LAB-5

A* algorithm for 8-puzzle problem:
$f(n) = g(n) + h(n)$

Algorithm & pseudocode:
To implement the A* algorithm for the 8-puzzle, we define a heuristics h(n):
1. No of misplaced tiles
2. Manhattan Distance

The A* algo will use $f(n) = g(n) + h(n)$, where
g(n) is the depth of the node
h(n) is heuristics, whether misplaced tile or manhattan.

Algo

Initialize
- start with initial state of the puzzle.
- Use a priority queue to hold the nodes, entered by $f(n) = g(n) + h(n)$
- Keep a set of visited nodes to avoid re-exploring nodes

Expand nodes
- while the priority queue is not empty.
- Remove the node with the lowest f(n) from the queue
- If this node is the goal, return the solution
- Generate all possible child node by moving the blank space
- for each child, calculate g(n)
- calculate h(n) by chosen state
- If the child has not been visited or if it has a better f(n) than before, add it to the queue.

Termination
- If the goal is found, return the path and total cost
- If no solution is found, return failure.

::: state space (manhattan)

final state

1 2 3
8 0 4
7 6 5

$$\begin{bmatrix} 2 & 8 & 3 \\ 1 & 6 & 4 \\ 7 & 0 & 5 \end{bmatrix}$$ h = 1+1+1+0+1+1+0+1 = 4

left: $\begin{bmatrix} 2 & 8 & 3 \\ 1 & 6 & 4 \\ 0 & 7 & 5 \end{bmatrix}$ h=4, f=5

up: $\begin{bmatrix} 2 & 8 & 3 \\ 1 & 0 & 4 \\ 7 & 6 & 5 \end{bmatrix}$ f = 3+1 = 4

right: $\begin{bmatrix} 2 & 8 & 3 \\ 1 & 6 & 4 \\ 7 & 5 & 0 \end{bmatrix}$ h = 1+1+1+1+1 = 4, f = 1+4 = 5

$\begin{bmatrix} 2 & 1 & 3 \\ 1 & 8 & 4 \\ 7 & 6 & 5 \end{bmatrix}$ 1+1+2

f = 2+4 = 6

$\begin{bmatrix} 2 & 8 & 3 \\ 1 & 4 & 0 \\ 7 & 6 & 5 \end{bmatrix}$ 1+1+0+1+1+2 = 6

f = 2+6 = 8

left: $\begin{bmatrix} 0 & 2 & 3 \\ 1 & 8 & 4 \\ 7 & 6 & 5 \end{bmatrix}$

down: $\begin{bmatrix} 2 & 1 & 3 \\ 1 & 0 & 4 \\ 7 & 6 & 5 \end{bmatrix}$

right: $\begin{bmatrix} 2 & 3 & 0 \\ 1 & 8 & 4 \\ 7 & 6 & 5 \end{bmatrix}$

g=4

down: $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 8 & 4 \\ 7 & 6 & 5 \end{bmatrix}$ h = 1+1+0 = 2, f = 4+2 = 6

right: $\begin{bmatrix} 1 & 2 & 3 \\ 8 & 0 & 4 \\ 7 & 6 & 5 \end{bmatrix}$ final state

$\begin{bmatrix} 2 & 0 & 3 \\ 1 & 8 & 4 \\ 7 & 6 & 5 \end{bmatrix}$ X

f = 4+4 = 8

Manhattan is optimal

State space tree (misplaced tiles)

Final state:

1	2	3
8	↑	4
7	6	5

Initial state

2	8	3
1	6	4
7	0	5

$g=1$, $h=3$, $f=1+3=4$

$g=1$, $h=5$, $f=6$

$g=2$, $h=3$, $f=5$

$g=2$, $h=3$, $f=5$

$g=2$, $h=4$, $f=6$

$g=3$, $h=3$, $f=6$

$g=3$, $h=2$, $f=5$

$g=3$, $h=4$, $f=7$

$g=4$, $h=1$, $f=5$

$g=5$, $h=0$, $f=5$

$g=5$, $h=2$, $f=7$

Final