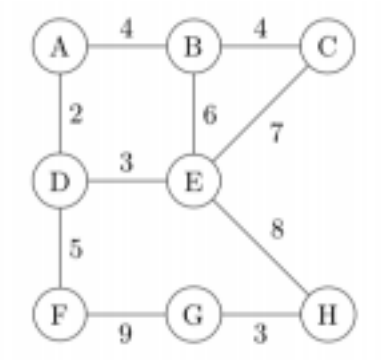
CSE317 Data Structures
Assigned: __ 202_ – Due: __ 202_
Prof. Amin Shoukry – Eng. Zyad Shokry

Graphs

1. Perform a depth-first search (DFS) over the following graph and collect the visited nodes in a list. Break ties alphabetically (i.e., the adjacent nodes from node *E* should be tried in the order *B*, *C*, *D*, *H*). Disregard the weights. Start from vertex *A*.



2. The same as Question 1 but now apply breadth-first search (BFS) over the same graph.

3. What is the maximum number of edges in a graph with V vertices, no parallel edges, and no self-loops? What is the minimum number of edges in a graph with V vertices, none of which are isolated (have degree 0)? What is the minimum number of edges in a connected graph with V vertices?

4. What does the BFS tree tell us about the distance from v to w when neither is at the root? **5.**

[**TA**] Describe how you would modify BFS to determine whether a graph is bipartite or not.

6. [**TA**] Describe how you would modify DFS to determine whether a graph contains a cycle or not.

7. Discuss informally that every connected graph has a vertex whose removal (including all adjacent edges) will not disconnect the graph and describe, in English, a DFS method that finds such a vertex.

8. For the graph of Question 1, find minimum spanning tree (MST) using *A* as starting node.

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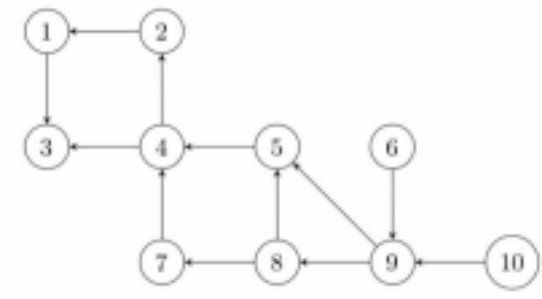
9. Describe how would you find a maximum spanning tree of an edge-weighted graph?

10. There are eight small islands in a lake, and the state wants to build seven bridges to connect them so that each island can be reached from any other one via one or more bridges. The cost of constructing a bridge is proportional to its length. The distances between pairs of islands are given in the following table

	1	2	3	4	5	6	7	8
1	-	240	210	340	280	200	345	120
2	-	-	265	175	215	180	185	155
3	-	-	-	260	115	350	435	195
4	-	-	-	-	160	330	295	230
5	-	-	-	-	-	360	400	170
6	-	-	-	-	-	-	175	205
7	-	-	-	-	-	-	-	305
8	-	-	-	-	-	-	-	-

Find which bridges to build to minimize the total construction cost.

11. Find two different topological orderings of the digraph below.



12. **[TA]** A set of ** integers are distributed among a √** × √** grid cells, where each number occupies a cell. Using topological sort, find the longest increasing sequence in the grid. You are allowed to move left, right, up and down only.

13. Is this true or false? Adding a constant to every edge weight does not change the solution to the single-source shortest-paths problem. Justify your answer.

14. Is this true or false? Multiplying a constant with every edge weight does not change the solution to the single-source shortest-paths problem.

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Recursive Formulas

1. For the following recurrences, give an expression for the runtime $$(())$$. Mention the method applied and whether the master theorem can be used in each recurrence or not. a. $$(()) = 3(()/2) + ()^2$$

b. $$(()) = (()- 3) + ()^2$$
c. $$(()) = (()/3) + (()/2) + ()$$
d. $$(()) = 4(()/2) + \log(())$$

2. Solve the recurrence formula below exactly!

$$(()) = 2(()/2) + \log(()) \text{ ; } (1) = 1 \text{ and for even } ()$$

Good Luck