COMPSCI 402 Artificial Intelligence

Assignment 1 – Search Total points: 8-point

Each question is worth 0.5 point. Leaving a question blank is worth 0 points. Answering incorrectly is worth -0.5 points.

Q1:

(a) Consider a graph search problem where for every action, the cost is at least ϵ, with $\epsilon > 0$. Assume the used heuristic is consistent. (Total: 3.5-point)

(i) [true or false] Depth-first graph search is guaranteed to return an optimal solution.

(ii) [true or false] Breadth-first graph search is guaranteed to return an optimal solution.

(iii) [true or false] Uniform-cost graph search is guaranteed to return an optimal solution.

(iv) [true or false] Greedy graph search is guaranteed to return an optimal solution.

(v) [true or false] A* graph search is guaranteed to return an optimal solution.

(vi) [true or false] A* graph search is guaranteed to expand no more nodes than depth-first graph search.

(vii) [true or false] A* graph search is guaranteed to expand no more nodes than uniform-cost graph search.

(b) Let h1(s) be an admissible A* heuristic. Let h2(s) = 2h1(s). Then: (total: 1.5-point)

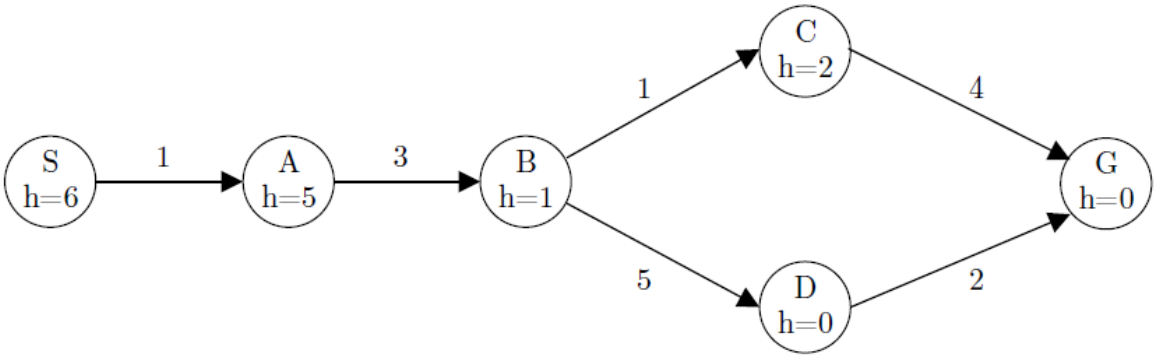
(i) [true or false] The solution found by A* tree search with h2 is guaranteed to be an optimal solution.

(ii) [true or false] The solution found by A* tree search with h2 is guaranteed to have a cost at most twice as much as the optimal path.

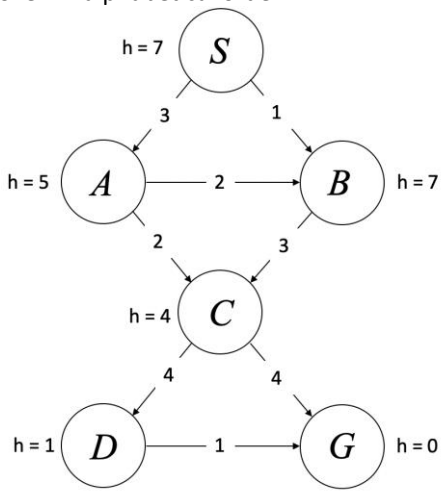
(iii) [true or false] The solution found by A* graph search with h2 is guaranteed to be an optimal solution.

(c) The heuristic values for the graph below are not correct. For which single state (S, A, B, C, D, or G) could you change the heuristic value to make everything admissible and consistent? What range of values are possible to make this correction? (Total: 1-point)

State: Range:



Q2: We will investigate various search algorithms for the following graph. Edges are labeled with their costs, and heuristic values h for states are labeled next to the states. S is the start state, and G is the goal state. In all search algorithms, assume ties are broken in alphabetical order.



(a) Select all boxes that describe the given heuristic values. (Multi-choice) (0.5-point)

☐ Admissible ☐ Consistent ☐ Neither

(b) Given the above heuristics, what is the order that the states are going to be expanded in, assuming we run A* graph search with the heuristic values provided. (0.5-point)

Index	1	2	3	4	5	Not expanded
S	◯	◯	◯	◯	◯	◯
A	◯	◯	◯	◯	◯	◯
B	◯	◯	◯	◯	◯	◯
C	◯	◯	◯	◯	◯	◯
D	◯	◯	◯	◯	◯	◯
G	◯	◯	◯	◯	◯	◯

(c) Assuming we run A* graph search with the heuristic values provided, what path is returned? (0.5-point)

◯ $S \to A \to B \to C \to D \to G$ ◯ $S \to A \to C \to G$ ◯ $S \to A \to C \to D \to G$
◯ $S \to B \to C \to G$ ◯ $S \to A \to B \to C \to G$ ◯ $None\ of\ the\ above$

(d) Given two admissible heuristics h_A and h_B. Which of the following are guaranteed to also be admissible heuristics? (Multi-choice) (0.5-point)

☐ $h_A + h_B$ ☐ $\frac{1}{2}(h_A)$ ☐ $\frac{1}{2}(h_B)$ ☐ $\frac{1}{2}(h_A + h_B)$ ☐ $h_A \times h_B$ ☐ $\max(h_A, h_B)$ ☐ $\min(h_A, h_B)$