CSGA 6525 Artificial Intelligence

Fall 2017

Assignment #4

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Question 1
Write PDDL sentences for Shakey's six actions and the initial states:
Initial states(At(Shakey,x0)^In(x0,Room3)^On(Shakey, Floor)^At(Box1,x1)^In(x1,Room1))^At(Box2,x2)^In(x2,Room1))^At(Box1,x3)^In(x3,Room1))^At(Box4,x4)^In(x4,Room1)^At(Switch1, x_s1)^In(x_s1, Room1)^At(Switch2, x_s2)^In(x_s2, Room2)^At(Switch3, x_s3)^In(x_s3, Room3)^At(Switch4, x_s4)^In(x_s4, Room4)^SwitchOn(Switch1)^SwitchOn(Switch4)^In(Door1, Room1)^In(Door1, Corridor)^In(Door2, Room2)^In(Door2, Corridor)^In(Door3, Room3)^In(Door3, Corridor)^In(Door4, Room4)^In(Door4, Corridor)^Agent(Shakey)^Box(Box1)^Box(Box2)^Box(Box3)^Box(Box4)^Switch(Switch1)^Switch(Switch2)^Switch(Switch3)^Switch(Switch4)^Door(Door1)^Door(Door2)^Door(Door3)^Door(Door4)^Room(Room1)^Room(Room2)^Room(Room3)^Room(Room4)^Corridor(Corridor)^Floor(Floor))

Action(Go(x,y,r)
    PRECOND:At(Shakey,x)^In(x,r)^In(y,r)^Room(r)^Agent(Shakey)
    EFFECT:¬At(Shakey,x)^At(Shakey,y))
Action(Push(b,x,y,r)
    PRECOND:At(Shakey,x)^At(b,x)^In(x,r)^In(y,r)^Room(r)^Agent(Shakey)^Box(b)
    EFFECT:¬At(b,x)^At(b,y))
Action(ClimbUp(x,b)
    PRECOND:At(Shakey,x)^On(Shakey,Floor)^At(b,x)^In(x,r)^Room(r)^Agent(Shakey)^Box(b)^Floor(Floor)
    EFFECT: ¬On(Shakey, Floor)^On(Shakey,b))
Action(ClimbDown(b,x)
    PRECOND:On(Shakey,b)^At(b,x)^In(x,r)^Room(r)^Agent(Shakey)^Box(b)^Floor(Floor)
    EFFECT:¬On(Shakey,b)^At(Shakey,x))
Action(TurnOn(s,b)
    PRECOND:On(Shakey,b)^At(Shakey,x)^At(s,x)^In(x,r)^Agent(Shakey)^Room(r)^Box(b)^Switch(s)
    EFFECT: SwithchOn(s))
Action(TurnOff(s,b)
    PRECOND:On(Shakey,b)^At(Shakey,x)^At(s,x)^In(x,r)^Agent(Shakey)^Room(r)^Box(b)^Switch(s)
    EFFECT: ¬SwithchOn(s))

Construct a plan for Shakey to get Box2 into Room2:

[Go(x0, Door3, Room3), Go(Door3, Door1, Corridor), Go(Door1, x_2, Room1), Push(Box2, x_2, Door1, Room1), Push(Box2, Door1, Door2, Corridor), Push(Box2, Door2, y, Room2)]; 'y' stands for the goal; if the goal is 'Door2' , we could stop at the step: Push(Box2, Door1, Door2, Corridor).

Question 2

The level cost of a literal is the number of actions in a plan that might possible achive the literal. When the literal appears in the planning graph, there might exsit mutex relation. Thus to achieve the literal we need go futher, which means the actual cost of the optimal plan would be greater than level cost of a literal. Therefore, the level cost of a literal in a planning graph can be no greater than the actual cost of the optimal plan for achieving.

Question 3

a. P(toothache) = 0.108 + 0.012 + 0.016 + 0.064 = 0.2

b. **P**(Cavity) = <P(cavity),P(¬cavity)>
= <(0.108,0.012+0.072+0.008),(0.016+0.064+0.144+0.576)>
= <0.2,0.8>

c. **P**(Toothache|cavity) = α, <P(toothache|cavity), P(¬toothache|cavity)]>
= α, <(0.108,0.012), (0.072+0.008)>
= α, <0.12,0.08>
= <0.6,0.4>

d. **P**(Cavity|toothache∨catch) = α, <P(cavity|toothache∨catch), P(cavity|toothache∨catch)]
= α, <(0.108+0.012+0.072) , (0.016+0.064+0.144)>
= α, <0.192,0.224>
≈ <0.46,0.54>

Question 4

(i) **P**(Slippery) = <P(slippery),P(Not slippery)>
= α, <(0.13+0.2+0.065+0.1),(0.04+0.31+0.11+0.045)>
= α, <0.495,0.505>
= <0.495,0.505>

(ii) **P**(Sandy|slippery) = α, <P(sandy|slippery) , P(Not sandy|slippery)>
= α, <(0.13+0.065),(0.2+0.1)>
= α, <0.195,0.3>
≈ <0.40, 0.60>

(iii) P(Not sandy and Not slippery|wet) = P(Not sandy ∧ Not slippery ∧wet) / P(Wet)
= 0.31/0.13+0.2+0.04+0.31
≈ 0.46