CS 271 - Introduction to Artificial Intelligence **Fall 2016**

HomeWork 6

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Problem 1 **Solution:**

PutHat PRECOND: $\neg Wear(hat)$
EFFECT: $Wear(hat)$

PutShoes PRECOND: $\neg Wear(shoes)$
EFFECT: $Wear(shoes)$

PutShirt PRECOND: $\neg Wear(shirt)$
EFFECT: $Wear(shirt)$

PutSocks PRECOND: $\neg Wear(socks)$
EFFECT: $Wear(socks)$

Problem 2 **Solution:**

Goal state: $On(C, Table) \wedge On(B, C) \wedge On(A, B) \wedge clear(A) \wedge clear(Table)$.

First Step valid action $Move(A, Table, B)$
State is $On(C, Table) \wedge On(B, C) \wedge On(A, Table) \wedge clear(A) \wedge clear(B) \wedge clear(Table)$.

Second Step valid action $Move(B, Table, C)$
State is $On(C, Table) \wedge On(B, Table) \wedge On(A, Table) \wedge clear(A) \wedge clear(B) \wedge clear(C) \wedge clear(Table)$.

Third Step valid action $MovetoTable(C, A)$
State is $On(C, A) \wedge On(B, Table) \wedge On(A, Table) \wedge clear(C) \wedge clear(B)$. which is the start state. Thus the problem solved.

Problem 3 **Solution:**

Initial state: $At(Monkey, A) \wedge At(Bananas) \wedge At(Box, C) \wedge Height(Monkey, Low) \wedge Height(Bananas, High)$

Action Schema :

Go(x,y) PRECOND: $At(Monkey, x)$
EFFECT: $At(Monkey, y) \wedge \neg At(Monkey, x)$

Push(x,y) PRECOND: $At(Monkey, x) \wedge At(Box, x) \wedge Height(Monkey, Low)$
EFFECT: $\neg At(Monkey, x) \wedge \neg At(Box, x) \wedge At(Monkey, y) \wedge At(Box, y)$

ClimbUp PRECOND: $At(Monkey, x) \wedge At(Box, x) \wedge Height(Monkey, Low)$
EFFECT: $\neg Height(Monkey, Low) \wedge Height(Monkey, High)$

ClimbDown PRECOND: $At(Monkey, x) \wedge At(Box, x) \wedge Height(Monkey, High)$
EFFECT: $\neg Height(Monkey, High) \wedge Height(Monkey, Low)$

Grasp PRECOND: $At(Monkey, x) \wedge At(Bananas, x) \wedge Height(Monkey, y) \wedge Height(Bananas, y)$
EFFECT: $With(Monkey, Bananas)$

UnGrasp PRECOND: $With(Monkey, Bananas)$
EFFECT: $\neg With(Monkey, Bananas)$

c $With(Monkey, Box, s) \wedge (\exists x)[At(Box, x, s_0) \wedge At(Box, x, s)]$
There is no way to represent the relationship between two state within the plan in STRIP. So no way to represent this goal.

d In function push, add $Pushable(Box)$ in PRECOND.

Problem 4 **Solution:**

See appendix.

Problem 5 **Solution:**

Init :

$F^0 = \{On(A, Table)^0, On(B, Table)^0, On(C, Table)^0, clear(A)^0, clear(B)^0, clear(C)^0,$
$\neg On(A, B)^0, \neg On(A, C)^0, \neg On(B, A)^0, \neg On(B, C)^0, \neg On(C, A)^0, \neg On(C, B)^0\}.$

Objective :

$On(A, B) \wedge On(B, C) \wedge clear(A)$

Move(a,x,y) :

PRECON: $PRE_0 = On(a, x) \wedge clear(a) \wedge clear(y)$
EFFECT: $EFF_0 = On(a, y) \wedge clear(x) \wedge \neg clear(y)$
Delete list: $Del_0 = clear(y)$
Add list: $Add_0 = On(a, y) \wedge clear(x)$

MovetoTable(a,x) :

PRECON: $Pre_1 = On(a, x) \wedge clear(a)$
EFFECT: $EFF_1 = On(a, Table) \wedge clear(x)$
Delete list: $Del_1 = \emptyset$
Add list: $Add_1 = On(a, Table) \wedge clear(x)$

t = 1 $MovetoTable(a, x)^1 \Rightarrow On(a, x)^0 \wedge clear(a)^0 \wedge On(a, Table)^1 \wedge clear(x)^1$
$MovetoTable(a, x, y)^1 \Rightarrow On(a, x)^0 \wedge clear(a)^0 \wedge clear(y)^0 \wedge On(a, y)^1 \wedge clear(x)^1 \wedge \neg clear(y)^1$
$\neg On(A, Table)^0 \wedge On(A, Table)^1 \Rightarrow MovetoTable(A, B)^1 \vee MovetoTable(A, C)^1$
$\neg On(B, Table)^0 \wedge On(B, Table)^1 \Rightarrow MovetoTable(B, A)^1 \vee MovetoTable(B, C)^1$
$\neg On(C, Table)^0 \wedge On(C, Table)^1 \Rightarrow MovetoTable(C, B)^1 \vee MovetoTable(C, A)^1$
$\neg On(A, B)^0 \wedge On(A, B)^1 \Rightarrow Move(A, C, B)^1 \vee Move(A, Table, B)^1$
$\neg On(A, C)^0 \wedge On(A, C)^1 \Rightarrow Move(A, B, C)^1 \vee Move(A, Table, C)^1$

$\neg On(B,A)^0 \wedge On(B,A)^1 \Rightarrow Move(B,C,A)^1 \vee Move(B,Table,A)^1$
$\neg On(B,C)^0 \wedge On(B,C)^1 \Rightarrow Move(B,A,C)^1 \vee Move(B,Table,C)^1$
$\neg On(C,A)^0 \wedge On(C,A)^1 \Rightarrow Move(C,B,A)^1 \vee Move(C,Table,A)^1$
$\neg On(C,B)^0 \wedge On(C,B)^1 \Rightarrow Move(C,A,B)^1 \vee Move(C,Table,B)^1$
...

t = 2 $MovetoTable(a,x)^2 \Rightarrow On(a,x)^1 \wedge clear(a)^1 \wedge On(a,Table)^2 \wedge clear(x)^2$
$MovetoTable(a,x,y)^2 \Rightarrow On(a,x)^1 \wedge clear(a)^1 \wedge clear(y)^1 \wedge On(a,y)^2 \wedge clear(x)^2 \wedge \neg clear(y)^2$
$\neg On(A,B)^1 \wedge On(A,B)^2 \Rightarrow Move(A,C,B)^2 \vee Move(A,Table,B)^2$
$\neg On(A,C)^1 \wedge On(A,C)^2 \Rightarrow Move(A,B,C)^2 \vee Move(A,Table,C)^2$
$\neg On(B,A)^1 \wedge On(B,A)^2 \Rightarrow Move(B,C,A)^2 \vee Move(B,Table,A)^2$
$\neg On(B,C)^1 \wedge On(B,C)^2 \Rightarrow Move(B,A,C)^2 \vee Move(B,Table,C)^2$
$\neg On(C,A)^1 \wedge On(C,A)^2 \Rightarrow Move(C,B,A)^2 \vee Move(C,Table,A)^2$
$\neg On(C,B)^1 \wedge On(C,B)^2 \Rightarrow Move(C,A,B)^2 \vee Move(C,Table,B)^2$
...