

## Functional and logic programming

- written exam -

### **Important:**

1. Subjects are graded as follows: of - 1p; A – 1.5p; B - 2.5p; C - 2.5p; D - 2.5p.
2. Prolog problems will be resolved using SWI Prolog. The following are required: (1) explanation of the code and of the reasoning behind it; (2) recursive model that solves the problem, for all the predicates used; (3) specification of every predicate (parameters and their meaning, flow model, type of the predicate - deterministic/non-deterministic).
3. Lisp problems will be resolved using Common Lisp. The following are required: (1) explanation of the code and of the reasoning behind it; (2) recursive model that solves the problem, for each function used; (3) specification of every function (parameters and their meaning).

**A.** The following function definition in LISP is given

```
(DEFUN F(L)
  (COND
    ((NULL L) 0)
    ((> (F (CAR L)) 2) (+ (CAR L) (F (CDR L))))
    (T (F (CAR L)))
  )
)
```

Rewrite the definition in order to avoid the double recursive call **(F (CAR L))**. Do NOT redefine the function. Do NOT use SET, SETQ, SETF. Justify your answer.

**B.** Given a list composed of integer numbers and sublists of integer numbers, write a SWI-Prolog program that verifies if all the elements of the list (including those in sublists) form a symmetrical sequence. For example, for the list [1, 5, [2,4], 7, 11, 25, [11, 7, 4], 2, 5, 1] the result will be true.

C. Write a PROLOG program that generates the list of all subsets of k elements in arithmetic progression. Write the mathematical models and flow models for the predicates used. For example, for  $L=[1,5,2,9,3]$  and  $k=3 \Rightarrow [[1,2,3],[1,5,9],[1,3,5]]$  (not necessarily in this order).

**D.** Given a nonlinear list, write a Lisp function to replace all the odd values from even levels with their natural successor. The superficial level is assumed 1. **A MAP function shall be used.**  
**Example** for the list (1 s 4 (3 f (7))) the result is (1 s 4 (4 f (7))).