

Tutorial 2

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1.2 Tutorial 2 : To understand State Space Problem Formulation

Aim : To understand state space based problem formulation of AI problem 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 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
Static, some description of the 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

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 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.

Transition Model: Also known as successor function which define which states 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.

Goal test: This acts as a stopping condition when the state passed to this function is goal state. It will return true and searching would stop.

Path cost: 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 (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.

(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 and down direction specifying the actions.

3. Successor function : If we apply 'down' operation to the start state, the next state has '5' and '-' switch.

4. Goal test : $\{(1,2,3), (4,5,6), (7,8, \dots)\}$

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

Soln:-

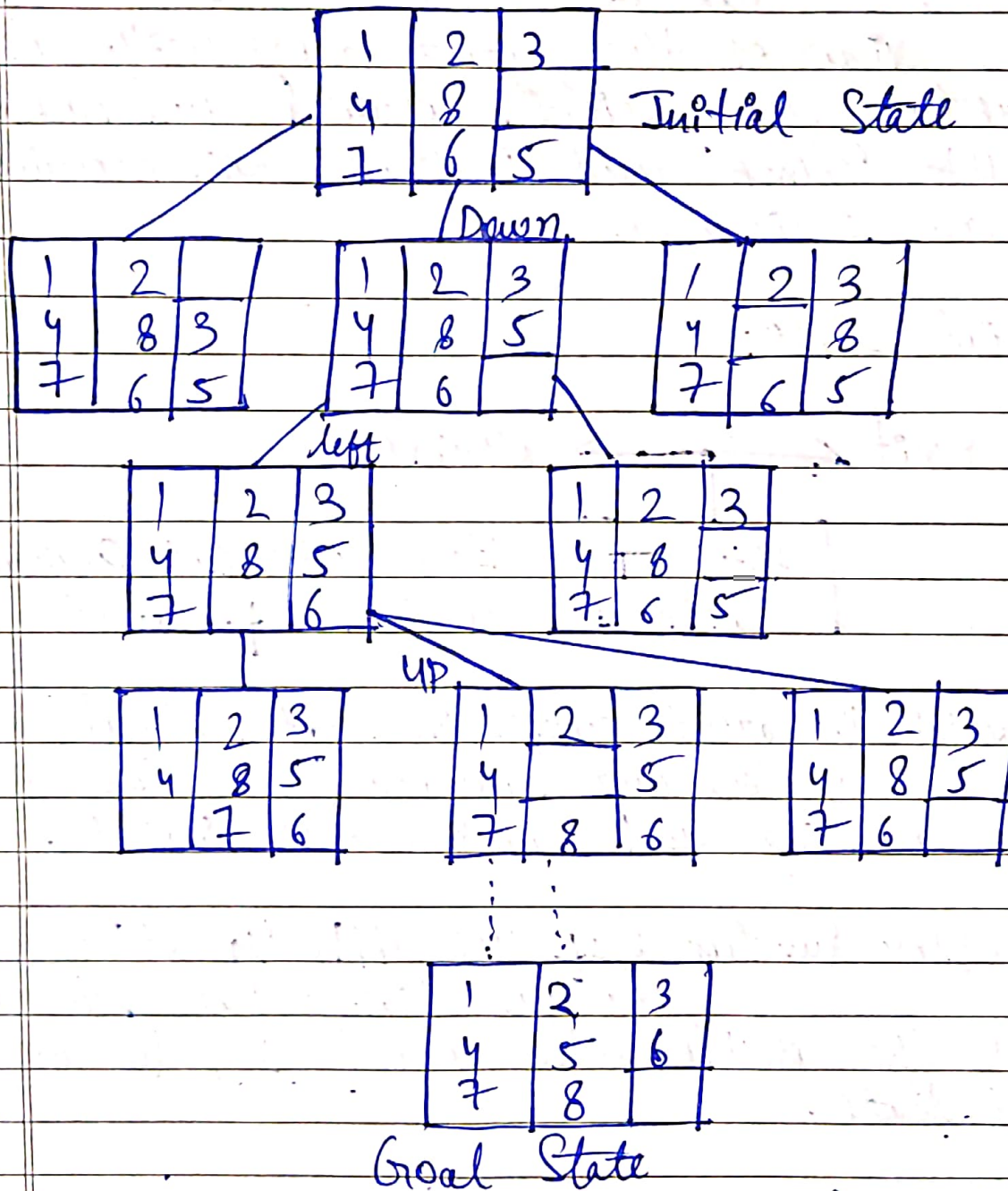
$\{(1,2,3), (4,8, \dots), (7,6,5)\} \rightarrow \{(1,2,3), (4,8,5), (7,6)\}$

$\{(1,2,3), (4,8,5), (7,6)\} \rightarrow \{(1,2,3), (4, \dots, 5), (7,8,6)\}$

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

Path Cost = 5 Steps

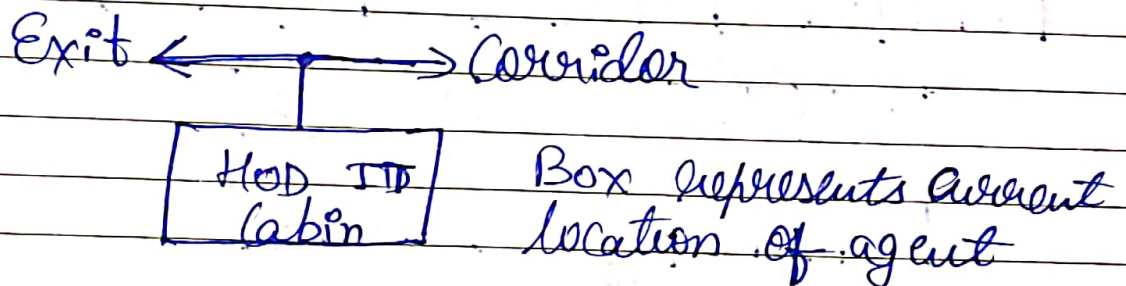
8 Puzzle Problem



(ii) Navigate to KACE workshop from HOD IT Cabin with minimum no. 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 around in direction left, right, forward and backwards. we use 'climb' and 'alight' for moving through staircases.

1. Initial State:



2. Actions : The agent moves in left, right, forward and backward directions along with alighting and climbing the stairs.

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

4. Goal test

Workshop



Corridor

5. Path Cost : NO. of actions to reach the workshop.
Path Cost = 8 directions + 4 stair cases
= 12

State Space

