

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 Fct(F L)
  (COND
    ((NULL L) NIL)
    ((FUNCALL F (CAR L)) (CONS (FUNCALL F (CAR L)) (Fct F (CDR L))))
    (T NIL)
  )
)
```

Rewrite the definition in order to avoid the double recursive call **FUNCALL 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. 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)))