Tutorial Sheet 4

Exercise 1

Compare the stack frame usage between the iterative and recursive definitions of the factorial function in the following code:

```
// Iterative function
long fact(int n) {
    long ans;
    for (ans = 1; n > 1; n--)
        ans *= n;
    return ans;
}
// Recursive function
long rfact(int n) {
    long ans;
    if (n > 0)
        ans = n * rfact(n - 1);
    else
        ans = 1;
    return ans;
}
```

Exercise 2

Implement iterative and recursive versions of the Fibonacci sequence, and compare:

- **Readability of the implementation.**
- **Stack frame usage.**

The Fibonacci sequence is a series of numbers where each number is the sum of the two preceding ones. It starts with 0 and 1. Mathematically, it is defined as:

- **F(0) = 0**
- **F(1) = 1**
- **F(n) = F(n - 1) + F(n - 2)** for **n > 1**

Exercise 3

Repeat Exercise 2, but this time implement iterative and recursive versions to compute the greatest common divisor (GCD) of two integers where x > y, and compare:

- **Readability of the implementation.**
- **Stack frame usage.**

The greatest common divisor (GCD) of two integers x and y is the largest positive integer that divides both numbers without leaving a remainder. It can be calculated using Euclid's algorithm:

- **If y == 0, then GCD(x, y) = x**
- **Else, GCD(x, y) = GCD(y, x % y)**

Exercise 4

Implement the following functions using recursion:

1. **A function that converts a decimal number into its base 16 (hexadecimal) representation.**
2. **A function that reverses a character string.**

Exercise 5

Write a function that expects a string with no numeric characters as input (passed by reference), and outputs the:

- **Input validity.**
- **Input length.**
- **Input's first character.**
- **Input's most frequent character.**

Finally, test the function inside a program that accepts a sequence of strings from an input stream.

Hint: Refer to `scanf()` to see how strings are passed by reference.

Exercise 6

Use functions from `<math.h>` to write two functions that transform the real number `x` in-place (pass-by-reference) to:

- `ceil(x)`
- `floor(x)`

In addition, also attempt the above without resorting to `<math.h>` functions.

Exercise 7

Write a program that exposes all of this lab's functions within a user menu. Structure the program's source code across multiple files.