**AI Assignment -1 Report**

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**Problem Statement:**

Solve the given 15 puzzle problem using A\* algorithm with the given 2 heuristics and report the time (number of nodes generated) and space (number of nodes present in memory) complexity.

**Heuristic 1:** Number of Misplaced Tiles

**Heuristic 2:** Sum of Manhattan distances of each tile from its goal state

**GOAL STATE: Assuming 0 as the blank space**

1 2 3 4

5 6 7 8

9 10 11 12

13 14 15 0

**Assuming a given input problem**

1 2 3 4

5 6 8 11

9 0 10 7

13 14 15 12

**Running the algorithm with Heuristic 1 only:**

Time Complexity – 12

Space Complexity – 48

**Running the algorithm with Heuristic 2 only:**

Time Complexity – 11

Space Complexity – 43

**Running the algorithm with Heuristic 1 and Heuristic 2 combined:**

Time Complexity – 10

Space Complexity – 39

**Time and Space Complexity According to Our Solution**

The time complexity we assumed is the number of nodes the algorithm traversed to reach the goal state.

The space complexity we assumed is the number of nodes the algorithm produced in the memory before reaching the goal state.

**Observation:**

We observed that A\* works fine with small or simple problems but it takes a good amount of time in solving complex problems. The is because as the value of h(n) increases, the number of path increases exponentially and hence, the algorithm has to traverse through more number of nodes/states to find the correct solution. Hence, at higher number of moves, A\* behaves as a BFS algorithm in 15 puzzle problem.