

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 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, each subset having an odd sum of elements and also even number of elements. Write the mathematical models and flow models for the predicates used. For example, for $[2,3,4] \Rightarrow [[2,3,4]]$.

D. Write a Lisp function to substitute all numerical values at any level of a given nonlinear list with a given value **e**. **A MAP function shall be used.**

Example, for the list (1 d (2 f (3))), **e**=0 the result is (0 d (0 f (0))).