CS4246/CS5446   AI Planning and Decision Making

Due: 9 Oct 2023@09:00

Assignment 1

Instructions

- Submit the PDF file containing your solutions on the Canvas.
    - You can use this Overleaf project to write your solutions.
- You have only one attempt on Canvas.
- You are required to specify your group number in your attempt (group number can be found from Canvas).
    - Update the `team.tex` file with the relevant details.
- **Total marks: 20; Weightage 10% of final marks**
- On collaboration:
    - The goal of the assignment is to understand and apply the concepts in the class.
    - You may discuss the assignment with other groups via the discussion forum.
    - It is OK for the solution ideas to arise out of such discussions. However, it is considered plagiarism if the solution submitted is highly similar to other submissions or to other sources.
- Citing help and reference
    - At the end of the assignment, clearly cite the sources you referred to when arriving at the answer (Books, External notes, Generative AI tools, etc.,).

Team members

Group number:
Member 1 details:
- Name:
- NUSNet id:
- Student number:

Member 2 details:
- Name:
- NUSNet id:
- Student number:

1 Classical planning: Elevator

You are developing a planner to operate an elevator in a building with just two floors ($Level0$ and $Level1$). You have three actions available for the elevator $Move$, $OpenDoor$, and $CloseDoor$. $Move$ automatically moves the elevator up if it is in $Level0$ and down if it is in $Level1$, you don't have to check for the direction. However, the elevator cannot move if the door is open. The elevator door can be opened only if it is closed, and it can be closed only if it is open.

1. (6 marks) Write the action schemas for $Move$, $CloseDoor$, and $OpenDoor$ actions following PDDL notations. You can use negative preconditions. State/define all the predicates and fluents you use in your action schema.

2. (4 marks) If negative preconditions are not allowed, how would your schema change? Write the updated schema for $Move$ and highlight the differences from your above answer.

2 Planning and Satisfiability

1. (2 marks) The fluents in a planning problem end up in the following form

$$(A \land B) \lor (P \land Q) \lor Z$$

after being simplified by Mr. Bean, who plans to use a SAT solver to determine the problem's satisfiability. Help Mr. Bean by writing the form of the expression that can be fed into a SAT solver. (Show the steps in arriving at the appropriate form).
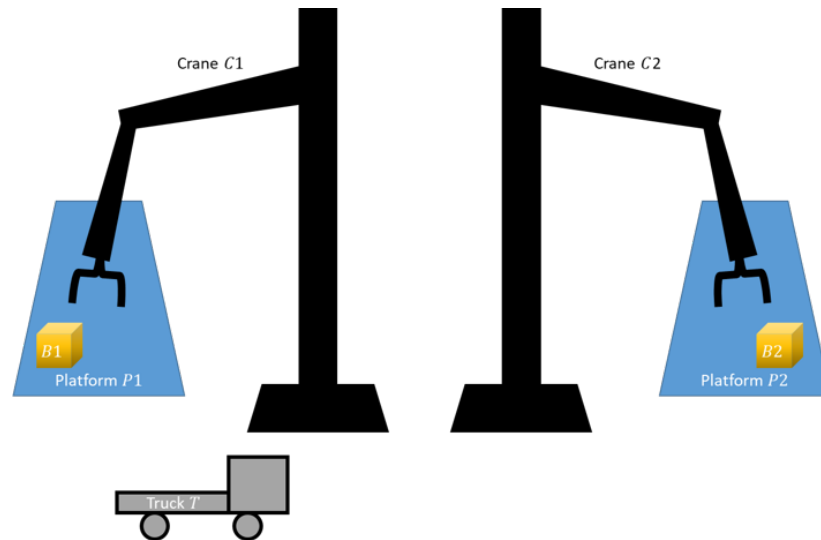
Figure 1: Swapping problem

3 Hierarchical planning: Transportation

Consider the following problem of swapping containers, $(B1, B2)$ on the two platforms, $(P1, P2)$. The cranes $(C1, C2)$ help to load and unload the containers onto the truck (T). Figure 1 shows the schematic representation of the problem.

1. (4 marks) Draw the HTN hierarchy (similar to the "Going to Changi Airport" example on Slide 4 of the Hierarchical Planning lecture notes) for this swapping problem. Clearly indicate the refinements and implementations in your answer.
Note: You are **not required to** include the precondition, effects, or the action schemas. Just writing which are the refinements and what are the implementations clearly is sufficient.

4   Decision theory

Company A (A) and Company B (B) are suing each other over patent infringements. If A wins, there is a 60% chance that it will dominate the market with a total valuation of \$400 billion, and a 40% chance that it will have a valuation of \$100 billion (after paying for the lawsuit).

1. (2 marks) Let q be the probability that A will win the patent lawsuit. Let X be the valuation if it loses the patent lawsuit. What is the expected monetary value for A's situation? Express your answer in the simplest form in terms of q and X.

2. (2 marks) If B decides to negotiate a settlement with A, what is the minimum value (in terms of X and q) that the CEO of A must demand?