

CS250: ARTIFICIAL INTELLIGENCE LAB

ASSIGNMENT-3: A* Search

(Read all the instructions carefully & adhere to them.)

Instructions:

1. Markings will be based on the correctness and soundness of the outputs. Marks will be deducted in case of plagiarism.
2. Proper indentation and appropriate comments are mandatory.
3. Please read the guidelines provided at the end of the problem statement.
4. Comments/explanations/intuitions should be provided in a separate text/word file and not the code file.
5. The assignment should be completed during the lab session from 9:15 AM to 11:30 AM.

Problem Statement: In a general search algorithm, each state (n) maintains a function

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

where $g(n)$ is the least cost from source state to state n found so far, and $h(n)$ is the estimated cost of the optimal path from state n to the goal state.

Implement a search algorithm for solving the 8-puzzle problem with the following assumptions.

A. $g(n)$ = least cost from source state to current state so far.

B. Heuristics

a. $h1(n) = 0$.

b. $h2(n)$ = number of tiles displaced from their destined position.

c. $h3(n)$ = sum of Manhattan distance of each tile from the goal

position.

d. $h_4(n)$ = Devise a heuristics such that $h(n) > h^*(n)$.

1. Observe and verify that better heuristics expands lesser states.
2. Observe and verify that all the states expanded by better heuristics should also be expanded by inferior heuristics.
3. Observe & verify monotone restrictions on the above provided heuristics.

Guidelines:

1. You should make use of two lists for the implementation. One (close list) for maintaining the already explored states and another (open list) for maintaining the states which are found but yet to be explored.
2. Input is given in a file in the following format. Read the input and store the information in a matrix. Configuration of the start state and the goal state can be anything. For example given below T1, T2, ..., T8 are tile numbers and B is blank space.

Start state			Goal state		
T6	T7	T3	T1	T2	T3
T8	T4	T2	T4	T5	T6
T1	B	T5	T7	T8	B

3. Output should have the following information:
 - a. **On success:**
 - i. Success Message
 - ii. Start State / Goal State
 - iii. Total number of states explored
 - iv. Total number of states to optimal path
 - v. Optimal Path
 - vi. Optimal Path Cost

vii. Time taken for execution

b. On failure:

i. Failure Message

ii. Start State / Goal State

iii. Total number of states explored before termination

4. Please make a table that should list the following for all the heuristics:

a. Total number of states explored.

b. Total number of states on optimal path.

c. Optimal path.

d. Optimal Cost of the path.

e. Total time taken for execution

5. Please try to make your code as generic as possible (Preferably in Python).

6. Compare and contrast between the results of all four heuristics $h1(n)$, $h2(n)$, $h3(n)$, and $h4(n)$ and state the reasons in a document file '*Why one heuristic is better than the other one?*'. While explaining, please comment on the optimality, time complexity etc.