

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(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. Given a nonlinear list containing numerical and non-numerical atoms, write a LISP program that replaces non-numerical atoms with the number of occurrences of that atom at the level of the list on which it is located. For example, for the list (F A 12 13 (B 11 (A D 15) C C (F)) 18 11 D (A F) F), the result will be (2 1 12 13 (1 11 (1 1 15) 2 2 (1)) 18 11 1 (1 1) 2).

C. Write a PROLOGO program that generates the list of arrangements of k elements from a list of integer numbers, having the given product P . Write the mathematical models and flow models for the predicates used. For example, for the list $[2, 5, 3, 4, 10]$, $k=2$ and $P=20 \Rightarrow [[2,10],[10,2],[5,4],[4,5]]$ (not necessarily in this order).

D. Given a nonlinear list, write a Lisp function to return the list with all even numerical atoms from an odd level removed. The superficial level is assumed 1. **A MAP function shall be used.**

Example **a)** if the list is (1 (2 A (4 A)) (6)) => (1 (2 A (A)) (6))

b) if the list is (1 (2 (C))) => (1 (2 (C)))