

## 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 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.** Given two lists composed of integer numbers and sublists of integer numbers, write a SWI-Prolog program that returns a list that contains all sublists that are formed by concatenation of two sublists, one from each of the two lists. For example, for the following two lists: [1,2, [4,2], 6, [3,2]] and [1,2,3,[5,6],8, 5,[2,3], 4,1,[3,3]] the result will be (not necessarily in this order): [[4,2,5,6], [4,2,2,3], [4,2,3,3], [3,2,5,6], [3,2,2,3], [3,2,3,3]].

**C.** Write a PROLOG program that generates the list of all subsets of even sum, using the elements of a list. Write the mathematical models and flow models for the predicates used.  
For example, for the list  $L=[2, 3, 4] \Rightarrow [[],[2],[4],[2,4]]$  (not necessarily in this order).

**D.** Given a nonlinear list, write a Lisp function to replace all the odd values from even levels with their natural successor. The superficial level is assumed 1. **A MAP function shall be used.**  
**Example** for the list (1 s 4 (3 f (7))) the result is (1 s 4 (4 f (7))).