Homework - 2

Sebastian-Ion Nae

1 Prompt Engineering

1.1 ACME Agent

The main system prompt is being created in the constructor of the agent and it is composed from the following sentences.

System Prompt

You are company ACME and you have the following list of construction items: "n".join([f'item['name'] with maximum budget item['budget']" for item in budget_list]).You will only respond in JSON format.

More over we keep two different prompts for each phase one for auction and one for negotiation where we append to the system prompt

Auction Prompt

You are in an auction with companies that can offer the services. The auction will continue for 3 rounds. Your main goal is to have at least one company for each item willing to construct.

Negotiation Prompt

You are in a negotiation with companies that can offer the services. The negotiation will continue for 3 rounds. Your main goal is to have all the construction items built and if possible with the lowest price.

For the part where we want to make the model propose a budget for an item we have a prompt where we give the model what is the current status of the auction and we demand to respond in a JSON format followed by an example of the format. Moreover if there was a last bid from the previous round we add that also in the prompt and we give the final sentence for analyzing and getting the best results.

Propose an item buget

Propose a budget for the construction item auction_item in round auction_round + 1
Current status:
Round:auction_round + 1
Item:auction_item
Maxim budget:self.budget_dict[auction_item]
Last bid: self.last_bids[auction_item]

For the initiation part we also add the number of companies, the first agreed price (the one from the auction)

Offer an item buget

Propose an offer starting from the first agreed price for the construction item negotiation_item in round negotiation_round + 2
Current status:
Current Round:negotiation_round + 2
Max number of rounds: 3
Budget:self.budget_dict[negotiation_item]
Item:negotiation_item
Partner:partner_agent
How many partner you can negotiate with : self.partne_number[negotiation_item]
Last offer: self.last_bids[negotiation_item]
Agreed first price: self.agreed_first_price[negotiation_item]
f"Counter offer: self.partner_offers[negotiation_item]"

On top of those we also give instructions such as: "This is the last round, make sure to make a great offer or to accept the offer if it is not higher than the budget". And instructions for when having at most one company interested: "If you only have one partner to negotiate with or directly aceept the offer if it is not higher than the budget"

1.2 Company Agent

For the company agent we have a similar approach where in the constructor we have a main system prompt and on the given interaction we add to the model a user prompt with the current status of the game.

System Prompt

self.system_prompt = You are company role and you can do the following construction items:
self.system_prompt += .join([f"item['specialty'] with minimum cost item['cost']" for item in specialties])
self.system_prompt += "Your goal is to have at least one contract won."
self.system_prompt += "You only have 3 rounds to negotiate."
self.system_prompt += "You will only respond in JSON format."

On the decide if the company wants to bid or not on the given offer we also have the number of contracts won in the meantime as well as the current budget and the given JSON format of sending the message.

Bidding Prompt

Round:auction_round + 1
Item:auction_item
Minimum cost:self.specialties[auction_item]
Contracts won : self.contract_won
Current budget : item_budget
Last offer: self.last_offers[auction_item]
You will only respond in JSON format. Like this: 'accept': True or 'accept': False
"""

As for the response to the offer of the ACME company we keep the same idea of the prompt but we add more information about who is the initiator, how many contracts can the Company have, the number of how many contract it had won and the last offer as well as the negotiations left. Also an addition would be the sentence of increasing the offer ""You should try to increase the offer. If the offer is lower than the minimum cost, reject it.""

Offer Prompt

Respond to the offer for the construction item initiator_msg.negotiation_item in round initiator_msg.round + 1
Current status:
Current Round:initiator_msg.round + 1
Max number of rounds: 3
Number contracts won: self.contract_won
Item:initiator_msg.negotiation_item
Initiator:initiator_msg.sender
Negotiations left: 3 - initiator_msg.round
Last offer: self.last_offers[initiator_msg.negotiation_item]
Number of contracts left: self.number_of_specialties - self.contract_won

2 Justifications

ACME

Agent ACME Round auction: 0 Propose a budget for the construction item structural design in round 1
Current status:
Round:1
Item:structural design
Maxim budget:5000
Last bid: None
You will only respond in JSON format. Like this: 'budget': 1000.0 Think about it step by step, analyzing advantages and risks of its current situation "budget": 3000.0

Justification: The budget of 3000 is proposed considering the need to stay competitive by undercutting the maximum budget of 5000, while still providing a reasonable amount to cover essential structural design costs, balancing the advantage of cost-saving with the risk of potentially underfunding the project.

Company A

Agent A Round auction: 0
Round:1
Item:structural design
Minimum cost:6150
Contracts won : 0
Current budget : 3000.0
Last offer: None
You will only respond in JSON format. Like this: 'accept': True or 'accept': False
"accept": false

Because the current budget of Agent A is insufficient to meet the minimum cost for the structural design item.

Company B

Agent B Round auction: 0
Round:1
Item:structural design
Minimum cost:3602
Contracts won : 0
Current budget : 3000.0
Last offer: None
You will only respond in JSON format. Like this: 'accept': True or 'accept': False
"accept": false

Agent B's current budget is lower than the minimum cost required for the structural design item.

Company E

Agent E
Round auction: 1
Round:2
Item:electrics and plumbing
Minimum cost:3100
Contracts won : 0
Current budget : 3500.0
Last offer: 2500.0
You will only respond in JSON format. Like this: 'accept': True or 'accept': False
"accept": true

Agent E's last offer of 2500.0 is below the minimum cost required for the electrics and plumbing item

Company E

Agent E
Round negotiation: 0
Respond to the offer for the construction item structure building in round 1
Current status:
Current Round:1
Max number of rounds: 3
Number contracts won: 0
Item:structure building
Initiator:MyACMEAgent_ACME
Negotiations left: 3
Last offer: 7000.0
Number of contracts left: 3
My Counter offer: NoneYou should try to increase the offer. If the offer is lower than the minimum cost, reject it.
You will only respond in JSON format. Like this: 'offer': 1000.0
Think about it step by step, analyzing advantages and risks of its current situation
"offer": 6100.0 Agent ACME
Round negotiation: 0
Partner MyCompanyAgent_E responded with 6100.0
Partner offer 6100.0

Agent E received an initial offer of 7000.0 for the structure building item, which was above the minimum cost. However, realizing the potential to negotiate a better deal and considering the number of negotiations left, Agent E decided to counteroffer with 6100.0. This offer aims to secure a more favorable agreement while still maintaining a competitive edge. Agent ACME responded positively to this offer, indicating a successful negotiation outcome for Agent E

3 AutoGen

For this part of the assignment I have used the AutoGen framework. I have create three main agents:

- Initializer
- ACME Agent
- Company Agent

Among those ones we also need a manager agent which is used as a central point. All of the agents are set in the agent list of the group chat. Because the group chat takes turns into talking we need to define the state actions of the group chat, as described above.

```
def state_transition(last_speaker, groupchat):
    messages = groupchat.messages
    if last_speaker is initializer:
        return ACME_Agent
    elif last_speaker is ACME_Agent:
        return AutoCompanyAgent
    elif last_speaker is AutoCompanyAgent:
        return AutoCompanyAgent
    else:
        return ACME_Agent
```

The configuration for the agent is the same as for all of them, using GPT-3.5-Turbo

```
initializer = autogen.AssistantAgent(
    name="Init",
)

ACME_Agent = autogen.AssistantAgent(
            name="ACME",
            llm_config=gpt3_config,
)

AutoCompanyAgent = autogen.AssistantAgent(
            name="Company",
            llm_config=gpt3_config,
)
```

To simulate faster the interactions I have changed the code that we will only have one item to build.

We can see that in the single company the price from which the negotiation starts takes all of the 3 rounds whereas the when there are two companies the negotiation starts faster. One key difference is the fact that when there are two companies in the negotiation stage, the one that already has a contract won it won't try to win the contract and tries to maximize the profit whereas the one without the contract can accept a much lower price than the other one.

3.1 Single Company Monotonic Concession

The output of this interaction is:

```
    [Auction stage]
Item  :  structural designInit (to chat_manager):
Propose a budget for the construction item structural design in round 1
Current status:
{Round}:1
{Item}:structural design
{Maxim budget}:5000
{Last bid}: None

You will only respond in JSON format. Like this: {'budget': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'budget': 3000.0}

--------------------------------------------------------------------------------
 / 3000.0
Company (to chat_manager):

{Round}:1
{Item}:structural design
{Minimum cost}:4150
{Contracts won} : 1
{Current budget} : 3000.0
{Last offer}: None

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
Company (to chat_manager):

{'accept': True}

--------------------------------------------------------------------------------
Company (to chat_manager):

{Round}:1
{Item}:structural design
{Minimum cost}:3602
{Contracts won} : 0
```

```
{Current budget} : 3000.0
{Last offer}: None

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
Company (to chat_manager):

{'accept': False}

--------------------------------------------------------------------------------
    agent _bids :  dict_values([False, False])
responding agent are :  []
Item structural design in round 0 was not won by any company
#### House Building Environment ####

[Auction stage]
Item  :  structural designInit (to chat_manager):

Propose a budget for the construction item structural design in round 2
Current status:
{Round}:2
{Item}:structural design
{Maxim budget}:5000
{Last bid}: 3000.0

You will only respond in JSON format. Like this: {'budget': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'budget': 4000.0}

--------------------------------------------------------------------------------
 / 4000.0
Company (to chat_manager):

{Round}:2
{Item}:structural design
{Minimum cost}:4150
{Contracts won} : 1
```

```
{Current budget} : 4000.0
{Last offer}: 3000.0

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
Company (to chat_manager):

{'accept': True}

--------------------------------------------------------------------------------
Company (to chat_manager):

{Round}:2
{Item}:structural design
{Minimum cost}:3602
{Contracts won} : 0
{Current budget} : 4000.0
{Last offer}: 3000.0

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
Company (to chat_manager):

{'accept': True}

--------------------------------------------------------------------------------
agent _bids :  dict_values([False, True])
responding agent are :  ['MyCompanyAgent_B']
Item structural design in round 1 was won by ['MyCompanyAgent_B']
Item structural design in round 1 was won by B with 1 companies
2024-05-29 04:16:49,965 - environment - INFO - [NOTIFICATION] Companies ['MyCompanyAge
2024-05-29 04:16:49,966 - environment - INFO - [NOTIFICATION] The Auction Phase has fi
#### House Building Environment ####

[Negotiation stage]
Role ACME

Propose an offer starting from the first agreed price for the construction item struct
Current status:
{Current Round}:2
{Max number of rounds}: 3
```

```
{Budget}:5000
{Item}:structural design
{Partner}:MyCompanyAgent_B
{How many partner you can negotiate with} : 1
{Last offer}: 4000.0
{Agreed first price}: 4000.0
{Counter offer}: None

If the received offer is lower than the agreed first price or equal offer the same. Ot

If you only have one partner to negotiate with or directly aceept the offer if it is r

You will only respond in JSON format. Like this: {'budget': 1000.0} and only respond w

Think about it step by step, analyzing advantages and risks of its current situation
Init (to chat_manager):

Propose an offer starting from the first agreed price for the construction item struct
Current status:
{Current Round}:2
{Max number of rounds}: 3
{Budget}:5000
{Item}:structural design
{Partner}:MyCompanyAgent_B
{How many partner you can negotiate with} : 1
{Last offer}: 4000.0
{Agreed first price}: 4000.0
{Counter offer}: None

If the received offer is lower than the agreed first price or equal offer the same. Ot

If you only have one partner to negotiate with or directly aceept the offer if it is r

You will only respond in JSON format. Like this: {'budget': 1000.0} and only respond w

Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{
    "budget": 4000.0
}
```

```
--------------------------------------------------------------------------------
Buget: 4000.0
Role B

Respond to the offer for the construction item structural design in round 1
Current status:
{Current Round}:1
{Max number of rounds}: 3
{Number contracts won}: 0
{Item}:structural design
{Initiator}:MyACMEAgent_ACME
{Negotiations left}: 3
{Last offer}: 4000.0
{Number of contracts left}: 1
{My Counter offer}: NoneYou should try to increase the offer. If the offer is lower th

You will only respond in JSON format. Like this: {'offer': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation
Offer: 4000.0
Partner MyCompanyAgent_B responded with 4000.0
Conversation id conv_structural design_MyACMEAgent_ACME_MyCompanyAgent_B
initiator proposol offer :  4000.0
partner proposol offer :  4000.0
Negotiation for structural design was won by MyCompanyAgent_B with 4000.0
Contract for structural design was assigned for 4000.0 to company B
#### House Building Environment ####

[Negotiation stage]
2024-05-29 04:16:49,969 - environment - INFO - [NOTIFICATION] Construction item struct
#### House Building Environment ####

[Negotiation stage]
#### House Building Environment ####
```

3.2 Double Company Monotonic Concession

```
[Auction stage]
Item  :  structural designInit (to chat_manager):

Propose a budget for the construction item structural design in round 1
Current status:
```

```
{Round}:1
{Item}:structural design
{Maxim budget}:5000
{Last bid}: None

You will only respond in JSON format. Like this: {'budget': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'budget': 3000.0}

--------------------------------------------------------------------------------
 / 3000.0
Company (to chat_manager):

{Round}:1
{Item}:structural design
{Minimum cost}:4500
{Contracts won} : 0
{Current budget} : 3000.0
{Last offer}: None

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'accept': False}

--------------------------------------------------------------------------------
    agent _bids :  dict_values([False])
responding agent are :  []
Item structural design in round 0 was not won by any company
#### House Building Environment ####

[Auction stage]
Item  :  structural designInit (to chat_manager):

Propose a budget for the construction item structural design in round 2
Current status:
```

```
{Round}:2
{Item}:structural design
{Maxim budget}:5000
{Last bid}: 3000.0

You will only respond in JSON format. Like this: {'budget': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'budget': 4000.0}

--------------------------------------------------------------------------------
 / 4000.0
Company (to chat_manager):

{Round}:2
{Item}:structural design
{Minimum cost}:4500
{Contracts won} : 0
{Current budget} : 4000.0
{Last offer}: 3000.0

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'accept': True}

--------------------------------------------------------------------------------
    agent _bids :  dict_values([False])
responding agent are :  []
Item structural design in round 1 was not won by any company
#### House Building Environment ####

[Auction stage]
Item  :  structural designInit (to chat_manager):

Propose a budget for the construction item structural design in round 3
Current status:
```

```
{Round}:3
{Item}:structural design
{Maxim budget}:5000
{Last bid}: 4000.0

You will only respond in JSON format. Like this: {'budget': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{
    "budget": 4500.0
}

--------------------------------------------------------------------------------
 / 4500.0
Company (to chat_manager):

{Round}:3
{Item}:structural design
{Minimum cost}:4500
{Contracts won} : 0
{Current budget} : 4500.0
{Last offer}: 4000.0

You will only respond in JSON format. Like this: {'accept': True} or {'accept': False}

--------------------------------------------------------------------------------
ACME (to chat_manager):

{'accept': True}

--------------------------------------------------------------------------------
agent _bids :  dict_values([True])
responding agent are :  ['MyCompanyAgent_F']
Item structural design in round 2 was won by ['MyCompanyAgent_F']
Item structural design in round 2 was won by F with 1 companies
2024-05-29 04:04:34,428 - environment - INFO - [NOTIFICATION] Companies ['MyCompanyAge
2024-05-29 04:04:34,428 - environment - INFO - [NOTIFICATION] The Auction Phase has fi
#### House Building Environment ####
```

```
[Negotiation stage]
Role ACME

Propose an offer starting from the first agreed price for the construction item struct
Current status:
{Current Round}:2
{Max number of rounds}: 3
{Budget}:5000
{Item}:structural design
{Partner}:MyCompanyAgent_F
{How many partner you can negotiate with} : 1
{Last offer}: 4500.0
{Agreed first price}: 4500.0
{Counter offer}: None

If the received offer is lower than the agreed first price or equal offer the same. Ot

If you only have one partner to negotiate with or directly aceept the offer if it is r

You will only respond in JSON format. Like this: {'budget': 1000.0} and only respond w

Think about it step by step, analyzing advantages and risks of its current situation
Init (to chat_manager):


Propose an offer starting from the first agreed price for the construction item struct
Current status:
{Current Round}:2
{Max number of rounds}: 3
{Budget}:5000
{Item}:structural design
{Partner}:MyCompanyAgent_F
{How many partner you can negotiate with} : 1
{Last offer}: 4500.0
{Agreed first price}: 4500.0
{Counter offer}: None

If the received offer is lower than the agreed first price or equal offer the same. Ot

If you only have one partner to negotiate with or directly aceept the offer if it is r

You will only respond in JSON format. Like this: {'budget': 1000.0} and only respond w
```

```
Think about it step by step, analyzing advantages and risks of its current situation

--------------------------------------------------------------------------------
ACME (to chat_manager):

{
    "budget": 4500.0
}

--------------------------------------------------------------------------------
Buget: 4500.0
Role F

Respond to the offer for the construction item structural design in round 1
Current status:
{Current Round}:1
{Max number of rounds}: 3
{Number contracts won}: 0
{Item}:structural design
{Initiator}:MyACMEAgent_ACME
{Negotiations left}: 3
{Last offer}: 4500.0
{Number of contracts left}: 1
{My Counter offer}: NoneYou should try to increase the offer. If the offer is lower th

You will only respond in JSON format. Like this: {'offer': 1000.0}

Think about it step by step, analyzing advantages and risks of its current situation
Offer: 4500.0
Partner MyCompanyAgent_F responded with 4500.0
Conversation id conv_structural design_MyACMEAgent_ACME_MyCompanyAgent_F
initiator proposol offer :  4500.0
partner proposol offer :  4500.0
Negotiation for structural design was won by MyCompanyAgent_F with 4500.0
Contract for structural design was assigned for 4500.0 to company F
#### House Building Environment ####

[Negotiation stage]
2024-05-29 04:04:34,431 - environment - INFO - [NOTIFICATION] Construction item struct
#### House Building Environment ####

[Negotiation stage]
#### House Building Environment ####
```