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Tutorial 2: To understand state space problem formulation.

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Tutorial 2: To understand state space problem formulation.

Aim - To understand state space based problem formulation of AI problems so that problem Solving Agent can be applied.

Theory - First we understand the problem solving agent. Algorithm shown in figure 3 shows agent program for problem solving agent. Agent First formulates goal and problem, then determines or rather 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 the current world
         state
        goal, a goal, initially null
        problem, a problem formulation.
state ← UPDATE-STATE(state, percept)
if seq is empty then do
    goal ← FORMULATE-GOAL(state)
    problem ← FORMULATE-PROBLEM(state, goal)
     seq ← SEARCH(problem)
action ← FIRST(seq)
```

seq ← REST(seq)
return action.

Figure 3: problem solving Agent Architecture

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

Initial State: It is the starting State of that problem it is in.

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

Transition Model: also known as successor function which define which state/s the system tends 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

Goal Test: This act as a stopping condition when the state passed to this function is goal state it will return

true or searching would stop.

Path cost: It is accumulated cost of performing certain sequence of actions. This can help in determing weather the action sequence under consideration is optimal.

Thus a problem can formally specified by identifying initial state, actions (operators) transition model (successor function), goal test and path cost. In term of problem solving agent solution is the path from initial state to a goal state, optimal solution is the lowest path cost of all solutions. 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.

1) 8-puzzle problem-

The problem can be formulated as-

- states- states can be represented by a 3x3 matrix data structure with blank denoted

by an underscore '_'.

1. Initial state : {{1,2,3} {4,8,_} {7,6,5}}
2. Actions: The blank space moves in left, right, up and down direction specifying the actions.
3. Successor function: If we apply down operation to the state start, the next state has '5' and '_' 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

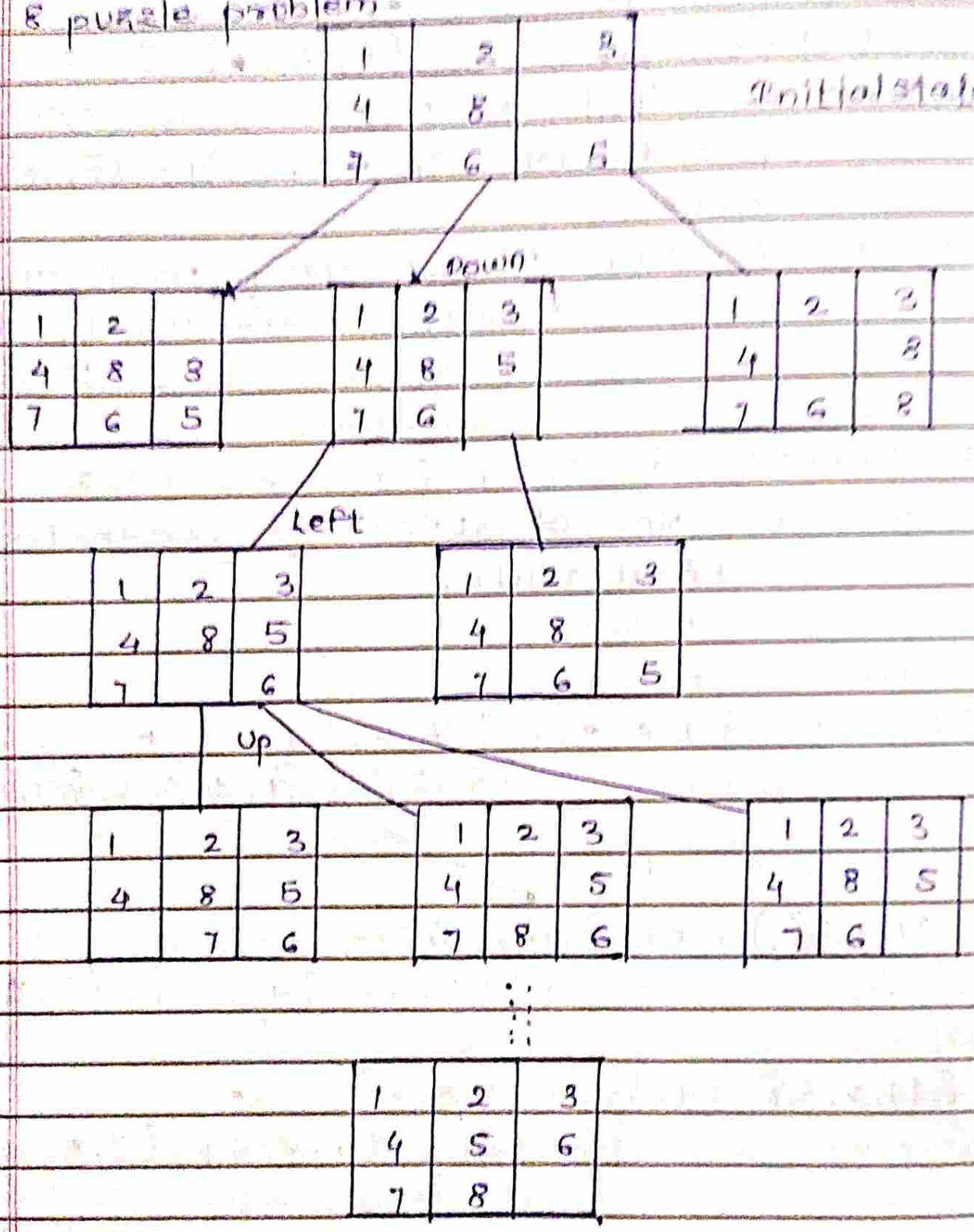
{{1,2,3} {4,8,_} {7,6,5}} →
{{1,2,3} {4,8,5} {7,6,_}}

{{1,2,3} {4,8,5} {7,_,6}} →
{{1,2,3} {4,_,5} {7,8,6}}

{{1,2,3} {4,5,_} {7,8,6}} →
{{1,2,3} {4,5,6} {7,8,_}}

Path cost = 5 steps

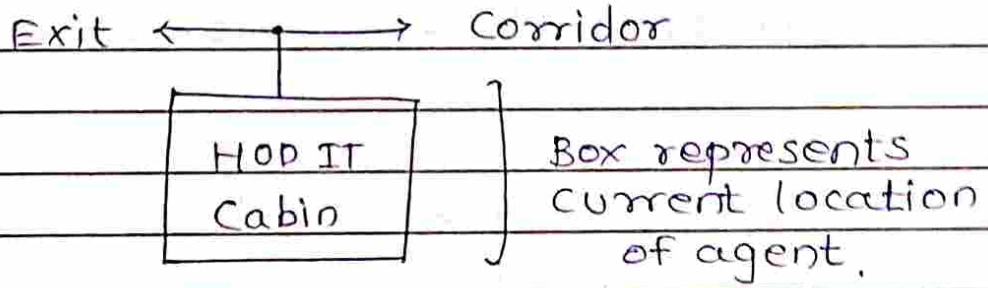
8 puzzle problem :



17 Navigate to KGCE workshop from HOD IT cabin with minimum number of moves. moves can be climbing or alighting staircase, turning left, right, walking through a corridor.

- States: It can be represented as a top view of the agent along with arrows in directions left, right, forward and backward. We use ~~down~~ climb and alight for moving through staircases.

1. Initial State -



2. Actions: The agent moves in left, right, forw -ard and backward directions along with alighting and climbing the stairs. (if any)

3. Successor function: If we apply right opera -ation to the start state, the agent enters the corridor - the first step towards goal state.

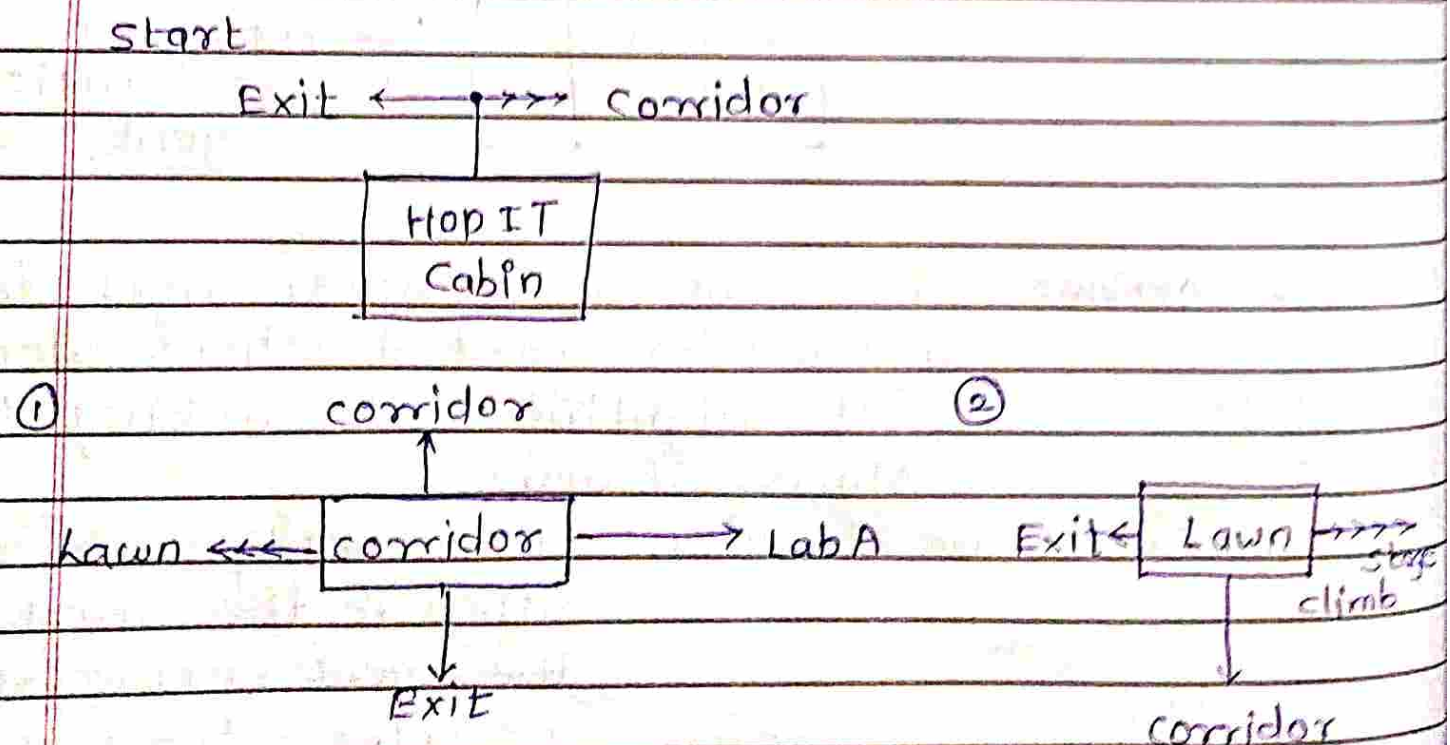
4. Goal Test:

5. Path cost: No. of actions to reach the workshop

Path cost = 8 directions + 4 staircases

= 12

HOD IT Cabin → KGCE workshop



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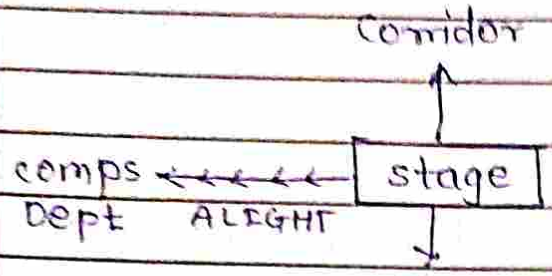
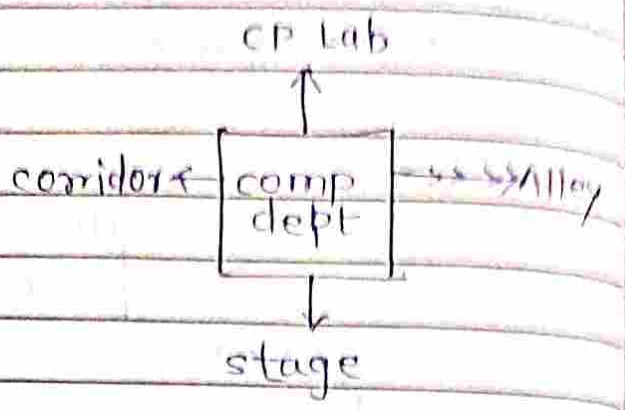
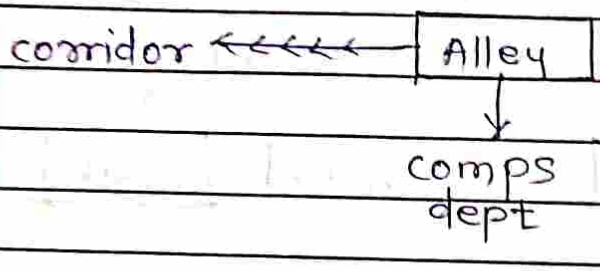

corridor
comps Dept
ALEGHT
stage
Lawn

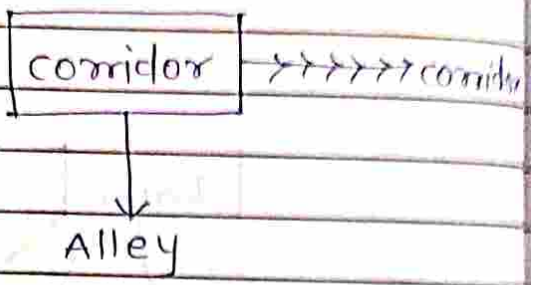
④


CP Lab
corridor
comp dept
Alley
stage

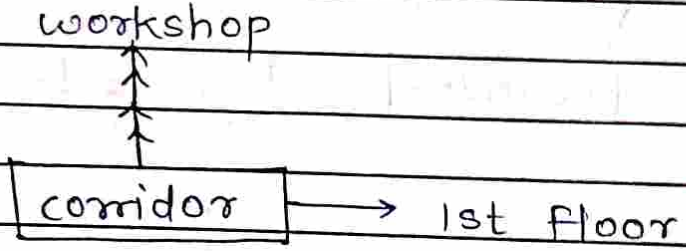
⑤


corridor
Alley
comps dept

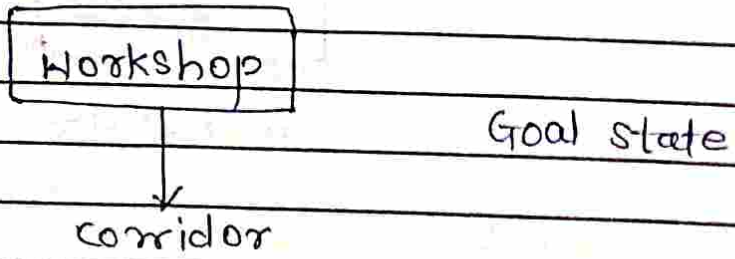
⑥


corridor
Alley

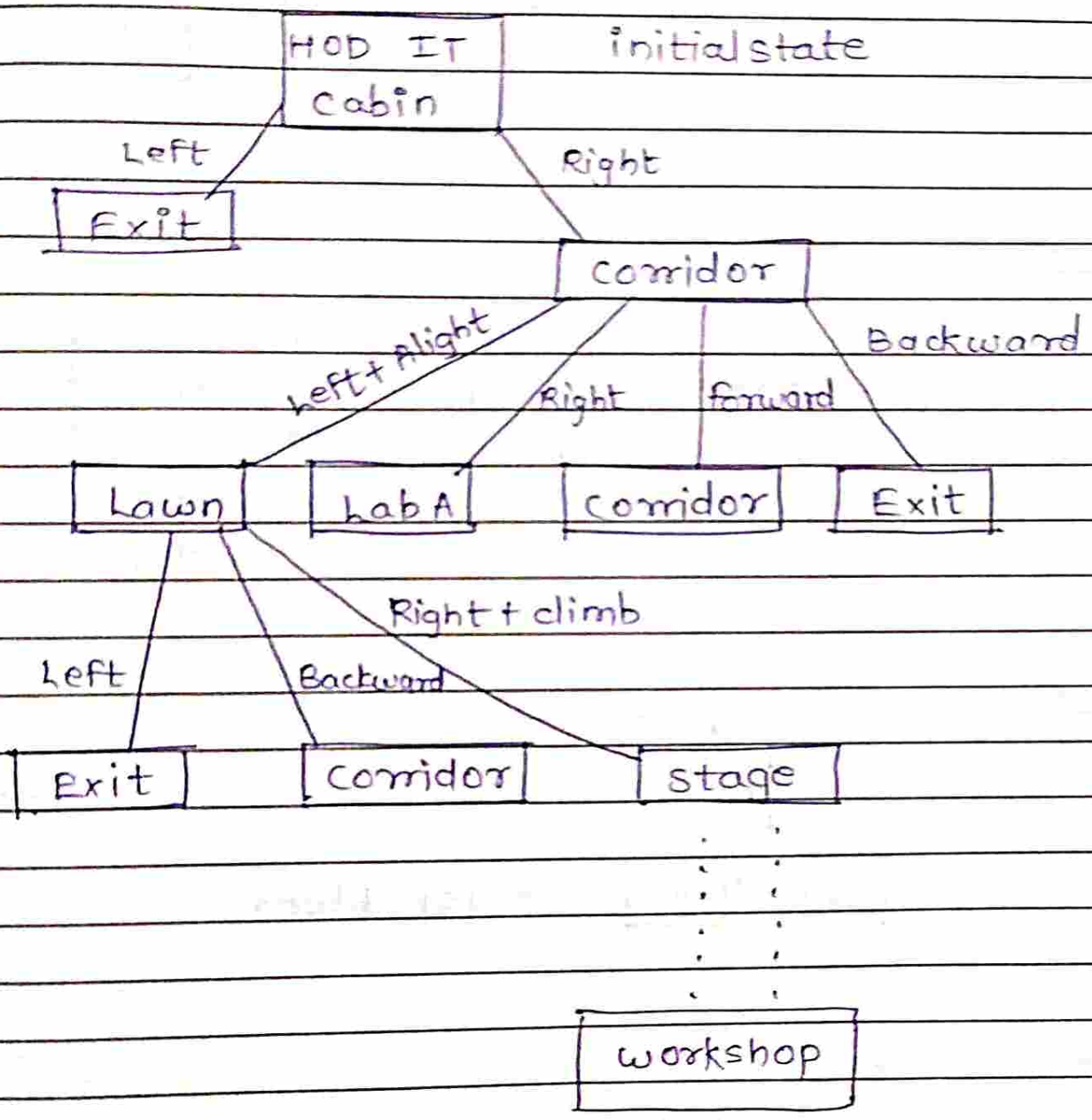
⑦


workshop
corridor
1st floor

⑧


Workshop
Goal state
corridor

state space -


HOD IT
Cabin
initial state
Left
Right
Exit
corridor
left + Alight
Right
forward
Backward
Lawn
Lab A
comidor
Exit
Right + climb
Left
Backward
Exit
corridor
stage
workshop
Goal state