KosAgent Strategy for Automated Negotiation Agents Competition (ANAC-2024)

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Abstract. The Automated Negotiation Agents Competition (ANAC) was held and I joined tournament of Automated Negotiation League (ANL). My agent is basically bullish and aim to reach an agreement with the other party as it approaches the end. In addition, it can choose the best option for the other person from a range of utility value choices I have determined. To implement it, I introduced some functional models. Also, I implemented to make suggestions so that the other party could not read my model.

1 Introduction

The Automated Negotiation Agents Competition (ANAC) is an international tournament that has held since 2010. I joined tournament of Automated Negotiation League (ANL). In this paper, I describe the detail of my agent (KosAgent) for ANAC. My agent's target aims to reach an agreement with the other party as it approaches the end.

2 Design

My agent is used different functional models for the acceptance and proposal strategies. However, I didn't implement opponent model. That's because I can find opponent's utility in this time. My agent is based on time dependent model. It is a model that decreases its own desired utility value over time.

2.1 Bidding Strategy

The bidding strategy uses time dependent function to compromise with the other party (1).

$$U_{target} = U_{max} - (U_{max} - U_{min}) \times (\frac{r}{R})^{\frac{1}{e}} \quad (1)$$

"U_{tatget}" means current utility value. "U_{min}" and "U_{max}" are meant to be the smallest and largest utility value (in this case, "U_{max}" is 1). As a result of parameter tuning, I determined that "U_{min}" is over 0.63. If reservation value is larger than 0.63, "U_{min}" is reservation value. If this is not the case, "U_{min}" is 0.63. "r" and "R" are current round and the number of negotiation in that session. "e" is a coefficient that varies with time. Creating a target function with these parameters resulted in Figure 1. This is the evolution of the proposal's own utility value when pitted against Boulware.

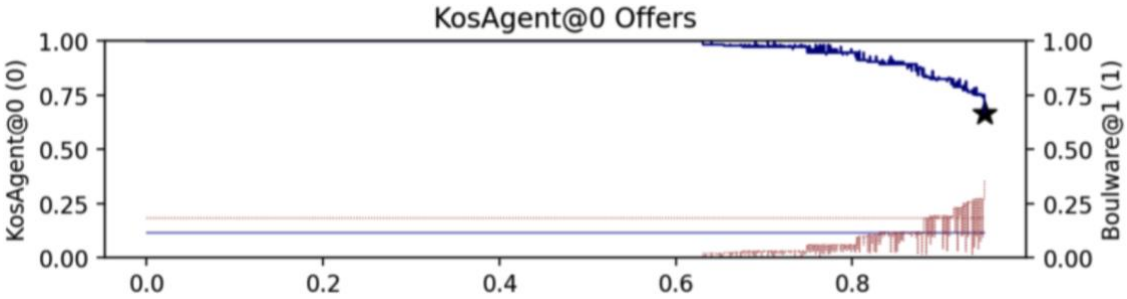

Figure 1: Bidding Function

As can be seen in Figure 1, my own utility value has swung upward several times during compromise. This is done by randomly selecting a proposal that is slightly higher than the utility value of the original proposal once every ten times to prevent the other party from estimating the model. We can find compromising all at once as I approach the end of negotiations.

2.2 Acceptance Strategy

The acceptance strategy is based on sigmoid function (2). It is a mathematical function used in machine learning and statistics to map input values to a range between 0 and 1, making it useful for tasks like binary classification. It has an S-shaped curve, which smoothly transforms input values into probabilities.

$$f(x) = \frac{1}{1+e^{-x}} \quad (2)$$

I created the acceptance function from equation (2). (3) shows. This function is used from 0.85 sec. Before 0.85 sec, I used time dependent functions as in the bidding strategy.

$$U_{accept} = \frac{1}{1+e^{40(2t-(1+0.85))}} \tag{3}$$

The actual graph of the acceptance function looks like Figure 2.

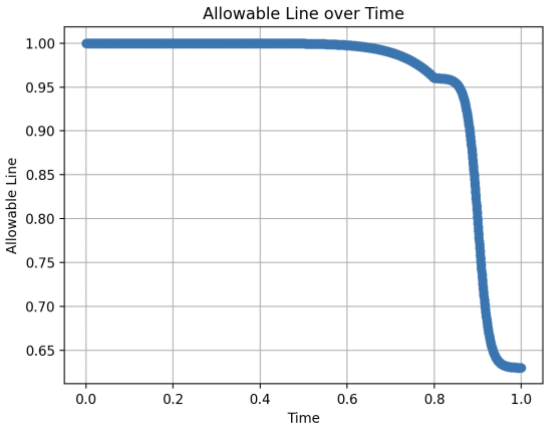

Figure 2: Acceptance Function

It can be observed that there's a tendency to compromise on the opponent's proposal after 0.85 seconds. Furthermore, to prevent negotiation breakdown in the final round, there is a protocol in place to automatically accept the opponent's proposal if it exceeds the reservation value.

3 Evaluation

When evaluating our negotiation agent, I joined the ANAC Live Competition. In the live competition, the final ranking of 4th out of 28 was obtained. Figure 3 shows. This is an advantageous position for a six-sevenths agent, indicating some competence.

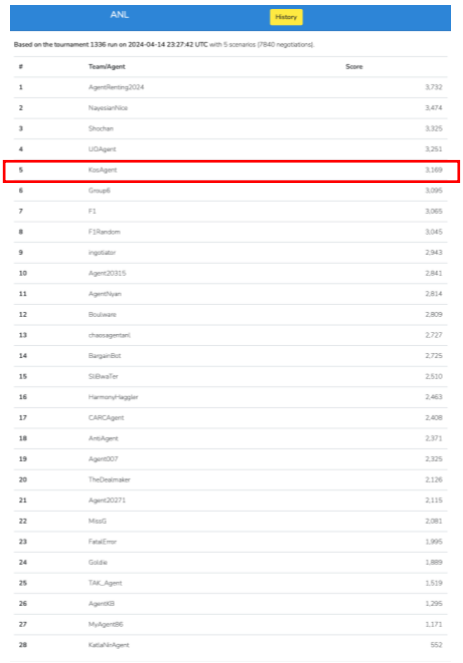

Figure 3: The result of Live Competition (2024-04-14 23:27:42 UTC)

4 Lesson and suggestions

Participating in ANAC for the first time provided me with an opportunity to deeply contemplate the design and construction of negotiation agents and strategies. Through my involvement in ANAC, I gained a more detailed understanding of negotiation models and the underlying principles behind them. This enabled me to derive insights for devising more effective strategies in the design of my negotiation agent. I learned that the choice of function for conceding significantly influences both proposal and acceptance behaviors. Participating in ANAC offered me fresh perspectives in negotiation theory and practice, contributing to my growth and learning.

5 Conclusion and Future Work

For this submission, I developed a negotiation agent called KosAgent, which tended to compromise more as the negotiation progressed. However, this agent was unable to implement an opponent model, such as estimating the opponent's reservation value. I think that estimating the opponent's reservation value and making proposals accordingly is important. Therefore, for next year's ANAC, For next year's ANAC, I would like to create an agent that incorporates an opponent model.