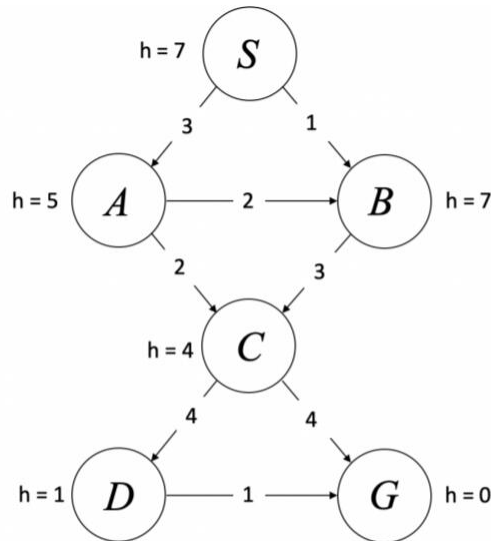


Remember that your work is graded on the quality of your writing and explanation as well as the validity.

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 box provided.



(1)	(2)
AB	D

- (1) The heuristic value is:
- (A) Admissible
  - (B) Consistent
  - (C) Neither
- (2) Given the above heuristics, what are the states not going to be expanded, assuming we run A\* graph search with the heuristic values provided.
- (A) A
  - (B) B
  - (C) C
  - (D) D
  - (E) S
  - (F) G
- (3) Assuming we run A\* graph search with the heuristic values provided, what path is returned?
- S -> B -> C -> G*

2. (10') 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. Design an algorithm for finding the shortest path from  $u$  to  $v$  by using matrix  $P$ , and write its pseudo-code.

**Algorithm 2** SOLUTION( $u, v, P$ )

```

if  $u == v$  then
  return  $\{u\}$ 
end if
return  $\{u\} + \text{FIND-PATH}(u, v, P) + \{v\}$ 

```

**Algorithm 3** FIND-PATH( $u, v, P$ )

```

if  $P[u, v] == -1$  then
  return  $\emptyset$ 
end if
 $k = P[u, v]$ 
return  $\text{FIND-PATH}(u, k, P) + \{k\} + \text{FIND-PATH}(k, v, P)$ 

```