FAST

National University of Computer & Emerging Sciences, Karachi

Fall-2021 CS-Department

Midterm I

October 11, 2021 Slot: 11 AM – 12 PM

Course Code: CS 2001	**Course Name: Data Structures**
Instructor Name:	**Muhammad Rafi / Dr. Ali Raza/Shahbaz/ M Sohail/ Mubashra Fayyaz**
Student Roll No:	**Section No:**

- Return the question paper.
- Read each question completely before answering it. There are **4 questions and 2 pages.**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict with any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- Be specific, to the point while coding, logic should be properly commented, and illustrate with diagram where necessary.

Time: 60 minutes. **Max Marks:** 40 points

Object Oriented Programming

Question No. 1 **[Time: 10 Min] [Marks: 10]**

Consider the class definition provide below:

```
class CharBuffer{
   private:
     char *Buffer;
     int size;
   public:
     CharBuffer();
     CharBuffer(int s);
     CharBuffer(const CharBuffer & rhs);
     CharBuffer* operator=(const CharBuffer & rhs); //?
     ~CharBuffer(); // ?
     void addBuffer(char * newBuffer); //?
     void removeBuffer(int n_size); // ?
};
```

You are required to provide the implementation details for the functions comments with the "//?" pattern. The function addBuffer add char stream at the right hand of the Buffer and removeBuffer remove n_size character from the left side of the Buffer.

Recursion	
Question No. 2	**[Time: 15 Min] [Marks: 10]**

a. What are the two important things one has to remember when designing a recursive solution? Is there any advantage of using recursion? [5]
b. Write a recursive function that returns the sum of the digits of a positive integer. For example: SumOfDigits(int x) when x=123 will return 1+2+3=6. [5]

Dynamic Safe Arrays & Variants	
Question No. 3	**[Time: 15 Min] [Marks: 10]**

A two dimensional array of characters can be considered as a field. Each cell is either water 'W' or a tree 'T'. A forest is a collection of connected trees. Two trees are connected if they share a side i.e. if they are adjacent to each other with respect to any of the four sides. Given the information about the field, write a function which inputs this 2-D array and returns the size of the largest forest, where size of a forest is the number of trees in it. Please see the sample case for clarity:

Sample Input:

5 TTTWW TWWTT TWWTT TWTTT WWTTT	First line contains the size of the matrix N. The next N lines contain N characters each, either 'W' or 'T'.

Sample Output: 10

Linked List and Variants	
Question No. 4	**[Time: 15 Min] [Marks: 10]**

a. A SinglyLinkedList in its vanilla implementation contains a loop. Write a function which return a Boolean value(True) if the list contains a loop or (False) otherwise. [5]
b. Write an efficient function that decides whether the list contains even number of nodes or odd number of nodes. [5]