Reputation based adaptive concession strategy.

Introduction:

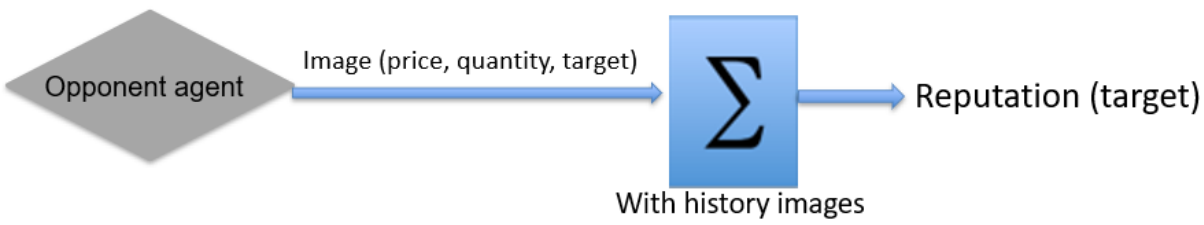
Reputation is usually defined as “what a social entity says about a target regarding his or her behavior.” A “social entity” is defined as a set of individuals plus a set of social relations among these individuals or properties that identify them as a group in front of its own members and the society at large. In the automated negotiating scenario, each agent can be regarded as a social entity with social relations built by negotiating with other agents.

Reputation implemented in the Agent 97 provides means of obtaining the level of collaboration exploiting learning from past negotiation records and serves as a basis of the optimal unit price. Generally, if the opponent agent proposes a unit price that is lower than expected unit price, the reputation of the opponent agent will be reduced in the case of selling and increased in the case of buying.

Design:

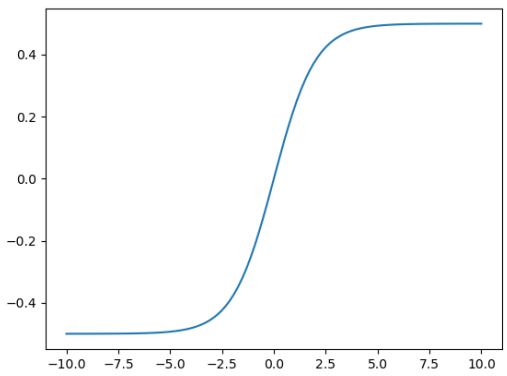
The expected unit price is selected from the best unit price that the opponent agent had offered, the best unit price that both agents had agreed on, the average unit price that Agent 97 had been offered and the best unit price among all contracts. When all of these records is empty, Agent 97 will simply use the best unit price under current status as the expected unit price.

The following figure shows the process of calculating the reputation.

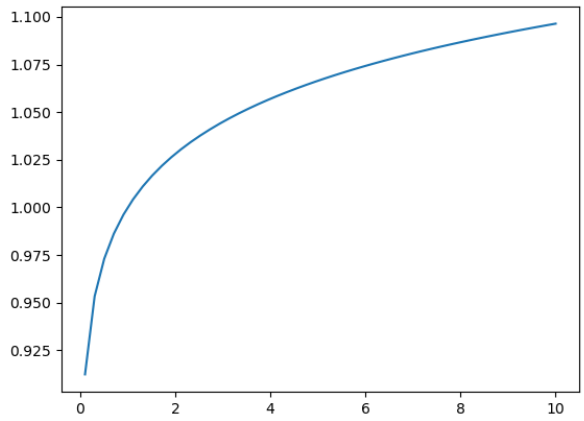


For Agent 97, I used negotiating images as source for reputation. It consists of aggregating the images that other agents in the environment negotiate with Agent 97 and taking this aggregation as the reputation value. With the information contained in proposals that Agent 97 received from other agents, images are obtained. The most important factor is the unit price. More specifically, first Agent 97 get the difference between expected unit price and proposed unit price by the opponent agent. After normalizing the value, Agent 97 sums the values up to get the reputation value. Additionally, when the opponent agent makes contracts with Agent 97, the reputation will also be increased, otherwise, for example, the negotiation breaks, the reputation will be reduced.

To get the concession rate for each agent according to the reputation, there is a sigmoid function used to normalize the reputation into a number within 0 to 1 range. After the normalization, the number can be used as the concession rate. The following figure shows the image of the sigmoid function.



When the reputation of the opponent agent is high, Agent 97 will accept the unit price that is higher than the expected price in the case of selling and lower in the case of buying. If there is no recorded reputation for the opponent agent, a time-based concession rate will be used.



The function used to obtain the time-based concession rate is based on function $y=x^{0.04}$. The graph of the function is showed on the left.

Results:

N. scores = 160 N. Worlds = 40

	agent_type	score
0	MyAgent	1.29407
1	LearningAgent	1.29322
2	GreedyOneShotAgent	0.814409
3	SyncRandomOneShotAgent	0.578816
4	RandomOneShotAgent	0.498742

N. scores = 180 N. Worlds = 60

	agent_type	score
0	MyAgent	1.26962
1	LearningAgent	1.23329
2	GreedyOneShotAgent	0.610692
3	RandomOneShotAgent	0.322644
4	SyncRandomOneShotAgent	0.237567

Two simulation results are shown in the above pictures. During the tuning process, learning agent has really been a competitive opponent. However, since Agent 97 became stronger every time I tuned the parameters after the simulation. Finally, it has a chance to beat learning agent in the tournaments. Interestingly, negative reputation appears more than positive reputation, which indicates the difficulty to predict the unit price that other agents may propose or accept.