Alexandria University
Faculty of Engineering
Computer and Systems Engineering Department


CS121: Computer Programming 1
Assigned: Saturday, November 30th, 2024
Due: Saturday, December 14th, 2024

# Lab 6
# Structs - Revision

## Lab Objectives

1. Getting Familiar with C programming language.
2. Practice Structs, revisit some previous topics.

## Problem Set

***1. Rational Numbers***

A rational number consists of a numerator and a denominator. You should write a program that supports the following operations on rational numbers:

1. Addition
2. Subtraction
3. Multiplication
4. Division

In this problem, you're required to take as input two rational numbers, and the required operation. The output should print the expression being evaluated along with its result.

**Notes:**

- Each rational number should be in the reduced form (i.e: divide both numerator and denominator by their greatest common divisor (GCD)).
- GCD is the greatest number that exactly divides two or more numbers with no remainder.
  For example, the factors of the number 12 are: 1, 2, 3, 4, 6, 12 and the factors of the number 30 are: 1, 2, 3, 5, 6, 10, 15, 30. So the GCD of 12 and 30 is 6.
  Implement a function to get the gcd of 2 integers and use it at the end of each operation.
- You are required to write a function for each of the above five operations.
- You are required to use structures to make a new data type called "Fraction", which contains 2 integers: numerator and denominator. You can read it with "%d/%d"

- The four functions should have the following prototypes:
  - Fraction add(Fraction num1, Fraction num2);
  - Fraction subtract(Fraction num1, Fraction num2);
  - Fraction multiply(Fraction num1, Fraction num2);
  - Fraction divide(Fraction num1, Fraction num2);

2. ***Circular Right Shift***

Shift array of size n to the right k places. integers that are shifted to the right are added back to the array from the left.

**Input Format**

first line contains two integers n & k
second line contains n integers

**Example:**

Sample Input

3 1
1 2 3

Sample Output

3 1 2

3. ***BigInteger Multiplication***

Given two positive numbers x and y multiply them. You should solve this problem using functions.

**Input Format :**

First line contains integer n
Second line contains integer x which consists of n digits
Third line contains integer m
Fourth line contains integer y which consists of m digits

**Constraints :**

$1 \leq n, m \leq 1000$
each digit d is $0 \leq d \leq 9$. Most significant digit is not 0 (except for 0).

**Output Format :**

x * y without any leading zeros (except for 0)

**Sample Input :**

10
1234554321
10
5432112345

**Sample Output :**
6706237767677192745
**Explanation :**
1234554321 X 5432112345 = 6706237767677192745

4. ***Bonus - Swapping Variables***
   Swapping two integers is a trivial task using a third one.
   Can you swap A, B using xor without another variable?

5. ***Bonus - Time***
   Write the following function assuming that you have a time structure that contains three members: hours, minutes and seconds (all of type int).

   **time split time(long long total seconds);**

   total seconds is a time represented as the number of seconds since midnight. The function should return a structure containing the equivalent time in hours (0-23), minutes (0-59), and seconds (0-59).

## NOTES

1. You are encouraged to ask any questions on MS teams, or in person.
2. Cheating will be severely penalized (for both parties). So, it is better to deliver nothing than deliver a copy!.
3. You are not allowed to use any AI Tool.
4. Submission details will be announced on MS Teams.

**Good Luck**