Exercise Activity – Fall 2024 Midterm (10/2/2024)

First Last Name:_____
ID:_____
Lab Section: _____

Add comments to explain your code. Choose 3 out of 4 questions. If you do all, we'll grade 3 plus the bonus. You can tear the front page, but be sure to write your name/ID on the second page.

Q1 : Write a C program that reads words from a file and counts how many words there are for each length. Display counts for word lengths up to 5 characters, and group all words of 6 characters or more into one category. **(**33.33points**)**

Input File (words.txt):
C programming is fun
Data structures are important

Output File (word_lengths.txt)
Word length counts:
1 letter: 1
2 letter: 1
3 letters: 2
4 letter: 1
5 letters: 0
6+ letters: 4

Q2: Read data from input.txt, which includes students' names, lab sections, and final grades. Extract the data for Lab 1 and Lab 2, sort the grades in ascending order, and save the results to **two output files named sortedlab1.txt and sortedlab2.txt, including header text line. (**33.33 points**)**

Input file:
stu1 lab1 88.5
stu2 lab2 66.5
stu3 lab1 76.2
stu4 lab1 90.3
stu5 lab2 76.2
stu6 lab1 70.3

Output file:
Sorted the ESE 124 grade on Lab1:
stu6 70.3
stu3 76.2
stu1 88.5
stu4 90.3

Sorted the ESE 124 grade on Lab2:
stu2 66.5
stu5 76.2

Q3 Write a C program to merge two 1D arrays into a third array that includes duplicates, **ordered by the number of duplicates**. If two numbers have the same count, sort them in ascending order.(33.33 points)

Input example:
First array: 7 7 7 6 6 5 4
Second array: 2 2 2 3 3 4 5 5 5 5 6 7

Expected output:
Merged array: [5, 7, 2, 6, 3, 4]

Explanation:
5 appears 5 times
7 appears 4 times
2 appears 3 times
6 appears 3 times
3 appears 2 times
4 appears 1 time

Q4: Design a C program to compute and display compute sin (x). The computation ends when the precision of the terms drops below a (epsilon: ε), where the value a (epsilon: ε) is input from the keyboard. **Calculate the sum of the values of the three smallest consecutive terms in a sequence and approximate the sin(x) value** (33.33 points).

$$\sin(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1)!} x^{2k+1} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots, \qquad x \in \mathbb{R};$$

Bonus Question (No partial points for this):Data is stored in an 8-bit variable called par. Bits [7-3] represent the data, and bits [2-0] represent the checksum. For example, in 11010011, the sum of bits from 3 to 7 is 3 (1+1+0+1+0). Write a program to verify the checksum. (10 points)

Steps:

Isolate bits [7-3] (e.g., 11010).
Isolate bits [2-0] (e.g., 011) and calculate the sum.
Use a loop to calculate the checksum of bits [7-3].

Verify using bitwise operators.

Data bits [7:3]: 11010
Provided checksum [2:0]: 011
Calculated checksum: 3
Checksum valid: Yes