

## Task 1: Solution

Constants: adult1, adult2, adult3, child1, child2, child3, boat, left\_side, right\_side

Initiate state:

At(adult1, left\_side)

At(adult2, left\_side)

At(adult3, left\_side)

At(child1, left\_side)

At(child2, left\_side)

At(child3, left\_side)

At(boat, left\_side)

Goal state:

At(adult1, right\_side)

At(adult2, right\_side)

At(adult3, right\_side)

At(child1, right\_side)

At(child2, right\_side)

At(child3, right\_side)

At(boat, right\_side)

Actions:

Predicate:

At(x,y) is true: if person x is at side y.

Action (Move2C person, from , to),

PRECOND:

At(person, from) AND Boat(from)

EFFECT:

At(person, to) AND Boat(to) AND Not At(person, from), AND Not Boat(from)

Action (Move1C person1, person2, from , to),

PRECOND:

At(person1, from) AND At(person2, from) AND Boat(from)

EFFECT:

At(person1, to) AND At(person2, to). AND Boat(to).

Not At(person1, from) AND Not At(person2, from), AND Not Boat(from)

Plan

1. Move1(adult1, child1, left_side, right_side)		
2. Move2(child1, right_side, left_side)		
3. Move1(adult2, child1, left_side, right_side)		
4. Move2(child1, right_side, left_side)		
5. Move1(adult3, child1, left_side, right_side)		
6. Move2(child1, right_side, left_side)		
7. Move1(child2, child1, left_side, right_side)		
8. Move2(child1, right_side, left_side)		
9. Move1(child3, child1, left_side, right_side)		

### Task 2: Solution

For each possible argument of the predicate, we must specify if the predicate returns true or false.

According to the 'Unique Names Assumption'.

we have  $A_5^4 = \frac{5!}{1!} = 120$  possible combinations of arguments at most.

we have 0 possible combinations of arguments at least.

{ In total,  $2^{120 \times 4} = 2^{480}$  possible world. at most

{ In total,  $2^0 = 1$  possible world. at least

$$\therefore f(n) = 2^n \text{ } n \in [0, 480]$$

The tight bound is  $\Theta(2^n) = f(n)$  there exist positive constant  $c_1, c_2$  and  $n_0$  such that

$$0 \leq c_1 g(n) \leq f(n) \leq c_2 g(n) \text{ for all } n \geq n_0.$$

### Task 3: Solution

(A ttt1)

(B ttt1) We will remove (eee3 c) and add (eee1 BC) and (eee2 b)

(C ttt1) based on Action aaa.

(ppp1 B C)

(ppp2 A)

(ppp2 B)

(ppp3 C)

(eee1 A C)

(eee2 C)

(eee3 C)

(eee3 A)

(eee1 B C)

(eee2 B)

#### Task 4: Solution

Moving boat may be successful or not.

$\begin{cases} \textcircled{1} \text{ If successful, the boat ends up where we want.} \\ \textcircled{2} \text{ If unsuccessful, the boat back to ori in side.} \end{cases}$

#### 1. Online Replanning:

In online replanning, we do not have to modify the action definitions.

Because before executing move2(person, from, to), we check if the states of the world is as expected. If not. we replan.

#### 2. Conditional Planning:

To model the uncertainty, we can allow the effects of an action to include disjunctions.

Action (Move2 (person, from, to)),

PRECOND:

At (person, from) AND Boat (from)

EFFECT:

(At (person, to) AND Boat (to) AND Not At (person, from), AND Not Boat (from))

OR (At (person, from) AND Boat (from)) No effect