CS561 - ARTIFICIAL INTELLIGENCE LAB

ASSIGNMENT-2: Hill Climbing and Simulated Annealing

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

Date: Aug 25, 2021 **Deadline:** September 02, 2021

Total Credit: 30 (Implementation: 20; Documentation & Explanation: 10)

Questions

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1. A local search algorithm tries to find the optimal solution by exploring the states in the local region. Hill climbing is a local search technique which always looks for a better solution in its neighbourhood.
    a. Implement the Hill Climbing Search Algorithm for solving the 8-puzzle problem.
    b. Check the algorithm for the following heuristics:
        i. h1(n) = number of tiles displaced from their destined position.
        ii. h2(n) = sum of Manhattan distance of each tile from the goal position.

Instructions:

1. 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

2. 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

2. Simulated Annealing

Simulated annealing (SA) is a generic probabilistic metaheuristic for the global optimization problem of applied mathematics, namely locating a good approximation to the global minimum of a given function in a large search space.

a. Implement **Simulated Annealing Search Algorithm** for solving the 8-puzzle problem. **Your start and Goal state should be the same as in Q.1**.

b. Input: Input should be taken from an input file and processed as a matrix. Other inputs are Temperature variable T, heuristic function, neighbourhood generating function, a probability function to decide state change, and a cooling function.

c. Output: All the following results should be stored in an output file:

- **i.** The success or failure message
- **ii.** Heuristics chosen, Temperature chosen, cooling function chosen, Start state, and Goal state.
- **iii.** (Sub) Optimal Path (on success),
- **iv.** Total number of states explored.
- **v.** Total amount of time taken.

d. Objective functions to be checked:

- **i.** h1 (n)= Number of displaced titles.
- **ii.** h2 (n)= Total Manhattan distance.

e. Constraints to be checked:

- **i.** Check whether the heuristics are admissible.
- **ii.** What happens if we make a new heuristics h3 (n)= h1 (n) * h2 (n).
- **iii.** What happens if you consider the blank tile as another tile?
- **iv.** What if the search algorithm got stuck into Local optimum? Is there any

way to get out of this?

Instructions:

1. The assignment should be completed and uploaded by **2nd Sep, 2021, 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. Make your observations to compare between Hill climbing and Simulated annealing with respect to the time complexity (for near optimal solution) and no of steps.
5. 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/YHdbUqR0exGjq4h9SdkD

For any queries regarding this assignment you can contact:
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