

Part 1: Written Problem

Question 2: Consider the heuristic function for the 8-puzzle given by:
 $h(s)$ = sum of permutation inversions. For example, $h(N) = 4 + 6 + 3 + 1 + 0 + 2 + 0 + 0 = 16$ (there are 4 numbers smaller than 5 that come after 5, 6 numbers smaller than 6 that come after 6, and so on) for the following board configuration N :

```
5 _ 8
4 2 1
7 3 6
```

Is 'h' Admissible? Prove your answer.

Answer:

Admissible Heuristics - Any heuristic can be called as admissible heuristic if and only if the heuristic satisfies following condition:

-- The minimum cost required from any state to reach to goal state must be equal or greater than the value of the heuristic of that particular state i.e any admissible heuristic of the state represents the minimum path from the current state to the goal state.

In order to determine if given heuristic is admissible or not, let us take following example of 8 Puzzle:

Initial state:

```
1 2 3
4 5 _
7 8 6
```

Goal State:

```
1 2 3
4 5 6
7 8 _
```

The given heuristic of 8 Puzzle is:

$h(s)$ = Sum of permutation inversions

Thus the $h(s)$ for following state will be:

$h(s) = 0+0+0+0+0+1+1+0 = 2$

But, as we can see only ONE step is required to bring this state back to our goal state. Just by sliding the '6' tile to empty we can get back our goal state and we required only one step for that. Thus, this contradicts with the actual definition of admissible heuristic and overestimates the cost to reach to the goal state.

Hence from above we can conclude that the given heuristic is not an admissible heuristic.