Experiment 1

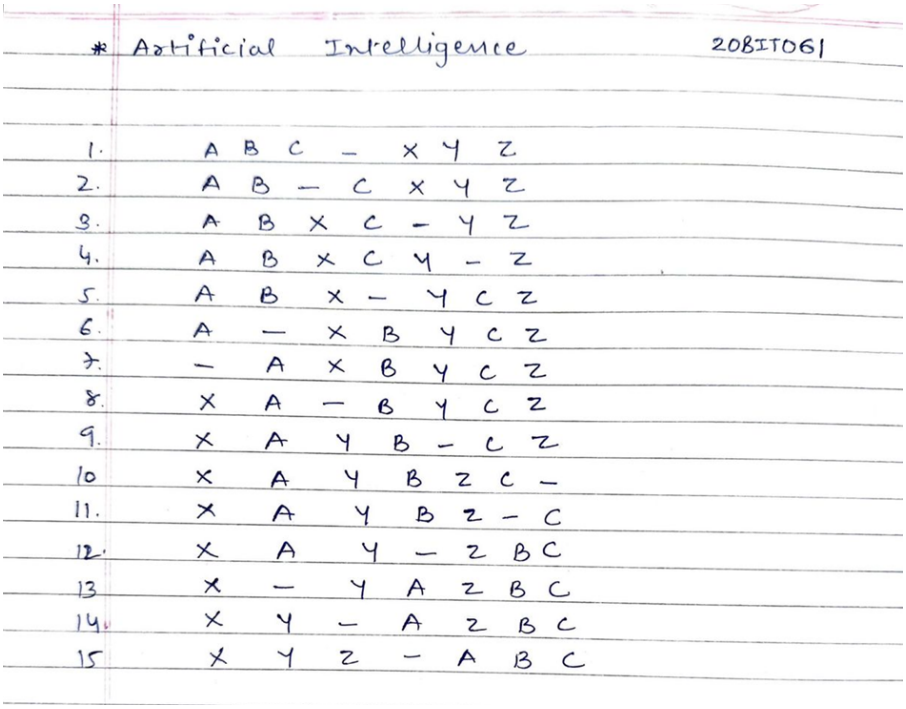
Objective

To be able to model a given problem in terms of state space search problem and solve the same using BFS/ DFS.

Problem Statement: A

In the rabbit leap problem (see the figure given below), three east-bound rabbits stand in a line blocked by three west-bound rabbits. They are crossing a stream with stones placed in the east-west direction in a line. There is one empty stone between them. The rabbits can only move forward one or two steps. They can jump over one rabbit if the need arises, but not more than that. Are they smart enough to cross each other without having to step into the water?

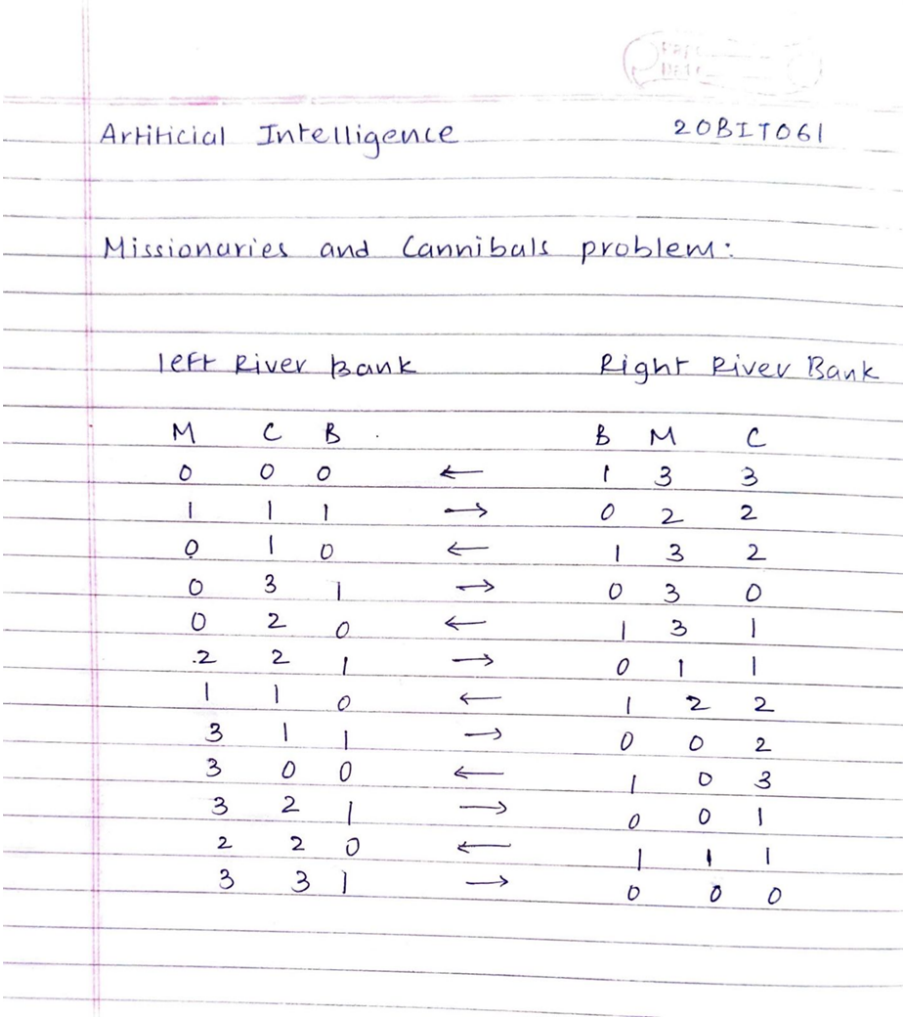
Solution



Problem Statement: B

The missionaries and cannibals' problem is usually stated as follows (see the figure given below). Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Find a way to get everyone to the other side without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place. This problem is famous in AI because it was the subject of the first paper that approached problem formulation from an analytical viewpoint.

Solution



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Missionaries and Cannibals problem:

Left River Bank				Right River Bank		
M	C	B		B	M	C
0	0	0	←	1	3	3
1	1	1	→	0	2	2
0	1	0	←	1	3	2
0	3	1	→	0	3	0
0	2	0	←	1	3	1
2	2	1	→	0	1	1
1	1	0	←	1	2	2
3	1	1	→	0	0	2
3	0	0	←	1	0	3
3	2	1	→	0	0	1
2	2	0	←	1	1	1
3	3	1	→	0	0	0

Lab Exercise

1.Model the problem as a state space search problem. How large is the search space?
For the problem A, the search state is around 109 states and for problem B the search state space is around 14 states.

2. Solve the problem using BFS. The optimal solution is the one with the fewest number of steps. Is the solution that you have acquired an optimal one? The program should print out the solution by listing a sequence of steps needed to reach the goal state from the initial state.
For Problem A, Using BFS we found the optimal solution with the fewest number of steps, for that we have to find the goal node using BFS. It required 109 states to be visited to find the goal node and from source node to get goal node we have do minimum 15 moves. For Problem B,
Using BFA we found the solution with the fewest number of steps, to reach goal node we have to visit around 14 states in total. To reach goal node from source node it required 11 steps.

3. Solve the problem using DFS. The program should print out the solution by listing a sequence of steps needed to reach the goal state from the initial state 4. Compare solutions found from BFS and DFS. Comment on solutions. Also, compare the time and space complexities of both.
For Problem A, Using DFS we found the optimal solution with the fewest number of steps, for that we have to find the goal node using DFS. It required 33 states to be visited to find the goal node and from source node to get goal node we have do minimum 15 moves. For Problem B, Using BFA we found the solution with the fewest number of step, to reach goal node we have to visit around 11 states in total. To reach goal node from source node it required 11 steps.

4. Compare solutions found from BFS and DFS. Comment on solutions. Also, compare the time and space complexities of both.

For Problem A In BFS Visit 109 nodes to search the goal node, while goal node can be found only in 15 moves. Which is not optimal solution. In DFS, only 32 states are visited to reach to the goal node. Time Complexity of both algorithm is O(bm), while space complexity of BFS is O(bm) and DFS is O(bm), where "b" is branching factor and "m" is depth of solution. For Problem B BFS visit 14 states to find goal node, goal node can be achieved only by 12 moves, while in DFS only 11 states are visited, here DFS is more optimal than BFS. Time Complexity of both algorithm is O(bm), while space complexity of BFS is O(bm) and DFS is O(bm), where "b" is branching factor and "m" is depth of solution.