Name: _____ **Date:** _____

Answer Key: Circuit Architectures: 12th Grade Algorithmic Blueprints Quiz

Seniors analyze the spatial complexity of Kruskal’s algorithm and optimize recursive structures using dynamic programming techniques to solve multifaceted network problems.

---

1. A logistical firm utilizes a greedy approach to find the Minimum Spanning Tree (MST) of a city's fiber-optic grid. Which algorithm is most likely being applied if the process involves sorting all edges by weight and adding them only if they do not create a cycle?

Answer: B) Kruskal’s Algorithm

Kruskal's algorithm is a greedy algorithm that builds a forest of MSTs by sorting edges and using a Disjoint Set Union (DSU) to avoid cycles.

2. When refactoring a recursive solution for the 'Longest Common Subsequence' problem to avoid redundant calculations, a developer uses a table to store results of subproblems. This technique is known as _____.

Answer: C) Memoization

Memoization is a core component of dynamic programming where results of expensive function calls are cached to optimize time complexity.

3. In Big O notation, an algorithm with a time complexity of O(2^n) is considered more efficient for large datasets than one with O(n^3).

Answer: B) False

Exponential time complexity O(2^n) grows much faster than polynomial time complexity O(n^3), making it significantly less efficient as 'n' increases.

4. Imagine you are designing a GPS system for a delivery drone that must calculate the shortest path in a graph where some edges might have negative weights (representing energy regeneration). Which algorithm would be most appropriate?

Answer: D) Bellman-Ford Algorithm

Unlike Dijkstra’s, the Bellman-Ford algorithm can handle graphs with negative edge weights and can detect negative cycles.

Name: _____ **Date:** _____

5. Which specific data structure is essential for implementing a Breadth-First Search (BFS) to ensure the shortest path is found in an unweighted graph?

Answer: B) Queue (FIFO)

BFS uses a Queue to explore neighbors level-by-level, ensuring that the first time a node is reached, it is via the shortest path.

6. A developer is optimizing a social media 'friend recommendation' engine. They decide to use a _____ to represent the network, where individuals are nodes and friendships are edges.

Answer: A) Adjacency Matrix

Adjacency matrices (or lists) are the standard mathematical and computational representations for graph-based problems like social networks.

7. P vs NP is a major unsolved problem in computer science where P represents problems solvable in polynomial time and NP represents problems whose solutions can be verified in polynomial time.

Answer: A) True

This is the fundamental definition of the P vs NP complexity classes, a central topic in theoretical computer science.

8. In the context of the Knapsack Problem, which approach guarantees the globally optimal solution for the '0/1' version (where items cannot be split)?

Answer: C) Dynamic Programming

A greedy approach works for the Fractional Knapsack problem, but only Dynamic Programming ensures the optimal solution for the 0/1 Knapsack problem.

9. When an algorithm solves a problem by using a 'divide and conquer' strategy, it splits the problem into smaller parts, solves them, and then uses a _____ step to combine the results.

Answer: B) Merging

Divide and conquer (like in Merge Sort) consists of three parts: Divide, Conquer (solve), and Combine (Merge).

10. An 'in-place' sorting algorithm is one that requires O(n) additional memory space beyond the input array to execute.

Answer: B) False

Name: _____ **Date:** _____

In-place algorithms require constant O(1) extra space (or at most logarithmic space) because they rearrange the data within the original structure.