

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

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

B. Given a heterogeneous list composed of numbers and nonempty linear numerical lists, write a SWI-Prolog program that inverts the sublists for which the lowest common multiple of the elements is greater than the square of the first element of the sublist. For example, for the list `[[4, 1, 18], 7, 2, -3, [6, 9, 11, 3], 4, [9, 4, 3]]`, the correct result is: `[[18, 1, 4], 7, 2, -3, [3, 11, 9, 6], 4, [9, 4, 3]]`.

C. Write a PROLOG program that generates the list of all subsets of sum **S** given, using the elements of a list, such that the number of even elements from each subset is even. Write the mathematical models and flow models for the predicates used. For example for the list [1, 2, 3, 4, 5, 6, 10] and $S=10 \Rightarrow [[1,2,3,4], [4,6]]$.

D. Write a Lisp function to substitute an element **e** by other element **e1** at all odd levels of a nonlinear list. The superficial level is assumed 1. **A MAP function shall be used.**

Example, for the list (1 d (2 d (d))), **e**=d and **e1**=f the result is (1 f (2 d (f))).