

Course: Data Structures and Algorithms **Assignment Type:** Structured Q&A **Due Date:** March 20, 2026 **Total Points:** 100

Instructions

Answer all questions in the spaces provided. Show all work for calculations and provide clear explanations for theoretical questions. Each question is worth the points indicated.

Section 1: Short Answer Questions (40 points)

Question 1 (10 points)

Define Big O notation and explain its importance in algorithm analysis. Provide an example of an algorithm with $O(n^2)$ time complexity.

Your Answer: [Space for answer]

Question 2 (10 points)

What is the difference between a stack and a queue? Give one real-world application example for each data structure.

Your Answer: [Space for answer]

Question 3 (10 points)

Explain the concept of recursion. What are the two essential components that every recursive function must have?

Your Answer: [Space for answer]

Question 4 (10 points)

Compare and contrast arrays and linked lists. List two advantages and two disadvantages of each.

Your Answer: [Space for answer]

Section 2: Problem-Solving Questions (40 points)

Question 5 (15 points)

Given the following array: [64, 34, 25, 12, 22, 11, 90]

- a) Show the step-by-step process of sorting this array using Bubble Sort (10 points)
- b) What is the time complexity of Bubble Sort in the worst case? (5 points)

Your Answer: [Space for answer]

Question 6 (15 points)

Consider a binary search tree with the following values inserted in order: 50, 30, 70, 20, 40, 60, 80

- a) Draw the resulting binary search tree (8 points)
- b) Show the tree after deleting node 30 (7 points)

Your Answer: [Space for answer]

Question 7 (10 points)

Write the pseudocode for a function that finds the maximum element in an array. Specify the time and space complexity.

Your Answer: [Space for answer]

Section 3: True/False with Justification (20 points)

For each statement, indicate whether it is TRUE or FALSE and provide a brief justification (2-3 sentences).

Question 8 (5 points)

A hash table always provides $O(1)$ lookup time.

Your Answer: [Space for answer]

Question 9 (5 points)

In a balanced binary search tree, the height is always $\log(n)$ where n is the number of nodes.

Your Answer: [Space for answer]

Question 10 (5 points)

Depth-First Search (DFS) uses a queue data structure for traversal.

Your Answer: [Space for answer]

Question 11 (5 points)

Dynamic programming can only be applied to problems that exhibit optimal substructure.

Your Answer: [Space for answer]

Submission Guidelines

- Answer all questions in a typed document
- Use clear formatting and label each answer with the question number
- Submit as a single PDF file
- Show all work for full credit