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):

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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 containing both numerical and non-numerical atoms, write a LISP program that returns the list from which non-numerical atoms are eliminated from 3 to 3 (counting from the left to the right, considering all elements regardless of level). The resulted list will keep the structure of the initial list. 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 the list (A B 12 (5 (A F (10) D (5 F) 1)) 9 (F 4 (D) 9 ((H 7) K) (4)) X).

C. Write a PROLOG program that generates the list of all permutations with the property the absolute value of difference between two consecutive values from each permutation is <=3. Write the mathematical models and flow models for the predicates used. For example, for L=[2,7,5] ⇒ [[2,5,7], [7,5,2]] (not necessarily in this order).

D. Given a nonlinear list, write a Lisp function to return the list with all atoms on 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