PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

Data Structures and Algorithms Exam

Instructions:

Answer all questions to the best of your ability. Show your work for problem-solving questions.

Multiple Choice Questions (4 points each)

Instructions: Choose the best answer for each question.

Question 1: What is the primary purpose of the provided code snippets related to "Merging two sorted arrays"?
A) To demonstrate different sorting algorithms.
B) To illustrate how to merge two unsorted arrays.
C) To merge two pre-sorted arrays into a single sorted array.
D) To show the limitations of array merging techniques.

Question 2: In the Insertion Sort algorithm, what is the purpose of the 'key' variable?
A) To store the index of the element being compared.
B) To temporarily store the element being inserted into the sorted portion.
C) To keep track of the number of comparisons made.
D) To mark the boundary between the sorted and unsorted portions of the array.

Question 3: Based on the provided examples of "Merging two sorted arrays", which of the following is most likely to be the first step in the merging process (assuming ascending order)?
A) Sorting the two arrays individually.
B) Comparing the first elements of each array.
C) Appending the second array to the first.
D) Reversing both arrays.

Question 4: In the Insertion Sort algorithm, the `while` loop condition `i > 0 and A[i] > key` serves to:
A) Iterate through the entire array, swapping adjacent elements.
B) Find the correct position for `key` within the sorted portion of the array.
C) Ensure that the algorithm terminates when the array is sorted.
D) Prevent out-of-bounds access to the array.

Short Answer Questions (6 points each)

Instructions: Answer each question in 2-3 sentences.

Question 5: Explain, in your own words, the general strategy for merging two sorted arrays.

Question 6: Explain how the Insertion Sort algorithm works at a high level.

Question 7: In the given Insertion Sort examples, what is the significance of the `i = i - 1` line within the `while` loop?

Problem-Solving Questions (10 points each)

Instructions: Provide detailed steps and reasoning for each question.

Question 8: Given two sorted arrays: `array1 = [2, 7, 9, 20]` and `array2 = [1, 11, 13]`, manually merge them into a single sorted array, showing each comparison and insertion step.

Question 9: Trace the execution of the Insertion Sort algorithm on the array `[9, 2, 5, 1, 8]`. Show the state of the array after each iteration of the outer loop (the 'j' loop).

Question 10: Assume you have two sorted arrays, `A` with size `m` and `B` with size `n`. What is the time complexity of the most efficient algorithm to merge these arrays into a single sorted array? Explain why.