

Agent Based Systems: Auction Game

I. INTRODUCTION

The project refers to the construction of an Auction game starring famous paintings of different artists. The Auction room has an announcer which represents the holder of the items to be sold. The bidders present their bid for that specific item being displayed for that round. The announcer visualizes the bids and declares the winner with the highest bid for that round. Moving from, the auctioneer collects all the payments and starts a new round with a new item to be sold. There are multiple objectives for this kind of auction.

The winning condition for some games is to gather a target number of paintings from the same artist, declaring the winner for that specific game. Otherwise, if the game would end when everyone runs off budget to utilized for new items being auctioned. A second scenario would be when every item of the auction system have been collected all and the person with the highest total of paintings wins the game.

II. THE GAME

The auction has a server name "AuctionServer", allowing to connect all the bidders into a specific room via a port. The winning condition is then announced. Alongside the bidder names and the number of the items being sold. The server declares an item to bid upon of the commencing round.

A game outcome is chosen by matching the game condition. Thus, requesting the bidder to pay the specific bid or a different quantity of cash. If the positive bid is been selected, then a random winner would be picked from the list of players. On the other hand, if the drawn bids are all = 0, no one wins that round and item are discarded. commencing the start of a new round.

The auction would continue until someone a winning condition is met. There are 3 possible outcomes; if everyone runs out of cash , the auction stops. If someone

has won the game by meeting the winning conditions, then he or she would win. On the other hand, if the auction has run out of items to be sold then, the game stop automatically.

In this auction system 4 games would be conducted and strategies to match the winning conditions needs to be performed to compete against other bots and real life players.

STRATEGY 1

This is the first game to be played in the auction. In this particular auction game the scope is to win 5 paintings of any artists, with the highest bid. The order of who wins when and what item is known. An example of this would be shown in Figure 1.

```
LAHIRU strategy 1 Budget left: 500.  
standing is: {'lahiru': {'Picasso': 3, 'Van_Gogh': 2, 'Rembrandt': 1, 'Da_Vinci': 4, 'money': 500}  
lahiru wins the Da_Vinci, and pays 50
```

Fig. 1. Auction Winner : Game 1 VS Bots

In this game, various strategies could be implemented to come up as the highest bidder, thus, obtaining the preferred painting. Players may try to bid aggressively to collect 5 paintings as quickly as possible; while trying to bid higher to block other players from collecting such painting. In this case, the preferred strategy devised, was A search for the paintings that would search for 'Da Vinci', 'Picasso', 'Van Gogh', 'Rembrandt' and their occurrences in the game for 5 times, if such would come by then collect it and try to come up with a score of 5, utilizing a counter for this job, was the perfect idea to compact the code into few single lines.

Initially, the idea was to bid aggressively to get a painting; for example, bidding 200 every time seemed efficient to gather the paintings as quickly as possible. However, notice that the longer the game would advance, the quicker the budget was lost.

Lowering the bid price would prove beneficial later on

as the longer the game goes players would slowly lose their budget and would be unable to make a consistent bid. Bidding 50 came to the advantage for the goal, whenever people would bet higher, the strategy devised would always bid 50. Following the principles of the agents, thus, this being a fundamental objective of a decision-making agent, as this can be related to a partially cooperative(V2) : "I'm happy with what you want, but even happier with what you don't".

50 is a composite number of 1000, this is because it is a competitive number when: n is a positive integer $n > 1$ which is not prime. Nash equilibrium is fundamental because players assume their knowledge based on strategies against others. Therefore, their strategies would be based around the knowledge by competing against others, allowing further analysis of the situation.

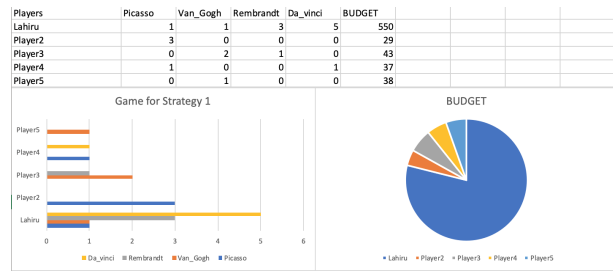


Fig. 2. Evaluation of 1st Strategy

As shown in Figure 2, we can notice players would constantly bid to obtain a painting. From this, we deduct that the players are bidding aggressively. Using a strategy that would wait for others to lose their budget is optimal for later scopes. Therefore, this particular objective claims 5 paintings much adequately.

STRATEGY 2

The second strategy consists of a similar game approach, where the bidders need to bid on the paintings to obtain at least 5 of them of any artists. The strategy that would be similar to such game, could be reutilized for the second strategy, however, we do not know the order of the auction, which limits our options. In this situation, a strategy needs to be implemented by depending mainly on the bidder's budget.

```
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 1000:
        bid = 175
        break
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 800:
        bid = 90
        break
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 700:
        bid = 100
        break
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 500:
        bid = 50
        break
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 200:
        bid = 60
        break
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 100:
        bid = 50
        break
for items in itemsinauction:
    if items == items and standings[mybidderid]['money'] <= 50:
        bid = 7
        break
```

Fig. 3. Strategy for game 2

In the figure above the code illustrates the budget and the list used as leverage, to bid with a higher probability of winning. This tactic is suitable for strategies that are trying to interpret the amount of bid a player is betting on. For example if everyone starts at 1000 and they bid 300, the budget will slowly decrease to 700.

players would try to bid high to obscure others. Hence, creating the illusion of possessing a high budget. If they bid high and they obtain the painting, the budget will go down drastically.

Despite that, there would be rounds which they cannot bid anything anymore, because their budget is too low and would not be able to compete anymore, as shown in the picture below, bidders weren't able to bid anymore after reaching a certain amount of budget, therefore giving our strategy the advantage.

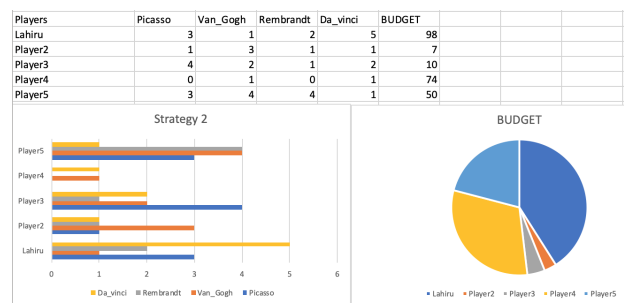


Fig. 4. Evaluation of 2nd Strategy

STRATEGY 3

In this auction game, the highest bid wins the game. The auction selects the highest bid from the bidders, and the player who bid such amount shall pay as requested. Hence, concluding that round. A new round would partake following a new painting to be bid, the game will stop after when everyone runs out of money.

Formidable strategies can be utilized for this kind of game. Some strategies can be thought logically and use a certain amount of bid to acquire the paintings. One key element to take into consideration is that this time the paintings have value, meaning a cost.

Picasso is worth 4, Van Gogh worth 6, Rembrandt worth 8 and Da Vinci worth 12. When bidding, it's important to take into consideration the paintings values. For example; if the auction starts a round with a Picasso painting, a player would bid low, because its value is less than a Da Vinci painting, therefore a Da Vinci would be more important to be obtained, however as this is a goal oriented game system, there can be different outputs to someone's decision, as a player can be partially cooperative(v2): "I'm happy with what you want, but even happier with what you don't" or instrumental or even multi-agent as this would allow maximum objective gain.

depend on the values of paintings the auction. Once the budget reaches 400 less, the strategy initialized would play passively letting other players bid as much as they want. Following this, our remaining budget would be handled to collect the rest of the paintings and reach the highest score.

On the picture below, we notice how this strategy manipulates players who tend to bid too aggressively. Evaluating the scores from the bar chart it represents how the budget even though having 1 Pound/Euro/Dollar has the highest score among the other players, this is due to the fact of the passive/aggressive bidding which emphasized the scope of the game. The highest bidder gets the painting.

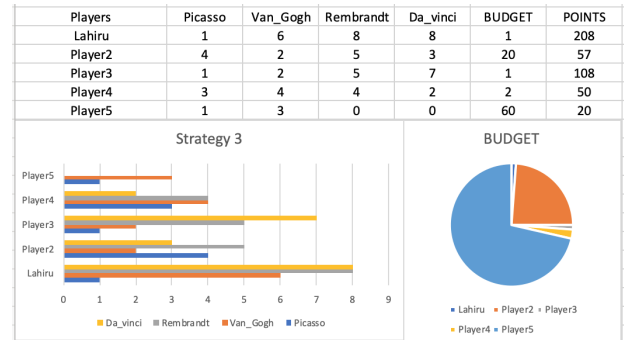


Fig. 6. Evaluation of 3rd Strategy

STRATEGY 4

The last and final game of the auction. This game is the most complex out of all the games, as it purely bases on the players' decisions and your own. Based on luck and strategies this could turn out to be in loss or win.

The rules of this game are the following: Highest total value at the end wins, the highest bidder pays the second highest bid and the auction order is known. Players need to take extreme precaution for this kind of game; the second highest bid would be chosen. This depends on the value of the paintings and the total budget, the player has.

Case N : 0, we have a set of players $P = \{p1, p2, p3\}$, their budgets are: $p1 = 100$, $p2 = 100$, $p3 = 100$, everyone bids 50, in this case the highest bid is the same as everyone, hence, a random winner shall be selected for this round

```
for value in values:
    if daV == value and itemsinauction[rd] == daV:
        bid = 165
        break
    if pic == value and itemsinauction[rd] == pic:
        bid = 150
        break
    if vG == value and itemsinauction[rd] == vG:
        bid = 130
        break
    if rM == value and itemsinauction[rd] == rM:
        bid = 110
        break
for cost in values:
    if cost == cost and standings[mybidderid]['money'] <= 400:
        bid = 100
        break
for costLess1 in values:
    if costLess1 == costLess1 and standings[mybidderid]['money'] <= 300:
        bid = 40
        break
for costLess2 in values:
    if costLess2 == costLess2 and standings[mybidderid]['money'] <= 200:
        bid = 60
        break
for costLess3 in values:
    if costLess3 == costLess3 and standings[mybidderid]['money'] <= 100:
        bid = 20
        break
```

Fig. 5. Third Strategy Code

The strategy is to have a cunning perceptive outsmart other players in making them think that you are going to bid higher when you are not. The strategy would

Case N : 1 , we have a set of players $P = \{p1,p2,p3\}$; p1 budget = 200, p2 budget = 100 and p3 budget = 50, p1 bids 45, p2 bids 25 and p3 bids 15; in this case the winner is p1 as he/she has the highest bid but I pay 15, and the game keeps going.

Case N: 2, consider a set of players, $P = \{p1,p2,p3\}$; p1 = 200, p2 = 100, p3 = 86, p1 bids 40, p2 bids 50, however p3 bids 65, in this case the winner has to be p3, because he/she has the highest bid, and will pay a bid of 40.

```
for cost in values:
    if cost == daV and standings[mybidderid]['money'] <= 1000:
        bid = 150
        break
    if cost == piC and standings[mybidderid]['money'] <= 1000:
        bid = 120
        break
    if cost == vG and standings[mybidderid]['money'] <= 1000:
        bid = 150
        break
    if cost == rM and standings[mybidderid]['money'] <= 1000:
        bid = 130
        break
for budget in itemsinauction:
    if budget == budget and standings[mybidderid]['money'] <= 700:
        bid = 100
        break
for budget in itemsinauction:
    if budget == budget and standings[mybidderid]['money'] <= 500:
        bid = 80
        break
for budget in itemsinauction:
    if budget == budget and standings[mybidderid]['money'] <= 300:
        bid = 75
        break
for budget in itemsinauction:
    if budget == budget and standings[mybidderid]['money'] <= 125:
        bid = 45
        break
for budget in itemsinauction:
    if budget == budget and standings[mybidderid]['money'] <= 50:
        bid = 25
        break
for budget in itemsinauction:
    if budget == budget and standings[mybidderid]['money'] <= 20:
        bid = 4
        break
```

Fig. 7. 4th Strategy Code

The strategy in this game is mainly being executed and experimented with other players. This tactic came advantageous to learn and train the strategy, allowing further understanding of the logic, behind the game.

The tactics taken into consideration were to initially bid a high amount of money when the budget was = 1000. However, this resulted in a 50% drop rate of success and resulting in obtaining paintings, causing a loss.

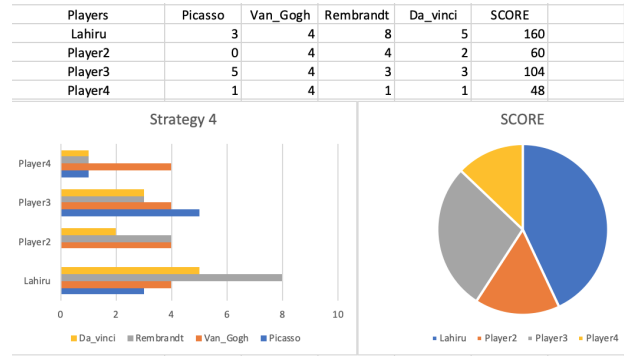


Fig. 8. Evaluation of 4th Strategy

Producing a situation where other players adapted for such. This strategy was left because it relied on aggressive behavior to bid. A static and passive bid was selected, commencing the budget at 1000, the bid selected was = 200. This is because that is what most people started within the beginning. Reducing the amount of money to bid was chosen to save bids for later rounds so that if a player would bid high they would have less budget at their disposal.

For example, if I bid 75 and my budget was 100, and a player bids 40 with a budget of 100 as well, I would win and I would also save money, by just paying 45 with a remainder of 55. So, from this our budget is been used more proportionally and more paintings can be collected by obscuring the truth and confusing the opponent.