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 both numerical and nonnumerical atoms, write a LISP program that builds a list containing as sublists non-numerical atoms on each level of the initial list (the first sublist of the result contains non-numerical atoms on the first level, the second sublist the non-numerical atoms from the second level etc.). For example, for the list (A B 12 (5 D (A F (10 B) D (5 F) 1)) C 9 (F 4 (D) 9 (F (H 7) K) (P 4)) X) the result will be ((A B C X) (D F) (A F D D F K P) (B F H)).

C. Write a PROLOG program that generates the list of permutations of the set 1..N, having the property that the absolute value of the difference between 2 consecutive values from the permutation is >=2. Write the mathematical models and flow models for the predicates used. For example, for N=4 ⇒ [[3,1,4,2], [2,4,1,3]] (not necessarily in this order).

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