Exercise 1 [Recursion]
Recursion is an element of computer programming, which is needed in some cases to achieve particular goals and, therefore, it is useful to understand how it works. In this exercise, we will choose to use recursion in a case where it is not really needed, but it is straightforward to use. Typically, recursion is used in functions and the main idea is to write a function which calls itself. Clearly, to avoid an endless recursion, a stop condition is required and it usually consists of an if-clause at the beginning of the function body.

(i) Implement a recursive function that, given a number $N$, returns $N!$. Use unsigned int variables for input and output types.

(ii) Implement a second version of your factorial function using unsigned long int variables.

(iii) Using the two implemented functions, figure out which is the largest value of $N$ as unsigned int for which the factorial is correctly evaluated without overflow problems.

(iv) Implement a

\[ \text{unsigned int BinomialCoefficient(const unsigned int n, const unsigned int k);} \]

function, which calculates

\[
\binom{n}{k} = \frac{n!}{k! \cdot (n-k)!}.
\]

(v) How large can be $n$ in order to obtain correct results for any $0 \leq k \leq n$? Is the condition found in item (iii) still valid? Are you able to provide a smarter implementation to calculate correctly, for example,

\[
\binom{30}{15} = 155117520?
\]

Exercise 2 [Basic exam-like questions]

(i) Which is the difference between an int variable and an unsigned int one?

(ii) Which is the difference between a float variable and a double one?

(iii) Suppose to have declared the variables int a; unsigned int b; float x; char c;. Write four assignment statements to initialize a, b, x and c to the following four values

\[
'a' \quad -3 \quad 5.68 \quad 1
\]

in a way such that no modification of the assigned value occurs.

(iv) What is a cast? Give an example.

(v) Given the assignment double x = 1/4; , which value is stored into x? How would you modify the code in order to have 0.25 stored into x?