loss on hold-out set: 0.010474945684628827
MeanAbsoluteError value on hold-out data: 0.08873774856328964
Epoch: 193

Loss on hold-out set: 0.0006937085750645825
MeanAbsoluteError value on hold-out data: 0.023751698434352875
Epoch: 194
```

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Loss on hold-out set: 0.0011153126335037605
MeanAbsoluteError value on hold-out data: 0.03146778419613838
Epoch: 195

Loss on hold-out set: 0.00045507187938450703
MeanAbsoluteError value on hold-out data: 0.01583537645637989
Epoch: 196
Loss on hold-out set: 0.0008300404962418335
MeanAbsoluteError value on hold-out data: 0.027281103655695915
Epoch: 197
Loss on hold-out set: 0.0029161073533552034
MeanAbsoluteError value on hold-out data: 0.04632069543004036
Epoch: 198

Loss on hold-out set: 0.0002811370255325788
MeanAbsoluteError value on hold-out data: 0.014746416360139847
Epoch: 199
Loss on hold-out set: 0.0009522995262938951
MeanAbsoluteError value on hold-out data: 0.028505608439445496
Epoch: 200

Loss on hold-out set: 0.0022745701717212796
MeanAbsoluteError value on hold-out data: 0.045352693647146225
Epoch: 201
Loss on hold-out set: 0.0007462501068532999
MeanAbsoluteError value on hold-out data: 0.023191921412944794
Epoch: 202

Loss on hold-out set: 0.0014305787792961513
MeanAbsoluteError value on hold-out data: 0.035994671285152435
Epoch: 203
Loss on hold-out set: 0.00011438646730052174
MeanAbsoluteError value on hold-out data: 0.007501027546823025
Epoch: 204
Loss on hold-out set: 0.00621520947398884
MeanAbsoluteError value on hold-out data: 0.07310006022453308
Epoch: 205

Loss on hold-out set: 0.005544600476111684
MeanAbsoluteError value on hold-out data: 0.06988759338855743
Epoch: 206
```

```
Loss on hold-out set: 0.0022452239146722214
MeanAbsoluteError value on hold-out data: 0.03772328794002533
Epoch: 207

Loss on hold-out set: 0.0006994392523275954
MeanAbsoluteError value on hold-out data: 0.024115554988384247
Epoch: 208
Loss on hold-out set: 0.000429907237828177
MeanAbsoluteError value on hold-out data: 0.017696058377623558
Epoch: 209

Loss on hold-out set: 0.0001366305971584682
MeanAbsoluteError value on hold-out data: 0.00953974574804306
Epoch: 210
Loss on hold-out set: 0.0007877967353644115
MeanAbsoluteError value on hold-out data: 0.02491157501935959
Epoch: 211
Loss on hold-out set: 0.00032555679458060434
MeanAbsoluteError value on hold-out data: 0.01416996493935585
Epoch: 212

Loss on hold-out set: 0.001358272141910025
MeanAbsoluteError value on hold-out data: 0.030428571626544
Epoch: 213
Loss on hold-out set: 0.0025742175722760813
MeanAbsoluteError value on hold-out data: 0.04963839426636696
Epoch: 214

Loss on hold-out set: 0.0003065218833009047
MeanAbsoluteError value on hold-out data: 0.015387973748147488
Epoch: 215
Loss on hold-out set: 0.00023353545111604035
MeanAbsoluteError value on hold-out data: 0.013487164862453938
Epoch: 216

Loss on hold-out set: 0.0013294120518756764
MeanAbsoluteError value on hold-out data: 0.03549272567033768
Epoch: 217
Loss on hold-out set: 0.00019415975215711763
MeanAbsoluteError value on hold-out data: 0.0112779401242733
Epoch: 218
```

```
Loss on hold-out set: 0.001884349771509213
MeanAbsoluteError value on hold-out data: 0.04167189076542854
Epoch: 219

Loss on hold-out set: 0.0004792206538175898
MeanAbsoluteError value on hold-out data: 0.02074122428894043
Epoch: 220
Loss on hold-out set: 0.00032090619788505137
MeanAbsoluteError value on hold-out data: 0.014478149823844433
Epoch: 221

Loss on hold-out set: 0.008463575371674128
MeanAbsoluteError value on hold-out data: 0.07631587237119675
Epoch: 222
Loss on hold-out set: 0.0030830204486846924
MeanAbsoluteError value on hold-out data: 0.044960107654333115
Epoch: 223

Loss on hold-out set: 0.0016938744478725962
MeanAbsoluteError value on hold-out data: 0.03808660805225372
Epoch: 224
Loss on hold-out set: 0.005384591640904546
MeanAbsoluteError value on hold-out data: 0.0657053217291832
Epoch: 225
Loss on hold-out set: 0.00018576103008984189
MeanAbsoluteError value on hold-out data: 0.011950955726206303
Epoch: 226

Loss on hold-out set: 0.0010872928458931191
MeanAbsoluteError value on hold-out data: 0.02971842512488365
Epoch: 227
Loss on hold-out set: 0.0015579054098842399
MeanAbsoluteError value on hold-out data: 0.03636499494314194
Epoch: 228

Loss on hold-out set: 0.0021152821968176533
MeanAbsoluteError value on hold-out data: 0.04473540931940079
Epoch: 229
Loss on hold-out set: 0.000574641815286928
MeanAbsoluteError value on hold-out data: 0.019081436097621918
Epoch: 230
```

```
Loss on hold-out set: 0.0018444312819545822
MeanAbsoluteError value on hold-out data: 0.03530636057257652
Epoch: 231
Loss on hold-out set: 0.00011795604534979378
MeanAbsoluteError value on hold-out data: 0.008449118584394455
Epoch: 232
Loss on hold-out set: 0.0031253589051110403
MeanAbsoluteError value on hold-out data: 0.049407925456762314
Epoch: 233

Loss on hold-out set: 0.001374203254402216
MeanAbsoluteError value on hold-out data: 0.029543478041887283
Epoch: 234
Loss on hold-out set: 0.00022745791648048908
MeanAbsoluteError value on hold-out data: 0.012183845043182373
Epoch: 235

Loss on hold-out set: 0.009110934167568172
MeanAbsoluteError value on hold-out data: 0.0930945947766304
Epoch: 236
Loss on hold-out set: 0.0022118632082960437
MeanAbsoluteError value on hold-out data: 0.04407418146729469
Epoch: 237

Loss on hold-out set: 0.0016160239964457495
MeanAbsoluteError value on hold-out data: 0.036320824176073074
Epoch: 238
Loss on hold-out set: 0.0004654877079052052
MeanAbsoluteError value on hold-out data: 0.01799013465642929
Epoch: 239
Loss on hold-out set: 0.0002680247385537119
MeanAbsoluteError value on hold-out data: 0.015185880474746227
Epoch: 240

Loss on hold-out set: 0.0016316383677933896
MeanAbsoluteError value on hold-out data: 0.030913958325982094
Epoch: 241
Loss on hold-out set: 0.009963653116886104
MeanAbsoluteError value on hold-out data: 0.08383233845233917
Epoch: 242
```

```
Loss on hold-out set: 0.0007867599820851215
MeanAbsoluteError value on hold-out data: 0.023690318688750267
Epoch: 243
Loss on hold-out set: 0.0009533128052550767
MeanAbsoluteError value on hold-out data: 0.029571127146482468
Epoch: 244

Loss on hold-out set: 0.00045516781184622753
MeanAbsoluteError value on hold-out data: 0.018724745139479637
Epoch: 245
Loss on hold-out set: 0.0024800223098801716
MeanAbsoluteError value on hold-out data: 0.04189277067780495
Epoch: 246
Loss on hold-out set: 0.004275499676753368
MeanAbsoluteError value on hold-out data: 0.05929724872112274
Epoch: 247

Loss on hold-out set: 0.00016159614772602384
MeanAbsoluteError value on hold-out data: 0.009610572829842567
Epoch: 248
Loss on hold-out set: 0.0004956570004911295
MeanAbsoluteError value on hold-out data: 0.019932273775339127
Epoch: 249

Loss on hold-out set: 0.005056094777371202
MeanAbsoluteError value on hold-out data: 0.06892117857933044
Epoch: 250
Loss on hold-out set: 0.000978667164287929
MeanAbsoluteError value on hold-out data: 0.02813640981912613
Epoch: 251

Loss on hold-out set: 0.0010292269372647361
MeanAbsoluteError value on hold-out data: 0.028723308816552162
Epoch: 252
Loss on hold-out set: 0.0004710568984072389
MeanAbsoluteError value on hold-out data: 0.015624587424099445
Epoch: 253
Loss on hold-out set: 0.0010207159295012908
MeanAbsoluteError value on hold-out data: 0.028967957943677902
Epoch: 254
```

Loss on hold-out set: 0.00010092540365544014
MeanAbsoluteError value on hold-out data: 0.008080683648586273
Epoch: 255
Loss on hold-out set: 0.0007642652781214565
MeanAbsoluteError value on hold-out data: 0.023365937173366547
Epoch: 256

Loss on hold-out set: 0.0007331963112976934
MeanAbsoluteError value on hold-out data: 0.023368850350379944
Epoch: 257
Loss on hold-out set: 0.007070833817124367
MeanAbsoluteError value on hold-out data: 0.07889358699321747
Epoch: 258

Loss on hold-out set: 0.0018287688560251678
MeanAbsoluteError value on hold-out data: 0.04005998745560646
Epoch: 259
Loss on hold-out set: 0.00015415390849479342
MeanAbsoluteError value on hold-out data: 0.010210663080215454
Epoch: 260
Loss on hold-out set: 0.002205264405347407
MeanAbsoluteError value on hold-out data: 0.04448407515883446
Epoch: 261

Loss on hold-out set: 0.0009470994201754886
MeanAbsoluteError value on hold-out data: 0.025327416136860847
Epoch: 262
Loss on hold-out set: 0.0005684493724921984
MeanAbsoluteError value on hold-out data: 0.019956478849053383
Epoch: 263

Loss on hold-out set: 0.002847227966412902
MeanAbsoluteError value on hold-out data: 0.04992922767996788
Epoch: 264
Loss on hold-out set: 9.743426042924901e-05
MeanAbsoluteError value on hold-out data: 0.0078049879521131516
Epoch: 265

Loss on hold-out set: 0.00012313747408500473
MeanAbsoluteError value on hold-out data: 0.00888631958514452
Epoch: 266

```
Loss on hold-out set: 0.006427451569054808
MeanAbsoluteError value on hold-out data: 0.061694517731666565
Epoch: 267
Loss on hold-out set: 0.000268982388661243
MeanAbsoluteError value on hold-out data: 0.013728279620409012
Epoch: 268

Loss on hold-out set: 0.000499928482375773
MeanAbsoluteError value on hold-out data: 0.020193738862872124
Epoch: 269
Loss on hold-out set: 0.002251424261235765
MeanAbsoluteError value on hold-out data: 0.04465075582265854
Epoch: 270

Loss on hold-out set: 0.00360780003081475
MeanAbsoluteError value on hold-out data: 0.057573746889829636
Epoch: 271
Loss on hold-out set: 0.002507401696805443
MeanAbsoluteError value on hold-out data: 0.048718806356191635
Epoch: 272

Loss on hold-out set: 0.004127447925774115
MeanAbsoluteError value on hold-out data: 0.06304557621479034
Epoch: 273
Loss on hold-out set: 0.0017128389860902513
MeanAbsoluteError value on hold-out data: 0.03690588101744652
Epoch: 274
Loss on hold-out set: 0.001076284795999527
MeanAbsoluteError value on hold-out data: 0.030648870393633842
Epoch: 275

Loss on hold-out set: 0.006644133877541337
MeanAbsoluteError value on hold-out data: 0.07782720774412155
Epoch: 276
Loss on hold-out set: 0.001033642703467714
MeanAbsoluteError value on hold-out data: 0.03114665485918522
Epoch: 277

Loss on hold-out set: 0.0003897618069978697
MeanAbsoluteError value on hold-out data: 0.01607161946594715
Epoch: 278
```

```
Loss on hold-out set: 0.0005850214677463685
MeanAbsoluteError value on hold-out data: 0.019827378913760185
Epoch: 279

Loss on hold-out set: 0.0026992936452318516
MeanAbsoluteError value on hold-out data: 0.03976236656308174
Epoch: 280
Loss on hold-out set: 9.659915459841224e-05
MeanAbsoluteError value on hold-out data: 0.007597212679684162
Epoch: 281
Loss on hold-out set: 0.0013237203737454756
MeanAbsoluteError value on hold-out data: 0.035276636481285095
Epoch: 282

Loss on hold-out set: 0.0016766463938568319
MeanAbsoluteError value on hold-out data: 0.03171386197209358
Epoch: 283
Loss on hold-out set: 0.00016951774575448195
MeanAbsoluteError value on hold-out data: 0.011243623681366444
Epoch: 284

Loss on hold-out set: 0.0036401645879128148
MeanAbsoluteError value on hold-out data: 0.039693742990493774
Epoch: 285
Loss on hold-out set: 0.00017287862075526
MeanAbsoluteError value on hold-out data: 0.010520050302147865
Epoch: 286

Loss on hold-out set: 0.004730345980663385
MeanAbsoluteError value on hold-out data: 0.05630897358059883
Epoch: 287
Loss on hold-out set: 0.006563436705619097
MeanAbsoluteError value on hold-out data: 0.06839076429605484
Epoch: 288
Loss on hold-out set: 0.00031873095680826476
MeanAbsoluteError value on hold-out data: 0.014056083746254444
Epoch: 289

Loss on hold-out set: 0.004776970084224429
MeanAbsoluteError value on hold-out data: 0.06211788207292557
Epoch: 290
```

```
Loss on hold-out set: 0.0027737074997276068
MeanAbsoluteError value on hold-out data: 0.04295044764876366
Epoch: 291

Loss on hold-out set: 0.00021441914265908833
MeanAbsoluteError value on hold-out data: 0.012738493271172047
Epoch: 292
Loss on hold-out set: 0.0023242870728219195
MeanAbsoluteError value on hold-out data: 0.03713323548436165
Early stopping at epoch 291
Fold: 3
Epoch: 1

Loss on hold-out set: 0.01722349545785359
MeanAbsoluteError value on hold-out data: 0.0963955819606781
Epoch: 2
Loss on hold-out set: 0.012203180098107882
MeanAbsoluteError value on hold-out data: 0.08764661103487015
Epoch: 3
Loss on hold-out set: 0.020003801078668663
MeanAbsoluteError value on hold-out data: 0.12083584815263748
Epoch: 4

Loss on hold-out set: 0.01696895089532648
MeanAbsoluteError value on hold-out data: 0.11819645762443542
Epoch: 5
Loss on hold-out set: 0.006789170471685273
MeanAbsoluteError value on hold-out data: 0.06658931821584702
Epoch: 6

Loss on hold-out set: 0.015464066793876035
MeanAbsoluteError value on hold-out data: 0.11493478715419769
Epoch: 7
Loss on hold-out set: 0.00908684783748218
MeanAbsoluteError value on hold-out data: 0.08298342674970627
Epoch: 8

Loss on hold-out set: 0.008408222746636187
MeanAbsoluteError value on hold-out data: 0.07861025631427765
Epoch: 9
Loss on hold-out set: 0.021904012454407557
```

```
MeanAbsoluteError value on hold-out data: 0.13439282774925232
Epoch: 10
Loss on hold-out set: 0.008619744663259812
MeanAbsoluteError value on hold-out data: 0.07593298703432083
Epoch: 11

Loss on hold-out set: 0.007348996387528521
MeanAbsoluteError value on hold-out data: 0.07245238125324249
Epoch: 12
Loss on hold-out set: 0.0037329529877752066
MeanAbsoluteError value on hold-out data: 0.05213674157857895
Epoch: 13

Loss on hold-out set: 0.005550030884998185
MeanAbsoluteError value on hold-out data: 0.0651635006070137
Epoch: 14
Loss on hold-out set: 0.004102498625538179
MeanAbsoluteError value on hold-out data: 0.05350887402892113
Epoch: 15

Loss on hold-out set: 0.008372733569038766
MeanAbsoluteError value on hold-out data: 0.0782574862241745
Epoch: 16
Loss on hold-out set: 0.009539064818194934
MeanAbsoluteError value on hold-out data: 0.09456392377614975
Epoch: 17
Loss on hold-out set: 0.012042592811797346
MeanAbsoluteError value on hold-out data: 0.09473013877868652
Epoch: 18

Loss on hold-out set: 0.004235999492396202
MeanAbsoluteError value on hold-out data: 0.05774421989917755
Epoch: 19
Loss on hold-out set: 0.0023636986568037954
MeanAbsoluteError value on hold-out data: 0.03467078134417534
Epoch: 20

Loss on hold-out set: 0.0012012004320110594
MeanAbsoluteError value on hold-out data: 0.027872316539287567
Epoch: 21
Loss on hold-out set: 0.009305093703525407
```

```
MeanAbsoluteError value on hold-out data: 0.09109389036893845
Epoch: 22

Loss on hold-out set: 0.006977497400449855
MeanAbsoluteError value on hold-out data: 0.0771547332406044
Epoch: 23
Loss on hold-out set: 0.0005248737039177545
MeanAbsoluteError value on hold-out data: 0.01729077287018299
Epoch: 24
Loss on hold-out set: 0.0049423449007528165
MeanAbsoluteError value on hold-out data: 0.056086279451847076
Epoch: 25

Loss on hold-out set: 0.01544564323765891
MeanAbsoluteError value on hold-out data: 0.1142842024564743
Epoch: 26
Loss on hold-out set: 0.014000846472169672
MeanAbsoluteError value on hold-out data: 0.11397287994623184
Epoch: 27

Loss on hold-out set: 0.0006568518812335762
MeanAbsoluteError value on hold-out data: 0.017985139042139053
Epoch: 28
Loss on hold-out set: 0.001029372847239886
MeanAbsoluteError value on hold-out data: 0.024194462224841118
Epoch: 29

Loss on hold-out set: 0.005365008455035942
MeanAbsoluteError value on hold-out data: 0.06058952212333679
Epoch: 30
Loss on hold-out set: 0.002070227770933083
MeanAbsoluteError value on hold-out data: 0.04019227623939514
Epoch: 31
Loss on hold-out set: 0.0006890421874621617
MeanAbsoluteError value on hold-out data: 0.019549814984202385
Epoch: 32

Loss on hold-out set: 0.0007857933607218521
MeanAbsoluteError value on hold-out data: 0.023151390254497528
Epoch: 33
Loss on hold-out set: 0.0016177746833169035
```

```
MeanAbsoluteError value on hold-out data: 0.03292535990476608
Epoch: 34

Loss on hold-out set: 0.0026006174905757818
MeanAbsoluteError value on hold-out data: 0.041419874876737595
Epoch: 35
Loss on hold-out set: 0.002013441258376198
MeanAbsoluteError value on hold-out data: 0.04099980741739273
Epoch: 36

Loss on hold-out set: 0.0005070423690735229
MeanAbsoluteError value on hold-out data: 0.01685393415391445
Epoch: 37
Loss on hold-out set: 0.001902043619858367
MeanAbsoluteError value on hold-out data: 0.04056780785322189
Epoch: 38
Loss on hold-out set: 0.00043680533833269564
MeanAbsoluteError value on hold-out data: 0.016073577105998993
Epoch: 39

Loss on hold-out set: 0.0008818757820076176
MeanAbsoluteError value on hold-out data: 0.02473684586584568
Epoch: 40
Loss on hold-out set: 0.0005046568860832069
MeanAbsoluteError value on hold-out data: 0.019107714295387268
Epoch: 41

Loss on hold-out set: 0.00031878915927206563
MeanAbsoluteError value on hold-out data: 0.013635101728141308
Epoch: 42
Loss on hold-out set: 0.0005491970722297472
MeanAbsoluteError value on hold-out data: 0.01819796673953533
Epoch: 43

Loss on hold-out set: 0.007541961169668606
MeanAbsoluteError value on hold-out data: 0.07643749564886093
Epoch: 44
Loss on hold-out set: 0.00370172195003501
MeanAbsoluteError value on hold-out data: 0.048852887004613876
Epoch: 45
Loss on hold-out set: 0.00017950582072704231
```

```
MeanAbsoluteError value on hold-out data: 0.010171009227633476
Epoch: 46

Loss on hold-out set: 0.0018458042260525481
MeanAbsoluteError value on hold-out data: 0.04073641449213028
Epoch: 47
Loss on hold-out set: 0.007352109233449612
MeanAbsoluteError value on hold-out data: 0.07673363387584686
Epoch: 48

Loss on hold-out set: 0.009808238994862353
MeanAbsoluteError value on hold-out data: 0.07774975150823593
Epoch: 49
Loss on hold-out set: 0.0005996077296523643
MeanAbsoluteError value on hold-out data: 0.020312011241912842
Epoch: 50

Loss on hold-out set: 0.0012527925760618278
MeanAbsoluteError value on hold-out data: 0.03160981833934784
Epoch: 51
Loss on hold-out set: 0.0018025737455380814
MeanAbsoluteError value on hold-out data: 0.035994838923215866
Epoch: 52
Loss on hold-out set: 0.0019775634531729986
MeanAbsoluteError value on hold-out data: 0.038251906633377075
Epoch: 53

Loss on hold-out set: 0.00028380274099098254
MeanAbsoluteError value on hold-out data: 0.013614743016660213
Epoch: 54
Loss on hold-out set: 0.001375142451641815
MeanAbsoluteError value on hold-out data: 0.03425142168998718
Epoch: 55

Loss on hold-out set: 0.0012506198337567703
MeanAbsoluteError value on hold-out data: 0.03229590505361557
Epoch: 56
Loss on hold-out set: 0.00013676644136597003
MeanAbsoluteError value on hold-out data: 0.008754496462643147
Epoch: 57
```

```
Loss on hold-out set: 0.0048548623786440915
MeanAbsoluteError value on hold-out data: 0.06740210205316544
Epoch: 58
Loss on hold-out set: 0.008633928173886878
MeanAbsoluteError value on hold-out data: 0.09048571437597275
Epoch: 59
Loss on hold-out set: 0.002236424812248775
MeanAbsoluteError value on hold-out data: 0.045156363397836685
Epoch: 60

Loss on hold-out set: 0.0013233732066250273
MeanAbsoluteError value on hold-out data: 0.02958531118929386
Epoch: 61
Loss on hold-out set: 0.0030321430281869005
MeanAbsoluteError value on hold-out data: 0.04568856582045555
Epoch: 62

Loss on hold-out set: 0.003237904448594366
MeanAbsoluteError value on hold-out data: 0.05538695678114891
Epoch: 63
Loss on hold-out set: 0.008591039039726769
MeanAbsoluteError value on hold-out data: 0.0795857310295105
Epoch: 64

Loss on hold-out set: 0.00017051574000756124
MeanAbsoluteError value on hold-out data: 0.010297429747879505
Epoch: 65
Loss on hold-out set: 0.0038116798137447666
MeanAbsoluteError value on hold-out data: 0.050046976655721664
Epoch: 66
Loss on hold-out set: 0.002725514250674418
MeanAbsoluteError value on hold-out data: 0.04731244966387749
Epoch: 67

Loss on hold-out set: 0.0005282136511855892
MeanAbsoluteError value on hold-out data: 0.0203737560659647
Epoch: 68
Loss on hold-out set: 0.001815556182659098
MeanAbsoluteError value on hold-out data: 0.03578081354498863
Epoch: 69
```

```
Loss on hold-out set: 0.0032506362934197697
MeanAbsoluteError value on hold-out data: 0.047459926456213
Epoch: 70
Loss on hold-out set: 0.0022578324590410504
MeanAbsoluteError value on hold-out data: 0.041223302483558655
Epoch: 71

Loss on hold-out set: 0.0037216349904026303
MeanAbsoluteError value on hold-out data: 0.05911653861403465
Epoch: 72
Loss on hold-out set: 0.00872662736635123
MeanAbsoluteError value on hold-out data: 0.08998177200555801
Epoch: 73
Loss on hold-out set: 0.0005719761123015944
MeanAbsoluteError value on hold-out data: 0.021824272349476814
Epoch: 74

Loss on hold-out set: 0.00228343451661723
MeanAbsoluteError value on hold-out data: 0.04501800984144211
Epoch: 75
Loss on hold-out set: 0.00572268884362919
MeanAbsoluteError value on hold-out data: 0.06758637726306915
Epoch: 76

Loss on hold-out set: 0.002049415056327624
MeanAbsoluteError value on hold-out data: 0.04381196200847626
Epoch: 77
Loss on hold-out set: 0.0019266867311671376
MeanAbsoluteError value on hold-out data: 0.0397469624876976
Epoch: 78

Loss on hold-out set: 0.004192151761214648
MeanAbsoluteError value on hold-out data: 0.060738805681467056
Epoch: 79
Loss on hold-out set: 0.00046007637034303376
MeanAbsoluteError value on hold-out data: 0.01826193369925022
Epoch: 80
Loss on hold-out set: 0.0009214005757322801
MeanAbsoluteError value on hold-out data: 0.027650980278849602
Epoch: 81
```

```
Loss on hold-out set: 0.0003895013443460422
MeanAbsoluteError value on hold-out data: 0.015649188309907913
Epoch: 82
Loss on hold-out set: 0.002323458004476769
MeanAbsoluteError value on hold-out data: 0.04237239062786102
Epoch: 83

Loss on hold-out set: 0.003984197109405484
MeanAbsoluteError value on hold-out data: 0.06232965365052223
Epoch: 84
Loss on hold-out set: 0.0009812716411293618
MeanAbsoluteError value on hold-out data: 0.02601732686161995
Epoch: 85

Loss on hold-out set: 0.0025887198613158296
MeanAbsoluteError value on hold-out data: 0.04693242162466049
Epoch: 86
Loss on hold-out set: 0.008442354654627187
MeanAbsoluteError value on hold-out data: 0.08970914781093597
Epoch: 87
Loss on hold-out set: 0.0020129630491802736
MeanAbsoluteError value on hold-out data: 0.034286580979824066
Epoch: 88

Loss on hold-out set: 0.00017025305299154882
MeanAbsoluteError value on hold-out data: 0.010625912807881832
Epoch: 89
Loss on hold-out set: 0.00024046549307448522
MeanAbsoluteError value on hold-out data: 0.012079658918082714
Epoch: 90

Loss on hold-out set: 0.004844384533401838
MeanAbsoluteError value on hold-out data: 0.06814637035131454
Epoch: 91
Loss on hold-out set: 0.0019435627785112178
MeanAbsoluteError value on hold-out data: 0.034136682748794556
Epoch: 92

Loss on hold-out set: 0.0016824410496545689
MeanAbsoluteError value on hold-out data: 0.03275326266884804
Epoch: 93
```

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Loss on hold-out set: 0.0028820361476391554
MeanAbsoluteError value on hold-out data: 0.05173417180776596
Epoch: 94
Loss on hold-out set: 0.0015177015447989106
MeanAbsoluteError value on hold-out data: 0.036299318075180054
Epoch: 95

Loss on hold-out set: 0.003026400160576616
MeanAbsoluteError value on hold-out data: 0.05143608897924423
Epoch: 96
Loss on hold-out set: 0.003155519287767155
MeanAbsoluteError value on hold-out data: 0.0428086519241333
Epoch: 97

Loss on hold-out set: 0.005623695241021258
MeanAbsoluteError value on hold-out data: 0.05838047340512276
Epoch: 98
Loss on hold-out set: 0.0006564341227723551
MeanAbsoluteError value on hold-out data: 0.01963769644498825
Epoch: 99

Loss on hold-out set: 0.005103061906993389
MeanAbsoluteError value on hold-out data: 0.0703468918800354
Epoch: 100
Loss on hold-out set: 0.005175713383193527
MeanAbsoluteError value on hold-out data: 0.06999021768569946
Epoch: 101
Loss on hold-out set: 0.0004287295908268009
MeanAbsoluteError value on hold-out data: 0.01862492598593235
Epoch: 102

Loss on hold-out set: 0.0002175810285344986
MeanAbsoluteError value on hold-out data: 0.011314923875033855
Epoch: 103
Loss on hold-out set: 0.0002589431990470205
MeanAbsoluteError value on hold-out data: 0.013627907261252403
Epoch: 104

Loss on hold-out set: 0.010129418889326709
MeanAbsoluteError value on hold-out data: 0.09539380669593811
Epoch: 105
```

```
Loss on hold-out set: 0.00032314407040498087
MeanAbsoluteError value on hold-out data: 0.01623053289949894
Epoch: 106

Loss on hold-out set: 0.0002775348038994707
MeanAbsoluteError value on hold-out data: 0.013683847151696682
Epoch: 107
Loss on hold-out set: 0.0031826558323310955
MeanAbsoluteError value on hold-out data: 0.04905138909816742
Epoch: 108
Loss on hold-out set: 0.001904787213009383
MeanAbsoluteError value on hold-out data: 0.04065275564789772
Epoch: 109

Loss on hold-out set: 0.0072069184056350166
MeanAbsoluteError value on hold-out data: 0.0677279457449913
Epoch: 110
Loss on hold-out set: 0.0003949473528856678
MeanAbsoluteError value on hold-out data: 0.01639762707054615
Epoch: 111

Loss on hold-out set: 0.0011128484870174102
MeanAbsoluteError value on hold-out data: 0.026392502710223198
Epoch: 112
Loss on hold-out set: 0.0017533508195940936
MeanAbsoluteError value on hold-out data: 0.03896081820130348
Epoch: 113

Loss on hold-out set: 0.0007537570574121284
MeanAbsoluteError value on hold-out data: 0.02288494072854519
Epoch: 114
Loss on hold-out set: 0.0027613049106938498
MeanAbsoluteError value on hold-out data: 0.05141234025359154
Epoch: 115
Loss on hold-out set: 0.0039619871282151765
MeanAbsoluteError value on hold-out data: 0.061908841133117676
Epoch: 116

Loss on hold-out set: 0.0009031311908204641
MeanAbsoluteError value on hold-out data: 0.021781112998723984
Epoch: 117
```

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Loss on hold-out set: 0.0015793074022180267
MeanAbsoluteError value on hold-out data: 0.038855984807014465
Epoch: 118

Loss on hold-out set: 0.0032130698008196695
MeanAbsoluteError value on hold-out data: 0.05467032268643379
Epoch: 119
Loss on hold-out set: 0.0028932445483016117
MeanAbsoluteError value on hold-out data: 0.04680296406149864
Epoch: 120

Loss on hold-out set: 0.003012959113610642
MeanAbsoluteError value on hold-out data: 0.04610826447606087
Epoch: 121
Loss on hold-out set: 0.0008776329757113542
MeanAbsoluteError value on hold-out data: 0.025335362181067467
Epoch: 122
Loss on hold-out set: 0.005758554175762194
MeanAbsoluteError value on hold-out data: 0.06671303510665894
Epoch: 123

Loss on hold-out set: 0.0019582526458959493
MeanAbsoluteError value on hold-out data: 0.04126119986176491
Epoch: 124
Loss on hold-out set: 0.0014494080179637031
MeanAbsoluteError value on hold-out data: 0.030390970408916473
Epoch: 125

Loss on hold-out set: 0.0037622411203171524
MeanAbsoluteError value on hold-out data: 0.04807562008500099
Epoch: 126
Loss on hold-out set: 0.003204798957865153
MeanAbsoluteError value on hold-out data: 0.050199639052152634
Epoch: 127

Loss on hold-out set: 0.0040473622003836295
MeanAbsoluteError value on hold-out data: 0.061220698058605194
Epoch: 128
Loss on hold-out set: 0.001580096797884575
MeanAbsoluteError value on hold-out data: 0.03941373527050018
Epoch: 129
```

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Loss on hold-out set: 0.0006133572730634894
MeanAbsoluteError value on hold-out data: 0.022165389731526375
Epoch: 130

Loss on hold-out set: 0.0024573739002724843
MeanAbsoluteError value on hold-out data: 0.03856393322348595
Epoch: 131
Loss on hold-out set: 0.0002904552675317973
MeanAbsoluteError value on hold-out data: 0.014077591709792614
Epoch: 132

Loss on hold-out set: 0.000502705607297165
MeanAbsoluteError value on hold-out data: 0.019983405247330666
Epoch: 133
Loss on hold-out set: 9.667098960822582e-05
MeanAbsoluteError value on hold-out data: 0.007498079910874367
Epoch: 134

Loss on hold-out set: 0.00046113064412825873
MeanAbsoluteError value on hold-out data: 0.018412964418530464
Epoch: 135
Loss on hold-out set: 0.0026618330905746135
MeanAbsoluteError value on hold-out data: 0.049840088933706284
Epoch: 136
Loss on hold-out set: 0.00019591229751573076
MeanAbsoluteError value on hold-out data: 0.011334292590618134
Epoch: 137

Loss on hold-out set: 0.00037152871872032326
MeanAbsoluteError value on hold-out data: 0.01580900140106678
Epoch: 138
Loss on hold-out set: 0.0005385067696417016
MeanAbsoluteError value on hold-out data: 0.02055545523762703
Epoch: 139

Loss on hold-out set: 0.0009139388649990517
MeanAbsoluteError value on hold-out data: 0.028913840651512146
Epoch: 140
Loss on hold-out set: 0.0008274890632102532
MeanAbsoluteError value on hold-out data: 0.02441503293812275
Epoch: 141
```

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Loss on hold-out set: 0.0017381288842963321
MeanAbsoluteError value on hold-out data: 0.03945629298686981
Epoch: 142
Loss on hold-out set: 0.0006929239898454398
MeanAbsoluteError value on hold-out data: 0.019034873694181442
Epoch: 143
Loss on hold-out set: 0.000226572277564888
MeanAbsoluteError value on hold-out data: 0.011943011544644833
Epoch: 144

Loss on hold-out set: 0.002339864582089441
MeanAbsoluteError value on hold-out data: 0.045469287782907486
Epoch: 145
Loss on hold-out set: 0.00015471867456134141
MeanAbsoluteError value on hold-out data: 0.009495721198618412
Epoch: 146

Loss on hold-out set: 0.0022881434664928486
MeanAbsoluteError value on hold-out data: 0.03970371559262276
Epoch: 147
Loss on hold-out set: 0.0063259606914860865
MeanAbsoluteError value on hold-out data: 0.07024910300970078
Epoch: 148

Loss on hold-out set: 0.0005505151223457817
MeanAbsoluteError value on hold-out data: 0.020749954506754875
Epoch: 149
Loss on hold-out set: 0.0008753778612507242
MeanAbsoluteError value on hold-out data: 0.0264494176954031
Epoch: 150
Loss on hold-out set: 0.010158401913940907
MeanAbsoluteError value on hold-out data: 0.10003918409347534
Epoch: 151

Loss on hold-out set: 0.000813468376041523
MeanAbsoluteError value on hold-out data: 0.02373160608112812
Epoch: 152
Loss on hold-out set: 0.0005721631002545889
MeanAbsoluteError value on hold-out data: 0.02100839465856552
Epoch: 153
```

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Loss on hold-out set: 0.002678263998989548
MeanAbsoluteError value on hold-out data: 0.044656429439783096
Epoch: 154
Loss on hold-out set: 0.0056269860028156215
MeanAbsoluteError value on hold-out data: 0.05795179307460785
Epoch: 155

Loss on hold-out set: 0.00047023367369547486
MeanAbsoluteError value on hold-out data: 0.01816415786743164
Epoch: 156
Loss on hold-out set: 0.0021504682122862767
MeanAbsoluteError value on hold-out data: 0.03962980583310127
Epoch: 157
Loss on hold-out set: 0.004889716593814748
MeanAbsoluteError value on hold-out data: 0.06643866747617722
Epoch: 158

Loss on hold-out set: 0.0006450081709772348
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Epoch: 159
Loss on hold-out set: 0.0013547016091511718
MeanAbsoluteError value on hold-out data: 0.030453963205218315
Epoch: 160

Loss on hold-out set: 0.002948816616221198
MeanAbsoluteError value on hold-out data: 0.039863161742687225
Epoch: 161
Loss on hold-out set: 0.0028854732933853355
MeanAbsoluteError value on hold-out data: 0.05242642015218735
Epoch: 162

Loss on hold-out set: 0.00024081644161404775
MeanAbsoluteError value on hold-out data: 0.012503686361014843
Epoch: 163
Loss on hold-out set: 0.0040222095724727425
MeanAbsoluteError value on hold-out data: 0.049233391880989075
Epoch: 164
Loss on hold-out set: 0.0028313419981194393
MeanAbsoluteError value on hold-out data: 0.05027204006910324
Epoch: 165
```

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Loss on hold-out set: 0.001803443650715053
MeanAbsoluteError value on hold-out data: 0.04161606729030609
Epoch: 166
Loss on hold-out set: 0.00039672730365834596
MeanAbsoluteError value on hold-out data: 0.015531904995441437
Epoch: 167

Loss on hold-out set: 0.0015040569373273424
MeanAbsoluteError value on hold-out data: 0.03526557609438896
Epoch: 168
Loss on hold-out set: 0.0010240037642818476
MeanAbsoluteError value on hold-out data: 0.028822218999266624
Epoch: 169

Loss on hold-out set: 0.0030001802037336995
MeanAbsoluteError value on hold-out data: 0.05447615683078766
Epoch: 170
Loss on hold-out set: 0.0015569119215277688
MeanAbsoluteError value on hold-out data: 0.036635078489780426
Epoch: 171
Loss on hold-out set: 0.0054125554327453885
MeanAbsoluteError value on hold-out data: 0.07088735699653625
Epoch: 172

Loss on hold-out set: 0.000982506965686168
MeanAbsoluteError value on hold-out data: 0.028431255370378494
Epoch: 173
Loss on hold-out set: 0.003435323613562754
MeanAbsoluteError value on hold-out data: 0.04714153707027435
Epoch: 174

Loss on hold-out set: 8.417352442588058e-05
MeanAbsoluteError value on hold-out data: 0.007195783779025078
Epoch: 175
Loss on hold-out set: 0.0018909255990625492
MeanAbsoluteError value on hold-out data: 0.038392532616853714
Epoch: 176

Loss on hold-out set: 0.0017927652557513543
MeanAbsoluteError value on hold-out data: 0.03806334733963013
Epoch: 177
```

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Loss on hold-out set: 0.004189972333343965
MeanAbsoluteError value on hold-out data: 0.05873030796647072
Epoch: 178
Loss on hold-out set: 0.006392318356250014
MeanAbsoluteError value on hold-out data: 0.07767742872238159
Epoch: 179

Loss on hold-out set: 0.005749649767364774
MeanAbsoluteError value on hold-out data: 0.062004104256629944
Epoch: 180
Loss on hold-out set: 0.00039268724711811435
MeanAbsoluteError value on hold-out data: 0.017021851614117622
Epoch: 181

Loss on hold-out set: 0.0005201788195076265
MeanAbsoluteError value on hold-out data: 0.0207142885774374
Epoch: 182
Loss on hold-out set: 0.00014041304841936965
MeanAbsoluteError value on hold-out data: 0.009649255312979221
Epoch: 183

Loss on hold-out set: 0.0005186684304914836
MeanAbsoluteError value on hold-out data: 0.02088409848511219
Epoch: 184
Loss on hold-out set: 0.0010038014235241072
MeanAbsoluteError value on hold-out data: 0.028314650058746338
Epoch: 185
Loss on hold-out set: 0.000722614092020584
MeanAbsoluteError value on hold-out data: 0.021824879571795464
Epoch: 186

Loss on hold-out set: 0.00014381591946792987
MeanAbsoluteError value on hold-out data: 0.009810728020966053
Epoch: 187
Loss on hold-out set: 6.61788331594185e-05
MeanAbsoluteError value on hold-out data: 0.005989014636725187
Epoch: 188

Loss on hold-out set: 0.0057154518685170585
MeanAbsoluteError value on hold-out data: 0.06882937997579575
Epoch: 189
```

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Loss on hold-out set: 0.0016438520313905819
MeanAbsoluteError value on hold-out data: 0.033365558832883835
Epoch: 190

Loss on hold-out set: 0.0015315288910642266
MeanAbsoluteError value on hold-out data: 0.031325384974479675
Epoch: 191
Loss on hold-out set: 0.005222725482391459
MeanAbsoluteError value on hold-out data: 0.07049782574176788
Epoch: 192
Loss on hold-out set: 0.0029647068586200476
MeanAbsoluteError value on hold-out data: 0.04345245659351349
Epoch: 193

Loss on hold-out set: 0.0016571515672174947
MeanAbsoluteError value on hold-out data: 0.037817999720573425
Epoch: 194
Loss on hold-out set: 0.0011257625467676138
MeanAbsoluteError value on hold-out data: 0.026820313185453415
Epoch: 195

Loss on hold-out set: 0.0071842344810387915
MeanAbsoluteError value on hold-out data: 0.07319781929254532
Epoch: 196
Loss on hold-out set: 0.0006011991104709782
MeanAbsoluteError value on hold-out data: 0.01946040615439415
Epoch: 197

Loss on hold-out set: 0.00028956408537591675
MeanAbsoluteError value on hold-out data: 0.013407928869128227
Epoch: 198
Loss on hold-out set: 0.0026273236809564488
MeanAbsoluteError value on hold-out data: 0.04709216579794884
Epoch: 199
Loss on hold-out set: 0.004468556493520737
MeanAbsoluteError value on hold-out data: 0.056933220475912094
Epoch: 200

Loss on hold-out set: 0.005223965804491725
MeanAbsoluteError value on hold-out data: 0.06870276480913162
Epoch: 201
```

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Loss on hold-out set: 0.00010086807742482051
MeanAbsoluteError value on hold-out data: 0.0076882983557879925
Epoch: 202

Loss on hold-out set: 0.004973674126501594
MeanAbsoluteError value on hold-out data: 0.06857055425643921
Epoch: 203
Loss on hold-out set: 0.0013409387985510485
MeanAbsoluteError value on hold-out data: 0.033346451818943024
Epoch: 204

Loss on hold-out set: 0.003768728014879993
MeanAbsoluteError value on hold-out data: 0.04861396923661232
Epoch: 205
Loss on hold-out set: 0.00013302214002968476
MeanAbsoluteError value on hold-out data: 0.00954966340214014
Epoch: 206
Loss on hold-out set: 0.0028069712155099425
MeanAbsoluteError value on hold-out data: 0.04362431541085243
Epoch: 207

Loss on hold-out set: 0.0007361518135959548
MeanAbsoluteError value on hold-out data: 0.022122986614704132
Epoch: 208
Loss on hold-out set: 0.0006296370078676514
MeanAbsoluteError value on hold-out data: 0.01978619024157524
Epoch: 209

Loss on hold-out set: 0.001887730771808752
MeanAbsoluteError value on hold-out data: 0.04165295511484146
Epoch: 210

Loss on hold-out set: 0.001115011882835201
MeanAbsoluteError value on hold-out data: 0.02841196022927761
Epoch: 211
Loss on hold-out set: 0.0036548151900725706
MeanAbsoluteError value on hold-out data: 0.05410723388195038
Epoch: 212
Loss on hold-out set: 0.0015245665396962846
MeanAbsoluteError value on hold-out data: 0.03326527774333954
Epoch: 213
```

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Loss on hold-out set: 0.0019553912903315256
MeanAbsoluteError value on hold-out data: 0.04207708314061165
Epoch: 214
Loss on hold-out set: 0.0006113019397681845
MeanAbsoluteError value on hold-out data: 0.021043332293629646
Epoch: 215

Loss on hold-out set: 0.002192257022085999
MeanAbsoluteError value on hold-out data: 0.037646517157554626
Epoch: 216
Loss on hold-out set: 0.0018692363020298736
MeanAbsoluteError value on hold-out data: 0.035345155745744705
Epoch: 217

Loss on hold-out set: 0.0005576100250306938
MeanAbsoluteError value on hold-out data: 0.019489968195557594
Epoch: 218
Loss on hold-out set: 0.0023510021939208464
MeanAbsoluteError value on hold-out data: 0.0358988493680954
Epoch: 219
Loss on hold-out set: 0.0021703760638566954
MeanAbsoluteError value on hold-out data: 0.04188265651464462
Epoch: 220

Loss on hold-out set: 0.0011041416271057511
MeanAbsoluteError value on hold-out data: 0.03035535104572773
Epoch: 221
Loss on hold-out set: 0.00046714351628907025
MeanAbsoluteError value on hold-out data: 0.01866173930466175
Epoch: 222

Loss on hold-out set: 0.00011208460845019934
MeanAbsoluteError value on hold-out data: 0.008518652990460396
Epoch: 223
Loss on hold-out set: 0.0026249714927481754
MeanAbsoluteError value on hold-out data: 0.04915469139814377
Epoch: 224

Loss on hold-out set: 0.0003991764512777861
MeanAbsoluteError value on hold-out data: 0.01663120463490486
Epoch: 225
```

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Loss on hold-out set: 0.00558893711838339
MeanAbsoluteError value on hold-out data: 0.06558489799499512
Epoch: 226
Loss on hold-out set: 0.0015354701151539172
MeanAbsoluteError value on hold-out data: 0.037836283445358276
Epoch: 227

Loss on hold-out set: 0.0013747646340302058
MeanAbsoluteError value on hold-out data: 0.03364729508757591
Epoch: 228
Loss on hold-out set: 0.0006563779315911233
MeanAbsoluteError value on hold-out data: 0.02365288883447647
Epoch: 229

Loss on hold-out set: 0.0003267615310116006
MeanAbsoluteError value on hold-out data: 0.014757949858903885
Epoch: 230
Loss on hold-out set: 0.00026555788021401634
MeanAbsoluteError value on hold-out data: 0.012677805498242378
Epoch: 231

Loss on hold-out set: 0.002180372497865132
MeanAbsoluteError value on hold-out data: 0.04325994476675987
Epoch: 232
Loss on hold-out set: 0.010339140492890562
MeanAbsoluteError value on hold-out data: 0.09572400152683258
Epoch: 233
Loss on hold-out set: 0.0023760770647121327
MeanAbsoluteError value on hold-out data: 0.04783821105957031
Epoch: 234

Loss on hold-out set: 0.0024694331056837526
MeanAbsoluteError value on hold-out data: 0.048638682812452316
Epoch: 235
Loss on hold-out set: 0.0007278262554401797
MeanAbsoluteError value on hold-out data: 0.023796798661351204
Epoch: 236

Loss on hold-out set: 0.0021031950933060478
MeanAbsoluteError value on hold-out data: 0.03938506543636322
Epoch: 237
```

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Loss on hold-out set: 0.0020371533963563187
MeanAbsoluteError value on hold-out data: 0.04330241307616234
Epoch: 238

Loss on hold-out set: 0.0003055929430826966
MeanAbsoluteError value on hold-out data: 0.014878503046929836
Epoch: 239
Loss on hold-out set: 0.0006913266884761729
MeanAbsoluteError value on hold-out data: 0.022667817771434784
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Loss on hold-out set: 0.0007258299197669008
MeanAbsoluteError value on hold-out data: 0.022913530468940735
Epoch: 241

Loss on hold-out set: 0.003015352554419743
MeanAbsoluteError value on hold-out data: 0.04298413172364235
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Loss on hold-out set: 0.0008046081098395266
MeanAbsoluteError value on hold-out data: 0.022039836272597313
Epoch: 243

Loss on hold-out set: 0.0007092972310991692
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Epoch: 244
Loss on hold-out set: 0.0014016652587867742
MeanAbsoluteError value on hold-out data: 0.028879838064312935
Epoch: 245

Loss on hold-out set: 0.00026295773152794154
MeanAbsoluteError value on hold-out data: 0.014270893298089504
Epoch: 246
Loss on hold-out set: 0.00032222940769445686
MeanAbsoluteError value on hold-out data: 0.015600061044096947
Epoch: 247
Loss on hold-out set: 0.0003356396669654974
MeanAbsoluteError value on hold-out data: 0.015180426649749279
Epoch: 248

Loss on hold-out set: 0.0018023985737402523
MeanAbsoluteError value on hold-out data: 0.0391598604619503
Epoch: 249
```

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Loss on hold-out set: 0.0007116393576974847
MeanAbsoluteError value on hold-out data: 0.022223858162760735
Epoch: 250

Loss on hold-out set: 0.0008058810240722128
MeanAbsoluteError value on hold-out data: 0.02739035338163376
Epoch: 251
Loss on hold-out set: 0.0003864888733785067
MeanAbsoluteError value on hold-out data: 0.01619960367679596
Epoch: 252

Loss on hold-out set: 0.00459516271283584
MeanAbsoluteError value on hold-out data: 0.055089715868234634
Epoch: 253
Loss on hold-out set: 0.0005601424033687051
MeanAbsoluteError value on hold-out data: 0.021712755784392357
Epoch: 254
Loss on hold-out set: 0.004517559860167759
MeanAbsoluteError value on hold-out data: 0.04922742024064064
Epoch: 255

Loss on hold-out set: 0.003909994981118611
MeanAbsoluteError value on hold-out data: 0.0581066720187664
Epoch: 256
Loss on hold-out set: 0.00771570046033178
MeanAbsoluteError value on hold-out data: 0.08311939984560013
Epoch: 257

Loss on hold-out set: 0.0049633892984794715
MeanAbsoluteError value on hold-out data: 0.06746935844421387
Epoch: 258
Loss on hold-out set: 0.00011643410964877279
MeanAbsoluteError value on hold-out data: 0.008234917186200619
Epoch: 259

Loss on hold-out set: 0.0013425923451515181
MeanAbsoluteError value on hold-out data: 0.03367054834961891
Epoch: 260
Loss on hold-out set: 0.0024635891895741224
MeanAbsoluteError value on hold-out data: 0.046845611184835434
Epoch: 261
```

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Loss on hold-out set: 0.002619889082520136
MeanAbsoluteError value on hold-out data: 0.044654831290245056
Epoch: 262

Loss on hold-out set: 0.004295382216306669
MeanAbsoluteError value on hold-out data: 0.06276174634695053
Epoch: 263
Loss on hold-out set: 0.0004601250153167972
MeanAbsoluteError value on hold-out data: 0.019183451309800148
Epoch: 264

Loss on hold-out set: 0.0008223763267908778
MeanAbsoluteError value on hold-out data: 0.02585229091346264
Epoch: 265
Loss on hold-out set: 0.002109797571652702
MeanAbsoluteError value on hold-out data: 0.04140870273113251
Epoch: 266

Loss on hold-out set: 0.00027464051839030745
MeanAbsoluteError value on hold-out data: 0.012608340010046959
Epoch: 267
Loss on hold-out set: 0.0019403215597516724
MeanAbsoluteError value on hold-out data: 0.03682593256235123
Epoch: 268
Loss on hold-out set: 0.0006580595592302936
MeanAbsoluteError value on hold-out data: 0.024446317926049232
Epoch: 269

Loss on hold-out set: 8.80131046869792e-05
MeanAbsoluteError value on hold-out data: 0.007496235892176628
Epoch: 270
Loss on hold-out set: 0.00020437167924163596
MeanAbsoluteError value on hold-out data: 0.011958938091993332
Epoch: 271

Loss on hold-out set: 0.0025018189168934312
MeanAbsoluteError value on hold-out data: 0.046710167080163956
Epoch: 272
Loss on hold-out set: 0.00021546411569163735
MeanAbsoluteError value on hold-out data: 0.012903470546007156
Epoch: 273
```

```
Loss on hold-out set: 0.004126942849584988
MeanAbsoluteError value on hold-out data: 0.060423966497182846
Epoch: 274
Loss on hold-out set: 0.0012628665593053614
MeanAbsoluteError value on hold-out data: 0.03449925407767296
Epoch: 275
Loss on hold-out set: 0.0014287450217774936
MeanAbsoluteError value on hold-out data: 0.03725054860115051
Epoch: 276

Loss on hold-out set: 0.004026366065123251
MeanAbsoluteError value on hold-out data: 0.058931320905685425
Epoch: 277
Loss on hold-out set: 6.922032688245443e-05
MeanAbsoluteError value on hold-out data: 0.006047551520168781
Epoch: 278

Loss on hold-out set: 0.0014312028319441847
MeanAbsoluteError value on hold-out data: 0.037019114941358566
Epoch: 279
Loss on hold-out set: 0.0008012069738470018
MeanAbsoluteError value on hold-out data: 0.026922371238470078
Epoch: 280

Loss on hold-out set: 0.0006138575720667307
MeanAbsoluteError value on hold-out data: 0.020571725443005562
Epoch: 281
Loss on hold-out set: 0.0023135293241856353
MeanAbsoluteError value on hold-out data: 0.03560870513319969
Epoch: 282
Loss on hold-out set: 0.0036786484332489116
MeanAbsoluteError value on hold-out data: 0.05192061886191368
Epoch: 283

Loss on hold-out set: 0.0011928744913477982
MeanAbsoluteError value on hold-out data: 0.02948881685733795
Epoch: 284
Loss on hold-out set: 0.00010492840634209902
MeanAbsoluteError value on hold-out data: 0.0074938698671758175
Epoch: 285
```

```
Loss on hold-out set: 0.002232404542155564
MeanAbsoluteError value on hold-out data: 0.04260777309536934
Epoch: 286
Loss on hold-out set: 0.0003172790041259889
MeanAbsoluteError value on hold-out data: 0.012985598295927048
Epoch: 287

Loss on hold-out set: 0.000228544237740737
MeanAbsoluteError value on hold-out data: 0.012539074756205082
Epoch: 288
Loss on hold-out set: 8.723509641380847e-05
MeanAbsoluteError value on hold-out data: 0.0074962712824344635
Epoch: 289
Loss on hold-out set: 0.0008796871240649905
MeanAbsoluteError value on hold-out data: 0.02634044736623764
Epoch: 290

Loss on hold-out set: 0.0001513914664558667
MeanAbsoluteError value on hold-out data: 0.010390163399279118
Epoch: 291
Loss on hold-out set: 0.00046502851598363904
MeanAbsoluteError value on hold-out data: 0.019018691033124924
Epoch: 292

Loss on hold-out set: 0.0031667386314698626
MeanAbsoluteError value on hold-out data: 0.046243686228990555
Epoch: 293
Loss on hold-out set: 0.0028445037813591106
MeanAbsoluteError value on hold-out data: 0.03885335847735405
Epoch: 294

Loss on hold-out set: 0.0016491973074153066
MeanAbsoluteError value on hold-out data: 0.03663666173815727
Epoch: 295
Loss on hold-out set: 0.00021037158772482404
MeanAbsoluteError value on hold-out data: 0.011937384493649006
Epoch: 296
Loss on hold-out set: 0.0015804245735385589
MeanAbsoluteError value on hold-out data: 0.03343982249498367
Epoch: 297
```

```
Loss on hold-out set: 0.0008512048433268708
MeanAbsoluteError value on hold-out data: 0.024159185588359833
Epoch: 298
Loss on hold-out set: 0.0002555716741231403
MeanAbsoluteError value on hold-out data: 0.013168703764677048
Epoch: 299

Loss on hold-out set: 0.0008457703765348665
MeanAbsoluteError value on hold-out data: 0.027566907927393913
Epoch: 300
Loss on hold-out set: 0.0005099898096107479
MeanAbsoluteError value on hold-out data: 0.01870850846171379
Epoch: 301

Loss on hold-out set: 0.0013630030443891883
MeanAbsoluteError value on hold-out data: 0.03526576608419418
Epoch: 302
Loss on hold-out set: 0.0006659133733981955
MeanAbsoluteError value on hold-out data: 0.021682333201169968
Epoch: 303
Loss on hold-out set: 0.0012047896993213467
MeanAbsoluteError value on hold-out data: 0.03175126016139984
Epoch: 304

Loss on hold-out set: 0.002519971424979823
MeanAbsoluteError value on hold-out data: 0.047608789056539536
Epoch: 305
Loss on hold-out set: 0.001536051293701998
MeanAbsoluteError value on hold-out data: 0.034505072981119156
Epoch: 306

Loss on hold-out set: 0.00042093912322473315
MeanAbsoluteError value on hold-out data: 0.019032657146453857
Epoch: 307
Loss on hold-out set: 0.0008109589689411223
MeanAbsoluteError value on hold-out data: 0.02656583860516548
Epoch: 308

Loss on hold-out set: 0.00356947976563658
MeanAbsoluteError value on hold-out data: 0.0542239174246788
Epoch: 309
```

```
Loss on hold-out set: 0.00010481029312359169
MeanAbsoluteError value on hold-out data: 0.008441329933702946
Epoch: 310
Loss on hold-out set: 0.0002367207531018981
MeanAbsoluteError value on hold-out data: 0.012966948561370373
Epoch: 311

Loss on hold-out set: 0.0036224364968282835
MeanAbsoluteError value on hold-out data: 0.04923110082745552
Epoch: 312
Loss on hold-out set: 0.000422312254418752
MeanAbsoluteError value on hold-out data: 0.01691390573978424
Epoch: 313

Loss on hold-out set: 0.001333895854518882
MeanAbsoluteError value on hold-out data: 0.026271836832165718
Epoch: 314
Loss on hold-out set: 0.006246769734259162
MeanAbsoluteError value on hold-out data: 0.0763205960392952
Epoch: 315

Loss on hold-out set: 0.001434884815742927
MeanAbsoluteError value on hold-out data: 0.03418368846178055
Early stopping at epoch 314
Fold: 4
Epoch: 1
Loss on hold-out set: 0.04688223744077342
MeanAbsoluteError value on hold-out data: 0.1876939833164215
Epoch: 2
Loss on hold-out set: 0.02127446380576917
MeanAbsoluteError value on hold-out data: 0.11946340650320053
Epoch: 3

Loss on hold-out set: 0.01760082465729543
MeanAbsoluteError value on hold-out data: 0.10706734657287598
Epoch: 4
Loss on hold-out set: 0.02649186085909605
MeanAbsoluteError value on hold-out data: 0.13591963052749634
Epoch: 5
```

```
Loss on hold-out set: 0.02795379050076008
MeanAbsoluteError value on hold-out data: 0.1572069525718689
Epoch: 6
Loss on hold-out set: 0.007951740740931459
MeanAbsoluteError value on hold-out data: 0.07348739355802536
Epoch: 7

Loss on hold-out set: 0.010961592446879618
MeanAbsoluteError value on hold-out data: 0.08761453628540039
Epoch: 8
Loss on hold-out set: 0.02046585482146059
MeanAbsoluteError value on hold-out data: 0.14037488400936127
Epoch: 9
Loss on hold-out set: 0.010403930542192288
MeanAbsoluteError value on hold-out data: 0.07671904563903809
Epoch: 10

Loss on hold-out set: 0.012205181776412896
MeanAbsoluteError value on hold-out data: 0.0913219228386879
Epoch: 11
Loss on hold-out set: 0.006650491251743266
MeanAbsoluteError value on hold-out data: 0.06691498309373856
Epoch: 12

Loss on hold-out set: 0.02121271033372198
MeanAbsoluteError value on hold-out data: 0.14123283326625824
Epoch: 13
Loss on hold-out set: 0.002115838512379144
MeanAbsoluteError value on hold-out data: 0.03603055328130722
Epoch: 14

Loss on hold-out set: 0.0016767889943106898
MeanAbsoluteError value on hold-out data: 0.03617115318775177
Epoch: 15
Loss on hold-out set: 0.0031784106312053545
MeanAbsoluteError value on hold-out data: 0.04728822782635689
Epoch: 16
Loss on hold-out set: 0.003405405940221889
MeanAbsoluteError value on hold-out data: 0.04882211983203888
Epoch: 17
```

```
Loss on hold-out set: 0.004501628290329661
MeanAbsoluteError value on hold-out data: 0.05395860970020294
Epoch: 18
Loss on hold-out set: 0.0022271239681036343
MeanAbsoluteError value on hold-out data: 0.038082629442214966
Epoch: 19

Loss on hold-out set: 0.011909315628664834
MeanAbsoluteError value on hold-out data: 0.1005827933549881
Epoch: 20
Loss on hold-out set: 0.01025930153472083
MeanAbsoluteError value on hold-out data: 0.07187355309724808
Epoch: 21

Loss on hold-out set: 0.006430554170427578
MeanAbsoluteError value on hold-out data: 0.07461285591125488
Epoch: 22
Loss on hold-out set: 0.0030282121317993316
MeanAbsoluteError value on hold-out data: 0.043862804770469666
Epoch: 23
Loss on hold-out set: 0.00110603281895497
MeanAbsoluteError value on hold-out data: 0.02728450484573841
Epoch: 24

Loss on hold-out set: 0.008893291665507215
MeanAbsoluteError value on hold-out data: 0.08326159417629242
Epoch: 25
Loss on hold-out set: 0.016736241855791638
MeanAbsoluteError value on hold-out data: 0.12488215416669846
Epoch: 26

Loss on hold-out set: 0.008042333714131798
MeanAbsoluteError value on hold-out data: 0.08702816814184189
Epoch: 27
Loss on hold-out set: 0.006096590609688844
MeanAbsoluteError value on hold-out data: 0.06926613301038742
Epoch: 28

Loss on hold-out set: 0.0006794966715720616
MeanAbsoluteError value on hold-out data: 0.020199280232191086
Epoch: 29
```

```
Loss on hold-out set: 0.0005544609843387402
MeanAbsoluteError value on hold-out data: 0.01728544756770134
Epoch: 30
Loss on hold-out set: 0.0043138868641108274
MeanAbsoluteError value on hold-out data: 0.05599533021450043
Epoch: 31

Loss on hold-out set: 0.004735222019787345
MeanAbsoluteError value on hold-out data: 0.053641196340322495
Epoch: 32
Loss on hold-out set: 0.0036896620877087116
MeanAbsoluteError value on hold-out data: 0.05053146183490753
Epoch: 33

Loss on hold-out set: 0.017018493797097887
MeanAbsoluteError value on hold-out data: 0.12110992521047592
Epoch: 34
Loss on hold-out set: 0.002125710797762232
MeanAbsoluteError value on hold-out data: 0.04389794170856476
Epoch: 35

Loss on hold-out set: 0.009570909264896597
MeanAbsoluteError value on hold-out data: 0.09423563629388809
Epoch: 36
Loss on hold-out set: 0.0009152104030363262
MeanAbsoluteError value on hold-out data: 0.022493882104754448
Epoch: 37
Loss on hold-out set: 0.0012289152613707951
MeanAbsoluteError value on hold-out data: 0.029803764075040817
Epoch: 38

Loss on hold-out set: 0.001635162060015968
MeanAbsoluteError value on hold-out data: 0.03558909147977829
Epoch: 39
Loss on hold-out set: 0.0003385934666896771
MeanAbsoluteError value on hold-out data: 0.015148533508181572
Epoch: 40

Loss on hold-out set: 0.008408267450119768
MeanAbsoluteError value on hold-out data: 0.07236365973949432
Epoch: 41
```

```
Loss on hold-out set: 0.013447730070246118
MeanAbsoluteError value on hold-out data: 0.09557884931564331
Epoch: 42

Loss on hold-out set: 0.00295532080677471
MeanAbsoluteError value on hold-out data: 0.03930123150348663
Epoch: 43
Loss on hold-out set: 0.008142245434490698
MeanAbsoluteError value on hold-out data: 0.08154100179672241
Epoch: 44
Loss on hold-out set: 0.005879821189280067
MeanAbsoluteError value on hold-out data: 0.07236752659082413
Epoch: 45

Loss on hold-out set: 0.0017502254673412868
MeanAbsoluteError value on hold-out data: 0.03897356614470482
Epoch: 46
Loss on hold-out set: 0.005989655253610441
MeanAbsoluteError value on hold-out data: 0.0739479511976242
Epoch: 47

Loss on hold-out set: 0.006412982475012541
MeanAbsoluteError value on hold-out data: 0.06418418884277344
Epoch: 48
Loss on hold-out set: 0.009928227003131593
MeanAbsoluteError value on hold-out data: 0.09762948006391525
Epoch: 49

Loss on hold-out set: 0.005732485159699406
MeanAbsoluteError value on hold-out data: 0.06107817962765694
Epoch: 50
Loss on hold-out set: 0.002016268986543374
MeanAbsoluteError value on hold-out data: 0.03546404093503952
Epoch: 51
Loss on hold-out set: 0.0009775948419701308
MeanAbsoluteError value on hold-out data: 0.025639059022068977
Epoch: 52

Loss on hold-out set: 0.0007634353657652225
MeanAbsoluteError value on hold-out data: 0.02273053117096424
Epoch: 53
```

```
Loss on hold-out set: 0.006397056792463575
MeanAbsoluteError value on hold-out data: 0.06348779052495956
Epoch: 54

Loss on hold-out set: 0.006010001990944147
MeanAbsoluteError value on hold-out data: 0.07139932364225388
Epoch: 55
Loss on hold-out set: 0.006071690370195678
MeanAbsoluteError value on hold-out data: 0.07114239037036896
Epoch: 56

Loss on hold-out set: 0.0028410418391493814
MeanAbsoluteError value on hold-out data: 0.04613422229886055
Epoch: 57
Loss on hold-out set: 0.000960459843294562
MeanAbsoluteError value on hold-out data: 0.019302168861031532
Epoch: 58
Loss on hold-out set: 0.003906635434499809
MeanAbsoluteError value on hold-out data: 0.059153761714696884
Epoch: 59

Loss on hold-out set: 0.0014284491522370704
MeanAbsoluteError value on hold-out data: 0.030500303953886032
Epoch: 60
Loss on hold-out set: 0.002984963989417468
MeanAbsoluteError value on hold-out data: 0.05186191573739052
Epoch: 61

Loss on hold-out set: 0.004897790827921459
MeanAbsoluteError value on hold-out data: 0.0650111734867096
Epoch: 62
Loss on hold-out set: 0.0007510603713204286
MeanAbsoluteError value on hold-out data: 0.02233574353158474
Epoch: 63

Loss on hold-out set: 0.0033835399579922004
MeanAbsoluteError value on hold-out data: 0.043087296187877655
Epoch: 64
Loss on hold-out set: 0.0018095419426182552
MeanAbsoluteError value on hold-out data: 0.033091746270656586
Epoch: 65
```

```
Loss on hold-out set: 0.005506416583167655
MeanAbsoluteError value on hold-out data: 0.05644581839442253
Epoch: 66

Loss on hold-out set: 0.005895354119794709
MeanAbsoluteError value on hold-out data: 0.07199571281671524
Epoch: 67
Loss on hold-out set: 0.008037685882300138
MeanAbsoluteError value on hold-out data: 0.08478201180696487
Epoch: 68

Loss on hold-out set: 0.005453895744202393
MeanAbsoluteError value on hold-out data: 0.06265638768672943
Epoch: 69
Loss on hold-out set: 0.0025786971008139
MeanAbsoluteError value on hold-out data: 0.046989232301712036
Epoch: 70

Loss on hold-out set: 0.0010188916681467422
MeanAbsoluteError value on hold-out data: 0.02623938024044037
Epoch: 71
Loss on hold-out set: 0.003914075870332974
MeanAbsoluteError value on hold-out data: 0.05559900403022766
Epoch: 72
Loss on hold-out set: 0.0021497606399602126
MeanAbsoluteError value on hold-out data: 0.043689195066690445
Epoch: 73

Loss on hold-out set: 0.003823107707181147
MeanAbsoluteError value on hold-out data: 0.04818389564752579
Epoch: 74
Loss on hold-out set: 0.00023700606834609061
MeanAbsoluteError value on hold-out data: 0.012417706660926342
Epoch: 75

Loss on hold-out set: 0.006208505747573716
MeanAbsoluteError value on hold-out data: 0.06106559932231903
Epoch: 76
Loss on hold-out set: 0.004320008048255529
MeanAbsoluteError value on hold-out data: 0.0545521005988121
Epoch: 77
```

```
Loss on hold-out set: 0.0037106090291802373
MeanAbsoluteError value on hold-out data: 0.049467314034700394
Epoch: 78
Loss on hold-out set: 0.0052416993172041005
MeanAbsoluteError value on hold-out data: 0.06537150591611862
Epoch: 79
Loss on hold-out set: 0.0034381603223404716
MeanAbsoluteError value on hold-out data: 0.046588506549596786
Epoch: 80

Loss on hold-out set: 0.000394850926698252
MeanAbsoluteError value on hold-out data: 0.014569619670510292
Epoch: 81
Loss on hold-out set: 0.009039097931236029
MeanAbsoluteError value on hold-out data: 0.0873139500617981
Epoch: 82

Loss on hold-out set: 0.003341797074036939
MeanAbsoluteError value on hold-out data: 0.05352107062935829
Epoch: 83
Loss on hold-out set: 0.001015261422643172
MeanAbsoluteError value on hold-out data: 0.030300650745630264
Epoch: 84

Loss on hold-out set: 0.0006763659351106201
MeanAbsoluteError value on hold-out data: 0.019979722797870636
Epoch: 85
Loss on hold-out set: 0.003366676258987614
MeanAbsoluteError value on hold-out data: 0.05631875619292259
Epoch: 86
Loss on hold-out set: 0.0004239088863999184
MeanAbsoluteError value on hold-out data: 0.01807374879717827
Epoch: 87

Loss on hold-out set: 0.00016385528579121456
MeanAbsoluteError value on hold-out data: 0.010900869034230709
Epoch: 88
Loss on hold-out set: 0.0009864335962837295
MeanAbsoluteError value on hold-out data: 0.02782885544002056
Epoch: 89
```

```
Loss on hold-out set: 0.0015313135393496072
MeanAbsoluteError value on hold-out data: 0.03571726009249687
Epoch: 90
Loss on hold-out set: 0.00011217446029019942
MeanAbsoluteError value on hold-out data: 0.007677038200199604
Epoch: 91

Loss on hold-out set: 0.002222583712344723
MeanAbsoluteError value on hold-out data: 0.04127757251262665
Epoch: 92
Loss on hold-out set: 0.00039233677047637424
MeanAbsoluteError value on hold-out data: 0.016755493357777596
Epoch: 93
Loss on hold-out set: 0.0002570474223050821
MeanAbsoluteError value on hold-out data: 0.012246254831552505
Epoch: 94

Loss on hold-out set: 0.009134531553302492
MeanAbsoluteError value on hold-out data: 0.0915423333644867
Epoch: 95
Loss on hold-out set: 0.0018550489995894687
MeanAbsoluteError value on hold-out data: 0.040994979441165924
Epoch: 96

Loss on hold-out set: 0.014927359830055918
MeanAbsoluteError value on hold-out data: 0.11589588224887848
Epoch: 97
Loss on hold-out set: 0.0037081038379775627
MeanAbsoluteError value on hold-out data: 0.05893126502633095
Epoch: 98

Loss on hold-out set: 0.00016322299571973936
MeanAbsoluteError value on hold-out data: 0.009245071560144424
Epoch: 99
Loss on hold-out set: 0.0034238696763558047
MeanAbsoluteError value on hold-out data: 0.04713316261768341
Epoch: 100
Loss on hold-out set: 0.0009588818731052535
MeanAbsoluteError value on hold-out data: 0.025964457541704178
Epoch: 101
```

```
Loss on hold-out set: 0.0020317481331793325
MeanAbsoluteError value on hold-out data: 0.03799403831362724
Epoch: 102
Loss on hold-out set: 0.00010646728229143523
MeanAbsoluteError value on hold-out data: 0.008331012912094593
Epoch: 103

Loss on hold-out set: 0.003131284544776593
MeanAbsoluteError value on hold-out data: 0.05402260646224022
Epoch: 104
Loss on hold-out set: 0.004437917377799749
MeanAbsoluteError value on hold-out data: 0.06675771623849869
Epoch: 105

Loss on hold-out set: 0.0016639741703069635
MeanAbsoluteError value on hold-out data: 0.03779032826423645
Epoch: 106
Loss on hold-out set: 0.00032640030881988684
MeanAbsoluteError value on hold-out data: 0.014759724028408527
Epoch: 107
Loss on hold-out set: 0.006635317046727453
MeanAbsoluteError value on hold-out data: 0.07870226353406906
Epoch: 108

Loss on hold-out set: 0.0011798974509084864
MeanAbsoluteError value on hold-out data: 0.027701018378138542
Epoch: 109
Loss on hold-out set: 0.002857663668692112
MeanAbsoluteError value on hold-out data: 0.051329318434000015
Epoch: 110

Loss on hold-out set: 0.0024651331560952322
MeanAbsoluteError value on hold-out data: 0.048135265707969666
Epoch: 111
Loss on hold-out set: 0.003469244743298207
MeanAbsoluteError value on hold-out data: 0.04877227917313576
Epoch: 112

Loss on hold-out set: 0.000260684233840688
MeanAbsoluteError value on hold-out data: 0.013833310455083847
Epoch: 113
```

```
Loss on hold-out set: 0.0003593793932980459
MeanAbsoluteError value on hold-out data: 0.016925711184740067
Epoch: 114
Loss on hold-out set: 0.0007162768160924315
MeanAbsoluteError value on hold-out data: 0.024740329012274742
Epoch: 115

Loss on hold-out set: 0.0007353958415998412
MeanAbsoluteError value on hold-out data: 0.021746356040239334
Epoch: 116
Loss on hold-out set: 0.0016735381380255734
MeanAbsoluteError value on hold-out data: 0.031233368441462517
Epoch: 117

Loss on hold-out set: 0.0013239756143385811
MeanAbsoluteError value on hold-out data: 0.033628612756729126
Epoch: 118
Loss on hold-out set: 0.004953583303306784
MeanAbsoluteError value on hold-out data: 0.06630987673997879
Epoch: 119

Loss on hold-out set: 0.0014272100358669246
MeanAbsoluteError value on hold-out data: 0.03093252331018448
Epoch: 120
Loss on hold-out set: 0.00011694790945122284
MeanAbsoluteError value on hold-out data: 0.00828008633106947
Epoch: 121
Loss on hold-out set: 0.0008876233976999563
MeanAbsoluteError value on hold-out data: 0.024002613499760628
Epoch: 122

Loss on hold-out set: 0.0031399737511362347
MeanAbsoluteError value on hold-out data: 0.05186443403363228
Epoch: 123
Loss on hold-out set: 0.003638518475262182
MeanAbsoluteError value on hold-out data: 0.05090704932808876
Epoch: 124

Loss on hold-out set: 0.00245781776694847
MeanAbsoluteError value on hold-out data: 0.04300856217741966
Epoch: 125
```

```
Loss on hold-out set: 0.00907655293121934
MeanAbsoluteError value on hold-out data: 0.08394984155893326
Epoch: 126

Loss on hold-out set: 0.01076923031359911
MeanAbsoluteError value on hold-out data: 0.09941601008176804
Epoch: 127
Loss on hold-out set: 0.0003241767865672175
MeanAbsoluteError value on hold-out data: 0.01505371369421482
Epoch: 128
Loss on hold-out set: 0.0005722301346915108
MeanAbsoluteError value on hold-out data: 0.020368481054902077
Epoch: 129

Loss on hold-out set: 0.001656594652948635
MeanAbsoluteError value on hold-out data: 0.03875025734305382
Epoch: 130
Loss on hold-out set: 0.00032325043243223
MeanAbsoluteError value on hold-out data: 0.015303459018468857
Epoch: 131

Loss on hold-out set: 0.0017225888025547778
MeanAbsoluteError value on hold-out data: 0.03542793169617653
Epoch: 132
Loss on hold-out set: 0.0004714314252071615
MeanAbsoluteError value on hold-out data: 0.018787100911140442
Epoch: 133

Loss on hold-out set: 0.004122018381687147
MeanAbsoluteError value on hold-out data: 0.06378442049026489
Epoch: 134
Loss on hold-out set: 0.00034672796027734876
MeanAbsoluteError value on hold-out data: 0.015849489718675613
Epoch: 135
Loss on hold-out set: 0.00018281911304386864
MeanAbsoluteError value on hold-out data: 0.010531164705753326
Epoch: 136

Loss on hold-out set: 0.0021615722050358143
MeanAbsoluteError value on hold-out data: 0.04570053145289421
Epoch: 137
```

```
Loss on hold-out set: 0.006069094275257417
MeanAbsoluteError value on hold-out data: 0.07295212149620056
Epoch: 138

Loss on hold-out set: 0.0007907764021573323
MeanAbsoluteError value on hold-out data: 0.01863141357898712
Epoch: 139
Loss on hold-out set: 0.0027343707624822855
MeanAbsoluteError value on hold-out data: 0.03982352092862129
Epoch: 140

Loss on hold-out set: 0.009998367567147528
MeanAbsoluteError value on hold-out data: 0.0887611135840416
Epoch: 141
Loss on hold-out set: 0.0018241738684342376
MeanAbsoluteError value on hold-out data: 0.0394321046769619
Epoch: 142
Loss on hold-out set: 0.0005259453277436218
MeanAbsoluteError value on hold-out data: 0.01967797242105007
Epoch: 143

Loss on hold-out set: 0.00010846870801677661
MeanAbsoluteError value on hold-out data: 0.007988476194441319
Epoch: 144
Loss on hold-out set: 0.0021294106928897755
MeanAbsoluteError value on hold-out data: 0.04423918575048447
Epoch: 145

Loss on hold-out set: 7.898023250163533e-05
MeanAbsoluteError value on hold-out data: 0.007109032943844795
Epoch: 146
Loss on hold-out set: 0.0016434728001643503
MeanAbsoluteError value on hold-out data: 0.031079545617103577
Epoch: 147

Loss on hold-out set: 0.0021893429470115472
MeanAbsoluteError value on hold-out data: 0.04014237970113754
Epoch: 148
Loss on hold-out set: 0.002685270571549024
MeanAbsoluteError value on hold-out data: 0.049489229917526245
Epoch: 149
```

```
Loss on hold-out set: 0.010338918239410435
MeanAbsoluteError value on hold-out data: 0.08489269018173218
Epoch: 150

Loss on hold-out set: 0.0010932480467350356
MeanAbsoluteError value on hold-out data: 0.026307299733161926
Epoch: 151
Loss on hold-out set: 0.00215429428499192
MeanAbsoluteError value on hold-out data: 0.041454702615737915
Epoch: 152

Loss on hold-out set: 0.00041112465052200217
MeanAbsoluteError value on hold-out data: 0.01717458665370941
Epoch: 153
Loss on hold-out set: 0.0021319958614185452
MeanAbsoluteError value on hold-out data: 0.037930890917778015
Epoch: 154

Loss on hold-out set: 0.00031329614284913987
MeanAbsoluteError value on hold-out data: 0.014577124267816544
Epoch: 155
Loss on hold-out set: 8.410983511047172e-05
MeanAbsoluteError value on hold-out data: 0.007045069243758917
Epoch: 156
Loss on hold-out set: 0.005281070047723395
MeanAbsoluteError value on hold-out data: 0.06909583508968353
Epoch: 157

Loss on hold-out set: 0.0023910594006468144
MeanAbsoluteError value on hold-out data: 0.04372468963265419
Epoch: 158
Loss on hold-out set: 0.0003923823533114046
MeanAbsoluteError value on hold-out data: 0.01665465161204338
Epoch: 159

Loss on hold-out set: 0.0023866885541273014
MeanAbsoluteError value on hold-out data: 0.037166398018598557
Epoch: 160
Loss on hold-out set: 0.002153022896631488
MeanAbsoluteError value on hold-out data: 0.03753715381026268
Epoch: 161
```

```
Loss on hold-out set: 0.004852087968694312
MeanAbsoluteError value on hold-out data: 0.06387431919574738
Epoch: 162
Loss on hold-out set: 0.001702212612144649
MeanAbsoluteError value on hold-out data: 0.03944158926606178
Epoch: 163
Loss on hold-out set: 0.0005835036821995995
MeanAbsoluteError value on hold-out data: 0.020134976133704185
Epoch: 164

Loss on hold-out set: 0.00018544805789133534
MeanAbsoluteError value on hold-out data: 0.010605349205434322
Epoch: 165
Loss on hold-out set: 0.00012179328561095255
MeanAbsoluteError value on hold-out data: 0.008851481601595879
Epoch: 166

Loss on hold-out set: 0.00034207781261232285
MeanAbsoluteError value on hold-out data: 0.016254669055342674
Epoch: 167
Loss on hold-out set: 0.0035428812926901238
MeanAbsoluteError value on hold-out data: 0.05383102968335152
Epoch: 168

Loss on hold-out set: 0.00023806870948257192
MeanAbsoluteError value on hold-out data: 0.012077800929546356
Epoch: 169
Loss on hold-out set: 0.0032001749412821873
MeanAbsoluteError value on hold-out data: 0.05295969545841217
Epoch: 170
Loss on hold-out set: 0.0016511257771136506
MeanAbsoluteError value on hold-out data: 0.03599875047802925
Epoch: 171

Loss on hold-out set: 0.00011353339713033555
MeanAbsoluteError value on hold-out data: 0.008359500207006931
Epoch: 172
Loss on hold-out set: 0.005560786928981543
MeanAbsoluteError value on hold-out data: 0.07285922020673752
Epoch: 173
```

```
Loss on hold-out set: 0.0014712743161778366
MeanAbsoluteError value on hold-out data: 0.03667513281106949
Epoch: 174
Loss on hold-out set: 0.0012254957192843513
MeanAbsoluteError value on hold-out data: 0.030281834304332733
Epoch: 175

Loss on hold-out set: 0.000291781902238394
MeanAbsoluteError value on hold-out data: 0.01418524980545044
Epoch: 176
Loss on hold-out set: 9.22805057988236e-05
MeanAbsoluteError value on hold-out data: 0.007775638718158007
Epoch: 177
Loss on hold-out set: 0.003745023161172867
MeanAbsoluteError value on hold-out data: 0.057280153036117554
Epoch: 178

Loss on hold-out set: 0.0007654966320842505
MeanAbsoluteError value on hold-out data: 0.023363731801509857
Epoch: 179
Loss on hold-out set: 0.0010656743875837751
MeanAbsoluteError value on hold-out data: 0.0260129664093256
Epoch: 180

Loss on hold-out set: 0.008150906701173102
MeanAbsoluteError value on hold-out data: 0.08821699023246765
Epoch: 181
Loss on hold-out set: 0.002306694464225854
MeanAbsoluteError value on hold-out data: 0.043853167444467545
Epoch: 182

Loss on hold-out set: 0.0081336201567735
MeanAbsoluteError value on hold-out data: 0.06322531402111053
Epoch: 183
Loss on hold-out set: 0.0015555644474391425
MeanAbsoluteError value on hold-out data: 0.034376360476017
Epoch: 184
Loss on hold-out set: 0.005149579473904201
MeanAbsoluteError value on hold-out data: 0.0700736790895462
Epoch: 185
```

```
Loss on hold-out set: 0.0016848832102758543
MeanAbsoluteError value on hold-out data: 0.038901254534721375
Epoch: 186
Loss on hold-out set: 0.000958348108854677
MeanAbsoluteError value on hold-out data: 0.026243768632411957
Epoch: 187

Loss on hold-out set: 0.0009467066016181239
MeanAbsoluteError value on hold-out data: 0.0262508112937212
Epoch: 188
Loss on hold-out set: 0.003132384403475693
MeanAbsoluteError value on hold-out data: 0.04725879803299904
Epoch: 189

Loss on hold-out set: 8.801178098240468e-05
MeanAbsoluteError value on hold-out data: 0.007934760302305222
Epoch: 190
Loss on hold-out set: 0.01079068479261228
MeanAbsoluteError value on hold-out data: 0.1003178134560585
Epoch: 191
Loss on hold-out set: 0.0003305254545661488
MeanAbsoluteError value on hold-out data: 0.015829119831323624
Epoch: 192

Loss on hold-out set: 0.005798294541559049
MeanAbsoluteError value on hold-out data: 0.07253517955541611
Epoch: 193
Loss on hold-out set: 8.514061223000422e-05
MeanAbsoluteError value on hold-out data: 0.006989547051489353
Epoch: 194

Loss on hold-out set: 0.00011600644834938325
MeanAbsoluteError value on hold-out data: 0.00848025269806385
Epoch: 195
Loss on hold-out set: 0.007288947501885039
MeanAbsoluteError value on hold-out data: 0.06665197759866714
Epoch: 196

Loss on hold-out set: 0.003743580808596952
MeanAbsoluteError value on hold-out data: 0.05770330876111984
Epoch: 197
```

```
Loss on hold-out set: 0.0027208015588777406
MeanAbsoluteError value on hold-out data: 0.05008062720298767
Epoch: 198
Loss on hold-out set: 0.0011139742938602076
MeanAbsoluteError value on hold-out data: 0.026779305189847946
Epoch: 199

Loss on hold-out set: 0.0007908747065812349
MeanAbsoluteError value on hold-out data: 0.024355784058570862
Epoch: 200
Loss on hold-out set: 9.334874942266782e-05
MeanAbsoluteError value on hold-out data: 0.0073331380262970924
Epoch: 201

Loss on hold-out set: 0.0032676985553864923
MeanAbsoluteError value on hold-out data: 0.05333670228719711
Epoch: 202
Loss on hold-out set: 0.004804387489067656
MeanAbsoluteError value on hold-out data: 0.06794757395982742
Epoch: 203

Loss on hold-out set: 0.00035083659791520664
MeanAbsoluteError value on hold-out data: 0.016216782853007317
Epoch: 204
Loss on hold-out set: 0.00039533950829146694
MeanAbsoluteError value on hold-out data: 0.0183851420879364
Epoch: 205
Loss on hold-out set: 0.005418332094060523
MeanAbsoluteError value on hold-out data: 0.07015092670917511
Epoch: 206

Loss on hold-out set: 0.003020330215804279
MeanAbsoluteError value on hold-out data: 0.045796796679496765
Epoch: 207
Loss on hold-out set: 0.0004583119838831148
MeanAbsoluteError value on hold-out data: 0.018394796177744865
Epoch: 208

Loss on hold-out set: 0.005337447925869908
MeanAbsoluteError value on hold-out data: 0.06980177760124207
Epoch: 209
```

```
Loss on hold-out set: 0.0002806128509941378
MeanAbsoluteError value on hold-out data: 0.013368758372962475
Epoch: 210

Loss on hold-out set: 0.00047008680745161006
MeanAbsoluteError value on hold-out data: 0.020013442263007164
Epoch: 211
Loss on hold-out set: 0.0017778878266523992
MeanAbsoluteError value on hold-out data: 0.03415178135037422
Epoch: 212
Loss on hold-out set: 0.000620471642053287
MeanAbsoluteError value on hold-out data: 0.020415358245372772
Epoch: 213

Loss on hold-out set: 0.0064769847917237455
MeanAbsoluteError value on hold-out data: 0.06801584362983704
Epoch: 214
Loss on hold-out set: 0.0006918885254500699
MeanAbsoluteError value on hold-out data: 0.023033753037452698
Epoch: 215

Loss on hold-out set: 0.0014152047224342823
MeanAbsoluteError value on hold-out data: 0.033562928438186646
Epoch: 216
Loss on hold-out set: 0.0003940871829399839
MeanAbsoluteError value on hold-out data: 0.016407392919063568
Epoch: 217

Loss on hold-out set: 0.0032116813651685205
MeanAbsoluteError value on hold-out data: 0.052099522203207016
Epoch: 218
Loss on hold-out set: 0.00035574312953810604
MeanAbsoluteError value on hold-out data: 0.01705080457031727
Epoch: 219
Loss on hold-out set: 0.003368814991387938
MeanAbsoluteError value on hold-out data: 0.055448323488235474
Epoch: 220

Loss on hold-out set: 0.00027213148756085763
MeanAbsoluteError value on hold-out data: 0.014236574061214924
Epoch: 221
```

```
Loss on hold-out set: 0.0009068543357508523
MeanAbsoluteError value on hold-out data: 0.028445011004805565
Epoch: 222

Loss on hold-out set: 0.0009337314737162419
MeanAbsoluteError value on hold-out data: 0.028027139604091644
Epoch: 223
Loss on hold-out set: 0.0006046979438646563
MeanAbsoluteError value on hold-out data: 0.022776884958148003
Epoch: 224

Loss on hold-out set: 0.0003147897680589397
MeanAbsoluteError value on hold-out data: 0.014296706765890121
Epoch: 225
Loss on hold-out set: 0.0013095069942729814
MeanAbsoluteError value on hold-out data: 0.03521133214235306
Epoch: 226
Loss on hold-out set: 0.0002878507179307884
MeanAbsoluteError value on hold-out data: 0.013803954236209393
Epoch: 227

Loss on hold-out set: 0.00518658770514386
MeanAbsoluteError value on hold-out data: 0.06952797621488571
Epoch: 228
Loss on hold-out set: 0.003116988601894783
MeanAbsoluteError value on hold-out data: 0.04686567187309265
Epoch: 229

Loss on hold-out set: 0.0004003804850591613
MeanAbsoluteError value on hold-out data: 0.017396681010723114
Epoch: 230
Loss on hold-out set: 0.000182738496472926
MeanAbsoluteError value on hold-out data: 0.010774941183626652
Epoch: 231

Loss on hold-out set: 0.0010221475884983583
MeanAbsoluteError value on hold-out data: 0.030031317844986916
Epoch: 232
Loss on hold-out set: 0.009188202608908926
MeanAbsoluteError value on hold-out data: 0.08544515818357468
Epoch: 233
```

```
Loss on hold-out set: 0.0013873247329943947
MeanAbsoluteError value on hold-out data: 0.030543312430381775
Epoch: 234

Loss on hold-out set: 0.0007498036221867162
MeanAbsoluteError value on hold-out data: 0.025057988241314888
Epoch: 235
Loss on hold-out set: 0.0008020397342209305
MeanAbsoluteError value on hold-out data: 0.027286197990179062
Epoch: 236

Loss on hold-out set: 0.00144251886688705
MeanAbsoluteError value on hold-out data: 0.03521300479769707
Epoch: 237
Loss on hold-out set: 0.003774573461019567
MeanAbsoluteError value on hold-out data: 0.05676071345806122
Epoch: 238

Loss on hold-out set: 0.0007900372895944331
MeanAbsoluteError value on hold-out data: 0.02279031276702881
Epoch: 239
Loss on hold-out set: 0.0021426649098949774
MeanAbsoluteError value on hold-out data: 0.04523651674389839
Epoch: 240
Loss on hold-out set: 0.0001624333079754641
MeanAbsoluteError value on hold-out data: 0.009361112490296364
Epoch: 241

Loss on hold-out set: 0.00014819103983297412
MeanAbsoluteError value on hold-out data: 0.009757841005921364
Epoch: 242
Loss on hold-out set: 0.003701911274609821
MeanAbsoluteError value on hold-out data: 0.0514884889125824
Epoch: 243

Loss on hold-out set: 0.0002987274991547955
MeanAbsoluteError value on hold-out data: 0.014234006404876709
Epoch: 244
Loss on hold-out set: 0.0004011817218270153
MeanAbsoluteError value on hold-out data: 0.0169538464397192
Epoch: 245
```

```
Loss on hold-out set: 0.0013306868911188627
MeanAbsoluteError value on hold-out data: 0.0303951445966959
Epoch: 246
Loss on hold-out set: 0.002335797662713698
MeanAbsoluteError value on hold-out data: 0.04067239165306091
Epoch: 247
Loss on hold-out set: 0.0034337741256292376
MeanAbsoluteError value on hold-out data: 0.051757894456386566
Epoch: 248

Loss on hold-out set: 0.0031684490719011854
MeanAbsoluteError value on hold-out data: 0.05488308519124985
Epoch: 249
Loss on hold-out set: 0.0008847458105135177
MeanAbsoluteError value on hold-out data: 0.021441496908664703
Epoch: 250

Loss on hold-out set: 0.00014627931886934675
MeanAbsoluteError value on hold-out data: 0.009984537027776241
Epoch: 251
Loss on hold-out set: 0.00034015454626309553
MeanAbsoluteError value on hold-out data: 0.016184426844120026
Epoch: 252

Loss on hold-out set: 0.0007359504483507148
MeanAbsoluteError value on hold-out data: 0.025305941700935364
Epoch: 253
Loss on hold-out set: 0.0032898932362773587
MeanAbsoluteError value on hold-out data: 0.04994157329201698
Epoch: 254
Loss on hold-out set: 0.0062072427411164555
MeanAbsoluteError value on hold-out data: 0.06497225910425186
Epoch: 255

Loss on hold-out set: 0.0004296641335323719
MeanAbsoluteError value on hold-out data: 0.015972940251231194
Epoch: 256
Loss on hold-out set: 0.0010898393894811825
MeanAbsoluteError value on hold-out data: 0.03067842870950699
Epoch: 257
```

```
Loss on hold-out set: 0.0051253302954137325
MeanAbsoluteError value on hold-out data: 0.06552731245756149
Epoch: 258
Loss on hold-out set: 0.0016139230158712184
MeanAbsoluteError value on hold-out data: 0.0333949513733387
Epoch: 259

Loss on hold-out set: 0.0021147465699219276
MeanAbsoluteError value on hold-out data: 0.04524948075413704
Epoch: 260
Loss on hold-out set: 0.00021217266164187874
MeanAbsoluteError value on hold-out data: 0.01102388184517622
Epoch: 261
Loss on hold-out set: 0.0009795471809671394
MeanAbsoluteError value on hold-out data: 0.029121048748493195
Epoch: 262

Loss on hold-out set: 0.0010546116723812052
MeanAbsoluteError value on hold-out data: 0.02500838041305542
Epoch: 263
Loss on hold-out set: 0.006531375792941877
MeanAbsoluteError value on hold-out data: 0.06932581216096878
Epoch: 264

Loss on hold-out set: 0.0008301088154049856
MeanAbsoluteError value on hold-out data: 0.024716243147850037
Epoch: 265
Loss on hold-out set: 0.008049432055226393
MeanAbsoluteError value on hold-out data: 0.08382777124643326
Epoch: 266

Loss on hold-out set: 0.0017607175478977816
MeanAbsoluteError value on hold-out data: 0.03815151005983353
Epoch: 267
Loss on hold-out set: 0.0025046002119779587
MeanAbsoluteError value on hold-out data: 0.04698559269309044
Epoch: 268
Loss on hold-out set: 0.0003830809104588947
MeanAbsoluteError value on hold-out data: 0.01745665818452835
Epoch: 269
```

```
Loss on hold-out set: 0.0025874500861391425
MeanAbsoluteError value on hold-out data: 0.03819449618458748
Epoch: 270
Loss on hold-out set: 0.0008844869610454355
MeanAbsoluteError value on hold-out data: 0.026971841230988503
Epoch: 271

Loss on hold-out set: 0.0004792650433955714
MeanAbsoluteError value on hold-out data: 0.017474958673119545
Epoch: 272
Loss on hold-out set: 0.0015403881802090577
MeanAbsoluteError value on hold-out data: 0.03644505515694618
Epoch: 273

Loss on hold-out set: 0.0003753556842899083
MeanAbsoluteError value on hold-out data: 0.015410810708999634
Early stopping at epoch 272
Fold: 5
Epoch: 1
Loss on hold-out set: 0.03395003133586475
MeanAbsoluteError value on hold-out data: 0.14042934775352478
Epoch: 2
Loss on hold-out set: 0.01883074814187629
MeanAbsoluteError value on hold-out data: 0.10917442291975021
Epoch: 3

Loss on hold-out set: 0.05834906920790672
MeanAbsoluteError value on hold-out data: 0.20151010155677795
Epoch: 4
Loss on hold-out set: 0.004676701750473252
MeanAbsoluteError value on hold-out data: 0.05896316096186638
Epoch: 5

Loss on hold-out set: 0.017753672919103076
MeanAbsoluteError value on hold-out data: 0.11504795402288437
Epoch: 6
Loss on hold-out set: 0.009048507948006903
MeanAbsoluteError value on hold-out data: 0.07619182765483856
Epoch: 7
```

```
Loss on hold-out set: 0.0197152259892651
MeanAbsoluteError value on hold-out data: 0.11987901479005814
Epoch: 8
Loss on hold-out set: 0.01148674903171403
MeanAbsoluteError value on hold-out data: 0.09304458647966385
Epoch: 9
Loss on hold-out set: 0.014175576557006155
MeanAbsoluteError value on hold-out data: 0.10118108987808228
Epoch: 10

Loss on hold-out set: 0.006905710856829371
MeanAbsoluteError value on hold-out data: 0.07213297486305237
Epoch: 11
Loss on hold-out set: 0.00593548035249114
MeanAbsoluteError value on hold-out data: 0.06321413069963455
Epoch: 12

Loss on hold-out set: 0.006123156619391271
MeanAbsoluteError value on hold-out data: 0.0620436891913414
Epoch: 13
Loss on hold-out set: 0.005442792815821511
MeanAbsoluteError value on hold-out data: 0.06818576157093048
Epoch: 14

Loss on hold-out set: 0.046617817665849416
MeanAbsoluteError value on hold-out data: 0.2140822857618332
Epoch: 15
Loss on hold-out set: 0.001290417425999684
MeanAbsoluteError value on hold-out data: 0.028271343559026718
Epoch: 16
Loss on hold-out set: 0.017659399791487625
MeanAbsoluteError value on hold-out data: 0.12688381969928741
Epoch: 17

Loss on hold-out set: 0.00699818626578365
MeanAbsoluteError value on hold-out data: 0.07303004711866379
Epoch: 18
Loss on hold-out set: 0.011851638688572816
MeanAbsoluteError value on hold-out data: 0.10458404570817947
Epoch: 19
```

```
Loss on hold-out set: 0.01965051836201123
MeanAbsoluteError value on hold-out data: 0.13703536987304688
Epoch: 20
Loss on hold-out set: 0.008679914820407118
MeanAbsoluteError value on hold-out data: 0.08102615177631378
Epoch: 21

Loss on hold-out set: 0.0005154624523129314
MeanAbsoluteError value on hold-out data: 0.019373156130313873
Epoch: 22
Loss on hold-out set: 0.0018559191043355636
MeanAbsoluteError value on hold-out data: 0.03740609437227249
Epoch: 23
Loss on hold-out set: 0.0051581472091908965
MeanAbsoluteError value on hold-out data: 0.05749309062957764
Epoch: 24

Loss on hold-out set: 0.0006364238465071789
MeanAbsoluteError value on hold-out data: 0.021564694121479988
Epoch: 25
Loss on hold-out set: 0.0007249519736173429
MeanAbsoluteError value on hold-out data: 0.02243020012974739
Epoch: 26

Loss on hold-out set: 0.015974041340606555
MeanAbsoluteError value on hold-out data: 0.1247953474521637
Epoch: 27
Loss on hold-out set: 0.006245249716032829
MeanAbsoluteError value on hold-out data: 0.06566718965768814
Epoch: 28

Loss on hold-out set: 0.01618885009416512
MeanAbsoluteError value on hold-out data: 0.1190432608127594
Epoch: 29
Loss on hold-out set: 0.0063908896408975124
MeanAbsoluteError value on hold-out data: 0.07548466324806213
Epoch: 30
Loss on hold-out set: 0.0012663061580886798
MeanAbsoluteError value on hold-out data: 0.028469543904066086
Epoch: 31
```

```
Loss on hold-out set: 0.0008393970617492284
MeanAbsoluteError value on hold-out data: 0.02440597489476204
Epoch: 32
Loss on hold-out set: 0.015974584966897964
MeanAbsoluteError value on hold-out data: 0.1142643466591835
Epoch: 33

Loss on hold-out set: 0.0037450307115380254
MeanAbsoluteError value on hold-out data: 0.05572996288537979
Epoch: 34
Loss on hold-out set: 0.01146245574844735
MeanAbsoluteError value on hold-out data: 0.10482729971408844
Epoch: 35

Loss on hold-out set: 0.007197799360645669
MeanAbsoluteError value on hold-out data: 0.08109918236732483
Epoch: 36
Loss on hold-out set: 0.006677177269011736
MeanAbsoluteError value on hold-out data: 0.07766259461641312
Epoch: 37
Loss on hold-out set: 0.0005950879089401237
MeanAbsoluteError value on hold-out data: 0.021150663495063782
Epoch: 38

Loss on hold-out set: 0.002489246328228286
MeanAbsoluteError value on hold-out data: 0.04396200180053711
Epoch: 39
Loss on hold-out set: 0.0009795361215115658
MeanAbsoluteError value on hold-out data: 0.025623176246881485
Epoch: 40

Loss on hold-out set: 0.00018251710987117673
MeanAbsoluteError value on hold-out data: 0.010349879041314125
Epoch: 41
Loss on hold-out set: 0.00027584405948540995
MeanAbsoluteError value on hold-out data: 0.01252426952123642
Epoch: 42

Loss on hold-out set: 0.000414418987929821
MeanAbsoluteError value on hold-out data: 0.017214491963386536
Epoch: 43
```

```
Loss on hold-out set: 0.0032982212557856527
MeanAbsoluteError value on hold-out data: 0.05185425654053688
Epoch: 44
Loss on hold-out set: 0.0008457818101825458
MeanAbsoluteError value on hold-out data: 0.027246719226241112
Epoch: 45

Loss on hold-out set: 0.0032510884837912662
MeanAbsoluteError value on hold-out data: 0.04313608258962631
Epoch: 46
Loss on hold-out set: 0.0008377109853816884
MeanAbsoluteError value on hold-out data: 0.023703157901763916
Epoch: 47

Loss on hold-out set: 0.0053376698467348304
MeanAbsoluteError value on hold-out data: 0.06503138691186905
Epoch: 48
Loss on hold-out set: 0.003453246151496257
MeanAbsoluteError value on hold-out data: 0.04713710397481918
Epoch: 49

Loss on hold-out set: 0.006725573513124671
MeanAbsoluteError value on hold-out data: 0.06629598140716553
Epoch: 50
Loss on hold-out set: 0.0013325185531617276
MeanAbsoluteError value on hold-out data: 0.033598724752664566
Epoch: 51
Loss on hold-out set: 0.002916462457505986
MeanAbsoluteError value on hold-out data: 0.04586957022547722
Epoch: 52

Loss on hold-out set: 0.004734392178111843
MeanAbsoluteError value on hold-out data: 0.06211083382368088
Epoch: 53
Loss on hold-out set: 0.0013463369936549238
MeanAbsoluteError value on hold-out data: 0.029111038893461227
Epoch: 54

Loss on hold-out set: 0.0025718112675739186
MeanAbsoluteError value on hold-out data: 0.048940349370241165
Epoch: 55
```

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Loss on hold-out set: 0.0029435339799549964
MeanAbsoluteError value on hold-out data: 0.0460665337741375
Epoch: 56

Loss on hold-out set: 0.00287231763026544
MeanAbsoluteError value on hold-out data: 0.05362071096897125
Epoch: 57
Loss on hold-out set: 0.00986670549692852
MeanAbsoluteError value on hold-out data: 0.08806810528039932
Epoch: 58
Loss on hold-out set: 0.0006423325227972652
MeanAbsoluteError value on hold-out data: 0.022442109882831573
Epoch: 59

Loss on hold-out set: 0.009749232259179865
MeanAbsoluteError value on hold-out data: 0.09701738506555557
Epoch: 60
Loss on hold-out set: 0.0010995724670855062
MeanAbsoluteError value on hold-out data: 0.030159199610352516
Epoch: 61

Loss on hold-out set: 0.002384207843403731
MeanAbsoluteError value on hold-out data: 0.04785431548953056
Epoch: 62
Loss on hold-out set: 0.0033271088198359522
MeanAbsoluteError value on hold-out data: 0.05538785085082054
Epoch: 63

Loss on hold-out set: 0.0005367964601776164
MeanAbsoluteError value on hold-out data: 0.01939476653933525
Epoch: 64
Loss on hold-out set: 0.01028373877384833
MeanAbsoluteError value on hold-out data: 0.10009199380874634
Epoch: 65
Loss on hold-out set: 0.0033193047690604415
MeanAbsoluteError value on hold-out data: 0.05591451749205589
Epoch: 66

Loss on hold-out set: 0.0022323067033929484
MeanAbsoluteError value on hold-out data: 0.042568206787109375
Epoch: 67
```

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Loss on hold-out set: 0.00027235166479450915
MeanAbsoluteError value on hold-out data: 0.013365711085498333
Epoch: 68

Loss on hold-out set: 0.0007519484830221959
MeanAbsoluteError value on hold-out data: 0.02523404359817505
Epoch: 69
Loss on hold-out set: 0.01010838576725551
MeanAbsoluteError value on hold-out data: 0.09748160094022751
Epoch: 70

Loss on hold-out set: 0.0039397552609443665
MeanAbsoluteError value on hold-out data: 0.05765368789434433
Epoch: 71
Loss on hold-out set: 0.0005724992287079138
MeanAbsoluteError value on hold-out data: 0.019273335114121437
Epoch: 72
Loss on hold-out set: 0.000869651246050905
MeanAbsoluteError value on hold-out data: 0.024312974885106087
Epoch: 73

Loss on hold-out set: 0.008971855576549257
MeanAbsoluteError value on hold-out data: 0.09140851348638535
Epoch: 74
Loss on hold-out set: 0.0005292106652632356
MeanAbsoluteError value on hold-out data: 0.019386764615774155
Epoch: 75

Loss on hold-out set: 0.004700513490076576
MeanAbsoluteError value on hold-out data: 0.06496924161911011
Epoch: 76
Loss on hold-out set: 0.0016599016629957727
MeanAbsoluteError value on hold-out data: 0.038674093782901764
Epoch: 77

Loss on hold-out set: 0.00611420434766582
MeanAbsoluteError value on hold-out data: 0.0749519020318985
Epoch: 78
Loss on hold-out set: 0.004559180832334927
MeanAbsoluteError value on hold-out data: 0.057852353900671005
Epoch: 79
```

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Loss on hold-out set: 0.0006071795277031404
MeanAbsoluteError value on hold-out data: 0.021023424342274666
Epoch: 80

Loss on hold-out set: 0.0006495028335068907
MeanAbsoluteError value on hold-out data: 0.02400062046945095
Epoch: 81
Loss on hold-out set: 0.0019128353700840048
MeanAbsoluteError value on hold-out data: 0.04088207334280014
Epoch: 82

Loss on hold-out set: 0.004781185582812343
MeanAbsoluteError value on hold-out data: 0.06679235398769379
Epoch: 83
Loss on hold-out set: 0.0010342401884762304
MeanAbsoluteError value on hold-out data: 0.0303444005548954
Epoch: 84

Loss on hold-out set: 0.0014368701127490827
MeanAbsoluteError value on hold-out data: 0.034049369394779205
Epoch: 85
Loss on hold-out set: 0.0030003563234848635
MeanAbsoluteError value on hold-out data: 0.04357852414250374
Epoch: 86
Loss on hold-out set: 0.009841362945735455
MeanAbsoluteError value on hold-out data: 0.09258164465427399
Epoch: 87

Loss on hold-out set: 0.005042387039533683
MeanAbsoluteError value on hold-out data: 0.0695156380534172
Epoch: 88
Loss on hold-out set: 0.006290485350681203
MeanAbsoluteError value on hold-out data: 0.06932452321052551
Epoch: 89

Loss on hold-out set: 0.01261124892958573
MeanAbsoluteError value on hold-out data: 0.10146162658929825
Epoch: 90
Loss on hold-out set: 0.0005388029177473592
MeanAbsoluteError value on hold-out data: 0.017390839755535126
Epoch: 91
```

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Loss on hold-out set: 0.00015515656663670337
MeanAbsoluteError value on hold-out data: 0.008938235230743885
Epoch: 92
Loss on hold-out set: 0.0014224508943568384
MeanAbsoluteError value on hold-out data: 0.03462502732872963
Epoch: 93
Loss on hold-out set: 0.0020469055411272813
MeanAbsoluteError value on hold-out data: 0.04171255975961685
Epoch: 94

Loss on hold-out set: 0.006360750711922135
MeanAbsoluteError value on hold-out data: 0.07330108433961868
Epoch: 95
Loss on hold-out set: 0.0005809139869857713
MeanAbsoluteError value on hold-out data: 0.02130131423473358
Epoch: 96

Loss on hold-out set: 0.0006315049415986453
MeanAbsoluteError value on hold-out data: 0.019658369943499565
Epoch: 97
Loss on hold-out set: 0.0027409765337194714
MeanAbsoluteError value on hold-out data: 0.04555072262883186
Epoch: 98

Loss on hold-out set: 0.007005840074270964
MeanAbsoluteError value on hold-out data: 0.07867909967899323
Epoch: 99
Loss on hold-out set: 0.0015930158718089973
MeanAbsoluteError value on hold-out data: 0.03926774114370346
Epoch: 100
Loss on hold-out set: 0.004404149251058698
MeanAbsoluteError value on hold-out data: 0.0581481009721756
Epoch: 101

Loss on hold-out set: 0.004804839812485235
MeanAbsoluteError value on hold-out data: 0.06213228404521942
Epoch: 102
Loss on hold-out set: 0.0025634574204949395
MeanAbsoluteError value on hold-out data: 0.04239627718925476
Epoch: 103
```

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Loss on hold-out set: 0.0014001292708728994
MeanAbsoluteError value on hold-out data: 0.0314301960170269
Epoch: 104
Loss on hold-out set: 0.00839057584692325
MeanAbsoluteError value on hold-out data: 0.08552040904760361
Epoch: 105

Loss on hold-out set: 0.004907779528626374
MeanAbsoluteError value on hold-out data: 0.06747616827487946
Epoch: 106
Loss on hold-out set: 0.00021108550572535023
MeanAbsoluteError value on hold-out data: 0.01063815038651228
Epoch: 107
Loss on hold-out set: 0.0014935180328653327
MeanAbsoluteError value on hold-out data: 0.029916033148765564
Epoch: 108

Loss on hold-out set: 0.0019717726723424028
MeanAbsoluteError value on hold-out data: 0.043650075793266296
Epoch: 109
Loss on hold-out set: 0.0005863371396636856
MeanAbsoluteError value on hold-out data: 0.02108839899301529
Epoch: 110

Loss on hold-out set: 0.0011943982099182904
MeanAbsoluteError value on hold-out data: 0.02918718382716179
Epoch: 111
Loss on hold-out set: 0.0031867934656994684
MeanAbsoluteError value on hold-out data: 0.047932934015989304
Epoch: 112

Loss on hold-out set: 0.0031797337079686777
MeanAbsoluteError value on hold-out data: 0.052595533430576324
Epoch: 113
Loss on hold-out set: 0.0010510811366007797
MeanAbsoluteError value on hold-out data: 0.029250692576169968
Epoch: 114
Loss on hold-out set: 0.0001898109632228235
MeanAbsoluteError value on hold-out data: 0.010677779093384743
Epoch: 115
```

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Loss on hold-out set: 0.0007635392913860935
MeanAbsoluteError value on hold-out data: 0.025329632684588432
Epoch: 116
Loss on hold-out set: 0.0017551689275673457
MeanAbsoluteError value on hold-out data: 0.04055732116103172
Epoch: 117

Loss on hold-out set: 0.0008949827502614685
MeanAbsoluteError value on hold-out data: 0.02892373502254486
Epoch: 118
Loss on hold-out set: 0.0023864625254645944
MeanAbsoluteError value on hold-out data: 0.047117117792367935
Epoch: 119

Loss on hold-out set: 0.0010634755017235875
MeanAbsoluteError value on hold-out data: 0.028108401224017143
Epoch: 120
Loss on hold-out set: 0.0010717541528200464
MeanAbsoluteError value on hold-out data: 0.031645964831113815
Epoch: 121
Loss on hold-out set: 0.001921615912579
MeanAbsoluteError value on hold-out data: 0.03752373531460762
Epoch: 122

Loss on hold-out set: 0.0007295616503272738
MeanAbsoluteError value on hold-out data: 0.024017350748181343
Epoch: 123
Loss on hold-out set: 0.0010114348094378198
MeanAbsoluteError value on hold-out data: 0.030799953266978264
Epoch: 124

Loss on hold-out set: 0.000857406882070271
MeanAbsoluteError value on hold-out data: 0.026713918894529343
Epoch: 125
Loss on hold-out set: 0.002209182645726417
MeanAbsoluteError value on hold-out data: 0.04287073761224747
Epoch: 126

Loss on hold-out set: 0.001798409569476332
MeanAbsoluteError value on hold-out data: 0.035248659551143646
Epoch: 127
```

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Loss on hold-out set: 0.0020687541691586375
MeanAbsoluteError value on hold-out data: 0.035825539380311966
Epoch: 128
Loss on hold-out set: 0.0023984520064134684
MeanAbsoluteError value on hold-out data: 0.046497732400894165
Epoch: 129

Loss on hold-out set: 0.00031414264438873442
MeanAbsoluteError value on hold-out data: 0.013761290349066257
Epoch: 130
Loss on hold-out set: 0.0026627969928085804
MeanAbsoluteError value on hold-out data: 0.04920149967074394
Epoch: 131

Loss on hold-out set: 0.0008186965382524899
MeanAbsoluteError value on hold-out data: 0.02545132488012314
Epoch: 132
Loss on hold-out set: 0.0016647358757576772
MeanAbsoluteError value on hold-out data: 0.037699948996305466
Epoch: 133

Loss on hold-out set: 0.00019511787026463674
MeanAbsoluteError value on hold-out data: 0.011136431246995926
Epoch: 134
Loss on hold-out set: 0.001617181081590908
MeanAbsoluteError value on hold-out data: 0.037175558507442474
Epoch: 135
Loss on hold-out set: 0.0035605247664664474
MeanAbsoluteError value on hold-out data: 0.05204632133245468
Epoch: 136

Loss on hold-out set: 0.0017739319176013982
MeanAbsoluteError value on hold-out data: 0.036187198013067245
Epoch: 137
Loss on hold-out set: 0.006201017714504685
MeanAbsoluteError value on hold-out data: 0.07592163234949112
Epoch: 138

Loss on hold-out set: 0.0035361868129777057
MeanAbsoluteError value on hold-out data: 0.044290147721767426
Epoch: 139
```

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Loss on hold-out set: 0.0027016381999211653
MeanAbsoluteError value on hold-out data: 0.04319020360708237
Epoch: 140

Loss on hold-out set: 0.0011127825959452561
MeanAbsoluteError value on hold-out data: 0.03148740902543068
Epoch: 141
Loss on hold-out set: 0.0026696450409612487
MeanAbsoluteError value on hold-out data: 0.047347407788038254
Epoch: 142
Loss on hold-out set: 0.003578854691503303
MeanAbsoluteError value on hold-out data: 0.057365719228982925
Epoch: 143

Loss on hold-out set: 0.0005381843324617616
MeanAbsoluteError value on hold-out data: 0.021499130874872208
Epoch: 144
Loss on hold-out set: 0.0034370489551552703
MeanAbsoluteError value on hold-out data: 0.05515995994210243
Epoch: 145

Loss on hold-out set: 0.0025861479890798883
MeanAbsoluteError value on hold-out data: 0.04866928607225418
Epoch: 146
Loss on hold-out set: 0.0002622217039710709
MeanAbsoluteError value on hold-out data: 0.012845117598772049
Epoch: 147

Loss on hold-out set: 0.00018200149601658007
MeanAbsoluteError value on hold-out data: 0.009005336090922356
Epoch: 148
Loss on hold-out set: 0.0009088663001810866
MeanAbsoluteError value on hold-out data: 0.024972952902317047
Epoch: 149
Loss on hold-out set: 0.0007974742080218025
MeanAbsoluteError value on hold-out data: 0.023357504978775978
Epoch: 150

Loss on hold-out set: 0.006429407279938459
MeanAbsoluteError value on hold-out data: 0.07287323474884033
Epoch: 151
```

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Loss on hold-out set: 0.003511064685881138
MeanAbsoluteError value on hold-out data: 0.04772542417049408
Epoch: 152

Loss on hold-out set: 0.012307207100093365
MeanAbsoluteError value on hold-out data: 0.10146962851285934
Epoch: 153
Loss on hold-out set: 0.004399538871699146
MeanAbsoluteError value on hold-out data: 0.05988472327589989
Epoch: 154

Loss on hold-out set: 0.001705974290546562
MeanAbsoluteError value on hold-out data: 0.035769347101449966
Epoch: 155
Loss on hold-out set: 0.001339597477843719
MeanAbsoluteError value on hold-out data: 0.03444316238164902
Epoch: 156
Loss on hold-out set: 0.001145715026983193
MeanAbsoluteError value on hold-out data: 0.02720782719552517
Epoch: 157

Loss on hold-out set: 0.004987676395103335
MeanAbsoluteError value on hold-out data: 0.05798967182636261
Epoch: 158
Loss on hold-out set: 0.002092057805774467
MeanAbsoluteError value on hold-out data: 0.035617150366306305
Epoch: 159

Loss on hold-out set: 0.00013691533630273106
MeanAbsoluteError value on hold-out data: 0.00845045130699873
Epoch: 160
Loss on hold-out set: 0.0007596891768376476
MeanAbsoluteError value on hold-out data: 0.024744724854826927
Epoch: 161

Loss on hold-out set: 0.0012240834101768477
MeanAbsoluteError value on hold-out data: 0.033669836819171906
Epoch: 162
Loss on hold-out set: 0.006620109546929598
MeanAbsoluteError value on hold-out data: 0.07955658435821533
Epoch: 163
```

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Loss on hold-out set: 0.0017188847663679294
MeanAbsoluteError value on hold-out data: 0.032013408839702606
Epoch: 164

Loss on hold-out set: 0.00036485993353250833
MeanAbsoluteError value on hold-out data: 0.014156434684991837
Epoch: 165
Loss on hold-out set: 0.00019107339280058762
MeanAbsoluteError value on hold-out data: 0.010283811017870903
Epoch: 166

Loss on hold-out set: 0.001962996503737356
MeanAbsoluteError value on hold-out data: 0.03712223842740059
Epoch: 167
Loss on hold-out set: 0.00037325847577968877
MeanAbsoluteError value on hold-out data: 0.01666896976530552
Epoch: 168

Loss on hold-out set: 0.0051867068479103705
MeanAbsoluteError value on hold-out data: 0.06209788843989372
Epoch: 169
Loss on hold-out set: 0.0017035715780886157
MeanAbsoluteError value on hold-out data: 0.034191522747278214
Epoch: 170
Loss on hold-out set: 0.0008062199839124722
MeanAbsoluteError value on hold-out data: 0.026572898030281067
Epoch: 171

Loss on hold-out set: 0.00510445493273437
MeanAbsoluteError value on hold-out data: 0.06477756053209305
Epoch: 172
Loss on hold-out set: 0.001354768157138356
MeanAbsoluteError value on hold-out data: 0.033672258257865906
Epoch: 173

Loss on hold-out set: 0.0027150994698916164
MeanAbsoluteError value on hold-out data: 0.04952142387628555
Epoch: 174
Loss on hold-out set: 0.0017102118248918227
MeanAbsoluteError value on hold-out data: 0.035305675119161606
Epoch: 175
```

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Loss on hold-out set: 0.0023199784835534437
MeanAbsoluteError value on hold-out data: 0.04522131383419037
Epoch: 176
Loss on hold-out set: 0.00015866230595357983
MeanAbsoluteError value on hold-out data: 0.01022857055068016
Epoch: 177
Loss on hold-out set: 0.00021782011442285563
MeanAbsoluteError value on hold-out data: 0.01129261776804924
Epoch: 178

Loss on hold-out set: 0.0011374352616257966
MeanAbsoluteError value on hold-out data: 0.031914375722408295
Epoch: 179
Loss on hold-out set: 0.0008337346454417067
MeanAbsoluteError value on hold-out data: 0.024803495034575462
Epoch: 180

Loss on hold-out set: 0.0013071275233024998
MeanAbsoluteError value on hold-out data: 0.033872343599796295
Epoch: 181
Loss on hold-out set: 0.0020692895133314388
MeanAbsoluteError value on hold-out data: 0.04306323453783989
Epoch: 182

Loss on hold-out set: 0.003694158579621996
MeanAbsoluteError value on hold-out data: 0.05781036242842674
Epoch: 183
Loss on hold-out set: 0.002376039246363299
MeanAbsoluteError value on hold-out data: 0.046724945306777954
Epoch: 184
Loss on hold-out set: 0.004513122207884278
MeanAbsoluteError value on hold-out data: 0.06363793462514877
Epoch: 185

Loss on hold-out set: 0.0010242500991028333
MeanAbsoluteError value on hold-out data: 0.027754981070756912
Epoch: 186
Loss on hold-out set: 0.0003490721511687817
MeanAbsoluteError value on hold-out data: 0.014591033570468426
Epoch: 187
```

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Loss on hold-out set: 0.0021095608327803867
MeanAbsoluteError value on hold-out data: 0.04354218393564224
Epoch: 188
Loss on hold-out set: 0.00013995305718188838
MeanAbsoluteError value on hold-out data: 0.009003949351608753
Epoch: 189

Loss on hold-out set: 0.0020924881266962203
MeanAbsoluteError value on hold-out data: 0.035859618335962296
Epoch: 190
Loss on hold-out set: 0.0009786377361576473
MeanAbsoluteError value on hold-out data: 0.025248771533370018
Epoch: 191
Loss on hold-out set: 0.0010890610116933072
MeanAbsoluteError value on hold-out data: 0.031216448172926903
Epoch: 192

Loss on hold-out set: 0.0004707838358756687
MeanAbsoluteError value on hold-out data: 0.019127925857901573
Epoch: 193
Loss on hold-out set: 0.002093240984582475
MeanAbsoluteError value on hold-out data: 0.03859071433544159
Epoch: 194

Loss on hold-out set: 0.0005767831878204431
MeanAbsoluteError value on hold-out data: 0.020653752610087395
Epoch: 195
Loss on hold-out set: 0.0006387080523251955
MeanAbsoluteError value on hold-out data: 0.02050618827342987
Epoch: 196

Loss on hold-out set: 0.005690560642895954
MeanAbsoluteError value on hold-out data: 0.06778690963983536
Epoch: 197
Loss on hold-out set: 0.0007529089426887887
MeanAbsoluteError value on hold-out data: 0.02544240653514862
Epoch: 198
Loss on hold-out set: 0.00022182246279304048
MeanAbsoluteError value on hold-out data: 0.0120339784771204
Epoch: 199
```

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Loss on hold-out set: 0.002526320650109223
MeanAbsoluteError value on hold-out data: 0.04733901843428612
Epoch: 200
Loss on hold-out set: 0.0005355210076751453
MeanAbsoluteError value on hold-out data: 0.021439336240291595
Epoch: 201

Loss on hold-out set: 0.0028512250698570695
MeanAbsoluteError value on hold-out data: 0.05185803771018982
Epoch: 202
Loss on hold-out set: 0.0011741146944197161
MeanAbsoluteError value on hold-out data: 0.032693374902009964
Epoch: 203

Loss on hold-out set: 0.002221223632139819
MeanAbsoluteError value on hold-out data: 0.04132853448390961
Epoch: 204
Loss on hold-out set: 0.002485320554114878
MeanAbsoluteError value on hold-out data: 0.04141910374164581
Epoch: 205
Loss on hold-out set: 0.004795807912679655
MeanAbsoluteError value on hold-out data: 0.0574837364256382
Epoch: 206

Loss on hold-out set: 0.0008358044017638479
MeanAbsoluteError value on hold-out data: 0.02597535401582718
Epoch: 207
Loss on hold-out set: 0.00024082111277883605
MeanAbsoluteError value on hold-out data: 0.012590321712195873
Epoch: 208

Loss on hold-out set: 0.0005379031354095787
MeanAbsoluteError value on hold-out data: 0.021715138107538223
Epoch: 209
Loss on hold-out set: 0.003540298718559955
MeanAbsoluteError value on hold-out data: 0.04690900444984436
Epoch: 210

Loss on hold-out set: 0.0013341729728771107
MeanAbsoluteError value on hold-out data: 0.034863900393247604
Epoch: 211
```

```
Loss on hold-out set: 0.0040238230555717435
MeanAbsoluteError value on hold-out data: 0.061570145189762115
Epoch: 212
Loss on hold-out set: 0.00313325844971197
MeanAbsoluteError value on hold-out data: 0.0545680969953537
Epoch: 213

Loss on hold-out set: 0.006393024864207421
MeanAbsoluteError value on hold-out data: 0.07526177167892456
Epoch: 214
Loss on hold-out set: 0.0015846423006483487
MeanAbsoluteError value on hold-out data: 0.037918854504823685
Epoch: 215

Loss on hold-out set: 0.00048340006365573833
MeanAbsoluteError value on hold-out data: 0.018558640033006668
Epoch: 216
Loss on hold-out set: 0.0008144868604306664
MeanAbsoluteError value on hold-out data: 0.026681609451770782
Epoch: 217

Loss on hold-out set: 0.00019271427195885086
MeanAbsoluteError value on hold-out data: 0.011254503391683102
Epoch: 218
Loss on hold-out set: 0.0004816858230956963
MeanAbsoluteError value on hold-out data: 0.020740246400237083
Epoch: 219
Loss on hold-out set: 0.00041828879329841584
MeanAbsoluteError value on hold-out data: 0.016079436987638474
Epoch: 220

Loss on hold-out set: 0.0024443062554512706
MeanAbsoluteError value on hold-out data: 0.042445216327905655
Epoch: 221
Loss on hold-out set: 0.0025048540472718222
MeanAbsoluteError value on hold-out data: 0.040393877774477005
Epoch: 222

Loss on hold-out set: 0.000358820181905425
MeanAbsoluteError value on hold-out data: 0.015188375487923622
Epoch: 223
```

```
Loss on hold-out set: 0.004380184890968459
MeanAbsoluteError value on hold-out data: 0.04891026392579079
Epoch: 224

Loss on hold-out set: 0.00393961276859045
MeanAbsoluteError value on hold-out data: 0.054327595978975296
Epoch: 225
Loss on hold-out set: 0.007832731020503811
MeanAbsoluteError value on hold-out data: 0.07578180730342865
Epoch: 226
Loss on hold-out set: 0.003955890358026538
MeanAbsoluteError value on hold-out data: 0.05931539461016655
Epoch: 227

Loss on hold-out set: 0.002929727846224393
MeanAbsoluteError value on hold-out data: 0.05117862671613693
Epoch: 228
Loss on hold-out set: 0.0012666665466635355
MeanAbsoluteError value on hold-out data: 0.030096840113401413
Epoch: 229

Loss on hold-out set: 0.004044766637629696
MeanAbsoluteError value on hold-out data: 0.06086736172437668
Epoch: 230
Loss on hold-out set: 0.0016845092011083449
MeanAbsoluteError value on hold-out data: 0.038914404809474945
Epoch: 231

Loss on hold-out set: 0.0009634606872818299
MeanAbsoluteError value on hold-out data: 0.02756229229271412
Epoch: 232
Loss on hold-out set: 0.004915433004498482
MeanAbsoluteError value on hold-out data: 0.05833720043301582
Epoch: 233
Loss on hold-out set: 0.00690685272482889
MeanAbsoluteError value on hold-out data: 0.07908985018730164
Epoch: 234

Loss on hold-out set: 0.0013297777124015348
MeanAbsoluteError value on hold-out data: 0.03163386881351471
Epoch: 235
```

```
Loss on hold-out set: 0.0033162630362702267
MeanAbsoluteError value on hold-out data: 0.053438037633895874
Epoch: 236

Loss on hold-out set: 0.005897618364542723
MeanAbsoluteError value on hold-out data: 0.06061984598636627
Epoch: 237
Loss on hold-out set: 0.0011286033966046358
MeanAbsoluteError value on hold-out data: 0.027181582525372505
Epoch: 238

Loss on hold-out set: 0.005278311071119138
MeanAbsoluteError value on hold-out data: 0.05344322323799133
Epoch: 239
Loss on hold-out set: 0.004041396513847368
MeanAbsoluteError value on hold-out data: 0.060829684138298035
Epoch: 240
Loss on hold-out set: 9.090534669147538e-05
MeanAbsoluteError value on hold-out data: 0.007181561551988125
Epoch: 241

Loss on hold-out set: 0.0012892437433557852
MeanAbsoluteError value on hold-out data: 0.0347864031791687
Epoch: 242
Loss on hold-out set: 0.0019203302217647433
MeanAbsoluteError value on hold-out data: 0.03887835890054703
Epoch: 243

Loss on hold-out set: 0.0034101935369627817
MeanAbsoluteError value on hold-out data: 0.0454913005232811
Epoch: 244
Loss on hold-out set: 0.0003176380102688979
MeanAbsoluteError value on hold-out data: 0.015512892045080662
Epoch: 245

Loss on hold-out set: 0.02192400928054537
MeanAbsoluteError value on hold-out data: 0.14500369131565094
Epoch: 246
Loss on hold-out set: 0.0010158982144535653
MeanAbsoluteError value on hold-out data: 0.026567773893475533
Epoch: 247
```

```
Loss on hold-out set: 0.004081564772474978
MeanAbsoluteError value on hold-out data: 0.05273443087935448
Epoch: 248

Loss on hold-out set: 0.0005864952358284167
MeanAbsoluteError value on hold-out data: 0.018861889839172363
Epoch: 249
Loss on hold-out set: 0.0035868900428925243
MeanAbsoluteError value on hold-out data: 0.05708370357751846
Epoch: 250

Loss on hold-out set: 0.001694309537664854
MeanAbsoluteError value on hold-out data: 0.03480027988553047
Epoch: 251
Loss on hold-out set: 0.0007518157861860735
MeanAbsoluteError value on hold-out data: 0.025107741355895996
Epoch: 252

Loss on hold-out set: 0.00019271863233630678
MeanAbsoluteError value on hold-out data: 0.01142696850001812
Epoch: 253
Loss on hold-out set: 0.001642017242764788
MeanAbsoluteError value on hold-out data: 0.035233207046985626
Epoch: 254
Loss on hold-out set: 0.0037210470265043633
MeanAbsoluteError value on hold-out data: 0.05914478749036789
Epoch: 255

Loss on hold-out set: 0.0005475811153051577
MeanAbsoluteError value on hold-out data: 0.02105719782412052
Epoch: 256
Loss on hold-out set: 0.0011838028814444052
MeanAbsoluteError value on hold-out data: 0.028543679043650627
Epoch: 257

Loss on hold-out set: 0.001382809182229851
MeanAbsoluteError value on hold-out data: 0.025955742225050926
Epoch: 258
Loss on hold-out set: 0.007024732285312244
MeanAbsoluteError value on hold-out data: 0.0766320526599884
Epoch: 259
```

```
Loss on hold-out set: 0.0009542630536348692
MeanAbsoluteError value on hold-out data: 0.027926422655582428
Epoch: 260
Loss on hold-out set: 0.007596456711845738
MeanAbsoluteError value on hold-out data: 0.07422497868537903
Epoch: 261
Loss on hold-out set: 0.001767980882764927
MeanAbsoluteError value on hold-out data: 0.035560380667448044
Epoch: 262

Loss on hold-out set: 0.0006326436622267855
MeanAbsoluteError value on hold-out data: 0.01981552690267563
Epoch: 263
Loss on hold-out set: 0.004160741976063166
MeanAbsoluteError value on hold-out data: 0.04950190708041191
Epoch: 264

Loss on hold-out set: 0.0025068696455231737
MeanAbsoluteError value on hold-out data: 0.0468970350921154
Epoch: 265
Loss on hold-out set: 0.00010065810472172285
MeanAbsoluteError value on hold-out data: 0.008111986331641674
Epoch: 266

Loss on hold-out set: 0.0003540618553025914
MeanAbsoluteError value on hold-out data: 0.015016522258520126
Epoch: 267
Loss on hold-out set: 0.001602019083553127
MeanAbsoluteError value on hold-out data: 0.036718934774398804
Epoch: 268
Loss on hold-out set: 0.0016986270701246603
MeanAbsoluteError value on hold-out data: 0.03463192284107208
Epoch: 269

Loss on hold-out set: 0.0026287519306476626
MeanAbsoluteError value on hold-out data: 0.04513929784297943
Epoch: 270
Loss on hold-out set: 0.004652712161519698
MeanAbsoluteError value on hold-out data: 0.059534620493650436
Epoch: 271
```

```
Loss on hold-out set: 0.002488772983529738
MeanAbsoluteError value on hold-out data: 0.03940189257264137
Epoch: 272
Loss on hold-out set: 0.0001756541626361598
MeanAbsoluteError value on hold-out data: 0.010813982225954533
Epoch: 273

Loss on hold-out set: 0.001843134207384927
MeanAbsoluteError value on hold-out data: 0.04072326794266701
Epoch: 274
Loss on hold-out set: 0.00017634209715262323
MeanAbsoluteError value on hold-out data: 0.010697374120354652
Epoch: 275
Loss on hold-out set: 0.001336387059252177
MeanAbsoluteError value on hold-out data: 0.03519072383642197
Epoch: 276

Loss on hold-out set: 0.00022967301525308618
MeanAbsoluteError value on hold-out data: 0.011847326532006264
Epoch: 277
Loss on hold-out set: 0.0023575199634901117
MeanAbsoluteError value on hold-out data: 0.040677156299352646
Epoch: 278

Loss on hold-out set: 0.000155706639296633
MeanAbsoluteError value on hold-out data: 0.009960921481251717
Epoch: 279
Loss on hold-out set: 0.0017344558644773705
MeanAbsoluteError value on hold-out data: 0.040132246911525726
Epoch: 280

Loss on hold-out set: 0.0004476775024418852
MeanAbsoluteError value on hold-out data: 0.017582042142748833
Epoch: 281
Loss on hold-out set: 0.004641274023534996
MeanAbsoluteError value on hold-out data: 0.0640229731798172
Epoch: 282
Loss on hold-out set: 0.0018422697446242506
MeanAbsoluteError value on hold-out data: 0.0384320430457592
Epoch: 283
```

```
Loss on hold-out set: 0.0008540024032949337
MeanAbsoluteError value on hold-out data: 0.027421439066529274
Epoch: 284
Loss on hold-out set: 0.0016044660338333675
MeanAbsoluteError value on hold-out data: 0.039373770356178284
Epoch: 285

Loss on hold-out set: 0.00034666229372045824
MeanAbsoluteError value on hold-out data: 0.014896247535943985
Epoch: 286
Loss on hold-out set: 0.0001581515565963595
MeanAbsoluteError value on hold-out data: 0.010072384029626846
Epoch: 287

Loss on hold-out set: 0.004060472594574094
MeanAbsoluteError value on hold-out data: 0.051989588886499405
Epoch: 288
Loss on hold-out set: 0.003494332078844309
MeanAbsoluteError value on hold-out data: 0.05843168869614601
Epoch: 289
Loss on hold-out set: 0.0009896541596390307
MeanAbsoluteError value on hold-out data: 0.02772539108991623
Epoch: 290

Loss on hold-out set: 0.0024301521480083466
MeanAbsoluteError value on hold-out data: 0.04286724701523781
Epoch: 291
Loss on hold-out set: 0.0005223591828585736
MeanAbsoluteError value on hold-out data: 0.02010704204440117
Epoch: 292

Loss on hold-out set: 0.00039950033325502384
MeanAbsoluteError value on hold-out data: 0.01692287251353264
Epoch: 293
Loss on hold-out set: 0.00016363698211664866
MeanAbsoluteError value on hold-out data: 0.010538420639932156
Epoch: 294

Loss on hold-out set: 0.0014639735122078232
MeanAbsoluteError value on hold-out data: 0.035675808787345886
Epoch: 295
```

```
Loss on hold-out set: 0.00011854121592997606
MeanAbsoluteError value on hold-out data: 0.008383345790207386
Epoch: 296
Loss on hold-out set: 0.004553366319409439
MeanAbsoluteError value on hold-out data: 0.05314900353550911
Epoch: 297

Loss on hold-out set: 0.002554570624072637
MeanAbsoluteError value on hold-out data: 0.04934457316994667
Epoch: 298
Loss on hold-out set: 0.0007124965902351375
MeanAbsoluteError value on hold-out data: 0.02108907885849476
Epoch: 299

Loss on hold-out set: 0.0003087572050779792
MeanAbsoluteError value on hold-out data: 0.012292114086449146
Epoch: 300
Loss on hold-out set: 0.00014163826459220478
MeanAbsoluteError value on hold-out data: 0.009123459458351135
Epoch: 301

Loss on hold-out set: 0.0006701549531758896
MeanAbsoluteError value on hold-out data: 0.02117719128727913
Epoch: 302
Loss on hold-out set: 0.003252528142184019
MeanAbsoluteError value on hold-out data: 0.045757390558719635
Epoch: 303
Loss on hold-out set: 0.0020365421660244465
MeanAbsoluteError value on hold-out data: 0.039817482233047485
Epoch: 304

Loss on hold-out set: 0.002354400831141642
MeanAbsoluteError value on hold-out data: 0.04701405391097069
Epoch: 305
Loss on hold-out set: 0.001352554004240249
MeanAbsoluteError value on hold-out data: 0.033765509724617004
Epoch: 306

Loss on hold-out set: 0.0015587555410872614
MeanAbsoluteError value on hold-out data: 0.03269651532173157
Epoch: 307
```

```
Loss on hold-out set: 0.0020766646401690586
MeanAbsoluteError value on hold-out data: 0.0437045581638813
Epoch: 308

Loss on hold-out set: 0.0006998130369798414
MeanAbsoluteError value on hold-out data: 0.022328250110149384
Epoch: 309
Loss on hold-out set: 0.0006324780988506973
MeanAbsoluteError value on hold-out data: 0.021001286804676056
Epoch: 310
Loss on hold-out set: 0.002083987812511623
MeanAbsoluteError value on hold-out data: 0.03898490592837334
Epoch: 311

Loss on hold-out set: 0.010852064405168806
MeanAbsoluteError value on hold-out data: 0.08042671531438828
Epoch: 312
Loss on hold-out set: 0.002638937705861671
MeanAbsoluteError value on hold-out data: 0.04444699361920357
Epoch: 313

Loss on hold-out set: 0.0012461784561829908
MeanAbsoluteError value on hold-out data: 0.03127582371234894
Epoch: 314
Loss on hold-out set: 0.00047604364226572216
MeanAbsoluteError value on hold-out data: 0.018052438274025917
Epoch: 315

Loss on hold-out set: 0.00013264174439037952
MeanAbsoluteError value on hold-out data: 0.007119547110050917
Epoch: 316
Loss on hold-out set: 0.0004355522188624101
MeanAbsoluteError value on hold-out data: 0.017048420384526253
Epoch: 317
Loss on hold-out set: 0.0010765926646334784
MeanAbsoluteError value on hold-out data: 0.025056330487132072
Epoch: 318

Loss on hold-out set: 0.00442311294110758
MeanAbsoluteError value on hold-out data: 0.05190746858716011
Epoch: 319
```

```
Loss on hold-out set: 0.0018300191150046885
MeanAbsoluteError value on hold-out data: 0.03685469552874565
Epoch: 320

Loss on hold-out set: 0.001524937231027122
MeanAbsoluteError value on hold-out data: 0.03415147215127945
Epoch: 321
Loss on hold-out set: 0.0003725119853957689
MeanAbsoluteError value on hold-out data: 0.015740590170025826
Epoch: 322

Loss on hold-out set: 0.0003468223710245054
MeanAbsoluteError value on hold-out data: 0.014398293569684029
Epoch: 323
Loss on hold-out set: 0.0004505745621697445
MeanAbsoluteError value on hold-out data: 0.019704632461071014
Epoch: 324
Loss on hold-out set: 0.004500046605244279
MeanAbsoluteError value on hold-out data: 0.04726088047027588
Epoch: 325

Loss on hold-out set: 0.0036283831245132853
MeanAbsoluteError value on hold-out data: 0.05175704509019852
Epoch: 326
Loss on hold-out set: 0.00019545522601609782
MeanAbsoluteError value on hold-out data: 0.010948818176984787
Epoch: 327

Loss on hold-out set: 0.0014065262512303889
MeanAbsoluteError value on hold-out data: 0.03251904621720314
Epoch: 328
Loss on hold-out set: 9.232403629409549e-05
MeanAbsoluteError value on hold-out data: 0.006611147429794073
Epoch: 329

Loss on hold-out set: 0.00012715905073231885
MeanAbsoluteError value on hold-out data: 0.009582665748894215
Epoch: 330
Loss on hold-out set: 0.001121156957067017
MeanAbsoluteError value on hold-out data: 0.026612792164087296
Epoch: 331
```

```
Loss on hold-out set: 0.0007965383057515803
MeanAbsoluteError value on hold-out data: 0.024924838915467262
Epoch: 332

Loss on hold-out set: 0.00015513592474495193
MeanAbsoluteError value on hold-out data: 0.008465221151709557
Epoch: 333
Loss on hold-out set: 0.0008080271904223732
MeanAbsoluteError value on hold-out data: 0.025330962613224983
Epoch: 334

Loss on hold-out set: 0.00016772029110662906
MeanAbsoluteError value on hold-out data: 0.010741928592324257
Epoch: 335
Loss on hold-out set: 0.001095007240240063
MeanAbsoluteError value on hold-out data: 0.026157284155488014
Epoch: 336

Loss on hold-out set: 0.001681836205534637
MeanAbsoluteError value on hold-out data: 0.033020634204149246
Epoch: 337
Loss on hold-out set: 0.0016798195096531085
MeanAbsoluteError value on hold-out data: 0.035400234162807465
Epoch: 338
Loss on hold-out set: 0.0013100575680644916
MeanAbsoluteError value on hold-out data: 0.029300382360816002
Epoch: 339

Loss on hold-out set: 0.001528263175194817
MeanAbsoluteError value on hold-out data: 0.030691182240843773
Epoch: 340
Loss on hold-out set: 0.0007760794417533491
MeanAbsoluteError value on hold-out data: 0.026334166526794434
Epoch: 341

Loss on hold-out set: 0.00016058057683819373
MeanAbsoluteError value on hold-out data: 0.009564856067299843
Epoch: 342
Loss on hold-out set: 0.002510168423343982
MeanAbsoluteError value on hold-out data: 0.04852212965488434
Epoch: 343
```

```
Loss on hold-out set: 0.0014238459157890507
MeanAbsoluteError value on hold-out data: 0.030299782752990723
Epoch: 344
Loss on hold-out set: 0.005570943201226848
MeanAbsoluteError value on hold-out data: 0.06956878304481506
Epoch: 345
Loss on hold-out set: 0.0012140285190460937
MeanAbsoluteError value on hold-out data: 0.032636579126119614
Epoch: 346

Loss on hold-out set: 0.000907897633234305
MeanAbsoluteError value on hold-out data: 0.024960191920399666
Epoch: 347
Loss on hold-out set: 0.002771648029530687
MeanAbsoluteError value on hold-out data: 0.04527794197201729
Epoch: 348

Loss on hold-out set: 0.0005651740606741182
MeanAbsoluteError value on hold-out data: 0.020214302465319633
Epoch: 349
Loss on hold-out set: 0.0016484253241547517
MeanAbsoluteError value on hold-out data: 0.03504985198378563
Epoch: 350

Loss on hold-out set: 0.0027244966477155685
MeanAbsoluteError value on hold-out data: 0.046582549810409546
Epoch: 351
Loss on hold-out set: 0.001901695754245988
MeanAbsoluteError value on hold-out data: 0.038080863654613495
Epoch: 352
Loss on hold-out set: 0.00036366474315790195
MeanAbsoluteError value on hold-out data: 0.0158853679895401
Epoch: 353

Loss on hold-out set: 0.0004601288653377976
MeanAbsoluteError value on hold-out data: 0.017947634682059288
Epoch: 354
Loss on hold-out set: 0.0001287232067365299
MeanAbsoluteError value on hold-out data: 0.009114639833569527
Epoch: 355
```

```
Loss on hold-out set: 0.0024059258035517166
MeanAbsoluteError value on hold-out data: 0.045290507376194
Epoch: 356
Loss on hold-out set: 0.006430578418076038
MeanAbsoluteError value on hold-out data: 0.0746472179889679
Epoch: 357

Loss on hold-out set: 0.00011330014915854138
MeanAbsoluteError value on hold-out data: 0.008150506764650345
Epoch: 358
Loss on hold-out set: 0.00018628229008754715
MeanAbsoluteError value on hold-out data: 0.010839588940143585
Epoch: 359
Loss on hold-out set: 0.001722057449764439
MeanAbsoluteError value on hold-out data: 0.03389100730419159
Epoch: 360

Loss on hold-out set: 0.00014893079112100947
MeanAbsoluteError value on hold-out data: 0.009628229774534702
Epoch: 361
Loss on hold-out set: 0.001012221203252141
MeanAbsoluteError value on hold-out data: 0.027125811204314232
Epoch: 362

Loss on hold-out set: 0.0007658840622752905
MeanAbsoluteError value on hold-out data: 0.021778983995318413
Epoch: 363
Loss on hold-out set: 0.000318124915273594
MeanAbsoluteError value on hold-out data: 0.01570398546755314
Epoch: 364

Loss on hold-out set: 0.0020449224393814802
MeanAbsoluteError value on hold-out data: 0.04123269021511078
Epoch: 365
Loss on hold-out set: 0.002864634252286383
MeanAbsoluteError value on hold-out data: 0.05040140077471733
Epoch: 366
Loss on hold-out set: 0.008964080696127244
MeanAbsoluteError value on hold-out data: 0.07818316668272018
Epoch: 367
```

```
Loss on hold-out set: 0.000803051283583045
MeanAbsoluteError value on hold-out data: 0.02555656246840954
Epoch: 368
Loss on hold-out set: 0.010328433609434537
MeanAbsoluteError value on hold-out data: 0.09535989165306091
Early stopping at epoch 367
Fold: 6
Epoch: 1

Loss on hold-out set: 0.04055541753768921
MeanAbsoluteError value on hold-out data: 0.16570967435836792
Epoch: 2
Loss on hold-out set: 0.01000935457912939
MeanAbsoluteError value on hold-out data: 0.08177273720502853
Epoch: 3

Loss on hold-out set: 0.014297113288193941
MeanAbsoluteError value on hold-out data: 0.10168824344873428
Epoch: 4
Loss on hold-out set: 0.006281637120991945
MeanAbsoluteError value on hold-out data: 0.06473641097545624
Epoch: 5
Loss on hold-out set: 0.0072905393317341805
MeanAbsoluteError value on hold-out data: 0.06276439875364304
Epoch: 6

Loss on hold-out set: 0.0164438361035926
MeanAbsoluteError value on hold-out data: 0.11998803168535233
Epoch: 7
Loss on hold-out set: 0.012632442837847131
MeanAbsoluteError value on hold-out data: 0.10879091173410416
Epoch: 8

Loss on hold-out set: 0.030733564336385046
MeanAbsoluteError value on hold-out data: 0.1729031354188919
Epoch: 9
Loss on hold-out set: 0.023559088552636758
MeanAbsoluteError value on hold-out data: 0.13819091022014618
Epoch: 10
```

```
Loss on hold-out set: 0.003171117909784828
MeanAbsoluteError value on hold-out data: 0.051423825323581696
Epoch: 11
Loss on hold-out set: 0.0038010513609541313
MeanAbsoluteError value on hold-out data: 0.050093136727809906
Epoch: 12
Loss on hold-out set: 0.0047594292222389156
MeanAbsoluteError value on hold-out data: 0.06013433635234833
Epoch: 13

Loss on hold-out set: 0.008683661464601755
MeanAbsoluteError value on hold-out data: 0.08546151220798492
Epoch: 14
Loss on hold-out set: 0.0017535896539422019
MeanAbsoluteError value on hold-out data: 0.030248107388615608
Epoch: 15

Loss on hold-out set: 0.035565810544150214
MeanAbsoluteError value on hold-out data: 0.1863715499639511
Epoch: 16
Loss on hold-out set: 0.00560091861656734
MeanAbsoluteError value on hold-out data: 0.07042759656906128
Epoch: 17

Loss on hold-out set: 0.012621867803058453
MeanAbsoluteError value on hold-out data: 0.0967695489525795
Epoch: 18
Loss on hold-out set: 0.002549826184154621
MeanAbsoluteError value on hold-out data: 0.03855590522289276
Epoch: 19
Loss on hold-out set: 0.0008636532999974276
MeanAbsoluteError value on hold-out data: 0.025818277150392532
Epoch: 20

Loss on hold-out set: 0.0033699954094897422
MeanAbsoluteError value on hold-out data: 0.04046405851840973
Epoch: 21
Loss on hold-out set: 0.016133719789130346
MeanAbsoluteError value on hold-out data: 0.10004346072673798
Epoch: 22
```

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Loss on hold-out set: 0.0006219131319085136
MeanAbsoluteError value on hold-out data: 0.020199701189994812
Epoch: 23
Loss on hold-out set: 0.0037277615629136562
MeanAbsoluteError value on hold-out data: 0.05433005467057228
Epoch: 24

Loss on hold-out set: 0.0099853818703975
MeanAbsoluteError value on hold-out data: 0.09526866674423218
Epoch: 25
Loss on hold-out set: 0.0233036426029035
MeanAbsoluteError value on hold-out data: 0.1510845422744751
Epoch: 26
Loss on hold-out set: 0.0003373702326955806
MeanAbsoluteError value on hold-out data: 0.014220904558897018
Epoch: 27

Loss on hold-out set: 0.004272089738930974
MeanAbsoluteError value on hold-out data: 0.06141354516148567
Epoch: 28
Loss on hold-out set: 0.0013343753401256566
MeanAbsoluteError value on hold-out data: 0.024740159511566162
Epoch: 29

Loss on hold-out set: 0.005877926812640258
MeanAbsoluteError value on hold-out data: 0.07290506362915039
Epoch: 30
Loss on hold-out set: 0.0009886991049695229
MeanAbsoluteError value on hold-out data: 0.025357414036989212
Epoch: 31

Loss on hold-out set: 0.005558068864047527
MeanAbsoluteError value on hold-out data: 0.05760190635919571
Epoch: 32
Loss on hold-out set: 0.001400016397903008
MeanAbsoluteError value on hold-out data: 0.030285079032182693
Epoch: 33
Loss on hold-out set: 0.0012822869092425598
MeanAbsoluteError value on hold-out data: 0.029239987954497337
Epoch: 34
```

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Loss on hold-out set: 0.0314057461385216
MeanAbsoluteError value on hold-out data: 0.16790932416915894
Epoch: 35
Loss on hold-out set: 0.0040708954246448615
MeanAbsoluteError value on hold-out data: 0.0526781789958477
Epoch: 36

Loss on hold-out set: 0.007708702036844832
MeanAbsoluteError value on hold-out data: 0.08140673488378525
Epoch: 37
Loss on hold-out set: 0.0005293194886430033
MeanAbsoluteError value on hold-out data: 0.017364056780934334
Epoch: 38

Loss on hold-out set: 0.006340643923197474
MeanAbsoluteError value on hold-out data: 0.07687768340110779
Epoch: 39
Loss on hold-out set: 0.010744149131434304
MeanAbsoluteError value on hold-out data: 0.09380318969488144
Epoch: 40
Loss on hold-out set: 0.0008965546938790274
MeanAbsoluteError value on hold-out data: 0.024092897772789
Epoch: 41

Loss on hold-out set: 0.0006285259774553456
MeanAbsoluteError value on hold-out data: 0.020669246092438698
Epoch: 42
Loss on hold-out set: 0.01821442081459931
MeanAbsoluteError value on hold-out data: 0.1344372183084488
Epoch: 43

Loss on hold-out set: 0.00995349371805787
MeanAbsoluteError value on hold-out data: 0.0724499449133873
Epoch: 44
Loss on hold-out set: 0.00030907787731848657
MeanAbsoluteError value on hold-out data: 0.01326350960880518
Epoch: 45

Loss on hold-out set: 0.0002869542222470045
MeanAbsoluteError value on hold-out data: 0.012491796165704727
Epoch: 46
```

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Loss on hold-out set: 0.003363060182891786
MeanAbsoluteError value on hold-out data: 0.051815904676914215
Epoch: 47
Loss on hold-out set: 0.00442059973387846
MeanAbsoluteError value on hold-out data: 0.055596064776182175
Epoch: 48

Loss on hold-out set: 0.000455340208385938
MeanAbsoluteError value on hold-out data: 0.0161965973675251
Epoch: 49
Loss on hold-out set: 0.0013411878441859568
MeanAbsoluteError value on hold-out data: 0.03297845274209976
Epoch: 50

Loss on hold-out set: 0.0034703457328890052
MeanAbsoluteError value on hold-out data: 0.05078432708978653
Epoch: 51
Loss on hold-out set: 0.0006861098393398736
MeanAbsoluteError value on hold-out data: 0.023936066776514053
Epoch: 52

Loss on hold-out set: 0.007537365491901126
MeanAbsoluteError value on hold-out data: 0.08392834663391113
Epoch: 53
Loss on hold-out set: 0.0017807711431357478
MeanAbsoluteError value on hold-out data: 0.03486748784780502
Epoch: 54
Loss on hold-out set: 0.00116722407983616
MeanAbsoluteError value on hold-out data: 0.03132150322198868
Epoch: 55

Loss on hold-out set: 0.002293749845453671
MeanAbsoluteError value on hold-out data: 0.04447769746184349
Epoch: 56
Loss on hold-out set: 0.0023465763411617707
MeanAbsoluteError value on hold-out data: 0.042255889624357224
Epoch: 57

Loss on hold-out set: 0.009261930361390114
MeanAbsoluteError value on hold-out data: 0.08488516509532928
Epoch: 58
```

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Loss on hold-out set: 0.0030317012486713274
MeanAbsoluteError value on hold-out data: 0.04904928803443909
Epoch: 59

Loss on hold-out set: 0.0030852273838328464
MeanAbsoluteError value on hold-out data: 0.053175102919340134
Epoch: 60
Loss on hold-out set: 0.002812319002779467
MeanAbsoluteError value on hold-out data: 0.04851393774151802
Epoch: 61
Loss on hold-out set: 0.000247556934482418
MeanAbsoluteError value on hold-out data: 0.012547832913696766
Epoch: 62

Loss on hold-out set: 0.0017418777736436044
MeanAbsoluteError value on hold-out data: 0.041099514812231064
Epoch: 63
Loss on hold-out set: 0.003990253599892769
MeanAbsoluteError value on hold-out data: 0.0533825047314167
Epoch: 64

Loss on hold-out set: 0.00028571629913390746
MeanAbsoluteError value on hold-out data: 0.013418072834610939
Epoch: 65
Loss on hold-out set: 0.006263316475919315
MeanAbsoluteError value on hold-out data: 0.07505626976490021
Epoch: 66

Loss on hold-out set: 0.010918614587613515
MeanAbsoluteError value on hold-out data: 0.10393820703029633
Epoch: 67
Loss on hold-out set: 0.00041866886645688543
MeanAbsoluteError value on hold-out data: 0.015000895597040653
Epoch: 68
Loss on hold-out set: 0.00046112339311678497
MeanAbsoluteError value on hold-out data: 0.016640936955809593
Epoch: 69

Loss on hold-out set: 0.006290999241173267
MeanAbsoluteError value on hold-out data: 0.07023963332176208
Epoch: 70
```

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Loss on hold-out set: 0.01674427038856915
MeanAbsoluteError value on hold-out data: 0.10517889261245728
Epoch: 71

Loss on hold-out set: 0.00025854330202231198
MeanAbsoluteError value on hold-out data: 0.011662044562399387
Epoch: 72
Loss on hold-out set: 0.00030406942927844023
MeanAbsoluteError value on hold-out data: 0.0141169847920537
Epoch: 73

Loss on hold-out set: 0.0075750274450651234
MeanAbsoluteError value on hold-out data: 0.08556787669658661
Epoch: 74
Loss on hold-out set: 0.000425052666936868
MeanAbsoluteError value on hold-out data: 0.018215015530586243
Epoch: 75
Loss on hold-out set: 0.007762699321444545
MeanAbsoluteError value on hold-out data: 0.07511304318904877
Epoch: 76

Loss on hold-out set: 0.006056262379778283
MeanAbsoluteError value on hold-out data: 0.06099525839090347
Epoch: 77
Loss on hold-out set: 0.004017998763759222
MeanAbsoluteError value on hold-out data: 0.048911355435848236
Epoch: 78

Loss on hold-out set: 0.0021545206296390723
MeanAbsoluteError value on hold-out data: 0.04405377060174942
Epoch: 79
Loss on hold-out set: 0.0003262327497525673
MeanAbsoluteError value on hold-out data: 0.012805181555449963
Epoch: 80

Loss on hold-out set: 0.001900842845706003
MeanAbsoluteError value on hold-out data: 0.04201807454228401
Epoch: 81
Loss on hold-out set: 0.0020368878530072315
MeanAbsoluteError value on hold-out data: 0.040015917271375656
Epoch: 82
```

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Loss on hold-out set: 0.0004966584632971457
MeanAbsoluteError value on hold-out data: 0.0192407239228487
Epoch: 83

Loss on hold-out set: 0.00012923781157171885
MeanAbsoluteError value on hold-out data: 0.009503506124019623
Epoch: 84
Loss on hold-out set: 0.0029179841346506563
MeanAbsoluteError value on hold-out data: 0.045404985547065735
Epoch: 85

Loss on hold-out set: 0.004135374511991229
MeanAbsoluteError value on hold-out data: 0.061000000685453415
Epoch: 86
Loss on hold-out set: 0.0020164656951757415
MeanAbsoluteError value on hold-out data: 0.03392082080245018
Epoch: 87

Loss on hold-out set: 0.00239003193564713
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Epoch: 88
Loss on hold-out set: 0.0006061695541055607
MeanAbsoluteError value on hold-out data: 0.019733989611268044
Epoch: 89
Loss on hold-out set: 0.0026218697728056994
MeanAbsoluteError value on hold-out data: 0.042559538036584854
Epoch: 90

Loss on hold-out set: 0.0012010287360421249
MeanAbsoluteError value on hold-out data: 0.03061753511428833
Epoch: 91
Loss on hold-out set: 0.0039097511076501435
MeanAbsoluteError value on hold-out data: 0.061041299253702164
Epoch: 92

Loss on hold-out set: 0.0024927844060584903
MeanAbsoluteError value on hold-out data: 0.042631082236766815
Epoch: 93
Loss on hold-out set: 0.0017689898876207216
MeanAbsoluteError value on hold-out data: 0.0379251092672348
Epoch: 94
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Loss on hold-out set: 0.0006849264526473624
MeanAbsoluteError value on hold-out data: 0.020749714225530624
Epoch: 95
Loss on hold-out set: 0.0013799629190803639
MeanAbsoluteError value on hold-out data: 0.030263839289546013
Epoch: 96
Loss on hold-out set: 0.0024956930595050964
MeanAbsoluteError value on hold-out data: 0.04117485135793686
Epoch: 97

Loss on hold-out set: 0.002381403647762324
MeanAbsoluteError value on hold-out data: 0.04518650099635124
Epoch: 98
Loss on hold-out set: 0.0008293045352080039
MeanAbsoluteError value on hold-out data: 0.021383769810199738
Epoch: 99

Loss on hold-out set: 0.002113603171892464
MeanAbsoluteError value on hold-out data: 0.044999781996011734
Epoch: 100
Loss on hold-out set: 0.0005309194613281372
MeanAbsoluteError value on hold-out data: 0.02034401334822178
Epoch: 101

Loss on hold-out set: 0.0008448975900786795
MeanAbsoluteError value on hold-out data: 0.023082049563527107
Epoch: 102
Loss on hold-out set: 0.002305322210304439
MeanAbsoluteError value on hold-out data: 0.034821778535842896
Epoch: 103
Loss on hold-out set: 0.004409511041428361
MeanAbsoluteError value on hold-out data: 0.053216077387332916
Epoch: 104

Loss on hold-out set: 0.0034880388993769884
MeanAbsoluteError value on hold-out data: 0.051445361226797104
Epoch: 105
Loss on hold-out set: 0.0034873068964641008
MeanAbsoluteError value on hold-out data: 0.04973282665014267
Epoch: 106
```

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Loss on hold-out set: 0.0028383222608161823
MeanAbsoluteError value on hold-out data: 0.04942679405212402
Epoch: 107
Loss on hold-out set: 0.00019354515825398266
MeanAbsoluteError value on hold-out data: 0.010186869651079178
Epoch: 108

Loss on hold-out set: 0.002230580979292946
MeanAbsoluteError value on hold-out data: 0.04184344410896301
Epoch: 109
Loss on hold-out set: 0.0031738052078123602
MeanAbsoluteError value on hold-out data: 0.05283980071544647
Epoch: 110
Loss on hold-out set: 0.0024813059883724365
MeanAbsoluteError value on hold-out data: 0.044314589351415634
Epoch: 111

Loss on hold-out set: 0.0014896154194242886
MeanAbsoluteError value on hold-out data: 0.03430011868476868
Epoch: 112
Loss on hold-out set: 0.003278856332014714
MeanAbsoluteError value on hold-out data: 0.0464923270046711
Epoch: 113

Loss on hold-out set: 0.000215047417441383
MeanAbsoluteError value on hold-out data: 0.01234378106892109
Epoch: 114
Loss on hold-out set: 0.002195945126004517
MeanAbsoluteError value on hold-out data: 0.04331246763467789
Epoch: 115

Loss on hold-out set: 0.005428256932646036
MeanAbsoluteError value on hold-out data: 0.0700594112277031
Epoch: 116
Loss on hold-out set: 0.00026183127192780375
MeanAbsoluteError value on hold-out data: 0.013543481938540936
Epoch: 117
Loss on hold-out set: 0.004372377015118088
MeanAbsoluteError value on hold-out data: 0.06404102593660355
Epoch: 118
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Loss on hold-out set: 0.020184843401823725
MeanAbsoluteError value on hold-out data: 0.13062439858913422
Epoch: 119
Loss on hold-out set: 0.006701206156451788
MeanAbsoluteError value on hold-out data: 0.07169223576784134
Epoch: 120

Loss on hold-out set: 0.0028463590923430665
MeanAbsoluteError value on hold-out data: 0.05301060155034065
Epoch: 121
Loss on hold-out set: 0.001370539822216545
MeanAbsoluteError value on hold-out data: 0.026157641783356667
Epoch: 122

Loss on hold-out set: 0.0030562151888651507
MeanAbsoluteError value on hold-out data: 0.04461997002363205
Epoch: 123
Loss on hold-out set: 0.00110182909494532
MeanAbsoluteError value on hold-out data: 0.026948682963848114
Epoch: 124
Loss on hold-out set: 0.003034146801967706
MeanAbsoluteError value on hold-out data: 0.04963081330060959
Epoch: 125

Loss on hold-out set: 0.0038940306819443193
MeanAbsoluteError value on hold-out data: 0.06096518412232399
Epoch: 126
Loss on hold-out set: 0.0022213245559084627
MeanAbsoluteError value on hold-out data: 0.03954854607582092
Epoch: 127

Loss on hold-out set: 0.00180658876031105
MeanAbsoluteError value on hold-out data: 0.03670588135719299
Epoch: 128
Loss on hold-out set: 0.00028535494597495666
MeanAbsoluteError value on hold-out data: 0.014585507102310658
Epoch: 129

Loss on hold-out set: 0.0001501331270057043
MeanAbsoluteError value on hold-out data: 0.009538411162793636
Epoch: 130
```

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Loss on hold-out set: 0.00015418758396533252
MeanAbsoluteError value on hold-out data: 0.009969934821128845
Epoch: 131
Loss on hold-out set: 0.006702475316290345
MeanAbsoluteError value on hold-out data: 0.06768890470266342
Epoch: 132

Loss on hold-out set: 0.00028997492336202413
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Loss on hold-out set: 0.0024915619620255063
MeanAbsoluteError value on hold-out data: 0.04786038398742676
Epoch: 134

Loss on hold-out set: 0.005393867580486196
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Epoch: 135
Loss on hold-out set: 0.0013299854638587152
MeanAbsoluteError value on hold-out data: 0.035150330513715744
Epoch: 136

Loss on hold-out set: 0.004537586422104921
MeanAbsoluteError value on hold-out data: 0.054855529218912125
Epoch: 137
Loss on hold-out set: 0.011345148419163056
MeanAbsoluteError value on hold-out data: 0.08970648050308228
Epoch: 138
Loss on hold-out set: 0.0027986183163842986
MeanAbsoluteError value on hold-out data: 0.046514105051755905
Epoch: 139

Loss on hold-out set: 0.0009475875662506691
MeanAbsoluteError value on hold-out data: 0.026885919272899628
Epoch: 140
Loss on hold-out set: 0.0012006614207556205
MeanAbsoluteError value on hold-out data: 0.029421387240290642
Epoch: 141

Loss on hold-out set: 0.0015360465373045632
MeanAbsoluteError value on hold-out data: 0.03815140202641487
Epoch: 142
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Loss on hold-out set: 0.00025043488494702615
MeanAbsoluteError value on hold-out data: 0.01248484943062067
Epoch: 143

Loss on hold-out set: 0.0009123600944544055
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Epoch: 144
Loss on hold-out set: 0.0006539498946429896
MeanAbsoluteError value on hold-out data: 0.021155254915356636
Epoch: 145
Loss on hold-out set: 0.0003681697375473699
MeanAbsoluteError value on hold-out data: 0.01512974500656128
Epoch: 146

Loss on hold-out set: 0.0051740371356053015
MeanAbsoluteError value on hold-out data: 0.06516732275485992
Epoch: 147
Loss on hold-out set: 0.0007215070904099516
MeanAbsoluteError value on hold-out data: 0.024406997486948967
Epoch: 148

Loss on hold-out set: 0.0019262628463496054
MeanAbsoluteError value on hold-out data: 0.04325141757726669
Epoch: 149
Loss on hold-out set: 0.001291625534317323
MeanAbsoluteError value on hold-out data: 0.03076263889670372
Epoch: 150

Loss on hold-out set: 0.0009950663328969053
MeanAbsoluteError value on hold-out data: 0.028400463983416557
Epoch: 151
Loss on hold-out set: 0.00024339731057157872
MeanAbsoluteError value on hold-out data: 0.013142530806362629
Epoch: 152
Loss on hold-out set: 0.0017031897732522339
MeanAbsoluteError value on hold-out data: 0.03469144180417061
Epoch: 153

Loss on hold-out set: 0.0036239707177238806
MeanAbsoluteError value on hold-out data: 0.05846115201711655
Epoch: 154
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Loss on hold-out set: 0.0022362470127908246
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Epoch: 155

Loss on hold-out set: 0.0003852874630995627
MeanAbsoluteError value on hold-out data: 0.016336435452103615
Epoch: 156
Loss on hold-out set: 0.0016885703496102775
MeanAbsoluteError value on hold-out data: 0.03926040232181549
Epoch: 157

Loss on hold-out set: 0.0013646071643701621
MeanAbsoluteError value on hold-out data: 0.03140600025653839
Epoch: 158
Loss on hold-out set: 0.002956168443363692
MeanAbsoluteError value on hold-out data: 0.04182795062661171
Epoch: 159
Loss on hold-out set: 0.0015017557722915495
MeanAbsoluteError value on hold-out data: 0.03739750012755394
Epoch: 160

Loss on hold-out set: 0.0034671268825020108
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Epoch: 161
Loss on hold-out set: 0.0029802546237728427
MeanAbsoluteError value on hold-out data: 0.04741650074720383
Epoch: 162

Loss on hold-out set: 0.0011830912387397672
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Epoch: 163
Loss on hold-out set: 0.0008802228840067983
MeanAbsoluteError value on hold-out data: 0.026694405823946
Epoch: 164

Loss on hold-out set: 0.005554584387157645
MeanAbsoluteError value on hold-out data: 0.07173362374305725
Epoch: 165
Loss on hold-out set: 0.0031687408918514848
MeanAbsoluteError value on hold-out data: 0.04851128160953522
Epoch: 166
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Loss on hold-out set: 0.0018158830602520279
MeanAbsoluteError value on hold-out data: 0.031233716756105423
Epoch: 167

Loss on hold-out set: 0.0023210382122280343
MeanAbsoluteError value on hold-out data: 0.03800676763057709
Epoch: 168
Loss on hold-out set: 0.001413237810733595
MeanAbsoluteError value on hold-out data: 0.028581148013472557
Epoch: 169

Loss on hold-out set: 0.0012971536239742168
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Loss on hold-out set: 0.000555283240308719
MeanAbsoluteError value on hold-out data: 0.020484719425439835
Epoch: 171

Loss on hold-out set: 0.00809805148414203
MeanAbsoluteError value on hold-out data: 0.07941988110542297
Epoch: 172
Loss on hold-out set: 0.0019129821864355887
MeanAbsoluteError value on hold-out data: 0.04130220785737038
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Loss on hold-out set: 0.0004599826185897525
MeanAbsoluteError value on hold-out data: 0.018696248531341553
Epoch: 174

Loss on hold-out set: 0.0007808626562889133
MeanAbsoluteError value on hold-out data: 0.025480570271611214
Epoch: 175
Loss on hold-out set: 0.00046709277999720404
MeanAbsoluteError value on hold-out data: 0.015351508744060993
Epoch: 176

Loss on hold-out set: 0.0034950081525104387
MeanAbsoluteError value on hold-out data: 0.05316077172756195
Epoch: 177
Loss on hold-out set: 0.0002661227585381961
MeanAbsoluteError value on hold-out data: 0.013437237590551376
Epoch: 178
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Loss on hold-out set: 0.0005828236878317382
MeanAbsoluteError value on hold-out data: 0.020644834265112877
Epoch: 179
Loss on hold-out set: 0.003701035365728395
MeanAbsoluteError value on hold-out data: 0.05524151399731636
Epoch: 180
Loss on hold-out set: 0.0017491929549058633
MeanAbsoluteError value on hold-out data: 0.03613772988319397
Epoch: 181

Loss on hold-out set: 0.0024657069838472773
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Epoch: 182
Loss on hold-out set: 0.002065674850850233
MeanAbsoluteError value on hold-out data: 0.043884534388780594
Epoch: 183

Loss on hold-out set: 0.000314204760278309
MeanAbsoluteError value on hold-out data: 0.014522591605782509
Epoch: 184
Loss on hold-out set: 0.0022596879030710886
MeanAbsoluteError value on hold-out data: 0.04343092069029808
Epoch: 185

Loss on hold-out set: 0.00013046866661170498
MeanAbsoluteError value on hold-out data: 0.009246386587619781
Epoch: 186
Loss on hold-out set: 0.0037078607336817576
MeanAbsoluteError value on hold-out data: 0.05051110312342644
Epoch: 187
Loss on hold-out set: 0.001314376073423773
MeanAbsoluteError value on hold-out data: 0.033309049904346466
Epoch: 188

Loss on hold-out set: 0.001118412914885474
MeanAbsoluteError value on hold-out data: 0.031792379915714264
Epoch: 189
Loss on hold-out set: 0.003106364281848073
MeanAbsoluteError value on hold-out data: 0.052048925310373306
Epoch: 190
```

```
Loss on hold-out set: 0.0016336612669484957
MeanAbsoluteError value on hold-out data: 0.03783337026834488
Epoch: 191
Loss on hold-out set: 0.0005192820099182427
MeanAbsoluteError value on hold-out data: 0.020740289241075516
Epoch: 192

Loss on hold-out set: 0.0004954830676849399
MeanAbsoluteError value on hold-out data: 0.01681867055594921
Epoch: 193
Loss on hold-out set: 0.002653933096943157
MeanAbsoluteError value on hold-out data: 0.05099043995141983
Epoch: 194
Loss on hold-out set: 0.0032347052225044797
MeanAbsoluteError value on hold-out data: 0.053534165024757385
Epoch: 195

Loss on hold-out set: 0.0050831809639930725
MeanAbsoluteError value on hold-out data: 0.06607753783464432
Epoch: 196
Loss on hold-out set: 0.0005511865082163629
MeanAbsoluteError value on hold-out data: 0.021055610850453377
Epoch: 197

Loss on hold-out set: 0.001269524176937661
MeanAbsoluteError value on hold-out data: 0.027355697005987167
Epoch: 198
Loss on hold-out set: 0.0006563514554207879
MeanAbsoluteError value on hold-out data: 0.024556901305913925
Epoch: 199

Loss on hold-out set: 0.001663927554285952
MeanAbsoluteError value on hold-out data: 0.030185528099536896
Epoch: 200
Loss on hold-out set: 0.00019898960142329867
MeanAbsoluteError value on hold-out data: 0.01053732167929411
Epoch: 201
Loss on hold-out set: 0.005894336782928024
MeanAbsoluteError value on hold-out data: 0.07119882106781006
Epoch: 202
```

Loss on hold-out set: 0.00042087934811466506
MeanAbsoluteError value on hold-out data: 0.017710335552692413
Epoch: 203
Loss on hold-out set: 0.0019521289338756884
MeanAbsoluteError value on hold-out data: 0.03745797276496887
Epoch: 204

Loss on hold-out set: 0.00022525182118572827
MeanAbsoluteError value on hold-out data: 0.012420582585036755
Epoch: 205
Loss on hold-out set: 0.00029305542869094225
MeanAbsoluteError value on hold-out data: 0.015114928595721722
Epoch: 206

Loss on hold-out set: 0.0001845940132625401
MeanAbsoluteError value on hold-out data: 0.011382246389985085
Epoch: 207
Loss on hold-out set: 0.0009882827455710088
MeanAbsoluteError value on hold-out data: 0.02651580423116684
Epoch: 208
Loss on hold-out set: 0.0003847294782255111
MeanAbsoluteError value on hold-out data: 0.014895865693688393
Epoch: 209

Loss on hold-out set: 0.000949238202468093
MeanAbsoluteError value on hold-out data: 0.026007389649748802
Epoch: 210
Loss on hold-out set: 0.0017675750256915177
MeanAbsoluteError value on hold-out data: 0.03639068827033043
Epoch: 211

Loss on hold-out set: 0.00040809250120738786
MeanAbsoluteError value on hold-out data: 0.015208951197564602
Early stopping at epoch 210
Fold: 7
Epoch: 1
Loss on hold-out set: 0.01606378611177206
MeanAbsoluteError value on hold-out data: 0.10199971497058868
Epoch: 2

```
Loss on hold-out set: 0.00991225684992969
MeanAbsoluteError value on hold-out data: 0.07740257680416107
Epoch: 3
Loss on hold-out set: 0.03676077936376844
MeanAbsoluteError value on hold-out data: 0.16392062604427338
Epoch: 4
Loss on hold-out set: 0.025409855746797154
MeanAbsoluteError value on hold-out data: 0.14928461611270905
Epoch: 5

Loss on hold-out set: 0.027876193901257857
MeanAbsoluteError value on hold-out data: 0.1470150351524353
Epoch: 6
Loss on hold-out set: 0.006439490909022946
MeanAbsoluteError value on hold-out data: 0.06768853217363358
Epoch: 7

Loss on hold-out set: 0.02501194631414754
MeanAbsoluteError value on hold-out data: 0.15404528379440308
Epoch: 8
Loss on hold-out set: 0.00777516035096986
MeanAbsoluteError value on hold-out data: 0.08209823817014694
Epoch: 9

Loss on hold-out set: 0.011027702130377293
MeanAbsoluteError value on hold-out data: 0.09524998813867569
Epoch: 10
Loss on hold-out set: 0.012954907824418374
MeanAbsoluteError value on hold-out data: 0.10777055472135544
Epoch: 11
Loss on hold-out set: 0.0030005257909319232
MeanAbsoluteError value on hold-out data: 0.04713848978281021
Epoch: 12

Loss on hold-out set: 0.0008713301005108016
MeanAbsoluteError value on hold-out data: 0.022973110899329185
Epoch: 13
Loss on hold-out set: 0.011519906377153737
MeanAbsoluteError value on hold-out data: 0.08227800577878952
Epoch: 14
```

```
Loss on hold-out set: 0.003961083845102361
MeanAbsoluteError value on hold-out data: 0.05695635452866554
Epoch: 15
Loss on hold-out set: 0.003675541707447597
MeanAbsoluteError value on hold-out data: 0.05176156014204025
Epoch: 16

Loss on hold-out set: 0.0023065353078501566
MeanAbsoluteError value on hold-out data: 0.03779036924242973
Epoch: 17
Loss on hold-out set: 0.002854940830729902
MeanAbsoluteError value on hold-out data: 0.041808124631643295
Epoch: 18
Loss on hold-out set: 0.011995964816638402
MeanAbsoluteError value on hold-out data: 0.10085060447454453
Epoch: 19

Loss on hold-out set: 0.0060191646750484195
MeanAbsoluteError value on hold-out data: 0.07150162011384964
Epoch: 20
Loss on hold-out set: 0.012786954242203916
MeanAbsoluteError value on hold-out data: 0.10632221400737762
Epoch: 21

Loss on hold-out set: 0.0024385195158954176
MeanAbsoluteError value on hold-out data: 0.04430378973484039
Epoch: 22
Loss on hold-out set: 0.010592731514147349
MeanAbsoluteError value on hold-out data: 0.09677594155073166
Epoch: 23

Loss on hold-out set: 0.0015501082941357578
MeanAbsoluteError value on hold-out data: 0.03303500637412071
Epoch: 24
Loss on hold-out set: 0.0049059966612341145
MeanAbsoluteError value on hold-out data: 0.060020510107278824
Epoch: 25
Loss on hold-out set: 0.015585886181465216
MeanAbsoluteError value on hold-out data: 0.10739012807607651
Epoch: 26
```

```
Loss on hold-out set: 0.01731418844844614
MeanAbsoluteError value on hold-out data: 0.13007080554962158
Epoch: 27
Loss on hold-out set: 0.009253715364528554
MeanAbsoluteError value on hold-out data: 0.0901847779750824
Epoch: 28

Loss on hold-out set: 0.003574195650539228
MeanAbsoluteError value on hold-out data: 0.05812160670757294
Epoch: 29
Loss on hold-out set: 0.00019548316777218133
MeanAbsoluteError value on hold-out data: 0.011129382997751236
Epoch: 30

Loss on hold-out set: 0.007142276237053531
MeanAbsoluteError value on hold-out data: 0.07652013748884201
Epoch: 31
Loss on hold-out set: 0.0009948771579989365
MeanAbsoluteError value on hold-out data: 0.024702683091163635
Epoch: 32
Loss on hold-out set: 0.00109327190356063
MeanAbsoluteError value on hold-out data: 0.025612030178308487
Epoch: 33

Loss on hold-out set: 0.0123579508758017
MeanAbsoluteError value on hold-out data: 0.10831102728843689
Epoch: 34
Loss on hold-out set: 0.0010844788381031558
MeanAbsoluteError value on hold-out data: 0.028603827580809593
Epoch: 35

Loss on hold-out set: 0.00864749142367925
MeanAbsoluteError value on hold-out data: 0.0860179215669632
Epoch: 36
Loss on hold-out set: 0.005852925657693829
MeanAbsoluteError value on hold-out data: 0.07458195835351944
Epoch: 37

Loss on hold-out set: 0.004604048893920013
MeanAbsoluteError value on hold-out data: 0.056758999824523926
Epoch: 38
```

```
Loss on hold-out set: 0.00041403300669376 87
MeanAbsoluteError value on hold-out data: 0.014541094191372395
Epoch: 39
Loss on hold-out set: 0.0029153463962887016
MeanAbsoluteError value on hold-out data: 0.04681345820426941
Epoch: 40

Loss on hold-out set: 0.00044695019148223637
MeanAbsoluteError value on hold-out data: 0.018086986616253853
Epoch: 41
Loss on hold-out set: 0.0033224795811942647
MeanAbsoluteError value on hold-out data: 0.05241420120000839
Epoch: 42

Loss on hold-out set: 0.00042834655531415 98
MeanAbsoluteError value on hold-out data: 0.01855790987610817
Epoch: 43
Loss on hold-out set: 0.0031873414159885476
MeanAbsoluteError value on hold-out data: 0.04602621868252754
Epoch: 44

Loss on hold-out set: 0.00864787373159613
MeanAbsoluteError value on hold-out data: 0.09001293778419495
Epoch: 45
Loss on hold-out set: 0.0066850945087415835
MeanAbsoluteError value on hold-out data: 0.07665342092514038
Epoch: 46
Loss on hold-out set: 0.003383684337937406
MeanAbsoluteError value on hold-out data: 0.05264972150325775
Epoch: 47

Loss on hold-out set: 0.007159055410219091
MeanAbsoluteError value on hold-out data: 0.07140883803367615
Epoch: 48
Loss on hold-out set: 0.0020471832249313593
MeanAbsoluteError value on hold-out data: 0.04308560490608215
Epoch: 49

Loss on hold-out set: 0.002006409124338201
MeanAbsoluteError value on hold-out data: 0.03655344620347023
Epoch: 50
```

```
Loss on hold-out set: 0.0007000806591739612
MeanAbsoluteError value on hold-out data: 0.022785820066928864
Epoch: 51

Loss on hold-out set: 0.002472706188979958
MeanAbsoluteError value on hold-out data: 0.04204225912690163
Epoch: 52
Loss on hold-out set: 0.004031779676941889
MeanAbsoluteError value on hold-out data: 0.06112389266490936
Epoch: 53
Loss on hold-out set: 0.00034817878622561693
MeanAbsoluteError value on hold-out data: 0.014569762162864208
Epoch: 54

Loss on hold-out set: 0.0037667858746967147
MeanAbsoluteError value on hold-out data: 0.0584975928068161
Epoch: 55
Loss on hold-out set: 0.0017641267040744424
MeanAbsoluteError value on hold-out data: 0.03605813533067703
Epoch: 56

Loss on hold-out set: 0.0007654863043821283
MeanAbsoluteError value on hold-out data: 0.022885799407958984
Epoch: 57
Loss on hold-out set: 0.005264982481354049
MeanAbsoluteError value on hold-out data: 0.0702044665813446
Epoch: 58

Loss on hold-out set: 0.00041446676394636076
MeanAbsoluteError value on hold-out data: 0.01824474148452282
Epoch: 59
Loss on hold-out set: 0.012315691781363316
MeanAbsoluteError value on hold-out data: 0.10705933719873428
Epoch: 60
Loss on hold-out set: 0.00629557589335101
MeanAbsoluteError value on hold-out data: 0.06833039969205856
Epoch: 61

Loss on hold-out set: 0.00236468600840973
MeanAbsoluteError value on hold-out data: 0.03835182636976242
Epoch: 62
```

```
Loss on hold-out set: 0.0055426680482923985
MeanAbsoluteError value on hold-out data: 0.06679962575435638
Epoch: 63

Loss on hold-out set: 0.000867141127985503
MeanAbsoluteError value on hold-out data: 0.024572860449552536
Epoch: 64
Loss on hold-out set: 0.003216672954814775
MeanAbsoluteError value on hold-out data: 0.05290712043642998
Epoch: 65

Loss on hold-out set: 0.0008276392805523106
MeanAbsoluteError value on hold-out data: 0.022732285782694817
Epoch: 66
Loss on hold-out set: 0.0011172374610656074
MeanAbsoluteError value on hold-out data: 0.027612319216132164
Epoch: 67
Loss on hold-out set: 0.0031662446313670705
MeanAbsoluteError value on hold-out data: 0.053821586072444916
Epoch: 68

Loss on hold-out set: 0.0006045785557944328
MeanAbsoluteError value on hold-out data: 0.017075680196285248
Epoch: 69
Loss on hold-out set: 0.0013939488313293882
MeanAbsoluteError value on hold-out data: 0.03455260396003723
Epoch: 70

Loss on hold-out set: 0.0001980034721782431
MeanAbsoluteError value on hold-out data: 0.011832186952233315
Epoch: 71
Loss on hold-out set: 0.0003977533612799432
MeanAbsoluteError value on hold-out data: 0.016786113381385803
Epoch: 72

Loss on hold-out set: 0.0033485814596393277
MeanAbsoluteError value on hold-out data: 0.05495624616742134
Epoch: 73
Loss on hold-out set: 0.004464384667309267
MeanAbsoluteError value on hold-out data: 0.06335417926311493
Epoch: 74
```

```
Loss on hold-out set: 0.00023190747223062708
MeanAbsoluteError value on hold-out data: 0.012281054630875587
Epoch: 75

Loss on hold-out set: 0.008513240808887141
MeanAbsoluteError value on hold-out data: 0.0891805961728096
Epoch: 76
Loss on hold-out set: 0.0015167599111529334
MeanAbsoluteError value on hold-out data: 0.031350649893283844
Epoch: 77

Loss on hold-out set: 0.002277441422588059
MeanAbsoluteError value on hold-out data: 0.04451162740588188
Epoch: 78
Loss on hold-out set: 0.0005537318980454334
MeanAbsoluteError value on hold-out data: 0.020168207585811615
Epoch: 79

Loss on hold-out set: 0.0011872133971857174
MeanAbsoluteError value on hold-out data: 0.02842874266207218
Epoch: 80
Loss on hold-out set: 0.0023020100114601
MeanAbsoluteError value on hold-out data: 0.045531243085861206
Epoch: 81
Loss on hold-out set: 0.007144881944571223
MeanAbsoluteError value on hold-out data: 0.08017019182443619
Epoch: 82

Loss on hold-out set: 0.00023211183724924922
MeanAbsoluteError value on hold-out data: 0.012017063796520233
Epoch: 83
Loss on hold-out set: 0.00134477302032922
MeanAbsoluteError value on hold-out data: 0.033155880868434906
Epoch: 84

Loss on hold-out set: 0.002038734150119126
MeanAbsoluteError value on hold-out data: 0.0377899594604969
Epoch: 85
Loss on hold-out set: 0.001673807523080281
MeanAbsoluteError value on hold-out data: 0.03992070257663727
Epoch: 86
```

```
Loss on hold-out set: 0.0022819052184266703
MeanAbsoluteError value on hold-out data: 0.04536262899637222
Epoch: 87
Loss on hold-out set: 0.00850854261911341
MeanAbsoluteError value on hold-out data: 0.08712033182382584
Epoch: 88
Loss on hold-out set: 0.005599855644894498
MeanAbsoluteError value on hold-out data: 0.07235531508922577
Epoch: 89

Loss on hold-out set: 0.0007555737309823078
MeanAbsoluteError value on hold-out data: 0.023113232105970383
Epoch: 90
Loss on hold-out set: 0.0001396654364985547
MeanAbsoluteError value on hold-out data: 0.008783351629972458
Epoch: 91

Loss on hold-out set: 0.009100887126156263
MeanAbsoluteError value on hold-out data: 0.07897239923477173
Epoch: 92
Loss on hold-out set: 0.0001827440682973247
MeanAbsoluteError value on hold-out data: 0.011043941602110863
Epoch: 93

Loss on hold-out set: 0.007215116971305439
MeanAbsoluteError value on hold-out data: 0.08153322339057922
Epoch: 94
Loss on hold-out set: 0.0013236527281281138
MeanAbsoluteError value on hold-out data: 0.03159268945455551
Epoch: 95
Loss on hold-out set: 0.0016487135518608348
MeanAbsoluteError value on hold-out data: 0.03275240585207939
Epoch: 96

Loss on hold-out set: 0.0014275050489231944
MeanAbsoluteError value on hold-out data: 0.03561580553650856
Epoch: 97
Loss on hold-out set: 0.0008721702698884266
MeanAbsoluteError value on hold-out data: 0.0278239194303751
Epoch: 98
```

```
Loss on hold-out set: 0.0034620740583964755
MeanAbsoluteError value on hold-out data: 0.05485403165221214
Epoch: 99
Loss on hold-out set: 0.0003564089253943946
MeanAbsoluteError value on hold-out data: 0.015553301200270653
Epoch: 100

Loss on hold-out set: 0.003647801133670977
MeanAbsoluteError value on hold-out data: 0.052778471261262894
Epoch: 101
Loss on hold-out set: 0.0015285803570545145
MeanAbsoluteError value on hold-out data: 0.03570836782455444
Epoch: 102
Loss on hold-out set: 0.0025344648830858724
MeanAbsoluteError value on hold-out data: 0.040750522166490555
Epoch: 103

Loss on hold-out set: 0.01269515257860933
MeanAbsoluteError value on hold-out data: 0.10769877582788467
Epoch: 104
Loss on hold-out set: 0.0026348760251754095
MeanAbsoluteError value on hold-out data: 0.04379500821232796
Epoch: 105

Loss on hold-out set: 0.00021437383838929236
MeanAbsoluteError value on hold-out data: 0.011977669782936573
Epoch: 106
Loss on hold-out set: 0.0004692699855825465
MeanAbsoluteError value on hold-out data: 0.017980879172682762
Epoch: 107

Loss on hold-out set: 0.0007198880193755031
MeanAbsoluteError value on hold-out data: 0.023312579840421677
Epoch: 108
Loss on hold-out set: 0.0017079775654045598
MeanAbsoluteError value on hold-out data: 0.03870183229446411
Epoch: 109
Loss on hold-out set: 0.0019544121044288787
MeanAbsoluteError value on hold-out data: 0.035033054649829865
Epoch: 110
```

```
Loss on hold-out set: 0.005840858876971262
MeanAbsoluteError value on hold-out data: 0.07175320386886597
Epoch: 111
Loss on hold-out set: 0.00010441448258851389
MeanAbsoluteError value on hold-out data: 0.007968129590153694
Epoch: 112

Loss on hold-out set: 0.0009107940547567393
MeanAbsoluteError value on hold-out data: 0.027467235922813416
Epoch: 113
Loss on hold-out set: 0.001456114205731345
MeanAbsoluteError value on hold-out data: 0.03421739116311073
Epoch: 114

Loss on hold-out set: 0.006681609499667372
MeanAbsoluteError value on hold-out data: 0.0798814669251442
Epoch: 115
Loss on hold-out set: 0.0016858285692121302
MeanAbsoluteError value on hold-out data: 0.03763700649142265
Epoch: 116
Loss on hold-out set: 0.002197180292569101
MeanAbsoluteError value on hold-out data: 0.04369892179965973
Epoch: 117

Loss on hold-out set: 0.0012096369422839157
MeanAbsoluteError value on hold-out data: 0.03118826448917389
Epoch: 118
Loss on hold-out set: 0.002278122884620513
MeanAbsoluteError value on hold-out data: 0.04443684220314026
Epoch: 119

Loss on hold-out set: 0.0015369775438947336
MeanAbsoluteError value on hold-out data: 0.035594645887613297
Epoch: 120
Loss on hold-out set: 0.0021050629605140004
MeanAbsoluteError value on hold-out data: 0.043190501630306244
Epoch: 121

Loss on hold-out set: 0.0018724541961481528
MeanAbsoluteError value on hold-out data: 0.04081781953573227
Epoch: 122
```

```
Loss on hold-out set: 0.00123291984865708
MeanAbsoluteError value on hold-out data: 0.032927341759204865
Epoch: 123
Loss on hold-out set: 0.00464160753680127
MeanAbsoluteError value on hold-out data: 0.06271153688430786
Epoch: 124

Loss on hold-out set: 0.0015331385158268468
MeanAbsoluteError value on hold-out data: 0.0361516959965229
Epoch: 125
Loss on hold-out set: 0.0035172761750540565
MeanAbsoluteError value on hold-out data: 0.05710378661751747
Epoch: 126

Loss on hold-out set: 0.004038149557475533
MeanAbsoluteError value on hold-out data: 0.0596926175057888
Epoch: 127
Loss on hold-out set: 0.001034118201849716
MeanAbsoluteError value on hold-out data: 0.026884028688073158
Epoch: 128

Loss on hold-out set: 0.0036843845238243894
MeanAbsoluteError value on hold-out data: 0.048628684133291245
Epoch: 129
Loss on hold-out set: 0.0004768325847440532
MeanAbsoluteError value on hold-out data: 0.016457244753837585
Epoch: 130
Loss on hold-out set: 0.0031050856092146467
MeanAbsoluteError value on hold-out data: 0.0529542975127697
Epoch: 131

Loss on hold-out set: 0.008529139549604483
MeanAbsoluteError value on hold-out data: 0.09146228432655334
Epoch: 132
Loss on hold-out set: 0.0038998200158987728
MeanAbsoluteError value on hold-out data: 0.057352036237716675
Epoch: 133

Loss on hold-out set: 0.0048563864547759295
MeanAbsoluteError value on hold-out data: 0.06247679144144058
Epoch: 134
```

```
Loss on hold-out set: 0.0010982456068242235
MeanAbsoluteError value on hold-out data: 0.030131734907627106
Epoch: 135

Loss on hold-out set: 0.0068865405628457665
MeanAbsoluteError value on hold-out data: 0.07712112367153168
Epoch: 136
Loss on hold-out set: 0.0029677781276404858
MeanAbsoluteError value on hold-out data: 0.05152036249637604
Epoch: 137
Loss on hold-out set: 0.008663664838033063
MeanAbsoluteError value on hold-out data: 0.07967688888311386
Epoch: 138

Loss on hold-out set: 0.004604986203568322
MeanAbsoluteError value on hold-out data: 0.05851512402296066
Epoch: 139
Loss on hold-out set: 0.0020933340336861356
MeanAbsoluteError value on hold-out data: 0.04453325271606445
Epoch: 140

Loss on hold-out set: 0.0004823134887763964
MeanAbsoluteError value on hold-out data: 0.01806284673511982
Epoch: 141
Loss on hold-out set: 0.001841197771552418
MeanAbsoluteError value on hold-out data: 0.03806908428668976
Epoch: 142

Loss on hold-out set: 0.0006193480096823935
MeanAbsoluteError value on hold-out data: 0.020069772377610207
Epoch: 143
Loss on hold-out set: 0.003043133399582335
MeanAbsoluteError value on hold-out data: 0.05269287899136543
Epoch: 144
Loss on hold-out set: 0.002756896595071469
MeanAbsoluteError value on hold-out data: 0.05168278142809868
Epoch: 145

Loss on hold-out set: 0.00039118717540986836
MeanAbsoluteError value on hold-out data: 0.015828033909201622
Epoch: 146
```

```
Loss on hold-out set: 0.0008945453196897038
MeanAbsoluteError value on hold-out data: 0.02845216542482376
Epoch: 147

Loss on hold-out set: 0.002624502372262733
MeanAbsoluteError value on hold-out data: 0.04670720919966698
Epoch: 148
Loss on hold-out set: 0.0016268214842836773
MeanAbsoluteError value on hold-out data: 0.032748036086559296
Epoch: 149

Loss on hold-out set: 0.007544997613877058
MeanAbsoluteError value on hold-out data: 0.08447417616844177
Epoch: 150
Loss on hold-out set: 0.0035473432258835863
MeanAbsoluteError value on hold-out data: 0.05566256865859032
Epoch: 151
Loss on hold-out set: 0.0008673427842690476
MeanAbsoluteError value on hold-out data: 0.022800443693995476
Epoch: 152

Loss on hold-out set: 0.004358246523354735
MeanAbsoluteError value on hold-out data: 0.06469521671533585
Epoch: 153
Loss on hold-out set: 0.0016285184537991881
MeanAbsoluteError value on hold-out data: 0.03642402961850166
Epoch: 154

Loss on hold-out set: 0.0004059017514269466
MeanAbsoluteError value on hold-out data: 0.01683613285422325
Epoch: 155
Loss on hold-out set: 0.0023316334201289074
MeanAbsoluteError value on hold-out data: 0.04645310342311859
Epoch: 156

Loss on hold-out set: 0.005667400679418019
MeanAbsoluteError value on hold-out data: 0.06947705894708633
Epoch: 157
Loss on hold-out set: 0.0006701549032836088
MeanAbsoluteError value on hold-out data: 0.02173757553100586
Epoch: 158
```

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Loss on hold-out set: 0.0013665166583710483
MeanAbsoluteError value on hold-out data: 0.03228483349084854
Epoch: 159

Loss on hold-out set: 0.003053462482057512
MeanAbsoluteError value on hold-out data: 0.04570407420396805
Epoch: 160
Loss on hold-out set: 0.003853194847969072
MeanAbsoluteError value on hold-out data: 0.058864299207925797
Epoch: 161

Loss on hold-out set: 0.00035141556041448245
MeanAbsoluteError value on hold-out data: 0.01559022068977356
Epoch: 162
Loss on hold-out set: 0.00042175224682848366
MeanAbsoluteError value on hold-out data: 0.017757993191480637
Epoch: 163

Loss on hold-out set: 0.001966195147750633
MeanAbsoluteError value on hold-out data: 0.03814846649765968
Epoch: 164
Loss on hold-out set: 0.00027991424264785437
MeanAbsoluteError value on hold-out data: 0.013642493635416031
Epoch: 165
Loss on hold-out set: 0.0023225342655288322
MeanAbsoluteError value on hold-out data: 0.04457022249698639
Epoch: 166

Loss on hold-out set: 0.000950616884178349
MeanAbsoluteError value on hold-out data: 0.02565603516995907
Epoch: 167
Loss on hold-out set: 0.0015559164374800666
MeanAbsoluteError value on hold-out data: 0.0330544076859951
Epoch: 168

Loss on hold-out set: 0.0010936833319387265
MeanAbsoluteError value on hold-out data: 0.028359629213809967
Epoch: 169
Loss on hold-out set: 0.00019838546618952284
MeanAbsoluteError value on hold-out data: 0.01155637763440609
Epoch: 170
```

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Loss on hold-out set: 0.0010767699984301413
MeanAbsoluteError value on hold-out data: 0.031159205362200737
Epoch: 171
Loss on hold-out set: 0.0016002441324027522
MeanAbsoluteError value on hold-out data: 0.035497598350048065
Epoch: 172
Loss on hold-out set: 0.0017472099446292435
MeanAbsoluteError value on hold-out data: 0.037987690418958664
Epoch: 173

Loss on hold-out set: 0.0006171502006639327
MeanAbsoluteError value on hold-out data: 0.02317301742732525
Epoch: 174
Loss on hold-out set: 0.005136206080870969
MeanAbsoluteError value on hold-out data: 0.06768147647380829
Epoch: 175

Loss on hold-out set: 0.0003314224200689101
MeanAbsoluteError value on hold-out data: 0.01546228677034378
Epoch: 176
Loss on hold-out set: 0.000783750433973702
MeanAbsoluteError value on hold-out data: 0.024409189820289612
Epoch: 177

Loss on hold-out set: 0.006304830911436251
MeanAbsoluteError value on hold-out data: 0.07716423273086548
Epoch: 178
Loss on hold-out set: 0.0006380281660572759
MeanAbsoluteError value on hold-out data: 0.019854363054037094
Epoch: 179
Loss on hold-out set: 0.002808728554685201
MeanAbsoluteError value on hold-out data: 0.04954993724822998
Epoch: 180

Loss on hold-out set: 0.002856301576165216
MeanAbsoluteError value on hold-out data: 0.053460635244846344
Epoch: 181
Loss on hold-out set: 0.0030952428268002613
MeanAbsoluteError value on hold-out data: 0.050051700323820114
Epoch: 182
```

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Loss on hold-out set: 0.0018503292230889201
MeanAbsoluteError value on hold-out data: 0.038585904985666275
Epoch: 183
Loss on hold-out set: 0.0010028400325349399
MeanAbsoluteError value on hold-out data: 0.028281060978770256
Epoch: 184

Loss on hold-out set: 0.00030247394378030937
MeanAbsoluteError value on hold-out data: 0.01496555469930172
Epoch: 185
Loss on hold-out set: 0.0003579785822824176
MeanAbsoluteError value on hold-out data: 0.016316581517457962
Epoch: 186
Loss on hold-out set: 0.0002518185626416068
MeanAbsoluteError value on hold-out data: 0.012909664772450924
Epoch: 187

Loss on hold-out set: 0.0009735044191724487
MeanAbsoluteError value on hold-out data: 0.02997681125998497
Epoch: 188
Loss on hold-out set: 0.0042203981429338455
MeanAbsoluteError value on hold-out data: 0.06142183765769005
Epoch: 189

Loss on hold-out set: 0.004382413080228227
MeanAbsoluteError value on hold-out data: 0.06475183367729187
Epoch: 190
Loss on hold-out set: 0.002359082539831953
MeanAbsoluteError value on hold-out data: 0.04627380520105362
Epoch: 191

Loss on hold-out set: 0.0003880253976343998
MeanAbsoluteError value on hold-out data: 0.015506443567574024
Epoch: 192
Loss on hold-out set: 0.0015830541461972253
MeanAbsoluteError value on hold-out data: 0.033278897404670715
Epoch: 193
Loss on hold-out set: 0.0036991906485387255
MeanAbsoluteError value on hold-out data: 0.052299145609140396
Epoch: 194
```

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Loss on hold-out set: 0.002168781972224159
MeanAbsoluteError value on hold-out data: 0.04422419145703316
Epoch: 195
Loss on hold-out set: 0.008882322747792517
MeanAbsoluteError value on hold-out data: 0.08637289702892303
Epoch: 196

Loss on hold-out set: 0.0018410551794139402
MeanAbsoluteError value on hold-out data: 0.03916410356760025
Epoch: 197
Loss on hold-out set: 0.0031139475759118795
MeanAbsoluteError value on hold-out data: 0.05404696986079216
Epoch: 198

Loss on hold-out set: 0.00037166820506432226
MeanAbsoluteError value on hold-out data: 0.01660686917603016
Epoch: 199
Loss on hold-out set: 0.0015418745876689041
MeanAbsoluteError value on hold-out data: 0.03667622432112694
Epoch: 200
Loss on hold-out set: 0.00030093188563893946
MeanAbsoluteError value on hold-out data: 0.015613644383847713
Epoch: 201

Loss on hold-out set: 0.002072598868315773
MeanAbsoluteError value on hold-out data: 0.037217024713754654
Epoch: 202
Loss on hold-out set: 0.00032078742515295744
MeanAbsoluteError value on hold-out data: 0.01588575914502144
Epoch: 203

Loss on hold-out set: 9.862830847851001e-05
MeanAbsoluteError value on hold-out data: 0.008081677369773388
Epoch: 204
Loss on hold-out set: 0.0010925349446811847
MeanAbsoluteError value on hold-out data: 0.027622075751423836
Epoch: 205

Loss on hold-out set: 0.0008763504281107869
MeanAbsoluteError value on hold-out data: 0.024987339973449707
Epoch: 206
```

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Loss on hold-out set: 0.0007580036596794214
MeanAbsoluteError value on hold-out data: 0.02308531291782856
Epoch: 207
Loss on hold-out set: 0.0006946944797943745
MeanAbsoluteError value on hold-out data: 0.0240541473031044
Epoch: 208

Loss on hold-out set: 0.0007723314587825111
MeanAbsoluteError value on hold-out data: 0.025389298796653748
Epoch: 209
Loss on hold-out set: 9.210327958239109e-05
MeanAbsoluteError value on hold-out data: 0.007990053854882717
Epoch: 210

Loss on hold-out set: 0.004616787889972329
MeanAbsoluteError value on hold-out data: 0.05827509984374046
Epoch: 211
Loss on hold-out set: 0.001889241044409573
MeanAbsoluteError value on hold-out data: 0.036904580891132355
Epoch: 212

Loss on hold-out set: 0.0001794468932660363
MeanAbsoluteError value on hold-out data: 0.010610743425786495
Epoch: 213
Loss on hold-out set: 0.002794979057008667
MeanAbsoluteError value on hold-out data: 0.046052150428295135
Epoch: 214
Loss on hold-out set: 0.000411970420308145
MeanAbsoluteError value on hold-out data: 0.017383567988872528
Epoch: 215

Loss on hold-out set: 0.00016288332075678876
MeanAbsoluteError value on hold-out data: 0.008333330973982811
Epoch: 216
Loss on hold-out set: 0.0006169202554571841
MeanAbsoluteError value on hold-out data: 0.01962769217789173
Epoch: 217

Loss on hold-out set: 0.00031740934355184436
MeanAbsoluteError value on hold-out data: 0.014299087226390839
Epoch: 218
```

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Loss on hold-out set: 0.004434346154864345
MeanAbsoluteError value on hold-out data: 0.06201183795928955
Epoch: 219

Loss on hold-out set: 0.002162299202089863
MeanAbsoluteError value on hold-out data: 0.040077563375234604
Epoch: 220
Loss on hold-out set: 0.00024161580118483731
MeanAbsoluteError value on hold-out data: 0.012504050508141518
Epoch: 221
Loss on hold-out set: 0.004392784122111542
MeanAbsoluteError value on hold-out data: 0.060509830713272095
Epoch: 222

Loss on hold-out set: 0.001376586450662996
MeanAbsoluteError value on hold-out data: 0.035347744822502136
Epoch: 223
Loss on hold-out set: 0.001265651363480304
MeanAbsoluteError value on hold-out data: 0.03359631448984146
Epoch: 224

Loss on hold-out set: 0.00035094411578029394
MeanAbsoluteError value on hold-out data: 0.015741564333438873
Epoch: 225
Loss on hold-out set: 0.0030227787169029136
MeanAbsoluteError value on hold-out data: 0.04941772297024727
Epoch: 226

Loss on hold-out set: 0.00020554452411098673
MeanAbsoluteError value on hold-out data: 0.011932151392102242
Epoch: 227
Loss on hold-out set: 0.00020595553672007685
MeanAbsoluteError value on hold-out data: 0.011617018841207027
Epoch: 228
Loss on hold-out set: 0.000584776617220736
MeanAbsoluteError value on hold-out data: 0.022861745208501816
Epoch: 229

Loss on hold-out set: 0.0011689655532661294
MeanAbsoluteError value on hold-out data: 0.03124796412885189
Epoch: 230
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Loss on hold-out set: 0.004515136159690363
MeanAbsoluteError value on hold-out data: 0.05097499489784241
Epoch: 231

Loss on hold-out set: 0.00041010311646719595
MeanAbsoluteError value on hold-out data: 0.019173335283994675
Epoch: 232
Loss on hold-out set: 0.00344403410729553
MeanAbsoluteError value on hold-out data: 0.05670883506536484
Epoch: 233

Loss on hold-out set: 0.006527221295982599
MeanAbsoluteError value on hold-out data: 0.06597907841205597
Epoch: 234
Loss on hold-out set: 0.00030512162733690014
MeanAbsoluteError value on hold-out data: 0.016117723658680916
Epoch: 235
Loss on hold-out set: 0.002287752244488469
MeanAbsoluteError value on hold-out data: 0.04270351305603981
Epoch: 236

Loss on hold-out set: 0.000550256555600624
MeanAbsoluteError value on hold-out data: 0.020234057679772377
Epoch: 237
Loss on hold-out set: 0.0038769260448004517
MeanAbsoluteError value on hold-out data: 0.06193690001964569
Epoch: 238

Loss on hold-out set: 0.0003531580150593072
MeanAbsoluteError value on hold-out data: 0.01605118438601494
Epoch: 239
Loss on hold-out set: 0.007624320885432618
MeanAbsoluteError value on hold-out data: 0.08519744127988815
Epoch: 240

Loss on hold-out set: 0.004441263553287301
MeanAbsoluteError value on hold-out data: 0.061788368970155716
Epoch: 241
Loss on hold-out set: 0.0019992312216865166
MeanAbsoluteError value on hold-out data: 0.041869714856147766
Epoch: 242
```

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Loss on hold-out set: 0.00031205798274770914
MeanAbsoluteError value on hold-out data: 0.014152794145047665
Epoch: 243

Loss on hold-out set: 0.0007276033533604018
MeanAbsoluteError value on hold-out data: 0.021289223805069923
Epoch: 244
Loss on hold-out set: 7.639984349745126e-05
MeanAbsoluteError value on hold-out data: 0.006298443302512169
Epoch: 245

Loss on hold-out set: 0.004510802815535239
MeanAbsoluteError value on hold-out data: 0.06355158984661102
Epoch: 246
Loss on hold-out set: 0.0015673617516378207
MeanAbsoluteError value on hold-out data: 0.03818284720182419
Epoch: 247

Loss on hold-out set: 0.0004313921838599656
MeanAbsoluteError value on hold-out data: 0.017311368137598038
Epoch: 248
Loss on hold-out set: 0.0009243763634003699
MeanAbsoluteError value on hold-out data: 0.02752363495528698
Epoch: 249
Loss on hold-out set: 0.0012795364184837257
MeanAbsoluteError value on hold-out data: 0.032847631722688675
Epoch: 250

Loss on hold-out set: 0.001220493286382407
MeanAbsoluteError value on hold-out data: 0.029561087489128113
Epoch: 251
Loss on hold-out set: 0.0004432943886578349
MeanAbsoluteError value on hold-out data: 0.01782984472811222
Epoch: 252

Loss on hold-out set: 0.00034709094740849523
MeanAbsoluteError value on hold-out data: 0.014131489209830761
Epoch: 253
Loss on hold-out set: 0.0004198435469464
MeanAbsoluteError value on hold-out data: 0.018147239461541176
Epoch: 254
```

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Loss on hold-out set: 9.935774245864845e-05
MeanAbsoluteError value on hold-out data: 0.007371795829385519
Epoch: 255
Loss on hold-out set: 0.0004690053714771888
MeanAbsoluteError value on hold-out data: 0.01924673654139042
Epoch: 256
Loss on hold-out set: 0.00012155806117724361
MeanAbsoluteError value on hold-out data: 0.008121275343000889
Epoch: 257

Loss on hold-out set: 9.487161462727402e-05
MeanAbsoluteError value on hold-out data: 0.007904047146439552
Epoch: 258
Loss on hold-out set: 0.004453104621331606
MeanAbsoluteError value on hold-out data: 0.053791869431734085
Epoch: 259

Loss on hold-out set: 0.0004697795583134783
MeanAbsoluteError value on hold-out data: 0.017433444038033485
Epoch: 260
Loss on hold-out set: 0.00030958999247689335
MeanAbsoluteError value on hold-out data: 0.014933607541024685
Epoch: 261

Loss on hold-out set: 0.001428650559059211
MeanAbsoluteError value on hold-out data: 0.035844236612319946
Epoch: 262
Loss on hold-out set: 0.0004706312652810344
MeanAbsoluteError value on hold-out data: 0.01732296496629715
Epoch: 263
Loss on hold-out set: 0.00016478914143850228
MeanAbsoluteError value on hold-out data: 0.01062732469290495
Epoch: 264

Loss on hold-out set: 0.0004402191428068493
MeanAbsoluteError value on hold-out data: 0.016809972003102303
Epoch: 265
Loss on hold-out set: 0.0018918172822200827
MeanAbsoluteError value on hold-out data: 0.029934685677289963
Epoch: 266
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Loss on hold-out set: 0.0016105134272947907
MeanAbsoluteError value on hold-out data: 0.03889700025320053
Epoch: 267
Loss on hold-out set: 0.0010435529319303377
MeanAbsoluteError value on hold-out data: 0.027308069169521332
Epoch: 268

Loss on hold-out set: 0.0028875383348869427
MeanAbsoluteError value on hold-out data: 0.05059296265244484
Epoch: 269
Loss on hold-out set: 0.006948316735880715
MeanAbsoluteError value on hold-out data: 0.06490710377693176
Epoch: 270
Loss on hold-out set: 0.00011764433085253196
MeanAbsoluteError value on hold-out data: 0.008386257104575634
Epoch: 271

Loss on hold-out set: 0.0005747506428243858
MeanAbsoluteError value on hold-out data: 0.0193440243601799
Epoch: 272
Loss on hold-out set: 0.0009300313873349556
MeanAbsoluteError value on hold-out data: 0.029801076278090477
Epoch: 273

Loss on hold-out set: 0.006233863066881895
MeanAbsoluteError value on hold-out data: 0.07673393189907074
Epoch: 274
Loss on hold-out set: 0.006264392552631242
MeanAbsoluteError value on hold-out data: 0.07695464789867401
Epoch: 275

Loss on hold-out set: 0.006771987769752741
MeanAbsoluteError value on hold-out data: 0.08059389889240265
Epoch: 276
Loss on hold-out set: 0.0007422465797779816
MeanAbsoluteError value on hold-out data: 0.024901235476136208
Epoch: 277
Loss on hold-out set: 0.00015468196735517786
MeanAbsoluteError value on hold-out data: 0.009747510775923729
Epoch: 278
```

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Loss on hold-out set: 0.0017059605036463057
MeanAbsoluteError value on hold-out data: 0.039184458553791046
Epoch: 279
Loss on hold-out set: 0.00032507428425430717
MeanAbsoluteError value on hold-out data: 0.015748068690299988
Epoch: 280

Loss on hold-out set: 0.0058525750147444865
MeanAbsoluteError value on hold-out data: 0.07448287308216095
Epoch: 281
Loss on hold-out set: 0.0012888740166090429
MeanAbsoluteError value on hold-out data: 0.030125770717859268
Epoch: 282

Loss on hold-out set: 0.00012089732522976451
MeanAbsoluteError value on hold-out data: 0.008527150377631187
Epoch: 283
Loss on hold-out set: 0.00856025397245373
MeanAbsoluteError value on hold-out data: 0.07834058254957199
Epoch: 284
Loss on hold-out set: 0.003587129259748118
MeanAbsoluteError value on hold-out data: 0.05648639053106308
Epoch: 285

Loss on hold-out set: 0.00012850192849457796
MeanAbsoluteError value on hold-out data: 0.009166313335299492
Epoch: 286
Loss on hold-out set: 0.0027396506629884243
MeanAbsoluteError value on hold-out data: 0.04889558628201485
Epoch: 287

Loss on hold-out set: 8.938438311036277e-05
MeanAbsoluteError value on hold-out data: 0.0075536505319178104
Epoch: 288
Loss on hold-out set: 0.0005731389267436628
MeanAbsoluteError value on hold-out data: 0.018944313749670982
Epoch: 289

Loss on hold-out set: 0.0005321118348677244
MeanAbsoluteError value on hold-out data: 0.021052734926342964
Epoch: 290
```

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Loss on hold-out set: 0.0015790308409902667
MeanAbsoluteError value on hold-out data: 0.031637080013751984
Epoch: 291
Loss on hold-out set: 7.78924472147732e-05
MeanAbsoluteError value on hold-out data: 0.006793620530515909
Epoch: 292

Loss on hold-out set: 0.0020355621818453074
MeanAbsoluteError value on hold-out data: 0.04139924421906471
Epoch: 293
Loss on hold-out set: 8.050791906758345e-05
MeanAbsoluteError value on hold-out data: 0.006928420625627041
Epoch: 294

Loss on hold-out set: 0.0004869262380192855
MeanAbsoluteError value on hold-out data: 0.017511531710624695
Epoch: 295
Loss on hold-out set: 0.0016685732573802983
MeanAbsoluteError value on hold-out data: 0.03829232603311539
Epoch: 296

Loss on hold-out set: 0.002773484497863267
MeanAbsoluteError value on hold-out data: 0.03928330913186073
Epoch: 297
Loss on hold-out set: 0.002844123701964106
MeanAbsoluteError value on hold-out data: 0.05192049965262413
Epoch: 298
Loss on hold-out set: 0.00019074947652240683
MeanAbsoluteError value on hold-out data: 0.010966768488287926
Epoch: 299

Loss on hold-out set: 0.002477117448246905
MeanAbsoluteError value on hold-out data: 0.04796764254570007
Epoch: 300
Loss on hold-out set: 0.0028648480573402984
MeanAbsoluteError value on hold-out data: 0.04983812943100929
Epoch: 301

Loss on hold-out set: 0.001702531407188092
MeanAbsoluteError value on hold-out data: 0.032625194638967514
Epoch: 302
```

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Loss on hold-out set: 0.0006529791571665555
MeanAbsoluteError value on hold-out data: 0.024464940652251244
Epoch: 303

Loss on hold-out set: 0.0021540180148024645
MeanAbsoluteError value on hold-out data: 0.04345197603106499
Epoch: 304
Loss on hold-out set: 0.003467423342434423
MeanAbsoluteError value on hold-out data: 0.05508624389767647
Epoch: 305
Loss on hold-out set: 0.0009087423802286919
MeanAbsoluteError value on hold-out data: 0.02608269639313221
Epoch: 306

Loss on hold-out set: 0.00059073166007043
MeanAbsoluteError value on hold-out data: 0.019562194123864174
Epoch: 307
Loss on hold-out set: 0.00017296743005447621
MeanAbsoluteError value on hold-out data: 0.010082047432661057
Epoch: 308

Loss on hold-out set: 0.00045470197801478207
MeanAbsoluteError value on hold-out data: 0.017640411853790283
Epoch: 309
Loss on hold-out set: 0.0023526765372870223
MeanAbsoluteError value on hold-out data: 0.041609831154346466
Epoch: 310

Loss on hold-out set: 9.174213222909852e-05
MeanAbsoluteError value on hold-out data: 0.007575579918920994
Epoch: 311
Loss on hold-out set: 0.0032317633407988717
MeanAbsoluteError value on hold-out data: 0.04531744495034218
Epoch: 312
Loss on hold-out set: 0.0038745839348328964
MeanAbsoluteError value on hold-out data: 0.061569686979055405
Epoch: 313

Loss on hold-out set: 0.0001743887218513659
MeanAbsoluteError value on hold-out data: 0.010656077414751053
Epoch: 314
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Loss on hold-out set: 0.0020167186823008315
MeanAbsoluteError value on hold-out data: 0.0396118201315403
Epoch: 315

Loss on hold-out set: 0.0006723866016337914
MeanAbsoluteError value on hold-out data: 0.021727249026298523
Epoch: 316
Loss on hold-out set: 0.00520949052380664
MeanAbsoluteError value on hold-out data: 0.06512262672185898
Epoch: 317

Loss on hold-out set: 0.0025030734416629586
MeanAbsoluteError value on hold-out data: 0.041310280561447144
Epoch: 318
Loss on hold-out set: 0.00687020697763988
MeanAbsoluteError value on hold-out data: 0.08175596594810486
Epoch: 319
Loss on hold-out set: 0.000163565221425545
MeanAbsoluteError value on hold-out data: 0.010492253117263317
Epoch: 320

Loss on hold-out set: 0.0006355243926269136
MeanAbsoluteError value on hold-out data: 0.023001648485660553
Epoch: 321
Loss on hold-out set: 0.0013779509962270303
MeanAbsoluteError value on hold-out data: 0.03132447227835655
Epoch: 322

Loss on hold-out set: 0.000501633168564045
MeanAbsoluteError value on hold-out data: 0.020546507090330124
Epoch: 323
Loss on hold-out set: 0.00039930579285802584
MeanAbsoluteError value on hold-out data: 0.017038092017173767
Epoch: 324

Loss on hold-out set: 0.0014858936857698219
MeanAbsoluteError value on hold-out data: 0.030155768617987633
Epoch: 325
Loss on hold-out set: 0.000777732755523175
MeanAbsoluteError value on hold-out data: 0.0234522745013237
Epoch: 326
```

```
Loss on hold-out set: 0.001130246216364737
MeanAbsoluteError value on hold-out data: 0.027211880311369896
Epoch: 327

Loss on hold-out set: 0.0006739473111727941
MeanAbsoluteError value on hold-out data: 0.023317599669098854
Epoch: 328
Loss on hold-out set: 0.001741519563698343
MeanAbsoluteError value on hold-out data: 0.0402674525976181
Epoch: 329

Loss on hold-out set: 0.0001861967736788626
MeanAbsoluteError value on hold-out data: 0.011503697372972965
Epoch: 330
Loss on hold-out set: 0.0030914116983434986
MeanAbsoluteError value on hold-out data: 0.05134441703557968
Epoch: 331

Loss on hold-out set: 0.004072093937013831
MeanAbsoluteError value on hold-out data: 0.0546598881483078
Epoch: 332
Loss on hold-out set: 0.00169324194679835
MeanAbsoluteError value on hold-out data: 0.03940436989068985
Epoch: 333
Loss on hold-out set: 0.0020530419756791423
MeanAbsoluteError value on hold-out data: 0.0435246042907238
Epoch: 334

Loss on hold-out set: 0.0002780324430204928
MeanAbsoluteError value on hold-out data: 0.01466248370707035
Epoch: 335
Loss on hold-out set: 0.00038187501611121533
MeanAbsoluteError value on hold-out data: 0.0177147276699543
Epoch: 336

Loss on hold-out set: 0.008076150103339128
MeanAbsoluteError value on hold-out data: 0.07862713932991028
Epoch: 337
Loss on hold-out set: 0.0003861159784719348
MeanAbsoluteError value on hold-out data: 0.01635308377444744
Epoch: 338
```

```
Loss on hold-out set: 0.00015176033411998992
MeanAbsoluteError value on hold-out data: 0.010294612497091293
Epoch: 339
Loss on hold-out set: 0.0010289123996959201
MeanAbsoluteError value on hold-out data: 0.027036158367991447
Epoch: 340
Loss on hold-out set: 0.0011878892546519637
MeanAbsoluteError value on hold-out data: 0.03290395811200142
Epoch: 341

Loss on hold-out set: 0.0003628380779576089
MeanAbsoluteError value on hold-out data: 0.015813985839486122
Epoch: 342
Loss on hold-out set: 0.0009686216529059623
MeanAbsoluteError value on hold-out data: 0.028594212606549263
Epoch: 343

Loss on hold-out set: 0.0007602372206747532
MeanAbsoluteError value on hold-out data: 0.025101926177740097
Epoch: 344
Loss on hold-out set: 0.0038519082258322407
MeanAbsoluteError value on hold-out data: 0.054395321756601334
Epoch: 345

Loss on hold-out set: 0.0010615807841531932
MeanAbsoluteError value on hold-out data: 0.02948050945997238
Epoch: 346
Loss on hold-out set: 0.000774541957071051
MeanAbsoluteError value on hold-out data: 0.02483498305082321
Epoch: 347
Loss on hold-out set: 0.0007661457680764475
MeanAbsoluteError value on hold-out data: 0.022914979606866837
Epoch: 348

Loss on hold-out set: 0.0001855198258583966
MeanAbsoluteError value on hold-out data: 0.011355271562933922
Epoch: 349
Loss on hold-out set: 0.004507520402382527
MeanAbsoluteError value on hold-out data: 0.06389307230710983
Epoch: 350
```

```
Loss on hold-out set: 0.00368668744340539
MeanAbsoluteError value on hold-out data: 0.05813734233379364
Epoch: 351
Loss on hold-out set: 7.7755441712465e-05
MeanAbsoluteError value on hold-out data: 0.006567480508238077
Epoch: 352

Loss on hold-out set: 0.0014351896243169904
MeanAbsoluteError value on hold-out data: 0.03258906304836273
Epoch: 353
Loss on hold-out set: 0.001692502642981708
MeanAbsoluteError value on hold-out data: 0.03581893816590309
Epoch: 354
Loss on hold-out set: 0.0010924804415221193
MeanAbsoluteError value on hold-out data: 0.02363770455121994
Epoch: 355

Loss on hold-out set: 0.0014823101893333451
MeanAbsoluteError value on hold-out data: 0.0340782105922699
Epoch: 356
Loss on hold-out set: 8.398177409877203e-05
MeanAbsoluteError value on hold-out data: 0.006932426709681749
Epoch: 357

Loss on hold-out set: 0.0003564118544870455
MeanAbsoluteError value on hold-out data: 0.016034744679927826
Epoch: 358
Loss on hold-out set: 0.0007867983991413244
MeanAbsoluteError value on hold-out data: 0.023025333881378174
Epoch: 359

Loss on hold-out set: 0.0028386380124304977
MeanAbsoluteError value on hold-out data: 0.05055786296725273
Epoch: 360
Loss on hold-out set: 0.0006450679627180632
MeanAbsoluteError value on hold-out data: 0.022085512056946754
Epoch: 361
Loss on hold-out set: 0.003411261797217386
MeanAbsoluteError value on hold-out data: 0.053120169788599014
Epoch: 362
```

```
Loss on hold-out set: 0.0003194983146386221
MeanAbsoluteError value on hold-out data: 0.016133766621351242
Epoch: 363
Loss on hold-out set: 0.00014191881304473748
MeanAbsoluteError value on hold-out data: 0.00898558646440506
Epoch: 364

Loss on hold-out set: 0.0027688542447452036
MeanAbsoluteError value on hold-out data: 0.05201272666454315
Epoch: 365
Loss on hold-out set: 0.0005658755378265466
MeanAbsoluteError value on hold-out data: 0.021694360300898552
Epoch: 366

Loss on hold-out set: 0.0017236983237255896
MeanAbsoluteError value on hold-out data: 0.03750523179769516
Epoch: 367
Loss on hold-out set: 0.00025167893285730055
MeanAbsoluteError value on hold-out data: 0.013749168254435062
Epoch: 368
Loss on hold-out set: 0.00027915387389449667
MeanAbsoluteError value on hold-out data: 0.015056268312036991
Epoch: 369

Loss on hold-out set: 0.0009654181527106889
MeanAbsoluteError value on hold-out data: 0.028070781379938126
Epoch: 370
Loss on hold-out set: 0.0012621964061898844
MeanAbsoluteError value on hold-out data: 0.03410474956035614
Epoch: 371

Loss on hold-out set: 0.00134355466746326
MeanAbsoluteError value on hold-out data: 0.03505060076713562
Epoch: 372
Loss on hold-out set: 0.002533673109220607
MeanAbsoluteError value on hold-out data: 0.04956555739045143
Early stopping at epoch 371
Fold: 8
Epoch: 1
```

```
Loss on hold-out set: 0.040486592799425125
MeanAbsoluteError value on hold-out data: 0.1666521430015564
Epoch: 2
Loss on hold-out set: 0.009571284321802003
MeanAbsoluteError value on hold-out data: 0.07804198563098907
Epoch: 3
Loss on hold-out set: 0.06944291133965765
MeanAbsoluteError value on hold-out data: 0.2551567256450653
Epoch: 4

Loss on hold-out set: 0.02408495039812156
MeanAbsoluteError value on hold-out data: 0.1422027349472046
Epoch: 5
Loss on hold-out set: 0.00949556945956179
MeanAbsoluteError value on hold-out data: 0.08358907699584961
Epoch: 6

Loss on hold-out set: 0.010970642124967915
MeanAbsoluteError value on hold-out data: 0.08984355628490448
Epoch: 7
Loss on hold-out set: 0.01060344957347427
MeanAbsoluteError value on hold-out data: 0.09159060567617416
Epoch: 8

Loss on hold-out set: 0.005862762885434287
MeanAbsoluteError value on hold-out data: 0.06443829089403152
Epoch: 9
Loss on hold-out set: 0.0034451886811958893
MeanAbsoluteError value on hold-out data: 0.0497572124004364
Epoch: 10
Loss on hold-out set: 0.006460304438535657
MeanAbsoluteError value on hold-out data: 0.06703327596187592
Epoch: 11

Loss on hold-out set: 0.01407690386154822
MeanAbsoluteError value on hold-out data: 0.10367176681756973
Epoch: 12
Loss on hold-out set: 0.004961790284141898
MeanAbsoluteError value on hold-out data: 0.058699365705251694
Epoch: 13
```

```
Loss on hold-out set: 0.005735629570803472
MeanAbsoluteError value on hold-out data: 0.0671306923031807
Epoch: 14
Loss on hold-out set: 0.003597344770761473
MeanAbsoluteError value on hold-out data: 0.049251049757003784
Epoch: 15

Loss on hold-out set: 0.0040658341188515934
MeanAbsoluteError value on hold-out data: 0.05851011350750923
Epoch: 16
Loss on hold-out set: 0.01772657914885453
MeanAbsoluteError value on hold-out data: 0.1325327605009079
Epoch: 17
Loss on hold-out set: 0.004311646201780864
MeanAbsoluteError value on hold-out data: 0.05577176436781883
Epoch: 18

Loss on hold-out set: 0.008537955449095793
MeanAbsoluteError value on hold-out data: 0.07312674820423126
Epoch: 19
Loss on hold-out set: 0.002124262458112623
MeanAbsoluteError value on hold-out data: 0.03678391873836517
Epoch: 20

Loss on hold-out set: 0.009760370611080102
MeanAbsoluteError value on hold-out data: 0.09731090813875198
Epoch: 21
Loss on hold-out set: 0.003604366011651499
MeanAbsoluteError value on hold-out data: 0.04903268814086914
Epoch: 22

Loss on hold-out set: 0.002383309865503439
MeanAbsoluteError value on hold-out data: 0.0434381403028965
Epoch: 23
Loss on hold-out set: 0.007859075641525643
MeanAbsoluteError value on hold-out data: 0.08383563160896301
Epoch: 24
Loss on hold-out set: 0.006937388397221055
MeanAbsoluteError value on hold-out data: 0.06912912428379059
Epoch: 25
```

```
Loss on hold-out set: 0.00864004749538643
MeanAbsoluteError value on hold-out data: 0.07761480659246445
Epoch: 26
Loss on hold-out set: 0.013465271065277713
MeanAbsoluteError value on hold-out data: 0.11019748449325562
Epoch: 27

Loss on hold-out set: 0.0032099134155682157
MeanAbsoluteError value on hold-out data: 0.054318949580192566
Epoch: 28
Loss on hold-out set: 0.006384282505937985
MeanAbsoluteError value on hold-out data: 0.06013314798474312
Epoch: 29

Loss on hold-out set: 0.0015682688681408763
MeanAbsoluteError value on hold-out data: 0.03237517923116684
Epoch: 30
Loss on hold-out set: 0.0038952911272644997
MeanAbsoluteError value on hold-out data: 0.0494186170399189
Epoch: 31
Loss on hold-out set: 0.0026205332916496055
MeanAbsoluteError value on hold-out data: 0.04485617205500603
Epoch: 32

Loss on hold-out set: 0.010830533823796682
MeanAbsoluteError value on hold-out data: 0.10340701043605804
Epoch: 33
Loss on hold-out set: 0.008185391247804676
MeanAbsoluteError value on hold-out data: 0.08045836538076401
Epoch: 34

Loss on hold-out set: 0.010389481937246663
MeanAbsoluteError value on hold-out data: 0.09778114408254623
Epoch: 35
Loss on hold-out set: 0.001916080530333732
MeanAbsoluteError value on hold-out data: 0.042451344430446625
Epoch: 36

Loss on hold-out set: 0.006349682541830199
MeanAbsoluteError value on hold-out data: 0.06879689544439316
Epoch: 37
```

```
Loss on hold-out set: 0.004398149105587176
MeanAbsoluteError value on hold-out data: 0.06508942693471909
Epoch: 38
Loss on hold-out set: 0.002753523161767849
MeanAbsoluteError value on hold-out data: 0.04809265583753586
Epoch: 39

Loss on hold-out set: 0.005483953149190971
MeanAbsoluteError value on hold-out data: 0.06677378714084625
Epoch: 40
Loss on hold-out set: 0.003838813098679696
MeanAbsoluteError value on hold-out data: 0.059128399938344955
Epoch: 41

Loss on hold-out set: 0.0005502324992059064
MeanAbsoluteError value on hold-out data: 0.01802821457386017
Epoch: 42
Loss on hold-out set: 0.0002677206669302125
MeanAbsoluteError value on hold-out data: 0.012557374313473701
Epoch: 43

Loss on hold-out set: 0.004654232512361237
MeanAbsoluteError value on hold-out data: 0.05973708629608154
Epoch: 44
Loss on hold-out set: 0.0007050995856323945
MeanAbsoluteError value on hold-out data: 0.02141754887998104
Epoch: 45
Loss on hold-out set: 0.007538496117506709
MeanAbsoluteError value on hold-out data: 0.08341347426176071
Epoch: 46

Loss on hold-out set: 0.005359653649585587
MeanAbsoluteError value on hold-out data: 0.06463512033224106
Epoch: 47
Loss on hold-out set: 0.0004486123964722667
MeanAbsoluteError value on hold-out data: 0.017874261364340782
Epoch: 48

Loss on hold-out set: 0.006419111741706729
MeanAbsoluteError value on hold-out data: 0.06438922882080078
Epoch: 49
```

```
Loss on hold-out set: 0.0017412501453821147
MeanAbsoluteError value on hold-out data: 0.037713803350925446
Epoch: 50

Loss on hold-out set: 0.009005718265793152
MeanAbsoluteError value on hold-out data: 0.08724717050790787
Epoch: 51
Loss on hold-out set: 0.0020828869559669067
MeanAbsoluteError value on hold-out data: 0.03739731013774872
Epoch: 52
Loss on hold-out set: 0.012298381754330226
MeanAbsoluteError value on hold-out data: 0.10710347443819046
Epoch: 53

Loss on hold-out set: 0.002483645736772035
MeanAbsoluteError value on hold-out data: 0.04197801649570465
Epoch: 54
Loss on hold-out set: 0.002296418949429478
MeanAbsoluteError value on hold-out data: 0.04520530253648758
Epoch: 55

Loss on hold-out set: 0.0014623575012332626
MeanAbsoluteError value on hold-out data: 0.03650235757231712
Epoch: 56
Loss on hold-out set: 0.003773271937721542
MeanAbsoluteError value on hold-out data: 0.056819528341293335
Epoch: 57

Loss on hold-out set: 0.00013249505406877558
MeanAbsoluteError value on hold-out data: 0.008541255258023739
Epoch: 58
Loss on hold-out set: 0.012820696325174399
MeanAbsoluteError value on hold-out data: 0.10703512281179428
Epoch: 59
Loss on hold-out set: 0.00380234353776489
MeanAbsoluteError value on hold-out data: 0.057607073336839676
Epoch: 60

Loss on hold-out set: 0.0028705663280561566
MeanAbsoluteError value on hold-out data: 0.049435392022132874
Epoch: 61
```

```
Loss on hold-out set: 0.0018288000719621778
MeanAbsoluteError value on hold-out data: 0.03861106559634209
Epoch: 62

Loss on hold-out set: 0.003062434827110597
MeanAbsoluteError value on hold-out data: 0.049623824656009674
Epoch: 63
Loss on hold-out set: 0.002922511227162821
MeanAbsoluteError value on hold-out data: 0.05030711740255356
Epoch: 64

Loss on hold-out set: 0.0005818787779259894
MeanAbsoluteError value on hold-out data: 0.01928098499774933
Epoch: 65
Loss on hold-out set: 0.00012626829473967
MeanAbsoluteError value on hold-out data: 0.009264383465051651
Epoch: 66
Loss on hold-out set: 0.001453400348379676
MeanAbsoluteError value on hold-out data: 0.03376187011599541
Epoch: 67

Loss on hold-out set: 0.011785388924181461
MeanAbsoluteError value on hold-out data: 0.10075303912162781
Epoch: 68
Loss on hold-out set: 0.0015007371881178447
MeanAbsoluteError value on hold-out data: 0.032094910740852356
Epoch: 69

Loss on hold-out set: 0.002833037736958691
MeanAbsoluteError value on hold-out data: 0.049872588366270065
Epoch: 70
Loss on hold-out set: 0.001898271297769887
MeanAbsoluteError value on hold-out data: 0.03970181569457054
Epoch: 71

Loss on hold-out set: 0.002422470599412918
MeanAbsoluteError value on hold-out data: 0.04668460786342621
Epoch: 72
Loss on hold-out set: 0.0012588590616360307
MeanAbsoluteError value on hold-out data: 0.03176345303654671
Epoch: 73
```

```
Loss on hold-out set: 0.003078094538068399
MeanAbsoluteError value on hold-out data: 0.04666660726070404
Epoch: 74

Loss on hold-out set: 0.0007795303078767445
MeanAbsoluteError value on hold-out data: 0.025088198482990265
Epoch: 75
Loss on hold-out set: 0.006015662037368331
MeanAbsoluteError value on hold-out data: 0.0765848457813263
Epoch: 76

Loss on hold-out set: 0.0003438884159550071
MeanAbsoluteError value on hold-out data: 0.015162714757025242
Epoch: 77
Loss on hold-out set: 0.0007756479899398983
MeanAbsoluteError value on hold-out data: 0.026517203077673912
Epoch: 78

Loss on hold-out set: 0.006703444357429232
MeanAbsoluteError value on hold-out data: 0.08021751046180725
Epoch: 79
Loss on hold-out set: 0.00022260582149361393
MeanAbsoluteError value on hold-out data: 0.012918148189783096
Epoch: 80
Loss on hold-out set: 0.004433022812008858
MeanAbsoluteError value on hold-out data: 0.06276247650384903
Epoch: 81

Loss on hold-out set: 0.004709941268499408
MeanAbsoluteError value on hold-out data: 0.057254888117313385
Epoch: 82
Loss on hold-out set: 0.0006627380333237734
MeanAbsoluteError value on hold-out data: 0.022516371682286263
Epoch: 83

Loss on hold-out set: 0.0019651426700875163
MeanAbsoluteError value on hold-out data: 0.03920477256178856
Epoch: 84
Loss on hold-out set: 0.0022883812032107797
MeanAbsoluteError value on hold-out data: 0.04131615161895752
Epoch: 85
```

```
Loss on hold-out set: 0.00039712112214017125
MeanAbsoluteError value on hold-out data: 0.017441444098949432
Epoch: 86
Loss on hold-out set: 0.00036410600296221673
MeanAbsoluteError value on hold-out data: 0.016021184623241425
Epoch: 87
Loss on hold-out set: 0.0009709757453362856
MeanAbsoluteError value on hold-out data: 0.027411017566919327
Epoch: 88

Loss on hold-out set: 0.001188601483590901
MeanAbsoluteError value on hold-out data: 0.02782495692372322
Epoch: 89
Loss on hold-out set: 0.0006016654536194567
MeanAbsoluteError value on hold-out data: 0.020800314843654633
Epoch: 90

Loss on hold-out set: 0.004647349705919623
MeanAbsoluteError value on hold-out data: 0.06231851503252983
Epoch: 91
Loss on hold-out set: 0.00816735698442374
MeanAbsoluteError value on hold-out data: 0.07234623283147812
Epoch: 92

Loss on hold-out set: 0.0030273038760891984
MeanAbsoluteError value on hold-out data: 0.05422293767333031
Epoch: 93
Loss on hold-out set: 0.005206467517252479
MeanAbsoluteError value on hold-out data: 0.06962176412343979
Epoch: 94
Loss on hold-out set: 0.0012294883823155292
MeanAbsoluteError value on hold-out data: 0.033271826803684235
Epoch: 95

Loss on hold-out set: 0.0008569149732855814
MeanAbsoluteError value on hold-out data: 0.026580264791846275
Epoch: 96
Loss on hold-out set: 0.0013747861459186034
MeanAbsoluteError value on hold-out data: 0.030935591086745262
Epoch: 97
```

```
Loss on hold-out set: 0.0002920232280822737
MeanAbsoluteError value on hold-out data: 0.0156524870544672
Epoch: 98
Loss on hold-out set: 0.0010156762603271221
MeanAbsoluteError value on hold-out data: 0.029430260881781578
Epoch: 99

Loss on hold-out set: 0.00036784016992896795
MeanAbsoluteError value on hold-out data: 0.015383410267531872
Epoch: 100
Loss on hold-out set: 0.002761869608158512
MeanAbsoluteError value on hold-out data: 0.051494501531124115
Epoch: 101
Loss on hold-out set: 9.13414574565e-05
MeanAbsoluteError value on hold-out data: 0.007820007391273975
Epoch: 102

Loss on hold-out set: 0.001598436476862324
MeanAbsoluteError value on hold-out data: 0.0343831405043602
Epoch: 103
Loss on hold-out set: 0.0008432598219120077
MeanAbsoluteError value on hold-out data: 0.024891452863812447
Epoch: 104

Loss on hold-out set: 0.00440934593124049
MeanAbsoluteError value on hold-out data: 0.06162966415286064
Epoch: 105
Loss on hold-out set: 0.0025429226557857226
MeanAbsoluteError value on hold-out data: 0.04244380444288254
Epoch: 106

Loss on hold-out set: 0.0011033885904388236
MeanAbsoluteError value on hold-out data: 0.028512630611658096
Epoch: 107
Loss on hold-out set: 0.0003048103327663349
MeanAbsoluteError value on hold-out data: 0.014726817607879639
Epoch: 108
Loss on hold-out set: 0.0030050010619951145
MeanAbsoluteError value on hold-out data: 0.05287856236100197
Epoch: 109
```

```
Loss on hold-out set: 0.0010461725843405084
MeanAbsoluteError value on hold-out data: 0.031322918832302094
Epoch: 110
Loss on hold-out set: 0.0019410553255251475
MeanAbsoluteError value on hold-out data: 0.037836648523807526
Epoch: 111

Loss on hold-out set: 0.0009178800391964614
MeanAbsoluteError value on hold-out data: 0.02780403383076191
Epoch: 112

Loss on hold-out set: 0.005697320049096431
MeanAbsoluteError value on hold-out data: 0.06453073769807816
Epoch: 113
Loss on hold-out set: 0.0009858739961470877
MeanAbsoluteError value on hold-out data: 0.029394319280982018
Epoch: 114
Loss on hold-out set: 0.0029964973883969443
MeanAbsoluteError value on hold-out data: 0.04237358272075653
Epoch: 115

Loss on hold-out set: 0.0011586063441687397
MeanAbsoluteError value on hold-out data: 0.03297633305191994
Epoch: 116
Loss on hold-out set: 0.0027993708582861082
MeanAbsoluteError value on hold-out data: 0.04952530935406685
Epoch: 117

Loss on hold-out set: 0.001144506103758301
MeanAbsoluteError value on hold-out data: 0.02447887696325779
Epoch: 118
Loss on hold-out set: 0.0015994085863764798
MeanAbsoluteError value on hold-out data: 0.0355418436229229
Epoch: 119

Loss on hold-out set: 0.0008228365664503404
MeanAbsoluteError value on hold-out data: 0.024260492995381355
Epoch: 120
Loss on hold-out set: 0.0009192659053951502
MeanAbsoluteError value on hold-out data: 0.028100991621613503
Epoch: 121
```

```
Loss on hold-out set: 0.0007569605825535421
MeanAbsoluteError value on hold-out data: 0.022055234760046005
Epoch: 122

Loss on hold-out set: 0.004620395584164986
MeanAbsoluteError value on hold-out data: 0.05521605163812637
Epoch: 123
Loss on hold-out set: 0.001737034846363323
MeanAbsoluteError value on hold-out data: 0.03307094797492027
Epoch: 124

Loss on hold-out set: 0.00016606779744116857
MeanAbsoluteError value on hold-out data: 0.010754114016890526
Epoch: 125
Loss on hold-out set: 0.0013742748581405198
MeanAbsoluteError value on hold-out data: 0.031342219561338425
Epoch: 126

Loss on hold-out set: 0.000766801564688129
MeanAbsoluteError value on hold-out data: 0.02708393894135952
Epoch: 127
Loss on hold-out set: 0.0015351078306723917
MeanAbsoluteError value on hold-out data: 0.03389419615268707
Epoch: 128
Loss on hold-out set: 0.0018629969895950385
MeanAbsoluteError value on hold-out data: 0.03852615877985954
Epoch: 129

Loss on hold-out set: 0.001987144783405321
MeanAbsoluteError value on hold-out data: 0.043596964329481125
Epoch: 130
Loss on hold-out set: 0.0003248917367143024
MeanAbsoluteError value on hold-out data: 0.015927612781524658
Epoch: 131

Loss on hold-out set: 0.0011120904652800942
MeanAbsoluteError value on hold-out data: 0.02875578962266445
Epoch: 132
Loss on hold-out set: 0.006096839306077787
MeanAbsoluteError value on hold-out data: 0.07417932152748108
Epoch: 133
```

```
Loss on hold-out set: 0.0014496139317218746
MeanAbsoluteError value on hold-out data: 0.02862618677318096
Epoch: 134
Loss on hold-out set: 0.002783183906493442
MeanAbsoluteError value on hold-out data: 0.05024383217096329
Epoch: 135
Loss on hold-out set: 0.0024116852852915016
MeanAbsoluteError value on hold-out data: 0.04346150532364845
Epoch: 136

Loss on hold-out set: 0.0005872502848173358
MeanAbsoluteError value on hold-out data: 0.022462980821728706
Epoch: 137
Loss on hold-out set: 0.005327136122754642
MeanAbsoluteError value on hold-out data: 0.07206079363822937
Epoch: 138

Loss on hold-out set: 0.0013348321164292948
MeanAbsoluteError value on hold-out data: 0.03255058825016022
Epoch: 139
Loss on hold-out set: 0.0015861780183123691
MeanAbsoluteError value on hold-out data: 0.030724601820111275
Epoch: 140

Loss on hold-out set: 0.00020572728473260731
MeanAbsoluteError value on hold-out data: 0.011910002678632736
Epoch: 141
Loss on hold-out set: 0.0009909530719076948
MeanAbsoluteError value on hold-out data: 0.02805018424987793
Epoch: 142
Loss on hold-out set: 0.0018981532360027944
MeanAbsoluteError value on hold-out data: 0.03982285410165787
Epoch: 143

Loss on hold-out set: 0.0024510453887549894
MeanAbsoluteError value on hold-out data: 0.04243088141083717
Epoch: 144
Loss on hold-out set: 0.0030230669737128274
MeanAbsoluteError value on hold-out data: 0.03754691034555435
Epoch: 145
```

```
Loss on hold-out set: 0.001327851354809744
MeanAbsoluteError value on hold-out data: 0.029601015150547028
Epoch: 146
Loss on hold-out set: 0.00616514017539365
MeanAbsoluteError value on hold-out data: 0.07741434127092361
Epoch: 147

Loss on hold-out set: 0.00276052052088614
MeanAbsoluteError value on hold-out data: 0.04684218764305115
Epoch: 148
Loss on hold-out set: 0.001569425404470946
MeanAbsoluteError value on hold-out data: 0.03412674367427826
Epoch: 149
Loss on hold-out set: 0.00044438669491293173
MeanAbsoluteError value on hold-out data: 0.01741538569331169
Epoch: 150

Loss on hold-out set: 0.007178068959287235
MeanAbsoluteError value on hold-out data: 0.07320189476013184
Epoch: 151
Loss on hold-out set: 0.0029544297805322067
MeanAbsoluteError value on hold-out data: 0.047411903738975525
Epoch: 152

Loss on hold-out set: 0.0002250027360527643
MeanAbsoluteError value on hold-out data: 0.012754690833389759
Epoch: 153
Loss on hold-out set: 0.0027937910719109432
MeanAbsoluteError value on hold-out data: 0.04430572688579559
Epoch: 154

Loss on hold-out set: 0.00027428450370540043
MeanAbsoluteError value on hold-out data: 0.013557287864387035
Epoch: 155
Loss on hold-out set: 0.00024072046341773654
MeanAbsoluteError value on hold-out data: 0.011905758641660213
Epoch: 156
Loss on hold-out set: 0.0010753290760996087
MeanAbsoluteError value on hold-out data: 0.03078424371778965
Epoch: 157
```

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Loss on hold-out set: 0.0012020490082379962
MeanAbsoluteError value on hold-out data: 0.02651873044669628
Epoch: 158
Loss on hold-out set: 0.0006697757344227284
MeanAbsoluteError value on hold-out data: 0.021324744448065758
Epoch: 159

Loss on hold-out set: 0.0013581714384989546
MeanAbsoluteError value on hold-out data: 0.027537532150745392
Epoch: 160
Loss on hold-out set: 0.001734535301303757
MeanAbsoluteError value on hold-out data: 0.0329599492251873
Epoch: 161

Loss on hold-out set: 0.0002620208459640188
MeanAbsoluteError value on hold-out data: 0.013778981752693653
Epoch: 162
Loss on hold-out set: 0.00033607575668221604
MeanAbsoluteError value on hold-out data: 0.015456982888281345
Epoch: 163
Loss on hold-out set: 0.0027788910416087936
MeanAbsoluteError value on hold-out data: 0.044227298349142075
Epoch: 164

Loss on hold-out set: 0.001149001539618309
MeanAbsoluteError value on hold-out data: 0.025342274457216263
Epoch: 165
Loss on hold-out set: 0.00885257510734456
MeanAbsoluteError value on hold-out data: 0.08955894410610199
Epoch: 166

Loss on hold-out set: 0.00031838576043290753
MeanAbsoluteError value on hold-out data: 0.014867465943098068
Epoch: 167
Loss on hold-out set: 0.0022950771131685804
MeanAbsoluteError value on hold-out data: 0.04802070930600166
Epoch: 168

Loss on hold-out set: 0.0003390984306211716
MeanAbsoluteError value on hold-out data: 0.016454502940177917
Epoch: 169
```

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Loss on hold-out set: 0.0031732681007789715
MeanAbsoluteError value on hold-out data: 0.05563546344637871
Epoch: 170
Loss on hold-out set: 0.001054900374063956
MeanAbsoluteError value on hold-out data: 0.029180213809013367
Epoch: 171

Loss on hold-out set: 0.00010918301229269543
MeanAbsoluteError value on hold-out data: 0.00874241441488266
Epoch: 172
Loss on hold-out set: 0.003086480511618512
MeanAbsoluteError value on hold-out data: 0.052897918969392776
Epoch: 173

Loss on hold-out set: 0.00023941715751009594
MeanAbsoluteError value on hold-out data: 0.012500218115746975
Epoch: 174
Loss on hold-out set: 0.0024131506881011383
MeanAbsoluteError value on hold-out data: 0.039330221712589264
Epoch: 175

Loss on hold-out set: 0.0025967733734952553
MeanAbsoluteError value on hold-out data: 0.046553924679756165
Epoch: 176
Loss on hold-out set: 0.00259896124979215
MeanAbsoluteError value on hold-out data: 0.0498097762465477
Epoch: 177
Loss on hold-out set: 0.00036594894897591857
MeanAbsoluteError value on hold-out data: 0.014545219950377941
Epoch: 178

Loss on hold-out set: 0.0015409624736223901
MeanAbsoluteError value on hold-out data: 0.037583548575639725
Epoch: 179
Loss on hold-out set: 0.0018779805728367396
MeanAbsoluteError value on hold-out data: 0.03724473714828491
Epoch: 180

Loss on hold-out set: 0.002277360164693424
MeanAbsoluteError value on hold-out data: 0.04262130707502365
Epoch: 181
```

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Loss on hold-out set: 0.0014459926335673248
MeanAbsoluteError value on hold-out data: 0.03201041743159294
Epoch: 182

Loss on hold-out set: 0.00464278449570494
MeanAbsoluteError value on hold-out data: 0.059858452528715134
Epoch: 183
Loss on hold-out set: 0.0005489147775473871
MeanAbsoluteError value on hold-out data: 0.019364669919013977
Epoch: 184
Loss on hold-out set: 0.0010855747885735972
MeanAbsoluteError value on hold-out data: 0.030928388237953186
Epoch: 185

Loss on hold-out set: 0.004925624766786184
MeanAbsoluteError value on hold-out data: 0.052810367196798325
Epoch: 186
Loss on hold-out set: 0.00027181899765439866
MeanAbsoluteError value on hold-out data: 0.013322269544005394
Epoch: 187

Loss on hold-out set: 0.0006380504886952362
MeanAbsoluteError value on hold-out data: 0.020246941596269608
Epoch: 188
Loss on hold-out set: 0.003138377015212817
MeanAbsoluteError value on hold-out data: 0.05020737275481224
Epoch: 189

Loss on hold-out set: 0.00031851826601528695
MeanAbsoluteError value on hold-out data: 0.014280437491834164
Epoch: 190
Loss on hold-out set: 0.0012215426125164544
MeanAbsoluteError value on hold-out data: 0.028319692239165306
Epoch: 191
Loss on hold-out set: 0.0016024150453241809
MeanAbsoluteError value on hold-out data: 0.03466244041919708
Epoch: 192

Loss on hold-out set: 0.0016283775413674967
MeanAbsoluteError value on hold-out data: 0.037718404084444046
Epoch: 193
```

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Loss on hold-out set: 0.0006189999902354819
MeanAbsoluteError value on hold-out data: 0.02020430564880371
Epoch: 194

Loss on hold-out set: 0.0012014629651925393
MeanAbsoluteError value on hold-out data: 0.033081747591495514
Epoch: 195
Loss on hold-out set: 0.002168272588668125
MeanAbsoluteError value on hold-out data: 0.045341916382312775
Epoch: 196

Loss on hold-out set: 0.0032914679697049515
MeanAbsoluteError value on hold-out data: 0.046715959906578064
Epoch: 197
Loss on hold-out set: 0.0073504249033119
MeanAbsoluteError value on hold-out data: 0.07921662926673889
Epoch: 198
Loss on hold-out set: 0.0017528799196173037
MeanAbsoluteError value on hold-out data: 0.0329471081495285
Epoch: 199

Loss on hold-out set: 9.247873718517699e-05
MeanAbsoluteError value on hold-out data: 0.007934041321277618
Epoch: 200
Loss on hold-out set: 0.00025149207587l5432
MeanAbsoluteError value on hold-out data: 0.013343507423996925
Epoch: 201

Loss on hold-out set: 0.00019599311885290911
MeanAbsoluteError value on hold-out data: 0.012052119709551334
Epoch: 202
Loss on hold-out set: 0.00012626776463418667
MeanAbsoluteError value on hold-out data: 0.00768350251019001
Epoch: 203

Loss on hold-out set: 0.0002390217871704538
MeanAbsoluteError value on hold-out data: 0.012288682162761688
Epoch: 204
Loss on hold-out set: 0.0008763936847182256
MeanAbsoluteError value on hold-out data: 0.02532048709690571
Epoch: 205
```

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Loss on hold-out set: 0.0009266952900881213
MeanAbsoluteError value on hold-out data: 0.02885477803647518
Epoch: 206

Loss on hold-out set: 0.0009965435684924679
MeanAbsoluteError value on hold-out data: 0.028362462297081947
Epoch: 207
Loss on hold-out set: 0.001639164235842015
MeanAbsoluteError value on hold-out data: 0.035212863236665726
Epoch: 208

Loss on hold-out set: 0.004111417901835271
MeanAbsoluteError value on hold-out data: 0.06052491068840027
Epoch: 209
Loss on hold-out set: 8.714303476153873e-05
MeanAbsoluteError value on hold-out data: 0.007347946986556053
Epoch: 210

Loss on hold-out set: 0.0006756647074195955
MeanAbsoluteError value on hold-out data: 0.022768588736653328
Epoch: 211
Loss on hold-out set: 0.000520978621872408
MeanAbsoluteError value on hold-out data: 0.020043328404426575
Epoch: 212
Loss on hold-out set: 0.0003153209924805976
MeanAbsoluteError value on hold-out data: 0.013823773711919785
Epoch: 213

Loss on hold-out set: 0.001509110676124692
MeanAbsoluteError value on hold-out data: 0.027764882892370224
Epoch: 214
Loss on hold-out set: 0.0036767525265791585
MeanAbsoluteError value on hold-out data: 0.04715936630964279
Epoch: 215

Loss on hold-out set: 0.007855393125542573
MeanAbsoluteError value on hold-out data: 0.08398112654685974
Epoch: 216
Loss on hold-out set: 0.0015700323357512908
MeanAbsoluteError value on hold-out data: 0.03512926027178764
Epoch: 217
```

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Loss on hold-out set: 0.00026305895257142505
MeanAbsoluteError value on hold-out data: 0.013969349674880505
Epoch: 218
Loss on hold-out set: 0.0011619608849287033
MeanAbsoluteError value on hold-out data: 0.03275829926133156
Epoch: 219
Loss on hold-out set: 0.005761120135762862
MeanAbsoluteError value on hold-out data: 0.06643631309270859
Epoch: 220

Loss on hold-out set: 0.0008261432189361326
MeanAbsoluteError value on hold-out data: 0.02609163522720337
Epoch: 221
Loss on hold-out set: 0.002058337359423084
MeanAbsoluteError value on hold-out data: 0.04390644654631615
Epoch: 222

Loss on hold-out set: 0.000998867754658152
MeanAbsoluteError value on hold-out data: 0.028526950627565384
Epoch: 223
Loss on hold-out set: 0.001888738595880568
MeanAbsoluteError value on hold-out data: 0.039207346737384796
Epoch: 224

Loss on hold-out set: 0.00036845221101040285
MeanAbsoluteError value on hold-out data: 0.01733001135289669
Epoch: 225
Loss on hold-out set: 0.001585257239639759
MeanAbsoluteError value on hold-out data: 0.033695340156555176
Epoch: 226
Loss on hold-out set: 0.001094017959465938
MeanAbsoluteError value on hold-out data: 0.028155984356999397
Epoch: 227

Loss on hold-out set: 0.0011326524295977183
MeanAbsoluteError value on hold-out data: 0.031298547983169556
Epoch: 228
Loss on hold-out set: 0.0008032476679155869
MeanAbsoluteError value on hold-out data: 0.02581382729113102
Epoch: 229
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Loss on hold-out set: 0.003983461930017386
MeanAbsoluteError value on hold-out data: 0.0568525493144989
Epoch: 230
Loss on hold-out set: 0.00016173465181574493
MeanAbsoluteError value on hold-out data: 0.009710178710520267
Epoch: 231

Loss on hold-out set: 0.00014500406645571014
MeanAbsoluteError value on hold-out data: 0.01054008211940527
Epoch: 232
Loss on hold-out set: 0.0001296884230604129
MeanAbsoluteError value on hold-out data: 0.008909645490348339
Epoch: 233
Loss on hold-out set: 0.001317204674705863
MeanAbsoluteError value on hold-out data: 0.03447365388274193
Epoch: 234

Loss on hold-out set: 0.0007891987832928342
MeanAbsoluteError value on hold-out data: 0.025434352457523346
Epoch: 235
Loss on hold-out set: 0.0012287509411440364
MeanAbsoluteError value on hold-out data: 0.03123421221971512
Epoch: 236

Loss on hold-out set: 0.001863586882661496
MeanAbsoluteError value on hold-out data: 0.03742970526218414
Epoch: 237
Loss on hold-out set: 0.0003945419573158558
MeanAbsoluteError value on hold-out data: 0.01726759970188141
Epoch: 238

Loss on hold-out set: 0.0005216576932330749
MeanAbsoluteError value on hold-out data: 0.01989704556763172
Epoch: 239
Loss on hold-out set: 0.002019570375393544
MeanAbsoluteError value on hold-out data: 0.0423099547624588
Epoch: 240
Loss on hold-out set: 0.004960590241742986
MeanAbsoluteError value on hold-out data: 0.0685093104839325
Epoch: 241
```

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Loss on hold-out set: 0.0008311160901420018
MeanAbsoluteError value on hold-out data: 0.02242133766412735
Epoch: 242
Loss on hold-out set: 0.0028575347304078086
MeanAbsoluteError value on hold-out data: 0.04313747584819794
Epoch: 243

Loss on hold-out set: 8.155473083856382e-05
MeanAbsoluteError value on hold-out data: 0.006896346807479858
Epoch: 244
Loss on hold-out set: 0.004145235288888216
MeanAbsoluteError value on hold-out data: 0.050411734730005264
Epoch: 245

Loss on hold-out set: 0.0025069510198331307
MeanAbsoluteError value on hold-out data: 0.04813116416335106
Epoch: 246
Loss on hold-out set: 0.003781287298936929
MeanAbsoluteError value on hold-out data: 0.053625669330358505
Epoch: 247
Loss on hold-out set: 0.0009570775104553572
MeanAbsoluteError value on hold-out data: 0.025749020278453827
Epoch: 248

Loss on hold-out set: 0.0006097789529511439
MeanAbsoluteError value on hold-out data: 0.020213136449456215
Epoch: 249
Loss on hold-out set: 0.002248401055112481
MeanAbsoluteError value on hold-out data: 0.04448193684220314
Epoch: 250

Loss on hold-out set: 0.0035489067169172423
MeanAbsoluteError value on hold-out data: 0.04856603220105171
Epoch: 251
Loss on hold-out set: 0.001380373158359102
MeanAbsoluteError value on hold-out data: 0.036689642816782
Epoch: 252

Loss on hold-out set: 0.002057931269519031
MeanAbsoluteError value on hold-out data: 0.0414460226893425
Epoch: 253
```

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Loss on hold-out set: 0.00014683851207207357
MeanAbsoluteError value on hold-out data: 0.007261048071086407
Epoch: 254
Loss on hold-out set: 0.0005161642496074949
MeanAbsoluteError value on hold-out data: 0.02055034413933754
Epoch: 255

Loss on hold-out set: 0.00039165316723353626
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Loss on hold-out set: 0.002026419487914869
MeanAbsoluteError value on hold-out data: 0.045023173093795776
Epoch: 257

Loss on hold-out set: 0.0002946560957103169
MeanAbsoluteError value on hold-out data: 0.01458006352186203
Epoch: 258
Loss on hold-out set: 0.0023569971256490263
MeanAbsoluteError value on hold-out data: 0.04560546949505806
Epoch: 259

Loss on hold-out set: 0.00048532451702547926
MeanAbsoluteError value on hold-out data: 0.020668523386120796
Epoch: 260
Loss on hold-out set: 0.000945798828200038
MeanAbsoluteError value on hold-out data: 0.02377067320048809
Epoch: 261
Loss on hold-out set: 0.0019094115289460336
MeanAbsoluteError value on hold-out data: 0.040588464587926865
Epoch: 262

Loss on hold-out set: 0.0027426060156098436
MeanAbsoluteError value on hold-out data: 0.05023931339383125
Epoch: 263
Loss on hold-out set: 0.0009920296724885702
MeanAbsoluteError value on hold-out data: 0.027242930606007576
Epoch: 264

Loss on hold-out set: 0.0015335681715181895
MeanAbsoluteError value on hold-out data: 0.03471146523952484
Epoch: 265
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Loss on hold-out set: 0.0023878853701587233
MeanAbsoluteError value on hold-out data: 0.04703569784760475
Epoch: 266

Loss on hold-out set: 0.0015654145806495632
MeanAbsoluteError value on hold-out data: 0.039513520896434784
Epoch: 267
Loss on hold-out set: 0.00040952595840540847
MeanAbsoluteError value on hold-out data: 0.01944330893456936
Epoch: 268
Loss on hold-out set: 0.0014536191343462893
MeanAbsoluteError value on hold-out data: 0.028973985463380814
Epoch: 269

Loss on hold-out set: 0.0004634560484971319
MeanAbsoluteError value on hold-out data: 0.01744689792394638
Epoch: 270
Loss on hold-out set: 0.0008180340020252126
MeanAbsoluteError value on hold-out data: 0.0266462080180645
Epoch: 271

Loss on hold-out set: 0.0029322244226932526
MeanAbsoluteError value on hold-out data: 0.05277945473790169
Epoch: 272
Loss on hold-out set: 0.0005503523030451366
MeanAbsoluteError value on hold-out data: 0.018183298408985138
Epoch: 273

Loss on hold-out set: 0.00436097669548222
MeanAbsoluteError value on hold-out data: 0.06103480979800224
Epoch: 274
Loss on hold-out set: 0.005219708762264678
MeanAbsoluteError value on hold-out data: 0.06984372437000275
Epoch: 275
Loss on hold-out set: 0.0035393670134778532
MeanAbsoluteError value on hold-out data: 0.05607094615697861
Epoch: 276

Loss on hold-out set: 0.001433252589777112
MeanAbsoluteError value on hold-out data: 0.03238216042518616
Epoch: 277
```

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Loss on hold-out set: 0.001701717431257878
MeanAbsoluteError value on hold-out data: 0.03768904134631157
Epoch: 278

Loss on hold-out set: 0.00276784276190613
MeanAbsoluteError value on hold-out data: 0.049685195088386536
Epoch: 279
Loss on hold-out set: 0.0024457790090569426
MeanAbsoluteError value on hold-out data: 0.03893055394291878
Epoch: 280

Loss on hold-out set: 0.0018012433013479625
MeanAbsoluteError value on hold-out data: 0.035608720034360886
Epoch: 281
Loss on hold-out set: 0.0007090267400989043
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Epoch: 282
Loss on hold-out set: 0.0003446161707480704
MeanAbsoluteError value on hold-out data: 0.01605992019176483
Epoch: 283

Loss on hold-out set: 0.0016213676260252083
MeanAbsoluteError value on hold-out data: 0.03230738267302513
Epoch: 284
Loss on hold-out set: 6.421054526331968e-05
MeanAbsoluteError value on hold-out data: 0.006444605533033609
Epoch: 285

Loss on hold-out set: 0.0026795814212943825
MeanAbsoluteError value on hold-out data: 0.04285280779004097
Epoch: 286
Loss on hold-out set: 0.0031345068543617216
MeanAbsoluteError value on hold-out data: 0.05056132376194
Epoch: 287

Loss on hold-out set: 0.0010442552572515393
MeanAbsoluteError value on hold-out data: 0.029868418350815773
Epoch: 288
Loss on hold-out set: 0.0019879832065531184
MeanAbsoluteError value on hold-out data: 0.04365481808781624
Epoch: 289
```

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Loss on hold-out set: 0.0043004959422562805
MeanAbsoluteError value on hold-out data: 0.05514565110206604
Epoch: 290

Loss on hold-out set: 0.006035125614809138
MeanAbsoluteError value on hold-out data: 0.06454179435968399
Epoch: 291
Loss on hold-out set: 0.002089495155295091
MeanAbsoluteError value on hold-out data: 0.041784752160310745
Epoch: 292

Loss on hold-out set: 0.00110885312980307
MeanAbsoluteError value on hold-out data: 0.03123084455728531
Epoch: 293
Loss on hold-out set: 0.0015698047521124994
MeanAbsoluteError value on hold-out data: 0.03509441763162613
Epoch: 294

Loss on hold-out set: 0.002751759552795972
MeanAbsoluteError value on hold-out data: 0.044295668601989746
Epoch: 295
Loss on hold-out set: 0.0011689782841131091
MeanAbsoluteError value on hold-out data: 0.03200094401836395
Epoch: 296
Loss on hold-out set: 0.002769381373322436
MeanAbsoluteError value on hold-out data: 0.04590633511543274
Epoch: 297

Loss on hold-out set: 0.0017116375550228571
MeanAbsoluteError value on hold-out data: 0.032989248633384705
Epoch: 298
Loss on hold-out set: 0.0019017111709607498
MeanAbsoluteError value on hold-out data: 0.036803554743528366
Epoch: 299

Loss on hold-out set: 0.0012759828989926194
MeanAbsoluteError value on hold-out data: 0.031656354665756226
Epoch: 300
Loss on hold-out set: 0.0012356871905337488
MeanAbsoluteError value on hold-out data: 0.027912257239222527
Epoch: 301
```

```
Loss on hold-out set: 0.0029161160512428197
MeanAbsoluteError value on hold-out data: 0.04351963847875595
Epoch: 302
Loss on hold-out set: 0.0008730761058229421
MeanAbsoluteError value on hold-out data: 0.02440572902560234
Epoch: 303
Loss on hold-out set: 0.0004590943156342421
MeanAbsoluteError value on hold-out data: 0.016206640750169754
Epoch: 304

Loss on hold-out set: 0.0004939930762962572
MeanAbsoluteError value on hold-out data: 0.01868527941405773
Epoch: 305
Loss on hold-out set: 0.00287354937089341
MeanAbsoluteError value on hold-out data: 0.050904322415590286
Epoch: 306

Loss on hold-out set: 0.006950228741126401
MeanAbsoluteError value on hold-out data: 0.08109766989946365
Epoch: 307
Loss on hold-out set: 0.0005402339323024664
MeanAbsoluteError value on hold-out data: 0.019740654155611992
Epoch: 308

Loss on hold-out set: 0.0014876534530360783
MeanAbsoluteError value on hold-out data: 0.035728588700294495
Epoch: 309
Loss on hold-out set: 0.0027791816142520736
MeanAbsoluteError value on hold-out data: 0.051422446966171265
Epoch: 310
Loss on hold-out set: 9.108437682568495e-05
MeanAbsoluteError value on hold-out data: 0.00724497577175498
Epoch: 311

Loss on hold-out set: 0.002261293536451246
MeanAbsoluteError value on hold-out data: 0.045888617634773254
Epoch: 312
Loss on hold-out set: 0.0034336570118154797
MeanAbsoluteError value on hold-out data: 0.05214471369981766
Epoch: 313
```

```
Loss on hold-out set: 0.005350280287010329
MeanAbsoluteError value on hold-out data: 0.060292020440101624
Epoch: 314
Loss on hold-out set: 0.0003055125624606652
MeanAbsoluteError value on hold-out data: 0.013764833100140095
Epoch: 315

Loss on hold-out set: 0.000897173270849245
MeanAbsoluteError value on hold-out data: 0.025207195430994034
Epoch: 316
Loss on hold-out set: 0.0012441675976983138
MeanAbsoluteError value on hold-out data: 0.032281242311000824
Epoch: 317
Loss on hold-out set: 0.0003964039372346763
MeanAbsoluteError value on hold-out data: 0.016673104837536812
Epoch: 318

Loss on hold-out set: 0.008004027684884412
MeanAbsoluteError value on hold-out data: 0.08694751560688019
Epoch: 319
Loss on hold-out set: 0.000534174036667017
MeanAbsoluteError value on hold-out data: 0.019964609295129776
Epoch: 320

Loss on hold-out set: 0.0019642431621572803
MeanAbsoluteError value on hold-out data: 0.04278063401579857
Epoch: 321
Loss on hold-out set: 7.442397639221911e-05
MeanAbsoluteError value on hold-out data: 0.006864945869892836
Epoch: 322

Loss on hold-out set: 0.00032329600487303523
MeanAbsoluteError value on hold-out data: 0.015840817242860794
Epoch: 323
Loss on hold-out set: 0.004755085334181786
MeanAbsoluteError value on hold-out data: 0.06452734768390656
Epoch: 324
Loss on hold-out set: 0.0015174913818814925
MeanAbsoluteError value on hold-out data: 0.03397689014673233
Epoch: 325
```

```
Loss on hold-out set: 0.00012199610864627175
MeanAbsoluteError value on hold-out data: 0.007661842275410891
Epoch: 326
Loss on hold-out set: 0.0024229655474690454
MeanAbsoluteError value on hold-out data: 0.04869045689702034
Epoch: 327

Loss on hold-out set: 7.762908483398081e-05
MeanAbsoluteError value on hold-out data: 0.006884267553687096
Epoch: 328
Loss on hold-out set: 0.0014321253734773823
MeanAbsoluteError value on hold-out data: 0.031367238610982895
Epoch: 329

Loss on hold-out set: 0.0012305900953443988
MeanAbsoluteError value on hold-out data: 0.033428605645895004
Epoch: 330
Loss on hold-out set: 0.00046060238050163856
MeanAbsoluteError value on hold-out data: 0.017161665484309196
Epoch: 331
Loss on hold-out set: 0.0019191352184861898
MeanAbsoluteError value on hold-out data: 0.037652455270290375
Epoch: 332

Loss on hold-out set: 0.0008945396693889052
MeanAbsoluteError value on hold-out data: 0.028555089607834816
Epoch: 333
Loss on hold-out set: 0.0001487598825146311
MeanAbsoluteError value on hold-out data: 0.010579614900052547
Epoch: 334

Loss on hold-out set: 0.0014941262447142176
MeanAbsoluteError value on hold-out data: 0.03471776470541954
Epoch: 335
Loss on hold-out set: 0.0004645664427828576
MeanAbsoluteError value on hold-out data: 0.01834011636674404
Epoch: 336

Loss on hold-out set: 0.00012642872232910513
MeanAbsoluteError value on hold-out data: 0.00913390051573515
Epoch: 337
```

```
Loss on hold-out set: 0.0009870352888745922
MeanAbsoluteError value on hold-out data: 0.024963226169347763
Epoch: 338
Loss on hold-out set: 0.001446824412726398
MeanAbsoluteError value on hold-out data: 0.028095928952097893
Epoch: 339

Loss on hold-out set: 0.0005992451941503012
MeanAbsoluteError value on hold-out data: 0.0193096324801445
Epoch: 340
Loss on hold-out set: 0.002857873249532921
MeanAbsoluteError value on hold-out data: 0.04068339243531227
Epoch: 341

Loss on hold-out set: 0.001232772458544267
MeanAbsoluteError value on hold-out data: 0.028289921581745148
Epoch: 342
Loss on hold-out set: 0.006019473275435823
MeanAbsoluteError value on hold-out data: 0.07677004486322403
Epoch: 343

Loss on hold-out set: 0.0002670220897666046
MeanAbsoluteError value on hold-out data: 0.014045505784451962
Epoch: 344
Loss on hold-out set: 0.0017604428908920714
MeanAbsoluteError value on hold-out data: 0.03688846528530121
Epoch: 345
Loss on hold-out set: 0.00101929870600413
MeanAbsoluteError value on hold-out data: 0.024592282250523567
Epoch: 346

Loss on hold-out set: 0.0015635286856974875
MeanAbsoluteError value on hold-out data: 0.03317217901349068
Epoch: 347
Loss on hold-out set: 0.00492353574372828
MeanAbsoluteError value on hold-out data: 0.05662599205970764
Epoch: 348

Loss on hold-out set: 0.0027618148763264927
MeanAbsoluteError value on hold-out data: 0.04912121593952179
Epoch: 349
```

```
Loss on hold-out set: 0.00013940600183559582
MeanAbsoluteError value on hold-out data: 0.009952682070434093
Epoch: 350

Loss on hold-out set: 0.003900709528742092
MeanAbsoluteError value on hold-out data: 0.05961171165108681
Epoch: 351
Loss on hold-out set: 0.0007044373113395912
MeanAbsoluteError value on hold-out data: 0.023940250277519226
Epoch: 352
Loss on hold-out set: 0.0005233623544752065
MeanAbsoluteError value on hold-out data: 0.020553626120090485
Epoch: 353

Loss on hold-out set: 0.0005533330258913338
MeanAbsoluteError value on hold-out data: 0.020716354250907898
Epoch: 354
Loss on hold-out set: 0.003100984447103526
MeanAbsoluteError value on hold-out data: 0.04382632300257683
Epoch: 355

Loss on hold-out set: 0.0028042695485055447
MeanAbsoluteError value on hold-out data: 0.050951119512319565
Epoch: 356
Loss on hold-out set: 0.0004651884872665895
MeanAbsoluteError value on hold-out data: 0.019604461267590523
Epoch: 357

Loss on hold-out set: 0.0020255921075918843
MeanAbsoluteError value on hold-out data: 0.03728462755680084
Epoch: 358
Loss on hold-out set: 0.0025092916330322623
MeanAbsoluteError value on hold-out data: 0.03973240777850151
Epoch: 359
Loss on hold-out set: 0.0015021177906809108
MeanAbsoluteError value on hold-out data: 0.038198985159397125
Epoch: 360

Loss on hold-out set: 7.640190623143488e-05
MeanAbsoluteError value on hold-out data: 0.0071401740424335
Epoch: 361
```

```
Loss on hold-out set: 0.00015412880020448938
MeanAbsoluteError value on hold-out data: 0.010129999369382858
Epoch: 362

Loss on hold-out set: 0.0007175642697672759
MeanAbsoluteError value on hold-out data: 0.02478608675301075
Epoch: 363
Loss on hold-out set: 0.0012443844628121173
MeanAbsoluteError value on hold-out data: 0.03336465731263161
Epoch: 364

Loss on hold-out set: 0.00548336432049317
MeanAbsoluteError value on hold-out data: 0.06605549156665802
Epoch: 365
Loss on hold-out set: 0.00019929494322111298
MeanAbsoluteError value on hold-out data: 0.01182890497148037
Epoch: 366
Loss on hold-out set: 0.003352767604935382
MeanAbsoluteError value on hold-out data: 0.046521686017513275
Epoch: 367

Loss on hold-out set: 0.004146752380100744
MeanAbsoluteError value on hold-out data: 0.06008138135075569
Epoch: 368
Loss on hold-out set: 0.003720010131863611
MeanAbsoluteError value on hold-out data: 0.06121598556637764
Epoch: 369

Loss on hold-out set: 0.0018287153715001686
MeanAbsoluteError value on hold-out data: 0.0411355197429657
Epoch: 370
Loss on hold-out set: 0.003920204172443066
MeanAbsoluteError value on hold-out data: 0.05726030841469765
Epoch: 371

Loss on hold-out set: 0.004149758256971836
MeanAbsoluteError value on hold-out data: 0.058553434908390045
Epoch: 372
Loss on hold-out set: 0.0011487094868373657
MeanAbsoluteError value on hold-out data: 0.03260217234492302
Epoch: 373
```

```
Loss on hold-out set: 0.0016334225656464696
MeanAbsoluteError value on hold-out data: 0.03875373303890228
Epoch: 374

Loss on hold-out set: 0.001205103239044547
MeanAbsoluteError value on hold-out data: 0.033484525978565216
Epoch: 375
Loss on hold-out set: 0.0024118075712717007
MeanAbsoluteError value on hold-out data: 0.03903377428650856
Epoch: 376

Loss on hold-out set: 0.003488664182701281
MeanAbsoluteError value on hold-out data: 0.05886514484882355
Epoch: 377
Loss on hold-out set: 0.0002133357068357457
MeanAbsoluteError value on hold-out data: 0.013133053667843342
Epoch: 378

Loss on hold-out set: 0.0025284411053040196
MeanAbsoluteError value on hold-out data: 0.04222027212381363
Epoch: 379
Loss on hold-out set: 0.00428515433200768
MeanAbsoluteError value on hold-out data: 0.058813706040382385
Epoch: 380
Loss on hold-out set: 0.0006350402171457452
MeanAbsoluteError value on hold-out data: 0.021031374111771584
Epoch: 381

Loss on hold-out set: 0.0001679823887700747
MeanAbsoluteError value on hold-out data: 0.010662288405001163
Epoch: 382
Loss on hold-out set: 0.0006956790873248662
MeanAbsoluteError value on hold-out data: 0.023500239476561546
Epoch: 383

Loss on hold-out set: 0.0011264964206410305
MeanAbsoluteError value on hold-out data: 0.02707846648991108
Epoch: 384
Loss on hold-out set: 0.0001525274388508738
MeanAbsoluteError value on hold-out data: 0.01015329360961914
Epoch: 385
```

```
Loss on hold-out set: 0.00011792985502065026
MeanAbsoluteError value on hold-out data: 0.00923529639840126
Epoch: 386
Loss on hold-out set: 0.0018888504377433232
MeanAbsoluteError value on hold-out data: 0.03805872052907944
Epoch: 387
Loss on hold-out set: 0.0008790015376039914
MeanAbsoluteError value on hold-out data: 0.028353344649076462
Epoch: 388

Loss on hold-out set: 0.0011456530524550804
MeanAbsoluteError value on hold-out data: 0.03275910019874573
Epoch: 389
Loss on hold-out set: 0.0021660619947527137
MeanAbsoluteError value on hold-out data: 0.03835877403616905
Epoch: 390

Loss on hold-out set: 0.003827751747199467
MeanAbsoluteError value on hold-out data: 0.045697249472141266
Epoch: 391
Loss on hold-out set: 0.0012664616058048392
MeanAbsoluteError value on hold-out data: 0.03151100128889084
Epoch: 392

Loss on hold-out set: 0.0009666323312558234
MeanAbsoluteError value on hold-out data: 0.023589730262756348
Epoch: 393
Loss on hold-out set: 0.0012926624954811164
MeanAbsoluteError value on hold-out data: 0.033361271023750305
Epoch: 394
Loss on hold-out set: 0.0005428416188806295
MeanAbsoluteError value on hold-out data: 0.018592262640595436
Epoch: 395

Loss on hold-out set: 0.0008388190763071179
MeanAbsoluteError value on hold-out data: 0.025002699345350266
Epoch: 396
Loss on hold-out set: 0.0007070131084349539
MeanAbsoluteError value on hold-out data: 0.02447407692670822
Epoch: 397
```

```
Loss on hold-out set: 0.00017907966685015708
MeanAbsoluteError value on hold-out data: 0.011124995537102222
Epoch: 398
Loss on hold-out set: 0.001339735247061721
MeanAbsoluteError value on hold-out data: 0.02990013174712658
Epoch: 399

Loss on hold-out set: 9.228479861381597e-05
MeanAbsoluteError value on hold-out data: 0.007161509245634079
Epoch: 400
Loss on hold-out set: 0.00014193096805164323
MeanAbsoluteError value on hold-out data: 0.009357422590255737
Epoch: 401
Loss on hold-out set: 0.0005842556420248002
MeanAbsoluteError value on hold-out data: 0.019736958667635918
Epoch: 402

Loss on hold-out set: 0.0043717361986637115
MeanAbsoluteError value on hold-out data: 0.06105538830161095
Epoch: 403
Loss on hold-out set: 0.00010168232360488869
MeanAbsoluteError value on hold-out data: 0.007966112345457077
Epoch: 404

Loss on hold-out set: 0.00258474811978106
MeanAbsoluteError value on hold-out data: 0.04469703137874603
Epoch: 405
Loss on hold-out set: 0.003268245674137558
MeanAbsoluteError value on hold-out data: 0.0489291250705719
Epoch: 406

Loss on hold-out set: 0.0007457257057207503
MeanAbsoluteError value on hold-out data: 0.022225355729460716
Epoch: 407
Loss on hold-out set: 0.002352445854090287
MeanAbsoluteError value on hold-out data: 0.041783321648836136
Epoch: 408
Loss on hold-out set: 0.002762551053560206
MeanAbsoluteError value on hold-out data: 0.047695111483335495
Epoch: 409
```

```
Loss on hold-out set: 0.0018428384625752056
MeanAbsoluteError value on hold-out data: 0.03463463857769966
Epoch: 410
Loss on hold-out set: 0.001180652861616441
MeanAbsoluteError value on hold-out data: 0.03349767625331879
Epoch: 411

Loss on hold-out set: 0.0008671497801385288
MeanAbsoluteError value on hold-out data: 0.024658983573317528
Epoch: 412
Loss on hold-out set: 0.0009859790360288961
MeanAbsoluteError value on hold-out data: 0.026649296283721924
Early stopping at epoch 411
Fold: 9
Epoch: 1

Loss on hold-out set: 0.021537829722676958
MeanAbsoluteError value on hold-out data: 0.11480756849050522
Epoch: 2
Loss on hold-out set: 0.028058163688651154
MeanAbsoluteError value on hold-out data: 0.1529805064201355
Epoch: 3
Loss on hold-out set: 0.026033791846462657
MeanAbsoluteError value on hold-out data: 0.13841848075389862
Epoch: 4

Loss on hold-out set: 0.04856426215597561
MeanAbsoluteError value on hold-out data: 0.19691555202007294
Epoch: 5
Loss on hold-out set: 0.010510362418634551
MeanAbsoluteError value on hold-out data: 0.07621926069259644
Epoch: 6

Loss on hold-out set: 0.0048960622932229724
MeanAbsoluteError value on hold-out data: 0.05537857487797737
Epoch: 7
Loss on hold-out set: 0.011390188043670995
MeanAbsoluteError value on hold-out data: 0.09675078094005585
Epoch: 8
```

```
Loss on hold-out set: 0.003386606478930584
MeanAbsoluteError value on hold-out data: 0.04454294219613075
Epoch: 9
Loss on hold-out set: 0.004916421337319272
MeanAbsoluteError value on hold-out data: 0.0549888089299202
Epoch: 10
Loss on hold-out set: 0.006980588493336525
MeanAbsoluteError value on hold-out data: 0.0654509961605072
Epoch: 11

Loss on hold-out set: 0.0024634069995954633
MeanAbsoluteError value on hold-out data: 0.038064416497945786
Epoch: 12
Loss on hold-out set: 0.007747269202289837
MeanAbsoluteError value on hold-out data: 0.08433397114276886
Epoch: 13

Loss on hold-out set: 0.005889855923929385
MeanAbsoluteError value on hold-out data: 0.058701179921627045
Epoch: 14
Loss on hold-out set: 0.013726182814155306
MeanAbsoluteError value on hold-out data: 0.11044042557477951
Epoch: 15

Loss on hold-out set: 0.0027907250582107474
MeanAbsoluteError value on hold-out data: 0.03982941806316376
Epoch: 16
Loss on hold-out set: 0.012357589389596666
MeanAbsoluteError value on hold-out data: 0.10199712961912155
Epoch: 17
Loss on hold-out set: 0.007459550031593868
MeanAbsoluteError value on hold-out data: 0.07924970984458923
Epoch: 18

Loss on hold-out set: 0.010663212942225593
MeanAbsoluteError value on hold-out data: 0.10067076981067657
Epoch: 19
Loss on hold-out set: 0.004394185380078852
MeanAbsoluteError value on hold-out data: 0.05114247277379036
Epoch: 20
```

```
Loss on hold-out set: 0.003185218299872109
MeanAbsoluteError value on hold-out data: 0.051091957837343216
Epoch: 21
Loss on hold-out set: 0.012725904051746641
MeanAbsoluteError value on hold-out data: 0.10877455770969391
Epoch: 22

Loss on hold-out set: 0.009349556174129248
MeanAbsoluteError value on hold-out data: 0.09246162325143814
Epoch: 23
Loss on hold-out set: 0.03632584693176406
MeanAbsoluteError value on hold-out data: 0.18881122767925262
Epoch: 24
Loss on hold-out set: 0.012884963170758315
MeanAbsoluteError value on hold-out data: 0.10519193857908249
Epoch: 25

Loss on hold-out set: 0.0025643196422606707
MeanAbsoluteError value on hold-out data: 0.0398145392537117
Epoch: 26
Loss on hold-out set: 0.003165817270720644
MeanAbsoluteError value on hold-out data: 0.04592112451791763
Epoch: 27

Loss on hold-out set: 0.0006532498560513236
MeanAbsoluteError value on hold-out data: 0.021080462262034416
Epoch: 28
Loss on hold-out set: 0.0034812858793884516
MeanAbsoluteError value on hold-out data: 0.05658159777522087
Epoch: 29

Loss on hold-out set: 0.001406199049337634
MeanAbsoluteError value on hold-out data: 0.03166646137833595
Epoch: 30
Loss on hold-out set: 0.009147826183055128
MeanAbsoluteError value on hold-out data: 0.09499702602624893
Epoch: 31
Loss on hold-out set: 0.0016038251175944293
MeanAbsoluteError value on hold-out data: 0.035220809280872345
Epoch: 32
```

```
Loss on hold-out set: 0.003545678486781461
MeanAbsoluteError value on hold-out data: 0.05396057665348053
Epoch: 33
Loss on hold-out set: 0.013283558988145419
MeanAbsoluteError value on hold-out data: 0.11465302109718323
Epoch: 34

Loss on hold-out set: 0.005537861459223288
MeanAbsoluteError value on hold-out data: 0.059978462755680084
Epoch: 35
Loss on hold-out set: 0.0035669060557016303
MeanAbsoluteError value on hold-out data: 0.055307384580373764
Epoch: 36

Loss on hold-out set: 0.0017441597966743366
MeanAbsoluteError value on hold-out data: 0.03557977080345154
Epoch: 37
Loss on hold-out set: 0.005578434294355767
MeanAbsoluteError value on hold-out data: 0.07134763896465302
Epoch: 38
Loss on hold-out set: 0.002782209809603436
MeanAbsoluteError value on hold-out data: 0.0491454042494297
Epoch: 39

Loss on hold-out set: 0.0006115963915362954
MeanAbsoluteError value on hold-out data: 0.01987091451883316
Epoch: 40
Loss on hold-out set: 0.00039204749815066213
MeanAbsoluteError value on hold-out data: 0.014499894343316555
Epoch: 41

Loss on hold-out set: 0.002748608738849206
MeanAbsoluteError value on hold-out data: 0.04073528200387955
Epoch: 42
Loss on hold-out set: 0.0005049259572323146
MeanAbsoluteError value on hold-out data: 0.016338873654603958
Epoch: 43

Loss on hold-out set: 0.00035043239976013344
MeanAbsoluteError value on hold-out data: 0.015367171727120876
Epoch: 44
```

```
Loss on hold-out set: 0.0015327226142939512
MeanAbsoluteError value on hold-out data: 0.03020498901605606
Epoch: 45
Loss on hold-out set: 0.0005774413106597162
MeanAbsoluteError value on hold-out data: 0.016993308439850807
Epoch: 46

Loss on hold-out set: 0.011260415959571089
MeanAbsoluteError value on hold-out data: 0.1010579988360405
Epoch: 47
Loss on hold-out set: 0.00596898069073047
MeanAbsoluteError value on hold-out data: 0.07594548165798187
Epoch: 48

Loss on hold-out set: 0.00024035548059535877
MeanAbsoluteError value on hold-out data: 0.012454168871045113
Epoch: 49
Loss on hold-out set: 0.00017194731611068294
MeanAbsoluteError value on hold-out data: 0.010786906816065311
Epoch: 50

Loss on hold-out set: 0.010025543959013053
MeanAbsoluteError value on hold-out data: 0.09896165877580643
Epoch: 51
Loss on hold-out set: 0.0002777446040584307
MeanAbsoluteError value on hold-out data: 0.013964452780783176
Epoch: 52
Loss on hold-out set: 0.0047474029873098645
MeanAbsoluteError value on hold-out data: 0.05757756158709526
Epoch: 53

Loss on hold-out set: 0.0025241706586842027
MeanAbsoluteError value on hold-out data: 0.03933797404170036
Epoch: 54
Loss on hold-out set: 0.00718843677480306
MeanAbsoluteError value on hold-out data: 0.0819353312253952
Epoch: 55

Loss on hold-out set: 0.003473159225125398
MeanAbsoluteError value on hold-out data: 0.05701917037367821
Epoch: 56
```

```
Loss on hold-out set: 0.005323315970599651
MeanAbsoluteError value on hold-out data: 0.0621839240193367
Epoch: 57

Loss on hold-out set: 0.00230268483781921
MeanAbsoluteError value on hold-out data: 0.04572088643908501
Epoch: 58
Loss on hold-out set: 0.007136579869048936
MeanAbsoluteError value on hold-out data: 0.08234041184186935
Epoch: 59
Loss on hold-out set: 0.001228663097468338
MeanAbsoluteError value on hold-out data: 0.03326430171728134
Epoch: 60

Loss on hold-out set: 0.0014674640593252011
MeanAbsoluteError value on hold-out data: 0.032604802399873734
Epoch: 61
Loss on hold-out set: 0.0018718423089012504
MeanAbsoluteError value on hold-out data: 0.04013192653656006
Epoch: 62

Loss on hold-out set: 0.0006559895492890584
MeanAbsoluteError value on hold-out data: 0.019604869186878204
Epoch: 63
Loss on hold-out set: 0.0019653941105519023
MeanAbsoluteError value on hold-out data: 0.0408543162047863
Epoch: 64

Loss on hold-out set: 0.005227496315326009
MeanAbsoluteError value on hold-out data: 0.07092537730932236
Epoch: 65
Loss on hold-out set: 0.000669042147429926
MeanAbsoluteError value on hold-out data: 0.02160731703042984
Epoch: 66
Loss on hold-out set: 0.0010224079347348639
MeanAbsoluteError value on hold-out data: 0.02992943674325943
Epoch: 67

Loss on hold-out set: 0.0021268302641276804
MeanAbsoluteError value on hold-out data: 0.043934620916843414
Epoch: 68
```

```
Loss on hold-out set: 0.005852905235120228
MeanAbsoluteError value on hold-out data: 0.0736255943775177
Epoch: 69

Loss on hold-out set: 0.0002425191134014832
MeanAbsoluteError value on hold-out data: 0.012847826816141605
Epoch: 70
Loss on hold-out set: 0.00635392072477511
MeanAbsoluteError value on hold-out data: 0.07679395377635956
Epoch: 71

Loss on hold-out set: 0.0031325913732871413
MeanAbsoluteError value on hold-out data: 0.040691833943128586
Epoch: 72
Loss on hold-out set: 0.003940246566863996
MeanAbsoluteError value on hold-out data: 0.06263823062181473
Epoch: 73
Loss on hold-out set: 0.0016031503161814595
MeanAbsoluteError value on hold-out data: 0.035842567682266235
Epoch: 74

Loss on hold-out set: 0.0002008477645826393
MeanAbsoluteError value on hold-out data: 0.010036194697022438
Epoch: 75
Loss on hold-out set: 0.0002134875997268994
MeanAbsoluteError value on hold-out data: 0.012293304316699505
Epoch: 76

Loss on hold-out set: 0.003952406479844025
MeanAbsoluteError value on hold-out data: 0.059394389390945435
Epoch: 77
Loss on hold-out set: 0.0001222846653295814
MeanAbsoluteError value on hold-out data: 0.008686777204275131
Epoch: 78

Loss on hold-out set: 0.0036893822585365604
MeanAbsoluteError value on hold-out data: 0.054482609033584595
Epoch: 79
Loss on hold-out set: 0.002608754938202245
MeanAbsoluteError value on hold-out data: 0.039752159267663956
Epoch: 80
```

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Loss on hold-out set: 0.0026589149077023777
MeanAbsoluteError value on hold-out data: 0.04717518761754036
Epoch: 81

Loss on hold-out set: 0.001569861313328147
MeanAbsoluteError value on hold-out data: 0.038346029818058014
Epoch: 82
Loss on hold-out set: 0.00264774336080466
MeanAbsoluteError value on hold-out data: 0.04429146647453308
Epoch: 83

Loss on hold-out set: 0.010021394384758813
MeanAbsoluteError value on hold-out data: 0.08155980706214905
Epoch: 84
Loss on hold-out set: 0.0002574900260827105
MeanAbsoluteError value on hold-out data: 0.013636194169521332
Epoch: 85

Loss on hold-out set: 0.0032732334387089524
MeanAbsoluteError value on hold-out data: 0.05475061386823654
Epoch: 86
Loss on hold-out set: 0.008538311813026667
MeanAbsoluteError value on hold-out data: 0.09120616316795349
Epoch: 87
Loss on hold-out set: 0.0009799276179234897
MeanAbsoluteError value on hold-out data: 0.028168609365820885
Epoch: 88

Loss on hold-out set: 0.0003377774534913312
MeanAbsoluteError value on hold-out data: 0.01311477180570364
Epoch: 89
Loss on hold-out set: 0.012170417101255484
MeanAbsoluteError value on hold-out data: 0.10583131015300751
Epoch: 90

Loss on hold-out set: 0.006681358242141349
MeanAbsoluteError value on hold-out data: 0.07547353953123093
Epoch: 91
Loss on hold-out set: 0.0026765088051823632
MeanAbsoluteError value on hold-out data: 0.05124485865235329
Epoch: 92
```

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Loss on hold-out set: 0.0009832210988471551
MeanAbsoluteError value on hold-out data: 0.02101324312388897
Epoch: 93
Loss on hold-out set: 0.005965576108012881
MeanAbsoluteError value on hold-out data: 0.07135768979787827
Epoch: 94
Loss on hold-out set: 0.0027639820390114827
MeanAbsoluteError value on hold-out data: 0.04300134629011154
Epoch: 95

Loss on hold-out set: 0.003545709153903382
MeanAbsoluteError value on hold-out data: 0.052194900810718536
Epoch: 96
Loss on hold-out set: 0.0017449327112574662
MeanAbsoluteError value on hold-out data: 0.04078323394060135
Epoch: 97

Loss on hold-out set: 0.0002875790981176708
MeanAbsoluteError value on hold-out data: 0.013280248269438744
Epoch: 98
Loss on hold-out set: 0.0005270258906031293
MeanAbsoluteError value on hold-out data: 0.019970133900642395
Epoch: 99

Loss on hold-out set: 0.00041013767934470834
MeanAbsoluteError value on hold-out data: 0.01747911050915718
Epoch: 100
Loss on hold-out set: 0.002865464592884694
MeanAbsoluteError value on hold-out data: 0.04821547493338585
Epoch: 101
Loss on hold-out set: 0.002616899986086147
MeanAbsoluteError value on hold-out data: 0.042582906782627106
Epoch: 102

Loss on hold-out set: 0.001499449326989374
MeanAbsoluteError value on hold-out data: 0.0323716439306736
Epoch: 103
Loss on hold-out set: 0.002476900616394622
MeanAbsoluteError value on hold-out data: 0.0485997311770916
Epoch: 104
```

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Loss on hold-out set: 0.007230722811073065
MeanAbsoluteError value on hold-out data: 0.08289588987827301
Epoch: 105
Loss on hold-out set: 0.0028184328028666122
MeanAbsoluteError value on hold-out data: 0.05032215267419815
Epoch: 106

Loss on hold-out set: 0.0015587644551747612
MeanAbsoluteError value on hold-out data: 0.038013577461242676
Epoch: 107
Loss on hold-out set: 0.001592874842961984
MeanAbsoluteError value on hold-out data: 0.03424924612045288
Epoch: 108
Loss on hold-out set: 0.0012349666794762015
MeanAbsoluteError value on hold-out data: 0.03164317086338997
Epoch: 109

Loss on hold-out set: 0.008858178875276021
MeanAbsoluteError value on hold-out data: 0.0857270210981369
Epoch: 110
Loss on hold-out set: 0.002865787030064634
MeanAbsoluteError value on hold-out data: 0.052469316869974136
Epoch: 111

Loss on hold-out set: 0.00018702817344871750
MeanAbsoluteError value on hold-out data: 0.009937513619661331
Epoch: 112
Loss on hold-out set: 0.0025773522377546343
MeanAbsoluteError value on hold-out data: 0.04681507125496864
Epoch: 113

Loss on hold-out set: 0.0027025797670441015
MeanAbsoluteError value on hold-out data: 0.048685792833566666
Epoch: 114
Loss on hold-out set: 0.0003129853679898328
MeanAbsoluteError value on hold-out data: 0.014904510229825974
Epoch: 115
Loss on hold-out set: 0.0008338281602066543
MeanAbsoluteError value on hold-out data: 0.022959640249609947
Epoch: 116
```

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Loss on hold-out set: 0.0017768180197370903
MeanAbsoluteError value on hold-out data: 0.040862105786800385
Epoch: 117
Loss on hold-out set: 0.00036429771197228026
MeanAbsoluteError value on hold-out data: 0.015002255327999592
Epoch: 118

Loss on hold-out set: 0.0019220059870609216
MeanAbsoluteError value on hold-out data: 0.04228178411722183
Epoch: 119
Loss on hold-out set: 0.00043114772415719926
MeanAbsoluteError value on hold-out data: 0.016790546476840973
Epoch: 120

Loss on hold-out set: 0.003279608508039798
MeanAbsoluteError value on hold-out data: 0.0546589195728302
Epoch: 121
Loss on hold-out set: 0.0004880594206042588
MeanAbsoluteError value on hold-out data: 0.01718451827764511
Epoch: 122
Loss on hold-out set: 0.001667701082104551
MeanAbsoluteError value on hold-out data: 0.03678378835320473
Epoch: 123

Loss on hold-out set: 0.00011391964289941825
MeanAbsoluteError value on hold-out data: 0.008635761216282845
Epoch: 124
Loss on hold-out set: 0.0028205932051475558
MeanAbsoluteError value on hold-out data: 0.049773234874010086
Epoch: 125

Loss on hold-out set: 0.0019448797517855252
MeanAbsoluteError value on hold-out data: 0.04281690716743469
Epoch: 126
Loss on hold-out set: 0.0008001057680563203
MeanAbsoluteError value on hold-out data: 0.026178527623414993
Epoch: 127

Loss on hold-out set: 0.0022817758643733604
MeanAbsoluteError value on hold-out data: 0.04404301568865776
Epoch: 128
```

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Loss on hold-out set: 0.0007010705137093152
MeanAbsoluteError value on hold-out data: 0.024474868550896645
Epoch: 129
Loss on hold-out set: 0.005094080265345318
MeanAbsoluteError value on hold-out data: 0.06392563134431839
Epoch: 130

Loss on hold-out set: 0.002151109219994396
MeanAbsoluteError value on hold-out data: 0.03781212493777275
Epoch: 131
Loss on hold-out set: 0.0002106177292132218
MeanAbsoluteError value on hold-out data: 0.011472305282950401
Epoch: 132

Loss on hold-out set: 0.005246627344084638
MeanAbsoluteError value on hold-out data: 0.06764820218086243
Epoch: 133
Loss on hold-out set: 0.0017458396697682993
MeanAbsoluteError value on hold-out data: 0.03765314444899559
Epoch: 134

Loss on hold-out set: 0.007003699894994497
MeanAbsoluteError value on hold-out data: 0.07352461665868759
Epoch: 135
Loss on hold-out set: 0.003851773849289332
MeanAbsoluteError value on hold-out data: 0.060021623969078064
Epoch: 136
Loss on hold-out set: 0.001062194085014718
MeanAbsoluteError value on hold-out data: 0.030196011066436768
Epoch: 137

Loss on hold-out set: 0.002526739578960197
MeanAbsoluteError value on hold-out data: 0.041230231523513794
Epoch: 138
Loss on hold-out set: 0.00209707542256053
MeanAbsoluteError value on hold-out data: 0.03959124907851219
Epoch: 139

Loss on hold-out set: 0.0009183010468924684
MeanAbsoluteError value on hold-out data: 0.024900376796722412
Epoch: 140
```

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Loss on hold-out set: 0.001174380541280178
MeanAbsoluteError value on hold-out data: 0.02834240347146988
Epoch: 141

Loss on hold-out set: 0.005242306739091873
MeanAbsoluteError value on hold-out data: 0.06388246268033981
Epoch: 142
Loss on hold-out set: 0.0013459973768996342
MeanAbsoluteError value on hold-out data: 0.02571886219084263
Epoch: 143
Loss on hold-out set: 0.002527576339031969
MeanAbsoluteError value on hold-out data: 0.04770193621516228
Epoch: 144

Loss on hold-out set: 0.0009838844250355447
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Loss on hold-out set: 0.0013004786368193372
MeanAbsoluteError value on hold-out data: 0.034619007259607315
Epoch: 146

Loss on hold-out set: 0.002589023023444627
MeanAbsoluteError value on hold-out data: 0.040896955877542496
Epoch: 147
Loss on hold-out set: 0.00019509338328914185
MeanAbsoluteError value on hold-out data: 0.011333707720041275
Epoch: 148

Loss on hold-out set: 0.004247428849339485
MeanAbsoluteError value on hold-out data: 0.06404448300600052
Epoch: 149
Loss on hold-out set: 0.002261939042780016
MeanAbsoluteError value on hold-out data: 0.04065924137830734
Epoch: 150
Loss on hold-out set: 0.00013673920745662014
MeanAbsoluteError value on hold-out data: 0.00964396819472313
Epoch: 151

Loss on hold-out set: 0.0018018684349954128
MeanAbsoluteError value on hold-out data: 0.04163062572479248
Epoch: 152
```

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Loss on hold-out set: 0.0008451439373727356
MeanAbsoluteError value on hold-out data: 0.026102030649781227
Epoch: 153

Loss on hold-out set: 0.00021257965792236582
MeanAbsoluteError value on hold-out data: 0.012661917135119438
Epoch: 154
Loss on hold-out set: 0.001762273139320314
MeanAbsoluteError value on hold-out data: 0.03909691050648689
Epoch: 155

Loss on hold-out set: 0.0018079685147053429
MeanAbsoluteError value on hold-out data: 0.03604511544108391
Epoch: 156
Loss on hold-out set: 0.00015628698747605085
MeanAbsoluteError value on hold-out data: 0.01029473077505827
Epoch: 157
Loss on hold-out set: 0.001277479642469968
MeanAbsoluteError value on hold-out data: 0.032968830317258835
Epoch: 158

Loss on hold-out set: 0.00012427801786023856
MeanAbsoluteError value on hold-out data: 0.009042760357260704
Epoch: 159
Loss on hold-out set: 0.0006876304022236061
MeanAbsoluteError value on hold-out data: 0.023165591061115265
Epoch: 160

Loss on hold-out set: 0.0010190916696696409
MeanAbsoluteError value on hold-out data: 0.029338352382183075
Epoch: 161
Loss on hold-out set: 0.0011306479282211512
MeanAbsoluteError value on hold-out data: 0.030709367245435715
Epoch: 162

Loss on hold-out set: 0.009770757651754789
MeanAbsoluteError value on hold-out data: 0.08668714761734009
Epoch: 163
Loss on hold-out set: 0.004379181191325188
MeanAbsoluteError value on hold-out data: 0.06516128778457642
Epoch: 164
```

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Loss on hold-out set: 0.0024456837314314078
MeanAbsoluteError value on hold-out data: 0.03599169850349426
Epoch: 165

Loss on hold-out set: 0.0014584149633135115
MeanAbsoluteError value on hold-out data: 0.03484385460615158
Epoch: 166
Loss on hold-out set: 0.0026305720010506256
MeanAbsoluteError value on hold-out data: 0.041185639798641205
Epoch: 167

Loss on hold-out set: 0.0012679231585934758
MeanAbsoluteError value on hold-out data: 0.03302399441599846
Epoch: 168
Loss on hold-out set: 0.0005205131102619427
MeanAbsoluteError value on hold-out data: 0.020017189905047417
Epoch: 169

Loss on hold-out set: 0.0007716717664152384
MeanAbsoluteError value on hold-out data: 0.024517156183719635
Epoch: 170
Loss on hold-out set: 0.0016705048702923314
MeanAbsoluteError value on hold-out data: 0.03605424985289574
Epoch: 171
Loss on hold-out set: 0.00021295362343412956
MeanAbsoluteError value on hold-out data: 0.012039355002343655
Epoch: 172

Loss on hold-out set: 0.0007054177902838481
MeanAbsoluteError value on hold-out data: 0.020625881850719452
Epoch: 173
Loss on hold-out set: 0.015076133023415293
MeanAbsoluteError value on hold-out data: 0.10880527645349503
Epoch: 174

Loss on hold-out set: 0.00015553542990736396
MeanAbsoluteError value on hold-out data: 0.009629757143557072
Epoch: 175
Loss on hold-out set: 0.00010758221677471218
MeanAbsoluteError value on hold-out data: 0.008320986293256283
Epoch: 176
```

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Loss on hold-out set: 0.0024525327275374104
MeanAbsoluteError value on hold-out data: 0.04843052849173546
Epoch: 177
Loss on hold-out set: 0.002055599869761084
MeanAbsoluteError value on hold-out data: 0.03660641610622406
Epoch: 178
Loss on hold-out set: 0.000742521694129599
MeanAbsoluteError value on hold-out data: 0.024755973368883133
Epoch: 179

Loss on hold-out set: 0.0003478109969624451
MeanAbsoluteError value on hold-out data: 0.016150563955307007
Epoch: 180
Loss on hold-out set: 0.00040299843073756037
MeanAbsoluteError value on hold-out data: 0.01692803204059601
Epoch: 181

Loss on hold-out set: 0.0007764454432097929
MeanAbsoluteError value on hold-out data: 0.025560181587934494
Epoch: 182
Loss on hold-out set: 0.0006098553505060929
MeanAbsoluteError value on hold-out data: 0.02113964594900608
Epoch: 183

Loss on hold-out set: 0.0030508974034871373
MeanAbsoluteError value on hold-out data: 0.04771735146641731
Epoch: 184
Loss on hold-out set: 0.0002805484670846324
MeanAbsoluteError value on hold-out data: 0.013974027708172798
Epoch: 185
Loss on hold-out set: 0.0012205067822443588
MeanAbsoluteError value on hold-out data: 0.032350458204746246
Epoch: 186

Loss on hold-out set: 0.001386836196096348
MeanAbsoluteError value on hold-out data: 0.030217697843909264
Epoch: 187
Loss on hold-out set: 0.002509576185340328
MeanAbsoluteError value on hold-out data: 0.04948197305202484
Epoch: 188
```

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Loss on hold-out set: 0.0012913997717467801
MeanAbsoluteError value on hold-out data: 0.033174362033605576
Epoch: 189
Loss on hold-out set: 0.004211036754505975
MeanAbsoluteError value on hold-out data: 0.061522796750068665
Epoch: 190

Loss on hold-out set: 0.0010694672985534584
MeanAbsoluteError value on hold-out data: 0.03091401979327202
Epoch: 191
Loss on hold-out set: 0.000458065522252582
MeanAbsoluteError value on hold-out data: 0.017887024208903313
Epoch: 192
Loss on hold-out set: 0.000373244088093218
MeanAbsoluteError value on hold-out data: 0.016010915860533714
Epoch: 193

Loss on hold-out set: 0.010039760598114558
MeanAbsoluteError value on hold-out data: 0.07568273693323135
Epoch: 194
Loss on hold-out set: 0.0035712374706885646
MeanAbsoluteError value on hold-out data: 0.05384967848658562
Epoch: 195

Loss on hold-out set: 0.003174018780035632
MeanAbsoluteError value on hold-out data: 0.05527060106396675
Epoch: 196
Loss on hold-out set: 0.002218112366140953
MeanAbsoluteError value on hold-out data: 0.04600260779261589
Epoch: 197

Loss on hold-out set: 0.002363861904346517
MeanAbsoluteError value on hold-out data: 0.04265221953392029
Epoch: 198
Loss on hold-out set: 0.00011117230626820986
MeanAbsoluteError value on hold-out data: 0.008772334083914757
Epoch: 199
Loss on hold-out set: 0.0006671925574274999
MeanAbsoluteError value on hold-out data: 0.023899434134364128
Epoch: 200
```

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Loss on hold-out set: 0.0002948083523993513
MeanAbsoluteError value on hold-out data: 0.013934173621237278
Epoch: 201
Loss on hold-out set: 0.0017775564920157194
MeanAbsoluteError value on hold-out data: 0.037918880581855774
Epoch: 202

Loss on hold-out set: 0.0012632297917402216
MeanAbsoluteError value on hold-out data: 0.03497554734349251
Epoch: 203
Loss on hold-out set: 0.0027928334727351156
MeanAbsoluteError value on hold-out data: 0.046086397022008896
Epoch: 204

Loss on hold-out set: 0.0017970406250762089
MeanAbsoluteError value on hold-out data: 0.035861171782016754
Epoch: 205
Loss on hold-out set: 0.0006780740430778158
MeanAbsoluteError value on hold-out data: 0.024642689153552055
Epoch: 206
Loss on hold-out set: 0.003581638880340116
MeanAbsoluteError value on hold-out data: 0.05631642043590546
Epoch: 207

Loss on hold-out set: 0.005410827829369477
MeanAbsoluteError value on hold-out data: 0.06594056636095047
Epoch: 208
Loss on hold-out set: 0.0024061031373483793
MeanAbsoluteError value on hold-out data: 0.04621566832065582
Epoch: 209

Loss on hold-out set: 0.002503542628671442
MeanAbsoluteError value on hold-out data: 0.04581193998456001
Epoch: 210
Loss on hold-out set: 0.00011642597642743826
MeanAbsoluteError value on hold-out data: 0.008718958124518394
Epoch: 211

Loss on hold-out set: 0.00043706679675129375
MeanAbsoluteError value on hold-out data: 0.018675103783607483
Epoch: 212
```

Loss on hold-out set: 0.006017078379435199
MeanAbsoluteError value on hold-out data: 0.07131342589855194
Epoch: 213
Loss on hold-out set: 0.0038483636786362956
MeanAbsoluteError value on hold-out data: 0.05658816918730736
Epoch: 214

Loss on hold-out set: 0.00441893472868417
MeanAbsoluteError value on hold-out data: 0.06498472392559052
Epoch: 215
Loss on hold-out set: 0.0028056217290993246
MeanAbsoluteError value on hold-out data: 0.04779649153351784
Epoch: 216

Loss on hold-out set: 0.004982364031353167
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Epoch: 217
Loss on hold-out set: 0.0038169709566448417
MeanAbsoluteError value on hold-out data: 0.04915371537208557
Epoch: 218

Loss on hold-out set: 0.0007372206392964083
MeanAbsoluteError value on hold-out data: 0.025189882144331932
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Loss on hold-out set: 0.001201896445958742
MeanAbsoluteError value on hold-out data: 0.03074868954718113
Epoch: 220
Loss on hold-out set: 0.0029382065237898913
MeanAbsoluteError value on hold-out data: 0.0499294139444828
Epoch: 221

Loss on hold-out set: 0.0031934165661888464
MeanAbsoluteError value on hold-out data: 0.043496273458004
Epoch: 222
Loss on hold-out set: 0.0011609841770093357
MeanAbsoluteError value on hold-out data: 0.029872270300984383
Epoch: 223

Loss on hold-out set: 0.0004290278406447864
MeanAbsoluteError value on hold-out data: 0.015948517248034477
Epoch: 224

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Loss on hold-out set: 0.002442584722302854
MeanAbsoluteError value on hold-out data: 0.03774641826748848
Epoch: 225

Loss on hold-out set: 0.00012543882517742792
MeanAbsoluteError value on hold-out data: 0.008102573454380035
Epoch: 226
Loss on hold-out set: 0.0005160678992979228
MeanAbsoluteError value on hold-out data: 0.01928573101758957
Epoch: 227
Loss on hold-out set: 0.0008170746399887971
MeanAbsoluteError value on hold-out data: 0.02692534402012825
Epoch: 228

Loss on hold-out set: 0.0013523410307243466
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Epoch: 229
Loss on hold-out set: 0.0009796253621711262
MeanAbsoluteError value on hold-out data: 0.03001251257956028
Epoch: 230

Loss on hold-out set: 0.00039427855933484225
MeanAbsoluteError value on hold-out data: 0.01645389385521412
Epoch: 231
Loss on hold-out set: 0.0006376695777622185
MeanAbsoluteError value on hold-out data: 0.02046659030020237
Epoch: 232

Loss on hold-out set: 0.0032184922768335256
MeanAbsoluteError value on hold-out data: 0.04931015521287918
Epoch: 233
Loss on hold-out set: 0.0013490514039793716
MeanAbsoluteError value on hold-out data: 0.029863372445106506
Epoch: 234
Loss on hold-out set: 0.004414131266197988
MeanAbsoluteError value on hold-out data: 0.06290879100561142
Epoch: 235

Loss on hold-out set: 0.0006925770139787346
MeanAbsoluteError value on hold-out data: 0.019165288656949997
Epoch: 236
```

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Loss on hold-out set: 0.003753054454656584
MeanAbsoluteError value on hold-out data: 0.06036118417978287
Epoch: 237

Loss on hold-out set: 0.00017216287129226008
MeanAbsoluteError value on hold-out data: 0.010678126476705074
Epoch: 238
Loss on hold-out set: 0.0011887539045086928
MeanAbsoluteError value on hold-out data: 0.03233947977423668
Epoch: 239

Loss on hold-out set: 0.0017888395148994668
MeanAbsoluteError value on hold-out data: 0.03991389274597168
Epoch: 240
Loss on hold-out set: 0.004828165085720164
MeanAbsoluteError value on hold-out data: 0.059615813195705414
Epoch: 241
Loss on hold-out set: 0.00650346212621246
MeanAbsoluteError value on hold-out data: 0.07063054293394089
Epoch: 242

Loss on hold-out set: 0.0012770025558503611
MeanAbsoluteError value on hold-out data: 0.03400305286049843
Epoch: 243
Loss on hold-out set: 0.006391992859010186
MeanAbsoluteError value on hold-out data: 0.07164216786623001
Epoch: 244

Loss on hold-out set: 7.659880403869985e-05
MeanAbsoluteError value on hold-out data: 0.007100554648786783
Epoch: 245
Loss on hold-out set: 0.0008214304481433439
MeanAbsoluteError value on hold-out data: 0.023449772968888283
Epoch: 246

Loss on hold-out set: 0.0005944588753793921
MeanAbsoluteError value on hold-out data: 0.020791523158550262
Epoch: 247
Loss on hold-out set: 0.002716855611652136
MeanAbsoluteError value on hold-out data: 0.04728049412369728
Epoch: 248
```

```
Loss on hold-out set: 0.008486446991030658
MeanAbsoluteError value on hold-out data: 0.07972832024097443
Epoch: 249

Loss on hold-out set: 0.0026469664548390676
MeanAbsoluteError value on hold-out data: 0.04386959969997406
Epoch: 250
Loss on hold-out set: 0.00015728908744806956
MeanAbsoluteError value on hold-out data: 0.009989285841584206
Epoch: 251

Loss on hold-out set: 0.00018478742016928403
MeanAbsoluteError value on hold-out data: 0.01191214844584465
Epoch: 252
Loss on hold-out set: 0.0005717951529991946
MeanAbsoluteError value on hold-out data: 0.02159646525979042
Epoch: 253

Loss on hold-out set: 0.0010849240934476256
MeanAbsoluteError value on hold-out data: 0.031281255185604095
Epoch: 254
Loss on hold-out set: 0.012755436024495534
MeanAbsoluteError value on hold-out data: 0.09787382185459137
Epoch: 255
Loss on hold-out set: 0.0009908862079360656
MeanAbsoluteError value on hold-out data: 0.026750510558485985
Epoch: 256

Loss on hold-out set: 0.00030562486374817254
MeanAbsoluteError value on hold-out data: 0.015024700202047825
Epoch: 257
Loss on hold-out set: 0.0013947621669753321
MeanAbsoluteError value on hold-out data: 0.03068011999130249
Epoch: 258

Loss on hold-out set: 0.00024387565229387422
MeanAbsoluteError value on hold-out data: 0.011088498868048191
Epoch: 259
Loss on hold-out set: 0.00027545024724011976
MeanAbsoluteError value on hold-out data: 0.013775147497653961
Epoch: 260
```

```
Loss on hold-out set: 0.0013666840469730751
MeanAbsoluteError value on hold-out data: 0.03403758630156517
Epoch: 261
Loss on hold-out set: 0.00046565103444403836
MeanAbsoluteError value on hold-out data: 0.01942155510187149
Epoch: 262
Loss on hold-out set: 0.0009440748752760035
MeanAbsoluteError value on hold-out data: 0.024624375626444817
Epoch: 263

Loss on hold-out set: 0.0012064494325646333
MeanAbsoluteError value on hold-out data: 0.03225262835621834
Epoch: 264
Loss on hold-out set: 0.0009383364896556097
MeanAbsoluteError value on hold-out data: 0.025419175624847412
Epoch: 265

Loss on hold-out set: 0.0011880181430439865
MeanAbsoluteError value on hold-out data: 0.027184316888451576
Epoch: 266
Loss on hold-out set: 0.000762340404825019
MeanAbsoluteError value on hold-out data: 0.02286669984459877
Epoch: 267

Loss on hold-out set: 0.002693518646992743
MeanAbsoluteError value on hold-out data: 0.03708108514547348
Epoch: 268
Loss on hold-out set: 0.000774699350586161
MeanAbsoluteError value on hold-out data: 0.02370443195104599
Epoch: 269
Loss on hold-out set: 0.0020841497129627635
MeanAbsoluteError value on hold-out data: 0.04222208634018898
Epoch: 270

Loss on hold-out set: 0.00036735625430342874
MeanAbsoluteError value on hold-out data: 0.01406008005142212
Epoch: 271
Loss on hold-out set: 0.0008162373913884429
MeanAbsoluteError value on hold-out data: 0.02276814915239811
Epoch: 272
```

```
Loss on hold-out set: 0.00040023854567780238
MeanAbsoluteError value on hold-out data: 0.01705746538937092
Epoch: 273
Loss on hold-out set: 0.006055800443781274
MeanAbsoluteError value on hold-out data: 0.0740828886628151
Epoch: 274

Loss on hold-out set: 0.0029244909528642893
MeanAbsoluteError value on hold-out data: 0.04453817754983902
Epoch: 275
Loss on hold-out set: 0.001322397355189813
MeanAbsoluteError value on hold-out data: 0.031449273228645325
Epoch: 276
Loss on hold-out set: 0.004855105254266944
MeanAbsoluteError value on hold-out data: 0.05767398327589035
Epoch: 277

Loss on hold-out set: 0.004474160494282842
MeanAbsoluteError value on hold-out data: 0.05511904135346413
Epoch: 278
Loss on hold-out set: 0.000882382325861337
MeanAbsoluteError value on hold-out data: 0.022889381274580956
Epoch: 279

Loss on hold-out set: 0.002336728386580944
MeanAbsoluteError value on hold-out data: 0.040170010179281235
Epoch: 280
Loss on hold-out set: 0.0033739079122564624
MeanAbsoluteError value on hold-out data: 0.05334116518497467
Epoch: 281

Loss on hold-out set: 0.0011076918038140451
MeanAbsoluteError value on hold-out data: 0.02962588146328926
Epoch: 282
Loss on hold-out set: 0.0010210085144665623
MeanAbsoluteError value on hold-out data: 0.027632366865873337
Epoch: 283
Loss on hold-out set: 0.0005624706141783722
MeanAbsoluteError value on hold-out data: 0.02204635925590992
Epoch: 284
```

```
Loss on hold-out set: 0.0017252084632803286
MeanAbsoluteError value on hold-out data: 0.03748539835214615
Epoch: 285
Loss on hold-out set: 0.00025240121093312543
MeanAbsoluteError value on hold-out data: 0.012293362990021706
Epoch: 286

Loss on hold-out set: 0.00010562301447082843
MeanAbsoluteError value on hold-out data: 0.007811158429831266
Epoch: 287
Loss on hold-out set: 0.0014239919504949025
MeanAbsoluteError value on hold-out data: 0.03558160364627838
Epoch: 288

Loss on hold-out set: 0.0009101647551038436
MeanAbsoluteError value on hold-out data: 0.02670440822839737
Epoch: 289
Loss on hold-out set: 0.004408829546134386
MeanAbsoluteError value on hold-out data: 0.062185462564229965
Epoch: 290
Loss on hold-out set: 0.00040389530684998523
MeanAbsoluteError value on hold-out data: 0.013829647563397884
Epoch: 291

Loss on hold-out set: 0.0004815614499550845
MeanAbsoluteError value on hold-out data: 0.01949252188205719
Epoch: 292
Loss on hold-out set: 0.0009203211437644703
MeanAbsoluteError value on hold-out data: 0.026289157569408417
Epoch: 293

Loss on hold-out set: 0.0001838152072325881
MeanAbsoluteError value on hold-out data: 0.012231390923261642
Epoch: 294
Loss on hold-out set: 0.0004888080293312669
MeanAbsoluteError value on hold-out data: 0.019005795940756798
Epoch: 295

Loss on hold-out set: 0.00016429961916791008
MeanAbsoluteError value on hold-out data: 0.010942122898995876
Epoch: 296
```

```
Loss on hold-out set: 0.00039127646180401953
MeanAbsoluteError value on hold-out data: 0.01778147928416729
Epoch: 297
Loss on hold-out set: 0.001956521949198629
MeanAbsoluteError value on hold-out data: 0.03703170269727707
Epoch: 298

Loss on hold-out set: 0.003412127461550491
MeanAbsoluteError value on hold-out data: 0.05463453382253647
Epoch: 299
Loss on hold-out set: 0.0021876119010682616
MeanAbsoluteError value on hold-out data: 0.03961950168013573
Epoch: 300

Loss on hold-out set: 0.00011911565629166685
MeanAbsoluteError value on hold-out data: 0.008735605515539646
Epoch: 301
Loss on hold-out set: 0.0010071557314534272
MeanAbsoluteError value on hold-out data: 0.030238542705774307
Epoch: 302

Loss on hold-out set: 0.0011262822247642492
MeanAbsoluteError value on hold-out data: 0.03209571912884712
Epoch: 303
Loss on hold-out set: 0.0019513595450137342
MeanAbsoluteError value on hold-out data: 0.04030205309391022
Epoch: 304
Loss on hold-out set: 0.0015152037043922714
MeanAbsoluteError value on hold-out data: 0.031178392469882965
Epoch: 305

Loss on hold-out set: 0.0020000666180359466
MeanAbsoluteError value on hold-out data: 0.03950333967804909
Epoch: 306
Loss on hold-out set: 0.0007167162423554276
MeanAbsoluteError value on hold-out data: 0.023935889825224876
Epoch: 307

Loss on hold-out set: 0.0003557701545235302
MeanAbsoluteError value on hold-out data: 0.016094963997602463
Epoch: 308
```

```
Loss on hold-out set: 0.0025244230969942044
MeanAbsoluteError value on hold-out data: 0.04149949923157692
Epoch: 309

Loss on hold-out set: 0.00696054520085454
MeanAbsoluteError value on hold-out data: 0.08088218420743942
Epoch: 310
Loss on hold-out set: 0.0016212879979450787
MeanAbsoluteError value on hold-out data: 0.030900750309228897
Epoch: 311
Loss on hold-out set: 0.0008298838760570756
MeanAbsoluteError value on hold-out data: 0.027668697759509087
Epoch: 312

Loss on hold-out set: 0.0018442090284744544
MeanAbsoluteError value on hold-out data: 0.035729531198740005
Epoch: 313
Loss on hold-out set: 0.0014849609163190638
MeanAbsoluteError value on hold-out data: 0.03729154169559479
Epoch: 314

Loss on hold-out set: 0.0005451849013167832
MeanAbsoluteError value on hold-out data: 0.018912289291620255
Epoch: 315
Loss on hold-out set: 0.0010409174719825387
MeanAbsoluteError value on hold-out data: 0.029320811852812767
Epoch: 316

Loss on hold-out set: 8.235458985187247e-05
MeanAbsoluteError value on hold-out data: 0.007119977381080389
Epoch: 317
Loss on hold-out set: 0.0031475271098315716
MeanAbsoluteError value on hold-out data: 0.05247821658849716
Epoch: 318
Loss on hold-out set: 0.001272899639194033
MeanAbsoluteError value on hold-out data: 0.02534542791545391
Epoch: 319

Loss on hold-out set: 0.0029562199488282204
MeanAbsoluteError value on hold-out data: 0.048253484070301056
Epoch: 320
```

```
Loss on hold-out set: 0.004100777441635728
MeanAbsoluteError value on hold-out data: 0.05366294085979462
Epoch: 321

Loss on hold-out set: 0.000246878615663653
MeanAbsoluteError value on hold-out data: 0.013059637509286404
Epoch: 322
Loss on hold-out set: 0.00011965885434100138
MeanAbsoluteError value on hold-out data: 0.008868608623743057
Epoch: 323

Loss on hold-out set: 0.0005097500896746558
MeanAbsoluteError value on hold-out data: 0.02091188170015812
Epoch: 324
Loss on hold-out set: 0.0022776153803403887
MeanAbsoluteError value on hold-out data: 0.04379897564649582
Epoch: 325
Loss on hold-out set: 0.0026899756131959812
MeanAbsoluteError value on hold-out data: 0.049000706523656845
Epoch: 326

Loss on hold-out set: 0.00045467717531469783
MeanAbsoluteError value on hold-out data: 0.01914624124765396
Epoch: 327
Loss on hold-out set: 0.00016836364998848045
MeanAbsoluteError value on hold-out data: 0.01139780506491661
Epoch: 328

Loss on hold-out set: 0.0015969085673402464
MeanAbsoluteError value on hold-out data: 0.03668481856584549
Epoch: 329
Loss on hold-out set: 0.000967985626110541
MeanAbsoluteError value on hold-out data: 0.02838815748691559
Epoch: 330

Loss on hold-out set: 0.0007893685999858592
MeanAbsoluteError value on hold-out data: 0.02421017363667488
Epoch: 331
Loss on hold-out set: 0.0029685802957309143
MeanAbsoluteError value on hold-out data: 0.05259391665458679
Epoch: 332
```

Loss on hold-out set: 0.0007943500864452549
MeanAbsoluteError value on hold-out data: 0.023831674829125404
Epoch: 333

Loss on hold-out set: 0.0006532499475205052
MeanAbsoluteError value on hold-out data: 0.02109655551612377
Epoch: 334
Loss on hold-out set: 0.0009751806418145341
MeanAbsoluteError value on hold-out data: 0.027787189930677414
Epoch: 335

Loss on hold-out set: 0.0003775792553954359
MeanAbsoluteError value on hold-out data: 0.013460814952850342
Epoch: 336
Loss on hold-out set: 0.0011532081989571452
MeanAbsoluteError value on hold-out data: 0.029646135866642
Epoch: 337

Loss on hold-out set: 0.0010590801082019294
MeanAbsoluteError value on hold-out data: 0.02661132626235485
Epoch: 338
Loss on hold-out set: 0.003834997902491263
MeanAbsoluteError value on hold-out data: 0.058661267161369324
Epoch: 339
Loss on hold-out set: 0.0025513203748102698
MeanAbsoluteError value on hold-out data: 0.048113204538822174
Epoch: 340

Loss on hold-out set: 0.0017606275921155299
MeanAbsoluteError value on hold-out data: 0.03882782533764839
Epoch: 341
Loss on hold-out set: 0.0007962173466304583
MeanAbsoluteError value on hold-out data: 0.02613804303109646
Epoch: 342

Loss on hold-out set: 0.0013114867781821107
MeanAbsoluteError value on hold-out data: 0.029221169650554657
Epoch: 343
Loss on hold-out set: 0.001144831916982574
MeanAbsoluteError value on hold-out data: 0.029479028657078743
Epoch: 344

```
Loss on hold-out set: 0.010385631384061915
MeanAbsoluteError value on hold-out data: 0.09844113141298294
Epoch: 345
Loss on hold-out set: 0.0006556004726527524
MeanAbsoluteError value on hold-out data: 0.017791489139199257
Epoch: 346
Loss on hold-out set: 0.0008011090436152049
MeanAbsoluteError value on hold-out data: 0.024563301354646683
Epoch: 347

Loss on hold-out set: 0.001737588891826038
MeanAbsoluteError value on hold-out data: 0.03661169856786728
Epoch: 348
Loss on hold-out set: 0.0008691030005658311
MeanAbsoluteError value on hold-out data: 0.025286532938480377
Epoch: 349

Loss on hold-out set: 0.0005746875166161251
MeanAbsoluteError value on hold-out data: 0.019078539684414864
Epoch: 350
Loss on hold-out set: 0.0023835788763660404
MeanAbsoluteError value on hold-out data: 0.04329526424407959
Epoch: 351

Loss on hold-out set: 0.010668484227997916
MeanAbsoluteError value on hold-out data: 0.09676109999418259
Epoch: 352
Loss on hold-out set: 0.0014630784779520972
MeanAbsoluteError value on hold-out data: 0.035127684473991394
Epoch: 353
Loss on hold-out set: 0.0006424816300360752
MeanAbsoluteError value on hold-out data: 0.02204510197043419
Epoch: 354

Loss on hold-out set: 0.0006844318912564111
MeanAbsoluteError value on hold-out data: 0.02224584110081196
Epoch: 355
Loss on hold-out set: 0.0026802031456359793
MeanAbsoluteError value on hold-out data: 0.04820794239640236
Epoch: 356
```

```
Loss on hold-out set: 0.0005943793886607247
MeanAbsoluteError value on hold-out data: 0.021983038634061813
Epoch: 357
Loss on hold-out set: 0.0033913455637437956
MeanAbsoluteError value on hold-out data: 0.047245755791664124
Epoch: 358

Loss on hold-out set: 0.00024890088908640403
MeanAbsoluteError value on hold-out data: 0.01382115762680769
Epoch: 359
Loss on hold-out set: 0.0006725153985566326
MeanAbsoluteError value on hold-out data: 0.023169636726379395
Epoch: 360
Loss on hold-out set: 0.000994705644968365
MeanAbsoluteError value on hold-out data: 0.024340486153960228
Epoch: 361

Loss on hold-out set: 0.00019123107215688963
MeanAbsoluteError value on hold-out data: 0.01124741230159998
Epoch: 362
Loss on hold-out set: 0.00024038880863892182
MeanAbsoluteError value on hold-out data: 0.011794121004641056
Epoch: 363

Loss on hold-out set: 0.00016719044443951652
MeanAbsoluteError value on hold-out data: 0.009889100678265095
Epoch: 364
Loss on hold-out set: 0.0001771121720334382
MeanAbsoluteError value on hold-out data: 0.011262888088822365
Epoch: 365

Loss on hold-out set: 0.0011469026212580502
MeanAbsoluteError value on hold-out data: 0.03207540884613991
Epoch: 366
Loss on hold-out set: 0.0012893874497552002
MeanAbsoluteError value on hold-out data: 0.028162561357021332
Epoch: 367
Loss on hold-out set: 0.0009888925290267383
MeanAbsoluteError value on hold-out data: 0.030311129987239838
Epoch: 368
```

Loss on hold-out set: 0.0016001551827814961
MeanAbsoluteError value on hold-out data: 0.029924437403678894
Epoch: 369
Loss on hold-out set: 0.00027834700553544493
MeanAbsoluteError value on hold-out data: 0.012417282909154892
Epoch: 370

Loss on hold-out set: 0.0023498487592275652
MeanAbsoluteError value on hold-out data: 0.04644671455025673
Epoch: 371
Loss on hold-out set: 0.0032235251939190285
MeanAbsoluteError value on hold-out data: 0.05427704378962517
Epoch: 372

Loss on hold-out set: 0.0008220107244726803
MeanAbsoluteError value on hold-out data: 0.02641560323536396
Early stopping at epoch 371
Fold: 10
Epoch: 1
Loss on hold-out set: 0.027887854991214617
MeanAbsoluteError value on hold-out data: 0.14217691123485565
Epoch: 2
Loss on hold-out set: 0.01306610953594957
MeanAbsoluteError value on hold-out data: 0.08808627724647522
Epoch: 3

Loss on hold-out set: 0.023303164036146233
MeanAbsoluteError value on hold-out data: 0.13367770612239838
Epoch: 4
Loss on hold-out set: 0.01646551286934742
MeanAbsoluteError value on hold-out data: 0.10991661995649338
Epoch: 5

Loss on hold-out set: 0.015091174415179662
MeanAbsoluteError value on hold-out data: 0.10247120261192322
Epoch: 6
Loss on hold-out set: 0.010811211940433298
MeanAbsoluteError value on hold-out data: 0.0850912407040596
Epoch: 7

```
Loss on hold-out set: 0.013582431046026093
MeanAbsoluteError value on hold-out data: 0.09910889714956284
Epoch: 8
Loss on hold-out set: 0.007872928266546555
MeanAbsoluteError value on hold-out data: 0.07066983729600906
Epoch: 9
Loss on hold-out set: 0.005081202485598624
MeanAbsoluteError value on hold-out data: 0.054257817566394806
Epoch: 10

Loss on hold-out set: 0.003398745703244848
MeanAbsoluteError value on hold-out data: 0.045187968760728836
Epoch: 11
Loss on hold-out set: 0.023114618712237904
MeanAbsoluteError value on hold-out data: 0.1393284946680069
Epoch: 12

Loss on hold-out set: 0.0028299216646701097
MeanAbsoluteError value on hold-out data: 0.04147738590836525
Epoch: 13
Loss on hold-out set: 0.016737901605665684
MeanAbsoluteError value on hold-out data: 0.11537668853998184
Epoch: 14

Loss on hold-out set: 0.0026235096655519946
MeanAbsoluteError value on hold-out data: 0.04089256376028061
Epoch: 15
Loss on hold-out set: 0.018535811321011612
MeanAbsoluteError value on hold-out data: 0.12702462077140808
Epoch: 16
Loss on hold-out set: 0.010531710726874215
MeanAbsoluteError value on hold-out data: 0.0953221246600151
Epoch: 17

Loss on hold-out set: 0.004367773853350849
MeanAbsoluteError value on hold-out data: 0.06114719435572624
Epoch: 18
Loss on hold-out set: 0.003147432563959488
MeanAbsoluteError value on hold-out data: 0.043927036225795746
Epoch: 19
```

```
Loss on hold-out set: 0.0037167841302497046
MeanAbsoluteError value on hold-out data: 0.049802348017692566
Epoch: 20
Loss on hold-out set: 0.021891637572220395
MeanAbsoluteError value on hold-out data: 0.14227323234081268
Epoch: 21

Loss on hold-out set: 0.013220860356731074
MeanAbsoluteError value on hold-out data: 0.11050073802471161
Epoch: 22
Loss on hold-out set: 0.028691724741033146
MeanAbsoluteError value on hold-out data: 0.16437338292598724
Epoch: 23
Loss on hold-out set: 0.007257727706538779
MeanAbsoluteError value on hold-out data: 0.07433871924877167
Epoch: 24

Loss on hold-out set: 0.019386232431445802
MeanAbsoluteError value on hold-out data: 0.13719111680984497
Epoch: 25
Loss on hold-out set: 0.01177451413656984
MeanAbsoluteError value on hold-out data: 0.10399419814348221
Epoch: 26

Loss on hold-out set: 0.005217355210334063
MeanAbsoluteError value on hold-out data: 0.07020695507526398
Epoch: 27
Loss on hold-out set: 0.0034718348179012537
MeanAbsoluteError value on hold-out data: 0.05028495192527771
Epoch: 28

Loss on hold-out set: 0.01137879304587841
MeanAbsoluteError value on hold-out data: 0.09576525539159775
Epoch: 29
Loss on hold-out set: 0.0011128321888723544
MeanAbsoluteError value on hold-out data: 0.025161098688840866
Epoch: 30
Loss on hold-out set: 0.018576589013848985
MeanAbsoluteError value on hold-out data: 0.1326196789741516
Epoch: 31
```

```
Loss on hold-out set: 0.010892681378339018
MeanAbsoluteError value on hold-out data: 0.10185525566339493
Epoch: 32
Loss on hold-out set: 0.0009843398916668125
MeanAbsoluteError value on hold-out data: 0.024916846305131912
Epoch: 33

Loss on hold-out set: 0.010563436429947615
MeanAbsoluteError value on hold-out data: 0.08402639627456665
Epoch: 34
Loss on hold-out set: 0.003533281419160111
MeanAbsoluteError value on hold-out data: 0.05809440463781357
Epoch: 35

Loss on hold-out set: 0.0026271026498372
MeanAbsoluteError value on hold-out data: 0.04142021760344505
Epoch: 36
Loss on hold-out set: 0.007129295579423862
MeanAbsoluteError value on hold-out data: 0.07056397199630737
Epoch: 37
Loss on hold-out set: 0.0004254730260332248
MeanAbsoluteError value on hold-out data: 0.016837334260344505
Epoch: 38

Loss on hold-out set: 0.009950459402586733
MeanAbsoluteError value on hold-out data: 0.0815589502453804
Epoch: 39
Loss on hold-out set: 0.00565336478341903
MeanAbsoluteError value on hold-out data: 0.05852324515581131
Epoch: 40

Loss on hold-out set: 0.00413537843685065
MeanAbsoluteError value on hold-out data: 0.06121407076716423
Epoch: 41
Loss on hold-out set: 0.004031626540901405
MeanAbsoluteError value on hold-out data: 0.055512819439172745
Epoch: 42

Loss on hold-out set: 0.0010840904059088124
MeanAbsoluteError value on hold-out data: 0.027938030660152435
Epoch: 43
```

```
Loss on hold-out set: 0.0035469401627779007
MeanAbsoluteError value on hold-out data: 0.04908989742398262
Epoch: 44
Loss on hold-out set: 0.0024678409099578857
MeanAbsoluteError value on hold-out data: 0.045956529676914215
Epoch: 45

Loss on hold-out set: 0.0036302493286452125
MeanAbsoluteError value on hold-out data: 0.05846177414059639
Epoch: 46
Loss on hold-out set: 0.0014144269516691566
MeanAbsoluteError value on hold-out data: 0.030222009867429733
Epoch: 47

Loss on hold-out set: 0.0034387219098529647
MeanAbsoluteError value on hold-out data: 0.05347417667508125
Epoch: 48
Loss on hold-out set: 0.005955352747280683
MeanAbsoluteError value on hold-out data: 0.061806730926036835
Epoch: 49

Loss on hold-out set: 0.0045300774176472
MeanAbsoluteError value on hold-out data: 0.058452900499105453
Epoch: 50
Loss on hold-out set: 0.006770880260903921
MeanAbsoluteError value on hold-out data: 0.06342558562755585
Epoch: 51
Loss on hold-out set: 0.001558121177367866
MeanAbsoluteError value on hold-out data: 0.033282503485679626
Epoch: 52

Loss on hold-out set: 0.0007331347359078271
MeanAbsoluteError value on hold-out data: 0.02303440496325493
Epoch: 53
Loss on hold-out set: 0.009845796440328871
MeanAbsoluteError value on hold-out data: 0.09215476363897324
Epoch: 54

Loss on hold-out set: 0.003492000379732677
MeanAbsoluteError value on hold-out data: 0.05718667060136795
Epoch: 55
```

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Loss on hold-out set: 0.0004829750895234091
MeanAbsoluteError value on hold-out data: 0.017927926033735275
Epoch: 56

Loss on hold-out set: 0.0021684004459530115
MeanAbsoluteError value on hold-out data: 0.03882434964179993
Epoch: 57
Loss on hold-out set: 0.004381755134090781
MeanAbsoluteError value on hold-out data: 0.04712677374482155
Epoch: 58
Loss on hold-out set: 0.008924352404262339
MeanAbsoluteError value on hold-out data: 0.08595015853643417
Epoch: 59

Loss on hold-out set: 0.005102615337818861
MeanAbsoluteError value on hold-out data: 0.06546308845281601
Epoch: 60
Loss on hold-out set: 0.0039351400919258595
MeanAbsoluteError value on hold-out data: 0.052133750170469284
Epoch: 61

Loss on hold-out set: 0.004227785493380257
MeanAbsoluteError value on hold-out data: 0.06292596459388733
Epoch: 62
Loss on hold-out set: 0.005255302314513496
MeanAbsoluteError value on hold-out data: 0.06528514623641968
Epoch: 63

Loss on hold-out set: 0.00019129138568782115
MeanAbsoluteError value on hold-out data: 0.010093634016811848
Epoch: 64
Loss on hold-out set: 0.0031934721461896387
MeanAbsoluteError value on hold-out data: 0.05409584566950798
Epoch: 65
Loss on hold-out set: 0.001897679096146021
MeanAbsoluteError value on hold-out data: 0.0385102778673172
Epoch: 66

Loss on hold-out set: 0.004554116965404579
MeanAbsoluteError value on hold-out data: 0.06525522470474243
Epoch: 67
```

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Loss on hold-out set: 0.006394430595849242
MeanAbsoluteError value on hold-out data: 0.0760563462972641
Epoch: 68

Loss on hold-out set: 0.00497146589415414
MeanAbsoluteError value on hold-out data: 0.06388431787490845
Epoch: 69
Loss on hold-out set: 0.0012980345719760017
MeanAbsoluteError value on hold-out data: 0.03158462047576904
Epoch: 70

Loss on hold-out set: 0.0029637266249795046
MeanAbsoluteError value on hold-out data: 0.04377441480755806
Epoch: 71
Loss on hold-out set: 0.004022603488660285
MeanAbsoluteError value on hold-out data: 0.0603022575378418
Epoch: 72
Loss on hold-out set: 0.0012210894201416522
MeanAbsoluteError value on hold-out data: 0.028410758823156357
Epoch: 73

Loss on hold-out set: 0.0009809574611218913
MeanAbsoluteError value on hold-out data: 0.029563480988144875
Epoch: 74
Loss on hold-out set: 0.0045231853146106005
MeanAbsoluteError value on hold-out data: 0.053135309368371964
Epoch: 75

Loss on hold-out set: 0.0011341656707892461
MeanAbsoluteError value on hold-out data: 0.03022339567542076
Epoch: 76
Loss on hold-out set: 0.00020066678449178914
MeanAbsoluteError value on hold-out data: 0.011205058544874191
Epoch: 77

Loss on hold-out set: 0.008239512398306812
MeanAbsoluteError value on hold-out data: 0.08448760956525803
Epoch: 78
Loss on hold-out set: 0.0027990820817649364
MeanAbsoluteError value on hold-out data: 0.051041603088378906
Epoch: 79
```

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Loss on hold-out set: 0.004984960192814469
MeanAbsoluteError value on hold-out data: 0.0574672594666481
Epoch: 80

Loss on hold-out set: 0.0002882896951632574
MeanAbsoluteError value on hold-out data: 0.012718644924461842
Epoch: 81
Loss on hold-out set: 0.0006979754814113091
MeanAbsoluteError value on hold-out data: 0.023497391492128372
Epoch: 82

Loss on hold-out set: 0.0018666312119291564
MeanAbsoluteError value on hold-out data: 0.03282800316810608
Epoch: 83
Loss on hold-out set: 0.0017590426806626575
MeanAbsoluteError value on hold-out data: 0.03427077457308769
Epoch: 84

Loss on hold-out set: 0.008337709121406078
MeanAbsoluteError value on hold-out data: 0.08616747707128525
Epoch: 85
Loss on hold-out set: 0.006663449773831027
MeanAbsoluteError value on hold-out data: 0.08051028102636337
Epoch: 86
Loss on hold-out set: 0.0033937876245805194
MeanAbsoluteError value on hold-out data: 0.044220998883247375
Epoch: 87

Loss on hold-out set: 0.013712848403624125
MeanAbsoluteError value on hold-out data: 0.1082686334848404
Epoch: 88
Loss on hold-out set: 0.0019661543774418533
MeanAbsoluteError value on hold-out data: 0.03752681612968445
Epoch: 89

Loss on hold-out set: 0.00212702587512987
MeanAbsoluteError value on hold-out data: 0.044820159673690796
Epoch: 90
Loss on hold-out set: 0.00023881403051616092
MeanAbsoluteError value on hold-out data: 0.011970380321145058
Epoch: 91
```

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Loss on hold-out set: 0.0032759380327271564
MeanAbsoluteError value on hold-out data: 0.04488478600978851
Epoch: 92
Loss on hold-out set: 0.003968180739320815
MeanAbsoluteError value on hold-out data: 0.04809294268488884
Epoch: 93
Loss on hold-out set: 0.002325088351166674
MeanAbsoluteError value on hold-out data: 0.04106656089425087
Epoch: 94

Loss on hold-out set: 0.0011585373057252063
MeanAbsoluteError value on hold-out data: 0.03265457972884178
Epoch: 95
Loss on hold-out set: 0.00017674334022294825
MeanAbsoluteError value on hold-out data: 0.010876455344259739
Epoch: 96

Loss on hold-out set: 0.002359239135070571
MeanAbsoluteError value on hold-out data: 0.04363042861223221
Epoch: 97
Loss on hold-out set: 0.0011252365823435997
MeanAbsoluteError value on hold-out data: 0.028006955981254578
Epoch: 98

Loss on hold-out set: 0.0028366695790152463
MeanAbsoluteError value on hold-out data: 0.048392366617918015
Epoch: 99
Loss on hold-out set: 0.001280798892756658
MeanAbsoluteError value on hold-out data: 0.03357050195336342
Epoch: 100
Loss on hold-out set: 0.003270914977682488
MeanAbsoluteError value on hold-out data: 0.05615241825580597
Epoch: 101

Loss on hold-out set: 0.00018679422126816853
MeanAbsoluteError value on hold-out data: 0.010638302192091942
Epoch: 102
Loss on hold-out set: 0.0011042996858512716
MeanAbsoluteError value on hold-out data: 0.030115168541669846
Epoch: 103
```

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Loss on hold-out set: 0.00013982112120304788
MeanAbsoluteError value on hold-out data: 0.009008106775581837
Epoch: 104
Loss on hold-out set: 0.00011333454209047236
MeanAbsoluteError value on hold-out data: 0.008494478650391102
Epoch: 105

Loss on hold-out set: 0.0036364194404866013
MeanAbsoluteError value on hold-out data: 0.05743095278739929
Epoch: 106
Loss on hold-out set: 0.00017767846916935274
MeanAbsoluteError value on hold-out data: 0.010586743243038654
Epoch: 107
Loss on hold-out set: 0.000563897321366572
MeanAbsoluteError value on hold-out data: 0.02272818610072136
Epoch: 108

Loss on hold-out set: 0.00010616672963286484
MeanAbsoluteError value on hold-out data: 0.008060507476329803
Epoch: 109
Loss on hold-out set: 0.0001655801513282183
MeanAbsoluteError value on hold-out data: 0.010917222127318382
Epoch: 110

Loss on hold-out set: 0.003400481538847089
MeanAbsoluteError value on hold-out data: 0.05222642794251442
Epoch: 111
Loss on hold-out set: 8.188517313101329e-05
MeanAbsoluteError value on hold-out data: 0.007414801046252251
Epoch: 112

Loss on hold-out set: 0.0038735315070620607
MeanAbsoluteError value on hold-out data: 0.04353838041424751
Epoch: 113
Loss on hold-out set: 0.003345833991521171
MeanAbsoluteError value on hold-out data: 0.05597548931837082
Epoch: 114
Loss on hold-out set: 0.0023955551109143664
MeanAbsoluteError value on hold-out data: 0.0478786937892437
Epoch: 115
```

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Loss on hold-out set: 0.0023267493483477403
MeanAbsoluteError value on hold-out data: 0.04371006041765213
Epoch: 116
Loss on hold-out set: 0.0022741654788010885
MeanAbsoluteError value on hold-out data: 0.04513764753937721
Epoch: 117

Loss on hold-out set: 0.0009176304613772247
MeanAbsoluteError value on hold-out data: 0.027713246643543243
Epoch: 118
Loss on hold-out set: 0.008620064106902905
MeanAbsoluteError value on hold-out data: 0.08512666821479797
Epoch: 119

Loss on hold-out set: 7.153752345142752e-05
MeanAbsoluteError value on hold-out data: 0.007000683341175318
Epoch: 120
Loss on hold-out set: 0.0038443164833422217
MeanAbsoluteError value on hold-out data: 0.05878245458006859
Epoch: 121
Loss on hold-out set: 0.0013636073729555523
MeanAbsoluteError value on hold-out data: 0.03139050304889679
Epoch: 122

Loss on hold-out set: 0.00010741845991495731
MeanAbsoluteError value on hold-out data: 0.008863725699484348
Epoch: 123
Loss on hold-out set: 0.005591984904770341
MeanAbsoluteError value on hold-out data: 0.05726991593837738
Epoch: 124

Loss on hold-out set: 0.010754114549074854
MeanAbsoluteError value on hold-out data: 0.10187248885631561
Epoch: 125
Loss on hold-out set: 0.0011896635572026884
MeanAbsoluteError value on hold-out data: 0.029788415879011154
Epoch: 126

Loss on hold-out set: 0.0010679391395699764
MeanAbsoluteError value on hold-out data: 0.031094999983906746
Epoch: 127
```

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Loss on hold-out set: 0.0017109367264700787
MeanAbsoluteError value on hold-out data: 0.040128424763679504
Epoch: 128
Loss on hold-out set: 0.003758296004629561
MeanAbsoluteError value on hold-out data: 0.05109923332929611
Epoch: 129

Loss on hold-out set: 0.00014103084998038997
MeanAbsoluteError value on hold-out data: 0.009048069827258587
Epoch: 130
Loss on hold-out set: 0.0009607982730293381
MeanAbsoluteError value on hold-out data: 0.024934254586696625
Epoch: 131

Loss on hold-out set: 0.0012646333114909275
MeanAbsoluteError value on hold-out data: 0.03465867415070534
Epoch: 132
Loss on hold-out set: 0.00011741026225666116
MeanAbsoluteError value on hold-out data: 0.008551112376153469
Epoch: 133

Loss on hold-out set: 0.0003456187363813764
MeanAbsoluteError value on hold-out data: 0.01569160260260105
Epoch: 134
Loss on hold-out set: 0.0019906446936407258
MeanAbsoluteError value on hold-out data: 0.03511951118707657
Epoch: 135
Loss on hold-out set: 0.0035397119354456663
MeanAbsoluteError value on hold-out data: 0.05713610723614693
Epoch: 136

Loss on hold-out set: 0.0004539817538378494
MeanAbsoluteError value on hold-out data: 0.01909882202744484
Epoch: 137
Loss on hold-out set: 0.00012435065062683343
MeanAbsoluteError value on hold-out data: 0.009456312283873558
Epoch: 138

Loss on hold-out set: 0.00041255548213874657
MeanAbsoluteError value on hold-out data: 0.016980722546577454
Epoch: 139
```

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Loss on hold-out set: 0.0002624030353867316
MeanAbsoluteError value on hold-out data: 0.013650880195200443
Epoch: 140

Loss on hold-out set: 0.003608117611812694
MeanAbsoluteError value on hold-out data: 0.05186288431286812
Epoch: 141
Loss on hold-out set: 0.0013874179899825581
MeanAbsoluteError value on hold-out data: 0.031110437586903572
Epoch: 142
Loss on hold-out set: 0.0010628881697942103
MeanAbsoluteError value on hold-out data: 0.025200918316841125
Epoch: 143

Loss on hold-out set: 0.00037058537626372915
MeanAbsoluteError value on hold-out data: 0.014851856045424938
Epoch: 144
Loss on hold-out set: 0.0033255418363426414
MeanAbsoluteError value on hold-out data: 0.0534684956073761
Epoch: 145

Loss on hold-out set: 0.002548612088763288
MeanAbsoluteError value on hold-out data: 0.04557807743549347
Epoch: 146
Loss on hold-out set: 0.002105445201907839
MeanAbsoluteError value on hold-out data: 0.04302794486284256
Epoch: 147

Loss on hold-out set: 0.0007180562492326967
MeanAbsoluteError value on hold-out data: 0.025060437619686127
Epoch: 148
Loss on hold-out set: 0.002992477633857301
MeanAbsoluteError value on hold-out data: 0.04594123736023903
Epoch: 149
Loss on hold-out set: 0.0009319119438129876
MeanAbsoluteError value on hold-out data: 0.02789994888007641
Epoch: 150

Loss on hold-out set: 0.001715768943540752
MeanAbsoluteError value on hold-out data: 0.03933162987232208
Epoch: 151
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Loss on hold-out set: 0.00030318374878593853
MeanAbsoluteError value on hold-out data: 0.013853561133146286
Epoch: 152

Loss on hold-out set: 0.0003737984308307724
MeanAbsoluteError value on hold-out data: 0.01605660654604435
Epoch: 153
Loss on hold-out set: 0.004246859212539026
MeanAbsoluteError value on hold-out data: 0.05571502074599266
Epoch: 154

Loss on hold-out set: 0.0008230906096287072
MeanAbsoluteError value on hold-out data: 0.025210127234458923
Epoch: 155
Loss on hold-out set: 0.0008739055940947894
MeanAbsoluteError value on hold-out data: 0.02671831287443638
Epoch: 156
Loss on hold-out set: 0.007449930866381952
MeanAbsoluteError value on hold-out data: 0.07910427451133728
Epoch: 157

Loss on hold-out set: 0.007145739759185484
MeanAbsoluteError value on hold-out data: 0.06932682543992996
Epoch: 158
Loss on hold-out set: 0.0017436234380251595
MeanAbsoluteError value on hold-out data: 0.039943113923072815
Epoch: 159

Loss on hold-out set: 0.00040133491815440044
MeanAbsoluteError value on hold-out data: 0.017754364758729935
Epoch: 160
Loss on hold-out set: 0.0002086417402356996
MeanAbsoluteError value on hold-out data: 0.011919255368411541
Epoch: 161

Loss on hold-out set: 0.00027822803323423225
MeanAbsoluteError value on hold-out data: 0.013944749720394611
Epoch: 162
Loss on hold-out set: 0.0008200111250127
MeanAbsoluteError value on hold-out data: 0.022891726344823837
Epoch: 163
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Loss on hold-out set: 0.0009095435878927154
MeanAbsoluteError value on hold-out data: 0.028886107727885246
Epoch: 164

Loss on hold-out set: 0.002214403058003102
MeanAbsoluteError value on hold-out data: 0.036974456161260605
Epoch: 165
Loss on hold-out set: 0.00011424663950622614
MeanAbsoluteError value on hold-out data: 0.00870981253683567
Epoch: 166

Loss on hold-out set: 0.0052489317022264
MeanAbsoluteError value on hold-out data: 0.05815397575497627
Epoch: 167
Loss on hold-out set: 0.0009810697956709191
MeanAbsoluteError value on hold-out data: 0.028732609003782272
Epoch: 168

Loss on hold-out set: 0.0012249365681782365
MeanAbsoluteError value on hold-out data: 0.028267687186598778
Epoch: 169
Loss on hold-out set: 0.0019043244953666414
MeanAbsoluteError value on hold-out data: 0.0414128303527832
Epoch: 170
Loss on hold-out set: 0.003073015682665365
MeanAbsoluteError value on hold-out data: 0.042631518095731735
Epoch: 171

Loss on hold-out set: 0.006057258728625519
MeanAbsoluteError value on hold-out data: 0.06486648321151733
Epoch: 172
Loss on hold-out set: 0.0009686762101149984
MeanAbsoluteError value on hold-out data: 0.026861082762479782
Epoch: 173

Loss on hold-out set: 0.009510948455759458
MeanAbsoluteError value on hold-out data: 0.09281442314386368
Epoch: 174
Loss on hold-out set: 0.002043779822997749
MeanAbsoluteError value on hold-out data: 0.04100007563829422
Epoch: 175
```

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Loss on hold-out set: 0.0038782474252262284
MeanAbsoluteError value on hold-out data: 0.05897298455238342
Epoch: 176
Loss on hold-out set: 0.0019872101755546673
MeanAbsoluteError value on hold-out data: 0.03651375323534012
Epoch: 177
Loss on hold-out set: 0.0002530382532443452
MeanAbsoluteError value on hold-out data: 0.012014500796794891
Epoch: 178

Loss on hold-out set: 0.0008753359351041061
MeanAbsoluteError value on hold-out data: 0.025251567363739014
Epoch: 179
Loss on hold-out set: 0.000899636560851442
MeanAbsoluteError value on hold-out data: 0.027051476761698723
Epoch: 180

Loss on hold-out set: 0.0031060661671550144
MeanAbsoluteError value on hold-out data: 0.04699566960334778
Epoch: 181
Loss on hold-out set: 0.004951183418078082
MeanAbsoluteError value on hold-out data: 0.06862536072731018
Epoch: 182

Loss on hold-out set: 0.00048816856620500663
MeanAbsoluteError value on hold-out data: 0.01839490234851837
Epoch: 183
Loss on hold-out set: 0.0003812258115171322
MeanAbsoluteError value on hold-out data: 0.016973499208688736
Epoch: 184
Loss on hold-out set: 0.00014287487959206504
MeanAbsoluteError value on hold-out data: 0.009973030537366867
Epoch: 185

Loss on hold-out set: 0.002239868776606662
MeanAbsoluteError value on hold-out data: 0.04581448435783386
Epoch: 186
Loss on hold-out set: 0.0027670400948928936
MeanAbsoluteError value on hold-out data: 0.04485334828495979
Epoch: 187
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Loss on hold-out set: 0.001804518313812358
MeanAbsoluteError value on hold-out data: 0.03850870952010155
Epoch: 188
Loss on hold-out set: 0.001289220223303086
MeanAbsoluteError value on hold-out data: 0.029264790937304497
Epoch: 189

Loss on hold-out set: 0.00021356898339165906
MeanAbsoluteError value on hold-out data: 0.011905236169695854
Epoch: 190
Loss on hold-out set: 0.0026313938765919636
MeanAbsoluteError value on hold-out data: 0.04794672131538391
Epoch: 191
Loss on hold-out set: 0.00020692814723588526
MeanAbsoluteError value on hold-out data: 0.012137973681092262
Epoch: 192

Loss on hold-out set: 0.0013124579064814107
MeanAbsoluteError value on hold-out data: 0.03373207151889801
Epoch: 193
Loss on hold-out set: 0.0004745549085782841
MeanAbsoluteError value on hold-out data: 0.017315799370408058
Epoch: 194

Loss on hold-out set: 0.002884712868503162
MeanAbsoluteError value on hold-out data: 0.05148562043905258
Epoch: 195
Loss on hold-out set: 0.0020473985433844583
MeanAbsoluteError value on hold-out data: 0.03819774091243744
Epoch: 196

Loss on hold-out set: 0.0049937051454825064
MeanAbsoluteError value on hold-out data: 0.06999117136001587
Epoch: 197
Loss on hold-out set: 0.0004468772967811674
MeanAbsoluteError value on hold-out data: 0.019241172820329666
Epoch: 198
Loss on hold-out set: 0.0007609641013134803
MeanAbsoluteError value on hold-out data: 0.0224161297082901
Epoch: 199
```

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Loss on hold-out set: 0.00014444920322733066
MeanAbsoluteError value on hold-out data: 0.009501414373517036
Epoch: 200
Loss on hold-out set: 0.0006582814052567951
MeanAbsoluteError value on hold-out data: 0.021166322752833366
Epoch: 201

Loss on hold-out set: 0.007619536614843777
MeanAbsoluteError value on hold-out data: 0.07666723430156708
Epoch: 202
Loss on hold-out set: 0.0003833527111315301
MeanAbsoluteError value on hold-out data: 0.01653415523469448
Epoch: 203

Loss on hold-out set: 0.0010346030384036048
MeanAbsoluteError value on hold-out data: 0.029593171551823616
Epoch: 204
Loss on hold-out set: 0.0005137731204740703
MeanAbsoluteError value on hold-out data: 0.021612823009490967
Epoch: 205
Loss on hold-out set: 0.0028261306163455758
MeanAbsoluteError value on hold-out data: 0.04833752661943436
Epoch: 206

Loss on hold-out set: 0.0009219153434969485
MeanAbsoluteError value on hold-out data: 0.02291785553097725
Epoch: 207
Loss on hold-out set: 0.004210011268566761
MeanAbsoluteError value on hold-out data: 0.062290530651807785
Epoch: 208

Loss on hold-out set: 0.004853034192430121
MeanAbsoluteError value on hold-out data: 0.06747942417860031
Epoch: 209
Loss on hold-out set: 0.00546394195407629
MeanAbsoluteError value on hold-out data: 0.0666765570640564
Epoch: 210

Loss on hold-out set: 0.0018145018257200718
MeanAbsoluteError value on hold-out data: 0.035807400941848755
Epoch: 211
```

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Loss on hold-out set: 0.00011290506933749254
MeanAbsoluteError value on hold-out data: 0.00860538613051176
Epoch: 212
Loss on hold-out set: 0.00198378340740289
MeanAbsoluteError value on hold-out data: 0.035132262855768204
Epoch: 213

Loss on hold-out set: 0.003377531355779086
MeanAbsoluteError value on hold-out data: 0.05091829597949982
Epoch: 214
Loss on hold-out set: 0.00043849779259679574
MeanAbsoluteError value on hold-out data: 0.019764726981520653
Epoch: 215

Loss on hold-out set: 0.0030581901249076638
MeanAbsoluteError value on hold-out data: 0.05400368571281433
Epoch: 216
Loss on hold-out set: 0.0034089259736772093
MeanAbsoluteError value on hold-out data: 0.0570051372051239
Epoch: 217

Loss on hold-out set: 0.0014696529833599925
MeanAbsoluteError value on hold-out data: 0.03145022317767143
Epoch: 218
Loss on hold-out set: 0.00042213725516506074
MeanAbsoluteError value on hold-out data: 0.01729455031454563
Epoch: 219
Loss on hold-out set: 0.003242636498595987
MeanAbsoluteError value on hold-out data: 0.05404407158493996
Epoch: 220

Loss on hold-out set: 0.0010817780026367732
MeanAbsoluteError value on hold-out data: 0.031897544860839844
Epoch: 221
Loss on hold-out set: 0.005752647162548133
MeanAbsoluteError value on hold-out data: 0.05979098752140999
Epoch: 222

Loss on hold-out set: 0.0009849998418108694
MeanAbsoluteError value on hold-out data: 0.02608492597937584
Epoch: 223
```

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Loss on hold-out set: 0.0015615819886858975
MeanAbsoluteError value on hold-out data: 0.03240593150258064
Epoch: 224

Loss on hold-out set: 0.0006104574505505818
MeanAbsoluteError value on hold-out data: 0.022850003093481064
Epoch: 225
Loss on hold-out set: 0.0026470176775806715
MeanAbsoluteError value on hold-out data: 0.04230981692671776
Epoch: 226
Loss on hold-out set: 0.0012963940223146761
MeanAbsoluteError value on hold-out data: 0.034161511808633804
Epoch: 227

Loss on hold-out set: 0.0007734994370756405
MeanAbsoluteError value on hold-out data: 0.02504110522568226
Epoch: 228
Loss on hold-out set: 0.0005096409669412034
MeanAbsoluteError value on hold-out data: 0.01994277909398079
Epoch: 229

Loss on hold-out set: 0.0010260067127611755
MeanAbsoluteError value on hold-out data: 0.026651298627257347
Epoch: 230
Loss on hold-out set: 0.0011328629084995814
MeanAbsoluteError value on hold-out data: 0.031335774809122086
Epoch: 231

Loss on hold-out set: 0.001194719915344779
MeanAbsoluteError value on hold-out data: 0.029357383027672768
Epoch: 232
Loss on hold-out set: 0.000672656182099932
MeanAbsoluteError value on hold-out data: 0.020657086744904518
Epoch: 233
Loss on hold-out set: 0.01185777091554233
MeanAbsoluteError value on hold-out data: 0.08456001430749893
Epoch: 234

Loss on hold-out set: 0.00011821272242481687
MeanAbsoluteError value on hold-out data: 0.009129652753472328
Epoch: 235
```

```
Loss on hold-out set: 0.000576105950001095
MeanAbsoluteError value on hold-out data: 0.022200454026460648
Epoch: 236

Loss on hold-out set: 0.00016140171854723512
MeanAbsoluteError value on hold-out data: 0.010255935601890087
Epoch: 237
Loss on hold-out set: 0.0006347026168701372
MeanAbsoluteError value on hold-out data: 0.021072573959827423
Epoch: 238

Loss on hold-out set: 0.001636394432612828
MeanAbsoluteError value on hold-out data: 0.03463689610362053
Epoch: 239
Loss on hold-out set: 0.0005621060263365507
MeanAbsoluteError value on hold-out data: 0.020610386505723
Epoch: 240
Loss on hold-out set: 0.0002706998056964949
MeanAbsoluteError value on hold-out data: 0.015208431519567966
Epoch: 241

Loss on hold-out set: 0.002819627124283995
MeanAbsoluteError value on hold-out data: 0.0513484850525856
Epoch: 242
Loss on hold-out set: 0.0009127016362201955
MeanAbsoluteError value on hold-out data: 0.02550208568572998
Epoch: 243

Loss on hold-out set: 0.0019736370304599404
MeanAbsoluteError value on hold-out data: 0.04115863889455795
Epoch: 244
Loss on hold-out set: 0.006483525370380708
MeanAbsoluteError value on hold-out data: 0.07326854765415192
Epoch: 245

Loss on hold-out set: 0.0008454124160510089
MeanAbsoluteError value on hold-out data: 0.024621909484267235
Epoch: 246
Loss on hold-out set: 0.00011431405541121162
MeanAbsoluteError value on hold-out data: 0.008975010365247726
Epoch: 247
```

```
Loss on hold-out set: 0.00016964140689067O1
MeanAbsoluteError value on hold-out data: 0.010702859610319138
Early stopping at epoch 246
```

```
metric_name = type(fun_control["metric_torch"]).__name__
print(f"loss: {df_eval}, Cross-validated {metric_name}: {df_metrics}")
```

```
loss: 0.0020684422772319524, Cross-validated MeanAbsoluteError: 0.03409036248922348
```

## 26.18 Detailed Hyperparameter Plots

```
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
l1:  0.05500431863118096
lr_mult:  100.0
epochs:  16.0030007551117
patience:  6.055303560032454
optimizer:  1.619740694909762
```

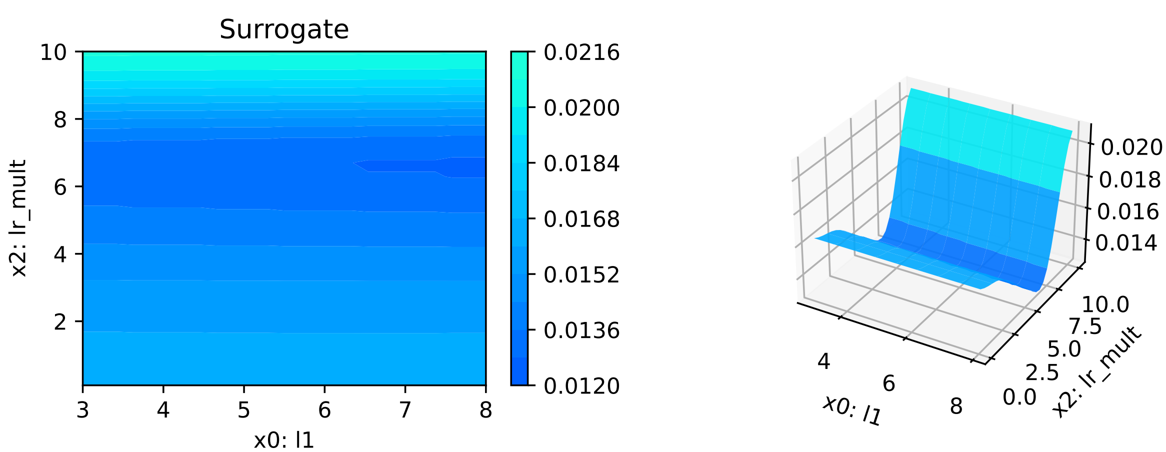
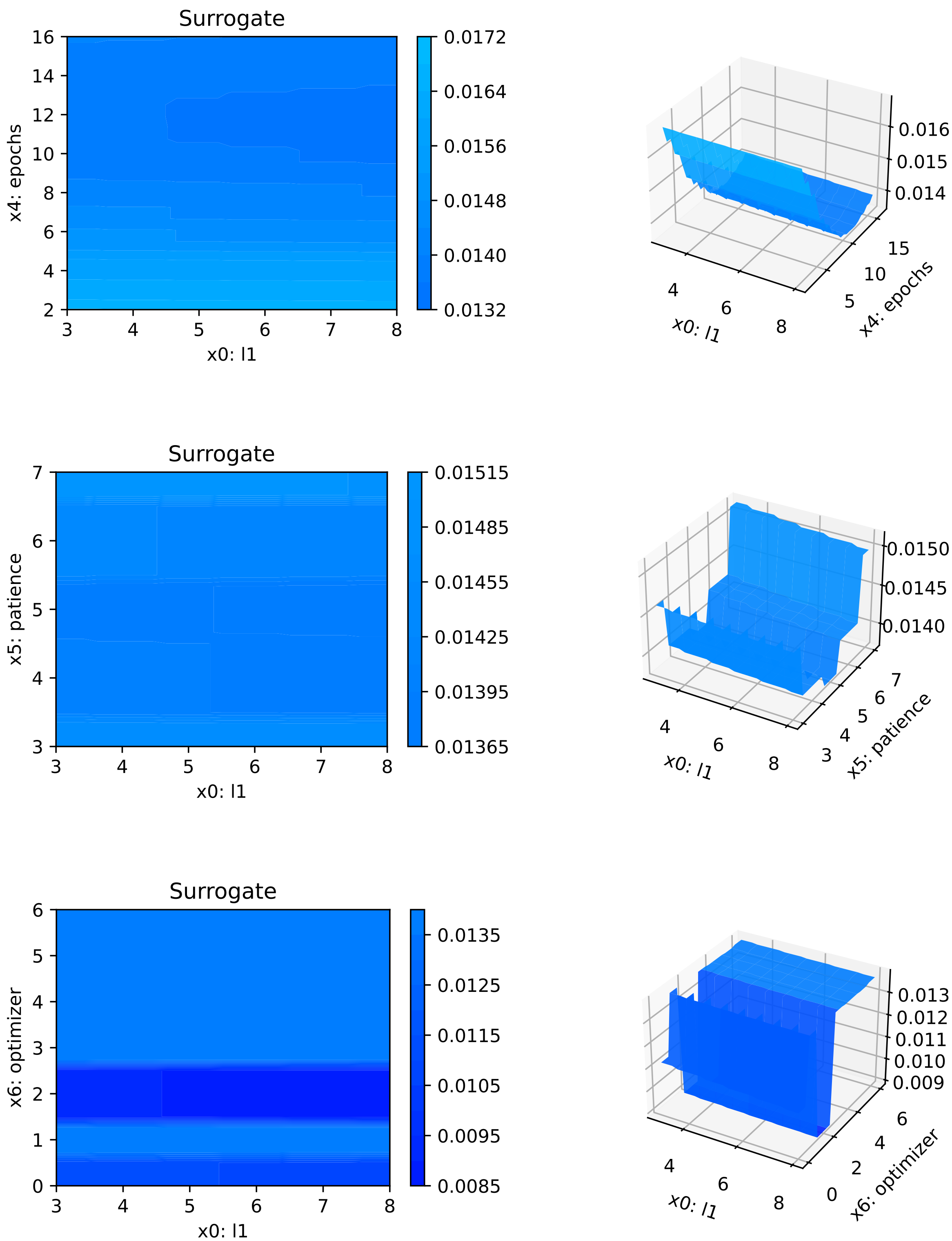
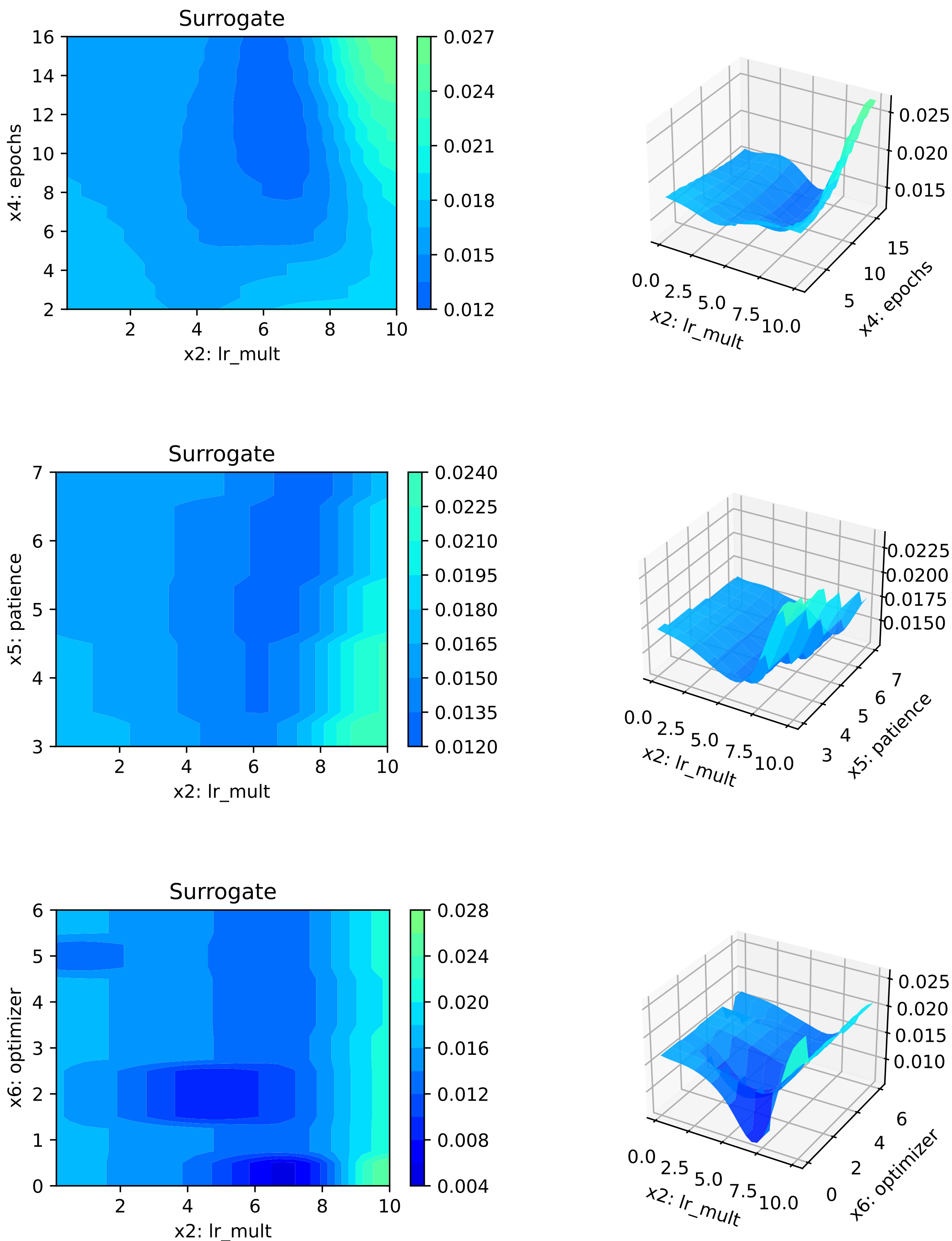
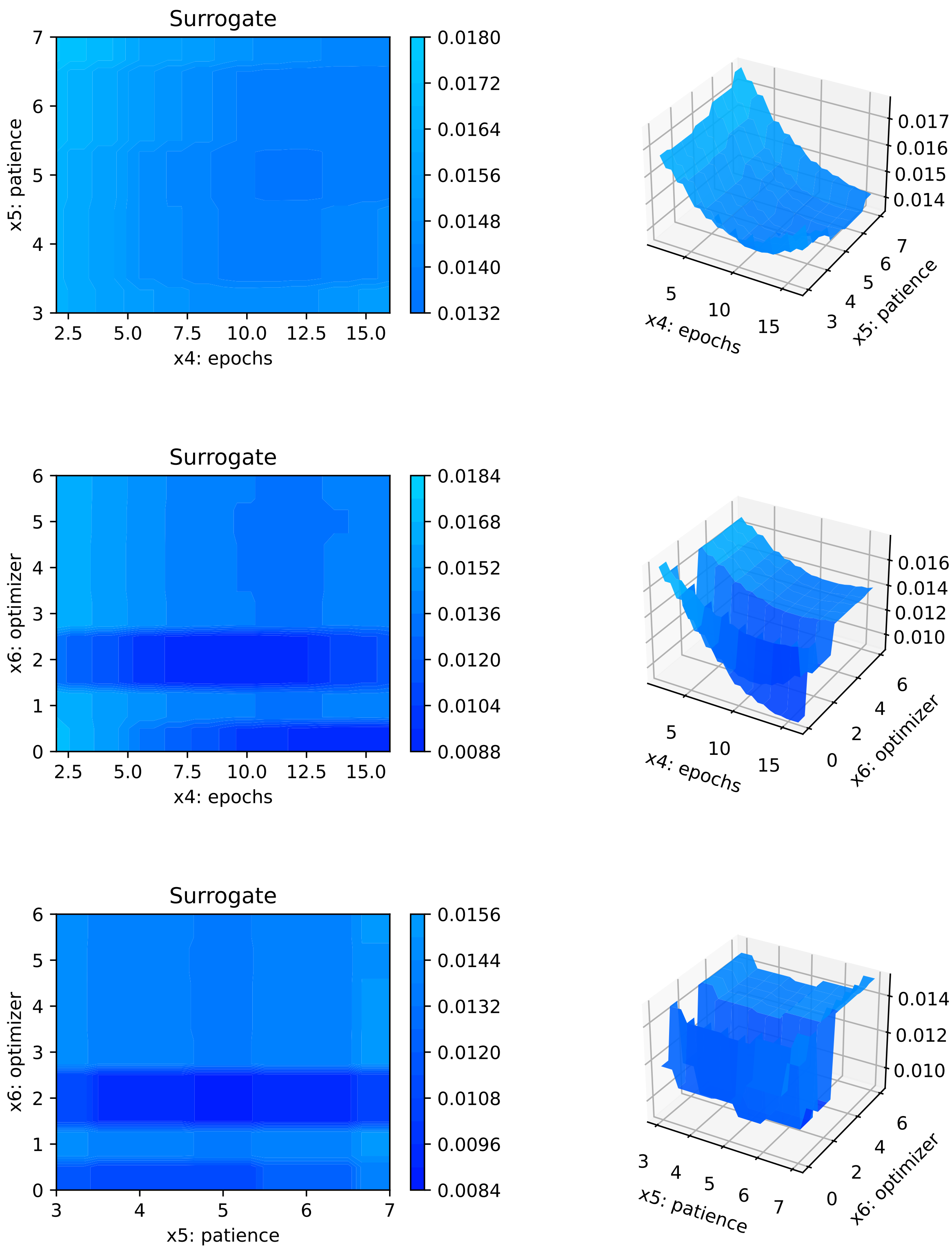



Figure 26.3: Contour plots.


Surrogate
x4: epochs
x0: l1
0.0172
0.0164
0.0156
0.0148
0.0140
0.0132
Surrogate
x5: patience
x0: l1
0.01515
0.01485
0.01455
0.01425
0.01395
0.01365
Surrogate
x6: optimizer
x0: l1
0.0135
0.0125
0.0115
0.0105
0.0095
0.0085



Surrogate
x4: epochs
x2: lr_mult
Surrogate
x5: patience
x2: lr_mult
Surrogate
x6: optimizer
x2: lr_mult


Surrogate
x5: patience
x4: epochs
0.0180
0.0172
0.0164
0.0156
0.0148
0.0140
0.0132
0.017
0.016
0.015
0.014
Surrogate
x6: optimizer
x4: epochs
0.0184
0.0168
0.0152
0.0136
0.0120
0.0104
0.0088
0.016
0.014
0.012
0.010
Surrogate
x6: optimizer
x5: patience
0.0156
0.0144
0.0132
0.0120
0.0108
0.0096
0.0084
0.014
0.012
0.010

## 26.19 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

```
Unable to display output for mime type(s): text/html
```

Parallel coordinates plots

```
Unable to display output for mime type(s): text/html
```

## 26.20 Summary and Outlook

This tutorial presents the hyperparameter tuning open source software `spotPython` for `PyTorch`. Some of the advantages of `spotPython` are:

- Numerical and categorical hyperparameters.
- Powerful surrogate models.
- Flexible approach and easy to use.
- Simple JSON files for the specification of the hyperparameters.
- Extension of default and user specified network classes.
- Noise handling techniques.
- Online visualization of the hyperparameter tuning process with `tensorboard`.

Currently, only rudimentary parallel and distributed neural network training is possible, but these capabilities will be extended in the future. The next version of `spotPython` will also include a more detailed documentation and more examples.

> **! Important**
>
> Important: This tutorial does not present a complete benchmarking study (Bartz-Beielstein et al. 2020). The results are only preliminary and highly dependent on the local configuration (hard- and software). Our goal is to provide a first impression of the performance of the hyperparameter tuning package `spotPython`. The results should be interpreted with care.

# 27 HPT: PyTorch With VBDP

In this tutorial, we will show how `spotPython` can be integrated into the `PyTorch` training workflow for a classifiaction task.

> **Note**
>
> Ensure that the correspondiing data is available as `./data/VBDP/train.csv`.

This document refers to the following software versions:

- `python`: 3.10.10
- `torch`: 2.0.1
- `torchvision`: 0.15.0

```
pip list | grep  "spot[RiverPython]"
```

```
spotPython                    0.2.34
spotRiver                     0.0.93
```

```
Note: you may need to restart the kernel to use updated packages.
```

`spotPython` can be installed via pip. Alternatively, the source code can be downloaded from gitHub: https://github.com/sequential-parameter-optimization/spotPython.

```
!pip install spotPython
```

- Uncomment the following lines if you want to for (re-)installation the latest version of `spotPython` from gitHub.

```
# import sys
# !{sys.executable} -m pip install --upgrade build
# !{sys.executable} -m pip install --upgrade --force-reinstall spotPython
```

## 27.1 Setup

Before we consider the detailed experimental setup, we select the parameters that affect run time, initial design size and the device that is used.

```
MAX_TIME = 60
INIT_SIZE = 10
DEVICE = None # "cpu" # "cuda:0"
```

```
from spotPython.utils.device import getDevice
DEVICE = getDevice(DEVICE)
print(DEVICE)
```

```
mps
```

```
import os
import copy
import socket
from datetime import datetime
from dateutil.tz import tzlocal
start_time = datetime.now(tzlocal())
HOSTNAME = socket.gethostname().split(".")[0]
experiment_name = '25-torch' + "_" + HOSTNAME + "_" + str(MAX_TIME) + "min_" + str(INIT_SI
experiment_name = experiment_name.replace(':', '-')
print(experiment_name)
if not os.path.exists('./figures'):
    os.makedirs('./figures')
```

```
25-torch_p040025_60min_10init_2023-06-17_18-29-23
```

## 27.2 Initialization of the `fun_control` Dictionary

`spotPython` uses a Python dictionary for storing the information required for the hyperparameter tuning process, which was described in Section 21.2.

```
from spotPython.utils.init import fun_control_init
fun_control = fun_control_init(task="classification",
    tensorboard_path="runs/25_spot_torch_vbdp",
```

```
        device=DEVICE)
```

# 28 PyTorch Data Loading

## 28.1 1. Load VBDP Data

```
import pandas as pd
from sklearn.preprocessing import OrdinalEncoder
train_df = pd.read_csv('./data/VBDP/train.csv')
# remove the id column
train_df = train_df.drop(columns=['id'])
n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
target_column = "prognosis"
# # Encoder our prognosis labels as integers for easier decoding later
enc = OrdinalEncoder()
train_df[target_column] = enc.fit_transform(train_df[[target_column]])
train_df.head()

# convert all entries to int for faster processing
train_df = train_df.astype(int)
```

```
from spotPython.data.vbdp import combine_features
df_new = train_df.copy()
# save the target column using "target_column" as the column name
target = train_df[target_column]
# remove the target column
df_new = df_new.drop(columns=[target_column])
train_df = combine_features(df_new)
# add the target column back
train_df[target_column] = target
train_df.head()
```

| | sudden_fever | headache | mouth_bleed | nose_bleed | muscle_pain | joint_pain | vomiting | rash | diar |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |

| | sudden_fever | headache | mouth_bleed | nose_bleed | muscle_pain | joint_pain | vomiting | rash | dia |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

- feature engineering: 6112 features

```python
from sklearn.model_selection import train_test_split
import numpy as np

n_samples = train_df.shape[0]
n_features = train_df.shape[1] - 1
train_df.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
train_df.head()
```

| | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 | ... | x6104 | x6105 | x6106 | x6107 | x6108 | x6109 | x61 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | ... | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | ... | 0 | 1 | 1 | 0 | 1 | 1 | 0 |

### 28.1.1 Check content of the target column

```python
train_df[target_column].head()
```

```
0     3
1     7
2     3
3    10
4     6
Name: prognosis, dtype: int64
```

```python
X_train, X_test, y_train, y_test = train_test_split(train_df.drop(target_column, axis=1),
                                                    random_state=42,
                                                    test_size=0.25,
                                                    stratify=train_df[target_column])
```

```
trainset = pd.DataFrame(np.hstack((X_train, np.array(y_train).reshape(-1, 1))))
testset = pd.DataFrame(np.hstack((X_test, np.array(y_test).reshape(-1, 1))))
trainset.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
testset.columns = [f"x{i}" for i in range(1, n_features+1)] + [target_column]
print(train_df.shape)
print(trainset.shape)
print(testset.shape)
```

```
(707, 6113)
(530, 6113)
(177, 6113)
```

```
import torch
from sklearn.model_selection import train_test_split
from spotPython.torch.dataframedataset import DataFrameDataset
dtype_x = torch.float32
dtype_y = torch.long
train_df = DataFrameDataset(train_df, target_column=target_column, dtype_x=dtype_x, dtype_
train = DataFrameDataset(trainset, target_column=target_column, dtype_x=dtype_x, dtype_y=d
test = DataFrameDataset(testset, target_column=target_column, dtype_x=dtype_x, dtype_y=dty
n_samples = len(train)
```

```
# add the dataset to the fun_control
fun_control.update({"data": train_df, # full dataset,
               "train": train,
               "test": test,
               "n_samples": n_samples,
               "target_column": target_column})
```

## 28.2 The Model (Algorithm) to be Tuned

## 28.3 Specification of the Preprocessing Model

After the training and test data are specified and added to the `fun_control` dictionary, `spotPython` allows the specification of a data preprocessing pipeline, e.g., for the scaling of the data or for the one-hot encoding of categorical variables, see Section 21.4.1. This feature is not used here, so we do not change the default value (which is `None`).

## 28.4 Select `algorithm` and `core_model_hyper_dict`

### 28.4.1 Implementing a Configurable Neural Network With spotPython

`spotPython` includes the `Net_vbdp` class which is implemented in the file `netvbdp.py`. The class is imported here.

This class inherits from the class `Net_Core` which is implemented in the file `netcore.py`, see Section 21.4.3.

# 29 add the nn model to the fun_control dictionary

```
from spotPython.torch.netvbdp import Net_vbdp
from spotPython.data.torch_hyper_dict import TorchHyperDict
from spotPython.hyperparameters.values import add_core_model_to_fun_control
fun_control = add_core_model_to_fun_control(core_model=Net_vbdp,
                              fun_control=fun_control,
                              hyper_dict=TorchHyperDict)
```

## 29.1 Modifying the Hyperparameters

`spotPython` provides functions for modifying the hyperparameters, their bounds and factors as well as for activating and de-activating hyperparameters without re-compilation of the Python source code. These functions were described in Section 21.5.3.

> Small number of epochs for demonstration purposes
>
> - `epochs` is set to 2 and 3 for demonstration purposes. These values are too small for a real application.

```
from spotPython.hyperparameters.values import modify_hyper_parameter_bounds

fun_control = modify_hyper_parameter_bounds(fun_control, "_L0", bounds=[n_features, n_feat
fun_control = modify_hyper_parameter_bounds(fun_control, "l1", bounds=[6, 13])
fun_control = modify_hyper_parameter_bounds(fun_control, "epochs", bounds=[2, 2])
fun_control = modify_hyper_parameter_bounds(fun_control, "patience", bounds=[2, 6])
fun_control = modify_hyper_parameter_bounds(fun_control, "lr_mult", bounds=[1e-3, 1e-3])
fun_control = modify_hyper_parameter_bounds(fun_control, "sgd_momentum", bounds=[0.9, 0.9]
```

```
from spotPython.hyperparameters.values import modify_hyper_parameter_levels
fun_control = modify_hyper_parameter_levels(fun_control, "optimizer",["Adam", "AdamW", "Ad
```

```
# fun_control = modify_hyper_parameter_levels(fun_control, "optimizer", ["Adam"])
# fun_control = modify_hyper_parameter_levels(fun_control, "leaf_model", ["LinearRegressio
# fun_control["core_model_hyper_dict"]
```

```
fun_control = modify_hyper_parameter_bounds(fun_control,
    "lr_mult", bounds=[1e-3, 1e-3])
fun_control = modify_hyper_parameter_bounds(fun_control,
    "sgd_momentum", bounds=[0.9, 0.9])
```

### 29.1.1 Optimizers

Optimizers are described in Section 21.6.

## 29.2 Evaluation

The evaluation procedure requires the specification of two elements:

1. the way how the data is split into a train and a test set (see Section 21.7)
2. the loss function (and a metric).

### 29.2.1 Loss Functions and Metrics

The loss function is specified by the key `"loss_function"`. We will use CrossEntropy loss for the multiclass-classification task.

```
from torch.nn import CrossEntropyLoss
loss_function = CrossEntropyLoss()
fun_control.update({"loss_function": loss_function})
```

### 29.2.2 Metric

- We will use the MAP@k metric for the evaluation of the model. Here is an example how this metric is calculated.

```
from spotPython.torch.mapk import MAPK
import torch
mapk = MAPK(k=2)
```

```python
target = torch.tensor([0, 1, 2, 2])
preds = torch.tensor(
    [
        [0.5, 0.2, 0.2],  # 0 is in top 2
        [0.3, 0.4, 0.2],  # 1 is in top 2
        [0.2, 0.4, 0.3],  # 2 is in top 2
        [0.7, 0.2, 0.1],  # 2 isn't in top 2
    ]
)
mapk.update(preds, target)
print(mapk.compute()) # tensor(0.6250)
```

```
tensor(0.6250)
```

```python
from spotPython.torch.mapk import MAPK
import torchmetrics
metric_torch = MAPK(k=3)
fun_control.update({"metric_torch": metric_torch})
```

## 29.3 Preparing the SPOT Call

The following code passes the information about the parameter ranges and bounds to `spot`.

```python
# extract the variable types, names, and bounds
from spotPython.hyperparameters.values import (get_bound_values,
    get_var_name,
    get_var_type,)
var_type = get_var_type(fun_control)
var_name = get_var_name(fun_control)
fun_control.update({"var_type": var_type,
                    "var_name": var_name})
lower = get_bound_values(fun_control, "lower")
upper = get_bound_values(fun_control, "upper")
```

Now, the dictionary `fun_control` contains all information needed for the hyperparameter tuning. Before the hyperparameter tuning is started, it is recommended to take a look at the experimental design. The method `gen_design_table` generates a design table as follows:

```python
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control))
```

```
| name          | type   | default   |    lower |    upper | transform             |
|---------------|--------|-----------|----------|----------|-----------------------|
| _L0           | int    | 64        | 6112     | 6112     | None                  |
| l1            | int    | 8         |    6     |   13     | transform_power_2_int |
| dropout_prob  | float  | 0.01      |    0     |    0.9   | None                  |
| lr_mult       | float  | 1.0       |    0.001 |    0.001 | None                  |
| batch_size    | int    | 4         |    1     |    4     | transform_power_2_int |
| epochs        | int    | 4         |    2     |    2     | transform_power_2_int |
| k_folds       | int    | 1         |    1     |    1     | None                  |
| patience      | int    | 2         |    2     |    6     | transform_power_2_int |
| optimizer     | factor | SGD       |    0     |    3     | None                  |
| sgd_momentum  | float  | 0.0       |    0.9   |    0.9   | None                  |
```

This allows to check if all information is available and if the information is correct.

## 29.4 The Objective Function `fun_torch`

The objective function `fun_torch` is selected next. It implements an interface from `PyTorch`'s training, validation, and testing methods to `spotPython`.

```python
from spotPython.fun.hypertorch import HyperTorch
fun = HyperTorch().fun_torch
```

```python
from spotPython.hyperparameters.values import get_default_hyperparameters_as_array
hyper_dict=TorchHyperDict().load()
X_start = get_default_hyperparameters_as_array(fun_control, hyper_dict)
```

## 29.5 Starting the Hyperparameter Tuning

The `spotPython` hyperparameter tuning is started by calling the `Spot` function as described in Section 21.12.

```python
import numpy as np
from spotPython.spot import spot
from math import inf
```

```python
spot_tuner = spot.Spot(fun=fun,
                   lower = lower,
                   upper = upper,
                   fun_evals = inf,
                   fun_repeats = 1,
                   max_time = MAX_TIME,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type = var_type,
                   var_name = var_name,
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models= False,
                   show_progress= True,
                   fun_control = fun_control,
                   design_control={"init_size": INIT_SIZE,
                                   "repeats": 1},
                   surrogate_control={"noise": True,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": len(var_name),
                                      "model_fun_evals": 10_000,
                                      "log_level": 50
                                      })
spot_tuner.run(X_start=X_start)
```

```
config: {'_L0': 6112, 'l1': 1024, 'dropout_prob': 0.26515610830779995, 'lr_mult': 0.001, 'ba
Epoch: 1

Loss on hold-out set: 2.397832570252595
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.18518517911434174
Epoch: 2

Loss on hold-out set: 2.3977911560623735
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1774691343307495
Epoch: 3
```

```
Loss on hold-out set: 2.397858496065493
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17515431344509125
Epoch: 4

Loss on hold-out set: 2.3978615248644792
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.16743825376033783
Returned to Spot: Validation loss: 2.3978615248644792
----------------------------------------------

config: {'_L0': 6112, 'l1': 256, 'dropout_prob': 0.6368989501775649, 'lr_mult': 0.001, 'batcl
Epoch: 1

Loss on hold-out set: 2.397526538596963
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1729559749364853
Epoch: 2

Loss on hold-out set: 2.397454689133842
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18553456664085388
Epoch: 3

Loss on hold-out set: 2.3974115623618073
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1871069073677063
Epoch: 4

Loss on hold-out set: 2.39755930990543
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18946540355682373
Returned to Spot: Validation loss: 2.39755930990543
----------------------------------------------

config: {'_L0': 6112, 'l1': 512, 'dropout_prob': 0.06795318590380832, 'lr_mult': 0.001, 'bat
Epoch: 1

Loss on hold-out set: 2.3972096218253083
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17845910787582397
Epoch: 2
```

```
Loss on hold-out set: 2.3971673632567785
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.18396227061748505
Epoch: 3

Loss on hold-out set: 2.3972019654399945
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.18160377442836761
Epoch: 4

Loss on hold-out set: 2.3971572821994998
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17688679695129395
Returned to Spot: Validation loss: 2.3971572821994998
----------------------------------------------

config: {'_L0': 6112, 'l1': 128, 'dropout_prob': 0.456533346732735, 'lr_mult': 0.001, 'batch_
Epoch: 1

Loss on hold-out set: 2.397113620110278
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.1878930777311325
Epoch: 2

Loss on hold-out set: 2.397159072588075
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19103772938251495
Epoch: 3

Loss on hold-out set: 2.3971150146340423
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19182388484477997
Epoch: 4

Loss on hold-out set: 2.3968697493931033
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19182388484477997
Returned to Spot: Validation loss: 2.3968697493931033
----------------------------------------------

config: {'_L0': 6112, 'l1': 2048, 'dropout_prob': 0.435068640608333, 'lr_mult': 0.001, 'batch
Epoch: 1
```

```
Loss on hold-out set: 2.3982484693880433
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.15740741789340973
Epoch: 2

Loss on hold-out set: 2.39828203342579
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.17129628360271454
Epoch: 3

Loss on hold-out set: 2.3981971917329012
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.1705246865749359
Epoch: 4

Loss on hold-out set: 2.39814344158879
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.16358023881912231
Returned to Spot: Validation loss: 2.39814344158879
----------------------------------------------

config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3175980093998585, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974495968728697
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21933957934379578
Epoch: 2

Loss on hold-out set: 2.3968855569947443
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21933962404727936
Epoch: 3

Loss on hold-out set: 2.3959995755609476
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.24056604504585266
Epoch: 4
```

```
Loss on hold-out set: 2.3947608515901386
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.23427671194076538
Returned to Spot: Validation loss: 2.3947608515901386
----------------------------------------------

config: {'_L0': 6112, 'l1': 128, 'dropout_prob': 0.10217787740156026, 'lr_mult': 0.001, 'bat
Epoch: 1

Loss on hold-out set: 2.3970074388715954
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1697530895471573
Epoch: 2

Loss on hold-out set: 2.3969787579995616
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1697530895471573
Epoch: 3

Loss on hold-out set: 2.397000754321063
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1697530895471573
Epoch: 4

Loss on hold-out set: 2.396945008525142
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1697530895471573
Returned to Spot: Validation loss: 2.396945008525142
----------------------------------------------

config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.5582660802134882, 'lr_mult': 0.001, 'bat
Epoch: 1

Loss on hold-out set: 2.397923292937102
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.15740740299224854
Epoch: 2

Loss on hold-out set: 2.397717555363973
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.18209876120090485
Epoch: 3
```

```
Loss on hold-out set: 2.397595264293529
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.18132716417312622
Epoch: 4

Loss on hold-out set: 2.397535041526512
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.18132716417312622
Returned to Spot: Validation loss: 2.397535041526512
----------------------------------------------

config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.8475085430864048, 'lr_mult': 0.001, 'bat
Epoch: 1

Loss on hold-out set: 2.3977992242237307
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.17767296731472015
Epoch: 2

Loss on hold-out set: 2.3980891344682225
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.17924527823925018
Epoch: 3

Loss on hold-out set: 2.39792289823856
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.16981132328510284
Epoch: 4

Loss on hold-out set: 2.397931420578147
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17138364911079407
Returned to Spot: Validation loss: 2.397931420578147
----------------------------------------------

config: {'_L0': 6112, 'l1': 64, 'dropout_prob': 0.8086972970888939, 'lr_mult': 0.001, 'batch_
Epoch: 1

Loss on hold-out set: 2.398003339767456
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1406249850988388
```

```
Epoch: 2
Loss on hold-out set: 2.397968258176531
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1495535522699356
Epoch: 3

Loss on hold-out set: 2.398138472012111
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1413690447807312
Epoch: 4
Loss on hold-out set: 2.398006796836853
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1428571343421936
Returned to Spot: Validation loss: 2.398006796836853
----------------------------------------------


config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.5827925614729339, 'lr_mult': 0.001, 'bat
Epoch: 1

Loss on hold-out set: 2.397922992706299
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.14197532832622528
Epoch: 2

Loss on hold-out set: 2.3978879186842175
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.1319444477558136
Epoch: 3

Loss on hold-out set: 2.3977497948540583
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.1489197462797165
Epoch: 4

Loss on hold-out set: 2.3976304442794234
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.15046297013759613
Returned to Spot: Validation loss: 2.3976304442794234
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 0.08%
```

```
config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.2856709300174571, 'lr_mult': 0.001, 'batc
Epoch: 1

Loss on hold-out set: 2.3977000353471287
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.19575469195842743
Epoch: 2

Loss on hold-out set: 2.397371660988286
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2216981202363968
Epoch: 3

Loss on hold-out set: 2.396899601198592
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.208333358168602
Epoch: 4

Loss on hold-out set: 2.396559346396968
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2012578547000885
Returned to Spot: Validation loss: 2.396559346396968
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 0.22%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.2491110437034876, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397888695752179
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.12962962687015533
Epoch: 2

Loss on hold-out set: 2.397542388350875
Accuracy on hold-out set: 0.06132075471698113
MAPK value on hold-out data: 0.15123455226421356
Epoch: 3
```

```
Loss on hold-out set: 2.397111557148121
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.1597222089767456
Epoch: 4

Loss on hold-out set: 2.3965668148464627
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.18672838807106018
Returned to Spot: Validation loss: 2.3965668148464627
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 0.39%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.4016565519463153, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3978510172861927
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17531445622444153
Epoch: 2

Loss on hold-out set: 2.397604951318705
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2004716992378235
Epoch: 3

Loss on hold-out set: 2.3973981794321313
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.2020440250635147
Epoch: 4

Loss on hold-out set: 2.397226095199585
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.20597481727600098
Returned to Spot: Validation loss: 2.397226095199585
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 0.72%
```

```
config: {'_L0': 6112, 'l1': 128, 'dropout_prob': 0.43232396904698, 'lr_mult': 0.001, 'batch_s
Epoch: 1

Loss on hold-out set: 2.3987006106466615
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.13836480677127838
Epoch: 2

Loss on hold-out set: 2.398763157286734
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.13522015511989594
Epoch: 3

Loss on hold-out set: 2.3988244398584904
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.13757863640785217
Epoch: 4

Loss on hold-out set: 2.398717614839662
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.14150945842266083
Returned to Spot: Validation loss: 2.398717614839662
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 0.80%


config: {'_L0': 6112, 'l1': 2048, 'dropout_prob': 0.32618024578548965, 'lr_mult': 0.001, 'ba
Epoch: 1

Loss on hold-out set: 2.397329177496568
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2012578248977661
Epoch: 2

Loss on hold-out set: 2.3971198594795085
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.2413521707057953
Epoch: 3
```

```
Loss on hold-out set: 2.396981639682122
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2279874086380005
Epoch: 4

Loss on hold-out set: 2.3967476340959655
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.25393080711364746
Returned to Spot: Validation loss: 2.3967476340959655
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 0.90%


config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.28157995144713244, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397636840928276
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.17610062658786774
Epoch: 2

Loss on hold-out set: 2.397417707263299
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.21619494259357452
Epoch: 3

Loss on hold-out set: 2.3969471769512825
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2492137998342514
Epoch: 4

Loss on hold-out set: 2.39652352063161
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.25235849618911743
Returned to Spot: Validation loss: 2.39652352063161
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 1.04%
```

```
config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.32746420084665695, 'lr_mult': 0.001, 'ba
Epoch: 1

Loss on hold-out set: 2.39746600277019
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.16116352379322052
Epoch: 2

Loss on hold-out set: 2.3971661599177234
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1729559600353241
Epoch: 3

Loss on hold-out set: 2.396647318354193
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1941823810338974
Epoch: 4

Loss on hold-out set: 2.396085464729453
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1878930777311325
Returned to Spot: Validation loss: 2.396085464729453
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 1.34%


config: {'_L0': 6112, 'l1': 4096, 'dropout_prob': 0.32935281047198406, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397489347547855
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19103775918483734
Epoch: 2

Loss on hold-out set: 2.397054429324168
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.20911946892738342
Epoch: 3
```

```
Loss on hold-out set: 2.3966097786741436
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.23270435631275177
Epoch: 4

Loss on hold-out set: 2.3958597880489423
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.23742137849330902
Returned to Spot: Validation loss: 2.3958597880489423
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 1.64%


config: {'_L0': 6112, 'l1': 1024, 'dropout_prob': 0.33239730398372586, 'lr_mult': 0.001, 'ba
Epoch: 1

Loss on hold-out set: 2.3974375283276594
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.2044753134250641
Epoch: 2

Loss on hold-out set: 2.3973044377786143
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.20987653732299805
Epoch: 3

Loss on hold-out set: 2.3973011440700955
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.20679013431072235
Epoch: 4

Loss on hold-out set: 2.3972682334758617
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.21296298503875732
Returned to Spot: Validation loss: 2.3972682334758617
----------------------------------------------
spotPython tuning: 2.3947608515901386 [----------] 1.69%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3221859860481166, 'lr_mult': 0.001, 'batc
```

```
Epoch: 1

Loss on hold-out set: 2.3972854524288536
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.2146226167678833
Epoch: 2

Loss on hold-out set: 2.3966557889614464
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.22562892735004425
Epoch: 3

Loss on hold-out set: 2.395792673218925
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.21776729822158813
Epoch: 4

Loss on hold-out set: 2.3944637595482594
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.22248424589633942
Returned to Spot: Validation loss: 2.3944637595482594
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 2.02%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32522693113778367, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397611271660283
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.19968554377555847
Epoch: 2

Loss on hold-out set: 2.397451157839793
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.2295597344636917
Epoch: 3
```

```
Loss on hold-out set: 2.397193728752856
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19968551397323608
Epoch: 4

Loss on hold-out set: 2.3968516700672655
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.21698111295700073
Returned to Spot: Validation loss: 2.3968516700672655
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 2.34%


config: {'_L0': 6112, 'l1': 128, 'dropout_prob': 0.4666137067979277, 'lr_mult': 0.001, 'batc
Epoch: 1

Loss on hold-out set: 2.3984525203704834
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.16430819034576416
Epoch: 2

Loss on hold-out set: 2.398510267149727
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1674528419971466
Epoch: 3

Loss on hold-out set: 2.3984579635116288
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.16509434580802917
Epoch: 4

Loss on hold-out set: 2.3984487731501742
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.16588051617145538
Returned to Spot: Validation loss: 2.3984487731501742
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 2.42%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3246363876614704, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3977928116636456
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.14465411007404327
Epoch: 2

Loss on hold-out set: 2.3973206843969956
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.2012578248977661
Epoch: 3

Loss on hold-out set: 2.3966073899898888
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.20990563929080963
Epoch: 4

Loss on hold-out set: 2.3955984160585224
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.23034587502479553
Returned to Spot: Validation loss: 2.3955984160585224
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 2.75%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263478113510505, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3977326132216543
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18160375952720642
Epoch: 2
```

```
Loss on hold-out set: 2.397377513489633
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18160375952720642
Epoch: 3

Loss on hold-out set: 2.396672104889492
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.2224842607975006
Epoch: 4

Loss on hold-out set: 2.3956107238553606
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.22641505300998688
Returned to Spot: Validation loss: 2.3956107238553606
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 3.08%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3260618936382081, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397300562768612
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.21855345368385315
Epoch: 2

Loss on hold-out set: 2.396683841381433
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2287735641002655
Epoch: 3

Loss on hold-out set: 2.395920065214049
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.22484277188777924
Epoch: 4
```

```
Loss on hold-out set: 2.3948537358697854
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.22091196477413177
Returned to Spot: Validation loss: 2.3948537358697854
----------------------------------------------
spotPython tuning: 2.3944637595482594 [----------] 3.40%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3267433126403279, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3975744607313625
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.2075471580028534
Epoch: 2

Loss on hold-out set: 2.3969426649921344
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2625785768032074
Epoch: 3

Loss on hold-out set: 2.3960414247692756
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.2625786364078522
Epoch: 4

Loss on hold-out set: 2.394743725938617
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2562893033027649
Returned to Spot: Validation loss: 2.394743725938617
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 3.73%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3232844320835162, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3974133077657447
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.17767298221588135
Epoch: 2

Loss on hold-out set: 2.396930793546281
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19654089212417603
Epoch: 3

Loss on hold-out set: 2.396045891743786
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19732701778411865
Epoch: 4

Loss on hold-out set: 2.394743964357196
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19575469195842743
Returned to Spot: Validation loss: 2.394743964357196
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 4.05%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32697261481084655, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3975190756455906
Accuracy on hold-out set: 0.19339622641509435
MAPK value on hold-out data: 0.2555031478404999
Epoch: 2

Loss on hold-out set: 2.3970775199386307
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.27358490228652954
Epoch: 3
```

```
Loss on hold-out set: 2.3964933134474844
Accuracy on hold-out set: 0.20754716981132076
MAPK value on hold-out data: 0.27987420558929443
Epoch: 4

Loss on hold-out set: 2.3956137603183962
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.27358487248420715
Returned to Spot: Validation loss: 2.3956137603183962
----------------------------------------------

spotPython tuning: 2.3944637595482594 [----------] 4.38%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3262153434116225, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397266684838061
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20597483217716217
Epoch: 2

Loss on hold-out set: 2.396590102393672
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.21226415038108826
Epoch: 3

Loss on hold-out set: 2.3957614043973527
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.20911948382854462
Epoch: 4

Loss on hold-out set: 2.3943307084857293
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.21147796511650085
Returned to Spot: Validation loss: 2.3943307084857293
----------------------------------------------

spotPython tuning: 2.3943307084857293 [----------] 4.71%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32706593365737413, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397391143834816
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2358490228652954
Epoch: 2

Loss on hold-out set: 2.396761898724538
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.23663519322872162
Epoch: 3

Loss on hold-out set: 2.3960223152952373
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.23270437121391296
Epoch: 4

Loss on hold-out set: 2.3947771135366187
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.22720125317573547
Returned to Spot: Validation loss: 2.3947771135366187
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 5.04%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3275180350958864, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397483281369479
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2075471580028534
Epoch: 2
```

```
Loss on hold-out set: 2.396928503828229
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.2562893331050873
Epoch: 3

Loss on hold-out set: 2.3962856778558694
Accuracy on hold-out set: 0.18867924528301888
MAPK value on hold-out data: 0.2413521558046341
Epoch: 4

Loss on hold-out set: 2.395201988939969
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.2154088169336319
Returned to Spot: Validation loss: 2.395201988939969
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 5.38%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3272555010258064, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397261956952653
Accuracy on hold-out set: 0.24528301886792453
MAPK value on hold-out data: 0.30267295241355896
Epoch: 2

Loss on hold-out set: 2.3967954527656987
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.26100626587867737
Epoch: 3

Loss on hold-out set: 2.3958354401138595
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.23820750415325165
Epoch: 4
```

```
Loss on hold-out set: 2.394513670003639
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19261005520820618
Returned to Spot: Validation loss: 2.394513670003639
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 5.72%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.328053979382131, 'lr_mult': 0.001, 'batcl

Epoch: 1

Loss on hold-out set: 2.397458409363369
Accuracy on hold-out set: 0.19339622641509435
MAPK value on hold-out data: 0.2759433686733246
Epoch: 2

Loss on hold-out set: 2.396953231883499
Accuracy on hold-out set: 0.22169811320754718
MAPK value on hold-out data: 0.32154083251953125
Epoch: 3

Loss on hold-out set: 2.396160881474333
Accuracy on hold-out set: 0.19339622641509435
MAPK value on hold-out data: 0.2822326719760895
Epoch: 4

Loss on hold-out set: 2.395031690597534
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.26965412497520447
Returned to Spot: Validation loss: 2.395031690597534
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 6.05%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3280168976389187, 'lr_mult': 0.001, 'batc

Epoch: 1
```

```
Loss on hold-out set: 2.397442381337004
Accuracy on hold-out set: 0.18867924528301888
MAPK value on hold-out data: 0.2429245114326477
Epoch: 2

Loss on hold-out set: 2.397004208474789
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2429245114326477
Epoch: 3

Loss on hold-out set: 2.3964029258152224
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.2570754587650299
Epoch: 4

Loss on hold-out set: 2.3953641090752944
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.26179239153862
Returned to Spot: Validation loss: 2.3953641090752944
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 6.38%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3273736240155946, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3975595033393717
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.1878930926322937
Epoch: 2

Loss on hold-out set: 2.39697191400348
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.25864776968955994
Epoch: 3
```

```
Loss on hold-out set: 2.3961280067011996
Accuracy on hold-out set: 0.18396226415094338
MAPK value on hold-out data: 0.26022011041641235
Epoch: 4

Loss on hold-out set: 2.3949224049190305
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.24056601524353027
Returned to Spot: Validation loss: 2.3949224049190305
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 6.71%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32745596457234605, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3973239052970454
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.1871069222688675
Epoch: 2

Loss on hold-out set: 2.396827274898313
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2578616142272949
Epoch: 3

Loss on hold-out set: 2.396106315108965
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.22955971956253052
Epoch: 4

Loss on hold-out set: 2.3948794850763284
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.23820754885673523
Returned to Spot: Validation loss: 2.3948794850763284
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 7.04%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32251169214087977, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397841548019985
Accuracy on hold-out set: 0.03773584905660377
MAPK value on hold-out data: 0.11871068179607391
Epoch: 2

Loss on hold-out set: 2.397428440597822
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19575469195842743
Epoch: 3

Loss on hold-out set: 2.396869367023684
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.22641505300998688
Epoch: 4

Loss on hold-out set: 2.3961538728678002
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.20911945402622223
Returned to Spot: Validation loss: 2.3961538728678002
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 7.38%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3308958528694951, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397642144617045
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.19025155901908875
Epoch: 2
```

```
Loss on hold-out set: 2.397276950332354
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2224843055009842
Epoch: 3

Loss on hold-out set: 2.396659491197118
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.22091194987297058
Epoch: 4

Loss on hold-out set: 2.3957890654509924
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.23270435631275177
Returned to Spot: Validation loss: 2.3957890654509924
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 7.72%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3282772409317181, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3975346403301887
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.19968554377555847
Epoch: 2

Loss on hold-out set: 2.39690818426744
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.20440250635147095
Epoch: 3

Loss on hold-out set: 2.396326289986664
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.23899370431900024
Epoch: 4
```

```
Loss on hold-out set: 2.395566481464314
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2570754289627075
Returned to Spot: Validation loss: 2.395566481464314
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 8.06%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3276438021119205, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974545811707118
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.16902515292167664
Epoch: 2

Loss on hold-out set: 2.3968880986267664
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.19025155901908875
Epoch: 3

Loss on hold-out set: 2.3959765119372674
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.18396222591400146
Epoch: 4

Loss on hold-out set: 2.3945730407282992
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.17688681185245514
Returned to Spot: Validation loss: 2.3945730407282992
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 8.41%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3282057205886534, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3970680596693508
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21305029094219208
Epoch: 2

Loss on hold-out set: 2.3964144193901205
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.22484275698661804
Epoch: 3

Loss on hold-out set: 2.395626864343319
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23427674174308777
Epoch: 4

Loss on hold-out set: 2.39444226588843
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2484276443719864
Returned to Spot: Validation loss: 2.39444226588843
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 8.76%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3291330252156265, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974026868928155
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2146226465702057
Epoch: 2

Loss on hold-out set: 2.396875835814566
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1745283156633377
Epoch: 3
```

```
Loss on hold-out set: 2.396131825896929
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.1808176189661026
Epoch: 4

Loss on hold-out set: 2.394982733816471
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.19025158882141113
Returned to Spot: Validation loss: 2.394982733816471
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 9.09%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32573149770806137, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974471991916873
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.24528300762176514
Epoch: 2

Loss on hold-out set: 2.3967843865448573
Accuracy on hold-out set: 0.18396226415094338
MAPK value on hold-out data: 0.30738991498947144
Epoch: 3

Loss on hold-out set: 2.396120899128464
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.31367921829223633
Epoch: 4

Loss on hold-out set: 2.3951099278791896
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.3113207519054413
Returned to Spot: Validation loss: 2.3951099278791896
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 9.43%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32936886000042964, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397459030151367
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18160375952720642
Epoch: 2

Loss on hold-out set: 2.397080228013812
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.17767298221588135
Epoch: 3

Loss on hold-out set: 2.3961848672830834
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.17295600473880768
Epoch: 4

Loss on hold-out set: 2.3949756397391266
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.17924530804157257
Returned to Spot: Validation loss: 2.3949756397391266
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 9.76%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3260059036786109, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397509215013036
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.20518867671489716
Epoch: 2
```

```
Loss on hold-out set: 2.3968870099985375
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.24685536324977875
Epoch: 3

Loss on hold-out set: 2.3961213489748396
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.25943389534950256
Epoch: 4

Loss on hold-out set: 2.395014564946013
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2492137998342514
Returned to Spot: Validation loss: 2.395014564946013
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 10.10%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32957314215828326, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397309379757575
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.23977984488010406
Epoch: 2

Loss on hold-out set: 2.396735537726924
Accuracy on hold-out set: 0.19339622641509435
MAPK value on hold-out data: 0.2845911383628845
Epoch: 3

Loss on hold-out set: 2.396062540558149
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2720125615596771
Epoch: 4
```

```
Loss on hold-out set: 2.3950391670442976
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2751571834087372
Returned to Spot: Validation loss: 2.3950391670442976
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 10.44%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3296837563026217, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3976159365671985
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.1933962106704712
Epoch: 2

Loss on hold-out set: 2.397342322007665
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.19575469195842743
Epoch: 3

Loss on hold-out set: 2.3969201546794965
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1871069222688675
Epoch: 4

Loss on hold-out set: 2.396351697309962
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1729559600353241
Returned to Spot: Validation loss: 2.396351697309962
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 10.80%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3230134059952062, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.397693544063928
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.1533018797636032
Epoch: 2

Loss on hold-out set: 2.397092099459666
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.16509434580802917
Epoch: 3

Loss on hold-out set: 2.3964498852783778
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.1745283007621765
Epoch: 4

Loss on hold-out set: 2.3951840715588264
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17845909297466278
Returned to Spot: Validation loss: 2.3951840715588264
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 11.14%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3231592465639637, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3972057711403325
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2641509175300598
Epoch: 2

Loss on hold-out set: 2.396723261419332
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2633647620677948
Epoch: 3
```

```
Loss on hold-out set: 2.3959449057309135
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2625786066055298
Epoch: 4

Loss on hold-out set: 2.394918698184895
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.24764147400856018
Returned to Spot: Validation loss: 2.394918698184895
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 11.49%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264430888084131, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397204763484451
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.22327043116092682
Epoch: 2

Loss on hold-out set: 2.3966897658582003
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.23899370431900024
Epoch: 3

Loss on hold-out set: 2.3960684110533514
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2437106966972351
Epoch: 4

Loss on hold-out set: 2.3947907933649026
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23349054157733917
Returned to Spot: Validation loss: 2.3947907933649026
----------------------------------------------

spotPython tuning: 2.3943307084857293 [#---------] 11.82%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32633591152441044, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397348646847707
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2555031478404999
Epoch: 2

Loss on hold-out set: 2.396724714423126
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2295597344636917
Epoch: 3

Loss on hold-out set: 2.3957541663691684
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.22720126807689667
Epoch: 4

Loss on hold-out set: 2.394284045921182
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2146226465702057
Returned to Spot: Validation loss: 2.394284045921182
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 12.15%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32619237602600337, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3971953661936634
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.2767295241355896
Epoch: 2
```

```
Loss on hold-out set: 2.3965778080922253
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2845911681652069
Epoch: 3

Loss on hold-out set: 2.395666981643101
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2712263762950897
Epoch: 4

Loss on hold-out set: 2.3944134802188515
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2555031180381775
Returned to Spot: Validation loss: 2.3944134802188515
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 12.49%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32596806089181013, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3977372646331787
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.1674528270959854
Epoch: 2

Loss on hold-out set: 2.3972058116265065
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.17688679695129395
Epoch: 3

Loss on hold-out set: 2.396589108233182
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1800314486026764
Epoch: 4
```

```
Loss on hold-out set: 2.395707269884505
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.195754736661911
Returned to Spot: Validation loss: 2.395707269884505
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 12.83%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263692846199997, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3975103936105406
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.21226413547992706
Epoch: 2

Loss on hold-out set: 2.39691165708146
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.26179245114326477
Epoch: 3

Loss on hold-out set: 2.396131250093568
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.25943392515182495
Epoch: 4

Loss on hold-out set: 2.394688327357454
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23349054157733917
Returned to Spot: Validation loss: 2.394688327357454
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 13.16%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3262477568213441, 'lr_mult': 0.001, 'batc

Epoch: 1
```

```
Loss on hold-out set: 2.3973050162477314
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19732703268527985
Epoch: 2

Loss on hold-out set: 2.3967832394365995
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.20361632108688354
Epoch: 3

Loss on hold-out set: 2.3958837356207505
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.21305029094219208
Epoch: 4

Loss on hold-out set: 2.3948254180404374
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.21383649110794067
Returned to Spot: Validation loss: 2.3948254180404374
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 13.50%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3261126065487413, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3976807639283955
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.16116352379322052
Epoch: 2

Loss on hold-out set: 2.3972630365839542
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.14937108755111694
Epoch: 3
```

```
Loss on hold-out set: 2.3968825385255634
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.14465411007404327
Epoch: 4

Loss on hold-out set: 2.3960005382321916
Accuracy on hold-out set: 0.06132075471698113
MAPK value on hold-out data: 0.14544028043746948
Returned to Spot: Validation loss: 2.3960005382321916
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 13.84%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32282871621386117, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397285285985695
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.20990563929080963
Epoch: 2

Loss on hold-out set: 2.396708200562675
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.23742136359214783
Epoch: 3

Loss on hold-out set: 2.396051339383395
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.25314465165138245
Epoch: 4

Loss on hold-out set: 2.3949931252677485
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2759433686733246
Returned to Spot: Validation loss: 2.3949931252677485
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 14.18%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263221902737017, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974264117906676
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.24213840067386627
Epoch: 2

Loss on hold-out set: 2.3968703386918553
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.24685533344745636
Epoch: 3

Loss on hold-out set: 2.3962427400193125
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.23663517832756042
Epoch: 4

Loss on hold-out set: 2.3953256247178563
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.22012577950954437
Returned to Spot: Validation loss: 2.3953256247178563
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 14.51%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32632239108523947, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974460115972556
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.19811320304870605
Epoch: 2
```

```
Loss on hold-out set: 2.3969149994400314
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20047171413898468
Epoch: 3

Loss on hold-out set: 2.396188942891247
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.18946541845798492
Epoch: 4

Loss on hold-out set: 2.3951840310726524
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.20518864691257477
Returned to Spot: Validation loss: 2.3951840310726524
----------------------------------------------

spotPython tuning: 2.394284045921182 [#---------] 14.85%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326282944533355, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3975674161371194
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.21776728332042694
Epoch: 2

Loss on hold-out set: 2.397103530056072
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20676100254058838
Epoch: 3

Loss on hold-out set: 2.396295911860916
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.20361635088920593
Epoch: 4
```

```
Loss on hold-out set: 2.395070822733753
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.19654090702533722
Returned to Spot: Validation loss: 2.395070822733753
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 15.19%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3262231064718506, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974542977674953
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.20440252125263214
Epoch: 2

Loss on hold-out set: 2.3968442745928495
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23349054157733917
Epoch: 3

Loss on hold-out set: 2.396186459739253
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.23820750415325165
Epoch: 4

Loss on hold-out set: 2.3951013718011245
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.24449683725833893
Returned to Spot: Validation loss: 2.3951013718011245
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 15.52%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3261680294644233, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3974752336178184
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1816037893295288
Epoch: 2

Loss on hold-out set: 2.3970887481041676
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.18867923319339752
Epoch: 3

Loss on hold-out set: 2.3965458689995534
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.18160377442836761
Epoch: 4

Loss on hold-out set: 2.3955572416197577
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.17924530804157257
Returned to Spot: Validation loss: 2.3955572416197577
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 15.86%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32629227671101246, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397265983077715
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.21698112785816193
Epoch: 2

Loss on hold-out set: 2.3969437536203637
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.22405660152435303
Epoch: 3
```

```
Loss on hold-out set: 2.396425575580237
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2154088169336319
Epoch: 4

Loss on hold-out set: 2.3956776115129577
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.21069180965423584
Returned to Spot: Validation loss: 2.3956776115129577
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 16.22%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264012703466499, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3974098889332898
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.2020440250635147
Epoch: 2

Loss on hold-out set: 2.3968949587839954
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.23820750415325165
Epoch: 3

Loss on hold-out set: 2.3961206157252475
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.24842765927314758
Epoch: 4

Loss on hold-out set: 2.394908014333473
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.26022011041641235
Returned to Spot: Validation loss: 2.394908014333473
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 16.59%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326351231022843, 'lr_mult': 0.001, 'batcl

Epoch: 1

Loss on hold-out set: 2.3973919085736544
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.22641508281230927
Epoch: 2

Loss on hold-out set: 2.3966351994928323
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.25393080711364746
Epoch: 3

Loss on hold-out set: 2.3958693180444106
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2366352081298828
Epoch: 4

Loss on hold-out set: 2.394498348236084
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.23742136359214783
Returned to Spot: Validation loss: 2.394498348236084
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 16.98%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32630579694921924, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3977958301328264
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.16902515292167664
Epoch: 2
```

```
Loss on hold-out set: 2.3972756277840093
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1737421751022339
Epoch: 3

Loss on hold-out set: 2.396628699212704
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17688679695129395
Epoch: 4

Loss on hold-out set: 2.3956262480537847
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17610064148902893
Returned to Spot: Validation loss: 2.3956262480537847
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 17.35%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32638230671963864, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3975054408019445
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.21305033564567566
Epoch: 2

Loss on hold-out set: 2.3970291569547832
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.24606919288635254
Epoch: 3

Loss on hold-out set: 2.396358750901132
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.22405658662319183
Epoch: 4
```

```
Loss on hold-out set: 2.3953346936207898
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.22012577950954437
Returned to Spot: Validation loss: 2.3953346936207898
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 17.73%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263716967512879, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397542661091067
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.26022011041641235
Epoch: 2

Loss on hold-out set: 2.3970702054365627
Accuracy on hold-out set: 0.2169811320754717
MAPK value on hold-out data: 0.3105345666408539
Epoch: 3

Loss on hold-out set: 2.396359200747508
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.2798742353916168
Epoch: 4

Loss on hold-out set: 2.395190603328201
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2570754587650299
Returned to Spot: Validation loss: 2.395190603328201
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 18.10%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32633955531443687, 'lr_mult': 0.001, 'ba

Epoch: 1
```

```
Loss on hold-out set: 2.397428089717649
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20518869161605835
Epoch: 2

Loss on hold-out set: 2.396907185608486
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23113209009170532
Epoch: 3

Loss on hold-out set: 2.3961305033485845
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21698111295700073
Epoch: 4

Loss on hold-out set: 2.3947917785284654
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21698109805583954
Returned to Spot: Validation loss: 2.3947917785284654
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 18.48%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32627160614689293, 'lr_mult': 0.001, 'ba



Epoch: 1

Loss on hold-out set: 2.3979333661637217
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.14858490228652954
Epoch: 2

Loss on hold-out set: 2.3976161974780963
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.16194969415664673
Epoch: 3
```

```
Loss on hold-out set: 2.3973383588610955
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.16352201998233795
Epoch: 4

Loss on hold-out set: 2.3968917423824094
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.17767296731472015
Returned to Spot: Validation loss: 2.3968917423824094
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 18.85%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32698532284905657, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397422601591866
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23113206028938293
Epoch: 2

Loss on hold-out set: 2.3968330734180956
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.2492138147354126
Epoch: 3

Loss on hold-out set: 2.396059274673462
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23270440101623535
Epoch: 4

Loss on hold-out set: 2.3947443647204705
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2295597344636917
Returned to Spot: Validation loss: 2.3947443647204705
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 19.22%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3271178126572132, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3976040606228812
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.15644654631614685
Epoch: 2

Loss on hold-out set: 2.397274039826303
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.15723270177841187
Epoch: 3

Loss on hold-out set: 2.396725020318661
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.15172958374023438
Epoch: 4

Loss on hold-out set: 2.396036876822418
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.15566039085388184
Returned to Spot: Validation loss: 2.396036876822418
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 19.60%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3267862142649089, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3972500630144804
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18474845588207245
Epoch: 2
```

```
Loss on hold-out set: 2.3967400361906805
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.20361635088920593
Epoch: 3

Loss on hold-out set: 2.395884432882633
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.22562891244888306
Epoch: 4

Loss on hold-out set: 2.3947743469814085
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.23349052667617798
Returned to Spot: Validation loss: 2.3947743469814085
----------------------------------------------

spotPython tuning: 2.394284045921182 [##--------] 19.98%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326849826331756, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3969668082471163
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.18946540355682373
Epoch: 2

Loss on hold-out set: 2.3964447795220143
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.1863207370042801
Epoch: 3

Loss on hold-out set: 2.3954428501848906
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.19025154411792755
Epoch: 4
```

```
Loss on hold-out set: 2.394039122563488
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.19025154411792755
Returned to Spot: Validation loss: 2.394039122563488
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 20.38%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.327195557676161, 'lr_mult': 0.001, 'batcl

Epoch: 1

Loss on hold-out set: 2.3978032256072424
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1588050127029419
Epoch: 2

Loss on hold-out set: 2.3974051385555626
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.18553458154201508
Epoch: 3

Loss on hold-out set: 2.397033601436975
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1878930926322937
Epoch: 4

Loss on hold-out set: 2.3963154711813295
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.20361633598804474
Returned to Spot: Validation loss: 2.3963154711813295
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 20.75%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32675724656908683, 'lr_mult': 0.001, 'ba

Epoch: 1
```

```
Loss on hold-out set: 2.3975949602307014
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.21069180965423584
Epoch: 2

Loss on hold-out set: 2.39704899517995
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.23349054157733917
Epoch: 3

Loss on hold-out set: 2.396209424396731
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.25471699237823486
Epoch: 4

Loss on hold-out set: 2.3952124928528407
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.23270440101623535
Returned to Spot: Validation loss: 2.3952124928528407
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 21.12%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32672293758992677, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3977040929614373
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.19889937341213226
Epoch: 2

Loss on hold-out set: 2.3971097469329834
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.22484277188777924
Epoch: 3
```

```
Loss on hold-out set: 2.3964008790142133
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.23820754885673523
Epoch: 4

Loss on hold-out set: 2.395155717741768
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23977987468242645
Returned to Spot: Validation loss: 2.395155717741768
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 21.49%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266960909869835, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3972645750585593
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.25864776968955994
Epoch: 2

Loss on hold-out set: 2.396627088762679
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.26572325825691223
Epoch: 3

Loss on hold-out set: 2.3959039787076555
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.27908802032470703
Epoch: 4

Loss on hold-out set: 2.3947187234770575
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.30110061168670654
Returned to Spot: Validation loss: 2.3947187234770575
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 21.86%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32673212344919167, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974081075416422
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19889937341213226
Epoch: 2

Loss on hold-out set: 2.3968426236566507
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.22955971956253052
Epoch: 3

Loss on hold-out set: 2.3960534581598245
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.22562892735004425
Epoch: 4

Loss on hold-out set: 2.3946858082177505
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.25314465165138245
Returned to Spot: Validation loss: 2.3946858082177505
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 22.27%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3267840750518151, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3977322398491627
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.13836480677127838
Epoch: 2
```

```
Loss on hold-out set: 2.3970974751238554
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.16823898255825043
Epoch: 3

Loss on hold-out set: 2.3963338519042394
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.17610062658786774
Epoch: 4

Loss on hold-out set: 2.3951809991080806
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.1800314337015152
Returned to Spot: Validation loss: 2.3951809991080806
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 22.66%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326749315165244, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3973158980315588
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.24764150381088257
Epoch: 2

Loss on hold-out set: 2.39664611726437
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2358490377664566
Epoch: 3

Loss on hold-out set: 2.3957388805893234
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.24213837087154388
Epoch: 4
```

```
Loss on hold-out set: 2.3944111815038718
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.23899371922016144
Returned to Spot: Validation loss: 2.3944111815038718
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 23.07%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32687170337288884, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397194372033173
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.20911946892738342
Epoch: 2

Loss on hold-out set: 2.3965810784753763
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21776729822158813
Epoch: 3

Loss on hold-out set: 2.395841656990771
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2287735641002655
Epoch: 4

Loss on hold-out set: 2.394750176735644
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.23270435631275177
Returned to Spot: Validation loss: 2.394750176735644
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 23.46%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3269422482480189, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3972105350134507
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2633647620677948
Epoch: 2

Loss on hold-out set: 2.396779438234725
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2547169625759125
Epoch: 3

Loss on hold-out set: 2.3961779081596517
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.22641508281230927
Epoch: 4

Loss on hold-out set: 2.395067291439704
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.19968554377555847
Returned to Spot: Validation loss: 2.395067291439704
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 23.87%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3269323337417324, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397697687149048
Accuracy on hold-out set: 0.18867924528301888
MAPK value on hold-out data: 0.2562892735004425
Epoch: 2

Loss on hold-out set: 2.397124128521613
Accuracy on hold-out set: 0.2169811320754717
MAPK value on hold-out data: 0.2916666567325592
Epoch: 3
```

```
Loss on hold-out set: 2.396519791405156
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.2696540653705597
Epoch: 4

Loss on hold-out set: 2.3954360665015453
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23349052667617798
Returned to Spot: Validation loss: 2.3954360665015453
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 24.27%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3268388317899019, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397597794262868
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.16430819034576416
Epoch: 2

Loss on hold-out set: 2.397086004041276
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.18160377442836761
Epoch: 3

Loss on hold-out set: 2.3963538655694925
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19261007010936737
Epoch: 4

Loss on hold-out set: 2.395267864443221
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.21855345368385315
Returned to Spot: Validation loss: 2.395267864443221
----------------------------------------------

spotPython tuning: 2.394039122563488 [##--------] 24.67%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326790523418391, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397435723610644
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.18474841117858887
Epoch: 2

Loss on hold-out set: 2.396863388565351
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18238994479179382
Epoch: 3

Loss on hold-out set: 2.3960767152174465
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17216983437538147
Epoch: 4

Loss on hold-out set: 2.394925405394356
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17610064148902893
Returned to Spot: Validation loss: 2.394925405394356
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 25.06%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3267991068311024, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397438499162782
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.21540877223014832
Epoch: 2
```

```
Loss on hold-out set: 2.396895264679531
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.21619495749473572
Epoch: 3

Loss on hold-out set: 2.396128609495343
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.21305030584335327
Epoch: 4

Loss on hold-out set: 2.3951179306462125
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.21540877223014832
Returned to Spot: Validation loss: 2.3951179306462125
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 25.46%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3267625392804662, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3975235111308546
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20990565419197083
Epoch: 2

Loss on hold-out set: 2.3969828542673364
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.22405658662319183
Epoch: 3

Loss on hold-out set: 2.3964945505250177
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.21619495749473572
Epoch: 4
```

```
Loss on hold-out set: 2.39575280333465
Accuracy on hold-out set: 0.06132075471698113
MAPK value on hold-out data: 0.19575469195842743
Returned to Spot: Validation loss: 2.39575280333465
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 25.84%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32670304265944733, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3975016440985337
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18867924809455872
Epoch: 2

Loss on hold-out set: 2.3970199485994734
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.19261007010936737
Epoch: 3

Loss on hold-out set: 2.3962975268094047
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1871069073677063
Epoch: 4

Loss on hold-out set: 2.3951731312949702
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.1949685662984848
Returned to Spot: Validation loss: 2.3951731312949702
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 26.23%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32667404974213893, 'lr_mult': 0.001, 'ba

Epoch: 1
```

```
Loss on hold-out set: 2.3976477317090303
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17610064148902893
Epoch: 2

Loss on hold-out set: 2.397277643095772
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17924527823925018
Epoch: 3

Loss on hold-out set: 2.39662252732043
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.19103772938251495
Epoch: 4

Loss on hold-out set: 2.395675204834848
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.1878930777311325
Returned to Spot: Validation loss: 2.395675204834848
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 26.61%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266377883904264, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397644578285937
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2075471580028534
Epoch: 2

Loss on hold-out set: 2.3972525956495754
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.18474844098091125
Epoch: 3
```

```
Loss on hold-out set: 2.3966657080740297
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.17531445622444153
Epoch: 4

Loss on hold-out set: 2.3955859553139165
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.17610064148902893
Returned to Spot: Validation loss: 2.3955859553139165
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 27.00%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266167982821972, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3973235679122635
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.20833329856395721
Epoch: 2

Loss on hold-out set: 2.396709536606411
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.2067609578371048
Epoch: 3

Loss on hold-out set: 2.395833631731429
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.20283016562461853
Epoch: 4

Loss on hold-out set: 2.3946067252249086
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.21698111295700073
Returned to Spot: Validation loss: 2.3946067252249086
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 27.39%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266302643629441, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397320603424648
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2161949872970581
Epoch: 2

Loss on hold-out set: 2.396835871462552
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2216980904340744
Epoch: 3

Loss on hold-out set: 2.3962345528152755
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.20597483217716217
Epoch: 4

Loss on hold-out set: 2.395347244334671
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.20204399526119232
Returned to Spot: Validation loss: 2.395347244334671
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 27.80%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266006043144207, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974162857487515
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2028302103281021
Epoch: 2
```

```
Loss on hold-out set: 2.3970755316176504
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.23742136359214783
Epoch: 3

Loss on hold-out set: 2.3966022437473513
Accuracy on hold-out set: 0.19811320754716982
MAPK value on hold-out data: 0.27987417578697205
Epoch: 4

Loss on hold-out set: 2.395943245797787
Accuracy on hold-out set: 0.19339622641509435
MAPK value on hold-out data: 0.2908804416656494
Returned to Spot: Validation loss: 2.395943245797787
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 28.19%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266284062968548, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3973051107154704
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.23034588992595673
Epoch: 2

Loss on hold-out set: 2.396775744995981
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.21069180965423584
Epoch: 3

Loss on hold-out set: 2.395805642289935
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.20440250635147095
Epoch: 4
```

```
Loss on hold-out set: 2.394388306815669
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.20283019542694092
Returned to Spot: Validation loss: 2.394388306815669
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 28.61%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266778545080009, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397667682395791
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20361633598804474
Epoch: 2

Loss on hold-out set: 2.3970574163041025
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.21305032074451447
Epoch: 3

Loss on hold-out set: 2.396382345343536
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.20911945402622223
Epoch: 4

Loss on hold-out set: 2.3950937918896944
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.23270437121391296
Returned to Spot: Validation loss: 2.3950937918896944
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 29.03%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266565297177242, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3975255129472264
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18632075190544128
Epoch: 2

Loss on hold-out set: 2.396980924426385
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.21069180965423584
Epoch: 3

Loss on hold-out set: 2.3962897669594243
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.22405660152435303
Epoch: 4

Loss on hold-out set: 2.3950850333807603
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.22405660152435303
Returned to Spot: Validation loss: 2.3950850333807603
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 29.52%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266351548875681, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3974202578922488
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.24449685215950012
Epoch: 2

Loss on hold-out set: 2.3970024675693153
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.24449680745601654
Epoch: 3
```

```
Loss on hold-out set: 2.396151695611342
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2555031180381775
Epoch: 4

Loss on hold-out set: 2.3950918485533514
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.24056601524353027
Returned to Spot: Validation loss: 2.3950918485533514
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 29.95%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32661261594121793, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3978351107183493
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1533018797636032
Epoch: 2

Loss on hold-out set: 2.3973572838981196
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.17610064148902893
Epoch: 3

Loss on hold-out set: 2.396735947087126
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.19811318814754486
Epoch: 4

Loss on hold-out set: 2.3957415616737223
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.19025155901908875
Returned to Spot: Validation loss: 2.3957415616737223
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 30.36%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32660997092051575, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974849413026056
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.18238994479179382
Epoch: 2

Loss on hold-out set: 2.3970810017495787
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19889937341213226
Epoch: 3

Loss on hold-out set: 2.3963615489455887
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.19418242573738098
Epoch: 4

Loss on hold-out set: 2.395432472229004
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19575467705726624
Returned to Spot: Validation loss: 2.395432472229004
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 30.78%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265872831602057, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3975465117760426
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.14937110245227814
Epoch: 2
```

```
Loss on hold-out set: 2.3969307260693244
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.18474841117858887
Epoch: 3

Loss on hold-out set: 2.396194435515494
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.23349054157733917
Epoch: 4

Loss on hold-out set: 2.3951497257880443
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.26572325825691223
Returned to Spot: Validation loss: 2.3951497257880443
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 31.19%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32656380750884795, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397579269589118
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.207547128200531
Epoch: 2

Loss on hold-out set: 2.397209491369859
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.1878930628299713
Epoch: 3

Loss on hold-out set: 2.3966072280451938
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.19182392954826355
Epoch: 4
```

```
Loss on hold-out set: 2.395753041753229
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17767298221588135
Returned to Spot: Validation loss: 2.395753041753229
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 31.62%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32658339473949494, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3979018544251063
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.1312893182039261
Epoch: 2

Loss on hold-out set: 2.397360329358083
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.17216980457305908
Epoch: 3

Loss on hold-out set: 2.3966763829285243
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.15408805012702942
Epoch: 4

Loss on hold-out set: 2.3956973957565597
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.19811320304870605
Returned to Spot: Validation loss: 2.3956973957565597
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 32.05%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265854641193598, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3974861648847474
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.23270437121391296
Epoch: 2

Loss on hold-out set: 2.3970583789753466
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2555031180381775
Epoch: 3

Loss on hold-out set: 2.3963689129307584
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2680817246437073
Epoch: 4

Loss on hold-out set: 2.3953589313435106
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2743709981441498
Returned to Spot: Validation loss: 2.3953589313435106
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 32.47%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265660802773041, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3973014084797986
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.21698114275932312
Epoch: 2

Loss on hold-out set: 2.3967793977485514
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.21305030584335327
Epoch: 3
```

```
Loss on hold-out set: 2.3959639522264586
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2020440250635147
Epoch: 4

Loss on hold-out set: 2.39469228600556
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19889935851097107
Returned to Spot: Validation loss: 2.39469228600556
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 32.91%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32655557005640623, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397715541551698
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1745283007621765
Epoch: 2

Loss on hold-out set: 2.3971615332477496
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.16116352379322052
Epoch: 3

Loss on hold-out set: 2.3963156241290973
Accuracy on hold-out set: 0.07075471698113207
MAPK value on hold-out data: 0.17531444132328033
Epoch: 4

Loss on hold-out set: 2.395458162955518
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.16509436070919037
Returned to Spot: Validation loss: 2.395458162955518
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 33.34%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32654653311030374, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397563228067362
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17610062658786774
Epoch: 2

Loss on hold-out set: 2.3971395852430812
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.22641511261463165
Epoch: 3

Loss on hold-out set: 2.3964732008160285
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.25157228112220764
Epoch: 4

Loss on hold-out set: 2.395432953564626
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2570754289627075
Returned to Spot: Validation loss: 2.395432953564626
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 33.75%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32653712452076966, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397438836547564
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2287735790014267
Epoch: 2
```

```
Loss on hold-out set: 2.3968460829752796
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.24056601524353027
Epoch: 3

Loss on hold-out set: 2.3959603939416274
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.25157231092453003
Epoch: 4

Loss on hold-out set: 2.3948648200844818
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.23820748925209045
Returned to Spot: Validation loss: 2.3948648200844818
----------------------------------------------

spotPython tuning: 2.394039122563488 [###-------] 34.20%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326509339450472, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3977465674562275
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1525157392024994
Epoch: 2

Loss on hold-out set: 2.3974170279952713
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18553458154201508
Epoch: 3

Loss on hold-out set: 2.396911121764273
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.23191824555397034
Epoch: 4
```

```
Loss on hold-out set: 2.396074299542409
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2146226167678833
Returned to Spot: Validation loss: 2.396074299542409
----------------------------------------------
```

```
spotPython tuning: 2.394039122563488 [###-------] 34.65%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32661379187664563, 'lr_mult': 0.001, 'ba
```

```
Epoch: 1

Loss on hold-out set: 2.397657088513644
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.18553456664085388
Epoch: 2

Loss on hold-out set: 2.397138995944329
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.22641509771347046
Epoch: 3

Loss on hold-out set: 2.396533970562917
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.21698109805583954
Epoch: 4

Loss on hold-out set: 2.395632743835449
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.2075471580028534
Returned to Spot: Validation loss: 2.395632743835449
----------------------------------------------
```

```
spotPython tuning: 2.394039122563488 [####------] 35.11%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265944281762988, 'lr_mult': 0.001, 'bat
```

```
Epoch: 1
```

```
Loss on hold-out set: 2.397542373189386
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.180031418800354
Epoch: 2

Loss on hold-out set: 2.3971380692607953
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18474844098091125
Epoch: 3

Loss on hold-out set: 2.396435463203574
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.19025155901908875
Epoch: 4

Loss on hold-out set: 2.3953705823646403
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.1933962106704712
Returned to Spot: Validation loss: 2.3953705823646403
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 35.56%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265767331416932, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397503133090037
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.24528302252292633
Epoch: 2

Loss on hold-out set: 2.397044591183932
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.276729553937912
Epoch: 3
```

```
Loss on hold-out set: 2.3961408723075435
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.2853773534297943
Epoch: 4

Loss on hold-out set: 2.3949611546858303
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.2775156795978546
Returned to Spot: Validation loss: 2.3949611546858303
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 36.00%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265573008993615, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3979046974542007
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19025154411792755
Epoch: 2

Loss on hold-out set: 2.3974941631533064
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.18474841117858887
Epoch: 3

Loss on hold-out set: 2.3969532543758176
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.16430820524692535
Epoch: 4

Loss on hold-out set: 2.396038824657224
Accuracy on hold-out set: 0.06132075471698113
MAPK value on hold-out data: 0.1462264209985733
Returned to Spot: Validation loss: 2.396038824657224
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 36.45%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266101723566217, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397596444723741
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2075471580028534
Epoch: 2

Loss on hold-out set: 2.3972151099510914
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19103772938251495
Epoch: 3

Loss on hold-out set: 2.396580993004565
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.18160377442836761
Epoch: 4

Loss on hold-out set: 2.3956672515509263
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.1745283007621765
Returned to Spot: Validation loss: 2.3956672515509263
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 36.86%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265990649904272, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397549620214498
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1871069073677063
Epoch: 2
```

```
Loss on hold-out set: 2.3969534118220492
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2012578547000885
Epoch: 3

Loss on hold-out set: 2.3963178013855555
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1737421452999115
Epoch: 4

Loss on hold-out set: 2.3953109957137197
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.16902518272399902
Returned to Spot: Validation loss: 2.3953109957137197
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 37.32%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32658267257751983, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3975053103464954
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.20676101744174957
Epoch: 2

Loss on hold-out set: 2.3968588990985222
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2421383559703827
Epoch: 3

Loss on hold-out set: 2.3961970491229363
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.19025155901908875
Epoch: 4
```

```
Loss on hold-out set: 2.3951320378285534
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1800314486026764
Returned to Spot: Validation loss: 2.3951320378285534
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 37.80%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32656145829675615, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3978218177579484
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.14858491718769073
Epoch: 2

Loss on hold-out set: 2.3973434061374306
Accuracy on hold-out set: 0.06132075471698113
MAPK value on hold-out data: 0.14386793971061707
Epoch: 3

Loss on hold-out set: 2.3968332893443556
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.1650943160057068
Epoch: 4

Loss on hold-out set: 2.3958438837303304
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.16509434580802917
Returned to Spot: Validation loss: 2.3958438837303304
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 38.25%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32658671576851994, 'lr_mult': 0.001, 'ba

Epoch: 1
```

```
Loss on hold-out set: 2.3976440879533873
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.18396224081516266
Epoch: 2

Loss on hold-out set: 2.39710304872045
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.25314465165138245
Epoch: 3

Loss on hold-out set: 2.3963491421825482
Accuracy on hold-out set: 0.21226415094339623
MAPK value on hold-out data: 0.30738985538482666
Epoch: 4

Loss on hold-out set: 2.395291328430176
Accuracy on hold-out set: 0.18867924528301888
MAPK value on hold-out data: 0.29952824115753174
Returned to Spot: Validation loss: 2.395291328430176
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 38.75%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265653365137024, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3976605253399543
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2429245114326477
Epoch: 2

Loss on hold-out set: 2.3971949388396063
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.24528302252292633
Epoch: 3
```

```
Loss on hold-out set: 2.3964064301184886
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23113209009170532
Epoch: 4

Loss on hold-out set: 2.395499629794427
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23270440101623535
Returned to Spot: Validation loss: 2.395499629794427
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 39.24%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32655658415197875, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3973871761897825
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.22955971956253052
Epoch: 2

Loss on hold-out set: 2.3968664700130247
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.2350628674030304
Epoch: 3

Loss on hold-out set: 2.396162766330647
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.23113206028938293
Epoch: 4

Loss on hold-out set: 2.3951467523035013
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.21147796511650085
Returned to Spot: Validation loss: 2.3951467523035013
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 39.71%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265330339149958, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.39742891743498
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.179245263338089
Epoch: 2

Loss on hold-out set: 2.3967797261364057
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.20440250635147095
Epoch: 3

Loss on hold-out set: 2.3961318663831026
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.20597486197948456
Epoch: 4

Loss on hold-out set: 2.394927884047886
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.21069179475307465
Returned to Spot: Validation loss: 2.394927884047886
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 40.19%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32650646449451426, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3975379691933685
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.21698112785816193
Epoch: 2
```

```
Loss on hold-out set: 2.3970632643069862
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2437106817960739
Epoch: 3

Loss on hold-out set: 2.3964390259868695
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.24685533344745636
Epoch: 4

Loss on hold-out set: 2.395469849964358
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.22562891244888306
Returned to Spot: Validation loss: 2.395469849964358
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 40.67%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265084729392194, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3975152789421803
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.18946540355682373
Epoch: 2

Loss on hold-out set: 2.397147646490133
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19968555867671967
Epoch: 3

Loss on hold-out set: 2.3966620553214595
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19968552887439728
Epoch: 4
```

```
Loss on hold-out set: 2.3958575410662957
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19732706248760223
Returned to Spot: Validation loss: 2.3958575410662957
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 41.16%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265588478300606, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397547240527171
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.16352200508117676
Epoch: 2

Loss on hold-out set: 2.397111033493618
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.1933962106704712
Epoch: 3

Loss on hold-out set: 2.3963300776931473
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.19182388484477997
Epoch: 4

Loss on hold-out set: 2.39520422917492
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.19575467705726624
Returned to Spot: Validation loss: 2.39520422917492
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 41.65%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265375148648716, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3973254527685777
Accuracy on hold-out set: 0.18867924528301888
MAPK value on hold-out data: 0.26729559898376465
Epoch: 2

Loss on hold-out set: 2.3968407972803654
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2570754885673523
Epoch: 3

Loss on hold-out set: 2.3960482264464757
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2641509175300598
Epoch: 4

Loss on hold-out set: 2.394994429822238
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.2688678801059723
Returned to Spot: Validation loss: 2.394994429822238
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 42.12%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32651169755796156, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3973324838674293
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.25157231092453003
Epoch: 2

Loss on hold-out set: 2.3967435764816574
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2555030882358551
Epoch: 3
```

```
Loss on hold-out set: 2.3959011671678074
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2680817246437073
Epoch: 4

Loss on hold-out set: 2.394689335013336
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2562892436981201
Returned to Spot: Validation loss: 2.394689335013336
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 42.60%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264839809603488, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397365286665143
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2209119200706482
Epoch: 2

Loss on hold-out set: 2.39685047797437
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21069182455539703
Epoch: 3

Loss on hold-out set: 2.3962142782391243
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2012578547000885
Epoch: 4

Loss on hold-out set: 2.395067381408979
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19261007010936737
Returned to Spot: Validation loss: 2.395067381408979
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 43.10%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32645455273246826, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397551855950985
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.17767293751239777
Epoch: 2

Loss on hold-out set: 2.3970599489391975
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2342766970396042
Epoch: 3

Loss on hold-out set: 2.3965020224733173
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2421383559703827
Epoch: 4

Loss on hold-out set: 2.395575136508582
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.24449683725833893
Returned to Spot: Validation loss: 2.395575136508582
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 44.01%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326478912885779, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3974411307640797
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.21855345368385315
Epoch: 2
```

```
Loss on hold-out set: 2.3968787103329063
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2358490526676178
Epoch: 3

Loss on hold-out set: 2.396066670147878
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.23034590482711792
Epoch: 4

Loss on hold-out set: 2.3949414963992135
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.22720122337341309
Returned to Spot: Validation loss: 2.3949414963992135
----------------------------------------------

spotPython tuning: 2.394039122563488 [####------] 44.97%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264431060981789, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397420676249378
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.1871069073677063
Epoch: 2

Loss on hold-out set: 2.3967834463659323
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1800314337015152
Epoch: 3

Loss on hold-out set: 2.3958806136869035
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.179245263338089
Epoch: 4
```

```
Loss on hold-out set: 2.3944766701392406
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.179245263338089
Returned to Spot: Validation loss: 2.3944766701392406
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 45.89%

config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32638939078883733, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397654375939999
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.21383649110794067
Epoch: 2

Loss on hold-out set: 2.3971070613501206
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.2586477994918823
Epoch: 3

Loss on hold-out set: 2.39634629465499
Accuracy on hold-out set: 0.18396226415094338
MAPK value on hold-out data: 0.2853773236274719
Epoch: 4

Loss on hold-out set: 2.395360177417971
Accuracy on hold-out set: 0.1792452830188679
MAPK value on hold-out data: 0.2830188572406769
Returned to Spot: Validation loss: 2.395360177417971
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 46.86%

config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263937265144769, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.397312578165306
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.23349051177501678
Epoch: 2

Loss on hold-out set: 2.396701434873185
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2539307773113251
Epoch: 3

Loss on hold-out set: 2.3959448247585655
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.26022011041641235
Epoch: 4

Loss on hold-out set: 2.394728566115757
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.25314459204673767
Returned to Spot: Validation loss: 2.394728566115757
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 47.84%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32632333109966427, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974343650745897
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.1816037893295288
Epoch: 2

Loss on hold-out set: 2.3969687830727056
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.1871068924665451
Epoch: 3
```

```
Loss on hold-out set: 2.3963921654899165
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.18789303302764893
Epoch: 4

Loss on hold-out set: 2.3956456769187495
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.179245263338089
Returned to Spot: Validation loss: 2.3956456769187495
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 48.77%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32640478634529096, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3976747404854253
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.17845910787582397
Epoch: 2

Loss on hold-out set: 2.3973056235403383
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18553458154201508
Epoch: 3

Loss on hold-out set: 2.3967653310523844
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.19339624047279358
Epoch: 4

Loss on hold-out set: 2.3957566405242345
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.1949685662984848
Returned to Spot: Validation loss: 2.3957566405242345
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 49.70%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32648545082449526, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974996332852347
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.2295597493648529
Epoch: 2

Loss on hold-out set: 2.397029035496262
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.2492138296365738
Epoch: 3

Loss on hold-out set: 2.3963663847941272
Accuracy on hold-out set: 0.16981132075471697
MAPK value on hold-out data: 0.30031445622444153
Epoch: 4

Loss on hold-out set: 2.3954661342332946
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.27358487248420715
Returned to Spot: Validation loss: 2.3954661342332946
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 50.61%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264893954512077, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3973615574386886
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.26022011041641235
Epoch: 2
```

```
Loss on hold-out set: 2.3969448242547378
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.23113204538822174
Epoch: 3

Loss on hold-out set: 2.396153337550613
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.21226415038108826
Epoch: 4

Loss on hold-out set: 2.3951113538922004
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.18632075190544128
Returned to Spot: Validation loss: 2.3951113538922004
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 51.52%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326462889241711, 'lr_mult': 0.001, 'batcl

Epoch: 1

Loss on hold-out set: 2.397405543417301
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.21619494259357452
Epoch: 2

Loss on hold-out set: 2.396802065507421
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.24685531854629517
Epoch: 3

Loss on hold-out set: 2.396016926135657
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2649371325969696
Epoch: 4
```

```
Loss on hold-out set: 2.3950797656797014
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2712264060974121
Returned to Spot: Validation loss: 2.3950797656797014
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 52.43%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264336056336691, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397335947684522
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2209119200706482
Epoch: 2

Loss on hold-out set: 2.396868867694207
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.21619494259357452
Epoch: 3

Loss on hold-out set: 2.3962715751719923
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2020440250635147
Epoch: 4

Loss on hold-out set: 2.395382390832001
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.20911946892738342
Returned to Spot: Validation loss: 2.395382390832001
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 53.38%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264283804805276, 'lr_mult': 0.001, 'batc

Epoch: 1
```

```
Loss on hold-out set: 2.3974011124305004
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2083333283662796
Epoch: 2

Loss on hold-out set: 2.3968583412890165
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.23191821575164795
Epoch: 3

Loss on hold-out set: 2.3961367112285687
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.22405657172203064
Epoch: 4

Loss on hold-out set: 2.3948933988247276
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.22012579441070557
Returned to Spot: Validation loss: 2.3948933988247276
----------------------------------------------

spotPython tuning: 2.394039122563488 [#####-----] 54.31%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32638287404752697, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3975002765655518
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.1588050127029419
Epoch: 2

Loss on hold-out set: 2.3969752608605153
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.14937107264995575
Epoch: 3
```

```
Loss on hold-out set: 2.396153877366264
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.14858491718769073
Epoch: 4

Loss on hold-out set: 2.3949120854431727
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.1666666716337204
Returned to Spot: Validation loss: 2.3949120854431727
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 55.25%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32632256191592973, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397604416001518
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17216983437538147
Epoch: 2

Loss on hold-out set: 2.397040358129537
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2287735641002655
Epoch: 3

Loss on hold-out set: 2.396151344731169
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.25157231092453003
Epoch: 4

Loss on hold-out set: 2.395016868159456
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23113207519054413
Returned to Spot: Validation loss: 2.395016868159456
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 56.24%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3262745551083184, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3974320573626824
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20990565419197083
Epoch: 2

Loss on hold-out set: 2.3968500956049503
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2004716992378235
Epoch: 3

Loss on hold-out set: 2.3959684236994327
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20597484707832336
Epoch: 4

Loss on hold-out set: 2.394737369609329
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20125789940357208
Returned to Spot: Validation loss: 2.394737369609329
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 57.20%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32616169206135937, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974099968964198
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19339622557163239
Epoch: 2
```

```
Loss on hold-out set: 2.397005355583047
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.19575472176074982
Epoch: 3

Loss on hold-out set: 2.396546759695377
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1933962106704712
Epoch: 4

Loss on hold-out set: 2.395454987040106
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18553458154201508
Returned to Spot: Validation loss: 2.395454987040106
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 58.17%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32623348920328765, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3977976565091117
Accuracy on hold-out set: 0.09433962264150944
MAPK value on hold-out data: 0.19025155901908875
Epoch: 2

Loss on hold-out set: 2.397389474904762
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.16116352379322052
Epoch: 3

Loss on hold-out set: 2.396748403333268
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.14858491718769073
Epoch: 4
```

```
Loss on hold-out set: 2.3959592603287607
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.1328616440296173
Returned to Spot: Validation loss: 2.3959592603287607
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 59.13%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32646266848716576, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3973146114709243
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2287735790014267
Epoch: 2

Loss on hold-out set: 2.3966929777613224
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.2350628823041916
Epoch: 3

Loss on hold-out set: 2.39576977153994
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.2492137998342514
Epoch: 4

Loss on hold-out set: 2.394499468353559
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.262578547000885
Returned to Spot: Validation loss: 2.394499468353559
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 60.08%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32643045020119643, 'lr_mult': 0.001, 'ba

Epoch: 1
```

```
Loss on hold-out set: 2.3977675482911884
Accuracy on hold-out set: 0.04716981132075472
MAPK value on hold-out data: 0.15644654631614685
Epoch: 2

Loss on hold-out set: 2.397093844863604
Accuracy on hold-out set: 0.04716981132075472
MAPK value on hold-out data: 0.16823901236057281
Epoch: 3

Loss on hold-out set: 2.396258646587156
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.15644654631614685
Epoch: 4

Loss on hold-out set: 2.3950405750634536
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.14858491718769073
Returned to Spot: Validation loss: 2.3950405750634536
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 61.19%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263962973287677, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397441971976802
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.2020440250635147
Epoch: 2

Loss on hold-out set: 2.3970607631611376
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.19889934360980988
Epoch: 3
```

```
Loss on hold-out set: 2.396564875008925
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.19103769958019257
Epoch: 4

Loss on hold-out set: 2.395694359293524
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1800314486026764
Returned to Spot: Validation loss: 2.395694359293524
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 62.19%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32646104029190787, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974778022406236
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.17688681185245514
Epoch: 2

Loss on hold-out set: 2.396977375138481
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.17138364911079407
Epoch: 3

Loss on hold-out set: 2.3962864965762734
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.1603773832321167
Epoch: 4

Loss on hold-out set: 2.395187737806788
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1729559600353241
Returned to Spot: Validation loss: 2.395187737806788
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 63.16%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264388011557958, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.3975587655913153
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.21147799491882324
Epoch: 2

Loss on hold-out set: 2.397082706667342
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.27279868721961975
Epoch: 3

Loss on hold-out set: 2.3964609470007554
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.277515709400177
Epoch: 4

Loss on hold-out set: 2.3953725706856206
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.27201253175735474
Returned to Spot: Validation loss: 2.3953725706856206
----------------------------------------------

spotPython tuning: 2.394039122563488 [######----] 64.17%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326435447282631, 'lr_mult': 0.001, 'batch

Epoch: 1

Loss on hold-out set: 2.3974553144203044
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19261004030704498
Epoch: 2
```

```
Loss on hold-out set: 2.397056111749613
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.1863207370042801
Epoch: 3

Loss on hold-out set: 2.3964009464911693
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.2012578696012497
Epoch: 4

Loss on hold-out set: 2.3955967066422947
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19889937341213226
Returned to Spot: Validation loss: 2.3955967066422947
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 65.18%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264758029589014, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.39732104877256
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2342766970396042
Epoch: 2

Loss on hold-out set: 2.396727152590482
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.26572325825691223
Epoch: 3

Loss on hold-out set: 2.395956390308884
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.26729556918144226
Epoch: 4
```

```
Loss on hold-out set: 2.394765125130707
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.25943395495414734
Returned to Spot: Validation loss: 2.394765125130707
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 66.18%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264376491442641, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3973909728931933
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.25314462184906006
Epoch: 2

Loss on hold-out set: 2.3969907805604755
Accuracy on hold-out set: 0.22169811320754718
MAPK value on hold-out data: 0.3262578547000885
Epoch: 3

Loss on hold-out set: 2.396239811519407
Accuracy on hold-out set: 0.21226415094339623
MAPK value on hold-out data: 0.31682389974594116
Epoch: 4

Loss on hold-out set: 2.395308166180017
Accuracy on hold-out set: 0.21226415094339623
MAPK value on hold-out data: 0.31525158882141113
Returned to Spot: Validation loss: 2.395308166180017
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 67.22%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264267657580666, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3972246961773567
Accuracy on hold-out set: 0.2028301886792453
MAPK value on hold-out data: 0.3026729226112366
Epoch: 2

Loss on hold-out set: 2.396544339521876
Accuracy on hold-out set: 0.24056603773584906
MAPK value on hold-out data: 0.34905657172203064
Epoch: 3

Loss on hold-out set: 2.3960078932204336
Accuracy on hold-out set: 0.25471698113207547
MAPK value on hold-out data: 0.35613203048706055
Epoch: 4

Loss on hold-out set: 2.3949789281161324
Accuracy on hold-out set: 0.23113207547169812
MAPK value on hold-out data: 0.3600628674030304
Returned to Spot: Validation loss: 2.3949789281161324
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 68.28%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32638962852297826, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397316374868717
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.2625785768032074
Epoch: 2

Loss on hold-out set: 2.3968821021745788
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.261006236076355
Epoch: 3
```

```
Loss on hold-out set: 2.396362875992397
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.23349054157733917
Epoch: 4

Loss on hold-out set: 2.395189010872031
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.23191821575164795
Returned to Spot: Validation loss: 2.395189010872031
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 69.30%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263697550914146, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.39749140109656
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.2555030882358551
Epoch: 2

Loss on hold-out set: 2.396931157921845
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2625786364078522
Epoch: 3

Loss on hold-out set: 2.3961555193055353
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.26729559898376465
Epoch: 4

Loss on hold-out set: 2.3948410367066004
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2625785768032074
Returned to Spot: Validation loss: 2.3948410367066004
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 70.32%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3263059788268224, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397339924326483
Accuracy on hold-out set: 0.16037735849056603
MAPK value on hold-out data: 0.235849067568779
Epoch: 2

Loss on hold-out set: 2.396791246702086
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.23742137849330902
Epoch: 3

Loss on hold-out set: 2.396035504790972
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.2287735641002655
Epoch: 4

Loss on hold-out set: 2.395110805079622
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.2146226167678833
Returned to Spot: Validation loss: 2.395110805079622
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 71.42%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32627350697124374, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397530677183619
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18632075190544128
Epoch: 2
```

```
Loss on hold-out set: 2.3973057000142224
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.15801888704299927
Epoch: 3

Loss on hold-out set: 2.396686207573369
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1533019244670868
Epoch: 4

Loss on hold-out set: 2.3961666260125503
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.15880504250526428
Returned to Spot: Validation loss: 2.3961666260125503
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 72.46%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265469407685374, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397517447201711
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17216980457305908
Epoch: 2

Loss on hold-out set: 2.3970708937015175
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18553456664085388
Epoch: 3

Loss on hold-out set: 2.396379902677716
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18396227061748505
Epoch: 4
```

```
Loss on hold-out set: 2.395388702176652
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1808176040649414
Returned to Spot: Validation loss: 2.395388702176652
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 73.57%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265283855554413, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3978200633570834
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.16902515292167664
Epoch: 2

Loss on hold-out set: 2.3972433018234542
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.17688679695129395
Epoch: 3

Loss on hold-out set: 2.3963686070352233
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.17216983437538147
Epoch: 4

Loss on hold-out set: 2.3951443411269278
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.18553459644317627
Returned to Spot: Validation loss: 2.3951443411269278
----------------------------------------------

spotPython tuning: 2.394039122563488 [#######---] 74.63%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32651133376854236, 'lr_mult': 0.001, 'ba

Epoch: 1
```

```
Loss on hold-out set: 2.397361013124574
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.21069182455539703
Epoch: 2

Loss on hold-out set: 2.3967328296517425
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.24842765927314758
Epoch: 3

Loss on hold-out set: 2.395926403549482
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.23349057137966156
Epoch: 4

Loss on hold-out set: 2.3948114773012557
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.24764147400856018
Returned to Spot: Validation loss: 2.3948114773012557
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 76.07%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264969172590774, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397436164460092
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.1816037893295288
Epoch: 2

Loss on hold-out set: 2.3967887860424115
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.21462266147136688
Epoch: 3
```

```
Loss on hold-out set: 2.396074798871886
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.21619494259357452
Epoch: 4

Loss on hold-out set: 2.394819399095931
Accuracy on hold-out set: 0.12735849056603774
MAPK value on hold-out data: 0.2287735790014267
Returned to Spot: Validation loss: 2.394819399095931
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 77.50%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3264752364785543, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397707115929082
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2154088318347931
Epoch: 2

Loss on hold-out set: 2.3971404489481225
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.2641509473323822
Epoch: 3

Loss on hold-out set: 2.39646060511751
Accuracy on hold-out set: 0.2028301886792453
MAPK value on hold-out data: 0.30031445622444153
Epoch: 4

Loss on hold-out set: 2.3956064458163278
Accuracy on hold-out set: 0.17452830188679244
MAPK value on hold-out data: 0.2680817246437073
Returned to Spot: Validation loss: 2.3956064458163278
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 79.11%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32646078206041607, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397672342804243
Accuracy on hold-out set: 0.07547169811320754
MAPK value on hold-out data: 0.16509437561035156
Epoch: 2

Loss on hold-out set: 2.397243193860324
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18238994479179382
Epoch: 3

Loss on hold-out set: 2.396785164779087
Accuracy on hold-out set: 0.08962264150943396
MAPK value on hold-out data: 0.18317610025405884
Epoch: 4

Loss on hold-out set: 2.3958532945165096
Accuracy on hold-out set: 0.10849056603773585
MAPK value on hold-out data: 0.19889935851097107
Returned to Spot: Validation loss: 2.3958532945165096
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 80.54%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326545385762575, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.397588792836891
Accuracy on hold-out set: 0.06132075471698113
MAPK value on hold-out data: 0.1721697896718979
Epoch: 2
```

```
Loss on hold-out set: 2.3970288960438855
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.18238994479179382
Epoch: 3

Loss on hold-out set: 2.3963842212029225
Accuracy on hold-out set: 0.04716981132075472
MAPK value on hold-out data: 0.16509436070919037
Epoch: 4

Loss on hold-out set: 2.395470047896763
Accuracy on hold-out set: 0.04716981132075472
MAPK value on hold-out data: 0.16430817544460297
Returned to Spot: Validation loss: 2.395470047896763
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 82.00%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32654459757159227, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974148102526396
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.18946541845798492
Epoch: 2

Loss on hold-out set: 2.3968900239692545
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.22327043116092682
Epoch: 3

Loss on hold-out set: 2.396232285589542
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.21855345368385315
Epoch: 4
```

```
Loss on hold-out set: 2.3951864377507626
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2287735641002655
Returned to Spot: Validation loss: 2.3951864377507626
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 83.44%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32651925973185786, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397371341597359
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.17688679695129395
Epoch: 2

Loss on hold-out set: 2.3970451444949745
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.18160377442836761
Epoch: 3

Loss on hold-out set: 2.396635644840744
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.18238992989063263
Epoch: 4

Loss on hold-out set: 2.3962339950057694
Accuracy on hold-out set: 0.08490566037735849
MAPK value on hold-out data: 0.1800314337015152
Returned to Spot: Validation loss: 2.3962339950057694
----------------------------------------------

spotPython tuning: 2.394039122563488 [########--] 84.95%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265953149886094, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.397308538544853
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.19025155901908875
Epoch: 2

Loss on hold-out set: 2.3967961905137547
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2004716992378235
Epoch: 3

Loss on hold-out set: 2.395949750576379
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2004716843366623
Epoch: 4

Loss on hold-out set: 2.3947538294882142
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.20204399526119232
Returned to Spot: Validation loss: 2.3947538294882142
----------------------------------------------

spotPython tuning: 2.394039122563488 [#########-] 86.42%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3266194653150097, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3973917916135967
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.19811323285102844
Epoch: 2

Loss on hold-out set: 2.396903541852843
Accuracy on hold-out set: 0.14150943396226415
MAPK value on hold-out data: 0.21226413547992706
Epoch: 3
```

```
Loss on hold-out set: 2.3962033064860218
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.2350628823041916
Epoch: 4

Loss on hold-out set: 2.3952171217720464
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.26179245114326477
Returned to Spot: Validation loss: 2.3952171217720464
----------------------------------------------

spotPython tuning: 2.394039122563488 [#########-] 87.98%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32659924755599173, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397708254040412
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.14779874682426453
Epoch: 2

Loss on hold-out set: 2.3969883963746845
Accuracy on hold-out set: 0.0660377358490566
MAPK value on hold-out data: 0.15880505740642548
Epoch: 3

Loss on hold-out set: 2.3962007828478544
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.15880505740642548
Epoch: 4

Loss on hold-out set: 2.395091956516482
Accuracy on hold-out set: 0.05188679245283019
MAPK value on hold-out data: 0.16902516782283783
Returned to Spot: Validation loss: 2.395091956516482
----------------------------------------------

spotPython tuning: 2.394039122563488 [#########-] 89.49%
```

```
config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265921977783465, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3975318782734423
Accuracy on hold-out set: 0.04716981132075472
MAPK value on hold-out data: 0.16430819034576416
Epoch: 2

Loss on hold-out set: 2.3970402366710157
Accuracy on hold-out set: 0.04245283018867924
MAPK value on hold-out data: 0.167452871799469
Epoch: 3

Loss on hold-out set: 2.3962259427556454
Accuracy on hold-out set: 0.04245283018867924
MAPK value on hold-out data: 0.16823896765708923
Epoch: 4

Loss on hold-out set: 2.395091898036453
Accuracy on hold-out set: 0.04245283018867924
MAPK value on hold-out data: 0.16509434580802917
Returned to Spot: Validation loss: 2.395091898036453
----------------------------------------------

spotPython tuning: 2.394039122563488 [#########-] 90.90%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32658070833848557, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.397784210600943
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.1737421303987503
Epoch: 2
```

```
Loss on hold-out set: 2.3973105538566157
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.22720125317573547
Epoch: 3

Loss on hold-out set: 2.396533727645874
Accuracy on hold-out set: 0.15566037735849056
MAPK value on hold-out data: 0.22955971956253052
Epoch: 4

Loss on hold-out set: 2.3954838266912497
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.2216980755329132
Returned to Spot: Validation loss: 2.3954838266912497
----------------------------------------------

spotPython tuning: 2.394039122563488 [#########-] 92.43%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.326557867832634, 'lr_mult': 0.001, 'batc

Epoch: 1

Loss on hold-out set: 2.39765587392843
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.16823899745941162
Epoch: 2

Loss on hold-out set: 2.3972460143970995
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.20518866181373596
Epoch: 3

Loss on hold-out set: 2.3965662650342257
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.2216980904340744
Epoch: 4
```

```
Loss on hold-out set: 2.3955552892864875
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.2421383410692215
Returned to Spot: Validation loss: 2.3955552892864875
----------------------------------------------

spotPython tuning: 2.394039122563488 [#########-] 93.91%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265492140599922, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.397677133668144
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17688675224781036
Epoch: 2

Loss on hold-out set: 2.3971161797361553
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.20440246164798737
Epoch: 3

Loss on hold-out set: 2.396456727441752
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1878930628299713
Epoch: 4

Loss on hold-out set: 2.3954516851677083
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.1878930628299713
Returned to Spot: Validation loss: 2.3954516851677083
----------------------------------------------

spotPython tuning: 2.394039122563488 [##########] 95.42%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265297972736398, 'lr_mult': 0.001, 'bat

Epoch: 1
```

```
Loss on hold-out set: 2.3973990431371726
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.22562892735004425
Epoch: 2

Loss on hold-out set: 2.3967826321439922
Accuracy on hold-out set: 0.1320754716981132
MAPK value on hold-out data: 0.276729553937912
Epoch: 3

Loss on hold-out set: 2.39605868537471
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.27437102794647217
Epoch: 4

Loss on hold-out set: 2.3950287126145273
Accuracy on hold-out set: 0.13679245283018868
MAPK value on hold-out data: 0.26022011041641235
Returned to Spot: Validation loss: 2.3950287126145273
----------------------------------------------

spotPython tuning: 2.394039122563488 [##########] 96.93%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.3265161769786461, 'lr_mult': 0.001, 'bat

Epoch: 1

Loss on hold-out set: 2.3978289253306837
Accuracy on hold-out set: 0.05660377358490566
MAPK value on hold-out data: 0.15015724301338196
Epoch: 2

Loss on hold-out set: 2.3973237208600313
Accuracy on hold-out set: 0.12264150943396226
MAPK value on hold-out data: 0.21305032074451447
Epoch: 3
```

```
Loss on hold-out set: 2.3966134854082792
Accuracy on hold-out set: 0.10377358490566038
MAPK value on hold-out data: 0.2020440250635147
Epoch: 4

Loss on hold-out set: 2.3957774324237175
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.21619494259357452
Returned to Spot: Validation loss: 2.3957774324237175
----------------------------------------------

spotPython tuning: 2.394039122563488 [##########] 98.48%


config: {'_L0': 6112, 'l1': 8192, 'dropout_prob': 0.32653521670396246, 'lr_mult': 0.001, 'ba

Epoch: 1

Loss on hold-out set: 2.3974482563306703
Accuracy on hold-out set: 0.09905660377358491
MAPK value on hold-out data: 0.17688679695129395
Epoch: 2

Loss on hold-out set: 2.3969626831558517
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.2279874086380005
Epoch: 3

Loss on hold-out set: 2.396254062652588
Accuracy on hold-out set: 0.14622641509433962
MAPK value on hold-out data: 0.24056600034236908
Epoch: 4

Loss on hold-out set: 2.395116927488795
Accuracy on hold-out set: 0.1650943396226415
MAPK value on hold-out data: 0.27279868721961975
Returned to Spot: Validation loss: 2.395116927488795
----------------------------------------------

spotPython tuning: 2.394039122563488 [##########] 100.00% Done...

<spotPython.spot.spot.Spot at 0x2bdc87220>
```

## 29.6 Tensorboard

The textual output shown in the console (or code cell) can be visualized with Tensorboard as described in Section 21.13.

## 29.7 Results

After the hyperparameter tuning run is finished, the results can be analyzed as described in Section 21.14.

```
spot_tuner.plot_progress(log_y=False,
    filename="./figures/" + experiment_name+"_progress.png")
```

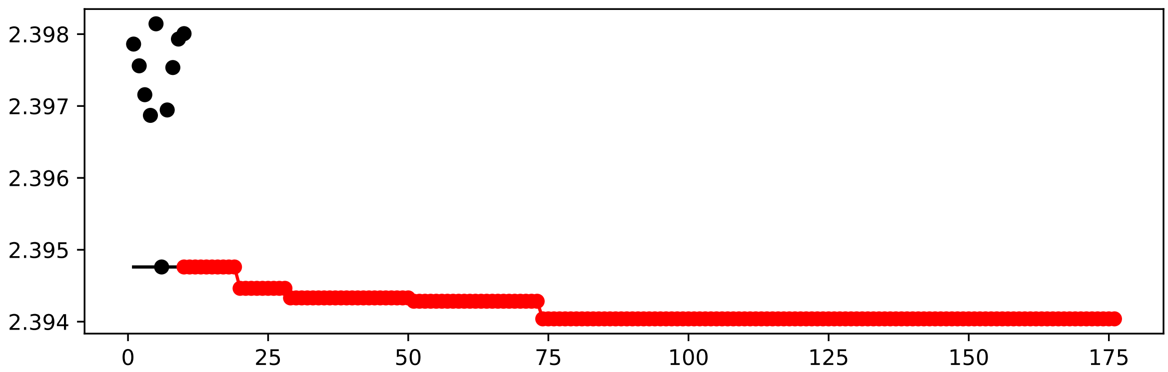



Figure 29.1: Progress plot. *Black* dots denote results from the initial design. *Red* dots illustrate the improvement found by the surrogate model based optimization.

```
from spotPython.utils.eda import gen_design_table
print(gen_design_table(fun_control=fun_control, spot=spot_tuner))
```

```
| name         | type   | default   |   lower |   upper |              tuned | transform
|--------------|--------|-----------|---------|---------|--------------------|----------------
| _L0          | int    | 64        |  6112.0 |  6112.0 |             6112.0 | None
| l1           | int    | 8         |     6.0 |    13.0 |               13.0 | transform_powe
| dropout_prob | float  | 0.01      |     0.0 |     0.9 | 0.326849826331756 | None
| lr_mult      | float  | 1.0       |   0.001 |   0.001 |              0.001 | None
| batch_size   | int    | 4         |     1.0 |     4.0 |                2.0 | transform_powe
| epochs       | int    | 4         |     2.0 |     2.0 |                2.0 | transform_powe
```

```
| k_folds      | int    | 1          |      1.0 |      1.0 |                  1.0 | None
| patience     | int    | 2          |      2.0 |      6.0 |                  3.0 | transform_powe
| optimizer    | factor | SGD        |      0.0 |      3.0 |                  3.0 | None
| sgd_momentum | float  | 0.0        |      0.9 |      0.9 |                  0.9 | None
```

```
spot_tuner.plot_importance(threshold=0.025,
    filename="./figures/" + experiment_name+"_importance.png")
```

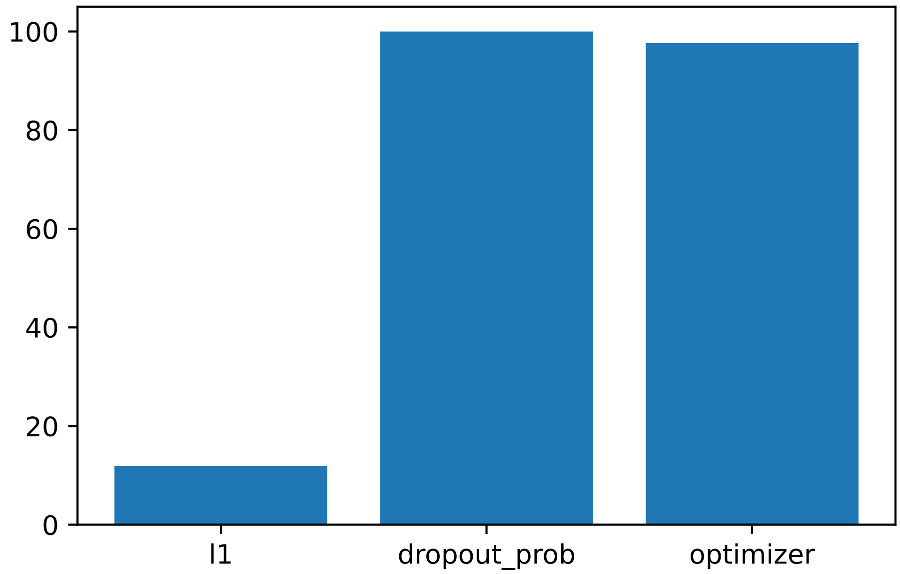



Figure 29.2: Variable importance plot, threshold 0.025.

## 29.8 Get the Tuned Architecture

```
from spotPython.hyperparameters.values import get_one_core_model_from_X
X = spot_tuner.to_all_dim(spot_tuner.min_X.reshape(1,-1))
model_spot = get_one_core_model_from_X(X, fun_control)
model_spot
```

```
Net_vbdp(
  (fc1): Linear(in_features=6112, out_features=8192, bias=True)
  (fc2): Linear(in_features=8192, out_features=4096, bias=True)
  (fc3): Linear(in_features=4096, out_features=2048, bias=True)
```

```
  (fc4): Linear(in_features=2048, out_features=1024, bias=True)
  (fc5): Linear(in_features=1024, out_features=11, bias=True)
  (relu): ReLU()
  (softmax): Softmax(dim=1)
  (dropout1): Dropout(p=0.326849826331756, inplace=False)
  (dropout2): Dropout(p=0.163424913165878, inplace=False)
)
```

## 29.9 Evaluation of the Tuned Architecture

```python
from spotPython.torch.traintest import (
    train_tuned,
    test_tuned,
    )
train_tuned(net=model_spot, train_dataset=train,
        loss_function=fun_control["loss_function"],
        metric=fun_control["metric_torch"],
        shuffle=True,
        device = fun_control["device"],
        path=None,
        task=fun_control["task"],)
```

```
Epoch: 1

Loss on hold-out set: 2.3975770833357326
Accuracy on hold-out set: 0.08018867924528301
MAPK value on hold-out data: 0.1666666567325592
Epoch: 2

Loss on hold-out set: 2.3970734758197136
Accuracy on hold-out set: 0.1179245283018868
MAPK value on hold-out data: 0.19103771448135376
Epoch: 3

Loss on hold-out set: 2.3965021484303026
Accuracy on hold-out set: 0.11320754716981132
MAPK value on hold-out data: 0.19103771448135376
Epoch: 4
```

```
Loss on hold-out set: 2.3953410364546865
Accuracy on hold-out set: 0.1509433962264151
MAPK value on hold-out data: 0.21226415038108826
Returned to Spot: Validation loss: 2.3953410364546865
----------------------------------------------
```

If path is set to a filename, e.g., `path = "model_spot_trained.pt"`, the weights of the trained model will be loaded from this file.

```
test_tuned(net=model_spot, test_dataset=test,
            shuffle=False,
            loss_function=fun_control["loss_function"],
            metric=fun_control["metric_torch"],
            device = fun_control["device"],
            task=fun_control["task"],)
```

```
Loss on hold-out set: 2.3941816965738933
Accuracy on hold-out set: 0.14124293785310735
MAPK value on hold-out data: 0.21296297013759613
Final evaluation: Validation loss: 2.3941816965738933
Final evaluation: Validation metric: 0.21296297013759613
----------------------------------------------
```

```
(2.3941816965738933, nan, tensor(0.2130))
```

## 29.10 Cross-validated Evaluations

- This is the evaluation that will be used in the comparison (evaluatecv has to be updated before, to get metric vlaues!):

```
from spotPython.torch.traintest import evaluate_cv
# modify k-kolds:
setattr(model_spot, "k_folds",  10)
df_eval, df_preds, df_metrics = evaluate_cv(net=model_spot,
    dataset=fun_control["data"],
    loss_function=fun_control["loss_function"],
    metric=fun_control["metric_torch"],
    task=fun_control["task"],
    writer=fun_control["writer"],
    writerId="model_spot_cv",
```

```python
    device = fun_control["device"])
```

```
Fold: 1
Epoch: 1

Loss on hold-out set: 2.397182729509142
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.17592591047286987
Epoch: 2

Loss on hold-out set: 2.3953606022728815
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.18981480598449707
Epoch: 3

Loss on hold-out set: 2.392339030901591
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.21450616419315338
Epoch: 4

Loss on hold-out set: 2.386865589353773
Accuracy on hold-out set: 0.14084507042253522
MAPK value on hold-out data: 0.2631172835826874
Fold: 2
Epoch: 1

Loss on hold-out set: 2.3961539268493652
Accuracy on hold-out set: 0.11267605633802817
MAPK value on hold-out data: 0.23379629850387573
Epoch: 2

Loss on hold-out set: 2.3934372001224093
Accuracy on hold-out set: 0.11267605633802817
MAPK value on hold-out data: 0.22453702986240387
Epoch: 3

Loss on hold-out set: 2.3875025378333197
Accuracy on hold-out set: 0.11267605633802817
MAPK value on hold-out data: 0.2361111044883728
Epoch: 4
```

```
Loss on hold-out set: 2.3776834275987415
Accuracy on hold-out set: 0.18309859154929578
MAPK value on hold-out data: 0.2685185372829437
Fold: 3
Epoch: 1

Loss on hold-out set: 2.3961585097842746
Accuracy on hold-out set: 0.22535211267605634
MAPK value on hold-out data: 0.33101850748062134
Epoch: 2

Loss on hold-out set: 2.3926848305596247
Accuracy on hold-out set: 0.15492957746478872
MAPK value on hold-out data: 0.28009259700775146
Epoch: 3

Loss on hold-out set: 2.3863042725457086
Accuracy on hold-out set: 0.15492957746478872
MAPK value on hold-out data: 0.2870370149612427
Epoch: 4

Loss on hold-out set: 2.3744228151109485
Accuracy on hold-out set: 0.16901408450704225
MAPK value on hold-out data: 0.28703704476356506
Fold: 4
Epoch: 1

Loss on hold-out set: 2.3970948590172663
Accuracy on hold-out set: 0.14084507042253522
MAPK value on hold-out data: 0.21759259700775146
Epoch: 2

Loss on hold-out set: 2.3956897258758545
Accuracy on hold-out set: 0.1267605633802817
MAPK value on hold-out data: 0.2361110895872116
Epoch: 3

Loss on hold-out set: 2.392979449696011
Accuracy on hold-out set: 0.1267605633802817
MAPK value on hold-out data: 0.22685186564922333
Epoch: 4
```

```
Loss on hold-out set: 2.388688047726949
Accuracy on hold-out set: 0.1267605633802817
MAPK value on hold-out data: 0.21990740299224854
Fold: 5
Epoch: 1

Loss on hold-out set: 2.397517694367303
Accuracy on hold-out set: 0.1267605633802817
MAPK value on hold-out data: 0.16435185074806213
Epoch: 2

Loss on hold-out set: 2.396567622820536
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.1527777910232544
Epoch: 3

Loss on hold-out set: 2.3977539804246693
Accuracy on hold-out set: 0.04225352112676056
MAPK value on hold-out data: 0.12268517911434174
Epoch: 4

Loss on hold-out set: 2.404960526360406
Accuracy on hold-out set: 0.028169014084507043
MAPK value on hold-out data: 0.12037035822868347
Fold: 6
Epoch: 1

Loss on hold-out set: 2.396921992301941
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.1944444477558136
Epoch: 2

Loss on hold-out set: 2.3954104052649603
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.2214505970478058
Epoch: 3

Loss on hold-out set: 2.393188410335117
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.21604938805103302
Epoch: 4
```

```
Loss on hold-out set: 2.3939036660724216
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.20601853728294373
Fold: 7
Epoch: 1

Loss on hold-out set: 2.3966770701938205
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.18287037312984467
Epoch: 2

Loss on hold-out set: 2.3950673474205866
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.19675926864147186
Epoch: 3

Loss on hold-out set: 2.390797350141737
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.1944444477558136
Epoch: 4

Loss on hold-out set: 2.3853341341018677
Accuracy on hold-out set: 0.09859154929577464
MAPK value on hold-out data: 0.2044752985239029
Fold: 8
Epoch: 1

Loss on hold-out set: 2.3969555960761175
Accuracy on hold-out set: 0.08571428571428572
MAPK value on hold-out data: 0.1944444477558136
Epoch: 2

Loss on hold-out set: 2.396068983607822
Accuracy on hold-out set: 0.07142857142857142
MAPK value on hold-out data: 0.1597222238779068
Epoch: 3

Loss on hold-out set: 2.3939570983250937
Accuracy on hold-out set: 0.07142857142857142
MAPK value on hold-out data: 0.1597222238779068
Epoch: 4
```

```
Loss on hold-out set: 2.39349635442098
Accuracy on hold-out set: 0.07142857142857142
MAPK value on hold-out data: 0.16898147761821747
Fold: 9
Epoch: 1

Loss on hold-out set: 2.3964671161439686
Accuracy on hold-out set: 0.11428571428571428
MAPK value on hold-out data: 0.21990740299224854
Epoch: 2

Loss on hold-out set: 2.3941902849409313
Accuracy on hold-out set: 0.12857142857142856
MAPK value on hold-out data: 0.21990740299224854
Epoch: 3

Loss on hold-out set: 2.3887558115853205
Accuracy on hold-out set: 0.1
MAPK value on hold-out data: 0.1944444477558136
Epoch: 4

Loss on hold-out set: 2.386909418635898
Accuracy on hold-out set: 0.04285714285714286
MAPK value on hold-out data: 0.15046295523643494
Fold: 10
Epoch: 1

Loss on hold-out set: 2.3962818384170532
Accuracy on hold-out set: 0.17142857142857143
MAPK value on hold-out data: 0.2708333432674408
Epoch: 2

Loss on hold-out set: 2.3935276534822254
Accuracy on hold-out set: 0.17142857142857143
MAPK value on hold-out data: 0.2638888955116272
Epoch: 3

Loss on hold-out set: 2.3862437672085233
Accuracy on hold-out set: 0.17142857142857143
MAPK value on hold-out data: 0.26851850748062134
Epoch: 4
```

```
Loss on hold-out set: 2.374820073445638
Accuracy on hold-out set: 0.17142857142857143
MAPK value on hold-out data: 0.26620373129844666
```

```python
metric_name = type(fun_control["metric_torch"]).__name__
print(f"loss: {df_eval}, Cross-validated {metric_name}: {df_metrics}")
```

```
loss: 2.386708405282762, Cross-validated MAPK: 0.21550926566123962
```

## 29.11 Detailed Hyperparameter Plots

```python
filename = "./figures/" + experiment_name
spot_tuner.plot_important_hyperparameter_contour(filename=filename)
```

```
l1:  11.936968586577134
dropout_prob:  99.99999999999999
optimizer:  97.6015719077037
```

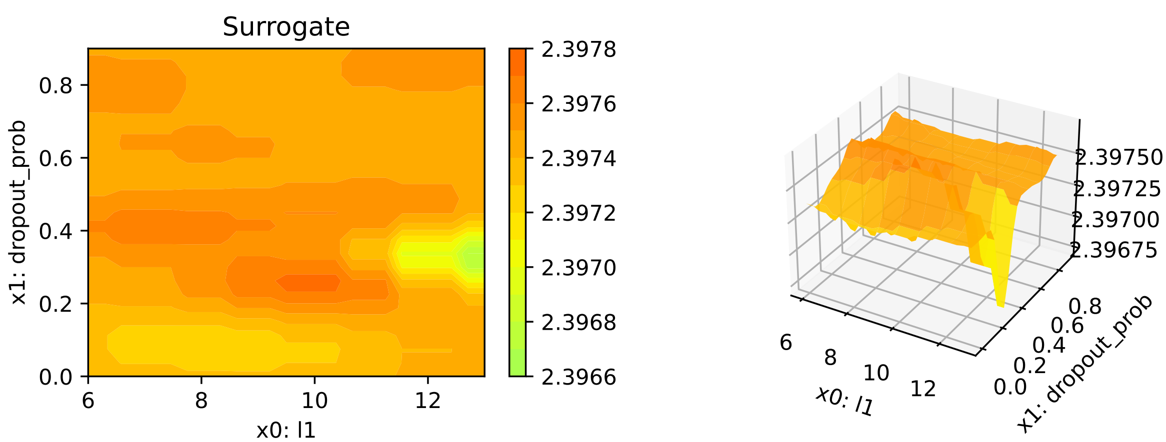
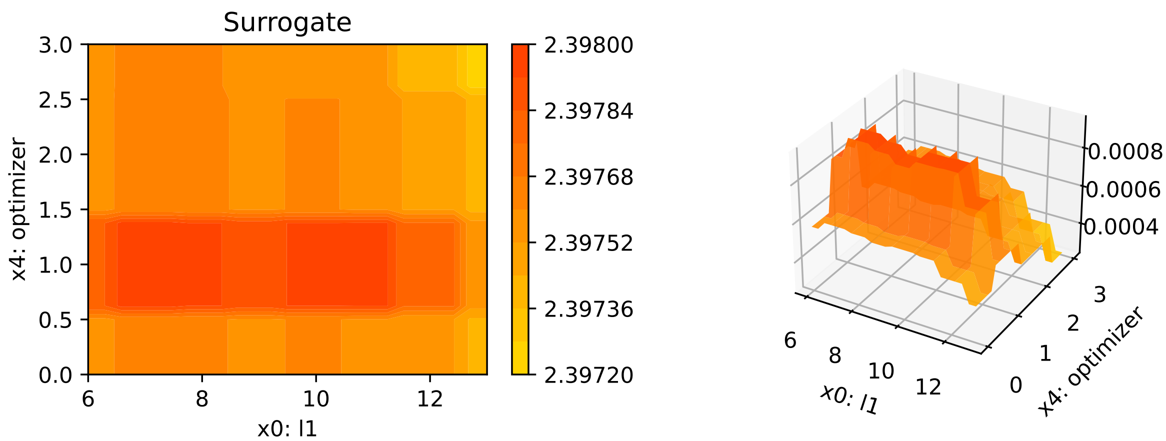
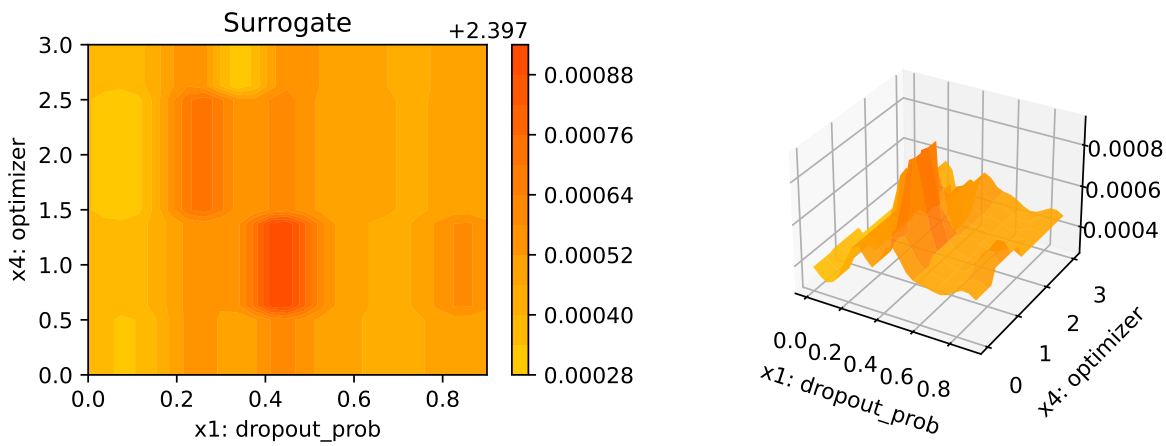



Figure 29.3: Contour plots.




## 29.12 Parallel Coordinates Plot

```
spot_tuner.parallel_plot()
```

Unable to display output for mime type(s): text/html

Parallel coordinates plots

Unable to display output for mime type(s): text/html

```
# close tensorbaoard writer
if fun_control["writer"] is not None:
    fun_control["writer"].close()
```

## 29.13 Plot all Combinations of Hyperparameters

- Warning: this may take a while.

```
PLOT_ALL = False
if PLOT_ALL:
    n = spot_tuner.k
    for i in range(n-1):
        for j in range(i+1, n):
            spot_tuner.plot_contour(i=i, j=j, min_z=min_z, max_z = max_z)
```

# 30 Documentation of the Sequential Parameter Optimization

This document describes the `Spot` features.

## 30.1 Example: spot

```
import numpy as np
from math import inf
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
from scipy.optimize import shgo
from scipy.optimize import direct
from scipy.optimize import differential_evolution
import matplotlib.pyplot as plt
```

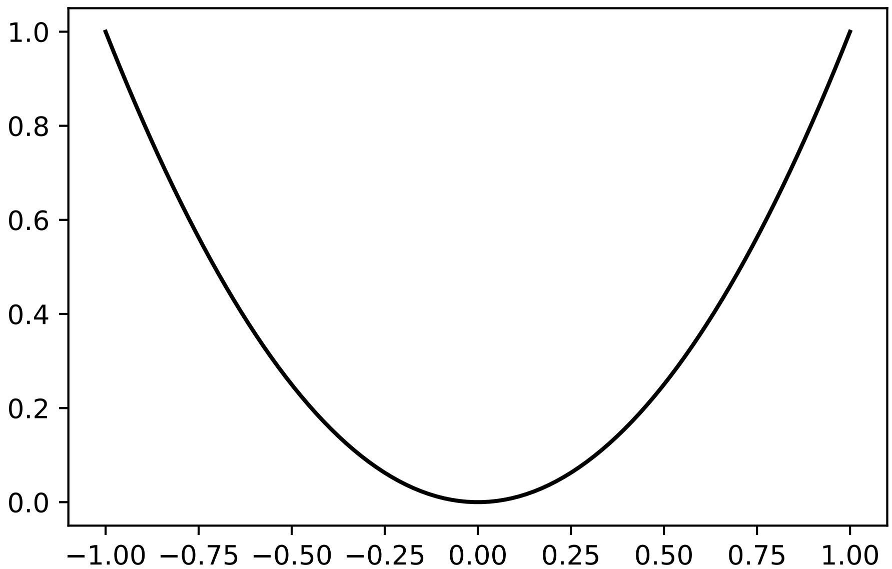
### 30.1.1 The Objective Function

The `spotPython` package provides several classes of objective functions. We will use an analytical objective function, i.e., a function that can be described by a (closed) formula:

$$f(x) = x^2$$

```
fun = analytical().fun_sphere
```

```
x = np.linspace(-1,1,100).reshape(-1,1)
y = fun(x)
plt.figure()
plt.plot(x,y, "k")
plt.show()
```




```
spot_1 = spot.Spot(fun=fun,
                   lower = np.array([-10]),
                   upper = np.array([100]),
                   fun_evals = 7,
                   fun_repeats = 1,
                   max_time = inf,
                   noise = False,
                   tolerance_x = np.sqrt(np.spacing(1)),
                   var_type=["num"],
                   infill_criterion = "y",
                   n_points = 1,
                   seed=123,
                   log_level = 50,
                   show_models=True,
                   fun_control = {},
                   design_control={"init_size": 5,
                                   "repeats": 1},
                   surrogate_control={"noise": False,
                                      "cod_type": "norm",
                                      "min_theta": -4,
                                      "max_theta": 3,
                                      "n_theta": 1,
                                      "model_optimizer": differential_evolution,
                                      "model_fun_evals": 1000,
```

```
})
```

`spot`'s `__init__` method sets the control parameters. There are two parameter groups:

1. external parameters can be specified by the user
2. internal parameters, which are handled by `spot`.

### 30.1.2 External Parameters

| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `fun` | object | objective function | | yes |
| `lower` | array | lower bound | | yes |
| `upper` | array | upper bound | | yes |
| `fun_evals` | int | number of function evaluations | 15 | no |
| `fun_evals` | int | number of function evaluations | 15 | no |
| `fun_control` | dict | noise etc. | {} | n |
| `max_time` | int | max run time budget | `inf` | no |
| `noise` | bool | if repeated evaluations of `fun` results in different values, then `noise` should be set to `True`. | `False` | no |

| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `tolerance_x` | float | tolerance for new x solutions. Minimum distance of new solutions, generated by `suggest_new_X`, to already existing solutions. If zero (which is the default), every new solution is accepted. | `0` | no |
| `var_type` | list | list of type information, can be either `"num"` or `"factor"` | `["num"]` | no |
| `infill_criterion` | string | Can be `"y"`, `"s"`, `"ei"` (negative expected improvement), or `"all"` | `"y"` | no |
| `n_points` | int | number of infill points | 1 | no |
| `seed` | int | initial seed. If `Spot.run()` is called twice, different results will be generated. To reproduce results, the `seed` can be used. | `123` | no |

| external parameter | type | description | default | mandatory |
| --- | --- | --- | --- | --- |
| `log_level` | int | log level with the following settings: `NOTSET` (`0`), `DEBUG` (`10`: Detailed information, typically of interest only when diagnosing problems.), `INFO` (`20`: Confirmation that things are working as expected.), `WARNING` (`30`: An indication that something unexpected happened, or indicative of some problem in the near future (e.g. 'disk space low'). The software is still working as expected.), `ERROR` (`40`: Due to a more serious problem, the software has not been able to perform some function.), and `CRITICAL` (`50`: A serious error, indicating that the program itself may be unable to continue running.) | `50` | no |

| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `show_models` | bool | Plot model. Currently only 1-dim functions are supported | `False` | no |
| `design` | object | experimental design | `None` | no |
| `design_control` | dict | control parameters | see below | no |
| `surrogate` | | surrogate model | `kriging` | no |
| `surrogate_control` | dict | control parameters | see below | no |
| `optimizer` | object | optimizer | see below | no |
| `optimizer_control` | dict | control parameters | see below | no |

- Besides these single parameters, the following parameter dictionaries can be specified by the user:
  - `fun_control`
  - `design_control`
  - `surrogate_control`
  - `optimizer_control`

## 30.2 The `fun_control` Dictionary

| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `sigma` | float | noise: standard deviation | `0` | yes |
| `seed` | int | seed for rng | `124` | yes |

## 30.3 The `design_control` Dictionary

| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `init_size` | int | initial sample size | `10` | yes |

| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `repeats` | int | number of repeats of the initial sammples | `1` | yes |

## 30.4 The `surrogate_control` Dictionary

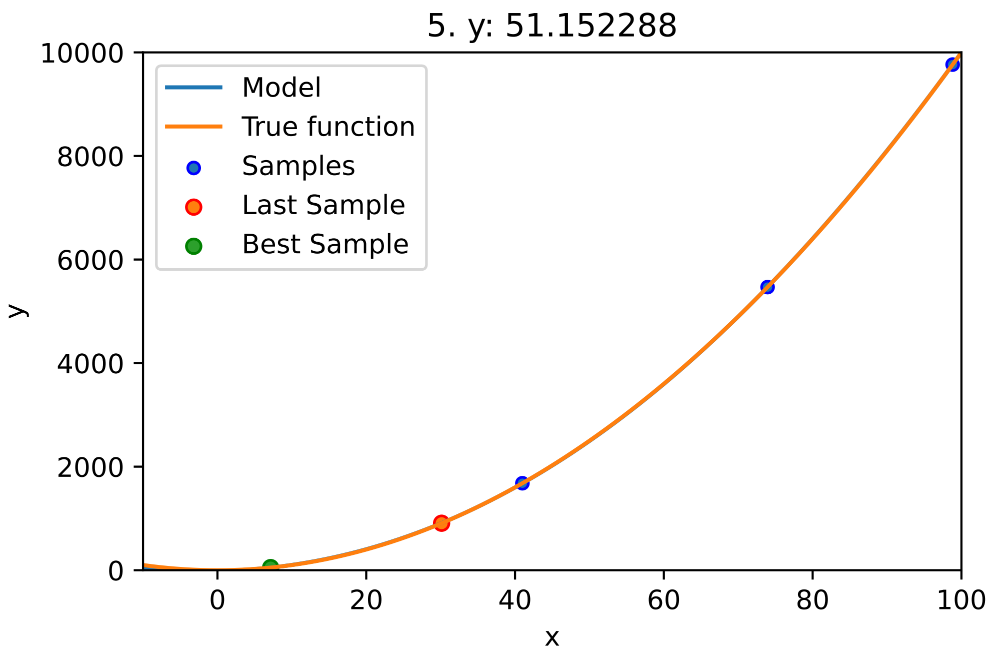
| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `noise` | | | | |
| `model_optimizer` | object | optimizer | `differential_evolution` | no |
| `model_fun_evals` | | | | |
| `min_theta` | | | `-3.` | |
| `max_theta` | | | `3.` | |
| `n_theta` | | | `1` | |
| `n_p` | | | `1` | |
| `optim_p` | | | `False` | |
| `cod_type` | | | `"norm"` | |
| `var_type` | | | | |
| `use_cod_y` | bool | | `False` | |

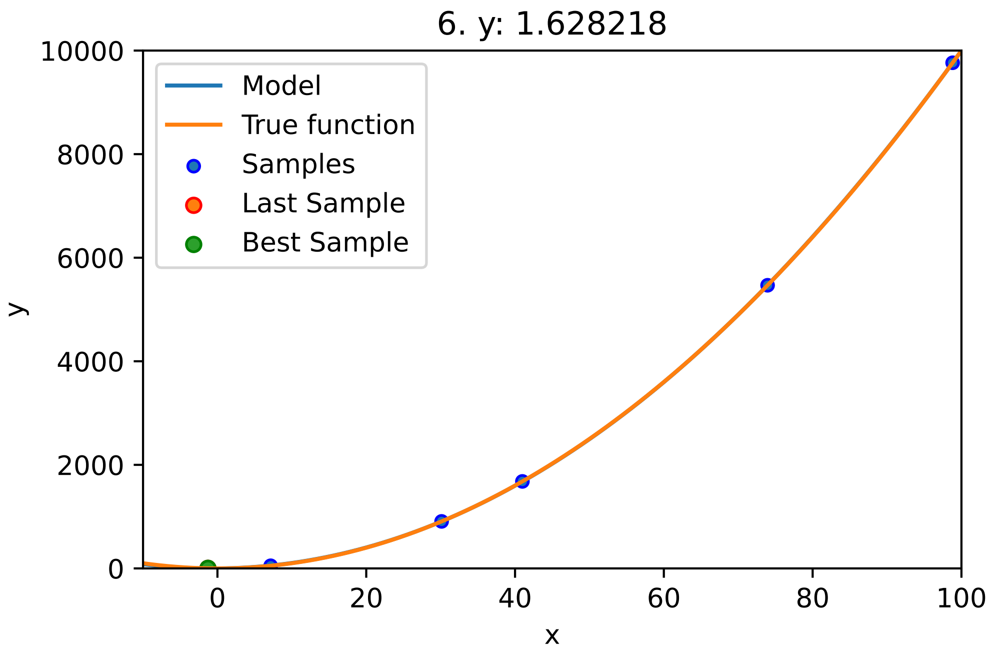
## 30.5 The `optimizer_control` Dictionary

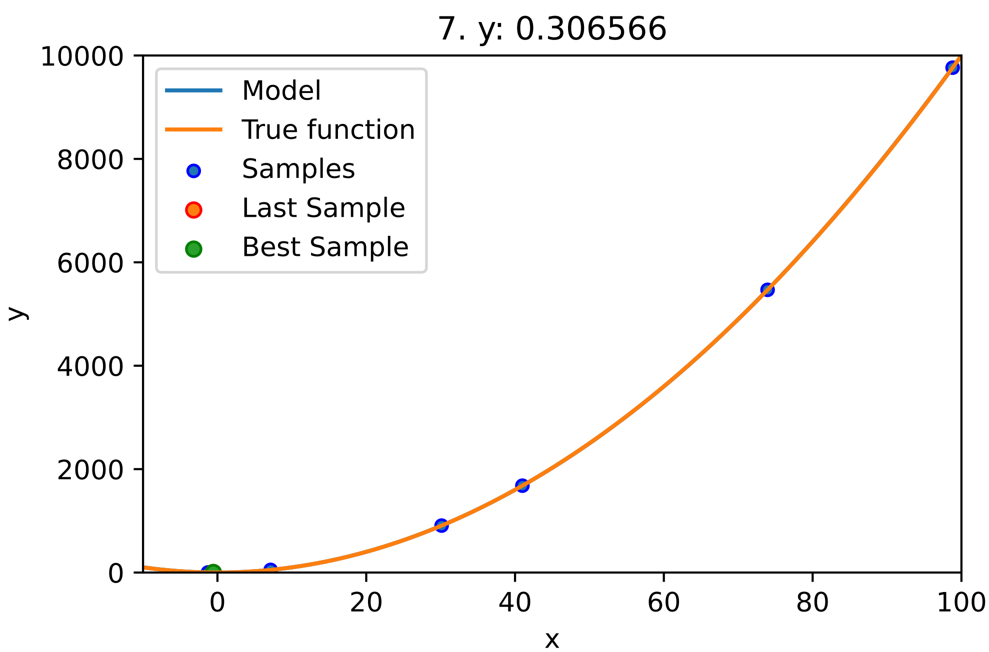
| external parameter | type | description | default | mandatory |
|---|---|---|---|---|
| `max_iter` | int | max number of iterations. Note: these are the cheap evaluations on the surrogate. | `1000` | no |

## 30.6 Run

```
spot_1.run()
```






```
<spotPython.spot.spot.Spot at 0x16c3867a0>
```

## 30.7 Print the Results

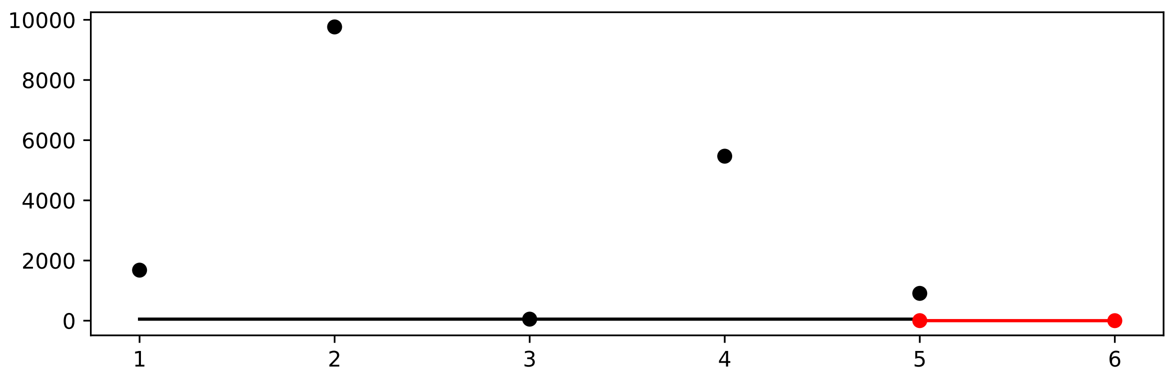
```
spot_1.print_results()
```

```
min y: 0.30656551286610595
x0: -0.5536835855126157
```

```
[['x0', -0.5536835855126157]]
```

## 30.8 Show the Progress

```
spot_1.plot_progress()
```

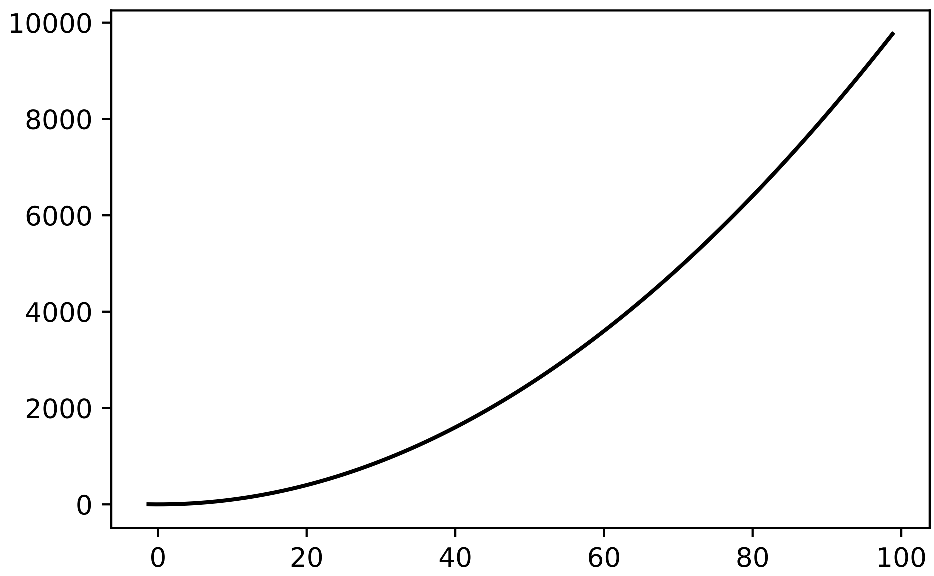



## 30.9 Visualize the Surrogate

- The plot method of the `kriging` surrogate is used.
- Note: the plot uses the interval defined by the ranges of the natural variables.

```
spot_1.surrogate.plot()
```

```
<Figure size 2700x1800 with 0 Axes>
```




## 30.10 Init: Build Initial Design

```
from spotPython.design.spacefilling import spacefilling
from spotPython.build.kriging import Kriging
from spotPython.fun.objectivefunctions import analytical
gen = spacefilling(2)
rng = np.random.RandomState(1)
lower = np.array([-5,-0])
upper = np.array([10,15])
fun = analytical().fun_branin
fun_control = {"sigma": 0,
               "seed": 123}

X = gen.scipy_lhd(10, lower=lower, upper = upper)
print(X)
y = fun(X, fun_control=fun_control)
print(y)
```

```
[[ 8.97647221 13.41926847]
 [ 0.66946019  1.22344228]
 [ 5.23614115 13.78185824]
 [ 5.6149825  11.5851384 ]
```

```
 [-1.72963184  1.66516096]
 [-4.26945568  7.1325531 ]
 [ 1.26363761 10.17935555]
 [ 2.88779942  8.05508969]
 [-3.39111089  4.15213772]
 [ 7.30131231  5.22275244]]
[128.95676449  31.73474356 172.89678121 126.71295908  64.34349975
  70.16178611  48.71407916  31.77322887  76.91788181  30.69410529]
```

## 30.11 Replicability

Seed

```
gen = spacefilling(2, seed=123)
X0 = gen.scipy_lhd(3)
gen = spacefilling(2, seed=345)
X1 = gen.scipy_lhd(3)
X2 = gen.scipy_lhd(3)
gen = spacefilling(2, seed=123)
X3 = gen.scipy_lhd(3)
X0, X1, X2, X3
```

```
(array([[0.77254938, 0.31539299],
        [0.59321338, 0.93854273],
        [0.27469803, 0.3959685 ]]),
 array([[0.78373509, 0.86811887],
        [0.06692621, 0.6058029 ],
        [0.41374778, 0.00525456]]),
 array([[0.121357  , 0.69043832],
        [0.41906219, 0.32838498],
        [0.86742658, 0.52910374]]),
 array([[0.77254938, 0.31539299],
        [0.59321338, 0.93854273],
        [0.27469803, 0.3959685 ]]))
```

## 30.12 Surrogates

### 30.12.1 A Simple Predictor

The code below shows how to use a simple model for prediction. Assume that only two (very costly) measurements are available:

1. f(0) = 0.5
2. f(2) = 2.5

We are interested in the value at $x_0 = 1$, i.e., $f(x_0 = 1)$, but cannot run an additional, third experiment.

```
from sklearn import linear_model
X = np.array([[0], [2]])
y = np.array([0.5, 2.5])
S_lm = linear_model.LinearRegression()
S_lm = S_lm.fit(X, y)
X0 = np.array([[1]])
y0 = S_lm.predict(X0)
print(y0)
```

```
[1.5]
```

Central Idea: Evaluation of the surrogate model `S_lm` is much cheaper (or / and much faster) than running the real-world experiment $f$.

## 30.13 Demo/Test: Objective Function Fails

SPOT expects `np.nan` values from failed objective function values. These are handled. Note: SPOT's counter considers only successful executions of the objective function.

```
import numpy as np
from spotPython.fun.objectivefunctions import analytical
from spotPython.spot import spot
import numpy as np
from math import inf
# number of initial points:
ni = 20
# number of points
n = 30
```

```python
fun = analytical().fun_random_error
lower = np.array([-1])
upper = np.array([1])
design_control={"init_size": ni}

spot_1 = spot.Spot(fun=fun,
            lower = lower,
            upper= upper,
            fun_evals = n,
            show_progress=False,
            design_control=design_control,)
spot_1.run()
# To check whether the run was successfully completed,
# we compare the number of evaluated points to the specified
# number of points.
assert spot_1.y.shape[0] == n
```

```
[ 0.53176481 -0.9053821  -0.02203599 -0.21843718  0.78240941 -0.58120945
 -0.3923345   0.67234256  0.31802454 -0.68898927 -0.75129705  0.97550354
  0.41757584  0.0786237   0.82585329  0.23700598 -0.49274073 -0.82319082
 -0.17991251  0.1481835 ]
```

```
[-1.]
```

```
[-0.58552368]
[-0.20126111]
```

```
[nan]
```

```
[-0.60100809]
```

```
[-0.97897336]
```

```
[-0.2748985]
```

```
[0.8359486]
[0.99035591]
```

```
[0.01641232]
[0.5629346]
```

## 30.14 PyTorch: Detailed Description of the Data Splitting

### 30.14.1 Description of the "train_hold_out" Setting

The "train_hold_out" setting is used by default. It uses the loss function specfied in fun_control and the metric specified in fun_control.

1. First, the method HyperTorch().fun_torch is called.
2. fun_torc(), which is implemented in the file hypertorch.py, calls evaluate_hold_out() as follows:

```
df_eval, _ = evaluate_hold_out(
    model,
    train_dataset=fun_control["train"],
    shuffle=self.fun_control["shuffle"],
    loss_function=self.fun_control["loss_function"],
    metric=self.fun_control["metric_torch"],
    device=self.fun_control["device"],
    show_batch_interval=self.fun_control["show_batch_interval"],
    path=self.fun_control["path"],
    task=self.fun_control["task"],
    writer=self.fun_control["writer"],
    writerId=config_id,
)
```

Note: Only the data set fun_control["train"] is used for training and validation. It is used in evaluate_hold_out as follows:

```
trainloader, valloader = create_train_val_data_loaders(
                dataset=train_dataset, batch_size=batch_size_instance, shuffle=shuffle
            )
```

create_train_val_data_loaders() splits the train_dataset into trainloader and valloader using torch.utils.data.random_split() as follows:

```
def create_train_val_data_loaders(dataset, batch_size, shuffle, num_workers=0):
    test_abs = int(len(dataset) * 0.6)
    train_subset, val_subset = random_split(dataset, [test_abs, len(dataset) - test_abs])
    trainloader = torch.utils.data.DataLoader(
        train_subset, batch_size=int(batch_size), shuffle=shuffle, num_workers=num_workers
    )
    valloader = torch.utils.data.DataLoader(
```

```
        val_subset, batch_size=int(batch_size), shuffle=shuffle, num_workers=num_workers
    )
    return trainloader, valloader
```

The optimizer is set up as follows:

```
optimizer_instance = net.optimizer
lr_mult_instance = net.lr_mult
sgd_momentum_instance = net.sgd_momentum
optimizer = optimizer_handler(
    optimizer_name=optimizer_instance,
    params=net.parameters(),
    lr_mult=lr_mult_instance,
    sgd_momentum=sgd_momentum_instance,
)
```

3. `evaluate_hold_out()` sets the `net` attributes such as `epochs`, `batch_size`, `optimizer`, and `patience`. For each epoch, the methods `train_one_epoch()` and `validate_one_epoch()` are called, the former for training and the latter for validation and early stopping. The validation loss from the last epoch (not the best validation loss) is returned from `evaluate_hold_out`.
4. The method `train_one_epoch()` is implemented as follows:

```
def train_one_epoch(
    net,
    trainloader,
    batch_size,
    loss_function,
    optimizer,
    device,
    show_batch_interval=10_000,
    task=None,
):
    running_loss = 0.0
    epoch_steps = 0
    for batch_nr, data in enumerate(trainloader, 0):
        input, target = data
        input, target = input.to(device), target.to(device)
        optimizer.zero_grad()
        output = net(input)
        if task == "regression":
```

```
            target = target.unsqueeze(1)
            if target.shape == output.shape:
                loss = loss_function(output, target)
            else:
                raise ValueError(f"Shapes of target and output do not match:
                 {target.shape} vs {output.shape}")
        elif task == "classification":
            loss = loss_function(output, target)
        else:
            raise ValueError(f"Unknown task: {task}")
        loss.backward()
        torch.nn.utils.clip_grad_norm_(net.parameters(), max_norm=1.0)
        optimizer.step()
        running_loss += loss.item()
        epoch_steps += 1
        if batch_nr % show_batch_interval == (show_batch_interval - 1):
            print(
                "Batch: %5d. Batch Size: %d. Training Loss (running): %.3f"
                % (batch_nr + 1, int(batch_size), running_loss / epoch_steps)
            )
            running_loss = 0.0
    return loss.item()
```

5. The method `validate_one_epoch()` is implemented as follows:

```
def validate_one_epoch(net, valloader, loss_function, metric, device, task):
    val_loss = 0.0
    val_steps = 0
    total = 0
    correct = 0
    metric.reset()
    for i, data in enumerate(valloader, 0):
        # get batches
        with torch.no_grad():
            input, target = data
            input, target = input.to(device), target.to(device)
            output = net(input)
            # print(f"target: {target}")
            # print(f"output: {output}")
            if task == "regression":
                target = target.unsqueeze(1)
```

```
                if target.shape == output.shape:
                    loss = loss_function(output, target)
                else:
                    raise ValueError(f"Shapes of target and output
                        do not match: {target.shape} vs {output.shape}")
                metric_value = metric.update(output, target)
            elif task == "classification":
                loss = loss_function(output, target)
                metric_value = metric.update(output, target)
                _, predicted = torch.max(output.data, 1)
                total += target.size(0)
                correct += (predicted == target).sum().item()
            else:
                raise ValueError(f"Unknown task: {task}")
            val_loss += loss.cpu().numpy()
            val_steps += 1
    loss = val_loss / val_steps
    print(f"Loss on hold-out set: {loss}")
    if task == "classification":
        accuracy = correct / total
        print(f"Accuracy on hold-out set: {accuracy}")
    # metric on all batches using custom accumulation
    metric_value = metric.compute()
    metric_name = type(metric).__name__
    print(f"{metric_name} value on hold-out data: {metric_value}")
    return metric_value, loss
```

#### 30.14.1.1 Description of the `"test_hold_out"` Setting

It uses the loss function specfied in `fun_control` and the metric specified in `fun_control`.

1. First, the method `HyperTorch().fun_torch` is called.
2. `fun_torc()` calls `spotPython.torch.traintest.evaluate_hold_out()` similar to the `"train_hold_out"` setting with one exception: It passes an additional `test` data set to `evaluate_hold_out()` as follows:

```
test_dataset=fun_control["test"]
```

`evaluate_hold_out()` calls `create_train_test_data_loaders` instead of `create_train_val_data_loaders`: The two data sets are used in `create_train_test_data_loaders` as follows:

```
def create_train_test_data_loaders(dataset, batch_size, shuffle, test_dataset,
        num_workers=0):
    trainloader = torch.utils.data.DataLoader(
        dataset, batch_size=int(batch_size), shuffle=shuffle,
        num_workers=num_workers
    )
    testloader = torch.utils.data.DataLoader(
        test_dataset, batch_size=int(batch_size), shuffle=shuffle,
        num_workers=num_workers
    )
    return trainloader, testloader
```

3. The following steps are identical to the `"train_hold_out"` setting. Only a different data loader is used for testing.

#### 30.14.1.2 Detailed Description of the `"train_cv"` Setting

It uses the loss function specfied in `fun_control` and the metric specified in `fun_control`.

1. First, the method `HyperTorch().fun_torch` is called.
2. `fun_torc()` calls `spotPython.torch.traintest.evaluate_cv()` as follows (Note: Only the data set `fun_control["train"]` is used for CV.):

```
df_eval, _ = evaluate_cv(
    model,
    dataset=fun_control["train"],
    shuffle=self.fun_control["shuffle"],
    device=self.fun_control["device"],
    show_batch_interval=self.fun_control["show_batch_interval"],
    task=self.fun_control["task"],
    writer=self.fun_control["writer"],
    writerId=config_id,
)
```

3. In ‘evaluate_cv(), the following steps are performed: The optimizer is set up as follows:

```
optimizer_instance = net.optimizer
lr_instance = net.lr
sgd_momentum_instance = net.sgd_momentum
optimizer = optimizer_handler(optimizer_name=optimizer_instance,
     params=net.parameters(), lr_mult=lr_mult_instance)
```

`evaluate_cv()` sets the `net` attributes such as `epochs`, `batch_size`, `optimizer`, and `patience`. CV is implemented as follows:

```
def evaluate_cv(
    net,
    dataset,
    shuffle=False,
    loss_function=None,
    num_workers=0,
    device=None,
    show_batch_interval=10_000,
    metric=None,
    path=None,
    task=None,
    writer=None,
    writerId=None,
):
    lr_mult_instance = net.lr_mult
    epochs_instance = net.epochs
    batch_size_instance = net.batch_size
    k_folds_instance = net.k_folds
    optimizer_instance = net.optimizer
    patience_instance = net.patience
    sgd_momentum_instance = net.sgd_momentum
    removed_attributes, net = get_removed_attributes_and_base_net(net)
    metric_values = {}
    loss_values = {}
    try:
        device = getDevice(device=device)
        if torch.cuda.is_available():
            device = "cuda:0"
            if torch.cuda.device_count() > 1:
                print("We will use", torch.cuda.device_count(), "GPUs!")
                net = nn.DataParallel(net)
        net.to(device)
        optimizer = optimizer_handler(
            optimizer_name=optimizer_instance,
            params=net.parameters(),
            lr_mult=lr_mult_instance,
            sgd_momentum=sgd_momentum_instance,
        )
        kfold = KFold(n_splits=k_folds_instance, shuffle=shuffle)
```

```
        for fold, (train_ids, val_ids) in enumerate(kfold.split(dataset)):
            print(f"Fold: {fold + 1}")
            train_subsampler = torch.utils.data.SubsetRandomSampler(train_ids)
            val_subsampler = torch.utils.data.SubsetRandomSampler(val_ids)
            trainloader = torch.utils.data.DataLoader(
                dataset, batch_size=batch_size_instance,
                sampler=train_subsampler, num_workers=num_workers
            )
            valloader = torch.utils.data.DataLoader(
                dataset, batch_size=batch_size_instance,
                sampler=val_subsampler, num_workers=num_workers
            )
            # each fold starts with new weights:
            reset_weights(net)
            # Early stopping parameters
            best_val_loss = float("inf")
            counter = 0
            for epoch in range(epochs_instance):
                print(f"Epoch: {epoch + 1}")
                # training loss from one epoch:
                training_loss = train_one_epoch(
                    net=net,
                    trainloader=trainloader,
                    batch_size=batch_size_instance,
                    loss_function=loss_function,
                    optimizer=optimizer,
                    device=device,
                    show_batch_interval=show_batch_interval,
                    task=task,
                )
                # Early stopping check. Calculate validation loss from one epoch:
                metric_values[fold], loss_values[fold] = validate_one_epoch(
                    net, valloader=valloader, loss_function=loss_function,
                    metric=metric, device=device, task=task
                )
                # Log the running loss averaged per batch
                metric_name = "Metric"
                if metric is None:
                    metric_name = type(metric).__name__
                    print(f"{metric_name} value on hold-out data:
                        {metric_values[fold]}")
```

```
                if writer is not None:
                    writer.add_scalars(
                        "evaluate_cv fold:" + str(fold + 1) +
                        ". Train & Val Loss and Val Metric" + writerId,
                        {"Train loss": training_loss, "Val loss":
                        loss_values[fold], metric_name: metric_values[fold]},
                        epoch + 1,
                    )
                    writer.flush()
                if loss_values[fold] < best_val_loss:
                    best_val_loss = loss_values[fold]
                    counter = 0
                    # save model:
                    if path is not None:
                        torch.save(net.state_dict(), path)
                else:
                    counter += 1
                    if counter >= patience_instance:
                        print(f"Early stopping at epoch {epoch}")
                        break
        df_eval = sum(loss_values.values()) / len(loss_values.values())
        df_metrics = sum(metric_values.values()) / len(metric_values.values())
        df_preds = np.nan
    except Exception as err:
        print(f"Error in Net_Core. Call to evaluate_cv() failed. {err=},
            {type(err)=}")
        df_eval = np.nan
        df_preds = np.nan
    add_attributes(net, removed_attributes)
    if writer is not None:
        metric_name = "Metric"
        if metric is None:
            metric_name = type(metric).__name__
        writer.add_scalars(
            "CV: Val Loss and Val Metric" + writerId,
            {"CV-loss": df_eval, metric_name: df_metrics},
            epoch + 1,
        )
        writer.flush()
    return df_eval, df_preds, df_metrics
```

4. The method `train_fold()` is implemented as shown above.

5. The method `validate_one_epoch()` is implemented as shown above. In contrast to the hold-out setting, it is called for each of the $k$ folds. The results are stored in a dictionaries `metric_values` and `loss_values`. The results are averaged over the $k$ folds and returned as `df_eval`.

#### 30.14.1.3 Detailed Description of the "test_cv" Setting

It uses the loss function specfied in `fun_control` and the metric specified in `fun_control`.

1. First, the method `HyperTorch().fun_torch` is called.
2. `fun_torc()` calls `spotPython.torch.traintest.evaluate_cv()` as follows:

```
df_eval, _ = evaluate_cv(
    model,
    dataset=fun_control["test"],
    shuffle=self.fun_control["shuffle"],
    device=self.fun_control["device"],
    show_batch_interval=self.fun_control["show_batch_interval"],
    task=self.fun_control["task"],
    writer=self.fun_control["writer"],
    writerId=config_id,
)
```

Note: The data set `fun_control["test"]` is used for CV. The rest is the same as for the `"train_cv"` setting.

#### 30.14.1.4 Detailed Description of the Final Model Training and Evaluation

There are two methods that can be used for the final evaluation of a Pytorch model:

1. `"train_tuned` and
2. `"test_tuned"`.

`train_tuned()` is just a wrapper to `evaluate_hold_out` using the `train` data set. It is implemented as follows:

```
def train_tuned(
    net,
    train_dataset,
    shuffle,
    loss_function,
    metric,
```

```
        device=None,
        show_batch_interval=10_000,
        path=None,
        task=None,
        writer=None,
):
    evaluate_hold_out(
        net=net,
        train_dataset=train_dataset,
        shuffle=shuffle,
        test_dataset=None,
        loss_function=loss_function,
        metric=metric,
        device=device,
        show_batch_interval=show_batch_interval,
        path=path,
        task=task,
        writer=writer,
    )
```

The `test_tuned()` procedure is implemented as follows:

```
def test_tuned(net, shuffle, test_dataset=None, loss_function=None,
    metric=None, device=None, path=None, task=None):
    batch_size_instance = net.batch_size
    removed_attributes, net = get_removed_attributes_and_base_net(net)
    if path is not None:
        net.load_state_dict(torch.load(path))
        net.eval()
    try:
        device = getDevice(device=device)
        if torch.cuda.is_available():
            device = "cuda:0"
            if torch.cuda.device_count() > 1:
                print("We will use", torch.cuda.device_count(), "GPUs!")
                net = nn.DataParallel(net)
        net.to(device)
        valloader = torch.utils.data.DataLoader(
            test_dataset, batch_size=int(batch_size_instance),
            shuffle=shuffle,
            num_workers=0
        )
```

```
        metric_value, loss = validate_one_epoch(
            net, valloader=valloader, loss_function=loss_function,
            metric=metric, device=device, task=task
        )
        df_eval = loss
        df_metric = metric_value
        df_preds = np.nan
    except Exception as err:
        print(f"Error in Net_Core. Call to test_tuned() failed. {err=},
            {type(err)=}")
        df_eval = np.nan
        df_metric = np.nan
        df_preds = np.nan
    add_attributes(net, removed_attributes)
    print(f"Final evaluation: Validation loss: {df_eval}")
    print(f"Final evaluation: Validation metric: {df_metric}")
    print("----------------------------------------------")
    return df_eval, df_preds, df_metric
```

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