

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. Given the following PROLOG predicate definition **f(integer, integer)**, with the flow model (i, o):

f(50, 1):-!.
f(I,Y):-J is I+1, **f(J,S)**, S<1, !, K is I-2, Y is K.

f(I,Y):-J is I+1, **f(J,Y)**.

Rewrite the definition in order to avoid the recursive call **f(J,V)** 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 ≥ 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. An n-ary tree is represented in Lisp as (node subtree1 subtree2 ...). Write a Lisp function to verify whether a node **x** occurs on an even level of the tree. The root level is assumed zero. **A MAP function shall be used.**

Example for the tree (a (b (g)) (c (d (e)) (f))) **a)** x=g => T **b)** x=h => NIL