

PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

Data Structures 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.

Question 1: Which of the following is NOT a basic operation typically associated with sets?

- A) Search (S, k)
- B) Insert (S, x)
- C) Heapify (S)
- D) Minimum (S)

Question 2: In the context of queues, what does "underflow" refer to?

- A) Trying to add an element to a full queue.
- B) Successfully removing an element from the queue.
- C) Trying to remove an element from an empty queue.
- D) When the head pointer equals the tail pointer.

Question 3: Which sorting algorithm has a worst-case time complexity of $O(n \lg n)$ and sorts in place?

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

Question 4: In a heap data structure represented as an array, what is the index of the left child of the node at index $*i$?

- A) $*i / 2$
- B) $*i - 1$
- C) $2 * *i + 1$
- D) $2 * *i$

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

Instructions: Answer each question in 2-3 complete sentences.

Question 5: Explain the difference between "stack overflow" and "stack underflow".

Question 6: Describe the purpose of the `next` and `prev` pointers in a doubly linked list.

Question 7: Briefly describe the primary advantage of using dynamic memory allocation for implementing a stack or queue compared to using a static array.

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

Instructions: Provide a detailed solution for each problem. Show all necessary steps.

Question 8: Using the provided INSERTION-SORT algorithm and the initial array $A = [9, 5, 1, 4, 3]$, trace the changes to the array during the first two iterations ($j = 2$ and $j = 3$) of the `for` loop. Show the values of `key`, `i`, and the array `A` after each step within the loop.

Question 9: Given the following sequence of numbers that are to be merged as efficiently as possible: 20, 12, 13, 11, 7, 9, 2, 1. Describe how you would go about merging these arrays and how the algorithm determines the most efficient method.

Question 10: Write pseudocode for a function `isEmpty(Q)` that checks if a queue `Q` is empty, assuming the queue is implemented using an array and has `head[Q]` and `tail[Q]` attributes to keep track of the front and rear of the queue, and a `length[Q]` attribute to record the maximum size of the queue. Your function should return `TRUE` if the queue is empty and `FALSE` otherwise.