

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(20, -1):-!.

f(I,Y):-J is I+1, **f(J,V)**, V>0, !, K is J, Y is K.

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 counts for how many sublists (including the initial list) the total number of numerical atoms on odd levels is equal with the total number of non-numerical atoms on odd levels. The superficial level is odd. For example, for the list (A B 12 (5 D (A F (B) D (5 F) 1) 5) C 9 (F 4 (D) 9 (F (H 7) K) (P 4)) X) the result will be 4 (the counted lists being (5 F) (H 7) (P 4) (5 D (A F (B) D (5 F) 1) 5)).

C. Write a PROLOG program that generates the list of all subsets with N elements, using the elements of a list, such that the sum of elements from a subset is an even number. Write the mathematical models and flow models for the predicates used. For example, for the list $L=[1, 3, 4, 2]$ and $N=2 \Rightarrow [[1,3], [2,4]]$.

D. Given a nonlinear list, write a Lisp function to return the list with all atoms on the level **k** replaced by 0. The superficial level is assumed 1. **A MAP function shall be used.**

Example for the list (a (1 (2 b)) (c (d))) **a)** k=2 => (a (0 (2 b)) (0 (d)))

b) k=1 => (0 (1 (2 b)) (c (d))) **c)** k=4 => the list does not change