

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 a numerical linear list, write a SWI-PROLOG program that applies a stable sorting on this list and sorts the elements in increasing order by the remainder of the division with 3. For example, for the list [10, 5, 6, 12, 7, 3, 20, 30] the result will be [6, 12, 3, 30, 10, 7, 5, 20]. (Obs: stable sort means that elements that are equal elements will remain in the same order as in the initial list, for example 6 and 12).

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 return the list with all even numerical atoms from an odd level removed. The superficial level is assumed 1. **A MAP function shall be used.**

Example **a)** if the list is (1 (2 A (4 A)) (6)) => (1 (2 A (A)) (6))

b) if the list is (1 (2 (C))) => (1 (2 (C)))