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: 12ᵗʰ Dec 2023   Total Time: 2 hours (1:30pm to 3:30pm)   Total Marks: 50
Student ID: Section

INSTRUCTIONS:

- Carefully read the following instructions before attempting the paper.
- Except your Roll No and Section, DO NOT WRITE anything on this paper.
- The Exam consists of 3 questions on 2 printed sides of 1 page.
- In case of any ambiguity, you may make assumptions, but your assumption must not contradict any question.

SUBMISSION INSTRUCTIONS:

- You must comment your student ID on top of each file.
- Name the .c file for each question according to Roll_No e.g. k23xxxxQ1.c, k23xxxxQ2.c etc.
- Create a folder with the name K23XXXX accroding to your student id.
- Put all your C files (1 for each question) in the above folder. Then paste this folder on the local share.
- Submissions are 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 to perform tasks listed below on the text file.

1. **Matrix Multiply:** Given the 2 matrices and their dimensions check their dimensions for compatibility and multiply them and return the resultant matrix.
2. **Sum Matrix:** Given 2 matrices if their dimensions are 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** file. 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. First line is the size of first matrix. After the first matrix the next line is the size of second matrix.

INPUT FILE

```
3, 3
11 12 13
21 22 23
31 32 33
3, 2
41 42
51 52
61 63
```

OUTPUT FILE

```
Product
1022 1052
1547 1597
2072 2132
Sum
Can not 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 console (as shown in example) and print the details of each shape, area and perimeter. For parallelogram also mention whether it is a rectangle, square or neither. For triangle aslo mention, if it is right angled, isocles or equivalateral triangle.

Hint: Distance between two points $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$, $\quad$ Area of circle $= \pi r^2$

Area of triangle $= \frac{1}{2}|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$

Input Sample	Output Sample
Enter Number of Shapes: 3 Enter Shapes: C 2 3 6 T 0 4 0 -4 5 4 T 0 0 6 0 3 5.2	Shape 1: Circle, Radius: 6 Area: 113.097 square units, Perimeter: 37.699 units Shape 2: Triangle Area: 32 square units, Perimeter: 24 units right-angled: NO, isosceles: NO, equilateral: NO Shape 3: Triangle Area: 15.6 square units Perimeter: 18 units right-angled: NO, isosceles: YES, equilateral: YES

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);
```

The function collatzSequence receives an input positive integers 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.

Input Sample	Output Sample
20 13 40 -1	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

The collatzSequence function will handle the calculation of the sequence for each number and return a pointer to pointers, each representing a sequence. It will terminate each sequence with -1 to indicate the end of the sequence.

The function is defined as:

```
If the current number n is even, divide it by 2: (n / 2).
If the current number n is odd, multiply it by 3 and add 1: (3n + 1).
```

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