AIMLT - Assignment 2

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A* Algorithm

Aim: Solve 8-puzzle problem using A* algorithm

Theory:

1. **Informed search:** It involves using knowledge about the problem to guide the search process. This knowledge is typically provided in the form of heuristic functions that estimate the desirability of different paths and states.

2. **A* algorithm:** The A* algorithm intelligently balances the cost of reaching a node from the start & the estimated cost to reach the goal through that node. It maintains an open list of nodes to explore and a closed list of nodes already evaluated.

3. A* ~~select~~ starts at the initial node and iteratively selects nodes with the lowest F cost from the open list. It expands these nodes by generating their neighbours and computing their F costs.

If the goal node is encountered, the algorithm terminates successfully. A* ensures optimality by considering all possible paths, but its efficiency relies on quality of heuristic function.

4. 8-puzzle problem

It is a classic sliding puzzle consisting of a 3 x 3 grid with numbers 1 to 8, and empty space aiming to reach a specific configuration. Often the one where tiles are ordered from 1 to 8.

→ Solve 8-puzzle Problem :

Initial state :

2	8	3
1	6	4
7	-	5

Goal state :

1	2	3
8	-	4
2	6	5

→ 1.

2	8	3
1	-	4
7	6	5

→

2	-	3
1	8	4
7	6	5

2	8	3
1	6	3
7	-	4

2	8	3
1	6	4
7	-	5

2	8	3
1	-	4
7	6	5

↓

1	2	3
8	-	4
7	6	5

Conclusion:

The successful implementation of A^* algorithm to solve the 8-puzzle problem was executed.

FAQs

1. What is a heuristic function? Advantages?

→ A heuristic function is an informed estimation used in search algorithms like A^*. It provides a calculated guess of the cost of distance from the current state to goal state. Heuristics guide the search by prioritizing paths that seem more promising; Reducing the search space and improving algorithms to make intelligent actions, focusing on paths that will lead to your executing faster.

2. Explain different heuristic functions that can be used for the 8-puzzle problem.?

→ ① Misplaced Tiles: Counts no. of tiles not in goal position.

② Manhatten distance: Total horizontal and vertical distance each tile is from goal.

③ Euclidean distance: Treating position as co-ordinates calculates distance to their goal position.

④ Linear Conflict: Considers conflict in rows and columns

⑤ Pattern Database: Pre-compiled for every possible value of tile

can yield a more informed heuristic.

(Q.3) Explain A* admissible property.

→ The A* algorithm is a pathfinding method that efficiently finds the shortest path between 2 points in a graph. It evaluates cost nodes based on a combined cost of the actual path from the start node, and a heuristic estimate to the goal.

→ The sum of these scores (f-score) guides the search. A* expands nodes with the lowest f-scores, leading to a balance between optimal pathfinding & efficient exploration. For instance, in a grid based, A* considers nodes diagonally adjacent to reach the goal while avoiding obstacles, ensuring an optimal path with exploration.

Q. What is the difference between A* and AO* algorithm?

A*	AO*
1. Moderate to high (stores all visited nodes)	1. High (stores all generated nodes and their open/closed status)
2. May expand nodes if better path found.	2. Avoids re-expanding.
3. Some Implementations use closed list to track nodes.	3. Maintains explicit closed list to track states.
4. priority queue = f-cost = g+h	4. priority queue = f-cost = g+h
5. Complete in finite state space.	5. May not be complete in cases with multiple optimal paths.