Problem solving Boot Camp

Note!!! all problems solution required in python, please try to solve the problems on your own as the purpose is to sharpen your skills for upcoming challenges for becoming a better developer.

1. Write a python program that takes a number of apples as input and tells the user how many dozens of apples he/she has and how many extra apples are left over. For example: if the number of apples = 50, the output should be: "4 dozens and 2 apples". (Note that, a dozen of something means 12 items of that thing.)

2. Write a program to evaluate each of the following expressions: (all parameters should be taken as input from the user).

$$(c) \quad \frac{a + \frac{b}{c}}{d + \frac{e}{f+g}}$$

$$(d) \quad (sin(x + y))^2$$

4 Problem 3 - Leap Year

A year with 366 days is called a leap year. A year is considered a leap year if it is divisible by 4 (for example, the year 1980), except it is not a leap year if it is divisible by 100 (for example, the year 1900); however, it is a leap year if it is divisible by 400 (for example, the year 2000). Write a program that asks the user for a year and computes whether that year is a leap year or not.

Note: You are **required** to draw and deliver a flaw chart for this problem.

2 Problem 1 - Factorial

Given an integer n (≤ 12), your program should calculate and print factorial n ($n!$).

3 Problem 2 - Prime

Given an integer n, your program should test whether it is a prime number or not.

4 Problem 3 - sin(x)

The sine of x can be calculated approximately by summing the first N terms of the infinite series:

$$sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + ... \text{ (}x \text{ in radians)}$$

Write a program that will read in a value for x (in degrees) and then calculate its sine by summing the first N terms, where N represents a positive integer that is read along with the value of x.

5 Problem 4 - 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 Outpu
3 1 2

2 Problem 1 - Matrix Transpose

Given matrix of dimension nxm find it's transpose, where $1 \leq n, m \leq 1000$.

3 Problem 2 - The Merge Of Sorted Arrays

Given two sorted arrays, merge them in a single sorted array, then print this array, where $0 \leq n, m \leq 100000$.

6 Problem 5 - The Greatest Common Divisor

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.
Write a C program that scans two numbers a, b ($0 \leq a, b \leq 1000$) and calculates their GCD.

6 Problem 5 - Union and Intersection

Given two arrays of integers, print the union array and the intersection array.
Notes:

- Assume that the input arrays **will consist** of duplicates.

- Your program should read the input arrays from the user.

- You can assume that the input arrays will have a size ≤ 20.

- You should eliminate the duplicates from the output.

For example:

If the input was:

- 8

- 12 32 14 35 89 16 120 14

- 9

- 9 9 12 8 17 120 35 12 36

Your output should look like:

- Array1: 12, 32, 14, 35, 89, 16, 120

- Array2: 9, 12, 8, 17, 120, 35, 36

- Union: 12, 32, 14, 35, 89, 16, 120, 9, 8, 17, 36

- Intersection: 12, 35, 120

2   Problem 1 - Max Row at the Top

Write a C program that given a two-dimensional array, reorders the rows such that the row with the highest row sum is the first row. The program should read N and M which are the number of rows and columns respectively. You can assume that $1 \le n, m, \le 20$. Then it will read in NxM integers that form the array. It should search for the row with the maximum sum and swap it with the first row.

If the program will be called with the following array
1 3 5 1
2 50 9 9
2 2 3 4

The output should be
2 50 9 9
1 3 5 1
2 2 3 4

3   Problem 2 - Matrix Multiplication

In this problem you are required to write a program to reads 2 matrices (of dimensions N x M and M x L), multiplies them and displays the output.

For example: $\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$ X $\begin{pmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{pmatrix}$ = $\begin{pmatrix} 58 & 64 \\ 139 & 154 \end{pmatrix}$

Your program should print both the input matrices and the multiplication result in any appropriate format.

7   [BONUS] Problem 6 - Convert to Base n

Write a program that uses a recursive method to convert an integer from base 10 to another base. Your program should read the integer and the base as inputs. The recursive function should **print** the number in the new base. So, if the inputs were:
number = 13, base = 2, then the output should be: 1101

Note: Supporting up to base 10 will get you half the bonus grade. Supporting higher bases will get you the full mark of the bonus.

6 Problem 5 - Circular Right Shift Subarray

Given array A of size n, we say that elements of A[i.....j] form a subarray. Your task is to perform circular right shift queries on subarrays of A . A circular right shift can be performed by reversing the array multiple times.

If we want to shif subarray A[i....j] to the right by k places, we can do that by calling a function that reverses a subarray.

Input Format :
first line contains n, size of the array
second line contains n integers of the array
third line contains q, number of queries
the next q lines each of them contains three integers
l, left index of the subarray
r, right index of the subarray
k, the number of elements to shift

Constraints :
$1 \leq n \leq 1000000$
$1 \leq q \leq 1000$
$1 \leq r - l + 1 \leq 1000$
k is non negative integer
no constraints on values of the array

Output Format :
print the array after performing all the queires

Sample Input :
5
1 2 3 4 5
2
0 1 1
2 4 10

Sample Output :
2 1 5 3 4

Explanation :
first query shifts subarray A[0..1] to the right by by 1
second query shifts subarray A[2...4] to the right by 10

4 Problem 3 - Sum of Digits

Write a recursive function to calculate and return the sum of digits of a given number.

7 Problem 6 - 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
first line contains integer m
second 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

2 Problem 1 - Fibonacci (Revisited)

Write a recursive program that calculates the nth term of Fibonacci series. Compare it with the iterative version.
Which one is faster? Why is that?