

CISC 352 Essay (Prompt #2) - Kabeer Adil
Among Us

ChatGPT Section (Planning):

LLM Prompt: Write a small essay on how you would apply the concept of planning (describe fluents, initial state, goal, and actions) in the context of AI to the problem setting of the game Among Us.

Applying the concept of planning in the context of artificial intelligence (AI) to the problem setting of the game Among Us offers an intriguing approach to analyzing player strategies and optimizing gameplay experiences. Planning involves generating a sequence of actions to achieve specific goals or objectives within a given environment. In Among Us, players take on the roles of Crewmates and Impostors aboard a spaceship or a space station, with distinct objectives for each role. Here's how planning concepts can be applied to the problem setting of Among Us, considering the fluents, initial state, goal, and actions:

Fluents:

Fluents represent the properties or conditions that can change over time in the game environment. In Among Us, fluents could include factors such as player locations, task completion status, suspicion levels, and sabotage events. For example, the location of players, whether tasks have been completed or not, and the level of suspicion towards certain players are all fluents that can change during gameplay.

Initial State:

The initial state represents the starting conditions of the game before any actions are taken. In Among Us, the initial state includes the positions of players, the status of completed tasks, the identities of Impostors (which are hidden from Crewmates), and any ongoing sabotage events. Crewmates begin the game with the goal of completing tasks and identifying Impostors, while Impostors aim to eliminate Crewmates and sabotage their efforts without getting caught.

Goal:

The goal specifies the desired state or conditions that players aim to achieve during gameplay. In Among Us, the goals differ for Crewmates and Impostors. Crewmates' primary goal is to complete all assigned tasks and identify and vote out the Impostors. Thus, the goal state for Crewmates might involve all tasks being completed and all Impostors being identified and ejected. Impostors' goal is to eliminate enough Crewmates to achieve numerical parity with the remaining Crewmates or to sabotage critical systems to cause a loss for the Crewmates. The goal state for Impostors might involve a certain number of Crewmates being eliminated without being caught.

Actions:

Actions represent the possible moves or decisions that players can make during the game. In Among Us, actions include moving to different locations, completing tasks, reporting dead

bodies, calling emergency meetings, and voting to eject suspected Impostors. Crewmates must strategically coordinate their actions to complete tasks efficiently, identify suspicious behavior, and vote out Impostors. Impostors, on the other hand, must deceive Crewmates, eliminate them discreetly, and sabotage tasks to create chaos and confusion.

By formalizing the game mechanics of Among Us using planning concepts such as fluents, initial state, goal, and actions, we can analyze player strategies, predict outcomes of actions, and optimize gameplay experiences. Planning algorithms can assist players in making informed decisions, developing effective strategies, and ultimately enhancing their overall gaming experiences in Among Us. Additionally, planning concepts provide valuable insights for game designers seeking to create compelling and balanced gameplay mechanics in social deduction games like Among Us.

Planning Section Critique:

The essay generated above holds information regarding planning in the context of AI and the game, Among Us. Its initial definition of what planning means is largely correct, as it is used to determine how to accomplish specific goals and tasks. Essentially, planning is used to train agents to “think” before they “act” within an established environment. ChatGPT describes fluents as properties that can change over time within the game setting. While this is not exactly incorrect, in the context of our class, fluents were described as what can be perceived as true or false within the game setting. For example, the wire matching minigame. If a certain wire is connected, the color of the wire, what two nodes are connected, these are all fluents. Can they change over time? Possibly, but the explanation is not the clearest. GPT also describes task completion status, suspicion levels and sabotage events as fluents. These also make sense, however, I do not recall “suspicion levels” being a physical part of the game. In terms of the initial state, we know it to be any fluents that are true at the start of the game. GPT is essentially correct here as well, as it declares the init state as representing the starting condition of the game before any actions are taken. However, starting conditions can change from game to game. The goal state is described by GPT as being the desired state or condition of the game that players aim to achieve during its duration. This definition is also largely true, however we describe it as fluents (states) that the agents (players) want to hold. This could be ensuring the reactor doesn’t have a meltdown, that all tasks are completed, or that the imposter is caught. For the Imposter, this could be sabotaging systems and murdering crewmates. All of these actions are something GPT understands and states as well. Overall, GPT is largely accurate when it comes to describing how planning and its various facets would affect a game like Among Us. There are certain departures from course teachings but they are not completely inaccurate by most metrics.

ChatGPT Section (Constraint Programming):

LLM Prompt: Write a small essay on how you would apply the concept of constraint programming (Describe what the variables, their domains, and the constraints might be) in the context of AI to the problem setting of the game Among Us.

Applying the concept of constraint programming to the problem setting of the game Among Us offers a structured approach to analyzing player interactions, decision-making processes, and strategic planning within the game environment. Constraint programming involves defining variables, specifying their domains, and establishing constraints that must be satisfied to model and solve a problem. In the context of Among Us, constraint programming can help simulate player behavior, identify optimal strategies, and predict outcomes of actions. Here's how the concept of constraint programming can be applied to Among Us.

Variables:

Variables represent the entities or aspects of the game that can vary or change during gameplay. In Among Us, variables could include player positions, suspicion levels, task completion status, and voting decisions. For example, a variable might represent the suspicion level of each player towards other players, with higher values indicating greater suspicion.

Domains:

Domains define the possible values that variables can take. In Among Us, domains for variables could be discrete or continuous, depending on the nature of the variable. For instance, the domain of player positions could include the various rooms or locations within the spaceship or space station, while the domain of suspicion levels could be a range of values representing different degrees of suspicion.

Constraints:

Constraints specify the relationships or limitations between variables. In Among Us, constraints can model the rules of the game, player interactions, and the outcomes of actions.

Examples of constraints in Among Us could include:

- Movement Constraints: Players can only move to adjacent rooms or locations within the spaceship.
- Line of Sight Constraints: Players can only see or interact with other players within their line of sight or within a certain range.
- Task Completion Constraints: Tasks must be completed in a certain order or within a specified time frame.
- Suspicion Constraints: The suspicion levels between players are consistent with observed actions and interactions.
- Voting Constraints: Players' voting decisions are based on their suspicion levels towards other players and the information available to them.

By defining variables, domains, and constraints in the context of Among Us, we can model the dynamics of player interactions, decision-making processes, and strategic planning within the game environment. Constraint programming techniques can then be used to simulate gameplay scenarios, analyze player strategies, and predict outcomes of actions. Additionally, constraint programming provides a structured framework for game designers to experiment with new features, balance gameplay mechanics, and create more engaging player experiences in Among Us.

Constraint Programming Section Critique:

We now cover GPT's interpretation of constraint programming through the lens of Among Us. The LLM states that constraint programming is involved with defining variables, specifying domains and establishing constraints. Within the context of our class, this is largely correct. When discussing variables, GPT describes them as entities or aspects of the game that are capable of changing through gameplay. However, it neglects to address the fact that variables can be continuous or discrete (it inaccurately touches upon it later). It also addresses suspicion levels as a variable and while that is part of the meta-gameplay, it is not something that is directly programmed into the game, as far as I am aware. When it touches on domains, it states that domains for variables could be discrete or continuous. However, this is not exactly correct. According to what we have gleaned from the course slides, there are discrete or continuous variables and there exist finite and infinite domains within the category of discrete variables. Finite domains are those that fall under boolean satisfiability (such as NP-Complete problems) and infinite domains can include integers and strings for contexts such as job scheduling. Finally for constraints, GPT defines them as rules that specify the relationships and limitations between variables. It also lists examples of constraints that Among Us might contain. While most of the constraints mentioned have validity, the suspicion constraints are, as previously mentioned, tied to a mechanic that does not actually exist in the programming and therefore cannot truly be constrained regularly. Additionally, the voting constraints are detailed as having to do with a player's suspicion levels towards other players. However, actual voting constraints would consider things like the amount of votes a player can have or if players choose to abstain from voting. Considering players' suspicion levels as part of voting is a process dependent on the players themselves, not any programming. There is also a lack of unary and binary constraint discussion, however this could likely be included with some adjustments to the LLM prompt. Therefore, while GPT has a solid understanding on what variables, domains and constraints are, it struggles to specify and consolidate all of them accurately.

ChatGPT Section (Heuristic Search):

LLM Prompt: Write a small essay on how you would apply the concept of heuristic search (Describe what the state-space would look like, the type of search that would be used, the heuristic, etc) in the context of AI to the problem setting of the game Among Us.

In the context of artificial intelligence, heuristic search algorithms are powerful techniques used to efficiently explore large search spaces by guiding the search towards the most promising solutions. When applied to the problem setting of the game Among Us, heuristic search can help AI agents analyze player behaviors, make informed decisions, and strategize effectively within the game environment.

Here's how heuristic search could be applied to Among Us:

State-Space Representation:

In Among Us, the state-space represents all possible configurations of the game at any given point in time. This includes the positions of players, the status of completed tasks, the presence of dead bodies, and the outcomes of previous actions. Each node in the state-space graph corresponds to a unique game state, and edges represent possible transitions between states based on player actions and game mechanics.

Type of Search:

A suitable type of heuristic search algorithm for Among Us could be A* (A-star) search. A* search is an informed search algorithm that efficiently explores the state-space by using a heuristic function to estimate the cost of reaching the goal from each state. A* search combines the benefits of breadth-first and greedy best-first search by considering both the cost of reaching a state and the estimated cost to reach the goal from that state.

Heuristic Function:

The heuristic function in Among Us should estimate the distance or cost from the current state to the goal state, which could be achieving objectives as a Crewmate or successfully eliminating Crewmates as an Impostor. The heuristic function could consider various factors such as the distances between players, the progress of task completion, the likelihood of encountering Impostors, and the risk of being eliminated.

Search Strategy:

The search strategy involves expanding nodes in the state-space based on their estimated cost to reach the goal. Nodes with lower estimated costs are explored first, allowing the algorithm to focus on more promising paths while pruning less promising ones. A* search maintains a priority queue of nodes ordered by their estimated total cost, which includes both the cost incurred so far (the actual cost) and the estimated cost to reach the goal (the heuristic cost).

Learning and Adaptation:

Heuristic search algorithms can be combined with machine learning techniques to improve their performance over time. By analyzing past game data and outcomes, AI agents can learn from experience and adapt their heuristic function to better predict Impostor behavior and optimize their strategies accordingly.

In summary, applying heuristic search to the problem setting of Among Us offers a structured approach to analyzing player behavior, decision-making processes, and strategic planning within the game environment. By leveraging heuristic search algorithms and techniques, AI agents can improve their performance, develop effective strategies, and ultimately enhance their overall gaming experiences in Among Us. Additionally, heuristic search provides valuable insights for game designers seeking to create compelling and balanced gameplay mechanics in social deduction games like Among Us.

Heuristic Search Section Critique:

When discussing the use of heuristic search, GPT presents a solid foundation of information. However, its initial definition of a heuristic search differs from the knowledge we gained in class. The course description of a heuristic search is that of a strategy that attempts to optimize a problem by iteratively improving upon a solution. Said solution found using a given heuristic function or a cost measure. GPT merely presents heuristic search as a way to explore large search spaces in order to find the most promising solution. While the end goals may be similar, the way they are laid out are not ideal in comparison. However, the LLM does more or less accurately describe why heuristic searches would be valuable in the context of Among Us. To elucidate, its description of the state space representation in relation to Among Us is accurate and the use of A* is a fair assumption to be made regarding potential strategies to employ. Its explanation of how functions A* is a little flawed though. GPT says it combines the benefits of BFS and Greedy search algorithms but this is only slightly true. In reality, A* search utilizes Greedy and a specific form of BFS known as UCS (Uniform Cost Search). UCS processes edge weights and heuristic costs in order to determine more optimal paths. Heuristics are key to allowing the machine to understand its environment and continue to grow and predict more outcomes further down the line. This sentiment is largely echoed by GPT in its "Learning and Adaptation" section, as well as in its concluding paragraph.

Meta-Analysis:

Utilizing an LLM like ChatGPT can come with a host of positive and negative outcomes depending on user objectives and the context in which it is used. When it comes to attempting to grasp larger ideas or specify certain concepts, GPT can be an incredibly versatile and accessible source of information. Its ability to efficiently respond with specific examples and scenarios also makes parsing through information simpler than attempting to reach the same conclusions through a search engine like Google. I like to imagine GPT as a sort of filter between the mass amounts of information Google can give me and the information I am actually seeking. Being able to constantly adjust your queries and have it respond to your inputs is also another way GPT works as an aid. When used to supplement and elucidate, GPT can be an immensely helpful tool. The problems arise when GPT's work/output is used as a substitute for actual work and thinking. Not only is it ethically incorrect to claim it is one's own work, it is damaging in the sense that it stands to reduce one's independent thinking and researching skills. Additionally, GPT is not a glowing standard for accuracy. While it can give incredibly precise information depending on user input, its training could contain bias and inaccuracies. Even simple questions can sometimes yield incorrect answers at which point further research needs to be carried out in order to create a more whole solution. To conclude, GPT is a powerful tool that can be used to gain broad, supplemental information in an efficient manner. However, basing entire projects and ways of reasoning upon it is not only unethical, but can actually be detrimental to the work being done.