

## COMP 2004

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### Assignment 1 - Introduction to C

1. (10%) Modular Arithmetic — For a positive fixed integer  $n$ , we define  $a \bmod n$  as the remainder of  $a$  when divided by  $n$ . Note that  $a \bmod n$  always yields a number less than  $n$ . C language uses `%` to denote mod, i.e.  $a \% b$  means  $a \bmod b$ . Create a program that runs four loops, separating outputs by a blank line. The loops should start in  $i=0$  until 100 and print all values  $i \bmod n$  where  $n$  equals 5, 10, 27 or 100.

For example, the loop for  $n=5$  will look like this:

```
for(i = 0; i < 100; i = i + 1)
    printf("%d, ", i%5);
```

Output (partial):

0, 1, 2, 3, 4, 0, 1, 2, 3, 4, 0, 1, 2, 3, 4, 0, ...

Write the other loops for  $n$  equals 10, 27 and 100.

2. (40%) Multiplication — We can also define a multiplication table modulo  $n$  in the following way:

For a given fixed integer  $n$  and any  $a, b \in \mathbb{Z}_n$ , ( $a, b < n$ )

$$(a \bmod n) \times (b \bmod n) = (a \times b) \bmod n$$

This allows us to define arithmetic “modulo  $n$ ” by  $a \times b \pmod n = (a \times b) \bmod n$ .

Example: Let  $n = 5$ .

$3 \times 1 = 3 \bmod 5$ ,  $3 \times 2 = 1 \bmod 5$ ,  $3 \times 3 = 4 \bmod 5$ , etc.

Write a program that generates the multiplication table modulo  $n$  of a given integer  $n$  provided as a command line parameter to the program.

For example running: `./a1q2 5`

Output:

Multiplication table for  $\mathbb{Z}_5$ :

0	1	2	3	4
0	0	0	0	0
1	0	1	2	3
2	0	2	4	1
3	0	3	1	4
4	0	4	3	2

Note that **the argument n for this program must be provided as a command-line parameter**. This means you must use parameters in the main function. You also need to notify the user if no parameter is passed.

3. (50%) Write a program that reads from a file located in the same folder a series of data points as integers, one each line. The program should calculate statistical values of the list in the file. The file will be called "sensor.csv" and a sample will be provided with the assignment instructions. Your code should be correct with **any number of data points** (i.e. **any file size**).

The output will be the number of data points (count), sum, mean, variance and standard deviation.

For example, for the accompanying input file "sensor.csv" with the following lines:

```
0
5
7
4
1
```

The expected output is:

```
Count: 5
Sum: 17
Mean: 3.400000
Variance: 6.640000
Standard Deviation: 2.576820
```