

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. The following function definition in LISP is given

```
(DEFUN F(L1 L2)
  (APPEND (F (CAR L1) L2)
    (COND
      ((NULL L1) (CDR L2))
      (T (LIST (F (CAR L1) L2) (CAR L2)))))
  )
)
```

Rewrite the definition in order to avoid the double recursive call **F (CAR L1) L2**. Do NOT redefine the function. Do NOT use SET, SETQ, SETF. Justify your answer.0

B. Given a list that represents a set, write a SWI-Prolog program that return all possible solutions to divide the set in k subsets. The k subsets must be disjoint and each element from the initial set must be part of one of the subsets. For example, for the set $[1,2,3]$ and $k = 2$, the solution is (not necessarily in this order): $[[[3, 2], [1]], [[2], [3, 1]], [[3], [2,1]]]$.

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 $L=[2,7,5] \Rightarrow [[2,5,7], [7,5,2]]$ (not necessarily in this order).

D. Given a nonlinear list, write a Lisp function to replace all even numerical values with their natural successor. **A MAP function shall be used.**

Example for the list (1 s 4 (2 f (7))) the result is (1 s 5 (3 f (7))).