



COMSATS UNIVERSITY ISLAMABAD
DEPARTMENT OF COMPUTER SCIENCE
Mid Term Examination, Fall 2023

Class/Section: -BSCS - 5A/B, BDS-5, BCT-5, BAI-5
Subject: -Design and Analysis of Algorithm
Instructor: -Tanveer Ahmed /Dr. Qurat ul Ain

Marks:- 25
Time:- 80 minutes
Dated:- November 7, 2023

- Students are required to display their ID cards.
- Attempt all questions. Return this question paper with your answer sheet.
- Use of Mobile Phones and Digital Diaries not allowed

CLO-1: Demonstrate fundamental concepts of algorithm along with an algorithmic approach to a given problem.

Question # 01: ----- **CLO-1** ----- **Marks = [5]**

a) Trace the following algorithm for the input [2,5,7,9,11] and describe what this algorithm computes.

ALGORITHM Something (A [1...n])

// Input: An array A[n] of n ($n \geq 2$) numbers in increasing order.

// Output:

1. $m \leftarrow (A[1] + A[n])/2$
2. $i \leftarrow 1$
3. **while** ($A[i] < m$) **do**
4. $i \leftarrow i + 1$
5. **if** ($(A[i] - A[1]) < (A[n] - A[i-1])$) **then**
6. **return** A[i]
7. **else return** A[i-1]

CLO-2: Design new algorithms for different computational problems

Question # 02: ----- **CLO-2** ----- **Marks = [5]**

Consider the problem of counting, in a given text, the number of substrings that start with an A and end with a B. For example, there are four such substrings in CABAAXBYA. Design an algorithm for this problem using Brute-Force approach.

CLO-4 Analyze best, average, and worst-case behaviors of an algorithm.

Question # 03: ----- **CLO-4** ----- **Marks = [5*3=15]**

- a) Let $C_{BubbleSort}(n)$ and $C_{InsertionSort}(n)$ denotes the time complexities of Bubble sort and Insertion sort respectively. Determine how the number of comparisons used in the **best case**, **average case**, and **worst case** changes when the size of the list to be sorted doubles from n to $2n$, where n is a positive integer. Justify your answer.
- b) Suppose there are two algorithms A and B that solve the same computational problem P. The time complexity function of Algorithm A is $f_A(n) = n^2 + 4n$ whereas $g_B(n) = 29n + 3$ be the time complexity function of Algorithm B in the worst case, for inputs of size n . For what input sizes is Algorithm A faster than Algorithm B (in worst case).