Simple exercises in C++

1. Write a program which reads a number, n, and then n numbers of type double, i.e., input data are

   $$n \quad x_1 \quad x_2 \quad x_3 \quad \ldots \quad x_n$$

   The program should write out the average of the positive x-values. If the number of positive values is less than 1, the text "too few numbers" should be written.

2. Write a program which reads 10 numbers, and computes the harmonic average,

   $$\frac{1}{H} = \frac{1}{10} \sum_{i=1}^{10} \frac{1}{a_i},$$

   for these numbers.

3. Write a function which converts an uppercase letter 'A'–'Z' to the corresponding lowercase lettter. If the parameter is not a letter it must be returned unchanged. Write a main program which calls the function.

4. Write a function which computes the binomial coefficient

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

   Write a main program which calls the function. Try to make the function work for as big n as possible.

5. Write a function which prints a positive integer in binary representation. Do not use arrays. Write a main program which calls the function.

6. Read 20 lines, where each line consists of a letter A–F and an amount.

   A 100
   B 350
   F 6000
   A 93
   .....

   Write a program which reads the lines and writes the total sum for each letter.

7. When solving a linear system of equations by LU-factorization, a substep is to solve a lower triangular system $Ly = d$. Example:

   $$\begin{pmatrix} 1.0 & 0 & 0 \\ 0.5 & 1.0 & 0 \\ 2.0 & 1.5 & 1.0 \end{pmatrix} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} 1 \\ 1.5 \\ 2.5 \end{pmatrix}$$

   Write in C++ a function which given a matrix L and a vector d, computes the solution y of the lower triangular system $Ly = d$.

8. Write a C++ program which reads a string, less than 10 characters long. This string represents an integer expressed in roman numbers. Let a function convert the number from roman to arabic form (i.e., our standard digits). Let then the main program write out both forms. The roman numbers are written according to: M = 1000, D = 500, C =100, L=50, X=10, V=5, I=1.

Examples:

LXXXVII = 87
CCXIX = 219
MCCCLIV = 1354
MMDCLXXIII = 2673

Note the difficulty when the numbers 4 and 9 are involved. This difficulty occurs also for higher numbers, e.g., MIC = 1099. Try to solve the problem for a case which is as general as possible.