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Assignment - 7

Task - 2 :-

Given :- Three adults and three children on left side of river.

weight of adult - 150 pounds
 weight of child - 75 pounds

Facts :-

let adults be A₁, A₂, A₃

let children be C₁, C₂, C₃

object Boat represented by B

left side represented by L

Right side represented by R

Initial state :- Three adults, three children and boat on left side of river.
 Left (A₁) \wedge Left (A₂) \wedge Left (A₃) \wedge Left (C₁) \wedge Left (C₂) \wedge Left (C₃) \wedge Left (B)

Goal state :- To move all three adults, three children and boat from left side of river to the right side of river.

Right (A₁) \wedge Right (A₂) \wedge Right (A₃) \wedge Right (C₁) \wedge Right (C₂) \wedge Right (C₃) \wedge Right (B)

Action 1 :- Move-Boat-Right (C1, C2)

Precondition :- left (C1) \wedge left (C2) \wedge left (B) \wedge ischild (C1) \wedge ischild (C2)

Effects :- Right (C1) \wedge Right (C2) \wedge Right (B) \wedge left (C3) \wedge left (A1)
 \wedge left (A2) \wedge left (A3)

Action 2 :- Move-Boat-Left (C2)

Precondition :- Right (C2) \wedge Right (B)

Effects :- left (A1) \wedge left (A2) \wedge left (A3) \wedge Right (C1) \wedge
left (C2) \wedge left (C3) \wedge left (B)

Action 3 :- Move-Boat-Right (C2, C3)

Precondition :- left (C2) \wedge left (C3) \wedge ischild (C2) \wedge ischild (C3)

Effects :- Right (C1) \wedge Right (C2) \wedge Right (C3) \wedge Right (B) \wedge
left (A1) \wedge left (A2) \wedge left (A3)

Action 4 :- Move-Boat-Left (C3)

Precondition :- R(C3) \wedge R(B)

Effects :- L(A1) \wedge L(A2) \wedge L(A3) \wedge L(C3) \wedge L(B) \wedge R(C1) \wedge R(C2)

Action 5 :- Move-Boat-Right (A1)

Precondition :- L(A1) \wedge L(B)

Effects :- L(A2) \wedge L(A3) \wedge L(C3) \wedge R(B) \wedge R(A1) \wedge R(C2) \wedge R(C1)

Action 6 :- Move_Boat_Left (C2)

Precondition :- R(C2) \wedge R(B)

Effects :- L(A2) \wedge L(A3) \wedge L(B) \wedge L(C2) \wedge L(C3) \wedge R(A1) \wedge R(C1)

Action 7 :- Move_Boat_Right (A2)

Precondition :- L(A2) \wedge L(B)

Effects :- L(A3) \wedge L(C2) \wedge L(C3) \wedge R(A1) \wedge R(A2) \wedge R(C1) \wedge R(B)

Action 8 :- Move_Boat_Left (C1)

Precondition :- R(C1) \wedge R(B)

Effects :- L(A3) \wedge L(C1) \wedge L(C2) \wedge L(C3) \wedge L(B) \wedge R(A1) \wedge R(A2)

Action 9 :- Move_Boat_Right (C1,C2)

Precondition :- L(C1) \wedge L(C2) \wedge L(B) \wedge isChild(C1) \wedge isChild(C2)

Effects :- L(A3) \wedge L(C3) \wedge R(A2) \wedge R(A1) \wedge R(C2) \wedge R(C1) \wedge R(B)

Action 10 :- Move_Boat_Left (C2)

Precondition :- R(C2) \wedge R(B)

Effects :- L(A3) \wedge L(C2) \wedge L(C3) \wedge L(B) \wedge R(A1) \wedge R(A2) \wedge R(C1)

Action 11 :- Move_Boat_Right (A3)

Precondition :- L(A3) \wedge L(B)

Effects :- L(C2) \wedge L(C3) \wedge R(C1) \wedge R(A1) \wedge R(A2) \wedge R(A3) \wedge R(B)

Action 12 :- Move_Boat-Left (C1)

Precondition :- $R(C1) \wedge R(B)$

Effects :- $L(C1) \wedge L(C2) \wedge L(C3) \wedge L(B) \wedge R(A1) \wedge R(A2) \wedge R(A3)$

Action 13 :- Move_Boat-Right (C1, C2)

Precondition :- $L(C1) \wedge L(C2) \wedge L(B) \wedge \text{ischild}(C1) \wedge \text{ischild}(C2)$

Effects :- $R(C1) \wedge R(C2) \wedge R(A1) \wedge R(A2) \wedge R(A3) \wedge R(B) \wedge L(C3)$

Action 14 :- Move_Boat-Left (C2)

Precondition :- $R(C2) \wedge R(B)$

Effects :- $L(C2) \wedge L(C3) \wedge L(B) \wedge R(C1) \wedge R(A1) \wedge R(A2) \wedge R(A3)$

Action 15 :- Move_Boat-Right (C2, C3)

Precondition :- $L(C2) \wedge L(C3) \wedge L(B) \wedge \text{ischild}(C2) \wedge \text{ischild}(C3)$

Effects :- $R(C1) \wedge R(C2) \wedge R(C3) \wedge R(B) \wedge R(A1) \wedge R(A2)$
 $\wedge R(A3)$

Task 3 :-

Given :-

Predicates : 5

Arguments : 3

Constants : 4

The number of unique states is found out as follows :-

Maximum Limit :-

Three arguments can be filled in 4 ways each
i.e. $4 \times 4 \times 4 = 64$

∴ We have 5 predicates

so, total possibilities

$$= 5 \times 4^3 = 5 \times 64 = 320$$

And each predicate can be either True or False.

∴ Maximum limit is 2^{320} .

Minimum Limit :-

Consider 1 predicate takes 1 argument

$$\therefore 4 \times 1 = 4$$

There are 5 predicates = $5 \times 4 = 20$

Predicates are boolean can be either True or False.

∴ Minimum limit is 2^{20} .

Task 4.

on applying aaa (B,C) to S1: (eee 2) and (eee1 B C) get added and (eee2 C) and (eee3 C) get deleted.

∴ The resulting state after applying action
B +aaa (B,C) is

(A tt1)

(B (ttt1))

(C ttt1)

(ppp1 BC)

(ppp2 A)

(ppp2 B)

(ppp3 C)

(eee1 AC)

(eee1 BC)

(eee2 B)

(eee3 A)

Task 5

1) Execution Monitoring / online Replanning :-

The plan made is same as in the deterministic case, (there is no violation in the current plan). The action is done repeatedly till the goal is achieved. In every action, the current state is monitored and further actions are taken if goal state is not met.

2) Conditional Planning :-

Certain modifications are required in case of conditional planning. The modifications are as follows :-

Action :- MoveOne-to-left (x)

Precond :- Right (x) \wedge Right (Boat) \wedge ischild OR Adult (x)

Effects :- (left (x) \wedge left (Boat)) OR (right (x) \wedge right (Boat))

Action :- MoveOne-to-right (x)

Precond :- Left (x) \wedge Left (Boat) \wedge ischild OR Adult (x)

Effects :- (right (x) \wedge right (Boat)) OR (left (x) \wedge left (Boat))

Action :- MoveTwo-to-Left (x, y)

Precond :- Right (x) \wedge Right (y) \wedge Right (Boat) \wedge
ischild (x) \wedge ischild (y)

Effects :- Left (x) \wedge Left (y) \wedge Left (Boat)

Action :- MoveTwo-to-Right (x, y)

Precond :- Left (x) \wedge Left (y) \wedge Left (Boat) \wedge
ischild (x) \wedge ischild (y)

Effects :- right (x) \wedge Right (y) \wedge Right (Boat)