

# Programming Exercise 5

Due Date and Time: 27. April 2009, 23:59

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You should work out the exercises independantly. Group cooperation is not allowed. Submit the sensibly documented program files. (Files for Bsp. 5: `bsp_5.cpp`, `bsp_5_fkt.cpp`, `bsp_5_fkt.hpp` ) Copy these to your directory in the global submission folder.

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14. Write the calculation fo the Taylor series from problem 10 (exercise 4) as a function so that this function may be called from a main program with the example usage (1 Pkt.)

```
cout << "Taylorapprox:  << ln_taylor(x,n)" << endl;
```

(You may choose the name and list of parameters).

Hint: Define and declare your function outside of the main program, but in the same file. See as an example § 7.3<sup>1</sup>.

You may not use input or output commands (such as `cin` or `cout`). That is to say that all necessary values should be transferred via the parameter list and return value.

Global variables may not be used here, nor may they be used in subsequent exercises.

*Test data*  $(x, n)$ : (1.9, 16), (0.01,1000), (0.01,10)

15. Analogous to problem 6 (Exercise 2).  
Write a function which computes the sum, arithmetic, geometric, and harmonic mean from 3 natural numbers and returns them to the program which calls it. (2 Pkt.)

The 3 natural numbers should additionally be ordered *in place* in ascending order and returned to the main program which calls your function. (This means that the original variables will be overwritten upon return.)

Hint: As with problem 14.

*input data*  $(n_1, n_2, n_3)$ : (16, 4, 1), (3, 5, 8)

16. We want to play Lotto and would like to determine the possible combinations of choosing  $k$  typed numbers from  $n$  numbers. The number of combinations is given by the binomial coefficient (2 Pkt.)

$$C_n^{(k)} = \binom{n}{k} = \frac{n!}{k!(n-k)!} \quad (1)$$

- Write a function `binom` to compute the above binomial coefficients (you may choose the function name).
- Notice that the factorial  $n!$  is not available in C++. There are (at least) two possible methods with which to remedy this shortcoming.

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<sup>1</sup><http://www.uni-graz.at/~haasegu/Lectures/Kurs-C/Script/html/node73.html>

- Return the number of possible combinations for the input data and compare your results with data on the Internet (See *Euromillionen*<sup>2</sup> )

*Input data*  $(n, k)$ : (45, 6), (50, 5), (9, 2), (6, 90)

17. We play Lotto further and want to know how large is the probability given a lottery ticket with  $k$  printed numbers out of  $n$  numbers, that  $r$  numbers are correct and  $z$  bonus numbers are correctly chosen. (We additionally assume that there is only one bonus number.). The corresponding formula for the probability is

$$p = \frac{\binom{k}{r} \binom{1}{z} \binom{n-k-1}{k-r-z}}{\binom{n}{k}} \quad (2) \quad (2 \text{ Pkt.})$$

and this should be implemented as a function. (Functions from problem 16 may be utilized).

Generate an “overview” of the probability for the input data, such that you have the  $r$ -numbers and  $z$ -numbers correct with  $r \in [0, k]$  and  $z \in [0, 1]$ . Compare also with *second Table §6.1*<sup>3</sup>

*Input data*  $(n, k)$ : (49, 6), (20, 4), (10, 2)

general tip:

Look at the following C++-functionality and use the following, should they be needed: `for`, `while`, `do`, `fabs`<sup>4</sup>, `string`, `cout.width`, `setw`

The commands `break`, `continue`, `goto` are **not permitted**.

Submission of solutions:

The submission of the solutions (as `*.cpp`-Files, `*.hpp`, ..., **no exe**-Files) may be carried out exclusively by copying these files in your directory (initially created as) `Lastname_Firstname` into the global submission folder `y: \\pers.ad.uni-graz.at\fs\ou\621\stud_haase>Lastname_Firstname` .

Instructions on how to do this can be found at: LV-Homepage<sup>5</sup>

The file names **must** follow the format `bsp_nummer`, with the corresponding file extension. For example, with Beispiel 1 (example 1) the file `bsp_1.cpp` would be submitted. Files with names which deviate from this formula will not be considered as submitted files.

<sup>2</sup><http://www.professionelle-lottosysteme.ch/wahrscheinlichkeit.html>

<sup>3</sup><http://de.wikipedia.org/wiki/Lotto>

<sup>4</sup><http://www.cplusplus.com/reference/clibrary/cmath/fabs.html>

<sup>5</sup><http://www.uni-graz.at/~haasegu/Lectures/Kurs-C/SS08/index.html>