

## 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(0, 0):-!.  
f(I,Y):-J is I-1, **f(J,V)**, V>1, !, K is I-2, 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 builds a list with the elements from the initial list, from positions  $k$  to  $k$  (counting from left to right, considering all elements regardless of level), in reverse order. For example, for the list (A B 12 (5 D (A F (10 B) D (5 F) 1)) C 9) and  $k = 3$  the result is (9 F B A 12).

**C.** Write a PROLOG program that generates the list of all subsets with values between the  $[a, b]$  interval such that the sum of elements from each subset is an odd value. Write the mathematical models and flow models for the predicates used. For example, for  $\mathbf{a}=2$  and  $\mathbf{b}=4 \Rightarrow [[2,3],[3,4],[2,3,4]]$  (not necessarily in this order).

**D.** Given a nonlinear list, write a Lisp function to return the list with all the numerical atoms that are multiple of 3 removed. **A MAP function shall be used.**

**Example**    **a)** if the list is (1 (2 A (3 A)) (6)) => (1 (2 A (A)) NIL)

**b)** if the list is (1 (2 (C))) => (1 (2 (C)))