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DOP	DOA	Sign	Marks

Tutorial 2: To understand State Space problem formulatio

Aim:- To understand State Space based problem formulation of AI problem solving Agent can be applies

Theory:-

First we understand the problem solving agent. Algorithm shown in figure 3 show agent program for problem solving agent. Agent first formulates goal & problem, then determines or rather search 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.

Problem Solving Agent Architecture.

Defining the Problem is referred to as problem formulation. It involves defining following five things:
Initial State. It is the starting state the problem is in.

Actions It defins all possible actions available to the agent, given it is in same 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 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.
Path cost: It is accumulated cost of performing certain sequence of actions. This can help in determining 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 & 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 upto depth level 3 or till goal node which ever is shallowest.

i) 8-puzzle problem

The problem can be formulated as:

- States: States can be represented by 3×3 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 & down direction specifying the actions
3. Successor function: If we apply down operation to the start the next state has '5' & '_' switch.
4. Goal test: {{1,2,3} {4,5,6}, {7,8...}}
5. Path cost: No. of steps to reach to the final state.

Soln:-

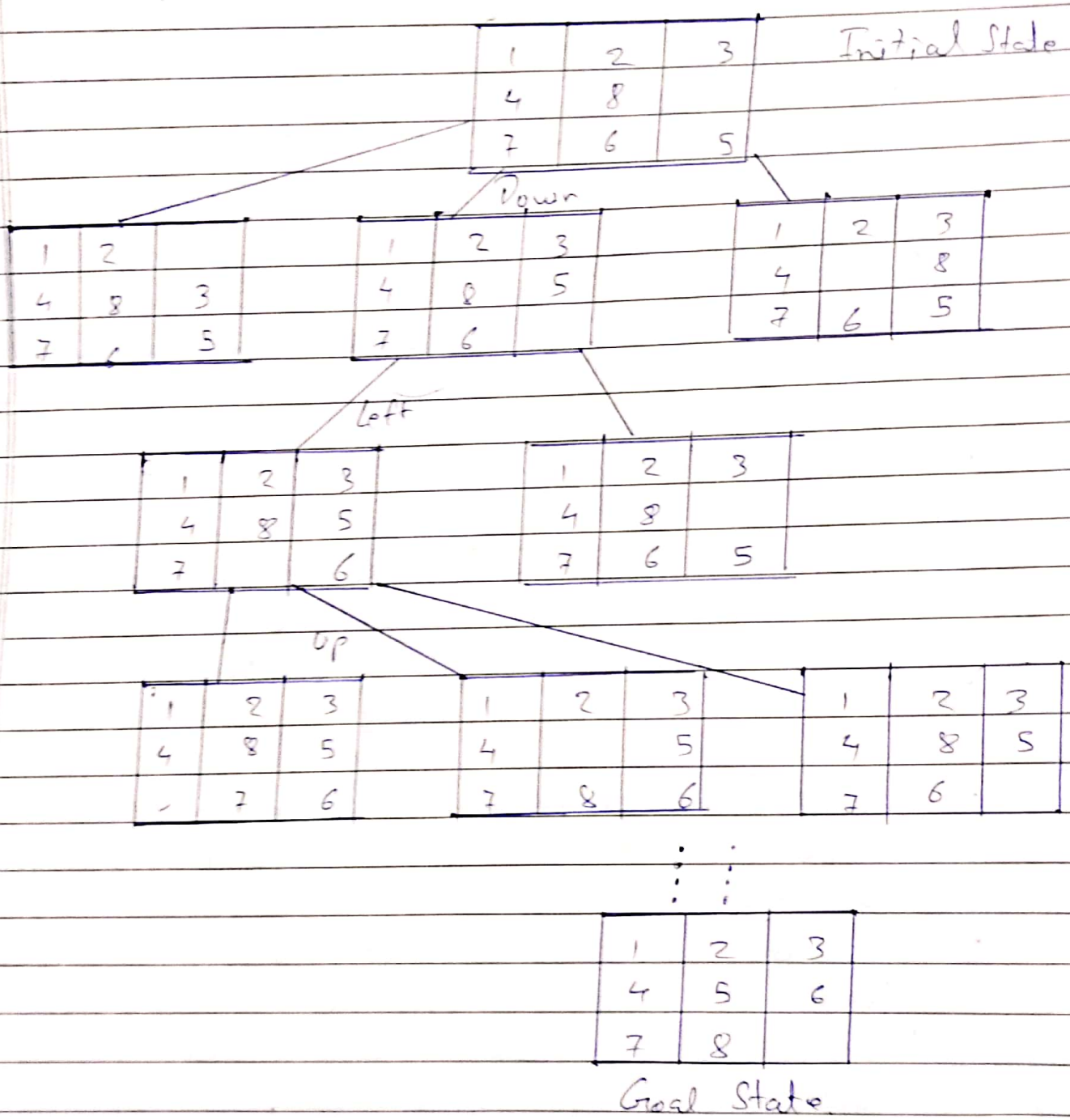
{{1,2,3}, {4,8,_}, {7,6,5}} → {{1,2,3}, {4,8,5}, {7,6,_}}

{{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

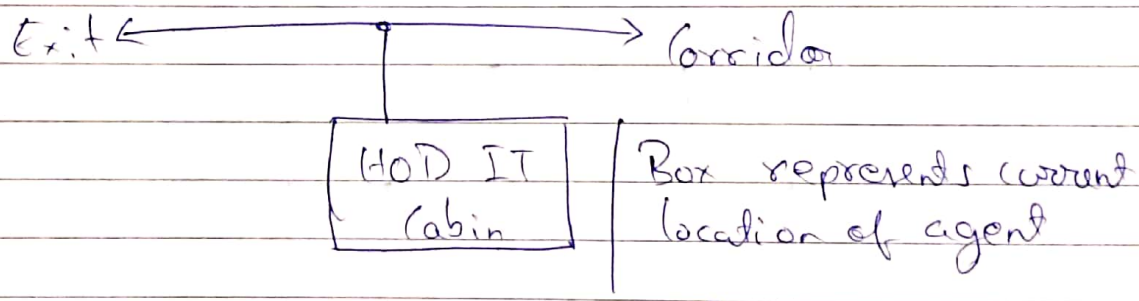
8 puzzle problem



ii) Navigate to KGiCE Workshop from HOD IT cabin with minimum number of 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 indication left, right, forward & backwards. We use 'climb' and 'alight' for moving through staircases

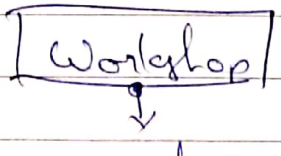
- Initial State:



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

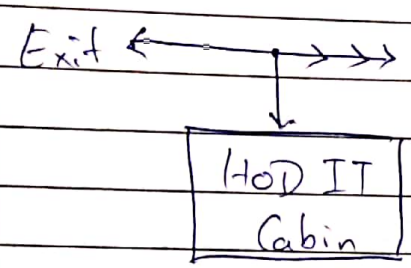
3 Successor function: if we apply 'right' operation to the start state, the agent enters the co-oridor the first step towards goal state.

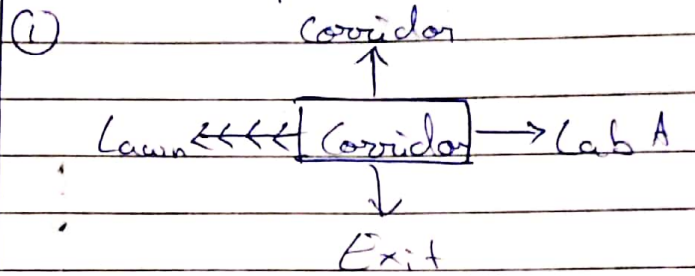
4 Goal test

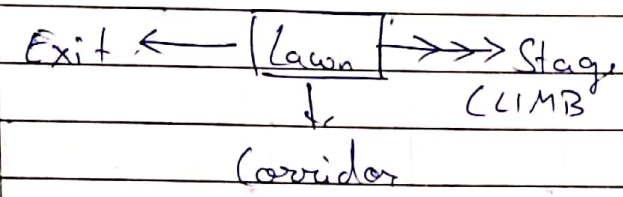


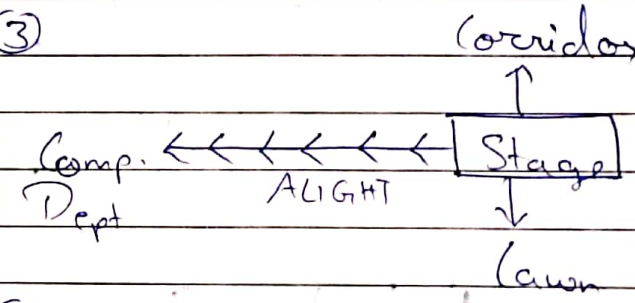
5. Path cost: No. of actions to reach the workshop
Path cost = 8 direction + 4 staircase = 12//

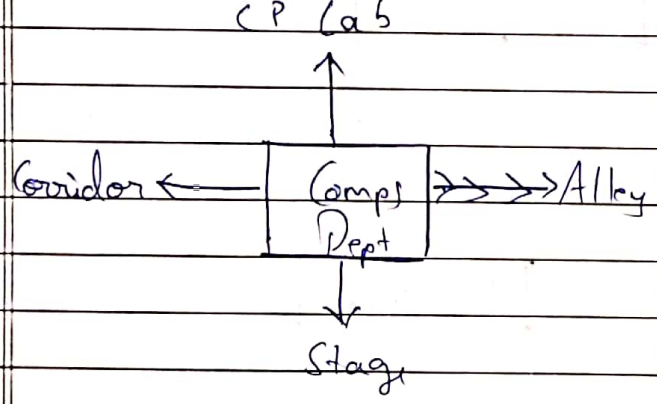
HoD IT Cabin → KGCE Workshop (Solution)

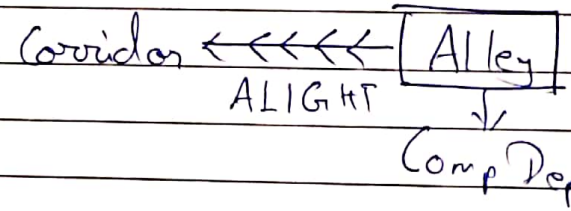


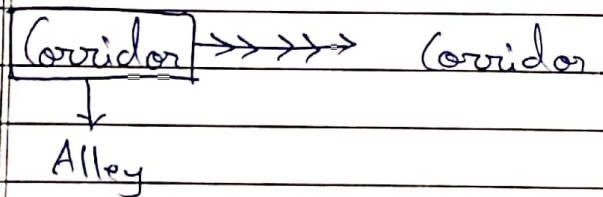
① 

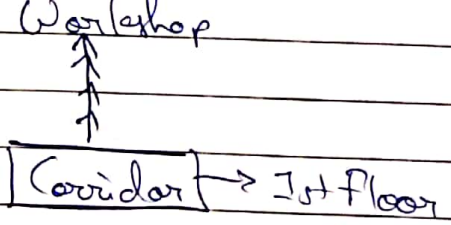
② 

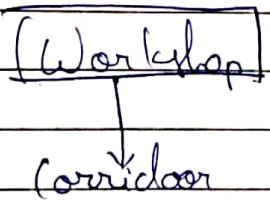
③ 

④ 

⑤ 

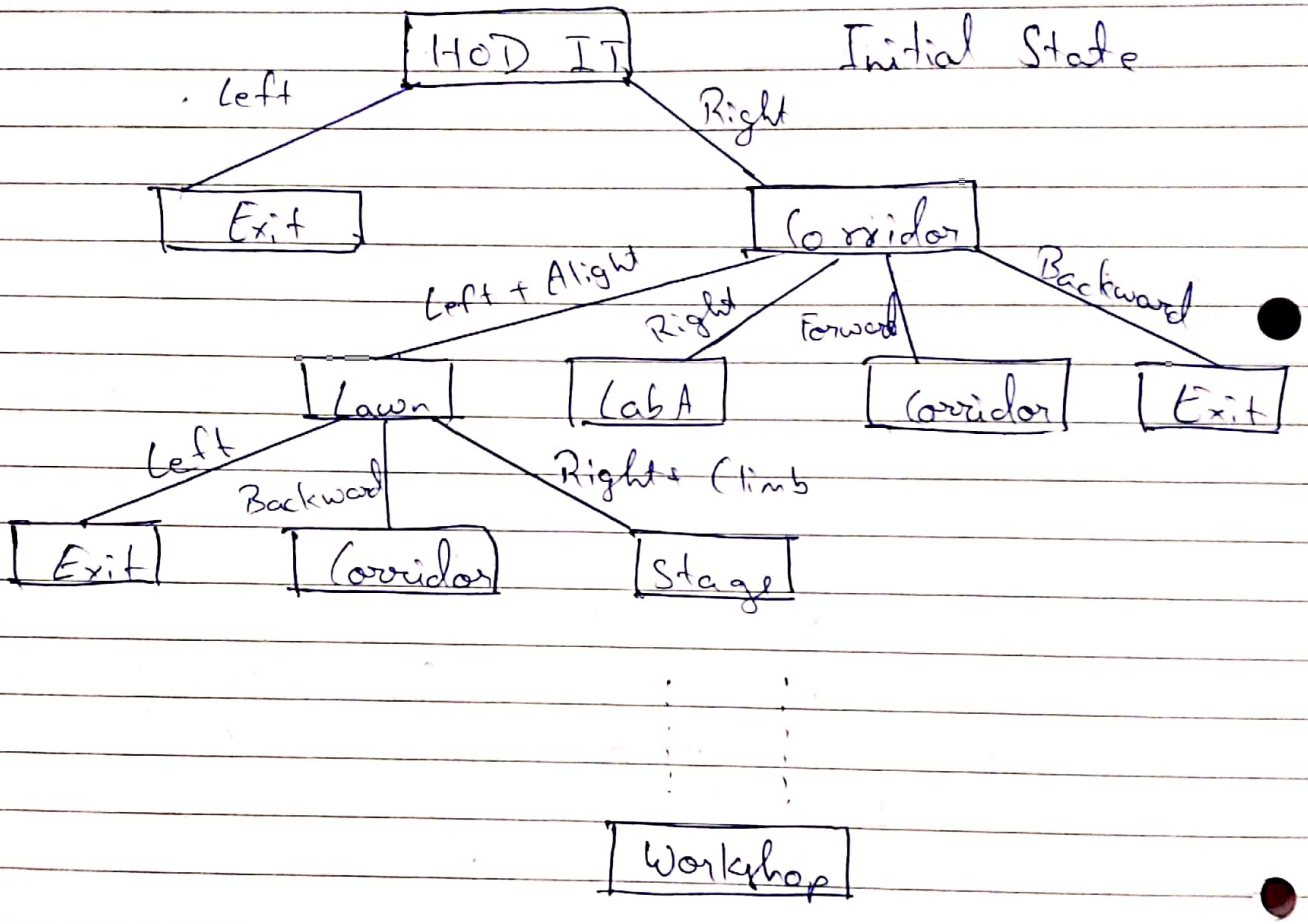
⑥ 

⑦ 

⑧ 

Goal State

State Space



Goal State