AI 2002 – Artificial Intelligence (Spring 2024)

Assignment 2

Topics Covered: Search methods (uninformed and informed), heuristics, time and space complexity, algorithms analysis	**Submission Deadline:** *Monday – March 04, 2024 by23.00 sharp*

Submission Guidelines:

- **Group assignment: 2 members (at max.)**
- Submit your code solution for Questions 1 & 3, and a PDF file for Questions 2 & 4, on the Google Classroom (of your respective section).
- Students are expected to submit their own code and answers, any help from internet/chatgpt/fellows is not allowed.

Basic overview:

In this assignment, students will work on two environments: "agents" and "eight puzzle" implemented with a graphical user-interface. The code repository is available at Github Repository, and is adapted from the AIMA, necessary changes are made by the teaching assistants to meet our needs. A complementary video for explaining the file structures and the two environments is available at Google Drive.

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Question 1

Implement the following uninformed search methods on the "agent" environment.

i. Breadth-first search
ii. Depth-first search
iii. Uninformed search with the following cost function: left operation = 1, up operation = 2, down operation = 3, right operation = 4
iv. Greedy Best-First search with the Manhattan distance as a heuristic function
v. A* search with the cost and heuristic functions as defined previously in UCS and Greedy BFS, respectively.

a. Make changes in the given code so that the user will specify the start and goal states.
b. For each algorithm, show the (a) time complexity, (b) space complexity, (c) complete path from start to goal.
c. Make changes in the UI of "agents" environment so that all the explored paths are also displayed as the agent is searching for the goal node. That is, use a different color to show the nodes placed on the fringe.

Question 2

Perform an analysis on the search methods based on your solution from the previous question as follows.

i. Create a table and list down the time complexity, space complexity, path length.
ii. Which algorithm has taken the maximum time complexity?
iii. Which algorithm has taken the maximum space complexity?
iv. Which algorithm has returned the longest path?
v. Which algorithm has returned the shortest path length (i.e., fewer nodes traversed from start to goal)?
vi. Which algorithm is time efficient?
vii. Which algorithm is space efficient?

Question 3

Implement the following informed search methods on the "eight puzzle" environment.

i. Greedy Best-First search with two heuristic functions:
    a. h1 = Manhattan distance
    b. h2 = No. of misplaced tiles
ii. A* search: use the cost function given in Q1(iii, for UCS) and the heuristic functions given in Q3(i, for Greedy BFS).

a. Make changes in the given code so that the user will specify the start and goal states.
b. For each algorithm, show the (a) time complexity, (b) space complexity, (c) complete path from start to goal.

Question 4

Perform an analysis on the informed search methods based on your solution from the previous question as follows.

i. Create a table and list down the time complexity, space complexity, path length.
ii. Which algorithm has taken the maximum time complexity?
iii. Which algorithm has taken the maximum space complexity?
iv. Which algorithm has returned the longest path?
v. Which algorithm has returned the shortest path length (i.e., fewer nodes traversed from start to goal)?
vi. Which algorithm is time efficient?
vii. Which algorithm is space efficient?
viii. Compare the two heuristic functions (h1 and h2) given for the “eight puzzle” problem based on *admissibility*, if both are admissible then which one would you pick and why?