

# PRACTICE EXAM

**Difficulty: MEDIUM**

**Questions: 10**

# Algorithm Exam

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

Instructions: Choose the best answer for each question.

**Question 1:** The algorithm illustrated involves the merging of two sorted arrays. Which line shows the two arrays merging and sorting together?

- A) 20 12
- B) 2 1 2
- C) 1 2 7 9 11
- D) 7 9

**Question 2:** In the provided INSERTION-SORT algorithm, what is the purpose of the `key` variable?

- A) To store the index of the element being inserted.
- B) To temporarily hold the value of the element being inserted.
- C) To track the number of iterations performed.
- D) To store the result of a comparison between two elements.

**Question 3:** According to the Bellman-Ford algorithm example, after several iterations, what does  $d[v]$  represent?

- A) The number of vertices in the graph.
- B) The estimated shortest path distance from the source vertex to vertex  $v$ .
- C) The weight of the edge connecting vertex  $u$  to vertex  $v$ .
- D) The predecessor of vertex  $v$  in the shortest path from the source.

**Question 4:** Based on the Bellman-Ford example, what step is performed on relaxed vertices?

- A) They are removed from the graph.
- B) Their adjacent vertices are examined and potentially updated.
- C) Their values are reset to infinity.
- D) They are ignored in subsequent iterations.

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

Instructions: Answer each question in 2-3 sentences.

**Question 5:** Explain how the INSERTION-SORT algorithm works at a high level using the given example code and data.

**Question 6:** What condition must be met in the `while` loop of the INSERTION-SORT algorithm for the algorithm to proceed?

**Question 7:** In the context of the Bellman-Ford algorithm, what does "relaxation" of an edge mean, and why is it important?

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

Instructions: Provide a detailed explanation for each answer.

**Question 8:** Given the initial array `[9, 8, 2, 4, 9, 3, 6]`, walk through the first \*three\* iterations ( $j = 2, 3$ , and 4) of the INSERTION-SORT algorithm as shown in the provided example. Show the state of the array `A` and the values of variables `key` and `i` at the end of each iteration.

**Question 9:** Consider the merging of two sorted arrays `[1, 2, 7, 9, 11]` and `[12, 13, 20]`. Show the steps involved in merging these two arrays into a single sorted array.

**Question 10:** Apply one more relaxation to the Bellman-Ford algorithm example by considering "z" as the selected vertex to relax. Show the updated  $d[v]$  and  $P[v]$  for each vertex that changes.