PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

Algorithms Exam - Medium Difficulty

Instructions: Please answer all questions to the best of your ability.

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

Instructions: Choose the best answer for each question and mark the corresponding letter.

Question 1: Which of the following best describes the purpose of the Bellman-Ford algorithm?
A) To find the shortest path in a graph with only positive edge weights.
B) To sort an array in ascending order.
C) To find the shortest path in a graph that may contain negative edge weights.
D) To merge two sorted arrays.

Question 2: In the given Insertion Sort algorithm, what is the purpose of the 'key' variable?
A) It represents the index of the element being inserted.
B) It temporarily stores the value of the element being inserted.
C) It stores the value of the element being compared against.
D) It represents the length of the array.

Question 3: Consider an array that is already sorted. What is the time complexity of Insertion Sort on this array?
A) $O(n^2)$
B) $O(\log n)$
C) $O(n)$
D) $O(1)$

Question 4: What is the initial distance assigned to all vertices (except the source) in the Bellman-Ford algorithm?
A) 0
B) 1
C) Infinity (∞)
D) -1

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

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

Question 5: Explain the core concept behind the Insertion Sort algorithm and how it sorts an array.

Question 6: Describe the purpose of the 'relaxation' step in the Bellman-Ford algorithm and why it's crucial for finding shortest paths.

Question 7: In the context of merging two sorted arrays, briefly outline the steps involved in efficiently combining them into a single sorted array.

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

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

Question 8: Using the provided Insertion Sort algorithm example, trace the execution of the algorithm for the array [9, 5, 1, 3]. Show the state of the array after each iteration of the outer loop (for j).

Question 9: Explain how the merging sorted array happens given these arrays: Array1 = [1, 2, 7, 9, 11] and Array2 = [12,13,20].

Question 10: Given the following graph with vertices S, A, B, C, D, T and edges as represented in the Bellman-Ford algorithm examples, perform ONE iteration of the Bellman-Ford algorithm. Assume 'S' is the source vertex. Show the updated distance (d[v]) for each vertex after this single iteration. You can assume you go through the vertices in alphabetical order (A, B, C, D, T). You do not need to show the predecessor (P[v]) update. You can use the edge weights defined in the slides. Assume the initial state is similar to slide 263.