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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 fig 3 shows agent 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
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 the problem is referred to as problem formulation. It involves defining following five things:

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

Action: It defines all possible action available to the agent. given it is in the 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 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 act as a stopping condition when the state passed to this function 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 weather the action sequence under consideration is optimal.

Thus a problem can formally specified by identifying initial state, actions transition model goal test and path cost. In term of problem solving agent

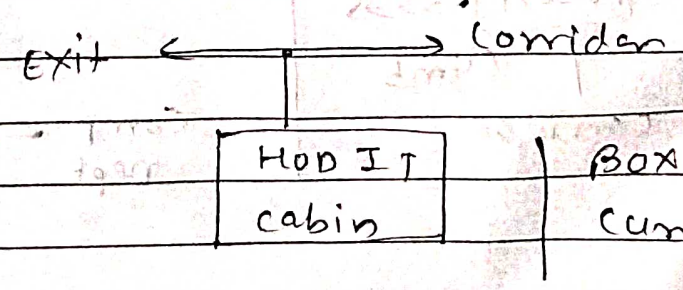
solution is the path from initial state to a goal state, optimal solution is the lowest path cost of all solutions. Process of finding a solution is called search.

working: Based on understanding of Problem formulation students need to formulate following Problem. They will clearly show state space up to depth level 3 or till goal node whichever is shallowest.

1) Navigate to KICE workshop from HOD IT cabin with minimum number of moves moves can by 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 direction left, right, forward and backward. we use climb and alight you moving throw through staircase

1) initial state:



Box represent current location of the agent

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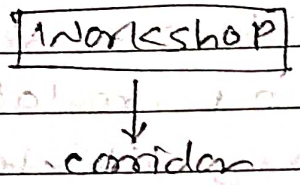
2) Action: The agent moves in left, right, forward and backward direction along with alighting and climbing the stairs

3) successors function: If we apply right operation to the start state the agent enter the corridor the first step towards goal state

4) goal test:

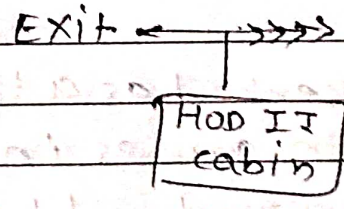


5) Path cost: No of actions to reach the workshop.

Path cost: 8 directions + 4 staircase
= 12

Hod IT cabin → KOCE workshop (solution)

1) count



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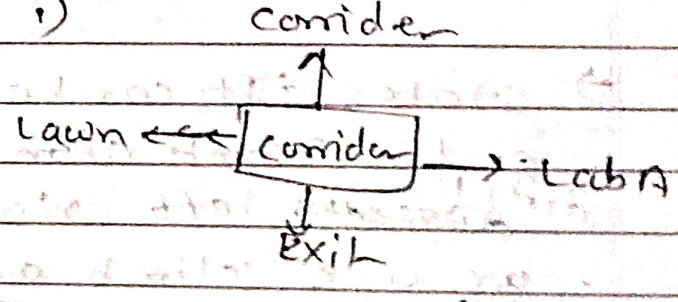

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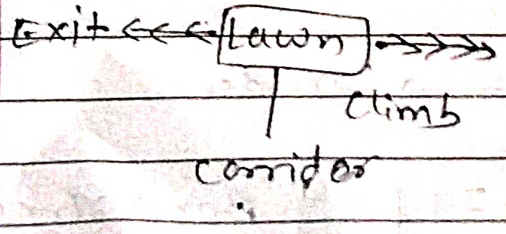

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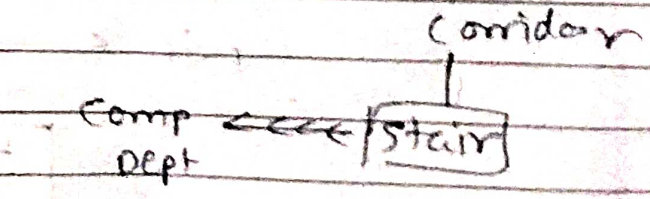

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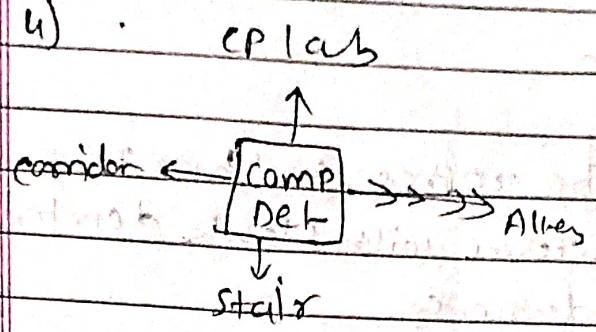

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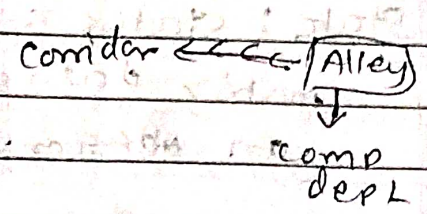

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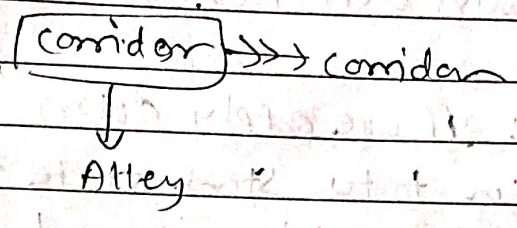

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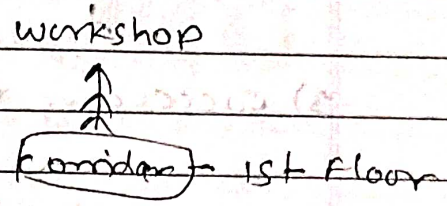

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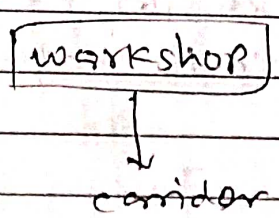
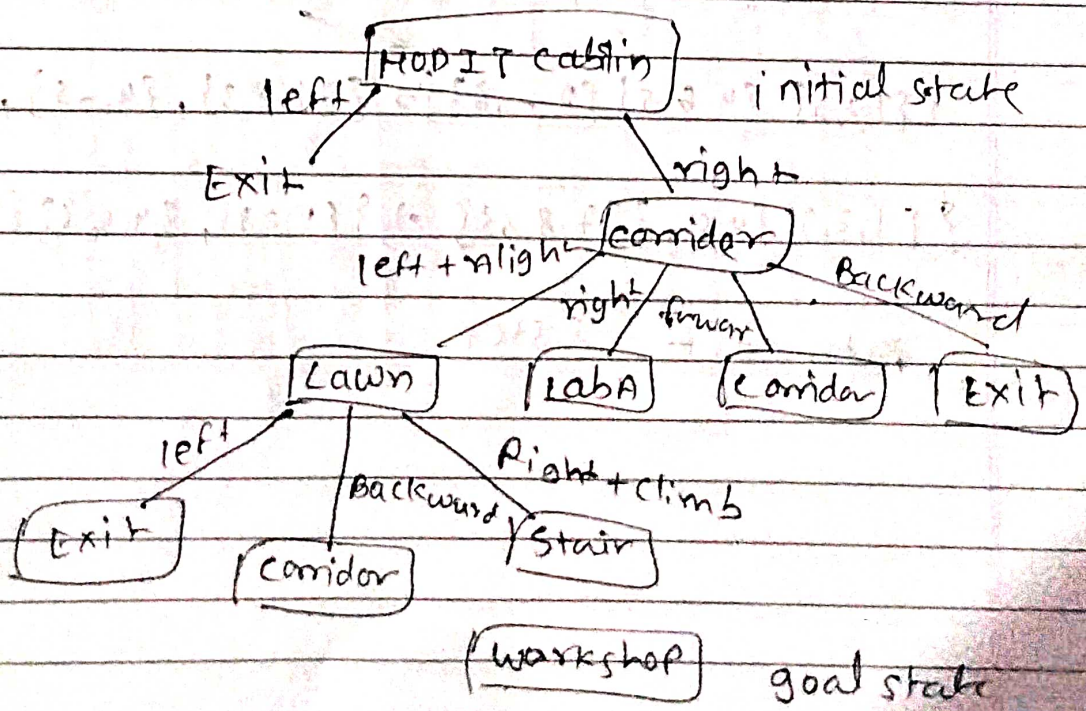


goal state

state space.



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2) 8 puzzle problem

State : states can be represented by a 3X3 matrix data structure with blank denoted by an ~~underscore~~ underscore

1) Initial state : {{1,2,3}, {4,8,_}, {7,6,5}}
2) Action : The blank space moves in left, right up and down direction specifying the action
3) successors function: If we apply down operation to the start state the next state has '5' and '_' switched
4) goal ~~state~~ : {{1,2,3}, {4,5,6}, {7,8,_}}
5) Path cost : No. of step for each to the final state

Solution:

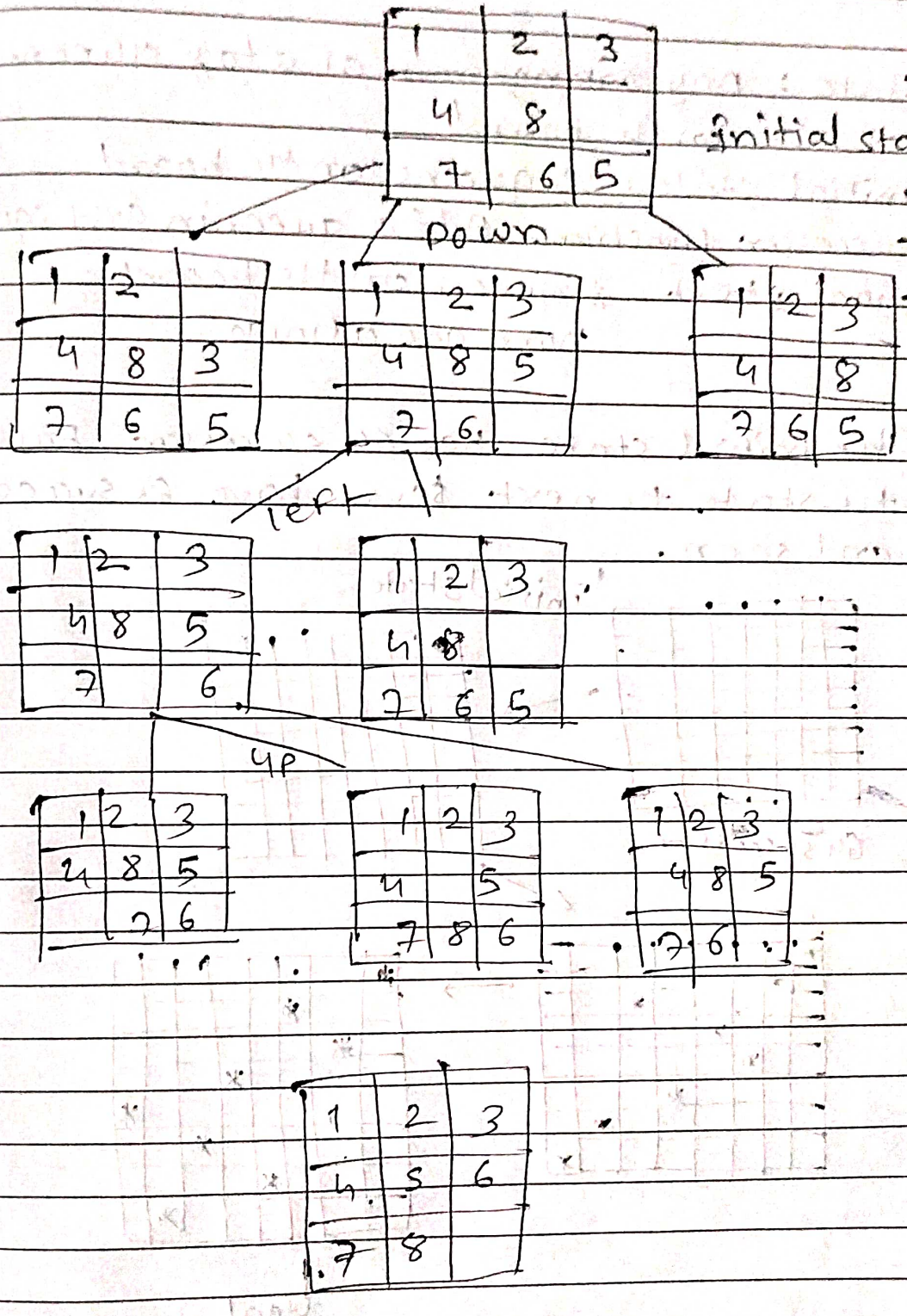
{{1,2,3}, {4,8,_}, {7,6,5}} → {{1,2,3}, {4,8,5}, {7,6,_}}

{{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 step

8 puzzle Problem



4) N queens Problem

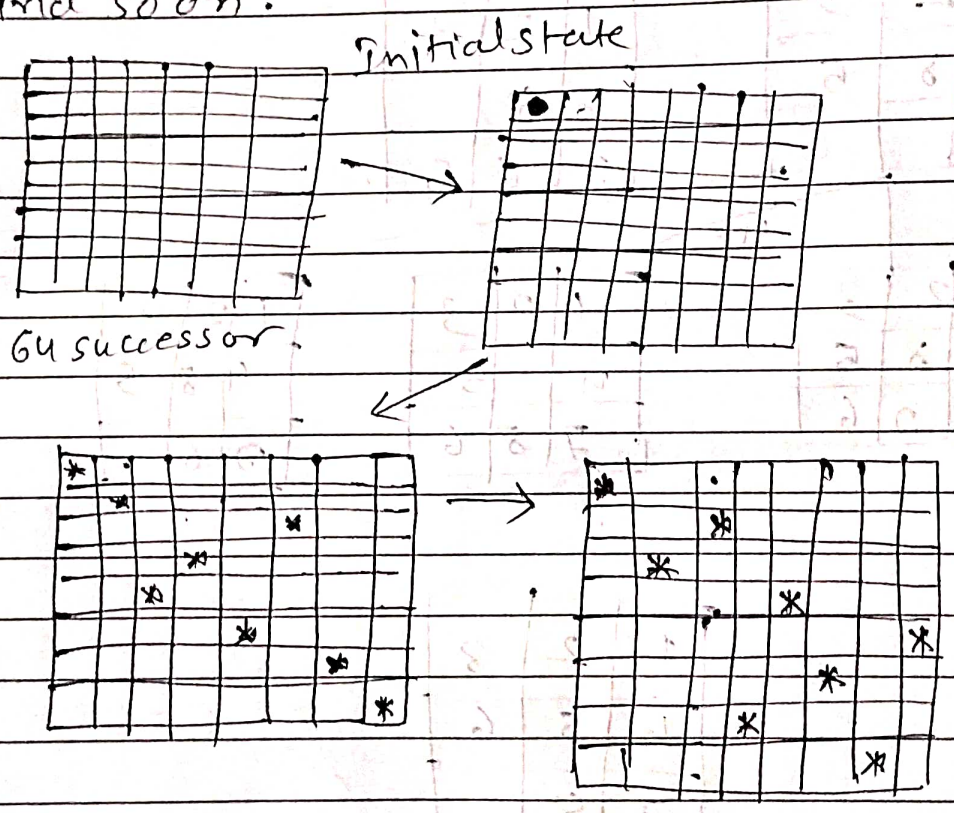
State : Any arrangement of 0 to 8 queens on the board

Initial state : 0 queens on the board

successor function : Add a queen in any square

goal test : 8 queen on the board none are attacks

The initial state has 64 successor. Each of the state the next level have 63 succession and so on.



5) Two room vaccum cleaner world

State:- The two room dirt

Initial state:- first room is dirt and has vaccum cleaner

Successor function:- clean the first room and the second.

Goal test:- the clean the both room

single state start ing the [right, suck]

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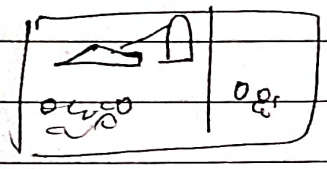

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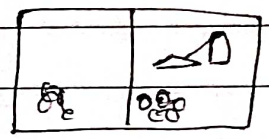

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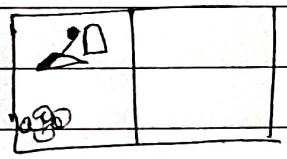

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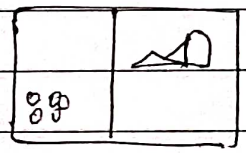

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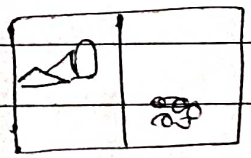

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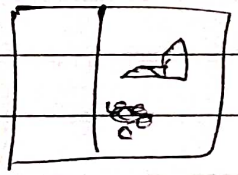

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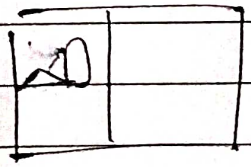

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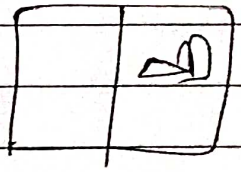

multiple state start the [right, suck, left, suck]
suck can dirty a clean end
detect location dirty or not dirty