

ALGOCAM
C Algorithm Olympiad



Wednesday December 18, 2024

The test consists of 5 problems of varying level. Students will send 5 different files, for each of the problems, to the address : hilbertbox@gmail.com; each expected C file must be in the form : *PBi-LASTNAME-FirstNames-ALGOCAM*, where *PBi* designates problem number *i*. Each problem is graded out of 8 points.

PROBLEM 1 ★

Solve in $\mathbb{R} \times \mathbb{R} \times \mathbb{R} \times \mathbb{R} \times \mathbb{R}$ the system :

$$\begin{cases} |x| + |y| + |z| + |t| + |s| &= 220 \\ \sqrt{|x|} + |y||z| + t^2 - |s| &= 443 \\ x^2 + \sqrt{|y|} - |z| - |t| - 30|s| &= 13151 \\ |x| - |y| + \sqrt{|z|} + t^2 - 4|s| &= 159 \\ |x||y| + |z| - 2|t| + \sqrt{|s|} &= 3009 \end{cases}$$

PROBLEM 2 ★★★

A cryptarithm is a numerical and logic puzzle that consists of a mathematical equation where the letters represent digits to be found. Each different letter represents a different digit and each digit is represented by the same letter.

Solve the cryptarithm below (give the product obtained as the answer) :

$$THREE \times NINE = TROIS \times NEUF$$

Constraints :

- THREE and NEUF are multiples of 9
- TROIS and NINE are multiples of 3

PROBLÈME 3 ★★★

In Cameroon, there are 6 coins : 5 FCFA, 10 FCFA, 25 CFA, 50 FCFA, 100 FCFA and 500 FCFA

We can arrive at 10000 FCFA like this : $60 \times 5 \text{ FCFA} + 20 \times 50 \text{ FCFA} + 12 \times 100 \text{ FCFA} + 15 \times 500 \text{ FCFA}$.

In how many ways can we arrive at 10000 FCFA, using the number of Cameroonian coins we want ?

PROBLEM 4 ★★★

In the thirteenth century, an Italian mathematician named Leonardo Fibonacci posed a small problem in one of his books, which featured rabbits. This little problem brought forward a particular sequence of numbers, called the Fibonacci sequence, after its inventor. He made the following assumptions :

- the first month, we place a pair of two rabbits in an enclosure ;
- a pair of rabbits can only procreate from the third month of their arrival in the enclosure (in other words, nothing happens during the first two months) ;
- each pair capable of procreating gives birth to a new pair every month ;
- finally, the rabbits never die.

The problem is the following : how many pairs of rabbits are there in the enclosure in the n th month ?

You are asked to create a small program that does this calculation automatically.

PROBLEM 5 ★★★

Write a program in C language that allows you to sort a vector of integers in ascending order, the size of this vector is chosen by the user. The numbers will either be entered by the user or chosen randomly and range from 0 to 40.

The various features of the program must meet the following requirements :

- The input will be done by calling a function *SaisiVEC*, the same function will be used for entering numbers manually or randomly
- The sorting will be performed by calling the function *heapSort*.
- The function *AfficheVEC* will be called before and after the sorting is performed.