Tutorial no: 2

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Tutorial 2: To understand State space problem for Formulation.

Aim: To understand State Spaces based problem formulation of AI problems so that problem Solving Agent can be applied.

Theory: First we understand ~~State Space based~~ problems of solving agent Agent first formulates goal & problem, then determines or rather searches an action sequence, after which it returns the next action to be executed in 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 ← 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.
```

fig. 3 problem Solving Agent Architecture

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

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

Actions: It defines all possible actions available to agent, given it is in some state s 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 then system tend to move to when a particular action is executed by the agent. Successive application of ~~transact~~ transition model gives rise to what is know as State Space.

Test: This act as a stopping condition when state passed to this function is goal state it will return true and searching would stop.

Cost: It is ~~included~~ accumulated cost of performing certain sequence of action. 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 and path cost. In term of problem solving agent solution is 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. This will clearly show state space up to depth level 3. or till goal node which ever is shallowest.

8 puzzle problem:-
The 8 puzzle consists of eight numbered, movable tiles set in a 3x3 frame. One cell of frame is always empty thus making it possible to move an adjacent numbered tile into empty cell. Such a puzzle is illustrated in following figure.

2	8	3
1	6	4
7		5

Initial State

1	2	3
8		4
7	6	5

Goal State

fig: Example of 8 puzzle.

This program is to change the initial configuration into goal configuration.
A solution to the problem is an appropriate sequence to problem is a of moves, such as "move tile 5 to the right, move tile 7 to left, move tile 6 to down" etc.

To solve a problem, we must specify the global database, the rules & the control strategy. For 8 puzzle problem that corresponds to 3 components

These elements are problem states moves & goal. In this problem each tile configuration is a state. The set of all possible configuration in the problem space, consists of 3,62,880 different configurations of the 8 tiles & blank space.

For the 8 puzzle, a straight forward description is a 3x3 array of matrix of numbers. Initial global database is description of the initial problem state. Virtually any kind of data structure can be used to describe states.

A move transforms one problem state into another state. The 8-puzzle is conveniently interpreted as having the following four moves:

- move empty space (block) to left, move blank up, move blank to the right & move blank down.
- These moves are modeled by production rules that operate on the state description in the appropriate manner.

The goal condition form the basis for termination. The control strategy repeatedly applies rules to state descriptions until description of goal state is produced. It also keeps track of rules that have been applied so that it can compose them into sequence representing problem solution.

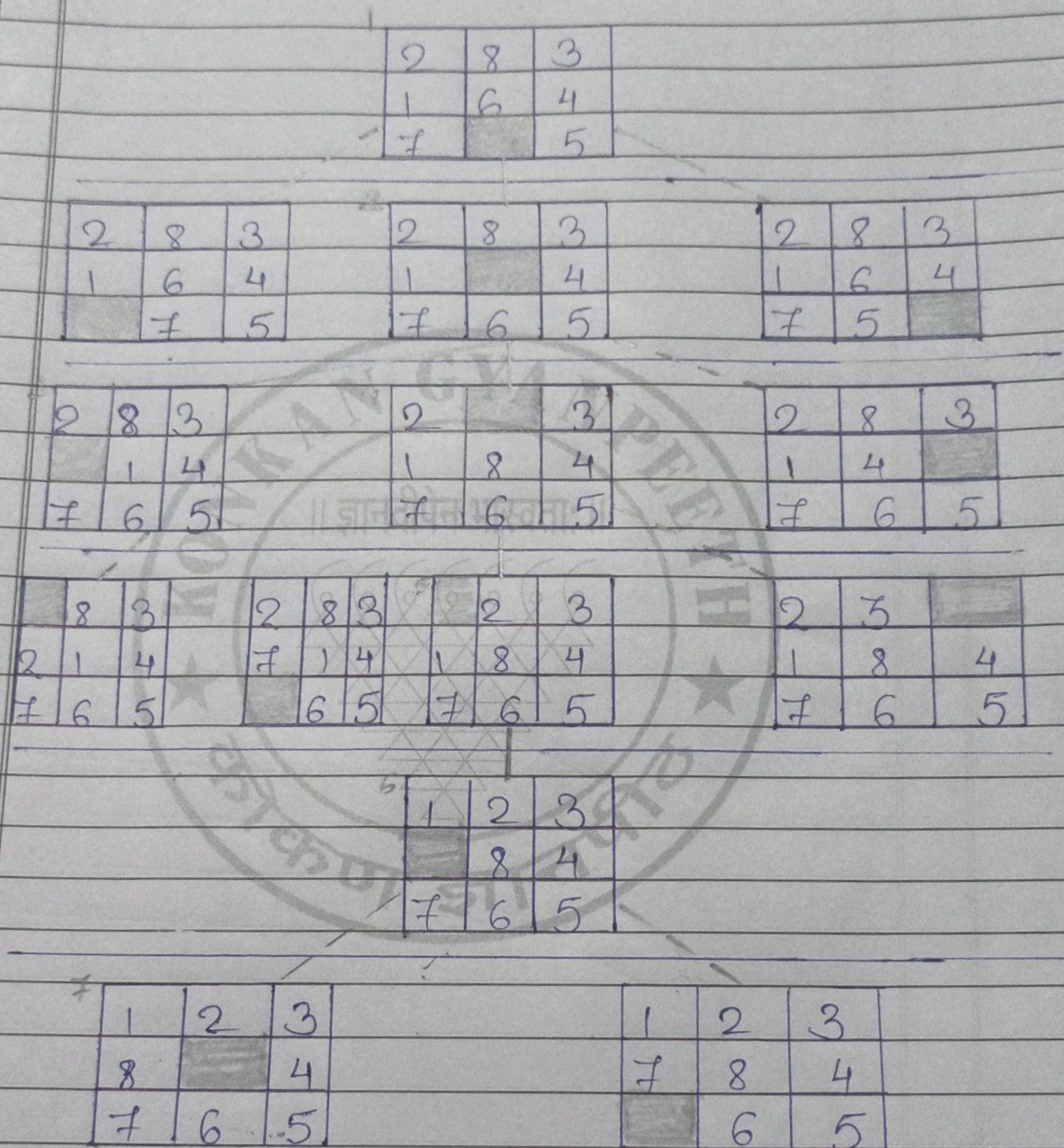
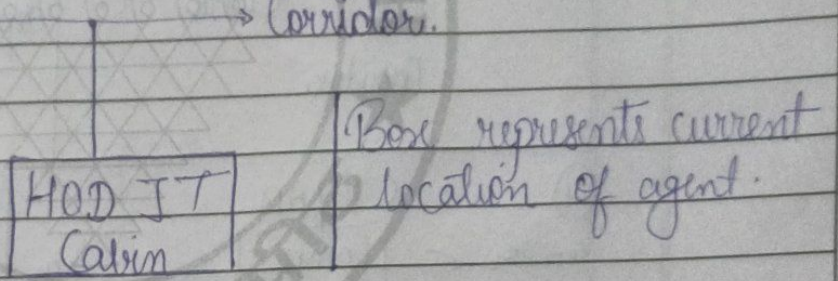


fig: Solution of 8 puzzle problem

ii) Navigate to KGCE to Workshop from HOD IT Cabin with minimum number of moves? moves can be climbing & alighting staircase, turning left, right walking through a corridor.

Note: It can be represented as a top view of the agent along with arrows in directions left, right, forward and backwards. We use 'climb' and 'alight' for moving through staircases.

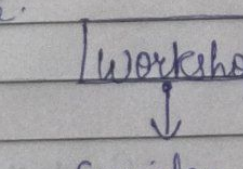
1. Initial State:



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

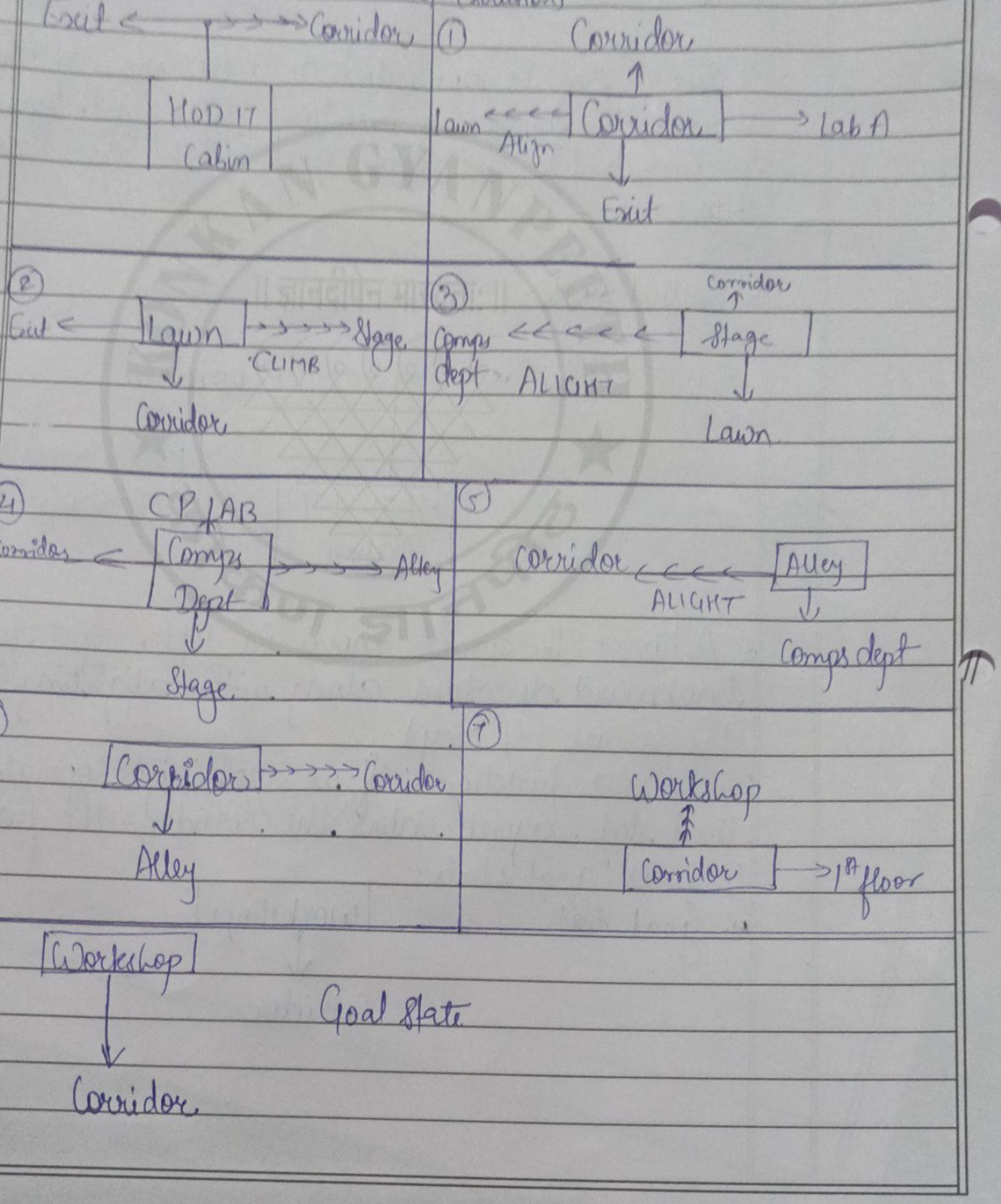
3. Successor function: If we apply 'right' operation to the start state, agent enters the corridor - the ~~first~~ first step towards goal state.

4. Goal test

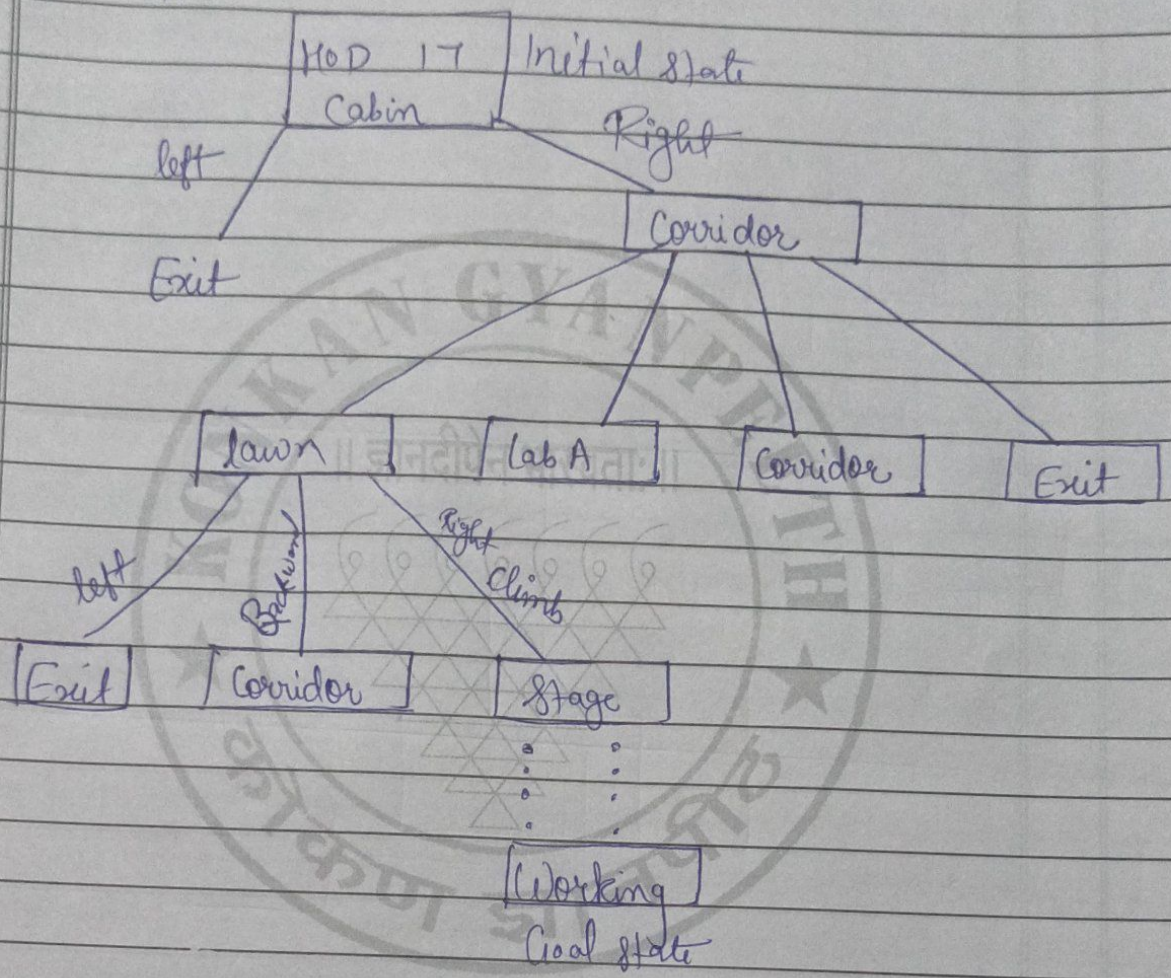


5. Path cost : No. of actions to reach the workshop
Path cost = 8 directions + 4 staircases
= 12

* HoD IT cabin → KGCE workshop (solution)



State Space.


HOD 17 Cabin
Initial State
Right
left
Corridor
Exit
Lawn
Lab A
Corridor
Exit
left
Backward
Right
Climb
Exit
Corridor
Stage
Working
Goal State