

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, 0):-!.

f(I,Y):-J is I+1, **f(J,V)**, V>2, !, K is I-2, Y is K+V-1.

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

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 that contains numerical and non-numerical atoms, write a Lisp program that builds a list that has a level for each level of the initial list and on each level has three elements: the number of numerical atoms on that level from the initial list, a sublist that contains these information for the rest of the levels and the numbers of nonnumerical atoms from that level in the initial list. For example, for the list (A B (4 A 3) 11 (5 (A (B) C 10) (1(2(3(4)5)6)7) X Y Z)) the result will be (1 (3 (3 (2 (2 (1 0) 0) 1) 2) 4) 2).

C. Write a PROLOG program that generates the list of all subsets, each subset having an odd sum of elements and also even number of elements. Write the mathematical models and flow models for the predicates used. For example, for $[2,3,4] \Rightarrow [[2,3,4]]$.

D. 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))).