Lecture 12-graphs

1. Which data structure is used for implementing BFS and DFS, respectively?
   a) Queue, Stack
   b) Stack, Queue
   c) Queue, Queue
   d) Stack, Stack
   Answer: a) Queue, Stack

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2. **Which of the following is NOT a typical application of graphs?**
   a) Social media follower relationships
   b) Web page hyperlinks
   c) Storing a list of student grades
   d) Airline flight paths
   Answer: c) Storing a list of student grades
   Explanation: Storing grades is a linear data task, not requiring graph relationships.

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3. **In a directed graph, the sum of all nodes' out-degrees equals:**
   a) The number of nodes
   b) The number of edges
   c) Twice the number of edges
   d) The number of cycles
   Answer: b) The number of edges
   Explanation: Each edge contributes exactly 1 to the out-degree of a node.

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4. **An undirected graph is connected if:**
   a) All nodes have even degrees
   b) There exists a path between every pair of nodes
   c) It contains no cycles
   d) It uses an adjacency matrix
   Answer: b) There exists a path between every pair of nodes

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5. **Which graph representation has O(1) time complexity to check if an edge exists?**
   a) Adjacency List
   b) Adjacency Matrix
   c) Hash Table
   d) Linked List
   Answer: b) Adjacency Matrix
   Explanation: Matrix allows direct access to edge existence.

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6. **A directed acyclic graph (DAG) can be topologically sorted because:**
   a) It contains cycles
   b) It has no undirected edges

c) It has no directed cycles
d) All nodes have equal in-degree and out-degree
Answer: c) It has no directed cycles
Explanation: Cycles prevent topological sorting.

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7. **In BFS traversal, which data structure is used?**
   a) Stack
   b) Queue
   c) Priority Queue
   d) Tree
   Answer: b) Queue
   Explanation: BFS processes nodes layer-by-layer using a queue.

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8. **Matrix multiplication of an adjacency matrix with itself helps identify:**
   a) Node degrees
   b) 2-hop neighbors
   c) Cycle existence
   d) Edge weights
   Answer: b) 2-hop neighbors
   Explanation: The resulting matrix entries indicate paths of length 2.

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9. **Kahn's algorithm for topological sorting starts by enqueuing nodes with:**
   a) Highest out-degree
   b) In-degree of 0
   c) Out-degree of 0
   d) Highest edge weight
   Answer: b) In-degree of 0
   Explanation: Nodes with no dependencies are processed first.

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10. **DFS post-order traversal of a graph is used to:**
    a) Find the shortest path
    b) Generate a topological sort (when reversed)
    c) Calculate node degrees
    d) Check graph connectivity
    Answer: b) Generate a topological sort (when reversed)

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11. **What is the space complexity of an adjacency list for a graph with |V| nodes and |E| edges?**
    a) O(|V|)
    b) O(|E|)
    c) O(|V| + |E|)
    d) $O(|V|^2)$
    Answer: c) O(|V| + |E|)

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12. **A cycle in a graph is defined as:**
    a) A path where all nodes have degree 2
    b) A path starting and ending at the same node
    c) A path with no repeated edges
    d) A path with exactly three nodes
    Answer: b) A path starting and ending at the same node

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13. **Which traversal visits nodes in the order "node, left, right" for trees?**
    a) Pre-order DFS
    b) Post-order DFS
    c) In-order DFS
    d) BFS
    Answer: a) Pre-order DFS

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14. **In a directed graph with edges (A→B), (B→C), and (C→A), topological sorting:**
    a) Is possible starting from A
    b) Is possible using Kahn's algorithm
    c) Is impossible due to a cycle
    d) Results in [A, B, C]
    Answer: c) Is impossible due to a cycle

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15. **Which statement about edge weights is TRUE?**
    a) They are only used in undirected graphs
    b) They represent numerical labels on edges
    c) They are unrelated to graph traversal
    d) They replace the need for adjacency lists
    Answer: b) They represent numerical labels on edges