

# Computer Science's Curriculum Placement Exam for XXX PhD Cycle

## Exam no. 2

- 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. The computation of *shortest paths* between places is a general problem that arises in many forms and many contexts. Discuss some algorithms that you know for efficiently computing the shortest paths in weighted graphs and explain the peculiarities of each revised algorithm.
2. *Dynamic programming* algorithms typically applies to optimization problems in which a set of choices must be made in order to arrive to an optimal solution. Discuss when dynamic programming is effective and give an example of how to transform an exponential-time algorithm into polynomial-time algorithms by exploiting dynamic programming.
3. Almost every new object has embedded sensors. The wireless sensor networks can change our lives. Algorithms ad hoc have been designed in this area, for example, to save energy and locate the sensors. Describe the *sensors* as a computational paradigm and discuss the main challenges, in your opinion, in designing algorithms for wireless sensor networks.
4. Verify if the following assertion is true or false, by providing a formal proof or an appropriate counterexample:  
  
(a) for any  $L$  regular language and  $L'$  context free language,  $L \cap L'$  is a context free language.
5. Describe *polymorphism* in *object-oriented programming* and provide a small example of use in your preferred programming language.
6. Describe *semaphores* and their use in concurrent programming. Discuss how *semaphores* can be implemented in your preferred programming language.
7. Survey the use of a scheduler in a uni-processor system. Describe the most common algorithms for scheduling the CPU.
8. Cybersecurity is becoming one of the important problems of contemporary systems and infrastructures. Describe some of the several techniques and algorithms used to guarantee authentication.
9. Quantitative evaluation and assessment of components, mechanisms and systems is driving evolution. Give a brief survey of the several approaches and modeling frameworks that have been proposed in the literature.
10. Multicore architectures are the recent evolution of processors and systems organization. Describe your knowledge in this area.