Course:	Design and Analysis of Algorithms	Course Code:	
Program:	BS (Software Engineering)	Semester:	Spring 2025
Duration:	30 Minutes	Total Marks:	
Paper Date:		Weight	
Section:		Page(s):	02
		Roll. No.	22L-7771
Exam:	Quiz 5	Name:	Hasan Yahya

Instruction/Notes: Honesty always gives fruit and Dishonesty is always harmful.

1. What is the primary purpose of Breadth-First Search (BFS)?

- A) To find the shortest path in a weighted graph.
- B) To explore all vertices at the present depth before moving to the next level.
- C) To sort vertices in topological order.
- D) To find cycles in a graph.

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2. In BFS, how are vertices typically colored to track their state?

- A) Red, Green, Blue
- B) White, Gray, Black
- C) Unvisited, Processing, Processed
- D) Undiscovered, Discovered, Finished

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3. What is the time complexity of BFS on a graph with V vertices and E edges?

- A) O(V^2)
- B) O(V+E)
- C) O(ElogV)
- D) O(VlogE)

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4. Which of the following is a property of a Minimum Spanning Tree (MST)?

- A) It contains all vertices of the graph and has the maximum total edge weight.
- B) It is unique for every graph.
- C) It connects all vertices with the minimum total edge weight and no cycles.
- D) It is only applicable to directed graphs.

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5. Which algorithm for finding an MST grows the tree by adding the cheapest edge connecting the tree to a new vertex?

- A) Kruskal's algorithm
- B) Prim's algorithm
- C) Dijkstra's algorithm
- D) Bellman-Ford algorithm

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6. In Kruskal's algorithm, how are edges processed?

- A) In arbitrary order.
- B) In order of increasing weight.
- C) In order of decreasing weight.
- D) Based on vertex degrees.

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7. What is the key data structure used in Kruskal's algorithm to efficiently check for cycles?

- A) Stack
- B) Queue
- C) Disjoint-set (Union-Find)
- D) Priority queue

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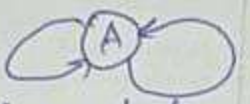
8. Which theorem justifies the "safe edge" strategy used in both Prim's and Kruskal's algorithms?

MCQs no)	1	2	3	4	5	6	7	8
	A	B	B	C	B	B	C	C

- A) Master Theorem
- B) Cut Property Theorem
- C) Pigeonhole Principle
- D) Central Limit Theorem

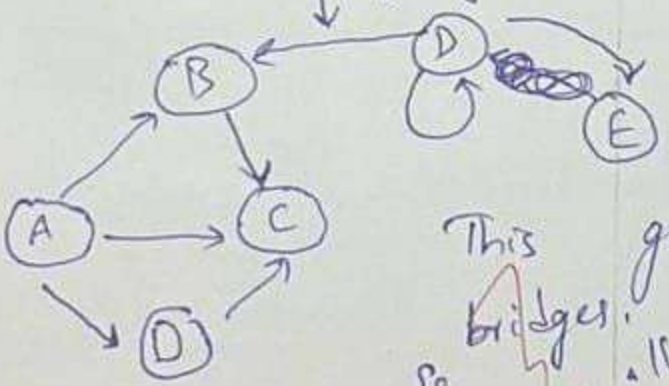
Q2: Explain how a vertex u of a directed graph can end up in a depth-first tree containing only u, even though u has both incoming and outgoing edges in G.

→ One of the ways this can happen is if the node connects to itself ie is self looping



it has both incoming or outgoing edges, but it will always only work after a restart and after it restart will happen. So, it will be in its own tree in DFS forest.

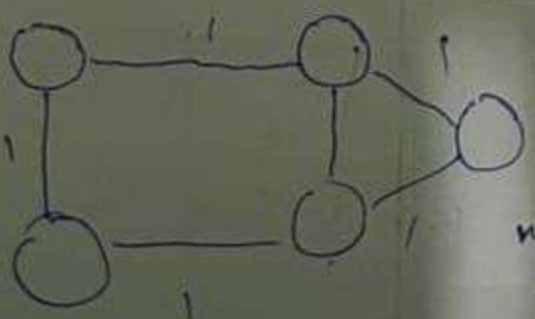
→ otherways is if graph is like this, only one bridge



This graph has 2 bridges. The seperate D, it to allow be in its own tress

→

of works



not unique

National University of Computer and Emerging Sciences, Lahore C

Course:	Design and Analysis of Algorithms	Course Code:	
Program:	BS (Software Engineering)	Semester:	
Duration:	30 Minutes	Total Marks:	
Paper Date:		Weight	
Section:	BSE-6C	Page(s):	
Exam:	Quiz 6	Roll. No.	
		Name:	

Instruction/Notes: Honesty always gives fruit and Dishonesty is always harmful.

1. What is the primary purpose of the Bellman-Ford algorithm?

- A) To find the shortest paths in a graph with nonnegative edge weights.
- B) To detect negative-weight cycles reachable from the source.
- C) To compute the longest path in a directed acyclic graph (DAG).
- D) To sort vertices topologically.

2. What is the time complexity of the Bellman-Ford algorithm for a graph with V vertices and E edges?

- A) $O(V \log V)$
- B) $O(VE)$
- C) $O(V+E)$
- D) $O(E \log V)$

3. In Dijkstra's algorithm, which data structure is most efficient for sparse graphs?

- A) Array
- B) Binary min-heap
- C) Fibonacci heap
- D) Queue

4. Which algorithm is best suited for finding shortest paths in a Directed Acyclic Graph (DAG)?

- A) Dijkstra's algorithm
- B) Bellman-Ford algorithm
- C) Topological sort followed by edge relaxation
- D) Breadth-First Search (BFS)

5. What invariant does Dijkstra's algorithm maintain?

- A) All vertices in the priority queue have correct shortest-path weights.
- B) The set S contains vertices with finalized shortest-path weights.
- C) The predecessor subgraph is always a BFS tree.
- D) Edge weights are relaxed in arbitrary order.

6. Why does Dijkstra's algorithm fail with negative-weight edges?

- A) It assumes edge weights are integers.
- B) It may incorrectly assume a path is shortest before processing negative edges.
- C) It cannot detect cycles.
- D) It requires a priority queue.

7. What property ensures correctness in the DAG shortest-paths algorithm?

- A) All edge weights are positive.

	1	2	3	4	5	6	7	8
Jo:	A	B	B	A	A	B	B	A
ns	✗	✓	✗	✗	✗	✓	✓	✓

- B) No cycles allow processing vertices in topological order.
- C) The graph is undirected.
- D) The algorithm uses BFS.

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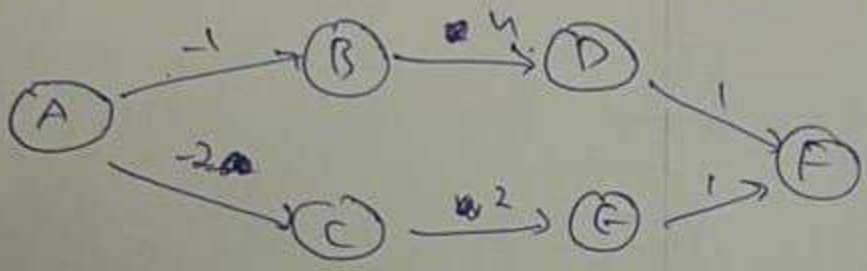
8. How does the Bellman-Ford algorithm detect negative-weight cycles?

- A) By checking if any edge can be relaxed after V−1 iterations.
- B) By running Dijkstra's algorithm twice.
- C) By sorting edges by weight.
- D) By using a Fibonacci heap.

Q2: Suppose that we are given a weighted, directed graph G = (V, E) in which edges that leave the source vertex s may have negative weights, all other edge weights are nonnegative, and there are no negative-weight cycles. Argue that Dijkstra's algorithm correctly finds shortest paths from s in this graph.

It does not.



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while dijkstras algorithm does find the shortest path, these paths will always account for negative edges weight. which means that the final cost will not be the same as it was positive

→ If it not possible to find non-negative weight path (shortest at-all in any form of we use Dijkstras is any-