

Tutorial 1-2-

AIM:- To understand State Space problem formulation.

THEORY:- First we understand the problem solving agent. Algorithm shown in figure shows agent program for problem solving agent. Agent first formulates goal & problem, then determines on whether searches an action sequence, after which it returns the next action to be executed in a sequential manner.

Function: SIMPLE-PROBLEM-SOLVING-AGENT(percept)
returns an action.

Static: seq, an action sequence, initially empty,
state, some description of current world state
goal, a goal, initially null
problem, a problem formulation

State \leftarrow UPDATE-STATE (state, percept)

If seq is empty then do

goal \leftarrow FORMULATE-GOAL (state)

problem \leftarrow FORMULATE-PROBLEM (state, goal)

seq \leftarrow SEARCH (problem)

action \leftarrow FIRST (seq)

seq \leftarrow REST (seq)

return action

Fig. Problem Solving Agent Architecture.

Defining the problem is referred to as problem formulation. It involves defining following five things:

- 1) Initial :- It is the starting state that the problem is in.

2) Action :- It defines all possible actions available to the agent, given it is in some state currently. It is a function $Action(s)$ that returns list of all possible actions.

3) Transition Model :- Also known as successor function which defines which state/s the system tend to move to when a particular action is executed by the agent. Successive application of transition model gives rise to what is known as state space.

4) Goal Test :- This act as a stopping condition when the state passed to this function is goal state it will return true & searching would stop.

5) Path Test :- It is accumulated cost of performing certain sequence of actions. This can help in determining whether the action sequence under consideration is optimal.

Thus a problem can formally specified by identifying initial state, actions, transition model, goal test & path test. In terms of problem solving agent solution is the path from initial state to a goal state, optimal solution is the lowest path cost of all solution. Process of finding a solution is called search.

WORKING:-

Based on understanding of problem formulation students need to formulate following problems. They will clearly show state space up to depth level 3 or till goal node which ever is shallowest.

9) 8-puzzle problem

The problem can be formulated as:

- States: States can be represented by a 3×3 matrix data structure with blank denoted by ' _ ' in underscore.

① Initial state: $\{\{1, 2, 3\}, \{4, 8, -\}, \{7, 6, 5\}\}$

② Actions: The blank space moves in left, right, up, down direction specify the action.

③ Successor function: If we apply 'down' operation to the start state, the next state has '5' & ' _ ' switched.

④ Goal test: $\{\{1, 2, 3\}, \{4, 5, 6\}, \{7, 8, -\}\}$

⑤ Path cost: No. of steps to reach to the final state.

- Solution:

$\{\{1, 2, 3\}, \{4, 8, -\}, \{7, 6, 5\}\} \rightarrow \{\{1, 2, 3\}, \{4, 8, 5\}, \{2, 6, 7\}\}$

$\{\{1, 2, 3\}, \{4, 8, 5\}, \{7, -6\}\} \rightarrow \{\{1, 2, 3\}, \{4, -5\}, \{7, 8, 6\}\}$

$\{\{1, 2, 3\}, \{4, 5, -\}, \{7, 8, 6\}\} \rightarrow \{\{1, 2, 3\}, \{4, 5, 6\}, \{7, 8, -\}\}$

Path cost = 5 steps

8 puzzle problem:-

1	2	3
		5

Initial state

1	2	
4	8	3
7	6	5

1	2	3
4	8	5
7	6	

Down

1	2	3
4		8
7	6	5

Left

1	2	3
4	8	5
7		6

1	2	3
4	8	
7	6	5

Up

1	2	3
4	8	5
7	6	

1	2	3
4	8	5
7	6	6

1	2	3
4	8	5
7	6	

1	2	3
4	5	6
5	8	

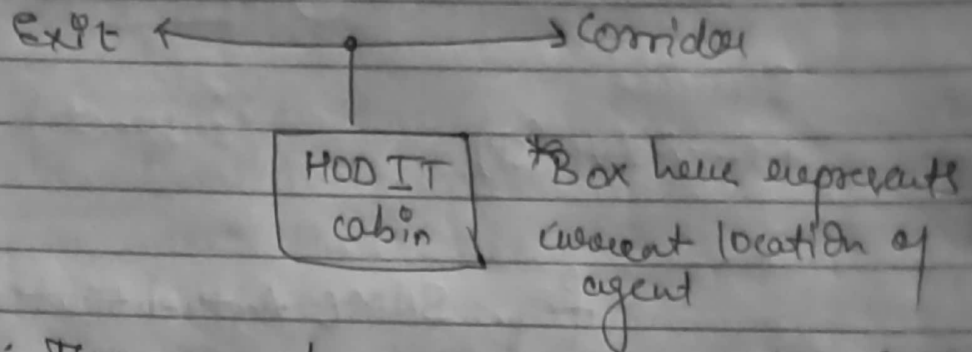
Goal state.

2. Navigate to KCEE workshop from HOD IT cabin with minimum number of moves, moves can be climbing on adjoining staircase, turning left, right, walking through a corridor.

- State: It can be represented as a top view of the agent along with arrows in direction

left, right, forward & backward. We use 'climb' & 'alight' for moving through staircase.

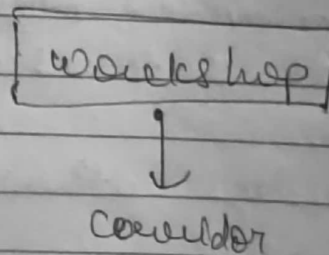
① Initial state:



② Actions: The agent means moves in left, right, forward & backward direction along with alighting & climbing the stairs (if any).

③ Successor functions: If we apply 'alight' operation to the start state, the agent enters the corridor - the first step toward goal state.

④ Goal state:-

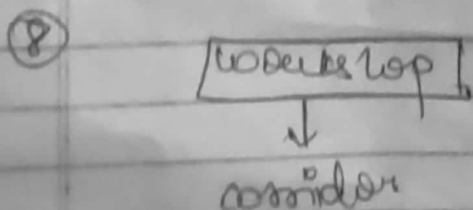
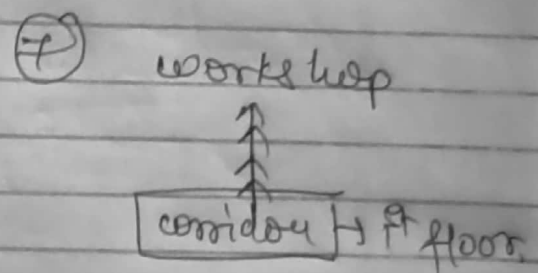
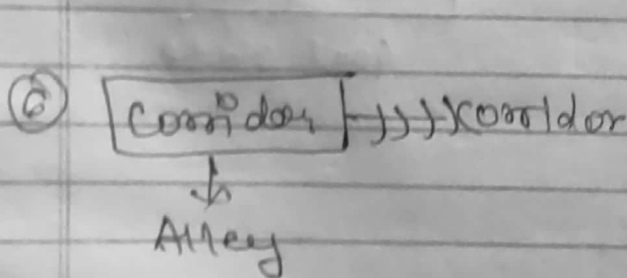
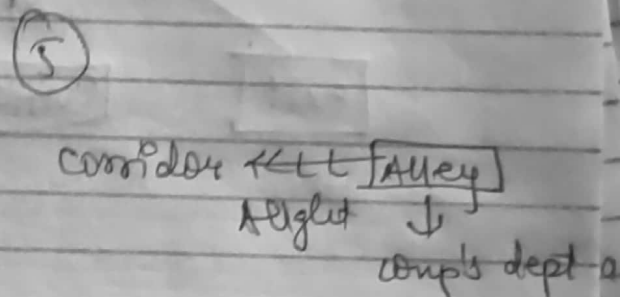
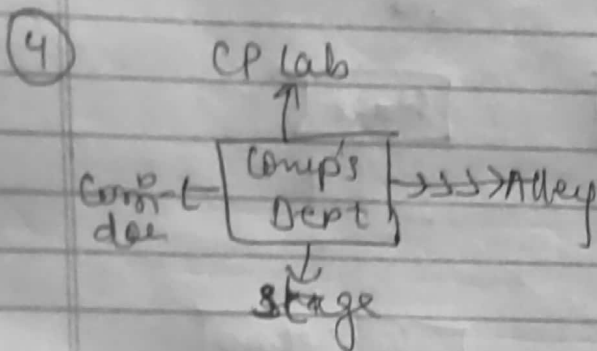
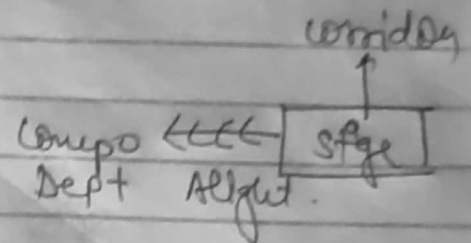
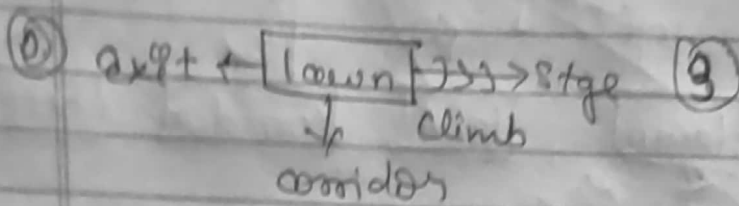
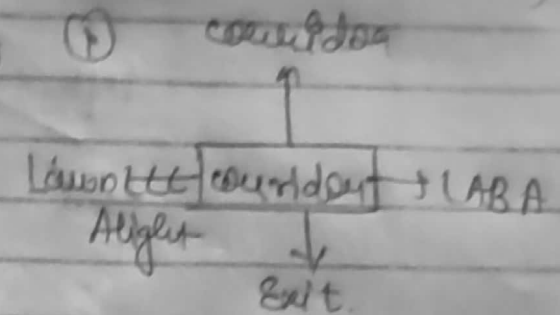
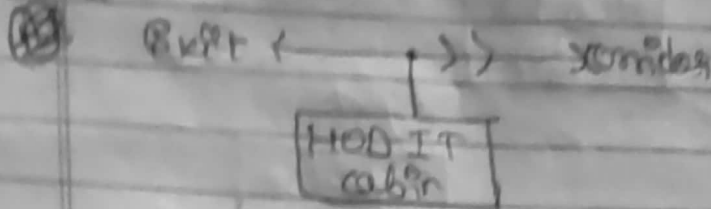


⑤ Path cost: Number of actions to reach the workshop.

$$\begin{aligned}\text{Path cost} &= 8 \text{ direction} + 4 \text{ staircase} \\ &= \underline{\underline{12}}\end{aligned}$$

HOD IT can → KQEE work loop (solution of this question)

Start



Goal state

State space.

