Functional and logic programming
- written exam -

Important:

1. Subjects are graded as follows: By default - 1p; A – 2p; B - 4p; C - 3p.
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(1, 1):-!.
f(K,X):-K1 is K-1, f(K1,Y), Y>1, !, K2 is K1-1, X is K2.
f(K,X):-K1 is K-1, f(K1,Y), Y>0.5, !, X is Y.
f(K,X):-K1 is K-1, f(K1,Y), X is Y-1.
```

Rewrite the definition in order to avoid the recursive call **f(J,V)** in all clauses. Do NOT redefine the predicate. Justify your answer.

B. For a given value N, generate the list of all permutations with elements N, N+1, ..., 2*N-1 with the property that the absolute value between two consecutive values from the permutation is <=2. Write the mathematical models and flow models for the predicates used.

C. An n-ary tree is represented in Lisp as (node subtree1 subtree2 ...). Write a Lisp function to determine the path from the root to a given node. **A MAP function shall be used.**

Example for the tree (a (b (g)) (c (d (e)) (f)))

(a) nod=e => (a c d e) (**b)** nod=v => ()