SISTEMAS DISTRIBUÍDOS

Ano lectivo de 2022/2023

1. GENERAL INFO

Semester: 2
Weekly load: 2H (lectures) + 2H (labs)
Credit units: 6 *ECTS*
Audience: Mestrado Integrado em Engenharia de Computadores e Telemática (*MIECT*)
Mestrado em Engenharia Informática (*MEI*)
Mestrado em Engenharia de Computadores e Telemática (*MECT*)
Scientific area / sub-area: Informática / Arquitectura dos Sistemas Computacionais
Coordination: António Rui Borges (*ARB*) – ruib@det.ua.pt

2. TEACHING STAFF

António Rui Borges (*ARB*) – ruib@det.ua.pt
T 5.ª feira: 9h – 11h (Anf IV)
LC1 5.ª feira: 11h – 13h (Room 101)
Tutorial 5.ª feira: 18h – 19h (Anf IV)
Student assistance is available by appointment (IEETA)

Óscar Pereira (*OMP*) – omp@ua.pt
LC2 5.ª feira: 14h – 16h (Room 101)
LC3 5.ª feira: 16h – 18h (Room 101)
LC4 5.ª feira: 18h – 20h (Room 101)
Student assistance is available by appointment (IT)

3. OBJECTIVES

- to acquaint the students to the principles and the underlying practice of the design of distributed systems through the presentation of the most important concepts about their implementation
- to introduce the most important paradigms of process communication and synchronization in a distributed fashion.

4. LEARNING OUTCOMES

- to gain a good understanding on the main issues related to the conception of distributed systems
- to develop skills for the design and the implementation of simple distributed applications
- to acquaint the students with the functionality of Java distributed programming environment.

5. PRE-REQUISITES

- basic knowledge about operating systems and multiprogrammed environments
- working knowledge of the application of the object oriented paradigm to the design of solutions
- working knowledge of sequential programming and some knowledge of the principles of concurrent programming.

6. SYLLABUS

- *Introduction to Java*
  general organization of the language
  characterization in terms of the object oriented paradigm and the concurrency model
- *Distributed Systems*
  overview of main issues
- *System models*
  architectural models
  fundamental models
- *Interprocess communication and synchronization*
  message passing
  method invocation on remote objects
- *Client-server models*
  overview
  code migration
- *Group communication models*
  distributed synchronization and mutual exclusion
  elective algorithms
  distributed transactions
- *Consistency and replication*
  data centered consistency
  client centered consistency
  protocols
- *Security*
  introductory concepts
  safe channels
  access control
  safety management.

7. BIBLIOGRAPHY

Distributed Systems – Principles and Paradigms, Tanenbaum A.S. e Steen M.v., Pearson Education International / Prentice Hall, 2006

Distributed Systems – Concepts and Design, Dollimore J., Kindberg T. e Coulouris G., Addison Wesley / Pearson Education Ltd, 2005

Distributed Systems – An Algorithmic Approach, Ghosh S., Chapman & Hall / CRC Computer and Information Science Series, 2007

The Java Language Specification ~Java SE 8 Edition, Gosling J., Joy B., Steele G., Bracha G. and Buckley A., Oracle America Inc., 2015

On-line support documentation for Java program developing environment by Oracle (Java Platform Standard Edition 8)

8. TEACHING / LEARNING MODEL

The course is organized in lectures, lab classes and tutorials.

Lectures present specific topics of the syllabus. The adopted approach tries to entice the students to participate actively in the discussion and to help them to develop skills of critical reasoning and to learn general techniques of problem solving. A challenge is placed to the students in the form of an open problem and its solution by individuals is supported (whoever does it, will get a bonus on the grade of the theoretical component).

Lab classes follow the motto "you learn by doing". They are organized in two parts. In the first, consisting of the first session, one aims to acquaint the students to advanced concepts of object oriented programming: a group of problems is presented and the students are challenged to solve them as best as they can – later on, specific features of the solutions are discussed in the tutorials. In the second,

consisting of the remaining sessions, a general problem is discussed and different implementations based on different communication constructs are to be worked out.

***Work assignment* 1**
Pure concurrent implementation of the problem running in a single platform.

***Work assignment* 2**
Distributed implementation of the problem, based on message passing, running in multiple platforms.

***Work assignment* 3**
Distributed implementation of the problem, based on method invocation on remote objects, running in multiple platforms.

Students are organized in working groups of two elements. Each group must present and defend its approach to the solution and its implementation during a query session.

Tutorials have for the most part an exposition character and aim to help the students to overcome deficiencies on the background knowledge some of them may have, as well as to provide a space for the discussion of specific aspects of the course.

9. GRADING

1. Course grade is determined by the formula

$$course\ grade \ = \ \frac{5 \text{ x } theoretical\ mark \ + \ 5 \text{ x } lab\ mark}{10} \ ,$$

   rounding is always carried out *half up* to unities, except when the lab mark is higher than the theoretical mark by more than three units; in this case, rounding is carried out *half down*.

2. Theoretical mark is obtained by seating to a written examination which takes place at *época normal* or *época de recurso* plus, optionally, by giving a good answer to the challenge placed during the lectures. A *minimum mark* of 8,5 units is required.

3. Lab mark is obtained by the evaluation of the three work assignments. Each has an equal weight. A *minimum mark* of 8,5 units is required. Lab mark has a *maximum* value of 16 units at this point. Its extension to 20 units requires the study and implementation of a small and more advanced distributed application which will be assigned to interested students that have previously reached the course grade of 16 units.

4. The student *passes* the course if the course grade is higher or equal to 10 units and simultaneously both the theoretical and lab marks are at least equal to the *minimum mark*.

5. The student *fails* the course if the course grade is lower than 10 units, or either the theoretical or the lab mark is lower than the *minimum mark*.

6. When the lab mark is lower than the *minimum mark*, the student *fails by minimum mark*.

7. A *regular* student may also *fail* by missing more than three lab classes. In this case, the student *fails by absence*.

10. SPECIAL DATES

deadline for delivering work assignment 1: 26 de Março de 2023

deadline for delivering work assignment 2: 7 de Maio de 2023

deadline for delivering work assignment 3: 7 de Junho de 2023