

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([], 0).

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

f([_|T],S):-**f(T,S1)**, S is S1+2.

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 all combinations of k elements with numbers from 1 to N , with the property that difference between two consecutive numbers from a combination has an even value. Write the mathematical models and flow models for the predicates used. For example, for the $\mathbf{N}=4$, $\mathbf{k}=2 \Rightarrow [[1,3],[2,4]]$ (not necessarily in this order).

C. Write a Lisp function to substitute an element **e** by other element **e1** at all odd levels of a nonlinear list. The superficial level is assumed 1. **A MAP function shall be used.**

Example, for the list (1 d (2 d (d))), **e**=d and **e1**=f the result is (1 f (2 d (f))).