Data Structures and Algorithms Fundamentals Quiz

Topic: Data Structures and Algorithms (DSA) | **Questions:** 10 | **Time:** 15 mins | **Passing:** 70%

Q1. What is the primary characteristic of an array as a data structure?

Difficulty: easy | Topic: Arrays

- **A)** It has a dynamic size that changes automatically.
- **B)** Elements are stored in contiguous memory locations.
- **C)** Elements can only be accessed sequentially.
- **D)** Data is organized in a hierarchical manner.

Answer: B

Explanation: Arrays store elements in contiguous memory locations, which allows for constant-time (O(1)) random access to any element using its index.

Q2. An algorithm must always terminate after a finite number of steps.

Difficulty: easy | Topic: Algorithm Basics

- **A)** True
- **B)** False

Answer: True

Explanation: One of the fundamental properties of an algorithm is finiteness, meaning it must always complete after a finite number of steps for all valid inputs.

Q3. The notation used to describe the upper bound of an algorithm's running time is called ____.

Difficulty: easy | Topic: Asymptotic Analysis

Answer: Big O notation

Explanation: Big O notation provides an asymptotic upper bound on the growth rate of a function, indicating the maximum time or space an algorithm might take in the worst-case scenario.

Q4. Which data structure is most efficient for inserting and deleting elements at arbitrary positions, given that elements are not frequently accessed by index?

Difficulty: medium | Topic: Linked Lists

- **A)** Array
- **B)** Linked List
- **C)** Hash Table
- **D)** Stack

Answer: B

Explanation: Linked lists allow O(1) insertion and deletion operations (after the position is found), as only pointers need to be updated. Arrays require shifting elements, making these operations O(n).

Q5. What is the worst-case time complexity for Bubble Sort?

Difficulty: medium | Topic: Sorting Algorithms

- **A)** O(n log n)
- **B)** O(n)
- **C)** O(n^2)
- **D)** O(log n)

Answer: C

Explanation: In the worst-case scenario (e.g., a reverse-sorted array), Bubble Sort performs approximately n^2 comparisons and swaps, leading to an O(n^2) time complexity.

Q6. The algorithm used to find the shortest path from a single source vertex to all other vertices in a graph with non-negative edge weights is known as ____ algorithm.

Difficulty: medium | Topic: Graph Algorithms

Answer: Dijkstra's

Explanation: Dijkstra's algorithm is a greedy algorithm that efficiently finds the shortest paths from a single source node to all other nodes in a graph with non-negative edge weights.

Q7. In-order traversal of a Binary Search Tree (BST) always produces elements in sorted order.

Difficulty: medium | Topic: Trees

- **A)** True
- **B)** False

Answer: True

Explanation: By definition, a Binary Search Tree maintains the property that all nodes in the left subtree are smaller than the root, and all nodes in the right subtree are larger. In-order traversal visits the left subtree, then the root, then the right subtree, thus yielding elements in non-decreasing order.

Q8. For implementing an 'undo' functionality in an application, which data structure is most appropriate?

Difficulty: medium | Topic: Data Structure Applications

- **A)** Queue
- **B)** Stack
- **C)** Heap
- **D)** Graph

Answer: B

Explanation: An 'undo' operation requires reversing the most recent action, which follows the Last-In, First-Out (LIFO) principle. A stack is the perfect data structure for LIFO operations.

Q9. Which of the following data structures has an amortized O(1) time complexity for its 'add' (append) operation, but can have a worst-case O(n) complexity?

Difficulty: hard | Topic: Amortized Analysis

- **A)** Fixed-size Array
- **B)** Singly Linked List
- **C)** Dynamic Array (e.g., ArrayList, vector)
- **D)** Doubly Linked List

Answer: C

Explanation: Dynamic arrays (like ArrayList in Java or vector in C++) typically double their capacity when full. This reallocation and copying of elements leads to an O(n) worst-case time for a single 'add' operation, but over a sequence of operations, the average (amortized) time complexity is O(1).

Q10. The Bellman-Ford algorithm is capable of detecting negative cycles in a graph because:

Difficulty: hard | Topic: Graph Algorithms

- **A)** It uses a priority queue to optimize path selection.
- **B)** It relaxes edges V-1 times and then checks for further relaxation in the V-th iteration.

- **C)** It only works on Directed Acyclic Graphs (DAGs).

- **D)** It uses a depth-first search approach to explore paths.

Answer: B

Explanation: The Bellman-Ford algorithm correctly finds shortest paths in V-1 iterations. If, after V-1 iterations, an edge can still be relaxed in the V-th iteration, it implies the existence of a negative cycle reachable from the source vertex.
