1 Vocabulary Check

Define each of the following terms:

1. Interference
2. Inconsistent effects/Inconsistency
3. Competing Needs

2 Compare and Contrast

1. What are some ways to find a plan using a classical planning environment model?
2. What classical planning assumptions are relaxed when using the GraphPlan heuristic? Why is this helpful compared to naive search?

3 Journey to Success(or-State Axioms)

1. First, let's review some definitions. What are successor-state axioms?

2. Consider the following Mini Pacman grid. In this simplified world, the only available actions are *Left, Right,* and *Stay*. The only possible states are $Pacman_{(1,1)}$ and $Pacman_{(2,1)}$. If Pacman tries to move into a wall, he will stay in the same state.

   Notice that Pacman's state and actions are both fluent, so we can set up successor-state axioms to define how Pacman moves in this world. Write the successor-state axiom corresponding to Figure 4.

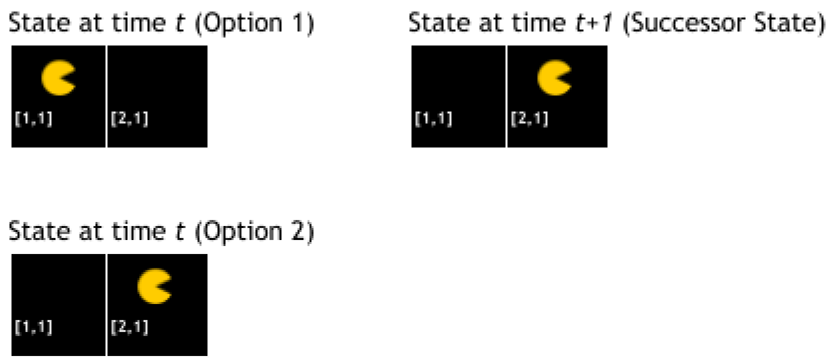


Figure 1: Mini Pacman Grid

3. Suppose that at time 0, Pacman is somewhere on a 5x5 grid ((1,1) at the bottom left, (5,5) at the top right) with only walls on the borders.

   For each of the following, state whether the entailment relation is correct. Explain your reasoning.

   (a) $Up^t \vee Right^t \models \neg Pacman^{t+1}_{(1,1)}$

   (b) $\neg Pacman^{t+1}_{(1,1)} \models Up^t \vee Right^t$

   (c) $Up^0 \wedge Up^2 \wedge Up^3 \models Pacman^4_{(x,y)} : x \in [1,5], y \in [4,5]$

   (d) $Up^t \wedge Right^t \models \neg Pacman^{t+1}_{(5,5)}$

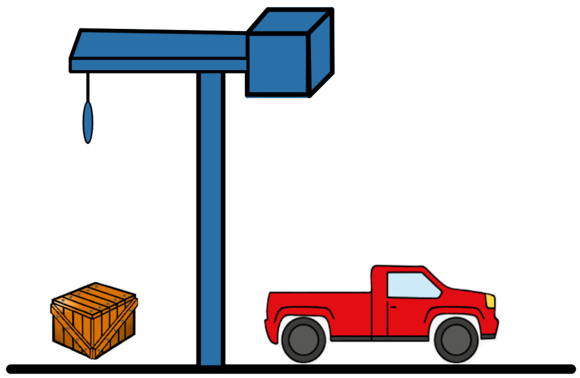
(e) $\neg Pacman_{(5,5)}^{t+1} \models Up^t \land Right^t$

(f) $Down^{t+1} \land Left^{t+1} \models Up^t \land Right^t$

4 Symbolic Planning - Crate Problem

In the Crane problem, you are given a crane, a package and a truck. The package starts on the left, the truck on the right, and the crane faces the left. The goal of this is to load the package onto the truck and have the crane be facing the left.

The crane can swing between left and right, with or without a payload, and it can pick up the crate if it is on the same side. The crate can only be loaded onto the truck using the crane.



(a) Draw the planning graph for the first 3 moves. You may use pictures instead of propositions.

(b) Formulate the crate problem as a symbolic plan. You will need to define your variables, instances, start/goal states, and operators.

(c) Draw the first two levels of the Graph Plan graph.

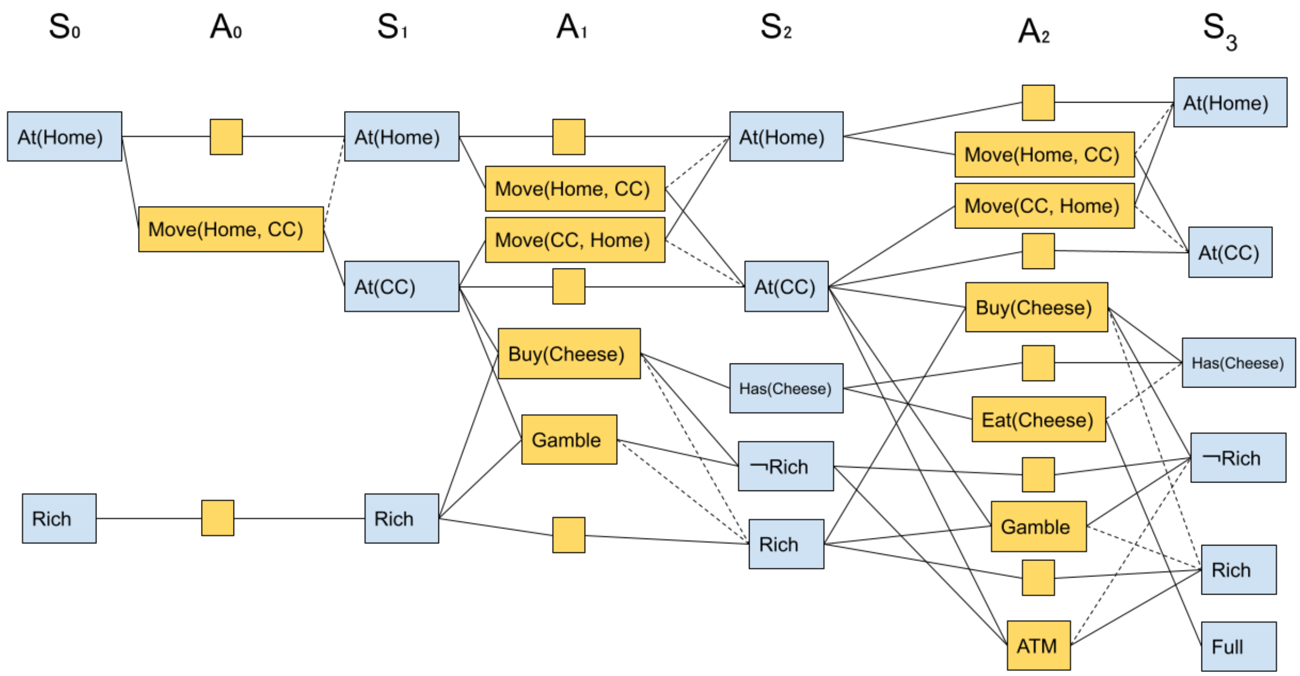
(d) Identify the exclusive actions in your graph and determine which type of mutex each is.

5 Mutex relation? I don't even know her!

Pinky is getting food from a Chuck E. Cheese. Pinky has the following actions:

- Move(A,B):
  - Preconditions: At(A)
  - Add list: At(B)
  - Delete list: At(A)
- Buy(Cheese):
  - Preconditions: At(ChuckyCheese), Rich
  - Add list: Has(Cheese), ¬ Rich
- Gamble
  - Preconditions: At(ChuckyCheese),Rich
  - Add list: ¬ Rich
  - Delete list: Rich
- ATM
  - Precondition: At(ChuckyCheese),¬ Rich
  - Add list: Rich
  - Delete list: ¬ Rich
- Eat(Cheese):
  - Preconditions: Has(Cheese)
  - Add list: Full
  - Delete list: Has(Cheese)

The start state contains the predicates Rich and At(Home).
The goal state is any state containing Full.
Below is the corresponding GraphPlan graph:



(a) Based on the above graph, list two actions that are mutex via inconsistent effects in level A_0.

(b) Based on the above graph, list two actions that are mutex via Interference in level A_1

(c) Based on the above graph, list two actions that are mutex via Competing needs in level A_2.