

## Functional and logic programming

- written exam -

### Important:

1. Subjects are graded as follows: By default - 1p; A – 2p; B - 4p; C - 3p.
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.** Let L be a list of numbers and given the following PROLOG predicate definition **f(list, integer)**, with the flow model (i, o):

f([], -1).

f([H|T],S):-H>0, **f(T,S1)**,S1<H,!,S is H.

f([\_|T],S):-**f(T,S1)**, S is S1.

Rewrite the definition in order to avoid the recursive call **f(T,S)** in both clauses. Do NOT redefine the predicate. Justify your answer.

**B.** Write a PROLOG program that generates the list of permutations of the set  $1..N$ , having the property that the absolute value of the difference between 2 consecutive values from the permutation is  $\geq 2$ . Write the mathematical models and flow models for the predicates used. For example, for  $N=4 \Rightarrow [[3,1,4,2], [2,4,1,3]]$  (not necessarily in this order).

**C.** Given a nonlinear list, write a Lisp function to return the list with all atoms on even levels replaced by zero. The superficial level is assumed 1. **A MAP function shall be used.**

**Example** for the list (a (1 (2 b)) (c (d))) the result is (a (0 (2 b)) (0 (d))).