DA221 : INTRODUCTION TO AI

**Experimenting with Heuristic Search using 8-puzzle :**

Solving 8-puzzle instance with A\*-algorithm

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# Introduction :

**What is A\*-algorithm?**

A\* is an informed search algorithm, or a best-first search , meaning that it is formulated in terms of weighted graphs: starting from a specific starting node of a graph, it aims to find a path to the given goal node having the smallest cost (least distance travelled, shortest time, etc.). It does this by maintaining a tree of paths originating at the start node and extending those paths one edge at a time until the goal node is reached.

At each iteration of its main loop, A\* needs to determine which of its path to extend. It does so based on the cost of the path and an estimate of the cost required to extend the path all the way to the goal. Specifically, A\* selects the path that minimizes

*f(n)* = *g(n)* + *h(n)*

Where n is the next node on the path, *g(n)*  is the cost of the path from the start node to *n,* and *h(n)* is a heuristic function that estimates the cost of the cheapest path from *n* to the goal. The heuristic function is problem-specific. If the heuristic function is admissible – meaning that if never overestimates the actual cost to get to the goal – A\* is guaranteed to return a least-cost path from start to goal.

**Find if the 8-puzzle instance is solvable?**

A\* Note that the 8-puzzle states are divided into two disjoint sets, such that any state is reachable from any other state in the same set, which no state is reachable from any state in the other set. Before you proceed with proceed with solving 8-puzzle instance using the A\*-algorithm, it is mandatory to you check (either manually or as part of your 8-puzzle solver implementation) that the instance is solvable.

Definition : For any other configuration besides the goal, whenever a tile with a greater number on it precedes a tile with a smaller number, the two tiles are said to be inverted.

Proposition : For a given puzzle configuration, let N denote the sum of the total number of inversions. Then (N mod 2) is invariant under any legal move. In other words, after a legal move on odd N remains odd whereas an N remains even.

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