

Tutorial 02

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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 2 show agent program for 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

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. Currently, it is a function $action(s)$ that returns list of all possible actions.

Transition model. also known as successor function which defines which state 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 passed to the function is goal. If 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 is optimal.

Thus a problem can formally specified by identifying state, actions, 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 clearly show state space up to depth level 3 or till goal node which ever is shallower.

1. Navigate to KACE Workshop from ItoD It cabin with minimum number of moves, moves can be climbing or alignments staircase, turning left, right, walking through a corridor.

2. 8 Puzzle game

The problem can be formulated as:

State: States can be represented by a 3×3 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 action.

3. Successor function: If we apply 'down' operation to the

Start state the next state has '5' and Switched

4 Goal test - $\{\{1, 2, 3\}, \{4, 5, 6\}, \{7, 8, 9\}\}$

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

- Solution:

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

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

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

path cost = 5 steps

8 Puzzle problem

1	2	3
4	8	
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	8	5
	7	6

1	2	3
4		5
7	8	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 queens on an $N \times N$ chess board where no two queens attack each other.

5 Two room Vacuum cleaner world.

6 Water Jug Problem