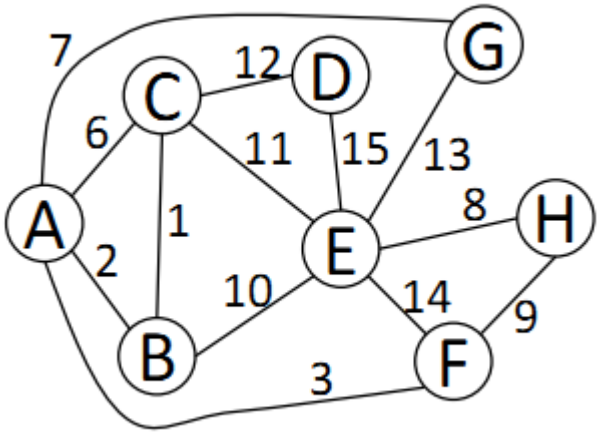
CSE -4303 Data Structures **Student id:**

Quiz # 4 **Time: 30 min**

1. Use Prim's algorithm starting at node A to compute the Minimum Spanning Tree (MST) of the following graph. In particular, write down the edges of the MST in the order in which Prim's algorithm adds them to the MST. Use the format (node 1; node 2) to denote an edge. -3



Solution:

SOLUTION:
The following edges are added to the MST in the given ordering: (A,B), (B,C), (A,F), (A,G), (F,H), (H,E), (C,D)

2. In the above figure consider all the edge weights as 1. Now, List the nodes in the order they would be visited in a depth-first search and breadth-first search of the graph starting at A. When choosing a node to explore next, break ties in favor of the alphabetically least. -4

Solution for DFS:

Solution for BFS:

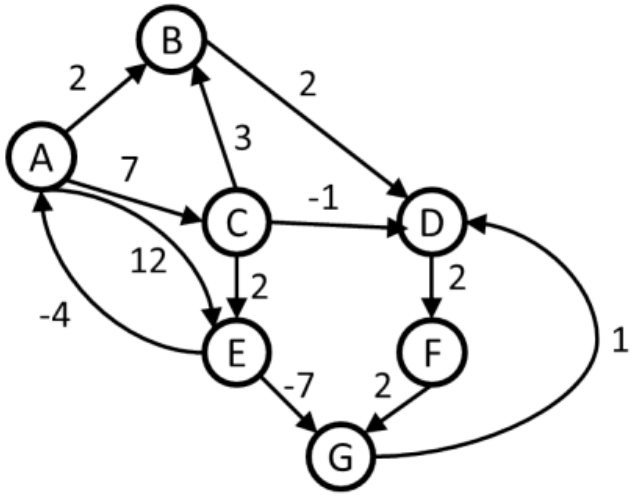
3. Consider an initially empty hash table of size M and hash function $h(x) = x \bmod M$. In the worst case, what is the time complexity (in Big-Oh notation) to insert n keys into the table if separate chaining is used to resolve collisions (without re-hashing)? Suppose that each entry (bucket) of the table stores an unordered linked list. When adding a new element to an unordered linked list, such an element is inserted at the beginning of the list. -2

What will be the answer if the linked lists are ordered?

Answer for first part: O(n)

Answer for second part: $O(n^2)$

4. Consider the following directed, weighted graph: -6



i. Even though the graph has negative weight edges, step through Dijkstra's algorithm to calculate shortest paths from A to every other vertex. Show your steps in the table below. Cross out old values and write in new ones, from left to right within each cell, as the algorithm proceeds. Also list the vertices in the order which you marked them visited.

Known vertices (in order marked known): A B D F C G E

Vertex	Known	Distance	Path
A	Y	0	
B	Y	2	A
C	Y	7	A
D	Y	4	B
E	Y	12 9	A C
F	Y	6	D
G	Y	8	F

Visited vertices (in order marked known):

ii. Dijkstra's algorithm found the wrong path to some of the vertices. For just the vertices where the wrong path was computed, indicate both the path that was computed and the correct path.

iii. What single edge could be removed from the graph such that Dijkstra's algorithm would happen to compute correct answers for all vertices in the remaining graph?

(b) Computed path to G is A,B,D,F,G but shortest path is A,C,E,G.
Computed path to D is A,B,D but shortest path is A,C,E,G,D.
Computed path to F is A,B,D,F but shortest path is A,C,E,G,D,F.

(c) The edge from E to G.