

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

f(100, 1):-!.

f(K,X):-K1 is K+1, **f(K1,Y)**, Y>1, !, K2 is K1-1, X is K2+Y.

f(K,X):-K1 is K+1, **f(K1,Y)**, Y>0.5, !, X is Y.

f(K,X):-K1 is K+1, **f(K1,Y)**, X is Y-K1.

Rewrite the definition in order to avoid the recursive call **f(J,V)** in all clauses. Do NOT redefine the predicate. Justify your answer.

B. Given a nonlinear list that contains numerical and non-numerical atoms, write a LISP program that replaces each even numerical atom on odd levels with the sum of its digits. The superficial level is odd. For example, for the list (A 2 (B 31 F (D 102 5 T (66) E) (D 10 (E R 51)) 99)) the result will be (A 2 (B 31 F (D 3 5 T (66) E) (D 1 (E R 51)) 99)).

C. For a given value N , generate the list of all permutations with elements $N, N+1, \dots, 2*N-1$ with the property that the absolute value between two consecutive values from the permutation is ≤ 2 . Write the mathematical models and flow models for the predicates used.

D. An n-ary tree is represented in Lisp as (node subtree1 subtree2 ...). Write a Lisp function to return the list of nodes on the given level **k**. The root level is assumed zero. **A MAP function shall be used.** ***Example*** for the tree (a (b (g)) (c (d (e)) (f)))

a) k=2 => (g d) **b)** k=5 => ()