

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. 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)**, 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. Given a nonlinear list containing both numerical and non-numerical atoms, write a Lisp program that builds a list with the elements from the initial list, from positions k to k (counting from left to right, considering all elements regardless of level), in reverse order. For example, for the list (A B 12 (5 D (A F (10 B) D (5 F) 1)) C 9) and $k = 3$ the result is (9 F B A 12).

C. 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).

D. 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))).