Automated Negotiation
Milestone 4

Team 8

October 2023

1 Introduction

Our goal is to create an agent which wins a negotiation against other rational agents while maximizing social welfare too.

Our agent aims to maximize it's own utility while maintaining a good utility for it's opponents too.

The assignment uses `Genius` platform to run the negotiation. To add the agent, we go to the `Parties` section and add the source code (`Team.class`) file as an agent.

2 Approach

2.1 Modelling Opponent Preference Profile

We use Logistic Regression to model the preference profile of the opponent. We label the bids proposed by opponent as positive samples and bids proposed by us and rejected by the opponent as negative samples.

We convert the bid received into a one-hot vector where each digit represents whether a choice for an issue was made or not. In the Japan trip domain, there are 4 issues with number of choices as 5, 4, 4 and 3 respectively so the one-hot vector would be of length 16 (5 + 4 + 4 + 3) and would contain 4 1's, each representing the choice made for the respective issue. So there will be one 1 in first 5 digits, one in next 4, one in next 3 and one in last 3. We pass an array of these vectors as the input features for the Logistic Regression.

Then we use this model to compute the probability that a bid will be accepted by the opponent.

2.2 Calculating Score for a Bid

We calculate the score of a bid as:

$$score(bid) = \beta * individual\_score(bid) + (1 - \beta) social\_score(bid)$$

We kept the value of β as 0.6 so as to give more weightage to individual score.

2.2.1 Individual Score

For calculating the individual score we maintain a threshold, which starts at 1 and decreases linear till a discounted target value we set.

If the utility pf the bid is below the threshold, the individual score of the bid is 0, otherwise, the individual is the average probability of acceptance by the opponents. This ensures if the bid has a bad utility for us, it is only proposed or accepted if it has a very good social score and if a there are multiple bids with good utilities for us, we propose the one that has the highest chance of being accepted by the opponent.

2.2.2 Social Score

The social score is calculated as follows:

$$social\_score(bid) = \frac{u(bid) + \sum(u_i'(bid))^2}{numOpoonents + 1}$$

Here $u(bid)$ is our own utility for the bid.
$u_i'(bid)$ are the probabilities of acceptance by the opponent for the bid given by our Logistic Regression Model. Since the bid utilities between 0 and 1 and we assume opponents are rational agents, we also treat this as the opponents' utility valuation for the bid.

2.3 Offering Strategy

We find the bid with the highest score and a utility higher than our reservation value and propose that bid.

2.4 Acceptance Criteria

We compare the utility of the bid proposed by the opponent with the bid we plan to propose next(described in section 2.3). If the utility of the bid proposed by opponent is equal or higher than the utility of our next bid we accept. Also if the number of rounds exceed 96% of total rounds we accept so as to not cause a negotiation failure.