Homework 2
601.464/664 Artificial Intelligence

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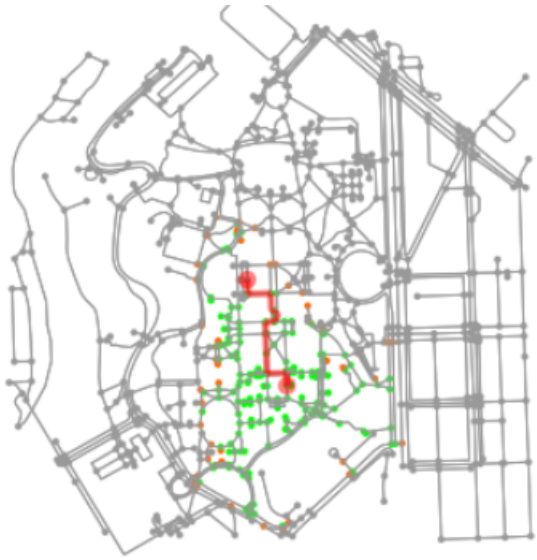
March 21, 2020

1 Open the following google colaboratory notebook. Follow all the steps specified in it. Include link to your solved notebook in your submission. Some parts of the notebook are optional and will not be graded.
Answer:
https://colab.research.google.com/drive/1s-BilbTqZ0epGX1YU96zRqSuWA3C7JpPscrollTo=6tPWbpCGfJH3



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(<Figure size 388.717x432 with 1 Axes>,
 <matplotlib.axes._subplots.AxesSubplot at 0x7fd10df3d828>)
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2 What is uninformed search and informed one. Name specific methods of both.
Answer:
An uninformed search is one that only uses the information available in the problem definition. There is no extra information given for the search algorithm. An informed search uses some sort of heuristic or knowledge to get to a solution. Methods of uninformed search are breadth-first search, depth-first search, and Uniform-cost search. Methods of informed search are Best-first search, and A* search.

3 Is depth-first search optimal if step costs are all equal? Is breadth-first optimal in this case?
Answer:
No depth-first search is not optimal if step costs are all equal. Breadth first search is optimal in the case that all step costs are equal, which is this case.

4 When is breadth-first search complete and optimal? What is the time and space complexity?
Answer:

Breadth first search is complete if b, the branching factor, is finite. It is optimal in the case where each step cost is 1. The time complexity is $O(b^{d+1})$ and the space complexity is $O(b^{d+1})$, where d if the depth of the least-cost solution.

5 Is breadth-first search optimal if cost of every step exceeds some small positive constant ϵ and costs are not equal? Why ? Is uniform-cost search optimal in this case?
Answer:
Breadth first search is not optimal if step costs are not equal and they exceed some positive constant ϵ.This is because breadth first search will expand all successor nodes in and traverse the tree in levels as it tries to find the target node. In this case where paths are not equal cost, this sort of search could lead to BFS returning a non-optimal solution since it is only concerned with reaching the target node rather than optimizing path cost. The assumption for equal cost paths allowed BFS to have the freedom of not having to worry about optimal path cost due to the fact that every path is of equal cost so it will certainly find the optimal path. Uniform cost search is optimal in this case due to the fact that it looks to expand the node with the least cost path. In doing so it will always find the least cost path since it is doing a similar procedure as BFS except that it ignores the unnecessary high cost paths and focuses on expansion of the nodes with the lowest cost, which will eventually lead to the optimal cost path.

6 What is the time and space complexity of uniform-cost search? Under what conditions it is complete?
Answer:
The time complexity of uniform cost search is the number of nodes where the path cost $g \leq$ the cost of the optimal solution, $O(b^{\lceil C^*/\epsilon \rceil})$. The space complexity is the number of nodes with the path cost $g \leq$ the cost of the optimal solution, $O(b^{\lceil C^*/\epsilon \rceil})$, where C^* is the cost of the optimal solution. Uniform-cost serach is complete if every step cost is greater than or equal to some positive constant ϵ.