Course: Data Structure

Term: Fall 2024

Practice 3 (for Graph)

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Multiple Choices Questions

(There is only one correct answer)

1. If a depth-first search starting from any vertex in an undirected graph can visit all vertices, the graph must be ( )

- A. Strongly connected graph
- B. Connected graph
- C. Cyclic graph
- D. A tree

2. The depth-first traversal algorithm of a graph stored in an adjacency list is most similar to which tree traversal?

- A. In-order traversal
- B. Pre-order traversal
- C. Post-order traversal
- D. Level-order traversal

3. What data structure is implicitly used in recursive calls of Depth First Search (DFS)?

- A. Queue
- B. Stack
- C. Adjacency matrix
- D. Priority queue

4. Which of the following statements is correct?

- A. Adjacency matrix is suitable for sparse graphs, and adjacency list is suitable for dense graphs.
- B. Adjacency matrix occupies fixed storage space, regardless of the number of edges.

> Means: the storage size of an adjacency matrix depends on the number of vertices in the graph (typically $V \times V$) and is independent of the actual number of edges. Even for sparse graphs, the same amount of storage is required.

- C. Edge lookup complexity in adjacency list is $O(1)$.
- D. None of the descriptions are correct.

5. In DFS code, when are "discovery time" and "completion time" set?

- A. Discovery time is set when the node turns "white", completion time is set when node turns "gray".
- B. Discovery time is set when the node turns "gray", completion time is set when node turns "black".
- C. Both discovery time and completion time are set when the node turns "black".
- D. Both discovery time and completion time are set when the node turns "white".

6. In breadth-first search (BFS), what kind of distance relationship is used to organize nodes?

I. Nodes closest to the source are explored first.

II. Nodes are accessed in lexicographical order.

III. Nodes farther away are discovered later.

IV. A random unvisited node is chosen each time.

- A. I, II
- B. I, III
- C. II, III, IV
- D. III, IV
- E. None of the above combinations is correct.

7. Which statements about breadth-first search (BFS) are correct?

I. When all edge weights are equal, BFS can solve the single-source shortest path problem.

II. BFS is similar to the post-order traversal of a tree.

III. When using an adjacency list, the time complexity of BFS is $O(n^2)$.

IV. A queue is used to implement BFS in a graph.

- A. I and IV
- B. I, III, and IV
- C. II and III

- D. III and IV
- E. None of the above combinations is correct.

Short Questions

1. Compare the advantages and disadvantages of adjacency matrix and adjacency list (one for each), and provide examples of their use cases.

Reference Answer：

	Advantages	Disadvantages	Scenarios
Adjacency Matrix	Querying whether an edge exists between two vertices is O(1).	Fixed storage space leads to wasted memory, especially for sparse graphs.	Suitable for graphs with high edge density.
Adjacency List	Requires less storage space, especially for sparse graphs.	Querying whether an edge exists between two vertices is O(k), where k is the number of adjacent vertices of a node.	Suitable for sparse graphs with low edge density.

2. In word ladder problems, is Breadth-First Search or Depth-First Search most commonly used to find the shortest path? Please list 2 key reasons (advantages) for the choice in 2-3 sentences each.

most commonly used method ：**Breadth-First Search (BFS)**.

Reference Answer：

Inherently Suitable for Shortest Path
BFS expands nodes level by level, ensuring first valid path from the start to the end is the shortest. It, directly aligns with the goal of finding shortest transformation sequence in problems.

Efficiency Through Avoiding Repetition and Backtracking
BFS tracks visited nodes, preventing duplicate visits. This is more efficient than Depth-First Search, which requires backtracking and may revisit nodes, especially in large search spaces.

If you have any questions or suggestions, pls feel free to contact TA via WeChat.

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