

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. Let **G** be LISP function and given the following definition

```
(DEFUN F(L)
  (COND
    ((NULL L) 0)
    (> (G L) 2) (+(G L) (F (CDR L))))
    (T (G L))
  )
)
```

Rewrite the definition in order to avoid the repeated call **(G L)**. Do NOT redefine the function. Do NOT use SET, SETQ, SETF. Justify your answer.

B. Given a linear list composed of numbers, write a SWI-Prolog program that returns the list in which each number that is smaller than its successor in the list is multiplied with two. Repeat this operation until there are no possible changes in the list. For example, for the list [1, 2, 3] the result will be [8, 16, 3].

C. Given a list made of integer numbers, generate using PROLOG the list of arrangements with even number of elements, having the sum an odd number. Write mathematical models and flow models for the predicates used. For example, for the list $L=[2,3,4] \Rightarrow [[2,3],[3,2],[3,4],[4,3]]$ (not necessarily in this order).

D. Given a nonlinear list, write a Lisp function to replace the numerical values on off levels and greater than a given value k to their natural predecessor. The superficial level is assumed 1. **A MAP function shall be used.** ***Example*** for the list (1 s 4 (3 f (7))) and

a) k=0 the result is (0 s 3 (3 f (6))) **b)** k=8 the result is (1 s 4 (3 f (7)))