Distributed AI and Intelligent Agents - Homework 2

SmartMuseum Agent Framework

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Task 1: Communication in MAS

The agents that interact in this system are:

- The profiler agent
- The tour guide agent
- The curator agent

ProfilerAgent

The profiler interacts with the tour guide to get a virtual tour (list of artefacts to visit) and the curator agent when “visiting” an artefact to get its detailed information.

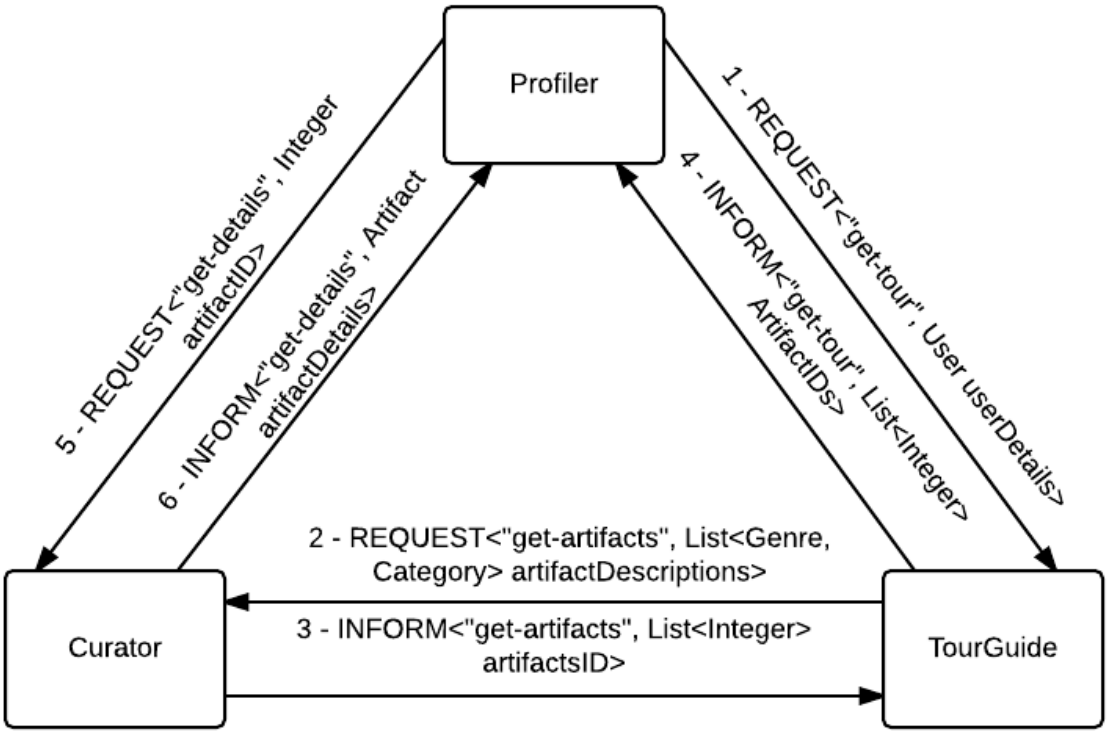
TourGuideAgent

The tour guide interacts with the **`CuratorAgent`** to get artefacts suiting the interests of a user:
When he gets at “get-tour” request from the **`ProfilerAgent`**, he builds a list of artifact’s (genre, category) pairs based on the user preferences, and he sends that list to the curator agent to get the ids of artifacts that verify those preferences.

CuratorAgent

The curator agent interacts with both the **`TourGuideAgent`** and the ProfilerAgent:

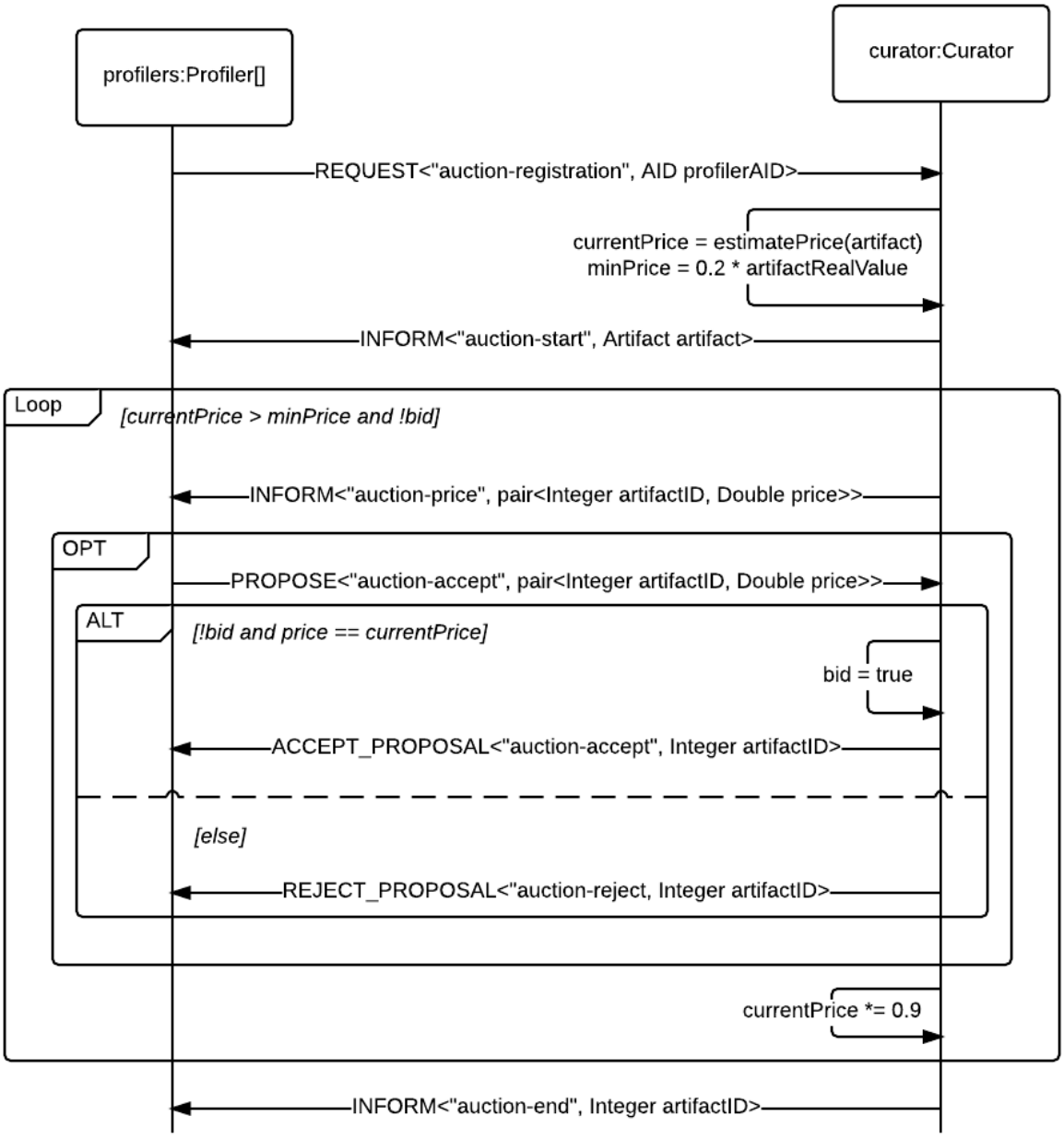
He gives a list of artifact ids to the **`TourGuideAgent`** when given a list of (genre, category) pairs by the **`TourGuideAgent`**, and **g**ives an artifact's detailed information when it's requested by the **`ProfilerAgent`**.



Interaction diagram: Message exchanged between the Profiler, Curator and TourGuide agents

Task 2: Negotiations in MAS - FIPA Dutch Auction

The Dutch Auction between the Profiler agents (buyers) and a Curator agent (seller) is processed according to the sequence diagram below.



Sequence diagram: Dutch auction protocol between the Profiler and Curator agents

ProfilerAgent

Description

Each agent have the same price estimate for a given artifact, which is randomly increased or lowered between 0 and 10% (in order to simulate the price variations retrieved from third-party knowledgeable API).

Dutch auction principle: An agent will accept the bid proposed by the curator agent as soon as the given bid is lower than the agent's bid.

Since the bidding strategy only depends on the price estimation and we want to avoid winner's curse, our agents will aim a price slightly under (3% less) the real artifact value (which has been estimated by third-party agents).

The price estimate is also decreased by 30% if the artifact category does not match the user's interests.

Behaviours

`DutchAuctionBuyerBehaviour` `extends` **`CyclicBehaviour`**

This is the main behaviour for profiler agents: when an auction starts (start-auction message received from a curator), the agent will estimate the price of the auctioned artifact (based on his interests, with some uncertainty) and will wait for an auctionning round where the bidding price is slightly lower to his estimation to send a proposal.

CuratorAgent

Description

According to the Dutch auction mechanisms, the seller (here the Curator agent) will start the auction with a bid higher than the one of any agent, then reduce it until an agent accepts it or the minimal selling value is reached. The auction will then be closed.

The initial price has been set twice higher than the real artifact value, and the minimal price is 30% of its real value.

The artifact price is reduced by 10% at each proposal made by the seller.

Behaviours

`CuratorStartAuction` `extends` **`WakerBehaviour`**

This behaviour starts an auction on a randomly picked artifact from the catalog. The initial price is set and a start-auction message is sent to all subscribed profiler agents.
This behaviour also starts the **`CuratorAuctionRound`** behaviour that will handle price change.

`CuratorAuctionRound` `extends` **`TickerBehaviour`**

At each auction round, the seller (the curator in our case) reduces the price of the product. If the price gets under the reserve price, the auction ends (with the current artifact not being sold), with an auction-end message being sent to everyone, and we start a new auction for a different artifact. Otherwise the auction continues.

`CuratorAuctioningBehaviour` `extends` **`CyclicBehaviour`**

This behaviour handles the bidding messages and subscribing profiler agents to the auctions. It will consider proposals by agents and accept them if they’re of an acceptable price (equal to the current bidding price), and reject proposals for different prices and items that are no longer

auctionned.

Results

As expected, the agents that have an interest in the auctioned artifact will win the auctions more often (and with a lower execution time) than the ones that have no interest in an artifact.
The uncertainty in price estimation and impact of the profiler agents' interests on price estimations allow us to illustrate the value perception diversity during an auction.

The number of messages exchanged between the seller and the buyers depend on two parameters:

- The **price reduction** between each proposal made by the seller :
  the quicker an accepted price is reached, the less messages are exchanged
- The **closeness** between the **buyer's price estimation** :
  If more than one agent accept a seller's proposal, the first one will win the auction, but additive REFUSE_PROPOSAL messages must be exchanged

Task 3: Game mechanism design in MAS

This problem has two main parameters:

- The quality of the sold artifact. Its states are:
  - High quality (HQ)
  - Low quality (LQ)
- If the artifact was sold or not to the profiler. Its states are:
  - Sold
  - Unsold

Three agents are involved in this process:

- The profiler agent is involved as he wants to buy an artifact, preferably of a high quality, and would prefer not to buy low quality artifacts.
- The curator agent is the medium between the profiler agent and the artist management. He prefers to sell an artifact (regardless of quality).
- The artist management ideally wants to sell a low quality product. But selling a high quality product is still preferable to not selling anything. (and not selling a high quality product is terrible because production costs are high)

Utility matrices

Curator / Artist Management	Sold	Unsold
HQ	1, 1	0, -1
LQ	1, 2	0, 0

Profiler / Artist Management	Sold	Unsold
HQ	4, 2	0, -2
LQ	1, 4	2, 0

The Nash equilibriums are highlighted in red in the matrices above.

The **dominant strategies** are as follow:

- Profiler: buy the products sold by the Artist Management, since the minimum value obtained with this strategy is 1 (0 otherwise).
- Artist Management: Sell a low quality product (0 is the minimum, -2 otherwise)