National University of Computer and Emerging Sciences, Karachi
Lab Final Exam
Fall 2023

Course Code: CL1002
Course Name: Programming Fundamental Lab
Instructor(s): Syed Farooq Zaidi, Syeda Mahnoor Javed, M. Nouman Hanif, Ali Haider
Date: Dec 12th, 2023
Time: 2 hours (1:30 PM to 3:30 PM)
Total Marks: 50
Section: BA7 1A

INSTRUCTIONS:

1. Carefully read the following instructions before attempting the paper.

2. Except your Roll No and Section, DO NOT WRITE anything on this paper.

3. The exam consists of 3 questions on 2 printed sides of 1 page.

4. In case of any ambiguity, you may make assumptions, but your assumption must not contradict any question.

SUBMISSION INSTRUCTIONS:

1. You must comment your student ID on top of each file.

2. Name the .c file for each question according to Roll_No, e.g., k23xxxxQ1.c, k23xxxxQ2.c, etc.

3. Create a folder with the name K23XXX according to your student ID.

4. Put all your .c files (1 for each question) in the above folder. Then paste this folder on the local share.

5. Create a shortcut on local storage that can be accessed using win+R keys and entering \\172.16.5.43.

QUESTION 1: FILING AND FUNCTIONS

(LLO: 4, TIME: 30 MINS, POINTS: 15)

You are developing a C program that performs matrix operations on a text file. Your task is to implement the two functions as follows:

1. **Matrix Multiply:** Given the 2 matrices and their dimensions, calculate and multiply them and return the resultant matrix.

2. **Sum Matrix:** Given 2 matrices, if their dimensions are the same, return their sum.

Your C program must read from the text file named input.txt and write back the product and sum of the matrices in output.txt. Print the sum and product on the console as well. You must select the function name and signature carefully and decide what will be their return type and how many arguments they must receive.

- **Input File Example:**

- 3 3

- 11 12 13

- 21 22 23

- 31 32 33

- 2 2

- 41 42

- 51 52

- 61 63

- **Output File Example:**

- Product

- 1022 1052

- 1547 1597

- 2072 2132

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- Sum

- Cannot be computed

QUESTION 2: STRUCTURES

(LLO: 4, TIME: 40 MINS, POINTS: 15)

Define a structure Point with members x and y representing the coordinates of a point in a 2D plane. Define another structure Line with members start and end, each of type Point, representing the start and end points of a line segment. Now define structures for circle, triangle, and parallelogram. Your program must take input from the user on the console (as shown in the example) and print the details of each shape, area, and perimeter. For parallelogram, also mention whether it is a rectangle, square, or neither. For triangles, also mention if it is right-angled, isosceles, or equilateral triangle.

- Hint:
  - Distance between two points =
  $$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
  - Area of triangle =
  $$\frac{1}{2} \times |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

- **Input Sample:**

- Enter Number of Shapes: 3

- Enter Shapes:

- C 2 3 6

- T 0 0 4 5 4 0

- T 0 0 6 0 3 5 2

- **Output Sample:**

- Shape 1: Circle, Radius: 6

- Area: 113.097 square units, Perimeter: 37.699 units

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- Shape 2: Triangle

- Area: 32 square units, Perimeter: 24 units

- Right-angled: NO, Isosceles: NO, Equilateral: NO

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- Shape 3: Triangle

- Area: 15.6 square units, Perimeter: 18 units

- Right-angled: NO, Isosceles: YES, Equilateral: NO

QUESTION 3: DMA AND POINTERS

(LLO: 3, TIME: 50 MINS, POINTS: 20)

Write a C program that takes a list of positive integers from the user until -1 is entered. For each positive integer, compute its Collatz Conjecture sequence and print the sequence. You are required to implement a function with the following signature:

int* collatzSequence(int input);

- **Function Details:**
  The function collatzSequence receives an input positive integer and returns a pointer (int*) that stores the Collatz Conjecture sequence for the number. The returned sequence must end with 1 to indicate termination.

Your program should take input until -1 is entered and print the Collatz Conjecture sequence for each positive number entered by the user.

  - **Function Logic:**

    - If the current number n is even, divide it by 2: $(n/2)(n / 2)$.

    - If the current number n is odd, multiply it by 3 and add 1: $(3n+1)(3n + 1)$.

The Collatz function is applied repeatedly to the result obtained from the previous iteration until the sequence reaches the value 1.

- **Input Sample:**

- 20

- 13

- 40

- -1

- **Output Sample:**

- 20 -> 10 -> 5 -> 16 -> 8 -> 4 -> 2 -> 1

- 13 -> 40 -> 20 -> 10 -> 5 -> 16 -> 8 -> 4 -> 2 -> 1

- 40 -> 20 -> 10 -> 5 -> 16 -> 8 -> 4 -> 2 -> 1