

Introduction to programming (NF05A)
— **exercices** 2020-2021 —

Université de technologie de Troyes

Tutorial 2

The following exercises must be implemented in functions. Only one function `main` must be used. It displays a menu allowing the user to choose the number of the exercise to solve.

Implement this main function and the corresponding menu using the `switch` structure for the choice between exercise.

Exercise 1.

Write a program that solves a second degree equation.

Exercise 2.

Analyze the program that tests if an integer is a prime number (seen in the lecture). Print all the prime numbers less than 50.

Exercise 3. Generic functions

Using a generic function, write a function `max` that returns the maximum of an array of integers.

Exercise 4. Decimal numbers

Write a recursive procedure that takes as parameter n and tests if n contains at least a zero in its decimal form.

Here, we make the convention that the base 10 writing of zero is zero.

Exercise 5. Fibonacci sequence

The Fibonacci sequence is a sequence of integers in which each term is the sum of the two preceding terms: $U_n = U_{n-1} + U_{n-2}$. It begins with the two terms 0 and 1. Thus, the first 7 terms of this sequence are: 0, 1, 1, 1, 2, 3, 5, 8.

- Write the iterative procedure that computes the n^{th} term of the Fibonacci sequence.
- Write the recursive version of the same procedure.

The result is returned in one of the parameters of the procedure.

Exercise 6. Palindromes

A palindrome is a word whose letters read from left to right are the same as those read from right to left. The words **radar**, **Hannah**, **Bob**, **refer** are palindromes.

- Write the iterative function that takes as input a word (string) and returns whether it's a palindrome or not.
- Write the recursive version of the same function.

Additional exercises - To go further

Exercise 7.

Compute the sum S of the serie S_n where the n^{th} term is $1/n^2$ with a margin of error of $\epsilon = 10^{-3}$: if S^* is the value of the infinite sum of the serie S_n and S is the value of the n first terms then $S^* - S < \epsilon$.

Find the stop condition on the last term according to the value of ϵ .

Exercise 8.

Given f a function defined over the interval $[0.1, 10]$ and $f(x) = \exp(-x)/x^3$. Compute its integral on this interval with a margin of error of 10^{-2} using the boxes method.

Exercise 9.

Write a program that computes the mean and the variance of N real numbers read from the keyboard input (without using an array).

Exercise 10.

Write a program that reads a string of maximal length $maxlength$ and prints it using the functions:

- `gets` and `puts`
- `getchar` and `putchar`

Exercise 11.

Write a program that allows to read two strings $s1$ and $s2$ of maximum size $size_{max}$ and compare them. It should print "strings $s1$ and $s2$ are identical" if the two strings are the same and "strings $s1$ and $s2$ are different" if the strings are different.

N.B. It is forbidden to use the functions of the standard libraries.

Exercise 12.

Write a program to extract a sub-string s between two positions $p1$ and $p2$ from another $s1$ string.

Exercise 13.

Write a program that calculates the number of occurrences of a $s1$ string inside a $s2$ string.

Exercise 14.

Write a program that:

- Reads an integer and returns if it's positive or negative.
- Reads a string and returns its length
- Returns the number π
- Reads a number and returns its square and root.

The program should display a numbered menu to the user. Depending on its choice, the program performs the requested function and asks the user again if he wants to use another function. The user must be able to terminate the program if he does not want to use any function.

Exercise 15. Number of occurrences in a string.

Write a recursive procedure, taking a character and a string, which allows to return in a third parameter the number of occurrences of the character in the string.

Exercise 16. Reversing a string.

Write a procedure, taking a character string as a parameter, which allows to invert the string. Thus, if the function receives `cours NF05A`, it returns the output, the string `A50FN sruoc`.

Is it possible to do this recursively? If yes, give the recursive version of this function.

Exercise 17. Evaluating a simple sum

Write a procedure, taking a string of characters composed of numbers and the symbols '+' and '-', which returns in an integer parameter the evaluation of this string. For example, if the procedure receives the string "15 + 16 - 1", the procedure should return the integer 30.

Exercise 18. Binomial coefficients

Write a recursive function to compute the combinations: $C_n^p = C_{n-1}^{p-1} + C_{n-1}^p$ for given n and p , with $0 < p < n$. Boundary conditions: $C_0^0 = 1 = C_i^0 = C_i^i$.

Exercise 19. Closest number

Write a recursive procedure that, given an integer X , returns in a parameter the value closest to X in an array of integers A .