Evaluating Human versus AI Efficiency in Negotiations

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Project Idea

Determine if AI can replicate negotiation strategies and overall success relative to human performance.

Problem Abstract

Our team is addressing the increasing artificial intelligence (AI) presence on the internet and how it can be applied to negotiation. With the recent rise of sophisticated AI technologies, the internet is experiencing a rapid rise of "bot accounts," or automated accounts that rely on large AI models to produce output instead of traditional human users. Our team plans to address the increase of AI-driven agents that impact online interactions and their subsequent negotiating patterns by evaluating their negotiation performance when compared to humans.

Bot accounts can interact with other human accounts in the same way human accounts interact with other human accounts, such as replying to posts, negotiating situations, and more, all while being indistinguishable from a human's perspective. For example, Nina Schnick, an adviser, speaker, and AI thought leader, stated that she believes close to 90% of online content will be completely AI generated in 2025 [1], meaning there must be hundreds if not thousands of artificially generated content from these bots all over the internet already. Therefore, it is not a huge leap for AI agents to take on the role of negotiators, especially when communicating through online mediums.

However, humans are starting to catch on to many tell-tale signs of content being AI generated. For example, many professors are now able to tell if Chat-GPT or a similar artificial intelligence wrote an essay for an assignment by using tools such as GPTZero with high levels of accuracy [2]. So, humans might be able to determine if the agent they are negotiating with is AI-driven, thereby lessening the negotiating power of the agent.

Within the ever-changing AI scene, there is ambiguity around whether or not humans can make this distinction. Our team plans to address whether or not AI-driven bots can be effective negotiating agents against humans. We plan to make conclusions on how effective these agents are over time when “simulating” a human’s negotiation tactics in a competitive network environment.

Our team has to main hypotheses that underlie our process that we will statistically verify or reject:

- *The type of agent has no effect on the success (utility) of the outcome.* In other words, this hypothesis claims that no relationship exists between agent type (human or AI) and negotiation success (defined by utility and measured by our metrics).

- *AI agents will be significantly faster at reaching a conclusion than human agents*. In other words, this hypothesis argues that AI agents will be faster, and therefore take less iterations to reach equilibrium, when compared to human agents.

Problem Importance

This problem is critically important in today’s day and age. With the heavy importance of negotiation in today’s life, users may be left behind as they become unable to outpace the speed and effectiveness of an AI-model’s negotiation skills. We hope to verify hypotheses surrounding AI and its possible usage in negotiation such that other negotiators know how to best set themselves up for success. Ideally this involves using AI models to either speed up the negotiation process or improve gained utility.

Addressing the Problem

To address this problem, we propose implementing two negotiator agents that can negotiate in a competitive network powered by ANAC [3]. ANAC is a group of tournaments, ranging from purely mathematically described agents to human-oriented agents, that is designed to compare the efficiency and effectiveness of negotiation agents. For example, one agent developed in ANAC could utilize an identity function to represent the utility gained from a given negotiation deal and make probabilistic decisions on whether or not to accept a negotiation status. However, all agents created for ANAC, regardless of their sub tournament goal, use mathematical and statistical methods to make decisions.

However, our team is not focusing on creating rigorously-logical agents but instead is focusing on delegating decision making to external sources, whether that be a human brain or a large language model. So, our team will be using the underlying negotiation framework used in all ANAC competitions, NegMAS. NegMAS is a python library for developing and evaluating negotiation agents through simulated environments [4]. Our team used NegMAS’ custom agent ability to develop agents that could delegate decision making to other sources of knowledge. Our team will develop two custom agents: one agent will be human driven, where humans provide input to make negotiating decisions, and one agent will be AI driven using a large language model. These two agents can play either the role of a buyer or a seller in the negotiation process.

Once our team has these two agents, we will encounter all three matchups as listed in the research paper by Cummin and Jensen [5]. In this paper, Cummins and Jensen address how artificial intelligence can impact the complicated area of negotiation when humans have access to AI tools. This paper defines three different matchups: solely humans, humans versus AI, and solely AI. These negotiation teams compete against other teams in a negotiation-style conversation, where each team could prepare separately to identify "bargaining chips" and primary goals of the resolution. Teams are then measured on a set of metrics, including preparation time, value realized, and time until completion. This paper constructs many key findings, which include:

- AI models can be trained to encourage mutually beneficial negotiations, incentivising users to be transparent about the negotiation and thereby increasing collaboration scores.
- Negotiation teams without access to an AI model often ran out of time and were therefore forced to make last minute, likely non optimal decisions. Therefore, the use of AI agents in negotiating led to a higher value realization in numerous situations.
- Teams with access to AI models are able to analyze and address negotiations much faster than teams without access, speeding up the negotiation process.

First, our team created a list of issues the negotiation will focus on. Simple negotiations, such as negotiations about a single price, can become so abstracted that the complex natural language has no effect on the outcome. For example, a human buyer could intrinsically value an item at $10 and will therefore never buy the item at above $10, thereby either obtaining the item for $10 or less or ending the negotiation. This style of negotiation offers so little wiggle room that it becomes extremely difficult to draw meaningful conclusions to test our hypotheses. In order to reduce this problem, we use three issues in our negotiation: price, quantity, and delivery time. As explained in the natural language prompts, different negotiating agents value these issues differently.

Each issue has a name and the associated value range negmas will use for that issue.

- Price: $1 to $30
- Quantity: 1 to 10 items
- Delivery time: 0 to 10 units of time

Each negotiator is shown a prompt that outlines the goal of the negotiation. The exact prompts for the buyer agent and seller agent are listed in the appendix. The prompt is the same for the human and AI agent, ensuring that no extra information is given to either party. The main goals of the negotiators depend on their roles and are summarized as follows.

Buyer agent:

- Wants the lowest price possible
- Wants the highest quantity possible
- Wants a quick delivery time
- Values lower price above other issues

Seller agent:

- Wants the highest price possible
- Wants the highest quantity possible
- Is relatively indifferent about delivery time
- Values higher price above other issues

By setting up the simulation in this manner, we create multiple dynamics that affect the decision making processes of the negotiators. The buyer and seller are primarily negotiating about the price of the items being sold, but they both have other issues to resolve and/or change to make a more favorable negotiation outcome. Both buyers and sellers would ideally want a high level of quantity at their preferred price, but this value may fluctuate depending on how the negotiation proceeds, especially considering that the negotiator does not know the intention of the other negotiator.

In addition, the delivery time represents a situation where one agent prefers an outcome while the other agent prefers no set outcome. This is intended to give the seller a way to force the buyer into a settlement by applying "concessions" to the delivery time field. Our team will study this effect by analyzing our results of various negotiations.

In order to ensure that our agents provide understandable output for NegMAS, we capture human input through specific prompting, where humans only enter relevant information to the negotiation. This includes only specifying the number for negotiation issues, or using a ‘y’ or ‘n’ character to accept or deny an offer. To ensure that the AI negotiator creates understandable output for the negotiation, we describe tool call functions that force the AI model to respond in pre-described manners, such as only saying "yes" or "no" [6]. This guarantees we can accurately conduct the simulation and do not have to plan for extra overhead of parsing natural language, which is not a goal set out to be studied/researched by this project.

In addition, our team defines two basic utility functions in order to plot a representative utility score for each agent throughout the negotiation. This is an approximation of the true utility function of each agent, as the true function is located inside the human’s brain or large language model and cannot accurately be graphed. For the purposes of drawing conclusions about overall trends, we represent each negotiation outcome as a linear function with the same weight for each issue following that agent's preferred outcome. So, for example, we define the utility of the negotiated price to the buyer as a linear function with a slope of negative one, meaning the lower the price the more utility the buyer receives. These utility function approximations are located in the appendix.

Because of our abstract setup, our team has the ability to define which two agents will participate in the negotiation (human vs human, ai vs ai, human vs ai), as well as which role will start in the negotiation (buyer or seller). Our team then ran through multiple different scenarios to test all different combinations of negotiation environments to gather results and draw conclusions for the project.

The negotiation process proceeds like a traditional negotiation. One agent starts off the negotiation by proposing a set of values for every issue. The opposing agent then has a choice to accept or reject that proposed outcome. If the opposing agent accepts the outcome, then the negotiation is finished, and the outcome is the set of values previously proposed. If the opposing agent rejects the outcome, then that agent then proposes a new set of values for every issue that will get offered to the original agent. This process repeats until either one agent accepts the negotiation or the limit of negotiation rounds is reached. A cap of 20 negotiation rounds was set for each negotiation, but no tested negotiation ever reached this limit, giving our team confidence that round limit is not an issue when verifying our hypotheses.

Challenges, Alternatives, and Justification of Approach

Some significant challenges our team encountered was a lack of understanding by AI models. During initial development, AI models would return information that could not be processed well or would fail to return coherent information entirely. For example, when an AI agent was asked to accept or reject a negotiation deal, it could instead return multiple sentences explaining why it would deny the offer. This proposes a significant challenge in how to run multiple rounds of a negotiation, as these long-winded explanations were hard to parse for the AI negotiator's true meaning. In order to remedy this, our team used prompt engineering and response validation to ensure that AI models would only return information that our negotiation setup could understand.

Another challenge our team faced was encoding negotiation results into understandable metrics. Because most of the decision making happens in a black box, we cannot describe how the internal thought process of the negotiators occurs with 100% accuracy. NegMAS contains many useful metrics to describe agent behavior as if all agent knowledge was known, as if the agent was purely described mathematically inside of python. However, we had no easy method of determining agent utility in a negotiation. Our team decided to go with a simple approach that could approximate utility using our buyer/seller utility functions, albeit with the knowledge that these utility functions are not completely accurate. However, these functions still give us an intuition about the agent's high-level capacity and understanding of the situation, thereby still helping us draw meaningful conclusions. An alternative method would be to customly tweak these utility functions for a more complex negotiation as the negotiation continues, but this was deemed too difficult by our team to implement.

One alternative would be to create an environment where agents could take advantage of the weaknesses presented by other agents. For example, if AI agents were informed that they were negotiating with humans, they could use tactics to overwhelm the human's information-absorbing abilities to obtain a better outcome. Another example could be a human agent utilizing prompting methods to force the AI agent to produce an outcome that would be better for the human. These methods would have to take place in a more open and natural negotiation environment, unlike the strict one implemented in this project. Specific negotiation metrics as described in this project would be hard to emulate, but metrics on the success of taking advantage of another agent could be more readily interpreted.

Evaluation of Approach

Our approach is evaluated using two main methods. First, NegMAS produces an output graph showing how the negotiation takes place over time. Secondly, we can directly look at the proposed outcomes and final outcome of the negotiation to draw conclusions about the success of each agent. Our team can graph these metrics over time until an agreement is reached in order to make valuable insights about the simulations in reference to our hypotheses.

Example NegMAS metrics for negotiation include:

- *Iteration Count*: length of a simulation or time it took to reach an agreement
- *Pareto Distance*: distance between current state and most efficient state
- *Max Welfare Distance*: distance between current state and state with maximum utility
- *Relative Time*: time taken for the negotiation to be completed
- *Negotiation success*: whether or not the negotiation succeeded

Example metrics our team can draw by analyzing how outcomes change over the negotiation include:

- *Utility Loss* = loss of utility when compared to true evaluation/expected outcome
- *Satisfaction level* = $\frac{total\ lost\ utility}{max\ utility}$
- *Utility* = how valuable a current state is to a given agent

A demonstration of our project can be seen as follows. First, we define what agents we want participating in the simulation and what role will offer a negotiation outcome first. In this example, we create two AI agents that will oppose one another.

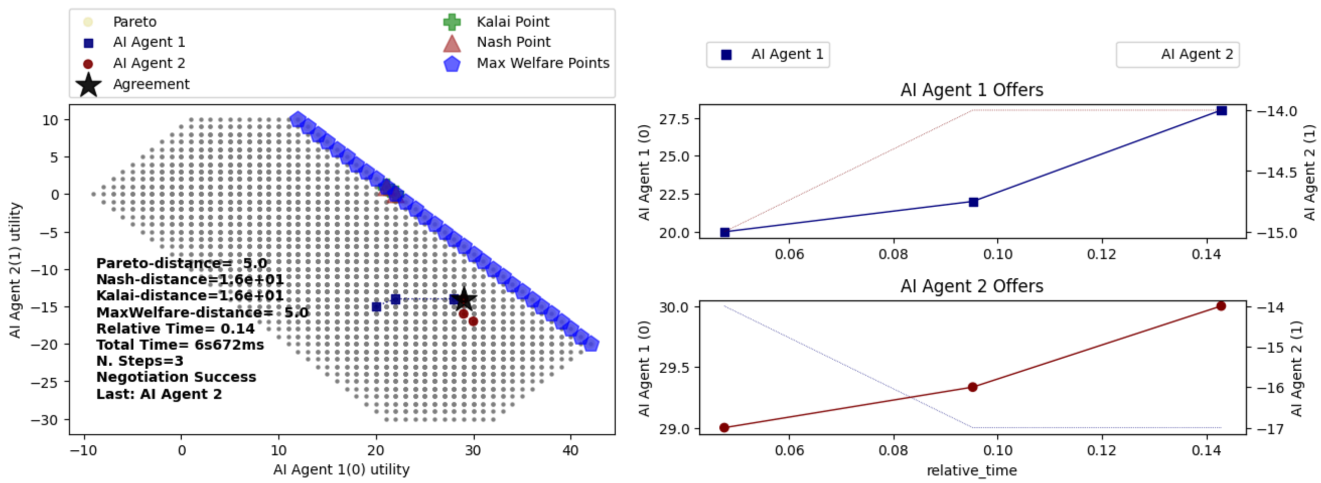
Python
```python
# Define what agent types will be run in this negotiation
agent_types = ["ai", "ai"]

# Define which role starts the negotiation
starter_role = "buyer"
```

Because both agents are AI driven, we can wait for the negotiation to end and then analyze all results, as human input is not needed. Once the negotiation is completed, the program outputs the final agreement as a python tuple of determined price, quantity, and delivery time, as well as all of the steps and proposed outcomes associated with them. Then, NegMAS can plot a graph showing advanced metric calculations according to our custom-defined negotiation metrics, as seen below.

Unset
```
Final Agreement: (23, 9, 3)
Step 1:
  Agent 1 (ai - buyer) proposed action (20, 5, 5)
  Agent 2 denied offer
Step 2:
  Agent 2 (ai - seller) proposed action (25, 8, 3)
  Agent 3 denied offer
Step 3:
  Agent 1 (ai - buyer) proposed action (20, 6, 4)
  Agent 2 denied offer
Step 4:
  Agent 2 (ai - seller) proposed action (24, 8, 3)
  Agent 3 denied offer
Step 5:
  Agent 1 (ai - buyer) proposed action (22, 8, 2)
  Agent 2 denied offer
Step 6:
  Agent 2 (ai - seller) proposed action (23, 9, 3)
  Agent 3 accepted offer
```

[Negotiation agreement and proposed outcomes log]



[NegMAS metric graph]

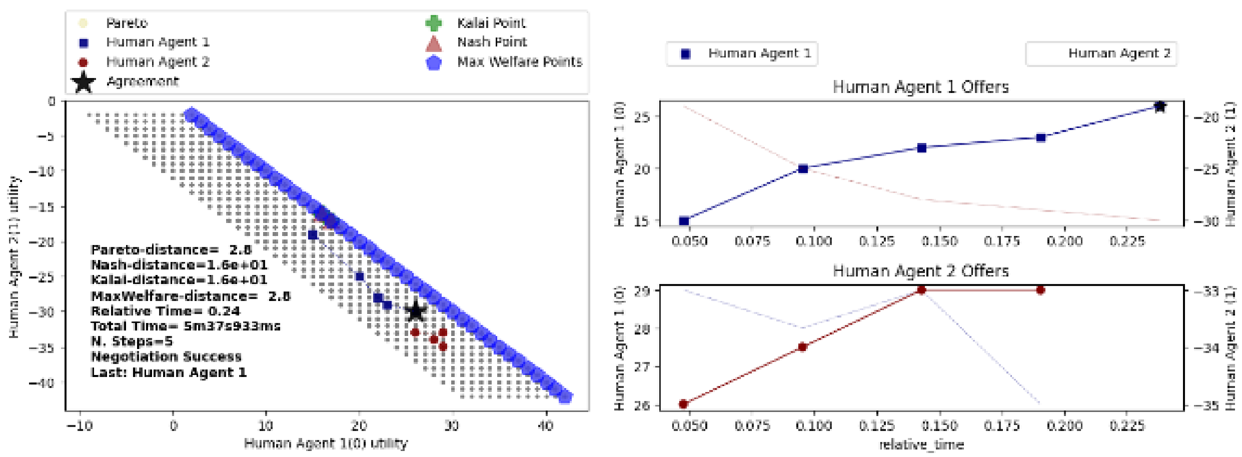
These steps can be analyzed directly by our team to produce conclusions. The exact same methodology can be used for human vs ai and human vs human negotiations, with the only difference being that humans are prompted for input as the program progresses, which can be seen in the appendix under human negotiation prompts.

Main Findings

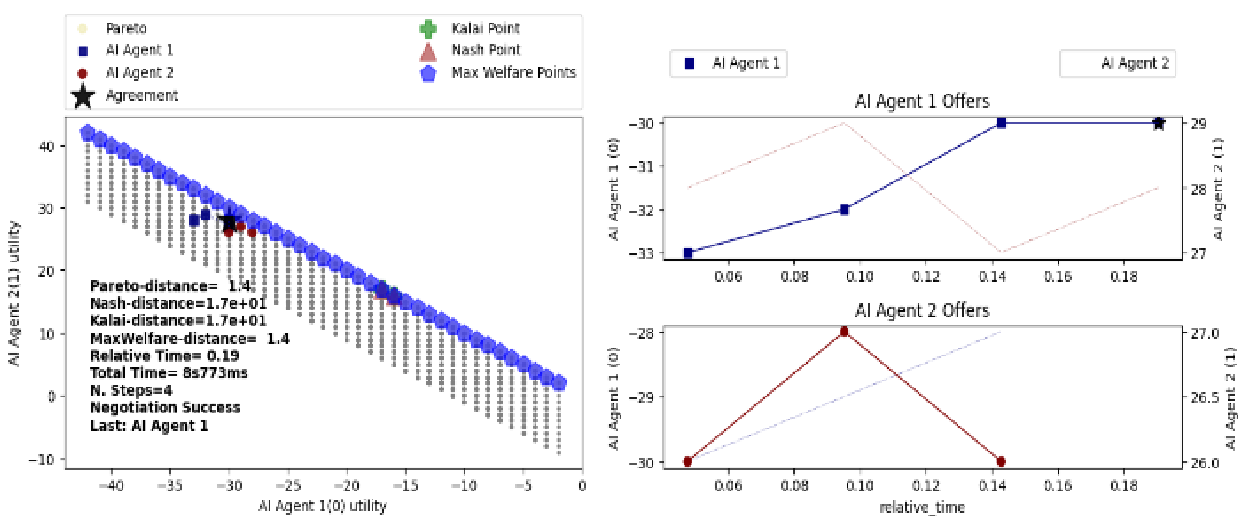
The data used to justify these conclusions can be seen in an external spreadsheet linked in the appendix.

As discussed in the beginning of the report, the first hypothesis proposed that the type of agent, regardless of type, would not have an impact on the outcome of the negotiation. The data gathered from our project appears to not support our hypothesis and instead supports the argument that humans are more effective negotiators when compared to AI. Human agents regularly led to higher satisfaction levels in negotiations when facing AI negotiators. This is supported by the average satisfaction scores for human agents negotiating against AI agents, which were 15% higher for human buyers versus AI sellers and more than 40% higher for human sellers versus AI buyers. Interestingly, negotiations with both human agents and both AI agents had similar satisfaction levels for both roles at approximately 70% seller satisfaction and 54.5% buyer satisfaction. This clearly suggests that AI negotiators perform suboptimally when negotiating against human agents.

The second hypothesis stated that AI agents would be significantly faster at reaching an agreement. Based on the results graph, we can see that the data on total negotiation time showed that the AI agents were much quicker when it came to reaching conclusions. AI only negotiations took approximately 6.42 seconds on average, whereas human-only negotiations took 184 seconds on average. So although AI agents were not as successful when it came to maximizing utility, they did seem to be significantly faster when it came to reaching conclusions. AI agents took on average the same number of rounds (5.857 rounds) to complete negotiations when compared to humans (6 rounds). Two example rounds can be seen below, in which the humans steadily decrease utility to reach their gain and take a significant amount of time, whereas the AI utility fluctuates around.

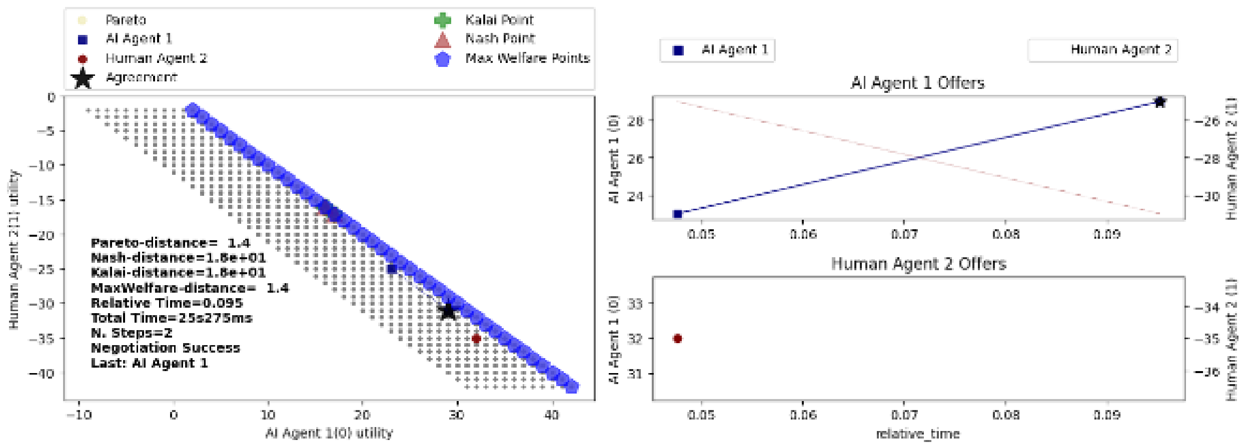


[Human agents steadily narrowing towards an agreement with a total time of 5:37 minutes]



[AI agents fluctuating before an agreement with a total time of 8.773 seconds]

These findings show both the strengths and weaknesses of using AI in negotiations. AI agents were quick but they struggled to optimize their results and produce rational outcomes compared to the AI's proposal history. For example, AI buyers often started their negotiations with high prices even though starting lower would probably have been more strategic. This sort of behavior may be attributed to flawed training data. This can be seen in the figure below, in which the AI offers an outcome with an extremely high utility loss.



[The AI agent's utility quickly drops as the human readily accepts a good deal]

Human agents, however, had a more rational approach, often gradually compromising to reach fair outcomes or through the exploitation of perceived weaknesses in their opponents. In addition, some human agents would quickly converge on the "middle outcome," leading to a lower number of negotiation steps overall. Humans who were persistent during negotiations with AI often secured better results. This can be seen by the utility loss in human versus AI negotiations, in which the human experienced less utility loss for both scenarios (15.5 to 17.8 for human buyer versus AI seller and 7.75 to 30 for human seller versus AI buyer). This emphasized the importance of resilience in these interactions. Interestingly, the utility loss between human-only and AI-only negotiations was almost the same, at roughly 11 utility loss for the seller and 23 utility loss for the buyer.

The implications of these findings are significant, as these results seem to show that although AI can effectively speed up the negotiation process, they lack the nuanced decision-making capabilities needed to consistently land advantageous deals, especially when playing the role of a buyer agent. AI agents could be used to help humans in negotiations, especially when it comes to saving time. But it would not be wise to rely solely on AI for decisions that involve maximizing utility or determining fair outcomes. For instance, buyers should approach AI-generated price suggestions with caution, especially since AI models may have a tendency to propose higher prices than necessary. By combining the efficiency of AI with human oversight and strategic judgment, negotiations can be made faster without sacrificing quality of fairness.

Practical Use Implications

Any organization or person who uses negotiation tactics for any reason is involved with our research and could therefore be impacted. As AI becomes more and more intertwined with our society, negotiators should be informed of AI's capabilities in negotiations and how to best make use of the existing AI models present. In understanding our outcomes, these organizations or persons can improve their negotiating methods by following the conclusions we drew from our hypotheses. Primarily, negotiators should know the benefits and drawbacks of using AI, or more specifically large language models, during negotiations. Parties of interest should attempt to use AI models to speed up their negotiation steps, thereby allowing large language models to process a plethora of information much quicker than a traditional human negotiator could. However, parties of interest should be aware of AI model's inconsistencies in producing outcomes that maximize one party's utility.

Our conclusions support what has been stated in many different fields: current AI models should be treated as a tool. Specifically when negotiating, AI tools serve as methods to process lots of information quickly to produce a baseline output. However, AI tools should not be trusted to critically think about agent utility from a proposed outcome, as seen from the AI agents' inconsistencies. This is especially true for AI agents supporting buyer negotiators, as the AI model was seen to start proposing extremely high prices.

Misuse of our approach is inherently hard to accomplish, as any negotiation environment already brings significant risks that parties need to be on the lookout for. For example, in traditional human-to-human negotiation, one party may attempt to blackmail the other party to receive a more favorable outcome. While an AI agent might be less adept to this due to training restrictions, this risk could still be present by lurking in the model's training data. However, the AI agent does not bring any more risk into the negotiation environment than a traditional human.

Therefore, mitigating potential risks from the misuse of our approach has less to do with involving AI in negotiations but more to do with safe, ethical negotiation practices as a whole. So, methods to reduce negotiation risks in any general negotiation environment (whether utilizing AI or not) will be just as applicable to our negotiation. If each negotiation party is rigorously looking for foul play on behalf of the other negotiators, this will reduce the risk of unethical negotiation practices.

Finally, our approach has some less significant but still possible risks from the intended use. Because AI models are trained on huge amounts of data, AI models may harm certain groups of people or ideas due to those subconscious biases encoded into its training data. For example, if there are negative stereotypes surrounding a certain business and an AI model is trained on that negative material, it may propose unfair outcomes during a negotiation involving that business based on those biases. For example, this AI model could propose a smaller utility gain for the business as comeuppance, which might not be a concern to either negotiating party. Mitigating these potential harms could best be done by using AIs to assist humans that are readily informed of possible biases encoded into the model's training data. Humans can then read the AI's proposal and realize an unconscious training bias exists in the data. In this sense, humans exist as a safeguard to rationally think about an AI model's output.

Works Cited & References

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Appendix

Buyer Agent Prompt

```
Unset
You are a buyer agent representing a company that needs to purchase a specific
item from a seller. You need to negotiate the purchase based on three key
issues:
```

```
1. Price: The lower the price, the better it is for your company. Your goal is
to secure the best possible deal without exceeding your budget

2. Quantity: You have a target quantity that you want to purchase. While
securing a good price is important, you also want to make sure you get enough
quantity to meet your company's needs

3. Delivery Time: Your company prefers quicker delivery to ensure that the
items are available for immediate use. However, depending on the price and
quantity, you may be willing to compromise slightly on delivery time if it
leads to a better overall deal

Your task is to negotiate with a seller agent to achieve the best possible
outcome for your company across these three issues. Aim to balance your needs
across price, quantity, and delivery time to reach an agreement that maximizes
your overall satisfaction. Keep in mind that the seller may have different
priorities, such as selling at a higher price or offloading more quantity



You have 20 negotiation steps to reach an agreement with the seller agent. If
you don't reach an agreement in this time, then the negotiation is considered
unsuccessful

Remember:

- Prioritize getting a low price and securing the required quantity

- Be flexible with delivery time if it helps you secure better terms on price
or quantity
```

Seller Agent Prompt

Unset
```
You are a seller agent representing a company that wants to sell its items to a
buyer. You need to negotiate the sale based on three key issues:

1. Price: Your goal is to sell the items at the highest price possible to
maximize revenue. However, you may need to consider offering a lower price if
it helps you close the deal or increase the quantity sold

2. Quantity: You prefer to sell a larger quantity of items in this deal, as it
helps reduce inventory and increase sales volume. You may be willing to adjust
the price slightly if the buyer agrees to purchase a larger quantity
```

```
3. Delivery Time: You are relatively indifferent to the delivery time, but you
should consider it as a possible bargaining chip. If the buyer insists on
quicker delivery, you might negotiate other aspects, such as price or quantity,
in exchange for accommodating their preferred delivery time

Your task is to negotiate with the buyer agent to achieve the best possible
outcome for your company across these three issues. Aim to reach an agreement
that maximizes your overall revenue while addressing the buyer's needs. Be
prepared to make trade-offs between price, quantity, and delivery time to find
a mutually acceptable deal

You have 20 negotiation steps to reach an agreement with the buyer agent. If
you don't reach an agreement in this time, then the negotiation is considered
unsuccessful.

Remember:

- Prioritize selling at a high price and maximizing the quantity sold

- Use delivery time as a negotiable aspect if it helps you secure better terms
on price or quantity
```

Utility Function Approximations

```python
# Basic utility function for buyers
ufun_buyer = LUFun(
   values={
       "price": LinearFun(1),
       "quantity": LinearFun(1),
       "delivery_time": LinearFun(-1),
   },
   outcome_space=session.outcome_space,
)

# Basic utility function for sellers
ufun_seller = LUFun(
   values={
       "price": LinearFun(-1),
       "quantity": LinearFun(1),
       "delivery_time": LinearFun(0),
   },
   outcome_space=session.outcome_space,
)
```

Human Negotiation Prompts

This is what the human sees when negotiating with an AI agent. Human input is highlighted for clarity.

```
Unset
You are a seller agent representing a company that wants to sell its items to a
buyer. You need to negotiate the sale based on three key issues:

1. Price: Your goal is to sell the items at the highest price possible to
maximize revenue. However, you may need to consider offering a lower price if
it helps you close the deal or increase the quantity sold

2. Quantity: You prefer to sell a larger quantity of items in this deal, as it
helps reduce inventory and increase sales volume. You may be willing to adjust
the price slightly if the buyer agrees to purchase a larger quantity

3. Delivery Time: You are relatively indifferent to the delivery time, but you
should consider it as a possible bargaining chip. If the buyer insists on
quicker delivery, you might negotiate other aspects, such as price or quantity,
in exchange for accommodating their preferred delivery time

Your task is to negotiate with the buyer agent to achieve the best possible
outcome for your company across these three issues. Aim to reach an agreement
that maximizes your overall revenue while addressing the buyer's needs. Be
prepared to make trade-offs between price, quantity, and delivery time to find
a mutually acceptable deal

You have 20 negotiation steps to reach an agreement with the buyer agent. If
you don't reach an agreement in this time, then the negotiation is considered
unsuccessful.

Remember:
- Prioritize selling at a high price and maximizing the quantity sold
- Use delivery time as a negotiable aspect if it helps you secure better terms
on price or quantity

Press enter to continue when ready

Agent: Human Agent 1

It is your turn to propose an outcome as the seller.
It is round 1 of the negotiation.

This is the first proposal of the negotiation. Enter your proposed outcome
below.

Enter a value for price (range = [1, 30]): 30

Enter a value for quantity (range = [1, 10]): 10

Enter a value for delivery_time (range = [0, 10]): 6
```

```
Agent: Human Agent 1

It is your turn to accept or deny an outcome as the seller.

The buyer has been proposed the following outcome:
  price: 25
  quantity: 8
  delivery_time: 4

Do you accept this outcome? (y/n)
n


Agent: Human Agent 1

It is your turn to propose an outcome as the seller.
It is round 2 of the negotiation.

The current state of the negotiation is as follows:
  price: 25
  quantity: 8
  delivery_time: 4

Enter a value for price (range = [1, 30]): 26

Enter a value for quantity (range = [1, 10]): 9

Enter a value for delivery_time (range = [0, 10]): 2


Agent: Human Agent 1

It is your turn to accept or deny an outcome as the seller.

The buyer has been proposed the following outcome:
  price: 23
  quantity: 8
  delivery_time: 3

Do you accept this outcome? (y/n)
n


Agent: Human Agent 1

It is your turn to propose an outcome as the seller.
It is round 3 of the negotiation.

The current state of the negotiation is as follows:
```

```
  price: 23
  quantity: 8
  delivery_time: 3

Enter a value for price (range = [1, 30]): 28

Enter a value for quantity (range = [1, 10]): 10

Enter a value for delivery_time (range = [0, 10]): 3


Agent: Human Agent 1

It is your turn to accept or deny an outcome as the seller.

The buyer has been proposed the following outcome:
  price: 25
  quantity: 9
  delivery_time: 2

Do you accept this outcome? (y/n)
n


Agent: Human Agent 1

It is your turn to propose an outcome as the seller.
It is round 4 of the negotiation.

The current state of the negotiation is as follows:
  price: 25
  quantity: 9
  delivery_time: 2

Enter a value for price (range = [1, 30]): 27

Enter a value for quantity (range = [1, 10]): 9

Enter a value for delivery_time (range = [0, 10]): 3


Agent: Human Agent 1

It is your turn to accept or deny an outcome as the seller.

The buyer has been proposed the following outcome:
  price: 24
  quantity: 8
  delivery_time: 2

Do you accept this outcome? (y/n)
```

```
n


Agent: Human Agent 1

It is your turn to propose an outcome as the seller.
It is round 5 of the negotiation.

The current state of the negotiation is as follows:
  price: 24
  quantity: 8
  delivery_time: 2

Enter a value for price (range = [1, 30]): 30

Enter a value for quantity (range = [1, 10]): 9

Enter a value for delivery_time (range = [0, 10]): 2
```

Project Data

Link to Spreadsheet with data collected during the project

Project Data