

**Computer Science's Curriculum
Placement Exam for XXXII PhD Cycle**

Exam no. 3

- Answer in a complete, deep, and comprehensive way to at least 3 questions.

Questions

1. The relational model is one of the most used logical models for databases. Explain the reason of this success.
2. A major shift in programming languages occurred with the introduction of Abstract Data Types (ADT). What are ADT? Why are they important? How do classes support ADT in mainstream object-oriented languages?
3. Illustrate “tail recursion”; provide some code example, discuss its advantages and interesting applications.
4. Provide a detailed analysis of the relations among the complexity classes P, NP, EXP, NEXP. In particular, show in which cases there is an inclusion relation, and if such an inclusion is proper or not. Finally, briefly illustrate the main open problems in this context.
5. The Depth First Search algorithm (DFS) is part of the “folklore” of computer science, but it is useful for solving different graph problems that occur, for example, in scheduling the tasks of a project or analyzing the network connectivity. Describe at least two problems that can be efficiently solved by DFS or by its variants.
6. Explain the “mutual exclusion” problem and some techniques used for its management and solution (e.g. semaphores)