

ID2209 – Distributed Artificial Intelligence and Intelligent Agents

Assignment 2 – Negotiations and Communication (FIPA)

Group 13

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Overview: Enhanced Festival with Auctioneer Dynamics

In the continuation of our simulation development in GAMA, we incorporated an Auctioneer agent within the festival environment to simulate dynamic interactions involving Dutch auctions. The Auctioneer agent interacts with festival attendees (Person agents) using the FIPA communication protocols, orchestrating auctions for items and managing bids.

A pivotal component introduced was the Dutch Auctioneer, designed to initiate, manage, and conclude auctions. It uses the FIPA protocols to inform Person agents about auction events and handle their responses to the Call for Proposals (CFPs).

How to run

To run the simulation model developed in this assignment, please follow these steps:

- Open GAMA Platform version 1.7.
- Import the provided project files into GAMA by selecting File > Import, navigating to the 'General' folder, and choosing 'Existing Projects into Workspace'. Select the archive file and complete the import process.
- Locate the Project2_Auction.gaml model within the imported project.
- Select the main experiment, which serves as the entry point for running the simulation.
- Press the 'Play' button or 'Start' to initiate the simulation run.

Species

Agent Auctioneer

The Auctioneer agent, distinguished by its grey square representation, is a central figure in the simulation's new auction mechanics. It uses FIPA protocols to interact with other agents, particularly during the auction process. The Auctioneer's decision-making is influenced by various internal states and responses from Agent Persons.

Parameter Tweaking:

Adjusting these parameters will influence the Auctioneer's behaviour:

- dutchPrice: The initial and decrementing price in the Dutch auction.
- minimumPrice: The threshold below which the auction is terminated if no bids are received.
- auctionCreationTime: The cycle during which the auctioneer begins the auction process.

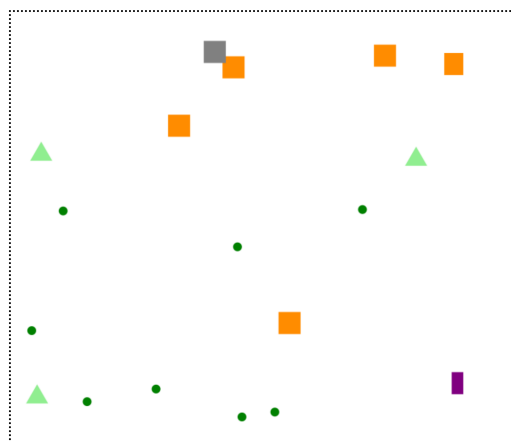


Figure 1: The info centres are represented as light green triangles. The stores are represented as

squares, with food stores being purple and drink stores being orange. The Persons (guests) who are dancing are represented as green circles. Hungry people are purple circles, and thirsty people are orange circles. In addition to this, the Dutch Auctioneer is represented by the grey square.

Implementation

Our simulation leverages the Foundation for Intelligent Physical Agents (FIPA) protocols to facilitate communication and negotiation between agents within a festival environment, enhanced by an auction process. The Auctioneer's logic was crafted to adhere to the Dutch auction format, initiating the auction with an announcement to all Person agents and handling their bids, until the price is accepted by a person or until the bid goes below the minimum price. There are two kinds of communication in this implementation:

1. Auctioneer Agent Communication
2. Person Agent Communication

1. Auctioneer Agent Communication:

- Informing of Auction Start:
 - At regular intervals, the Auctioneer uses the FIPA INFORM protocol to broadcast the start of an auction to all Person agents. This is implemented via a reflex that periodically initiates a conversation with potential participants, informing them of the auction's commencement.
 - The person can choose to participate in the auction or not, controlled by a probability of 0.005
- Initiating the Dutch Auction:
 - The Auctioneer initiates the Dutch auction process by sending PROPOSE messages to the Person agents who have shown interest in participating. These messages contain the current price of the item, which decrements over time to simulate the Dutch auction's bidding process.
- Accepting Bids:
 - Person agents can send ACCEPT_PROPOSAL messages if the proposed price matches their willingness to pay.
 - The Auctioneer listens for these acceptances and concludes the auction if a bid is accepted.
- Rejecting Bids:
 - If the Person agents find the price unacceptable, they can send REJECT_PROPOSAL messages back to the Auctioneer.
 - The Auctioneer monitors these rejections to adjust the auction dynamics accordingly.
- Concluding the Auction:
 - Once an offer is accepted or the price drops below a minimum threshold, the Auctioneer sends an INFORM message indicating the auction's end.
 - This message serves to notify all agents that the auction process has concluded.

2. Person Agent Communication:

- Participation Decision:
 - Person agents receive CFP messages from the Auctioneer and decide whether to

participate based on internal logic, which includes random chance and a maximum accepted price threshold.

- Auction Engagement:
 - Upon deciding to engage in the auction, Person agents communicate their intent to the Auctioneer using the ACCEPT_PROPOSAL or REJECT_PROPOSAL performatives, depending on whether the current auction price falls within their acceptable price range.
- Outcome Reception:
 - At the end of the auction, Person agents process INFORM messages from the Auctioneer to update their internal state, either concluding their participation in the auction or celebrating a winning bid.

The implementation effectively showcases how FIPA protocols can be employed to manage complex interactions within a multi-agent system. The use of these communication protocols allows for a dynamic and responsive simulation where agents can engage in real-time negotiations, reflecting a level of autonomy and decision-making that mirrors real-world scenarios.

Results

The simulation's execution showcases the Auctioneer's ability to manage an auction effectively. The logs provide insights into each stage of the auction, from the initial announcement to the final sale or auction conclusion. Observing the simulation in real time allows for a clear understanding of the Auctioneer's impact on the festival's dynamics.

```
Auctioneer 1.0 All the people Are Around: starting the auction
Auctioneer 1.0 receives reject messages from participants
Auctioneer 1.0 receives accept messages
Auctioneer 1.0 got accepted by Person(2): ['Person2, accept your offer ']
Auctioneer 1.0 Auction ended with sale
Person2 won the auction
```

Figure 2: The Dutch Auction was successful

```
Auctioneer 1.0 All the people Are Around: starting the auction
Auctioneer 1.0 receives reject messages from participants
Auctioneer 1.0 Auction ended without sale
```

Figure 3: The Dutch Auction was unsuccessful as the price went below the minimum price

Figures 2 and 3 depicting the logs from the auction's success or failure, offer a visual representation of the Auctioneer's effectiveness in engaging participants and finalizing sales. The outcome is directly influenced by the auction parameters and the Person agents' responsiveness to the auction process.

The addition of the Auctioneer agent adds a layer of complexity and interaction to the festival simulation, emphasizing the role of communication and negotiation in dynamic agent-based environments.

Challenge 1

To complete Challenge 1, we allowed multiple Dutch auctions. To do this, we created 3 auctioneers that performed auctions at the same time.

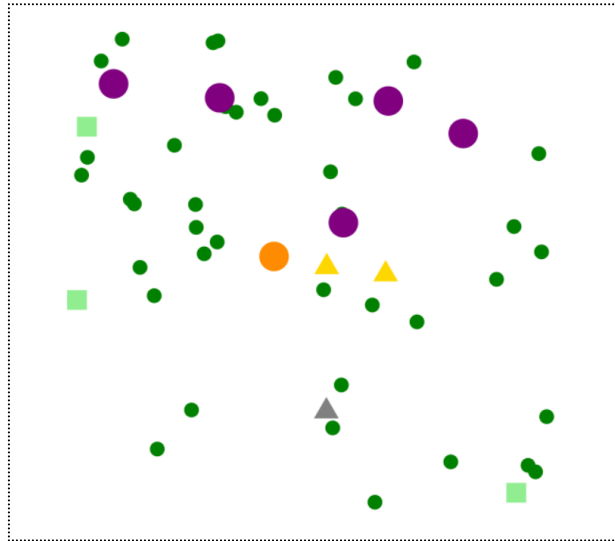


Figure 1 Challenge 1: the 3 auctioneers are represented by the triangles

The next step was to make the agent persons participate only in the auction that were interested. We created different items: Technology, Home, Clothes, and Vinted and implemented a solution to set a preferred item for each guest, in a random way.

```
Auctioneer 1 starting Dutch auction soon of typeHome  
Auctioneer 2 starting English auction soon of typeTechnology  
Auctioneer 3 starting English auction soon of typeVinted
```

Figure 2 Challenge 1: example of different types of items

Challenge 2

In addition to the Dutch auction, we implemented two more types of auction: the English auction and the Sealed auction.

We implemented it in the same way we did for the Dutch auction, but with the following logic:

- In the English auction, the auctioneer begins with the lowest acceptable price, bidders successively raise bids for the item until only a single bidder remains.
- In the Sealed auction, there is a single round, where bidders submit a sealed bid. Goods are then awarded to the agent that made the highest bid.

In our solution, each auctioneer can use only one type of auction, and according to this, they have different colours: gold for the English auctioneer, grey for the Dutch auctioneer and black for the sealed one.

```

Auctioneer 1 got an offer from Person(0) of 248 kronas.
Auctioneer 1 got an offer from Person(2) of 245 kronas.
Auctioneer Auctioneer 1: current bid is: 260. Offer more or miss your chance!
Person10: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 272 kronas.
Auctioneer 1 got an offer from Person(2) of 245 kronas.
Auctioneer Auctioneer 1: current bid is: 272. Offer more or miss your chance!
Auctioneer Auctioneer 1: current bid is: 272. Offer more or miss your chance!
Person2: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 287 kronas.
Bid ended. Winner is: Person(0) with a bid of 287
Person2: Price is too high I would like to withdraw
Auctioneer 1 starting English auction soon of typeTechnology
Auctioneer 1 got an offer from Person(0) of 305 kronas.
Auctioneer 2 starting Sealed auction soon of typeTechnology
Auctioneer 3 starting Dutch auction soon of typeHome
Person2: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 295 kronas.
Person2: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 304 kronas.
Person2: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 293 kronas.
Person2: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 317 kronas.
Person2: Price is too high I would like to withdraw
Auctioneer 1 got an offer from Person(0) of 306 kronas.
Person0 won the auction Technology
Person0 knows the auction is over.

```

Figure 1 Challenge 2: Example of starting different auctions for different items

The last part of the implementation was about the gained value of all three methods.

To do so, we printed the history of the different auctions and compared them.

It can be seen in the images that on average:

- The Dutch auction seems to be more variable and more favourable for the buyer (lower values on average)
- The English auction seems to be more favourable for the seller because has higher values of gain
- The sealed auction, with respect to the Dutch, has higher values and is more similar to the English one

```

DUTCH HISTORY
885
707
439
134
868
391
421
552
262
885
707
439
134
868
391
421
552
262
885
707
439
134

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SEALED HISTORY
875
718
718
718
584
584
584
995
609
609
354
354
931
584
931
584

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ENGLISH HISTORY
967
989
446
996
446
996
499
516
265
822

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Discussion / Conclusion

Positively, the assignment was beneficial in imparting knowledge on message passing and FIPA protocol to agents.

This segment highlighted the immense potential such functionalities hold in practical real-world applications.

Overall, the assignment provided a practical understanding of agent protocols and we enjoyed implementing it.