

Computer Science's Curriculum Placement Exam for XXXI PhD Cycle

Exam no. 1

Answer in a complete and comprehensive way to at least 5 questions.

Start each question on a new page. Write on only one side of the paper.

- 1) Give a survey of the tree data structure and describe the applications to the search problem.
- 2) Discuss the differences among best, worst and average case analysis of algorithms and give at least an example.
- 3) Illustrate the phases of logical, conceptual and physical database design.
- 4) Describe the main operators of relational algebra comparing them with SQL language.
- 5) Software Development Process: Iterative and Incremental Methods. Describe the main features of iterative incremental methods for managing the software development process and their relationship to the classical "Waterfall" approach.
- 6) UML: Activity Diagram. Describe UML and the purpose of Activity Diagrams (ADs) in the framework of the Unified Modeling Language
- 7) Discuss the Imperative Programming paradigm with respect to Declarative Programming paradigm pointing out the main concepts, differences, advantages/disadvantages and most suitable application domains.
- 8) Confidentiality is one of the main features of computer security. Describe the problem and illustrate some solutions
- 9) Describe the main services of a Real time OS Kernel and provide some examples
- 10) Multicore architectures are getting widely and widely used though they face many challenges. Describe how they work and their main challenges, including those related to caching.

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Exam no. 2

Answer in a complete and comprehensive way to at least 5 questions.

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- 1) Give a survey of the divide et impera algorithmic technique and describe at least one application.
- 2) Illustrate the strategies and tools to choose among different algorithms to solve the same problem.
- 3) Provide the basics of relational databases theory.
- 4) Software Development Process: Agile Methods. Describe the Agile methodology to the software development process. Discuss the main characteristics of Agile with respect to classical "Waterfall" approach.
- 5) UML: Class Diagram. Describe UML and the purpose of Class Diagrams (CDs) in the framework of the Unified Modeling Language
- 6) Polymorphism is commonly supported by Object Oriented Programming languages. Describe the concept of polymorphism in programming and discuss the main advantages from programmers and the main issues that the compiler designer has to face to provide support to polymorphism
- 7) Illustrate the purpose and the role of lexical analysis phase in the context of the program compilation process. Describe which models and techniques can be used to implement a lexical analyzer.
- 8) Cloud Computing is today one of the most popular computer paradigms. Describe how it works and the main challenges associated.
- 9) Critical systems are getting more and more important in our life. Describe the difference between safety and availability and how they can be achieved.
- 10) TCP-IP is the most well-known and the most used protocol stack. Describe it with special emphasis on the role and the services provided by layer 2 and the main known protocols

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Exam no. 3

Answer in a complete and comprehensive way to at least 5 questions.

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- 1) Describe and compare at least two ways to represent the graph data structure.
- 2) Illustrate the complexity of sorting an array by comparisons and provide some examples.
- 3) Discuss the problem of normalization of a relational database.
- 4) UML: Sequence Diagram. Describe UML and the purpose of Sequence Diagrams (SDs) in the framework of the Unified Modeling Language
- 5) Polymorphism. Many object oriented programming languages allow to manipulate polymorphic objects. Describe the characteristics polymorphism of objects and how it can be exploited in implementing and manipulating objects and data structures.
- 6) Present the main features and discuss advantages and drawbacks of Interpreted vs Compiled programming languages. Explain and motivate the increasing role of interpreted languages in the context of internet and web applications.
- 7) Real time Scheduling: define the problem and describe the most important known solutions
- 8) TCP-IP is the most well-known and the most used protocol stack. Describe it with special emphasis on the role and the services provided by TCP
- 9) Describe the main techniques for performance and dependability evaluation
- 10) Mutual exclusion is one of the basic problems in computer architectures. Describe the problem and some of the solutions