

Tutorial 2 :- To understand state space  
Problem formulation

Aim :- To understand state space based problem formulation of all problems so that problem solving Agent can be applied

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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 program for problem solving agent. Agent first formulates goal and problem, then determines or rather searches an action sequences, 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  $\leftarrow$  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

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 the starting state that the problem is in.

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

Transition Models :- 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 act 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, action (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.



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.

1) 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.

2) 8 Puzzle Problem.

3) The missionaries and cannibals problem. There are three missionaries and three cannibals who must cross a river using a boat which can carry at most two people, under the constraint that, for both bank, they cannot be out no. by cannibals, if they were would eat missionaries. The boat cannot cross the river by itself with no people on board.

4) N Queen's problem. Arrange N queens on a N cross N chess board where no two queens attack each other.

5) Two room vacuum cleaner world

6) Water Jug Problem.