CMP682 –Artificial Intelligence - Fall 2021

Homework 1

Due date: November 14, 2021

Goal:

In this homework, you will analyze different search algorithms to find a path in a maze.

Introduction:

Finding a path to exit from a maze is a fun application of search strategies that we discussed. In this homework, on a maze you will use three search strategies to be able to find a path to the exit: Iterative Deepening Search, Uniform Cost Search, and A* search. Finally, you will compare the search strategies based on the number of nodes expanded, time spent to find the path and length of the path. Overall, you will be able to analyze search strategies from different perspectives similar to the examples shown in https://emmilco.github.io/path_finder/.

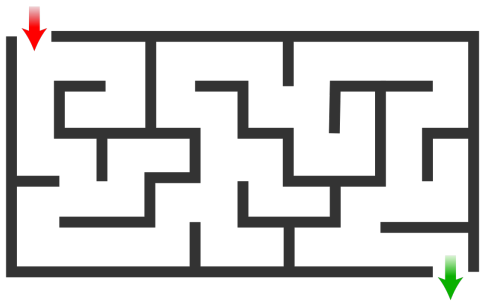
For implementing search algorithms, you can use any language. You can also make use of available codes. Some examples are shown below. You have to be very careful in providing all the references for the resources that you have used.

http://aima.cs.berkeley.edu/python/search.html
https://github.com/chitholian/AI-Search-Algorithms
https://artint.info/AIPython/

You will write a detailed report, and grading of your homework will be based on the information provided in the report.

Representation of mazes:

For all the mazes assume that, top left corner is the starting point and bottom right point is the exit. You can only move horizontally or vertically. The edges are assumed to be on the border of the cells. An edge is either a barrier or a blank, that is you cannot move from cell i,j to cell i+1,j if there is barrier in between.



Part 1 (10 pts): Generate your own maze

In this part, first you will generate your own mazes. There are many available codes around. However, it is important that there should be more than a single path to the goal state as we are comparing the search algorithms based on path cost. Provide the references properly.

Requirements for Part 1: You are required to generate mazes in five different sizes.

a) 10 x 10
b) 100 x 100
c) M x M where M is the last 2 digits of your student ID (if your ID is less than 50, you can use a size which is equal to 100-ID or 50+ID)
d) 500 x 500
e) (optional) 1000 x 1000 , or even higher if your capacity allows to work on this scale.

Generate 2 different mazes for each of the sizes given above. Show the mazes only for (a) and (c) in your report.

Part 2 (30 pts): Application of search strategies

In this part, you will apply three different search algorithms on mazes.

i) Iterative Deepening Search
ii) Uniform Cost Search
iii) A* search

For A* use the following heuristics

i) Euclidean distance
ii) Manhattan Distance

You will use the mazes that you generated in the first part. You should have 2 randomly generated mazes for each, all together for 4 scales it would be 8 mazes.

For each of the four methods above, run the search algorithm on the mazes. There will be 32 different solutions.

Requirements for Part 2:

In this part of your report, show the solutions as a path from start to the exit only for mazes (a) and (c) for all of the 4 strategies.

Part 3 (20 pts): Analysis of the search strategies

In this part, you will analyze and compare your solutions based on the following:

i) What is the length of the path found
ii) How many nodes are expanded by the algorithm
iii) What is the maximum time taken to find the path

Requirements for Part 3: In this part of your report, you should provide a table to compare all 40 solutions based on the 3 criteria specified above.

Part 4 (40 points)

Look for other search algorithms, that are applicable to solve maze problems. Explain the algorithm in your own words with providing proper references. Then, apply this new algorithm on the same 8 mazes that you have used in the previous parts. Compare the results based on the criteria on Part 3. Discuss the advantages and disadvantages.

Submission

You must submit a report in pdf format including all the requirements described above. Name the file as CMP682_HW1_Name_Surname.pdf where Name and Surname is yours ☺

Good luck