CS1571
Fall 2019
9/18 In-Class Worksheet

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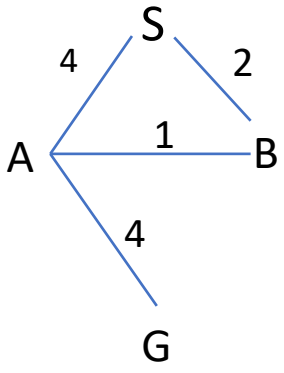
Where were you sitting in class today: Back right

A. Properties of Search with Evaluation Functions

For all questions, assume step cost exceeds some positive constant ϵ and a finite branching factor. You can reference this graph to help you think through the different scenarios.

1. For each of uniform cost search, greedy search, and A* search, if a state has been expanded, has the shortest path to that state been found?

For uniform cost search, if a node has been expanded the path that is found is the one with the lowest path cost so yes. For greedy search, because its searching for the node that is closest to the goal, the path cost could be significantly higher than choosing a path with a lower cost. For A* the shortest path is also found.



2. Is uniform cost search optimal and complete? Explain.

Uniform cost search is not complete because since it only cares about following the path with the lowest cost, there is a possibility that it could get stuck in an infinite loop. It is however, optimal because of the fact that it is choosing the node to expand based on the lowest cost so when it does find a solution, that solution will be the most optimal/lowest cost path.

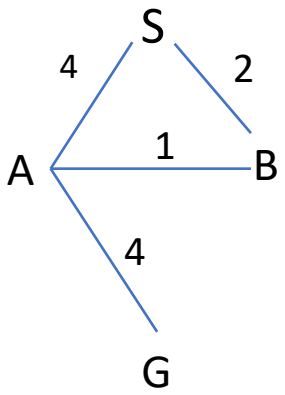
3. Specify a heuristic function for this graph where greedy search is not optimal.

Going to S

h(A)=4 instead of 3

Going to G

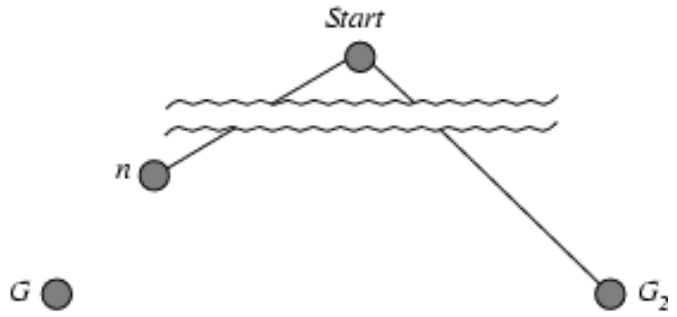
h(S)=8 instead of 7



4. Specify a heuristic function for the above graph where greedy search is not complete. Does it matter whether it is the graph search or tree search version?

The greedy search could not be complete when getting stuck in a loop between two states that are close instead of taking a longer route. Example would be going from S to G.

5. Now we're going to turn to the problem of whether A* is optimal or complete, starting with the tree search version.



Let n be an unexpanded node in the frontier such that *n* is on a shortest path to an optimal goal *G*. A suboptimal goal G_2 has been generated and is also in the frontier. Assume *h* is an admissible heuristic.

What the relationship between h(G) and h(G_2):

What is the relationship between g(G) and g(G_2):

What is the relationship between f(G) and f(G_2):

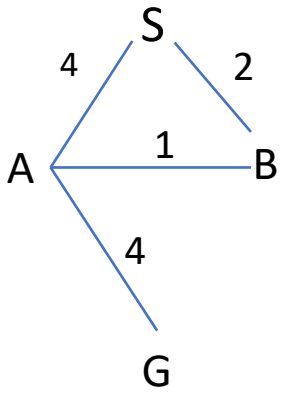
At node n, f(n) = g(n) + h(n). We know because *h* is admissible that

$$f(n) \leq g(n) + h^*(n)$$

What is the relationship between f(n) and f(G)

Which node is explored first, n or G_2?

6. Finally, let's discuss the graph search version. Assume *h* is admissible but not consistent. What is a heuristic function that will cause this search to find a suboptimal path?



7. If *h* is consistent, is the graph search version of A* optimal?

8. Is A* complete?