Homework Assignment 2
601.464/664 Artificial Intelligence Spring 2020

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Search

Question 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.

https://colab.research.google.com/drive/1XIz8O4zODUEbJtcj6qE9077_SqLEUwML

Question 2. What is uninformed search and informed one. Name specific methods of both

Uninformed search is a class of general-purpose search algorithms which operates in brute force-way. Uninformed search algorithms do not have additional information about state or search space other than how to traverse the tree, so it is also called blind search. Uninformed strategies use only the information available in the problem definition.
Uninformed methods:
• Breadth-first search
• Uniform-cost search
• Depth-first search
• Depth-limited search
• Iterative deepening search

Informed search tries to reduce the amount of search that must be done by making intelligent choices for the nodes that are selected for expansion using problem-specific knowledge. In other word, a node is selected for expansion based on an evaluation function that estimates cost to goal.
Informed methods:
• Best-first search
• A∗ search
• Heuristic algorithms
  - hill-climbing
  - simulated annealing
  - genetic algorithms
  - local search in continuous spaces

Question 3. Is depth-first search optimal if step costs are all equal? Is breadth-first optimal in this case?

Depth-first search is not optimal if step costs are all equal.
Breadth-first search is optimal if step costs are all equal.

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

BFS is complete when b is a finite number.
BFS is optimal when the cost of each step is equal to 1, or more generally, when path cost is a non-decreasing function of the depth of the node.

Suppose that b is the maximum branching factor of the search tree, and d is the depth of the least-cost solution. Then we have the following:
The time complexity is $O(b^{d+1})$.
The space complexity is $O(b^{d+1})$.

Question 5. Is breadth-first search optimal if cost of every step exceeds some small positive constant and costs are not equal? Why? Is uniform-cost search optimal in this case?

No, breadth-first search is not optimal if cost of every step exceeds some small positive constant and costs are not equal.
Because that BFS believes that the first found node is the optimal one. But if cost of every step exceeds some small positive constant and costs are not equal, the edge with least cost is not the first in the to-be-searched array. So the first element we find by BFS is not the optimal solution.
Yes, uniform-cost search is optimal in this case.

Question 6. What is the time and space complexity of uniform-cost search? Under what conditions it is complete?

If the step cost $\geq \varepsilon$,
The time complexity is $O(b^{\lceil C^*/\varepsilon \rceil})$,
The space complexity is also $O(b^{\lceil C^*/\varepsilon \rceil})$,
where C* is the cost of the optimal solution.
For uniform-cost search, completeness is guaranteed only if the cost of every step is some positive number.