Einführung in die Programmierung für Physiker

WS 2017/2018 – Marc Wagner

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Exercise sheet 10

To be corrected in tutorials in the week from 15/01/2018 to 19/01/2018

Exercise 1 [*Recursion*]

Recursion is an element of computer programming, which is needed in some case 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

```
unsigned int BinomialCoefficient(const unsigned int n, const unsigned int k);
```

function, which calculates

$$\binom{n}{k} = \frac{n!}{k!\,(n-k)!} \quad .$$

(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,

$$\binom{30}{15} = 155\,117\,520 \ ?$$

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'        -3        5.68        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`?