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AIES Lab Assignment 1

Aim: Solve 8-puzzle problem using A* algorithm

Objective: To study and implement A* algorithm for 8 puzzle problem.

Theory:

- Best first search is a graph search algorithm used in AI. It explores a graph by selecting the most promising node based on a heuristic function. The heuristic estimate the cost or value of reaching the goal from a particular node. Best-first search keeps a priority queue of nodes to expand and selects the one with the lowest heuristic value. OR graphs are used in decision analysis and optimisation. They represent decision problems with multiple possible actions or choices at each decision point.

- The 8-puzzle problem is a classic problem in artificial intelligence. It consists of a 3×3 grid with eight numbered tiles and one empty space. The goal is to rearrange the tiles from a given initial state to a desired goal state using the minimum no. of moves.

- Data structures and other details about the A* algorithm excluding the algorithm are as follows:
  - Nodes

- Queues
- Heuristic function
- closed set
- Open set

Input: Initial state and goal state

Output: Solution / goal state with optimal path.

A* Algorithm:

OPEN = nodes on frontier CLOSED = expanded nodes

OPEN = { < 5, nil > }

while OPEN is not empty.

remove from OPEN the node <n, p> with minimum f(n)

place <n, D> on CLOSED

if n is a goal state

return success (path P)

for each edge connecting n & on with cost c.

if <m, q> is a CLOSED on d {P|c} is cheaper than q.

→ then remove n from CLOSED.

put <m, {P|c}> an OPEN

else if <m, q> is an OPEN and {P|c} is cheaper than q.

→ then replace q with {P|c}

else if m is not an OPEN.

→ then put <m, {P|c}> on OPEN

return failure.

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FAQ's

1. What is a heuristic function? What is the advantage of using heuristic function?

Ans. A heuristic function, often denoted as "h(n)", is a crucial component in many search and optimization algorithms, including A*. It provides an estimate of the cost or distance from a given state or node in a search space to the goal state.

The key advantages of using a heuristic function are as follows:

- Guidance for search
- Efficiency
- Faster convergence
- Real world application (route planning, robotics, scheduling)

2. Explain A* algorithm with example.

Ans. A* algorithm is a searching algorithm that searches for the shortest path between the initial and the final state.

Ex:

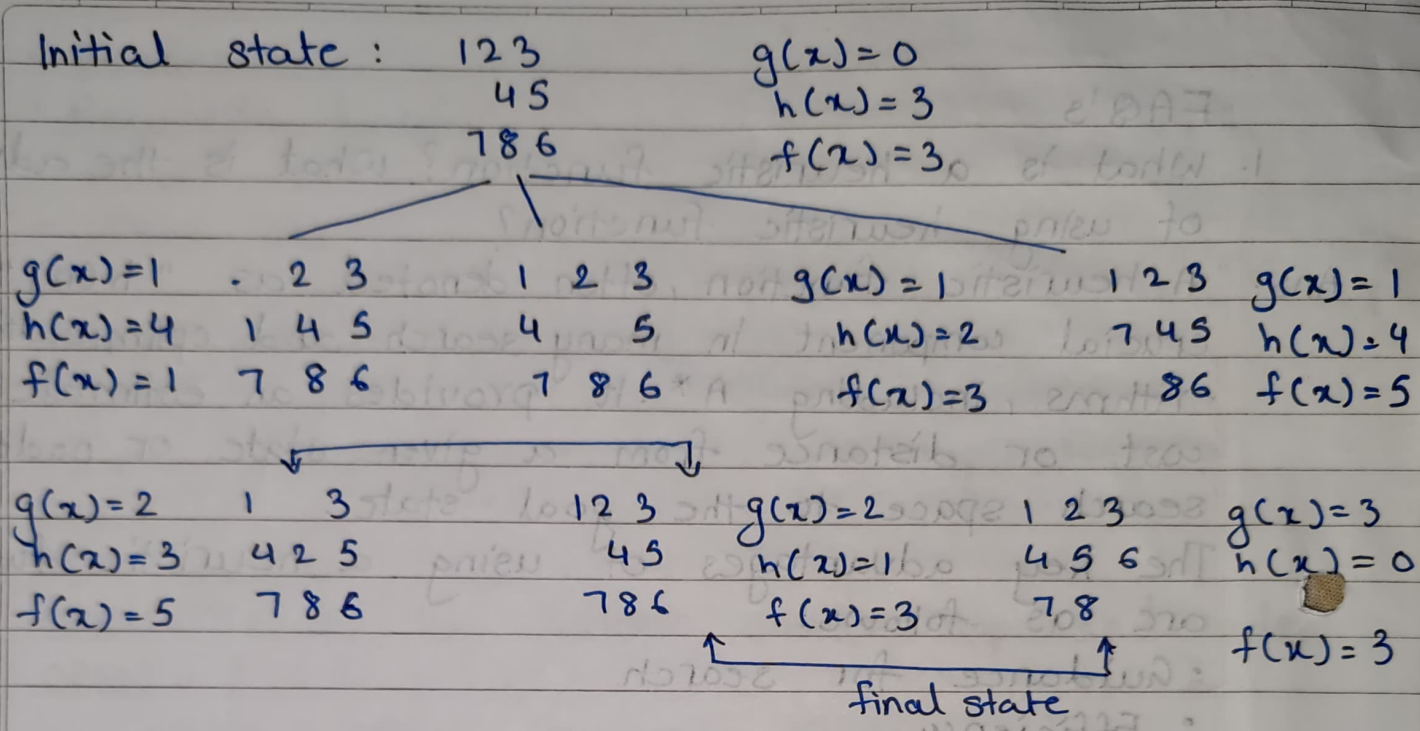
1	2	3
	4	5
7	8	6

1	2	3
4	5	6
7	8	

Consider, g(x) = depth of node
h(x) = no. of misplaced files.

$f(x) = g(x) + h(x)$

A* algorithm proceeds to take the path when f(x) has the least value.



3. Explain different heuristic functions that can be used for the 8-puzzle problem.

Ans. i) Hamming Distance:
- Counts the no. of tiles that are not in their goal positions.

ii) Manhattan distance:
- Calculates the sum of the manhattan distance of each tile from its current position to goal.

iii) Euclidean Distance:
- Computes the Euclidean dist. of each tile. (current to goal)

(iv) Max Heuristic:
- Considers both the Manhattan and misplaced tiles heuristic and chooses maximum of two values.

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