Problem Solving in AI

Problem Solving

- Method to derive solution steps beginning from initial description of the problem to desired solution.
- Task is solved by
  - A series of actions that minimize the difference between given stuation and desired goal.
- Problems are modelled as state-space problem
  - Where state space is set of all possible states including start state and goal state.
  - There is an operation that links two states
- Control Strategy: The order of application of rules to current state.

Problem Solving

- Two types of methods are there:
  - General purpose
  - Special Purpose
- General Purpose: applicable to wide variety of problems
- Special Purpose: tailor-made for a specific problem and usually exploits specific features of a particular problem.

Water Jug problem

We have two jugs, a 5 liter and 3 liter with no measuring marker on them. There is endless supply of water through the tap. Our task is to get 4 liters of water in the 5 liter jug.

Water Jug Problem-Solution

- State Space can be described as the set of ordered pairs of integers(X,Y) such that X represents the lts of water in 5 lt jug and Y represent for 3 lt jug.
- Start State is (0,0).
- Goal State is (4,N) for any value N<= 3
- Possible Operations
  - Fill 5 lt jug from tap
  - Empty 5 lt jug
  - Fill 3 lt jug
  - Empty 3 lt jug

Water Jug Problem-Solution

- Possible Operations Contd…
  - Empty 3 lt into 5 lt jug.
  - Empty 5 lt into 3 lt jug.
  - Pour water from 3 lt jug to 5 lt jug until 5 lt jug is full.
  - Pour water from 5 lt jug to 3 lt jug until 5 lt jug is full.

Water Jug Problem- Solution

- Production System

Table 2.1 Production Rules for Water Jug Problem

Rule No	Left of rule	Right of rule	Description
1	$(X, Y \mid X \leq 5)$	$(5, Y)$	Fill 5-g jug
2	$(X, Y \mid X > 0)$	$(0, Y)$	Empty 5-g jug
3	$(X, Y \mid Y \leq 3)$	$(X, 3)$	Fill 3-g jug
4	$(X, Y \mid Y > 0)$	$(X,0)$	Empty 3-g jug
5	$(X, Y \mid X + Y \leq 5 \wedge Y > 0)$	$(X + Y, 0)$	Empty 3-g into 5-g jug
6	$(X, Y \mid X + Y \leq 3 \wedge X > 0)$	$(0, X + Y)$	Empty 5-g into 3-g jug
7	$(X, Y \mid X + Y \geq 5 \wedge Y > 0)$	$(5, Y - (5 - X))$ until 5-g jug is full	Pour water from 3-g jug into 5-g jug
8	$(X, Y \mid X + Y \geq 3 \wedge X > 0)$	$(X - (3 - Y), 3)$	Pour water from 5-g jug into 3-g jug until 3-g jug is full

Water Jug Problem- Solution

- Solution Path 1

Table 2.2 Solution Path 1

Rule applied	5-g jug	3-g jug	Step No
Start state	0	0	
1	5	0	1
8	2	3	2
4	2	0	3
6	0	2	4
1	5	2	5
8	4	3	6
Goal state	4	–	

Water Jug Problem- Solution

- Solution Path 2

Table 2.3 Solution Path 2

Rule applied	5-g jug	3-g jug	Step No
Start state	0	0	
3	0	3	1
5	3	0	2
3	3	3	3
7.	5	1	4
2	0	1	5
5	1	0	6
3	1	3	7
5	4	0	8
Goal state	4	–	

Control Strategy

- In order to apply rules, we have to choose appropriate control strategy.

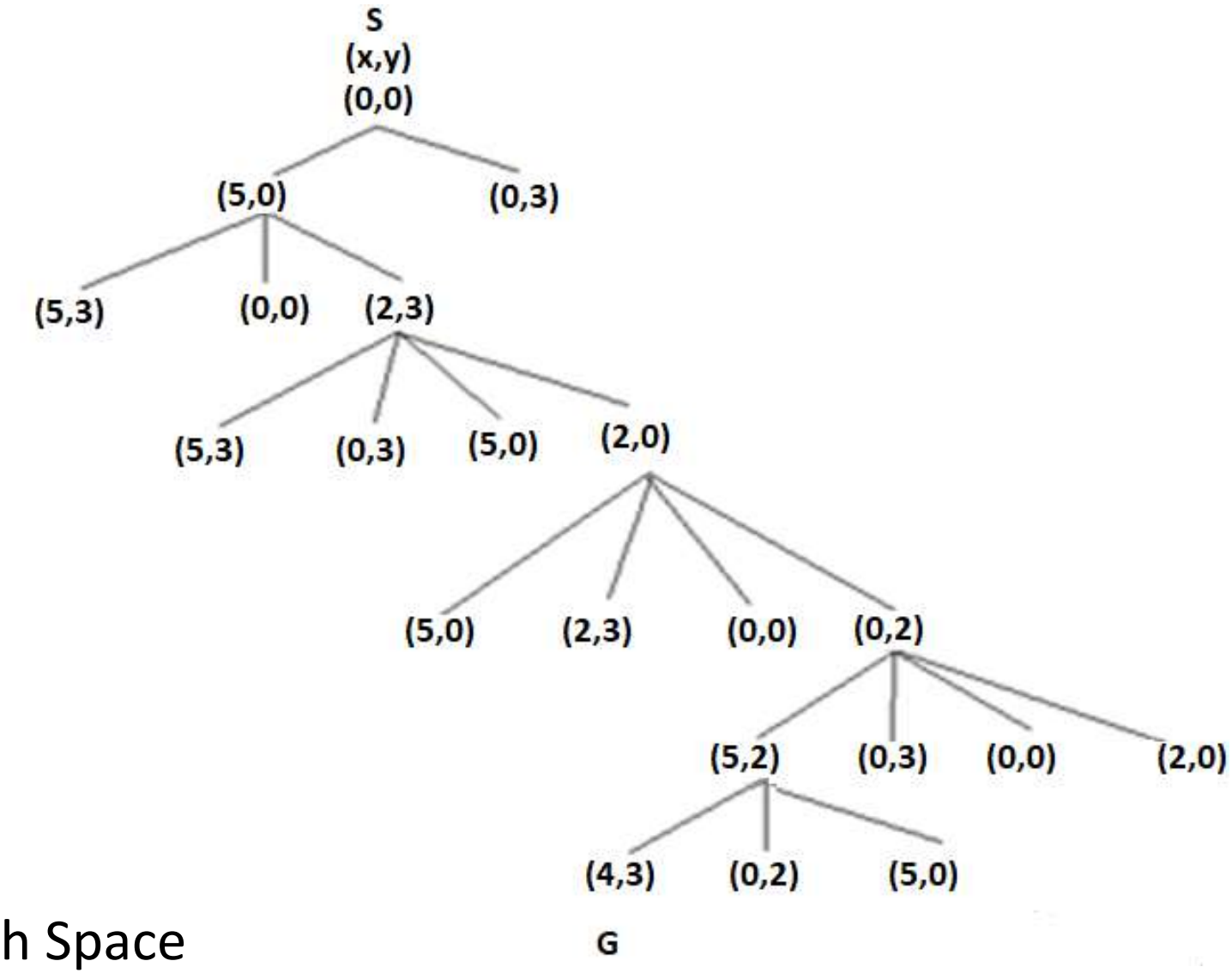
State-Space Search

- Consists of four components
  1. A set S containing start states of the problem.
  2. A set G containing goal states of the problem.
  3. Set of nodes (states) in the graph/tree. Each node represents the state in problem-solving process.
  4. Set of arcs connecting nodes. Each arc corresponds to operator that is a step in a problem-solving process.

Solution

- Solution Path is a path through the graph/tree from a node S to a node in G.
- The main objective of the search algorithm is to find the solution path in the graph.
- There may be more than one solution paths.
- It is similar to production system because we use production rules only instead of operators.

Water Jug Problem



Search Space

Missionary and Cannibals Problem

Three missionaries and three cannibals want to cross a river. There is a boat on there side of river that can be used by either one or two persons. How they should use the boat to cross the river in such a way that cannibals never outnumber missionaries on either side of the river? Is cannibals ever outnumber the missionaries then missionaries will be eaten. How can they all cross the river without anyone being eaten?

Any Queries?