

## Tutorial 2

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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 takes 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

State: seq., an action sequence, initially empty  
State, 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)

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

Initial state: It is the starting state that the problem is in.

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

Transition model: also known as Successor

function which defines which states the system tend to move to when a particular action is executed by 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 is passed to the function.

If goal test is goal, it will return true and searching would stop.

Path cost: It is accumulated cost of performing certain sequence of actions. It can help in determining whether action sequence under condition is optimal.

Thus a problem can formally specified by identifying state, action, transition model, goal test and Path cost. Process of finding a solution called Search.

Working: Based on understanding of problem formulation students need to formulate following problem, learn to show state space up to depth level 3 or till goal node which ever is shallower.

1. Naviga to KGCE Workshop from 1 to 0 IT cubin with minimum number of moves  
moves can be climbing or alighters  
shuttle, turning left, right, walking through a corridor

## 2. 8 Puzzle game

The Problem can be formulated as:

State: States can be represented by a  $3 \times 3$  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

Start State the next state has '5' and switch

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

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

- Solution:

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

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

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

Path cost = 5 steps

## 8 Puzzle problem

1	2	3
4	0	
7	6	5

initial state

1	2	
4	8	3
7	6	5

1	2	3
4	8	5
7	6	-

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

1	2	3
4	0	5
7	6	-

1	2	3
4	-	5
7	9	6

1	2	3
4	8	5
7	6	-

1	2	3
4	5	6
7	8	-

goal state

3 \* The missionaries and cannibals problem.

4 N Queen's problem. Arrange N queen on a  $N \times N$  chess board where no two queens attack each other.

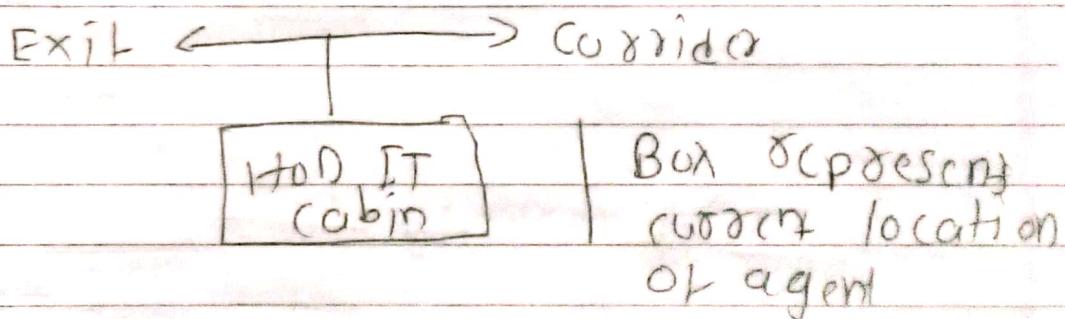
5 Two room vacuum cleaner world.

6 Water Jug Problem

ii) Navigate to KGC Workshop from HOD IT cabin with minimum number of moves,  
moves can be climbing on alighting staircase  
turning left, right, walking through considered.

State: It can be represented as a top view of  
the agent along with arrows in  
direction left, right, forward, forward  
and backwards because 'climb' and  
'alight' for moving through

1 Initial state:



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

3 Successor function: If we apply 'right'  
operation to the start state  
the agent enters the  
(consider - the first step  
towards goal state)

4) goal read

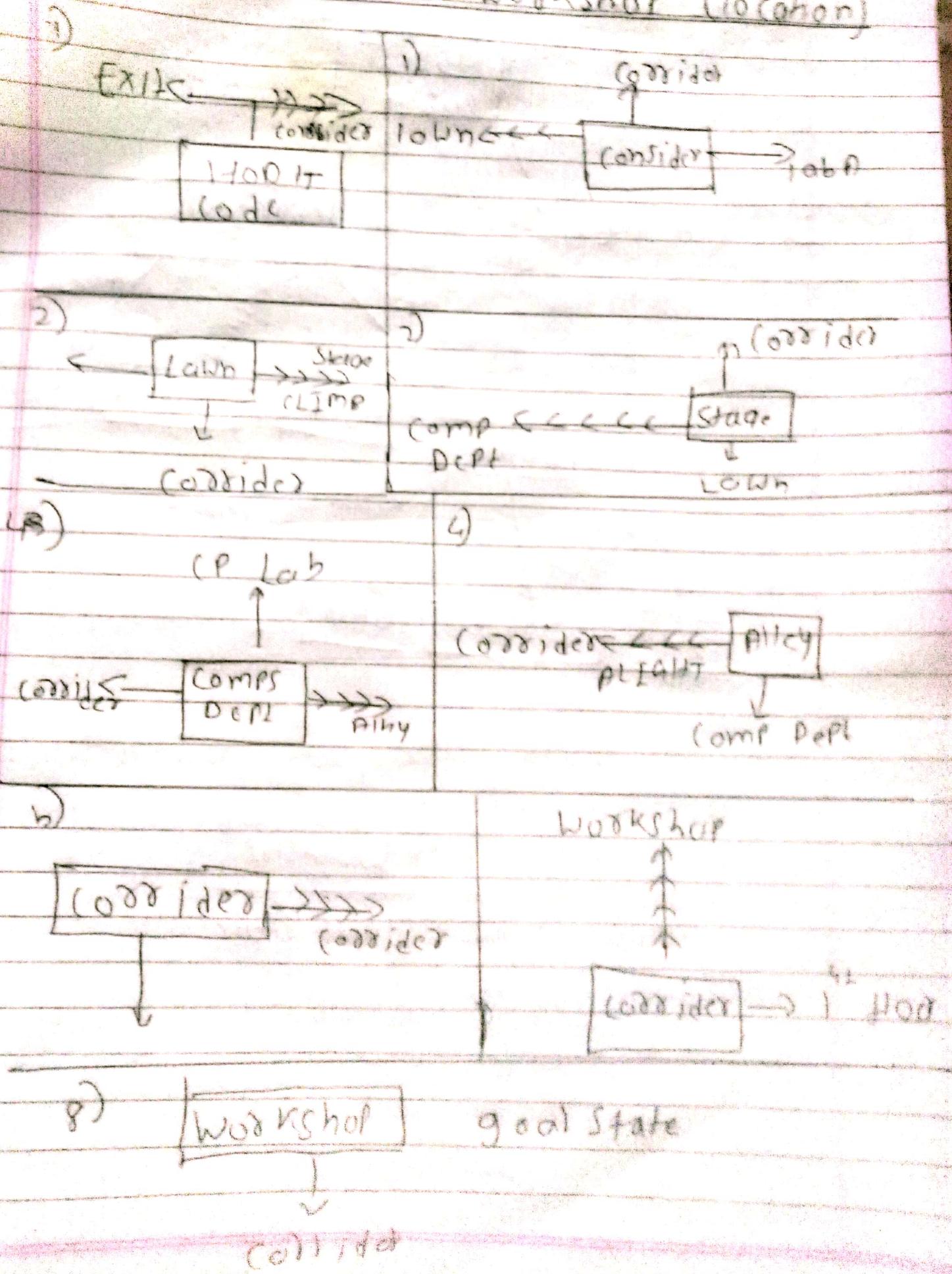
[Workshop]

( corrido )

5) path cost: No of actions to reach  
the Workshop

Path cost: 8 directions + 4 stairs cost  
= 12

# HOD EXIT RGCE Workshop (location)



## state space

