Name: _____ **Date:** _____

Answer Key: Big O and Heuristics: 11th Grade Algorithmic Synthesis Quiz

Logic-driven students analyze 10 complex scenarios involving Dijkstra's algorithm, O(log n) optimization, and memoization to solve computational bottlenecks.

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1. A logistics company needs to find the shortest path for deliveries in a weighted graph where some edges represent tolls. Which algorithmic approach is most appropriate for a single-source shortest path problem without negative weight edges?

Answer: B) Dijkstra's Algorithm

Dijkstra's algorithm is specifically designed for finding the shortest path between nodes in a graph with non-negative edge weights using a greedy approach.

2. A programmer is using Dynamic Programming to solve the Fibonacci sequence efficiently. By storing the results of expensive function calls, they are utilizing a technique called _____.

Answer: C) Memoization

Memoization is a technical term for caching the results of function calls to avoid redundant computations in overlapping subproblems.

3. An algorithm with a time complexity of O(2^n) is considered more efficient for large datasets than an algorithm with O(n^2) complexity.

Answer: B) False

O(2^n) represents exponential growth, which is significantly slower and less efficient than the polynomial growth of O(n^2) as the input size increases.

4. When designing a search feature for a massive, pre-sorted global database of Social Security numbers, which algorithm provides the best worst-case time complexity?

Answer: C) Binary Search

Binary search on a sorted list has a logarithmic time complexity of O(log n), making it the most efficient choice for large datasets compared to linear-time alternatives.

5. The 'Divide and Conquer' paradigm involves breaking a problem into independent subproblems, solving them, and then combining their solutions.

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Answer: A) True

Divide and Conquer is the standard paradigm used by algorithms like QuickSort and MergeSort to handle complex computational tasks by partitioning.

6. To solve the 'Traveling Salesperson Problem' for 500 cities timely, a developer must use a _____ algorithm, which provides a 'good enough' solution rather than the absolute optimum.

Answer: C) Heuristic

Heuristic algorithms are used for NP-hard problems to find practical, approximate solutions when finding the exact solution is computationally infeasible.

7. You are auditing a program that uses nested loops to compare every element in an array of size 'n' with every other element. What is the Big O complexity of this operation?

Answer: D) O(n^2)

Nested loops where each loop runs 'n' times result in a quadratic time complexity, expressed as O(n * n) or O(n^2).

8. In the context of problem decomposition, creating a high-level overview of an algorithm using a mix of natural language and code structures is known as _____.

Answer: B) Pseudocode

Pseudocode allows developers to focus on the logic and flow of an algorithm without worrying about the specific syntax of a programming language.

9. Space complexity refers solely to the amount of permanent hard drive storage an algorithm requires to run.

Answer: B) False

Space complexity refers to the total amount of working memory (RAM) an algorithm needs relative to the input size, not just permanent storage.

10. A developer is implementing a 'Undo' feature in a text editor. Which data structure is most efficient for managing the history of changes to allow for the 'last-in, first-out' (LIFO) retrieval of states?

Answer: B) Stack

Stacks operate on a LIFO (Last-In, First-Out) principle, making them the ideal structure for undo mechanisms where the most recent action is the first to be reversed.

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