CS561 - ARTIFICIAL INTELLIGENCE LAB

ASSIGNMENT-2: A* Search

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

Date: 25th August, 2022 **Deadline:4th September, 2022**

Total Credit: 30

Instructions:

1. The assignment should be completed and uploaded by **4th Sep, 2022, 11:59 PM IST.**
2. Markings will be based on the correctness and soundness of the outputs. Marks will be deducted in case of plagiarism.
3. Proper indentation and appropriate comments are mandatory.
4. You should zip all the required files and name the zip file as:
   roll_no_of_all_group_members .zip , eg. 1501cs11_1201cs03_1621cs05.zip.
5. Upload your assignment (**the zip file**) in the following link:
   https://www.dropbox.com/request/kRkZiHLGIEgGQxwOzFSK

For any queries regarding this assignment you can contact:
Kshitij Mishra (kmishra.kings@gmail.com) or
Aizan Zafar (aizanzafar@gmail.com)

Questions

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1. In a general search algorithm each state *(n)* maintains a function

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

where

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 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 tiles from the goal position.

d. $h4(n)$ = 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 and verify monotone restriction on the heuristics.
4. Observe un-reachability and provide a proof.
5. Observe and verify whether monotone restriction is followed for the following two Heuristics:

   Monotone restriction: $h(n) <= cost(n,m) + h(m)$

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

   b. $h3(n)$ = sum of Manhattan distance of each tiles from the goal position.

6. Observe and verify that if the cost of the empty tile is added (considering empty tile as another tile) then monotonicity will be violated.

Instructions:

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

T6	T7	T3
T8	T4	T2
T1	B	T5

Goal state

T1	T2	T3
T4	T5	T6
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 C/C++/Java/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.