

Design and Analysis of Algorithms Assignment

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Questions:

1. What is an algorithm?

- A) A type of computer hardware
- B) A set of instructions for solving a problem or performing a task
- C) A type of programming language
- D) A type of software application

Answer: B) A set of instructions for solving a problem or performing a task.

2. Consider the following algorithm for sorting an array of n elements:

```
for i = 1 to n
  for j = i + 1 to n
    if arr[i] > arr[j]
      swap arr[i] and arr[j]
```

What is the time complexity of this algorithm in terms of big O notation?

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

Answer: B) $O(n^2)$

3. Which of the following options best describes the time complexity of the divide and conquer algorithm for matrix multiplication, where n represents the size of the matrices?

- A) $O(n)$
- B) $O(n \log n)$
- C) $O(n^2)$
- D) $O(n^3)$

Answer: D ($O(n^3)$)

4. Which of the following is not a step in solving a problem using Dynamic Programming?

- A) Defining the subproblems
- B) Finding the base cases
- C) Creating a brute-force algorithm
- D) Combining solutions to subproblems

Answer: C) Creating a brute-force algorithm

5. Which of the following is/are true regarding the Divide and Conquer approach?

- A. The approach involves breaking down a problem into smaller subproblems that can be solved independently
- B. It is a top-down approach that recursively breaks down a problem into smaller subproblems
- C. The approach requires the subproblems to be of equal size to ensure efficiency
- D. Merge Sort and Quick Sort are examples of algorithms that use the Divide and Conquer approach

Select all that apply:

- A) A and B
- B) A, B, and C
- C) A and D
- D) A, B, and D

Answer: D) A, B, and D

6. Which of the following techniques is commonly used to establish the correctness of algorithms in DAA?

- A) Big-O notation
- B) Dynamic programming
- C) Greedy algorithms
- D) Mathematical induction

Answer: D) Mathematical induction

7. Which of the following is an efficient way to perform deletion of a node in a binary tree using dynamic programming?

- A) Traverse the tree recursively to find the node to be deleted, and then delete it.

- B) Replace the node to be deleted with its right child, and then delete the right child's leftmost descendant.
- C) Replace the node to be deleted with its left child, and then delete the left child's rightmost descendant.
- D) Replace the node to be deleted with its inorder successor, and then delete the inorder successor's leftmost descendant.

Answer: D) Replace the node to be deleted with its inorder successor, and then delete the inorder successor's leftmost descendant.

8. Which of the following statements is true about Fictitious Nodes in dynamic programming?

- A) Fictitious Nodes are nodes that do not exist in the original problem graph, but are added to simplify the calculation process.
- B) Fictitious Nodes are nodes that are added to the original problem graph to increase its complexity.
- C) Fictitious Nodes are nodes that are not involved in the calculation process of dynamic programming.
- D) Fictitious Nodes are nodes that are used in dynamic programming only for recursive algorithms.

Answer: A) Fictitious Nodes are nodes that do not exist in the original problem graph, but are added to simplify the calculation process.

9. Which of the following statements is true about Floyd's Algorithm in Design and Analysis of Algorithms?

- A) Floyd's Algorithm is used to find the shortest path between two nodes in a directed graph.
- B) Floyd's Algorithm is used to find the minimum spanning tree of a graph.
- C) Floyd's Algorithm is used to find the longest path between two nodes in an undirected graph.
- D) Floyd's Algorithm is used to find the maximum flow in a network.

Answer: A) Floyd's Algorithm is used to find the shortest path between two nodes in a directed graph.

10. What is the practical application of Warshall's Algorithm?

- A) Finding the shortest path between two nodes in a graph
- B) Finding the strongly connected components in a graph
- C) Finding the maximum flow in a network
- D) Finding the minimum spanning tree in a graph

Answer: B) Finding the strongly connected components in a graph.

11. What is the minimum number of moves required to solve the Tower of Hanoi problem with 64 discs, if each move takes 1 second to complete and the end of the universe is estimated to occur after 10^{100} years?

- A) Less than 10^{100} moves
- B) Exactly 10^{100} moves
- C) More than 10^{100} moves
- D) It is impossible to solve the Tower of Hanoi with 64 discs.

Answer: D) It is impossible to solve the Tower of Hanoi with 64 discs.

12. Which of the following sorting algorithms has the worst-case time complexity of $O(n^2)$?

- A) Merge sort
- B) Quick sort
- C) Heap sort
- D) Insertion sort

Answer: D) Insertion sort

13. Which of the following is true about recursive multiplication?

- A) Recursive multiplication is a divide-and-conquer algorithm that splits the problem into smaller subproblems.
- B) Recursive multiplication is an algorithm that uses a loop to repeatedly multiply two numbers.
- C) Recursive multiplication is an algorithm that uses dynamic programming to calculate the product of two numbers.
- D) Recursive multiplication is an algorithm that uses brute force to calculate the product of two numbers.

Answer: A) Recursive multiplication is a divide-and-conquer algorithm that splits the problem into smaller subproblems.

14. What is the time complexity of the Divide and Conquer approach to multiplication?

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

Answer: B) $O(n \log n)$