CS404 Agent Based Systems Coursework: Auction Games

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INTRODUCTION

In this project, two different strategies need to be made against two different auctions. In both auctions, there are four types of paintings from different painters that correlate to a given value for each painter.

There are some common assumptions, each game is finite game against other participants and therefore has an end, each agent move is dependant on the moves it played previously such as which players have won which paintings and how much money every player has left. The knowledge all agents have is the type of auction, the budget left to everyone, the items sold to each agent and for how much it was gotten for, whether the bid winner pays amount or second highest, the amount of items available and the order of the items.

The item importance differs for each player at different rounds, as they are affected by their budget and that of the other agents. A strategy is then gotten using what a player already knows as well as estimates from what is not entirely known. Brute force is not advised as it would be difficult or impossible to solve the game using such methods. Also, winning has the best valuation followed by a draw and then a loss which has a negative valuation.

COLLECTION GAME

The aim of this game is to be the first agent to have a certain collection of paintings from the auction. In this auction, the collection is set to [4,2] meaning that to win the auction you have to be the first person to have four paintings of one artist and two of another artist.
Because every agent has the same budget, it can be difficult to perform better than another agent as the valuations for one painting is just a component of the valuation for the winning collection of paintings.

$\sum_{i=1}^{n} valuation_i = budget$ for the sequence of bought items$[1..n]$

The valuation for the sequence of paintings which are won in the auction, which results in a win should be equal to the budget since money is not useful once the auction is over.
Because the bidding process is competitive the agent bid should be as large as possible and the number of bids needed to win should be as small as possible. The money left at the end does not count so the aim is to spend all the money during the auction. To be competitive enough money will only be spent on the smallest amount of artists needed to win the auction. In conclusion,

the strategy should be based off the following aims:

- Minimise the number of bids
- Minimise the money left at the end
- Maximise each bid per item
- Spend only on x painting types (where x is the number of painting types needed in the collection)

As the winning bid is the highest in each round, bidding differently in different rounds for example high in one round and low in another round can cause you to lose out overall as the low bids may lose. Therefore the best thing to do is to bid equally among all the rounds for your selected painting type(s). In cases where the bids cannot be divided equally, the remainder is distributed between the bids.

If the level of importance on each bidding is same and the money waste on paintings other than the 4 of one type and 2 of another type with a total of 6 same type is 0, then Bidding = budget/needtowin. As the budget for each player is 1001 and 'need to win' is 6, the bidding is 167 in 4 instances and 166 in 2 instances according to this formula.

The rule for this strategy when you find the two paintings you want, you only bid on those two till you win. One is gotten by finding the first paining that appears four times in the auction first while the second is found by finding the painting other than the first that appears twice in the auction first. If the first bid is not successful for either of the paintings, then it tries to find another winning sequence int the next round.

When the agent has two paintings, it reaches a point where it has to decide which of the paintings it is going to aim for collecting four and which just two. This decision comes when it needs to bid to increase a painting type in its collection from two to three. It checks the list to see if the painting will be the first among the pair to reach the collection aim of four first and if it is it bids normally for it otherwise it bids zero.

1	2	3	4	5	6	7	8
D	R	P	D	R	D	P	R
9	10	11					
R	P	D					

Fig.1 An Auction example.

From the auction example D and R will be the painting type bidder for. In the 6th round instead of bidding normally for D, zero will be bid because the agent checks which type of painting will reach the maximum for the bigger collection with first and on seeing that it will be R, it doesn't bid as it has reached the maximum for the smaller collection.
Also in order to stop opponents from winning, when they are in a round which could be their final round to win, the agent bids one higher than the opponents budget, this will then stop his chance from winning that round.

An extension to my bot to help its performance would be to add leniency to it so it can increase and decrease value according to its wins and losses. Also cooperative bots could be added, in which one bot helps another to win by stopping other bots from winning rounds. These bots will look at the budget and goals of the other bots and making bids based on theirs to make sure they lose.

VALUE GAME

This game differs to the collection game in the sense that all the rounds in the value game are played out except when every bot runs out of money whereas in the collection, the game ends when a bot gets a certain collection or each bot runs out of money. The aim of this game is to have the largest valuation at the end of the auction. Therefore we could say that the maximum target value is 1 + (the sum of all the values/ two).

Although this is seen as the maximum it is not necessarily the best to aim for as aiming for such will give us a low value for each painting and therefore reduce our chances of winning.

- Therefore, the better target value will be 1+ (sum of all the values/ number of bots).
- To calculate bid for a painting we use the value of the painting, the remaining budget and the value of each player which is calculated as the total remaining value/ number of players. The bid is then money left * painting value / player value.
- Agression is used when the bot keeps losing to increase bids and then falls when the bot makes a win
- Each round the bid for the current item is decided by the bot.

Although it is only a calculated pursuit of the average, but because other players are more or less, and are likely to be too restrained, relatively low bids, this strategy is always possible to obtain higher value. And still based on the remaining value and money calculation ratio, you can get more value as much as possible.

From lectures during the course, proof has been given that being genuine with an agent's valuation is dominant[1], but only in situations where all agents risks are neutral. It is unlikely that the bot needs to bid as much as the value that is selected, however this may become more of a problem as other aggressive bots come into play. But since we have aggression scaling that is taken care of. So it stops agents that want to take advantage of the second place bid cost.
Another thought is the target value. If only two bots are in the auction, average value plus 1 could assure winning and a higher value is pointless. It is harder when there are more players to predict the final score of winner, Following multiple tests, 1.2 is picked to be the coefficient of the final target value, as it is also a bit more than the original value.

CONCLUSION

The strategies that I have made for the auction use game theory and mechanism design to provide solutions which should hold up against both risk averse rational agents and agents with different risk attitudes. The first auction aims to divide the budget evenly between all bids that make up the classification, this is the optimal and dominant strategy although it could end up making the winner random at times. The second auction both aim to distribute the budget equally over a set of items which have a summed value of a calculated target, one which the agent predicts will provide a more than half of the points.