

Experimenting with Heuristic Search using 8-puzzle

Having identified solvable instances by checking inversions of the 8-puzzle, the A* - algorithm is expected to record the following vital parameters:

- The total running time in seconds
- Length of the solution (Total number of steps)
- Total number of nodes removed from frontier.

Following are the instances:

- Instance-1 : [1, 2, 3, 4, 5, 6, 7, 8, 0]
- Instance-2 : [1, 2, 3, 4, 5, 6, 0, 7, 8]
- Instance-3 : [1, 2, 3, 4, 5, 0, 7, 8, 6]
- Instance-4 : [1, 2, 3, 5, 0, 6, 4, 7, 8]
- Instance-5 : [1, 3, 6, 5, 0, 2, 4, 7, 8]
- Instance-6 : [1, 6, 2, 5, 7, 3, 4, 0, 8]
- Instance-7 : [4, 1, 3, 7, 2, 5, 0, 8, 6]
- Instance-8 : [8, 6, 7, 2, 5, 4, 3, 0, 1]
- Instance-9 : [8, 7, 6, 5, 4, 3, 2, 1, 0]
- Instance-10 : [5, 2, 8, 4, 1, 7, 0, 3, 6]

I am keeping the goal state : [0, 1, 2, 3, 4, 5, 6, 7, 8] for all instances.

HEURISTICS IMPLEMENTED :

Heuristic Function : $f(n) = g(n) + h(n)$

Where,

$f(n)$ = estimated cost of cheapest solution

- **Missing Tiles/ Misplaced Tiles** : The misplaced tile strategy is a very trivial heuristic that is used on the 8-puzzle problem. In this strategy, the numbers of the misplaced tiles, basically the tiles that are not in their goal positions are counted.
- **Manhattan Distance** : In this the priority is determined by summing the absolute distance or the total number of moves to be made by a tile to reach the goal state in an empty matrix of all tiles.
- **Euclidean Distance** : In this the priority is calculated by calculating for square root of sum of squares of differences of rows and columns of the present state and goal state.

Euclidean :

I-1 :

Time taken : 1.051487 seconds

Nodes removed from the frontier: 70134

Total Steps : 22

I-2:

Time taken : 1.793119 seconds

Nodes removed from the frontier: 72145

Total Steps: 22

I-3:

Time taken : 2.018796 seconds

Nodes removed from the frontier: 95128

Total Steps: 22

Nodes removed from the frontier: 38555

I-4:

Time taken : 2.003933 seconds

Total Steps: 20

Nodes removed from the frontier: 95128

I-8:

Total Steps: 22

Time taken : 4.761154 seconds

I-5:

Nodes removed from the frontier: 213050

Time taken : 2.203695 seconds

Total Steps: 27

Nodes removed from the frontier: 93044

I-9:

Total Steps: 22

Time taken : 4.044395 seconds

I-6:

Nodes removed from the frontier: 183233

Time taken : 1.334279 seconds

Total Steps: 28

Nodes removed from the frontier: 62682

I-10:

Total Steps: 21

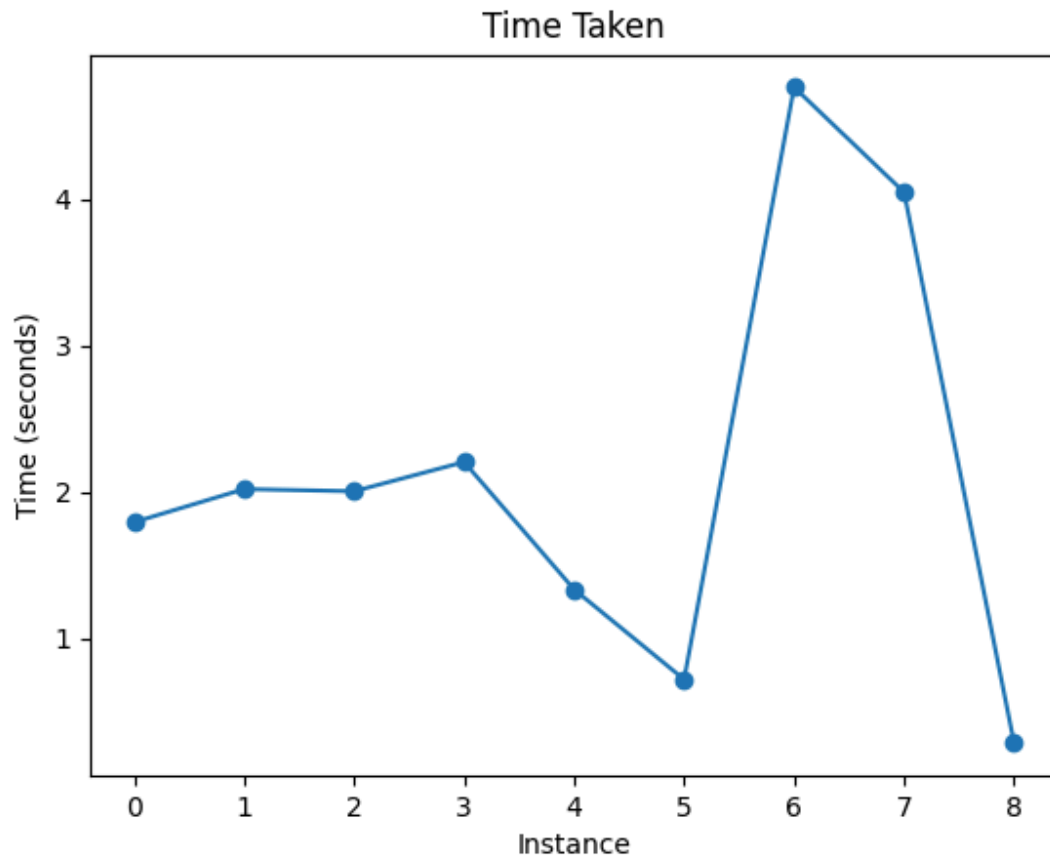
Time taken : 0.285161 seconds

I-7:

Nodes removed from the frontier: 13112

Time taken : 0.719966 seconds

Total Steps: 18



Manhattan :

I-1:

Time taken : 1.643444 seconds

Time taken : 1.584357 seconds

Nodes removed from the frontier: 68291

Nodes removed from the frontier: 70134

Total Steps: 21

Total Steps: 22

I-4:

I-2:

Time taken : 2.026253 seconds

Time taken : 1.673754 seconds

Nodes removed from the frontier: 95128

Nodes removed from the frontier: 72145

Total Steps: 22

Total Steps: 22

I-5:

I-3:

Time taken : 2.392154 seconds

Nodes removed from the frontier: 93044

Time taken : 4.254946 seconds

Total Steps: 22

Nodes removed from the frontier: 213050

I-6:

Total Steps: 27

Time taken : 1.586250 seconds

I-9:

Nodes removed from the frontier: 62682

Time taken : 3.189400 seconds

Total Steps: 21

Nodes removed from the frontier: 183233

I-7:

Total Steps: 28

Time taken : 0.871149 seconds

I-10:

Nodes removed from the frontier: 38555

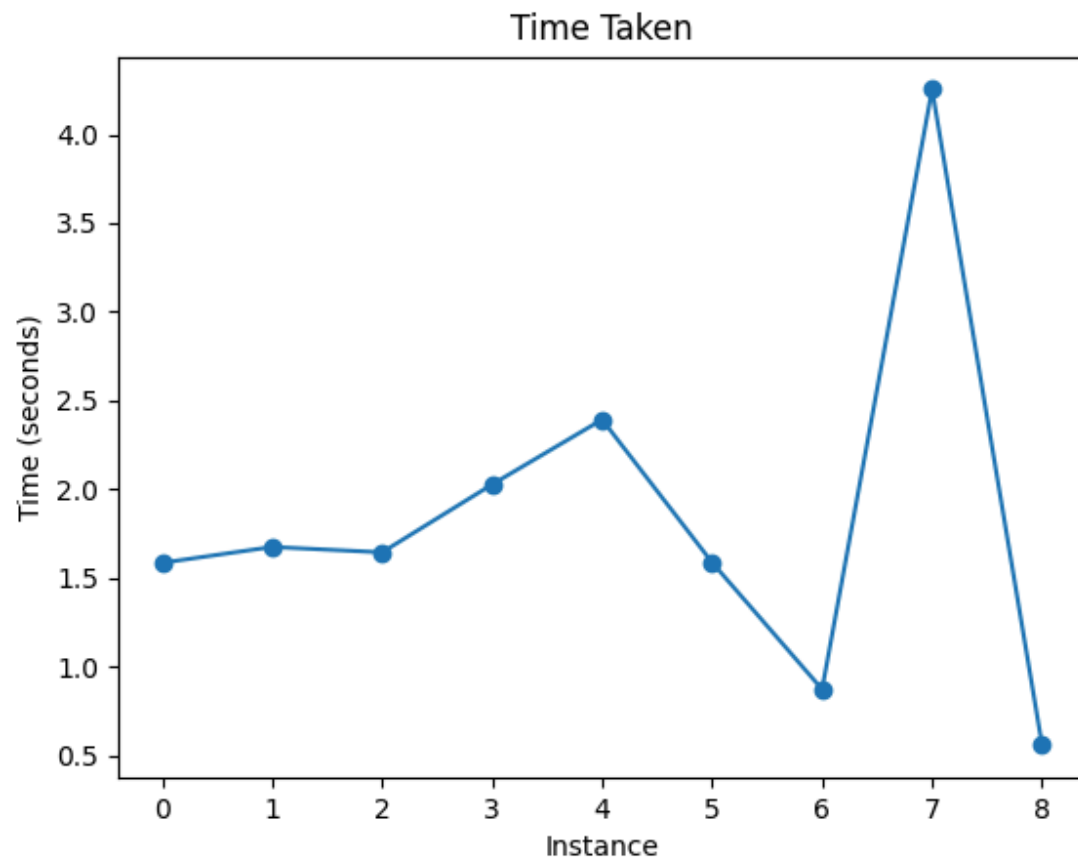
Time taken : 0.556209 seconds

Total Steps: 20

Nodes removed from the frontier: 13112

I-8:

Total Steps: 18



Misplaced Tiles:

I-1:

Time taken: 3.035140 seconds

Nodes removed from the frontier: 144542

Total Steps: 22

I-2:

Time taken: 3.477372 seconds

Nodes removed from the frontier: 152806

Total Steps: 22

I-3:

Time taken: 2.348265 seconds

Nodes removed from the frontier: 109790

Total Steps: 21

I-7:

Time taken: 1.882873 seconds

Nodes removed from the frontier: 84848

Total Steps: 20

I-4:

Time taken: 4.351202 seconds

Nodes removed from the frontier: 188957

Total Steps: 22

I-8:

Time taken: 6.734575 seconds

Nodes removed from the frontier: 338985

Total Steps: 27

I-5:

Time taken: 4.222229 seconds

Nodes removed from the frontier: 180111

Total Steps: 22

I-9:

Time taken: 6.995801 seconds

Nodes removed from the frontier: 349558

Total Steps: 28

I-6:

Time taken: 2.759580 seconds

Nodes removed from the frontier: 121998

Total Steps: 21

I-10:

Time taken: 0.774798 seconds

Nodes removed from the frontier: 36226

Total Steps: 18

