AI COURSE TUTORIALS: Planning September 17th 2021

Instructions: Solve the problems given below using pen and paper. Write your name and roll number clearly on every page. Take a scan or picture and post in chat box

1. The following table of actions describe a planning problem for determining the steps in starting a car. The initial and final states are also indicated. Apply the partial-order planning algorithm to draw the final partial order plan clearly showing the causal links (including the subgoals that they achieve) and ordering links.

Action	Pre-condition	Effects
Turn-Key	¬ Accelerator ∧ ¬ Ignition	Ignition
Press-Clutch	¬ Clutch	Clutch
Release-Clutch	Clutch	¬ Clutch
Press-Accl	¬ Accelerator	Accelerator
Release-Accl	Accelerator	¬ Accelerator
Set-Gear	Clutch	Gear-Set
Engage-Gear	Clutch ∧ Gear-Set ∧ ¬ Accelerator ∧ Ignition	Gear-Engaged ∧ ¬Clutch
START	¬ Clutch ∧ ¬ Accelerator ∧ ¬ Ignition	
FINISH	Gear-Engaged ∧ ¬Clutch ∧ Accelerator ∧ Ignition	

2. Consider the following problem - There are two locations C1 and C2, and two containers L1 and L2. If the ship is in the same location as a container, and the ship is empty, the ship can hold the container, as a result of this action, the container is on the ship and the ship is no longer empty. If the ship is in location x, it can move to location y, as a result of this action, the ship is in location y. If the ship has a container on it, and is in location x, then it can unload, and the effect of the action is that the container is in location x and the ship is empty. In the initial state, both containers and the ship are in L1 and the ship is empty. The goal is to have container C2 in L2.

a) Define the problem as a planning problem. Specify the predicates, objects, initial state, goal specification and the action schemas

b) Apply the partial-order planning algorithm to draw the final partial order plan clearly showing the causal links (including the subgoals that they achieve) and ordering links.

3. Consider a planning problem which requires an agent to hang a picture on the wall. In order to hang the picture, the wall must have a nail. The agent can drive a nail if it has a hammer and a nail. The agent can have an object by picking it up. It can also put down an object. The following table shows the possible set of operators:

Action	Pre-condition	Effect
Pick(x)		Has(x)
Drop(x)	Has(x)	EmptyHand $\wedge \neg$ Has(x)
HangPicture	On(Wall, Nail)	On(Wall, Picture)
DriveNail	Has(Nail) $\wedge$ Has(Hammer)	On(Wall, Nail) $\wedge \neg$ Has(Nail)

Draw (using a plan diagram) the final partial order plan which solves the problem. Clearly indicate the causal links and the (other) ordering links. The statement of the planning algorithm is not required –only the final partial order plan is to be given.