

PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

Algorithm Analysis Exam

Instructions: Please answer all questions to the best of your ability. Show your work where applicable.

Section 1: Multiple Choice Questions (4 points each, 40 points total)

Instructions: Choose the best answer for each question.

Question 1: What is the name of the example algorithm provided that sorts an array?

- A) Merge Sort
- B) Bubble Sort
- C) Insertion Sort
- D) Quick Sort

Question 2: In the provided code snippet for insertion sort, what does the variable 'key' represent?

- A) The index of the current element being compared.
- B) The value of the current element being inserted into the sorted portion.
- C) The number of elements in the array.
- D) The index of the last element in the sorted portion.

Question 3: Based on the provided content, what is the time complexity of the recurrence relation $T(n) = T(n-1) + \lg(n)$?

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

Question 4: According to the recurrence relation example, which method can be used to find the time complexity of recurrence?

- A) Stack Method
- B) Queue Method
- C) Recursion Tree Method
- D) Graph Method

Section 2: Short Answer Questions (6 points each, 30 points total)

Instructions: Answer the following questions in 2-3 sentences.

Question 5: Briefly explain the purpose of the inner `while` loop in the provided insertion sort algorithm.

Question 6: What is the significance of using both an upper bound and lower bound when analyzing the time complexity of an algorithm using substitution?

Question 7: Explain what the numbers represent in the initial sequence "48", "49", "50", "51", "52", "53", "54", "55".

Section 3: Problem-Solving Questions (10 points each, 30 points total)

Instructions: Provide detailed solutions for the following problems. Show all steps and clearly explain your reasoning.

Question 8: The first data section consists of many occurrences of "Merging two sorted arrays" followed by a set of repeating numbers. Explain what algorithm this most likely represents.

Question 9: In the Upper bound complexity, we find $-cn + c + n \leq 0$. Explain why we set $n=n_0=1$ when trying to determine if c is less than 0.

Question 10: In the provided content, there are examples of using substitution method to determine time complexity, show each substitution step to find the final time complexity.