

CS 445 Homework #7

Due Date: November 16, 2020

1. Given the action schemas and initial state from Figure 11.1 on page 346, list all the applicable concrete instances of $Fly(p, from, to)$ in the state described by:

$At(P_1, JFK) \wedge At(P_2, SFO) \wedge Plane(P_1) \wedge Plane(P_2) \wedge Airport(JFK) \wedge Airport(SFO)$

$Fly(P_1, JFK, JFK); Fly(P_2, SFO, SFO);$ //these both satisfy the preconditions, but would
//result in the effect being a contradiction. I'll
//have to ask about these in class

$Fly(P_1, JFK, SFO); Fly(P_2, SFO, JFK);$

2. The original STRIPS planner was designed to control Shakey the robot. The actions in Shakey's world include moving from place to place, pushing movable objects (such as boxes), climbing onto and down from rigid objects (such as boxes), and turning light switches on and off. The robot itself could not climb on a box or toggle a switch, but the planner was capable of finding and printing out plans that were beyond the robot's capabilities. Shakey's six actions are the following:

- Move from location x to location y within room r : $Go(x, y)$, which requires that Shakey be At x and the x and y are locations in the same room r . By convention, a door between two rooms is in both of them.

- Push a box b from location x to location y within the same room: $Push(b, x, y, r)$. You will need the predicate Box and constants for boxes.

- Climb onto or down from a box from position x : $ClimbUp(x, b)$ and $ClimbDown(x, b)$. You will need a predicate On and the constant $Floor$.

- Turn a light switch on or off: $TurnOn(s, b)$ and $TurnOff(s, b)$. To turn a light on or off, Shakey must be on top of a box at the light switch's location.

Write PDDL sentences for Shakey's six actions and the initial state of the version of Shakey's world given on the next page that consists of four rooms lined up along a corridor, where each room has a door and a light switch. Construct a plan for Shakey to get Box_2 into $Room_2$.

Solution:

(Go Start Door3 Room3)

(Go Door3 Door1 Corridor)

(Go Door1 BL2 Room1)

(Push B2 BL2 Door1 Room1)

(Push B2 Door1 Door2 Corridor)

//done but we're in the door so it would be more practical to continue

//further into the room

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(:predicates
(at ?x ?y) (on ?x ?y) (in ?x ?y) (box ?x) (turnedOn ?x))

(:action Go //shakey is on the floor and wants to move to a location within the same room
:parameters (?x ?y ?r)
:precondition (and (on Shakey Floor) (at Shakey ?x) (in ?x ?r) (in ?y ?r))
:effect (and (at Shakey ?y) (not (at Shakey ?x))))
//he is where he moved to and not where he was

(:action Push //shakey wants to push a box from one location to another
:parameters (?b ?x ?y ?r)
:precondition (and (on Shakey Floor) (at Shakey ?x) (box ?b) (at ?b ?x) (in ?x ?r)
(in ?y ?r))
:effect (and (at Shakey ?y) (at ?b ?y) (not (at Shakey ?x)) (not (at ?b ?x))))
//shakey moved to the location along with the box and neither are where they were

(:action ClimbUp //shakey wants to climb onto a box from the floor
:parameters (?x ?b)
:precondition (and (on Shakey Floor) (at Shakey ?x) (at ?b ?x) (box ?b))
:effect (and (on Shakey ?b) (not (on Shakey Floor))))
//shakey is no longer on the floor and he is on the box

(:action ClimbDown //shakey wants to climb down from a box that he's on
:parameters (?b)
:precondition (and (on Shakey ?b) (box ?b))
:effect (and (on Shakey Floor) (not (on Shakey ?b))))
//shakey is no longer on the box and he is on the floor

(:action TurnOn //shakey wants to turn on a switch but must be on a box at the switch
:parameters (?s ?b)
:precondition (and (on Shakey ?b) (box ?b) (at ?b ?s))
:effect (turnedOn ?s))
//the switch is now on

(:action TurnOff //shakey wants to turn off a switch but must be on a box at the switch
:parameters (?s ?b)
:precondition (and (on Shakey ?b) (box ?b) (at ?b ?s))
:effect (not (turnedOn ?s)))
//the switch is now off (not on)

(init:
(on Shakey Floor) (at Shakey Start) (in Start Room3)
(box B1) (at B1 BL1) (in BL1 Room1) //boxes are all in room1
(box B2) (at B2 BL2) (in BL2 Room1)
(box B3) (at B3 BL3) (in BL3 Room1)
(box B4) (at B4 BL4) (in BL4 Room1)
//define doors and switches
(in Door1 Room1) (in Door1 Corridor) (in Switch1 Room1) (turnedOn Switch1)
(in Door2 Room2) (in Door2 Corridor) (in Switch2 Room2) (not (turnedOn Switch2))
(in Door3 Room3) (in Door3 Corridor) (in Switch3 Room3) (not (turnedOn Switch3))
(in Door4 Room4) (in Door4 Corridor) (in Switch4 Room4) (turnedOn Switch4))

(goal (and (at B2 ?x) (in ?x Room2)) // can I use "?x" to indicate any location here?
//or do I need to list off all the possible locations? I'll ask in class

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