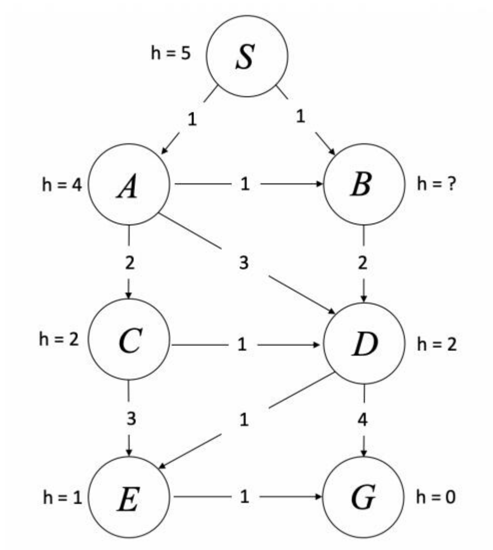
CS 101 Fall 2020 - Quiz 10-A

12/08/2020 - 20 Minutes **Name:** **ID number:** **Score:**

Remember that your work is graded on the quality of your writing and explanation as well as the validity.

1. (3'+3'+4') Consider A* algorithm on 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. Assume ties are broken in alphabetical order. Write your answer in the spaces provided.



(1) With the heuristic values fixed for all nodes other than B, for which values of $h(B)$ will A* graph search be guaranteed to return the optimal path? (All heuristics are consistent.) Either fill in the lower and upper bound in the spaces below or write "impossible" in two spaces.

$$\_\_\_\_\_\_\_\_\_\_ \leq h(B) \leq \_\_\_\_\_\_\_\_\_\_$$

(2) Given the above heuristics, and choose (one of) the heuristic you answered in (1), **write down** the heuristic $h(B)$ you used. What is the order of the states that are going to be expanded in, assuming we run A* graph search on it.

$h(B) =$ ___________

Expand order:____

(3) Based on (2), what path is returned?

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2. (5'+5') Consider the following implementation of the Floyd-Warshall algorithm. Assume $w_{ij} = \infty$ where there is no edge between vertex i and vertex j, and assume $w_{ii} = 0$ for every vertex i.

Algorithm 1 Floyd-Warshall

```
for i = 1 to n do
  for j = 1 to n do
    A[i, j, 0] = w_ij
    P[i, j] = −1
  end for
end for
for k = 1 to n do
  for i = 1 to n do
    for j = 1 to n do
      A[i, j, k] = A[i, j, k − 1]
      if A[i, j, k] > A[i, k, k − 1] + A[k, j, k − 1] then
        A[i, j, k] = A[i, k, k − 1] + A[k, j, k − 1]
        P[i, j] = k
      end if
    end for
  end for
end for
```

Assume matrix P, the output of the above algorithm is given. Consider the following matrix for graph G with 7 vertices. What is the shortest path from vertex 1 to vertex 2 in graph G? What is the shortest path from vertex 5 to vertex 7 in graph G?

P	1	2	3	4	5	6	7
1	-1	5	4	-1	4	4	-1
2	5	-1	5	5	-1	5	-1
3	4	5	-1	-1	-1	-1	6
4	-1	5	-1	-1	3	3	1
5	4	-1	-1	3	-1	3	6
6	4	5	-1	3	3	-1	-1
7	-1	-1	6	1	6	-1	-1