

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. The following function definition in LISP is given

```
(DEFUN F(L)
  (COND
    ((NULL L) 0)
    ((> (F (CAR L)) 1) (F (CDR L)))
    (T (+ (F (CAR L)) (F (CDR 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. Write a PROLOG program that generates the list of all subsets of k elements in arithmetic progression. Write the mathematical models and flow models for the predicates used. For example, for $L=[1,5,2,9,3]$ and $k=3 \Rightarrow [[1,2,3],[1,5,9],[1,3,5]]$ (not necessarily in this order).

C. An n-ary tree is represented in Lisp as (node subtree1 subtree2 ...). Write a Lisp function to verify whether a node **x** occurs on an even level of the tree. The root level is assumed zero. **A MAP function shall be used.**

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

a) $x=g \Rightarrow T$

b) $x=h \Rightarrow \text{NIL}$