UNIVERSIDADE LUSÍADA
LISBOA

Course Unit Program
Distributed Systems

Academic Year 2025/2026

1. Organic Unit

Faculty of Business and Economic Sciences

2. Course

Computer Engineering

3. Cycle

1st

4. Course Unit

Distributed Systems (L9028)

5. Scientific Area

6. Curricular Year

3rd

7. Type of Curricular Unit / Semester

2nd Semester

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8. Class type and workload (work time)

Theoretical classes:	
Practical classes:	
Theoretical-Practical Classes	30,00
Tutorial Guidance:	20,00

9. ECTS Credits

6,00

10. Scientific Area Coordinator

11. Regent

Prof. Doutor PEDRO RAMOS DOS SANTOS BRANDÃO

12. Assistants

13. Teaching Language

Portuguese

14. General Objectives

This course unit aims to:
1. Learn what a distributed system is, its characteristics;
2. Know the different implementation models of a system distributed, starting with the fundamental techniques, presenting technologies associated with the remote invocation of objects and service-oriented architectures.
3. At the end, students should be able to implement systems that communicate over sockets, distributed object systems, and websites.

15. Specific Objectives

Understand what distributed computing is.
Learn how to build a distributed virtual network.
Understand the fundamental techniques of distributed systems.

16. Skills to be acquired

Identify characteristics and distinguish distributed system models (shared vs. distributed memory; message-based communication).
Program client/server communication with sockets (TCP/UDP) and data serialization.
Apply remote invocation mechanisms (e.g., Java RMI) and evaluate their architectural suitability.
Analyze synchronization and failure models (logical clocks, timeouts, failure detection) and implement basic solutions.

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17. Teaching Methodology

theoretical presentation, exercise resolution, laboratory work (virtualization/experiments with sockets/RMI), possible short project and tutorial guidance, as well as support formats (scripts, exercise lists, code demos).

18. Course Unit Program

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1 Introduction to Distributed Computing
1.1 Characteristics of a distributed system
1.2 Examples of SD.s
1.3 Challenges in implementing SD.s
2 Distributed Programming Models
2.1 Shared memory systems versus distributed memory systems
2.2 Messaging communication models
2.2.1 Synchronous communication
2.2.2 Asynchronous communication
2.2.3 Remote procedure call
2.2.4 Ways to create and identify processes
2.3 Architectural models
2.3.1 - Client/Server Model
2.3.2 Multiple servers
2.3.3 - Proxies
2.3.4 Peer Processes
2.4 Fundamental models
2.4.1 Interaction/synchronism model
2.4.2 Failure model
2.4.3 Security
3 Communication between processes
3.1 - TCP and UDP Sockets
3.2 Serialization of data structures
3.3 Client/Server Communication
3.3.1 - The request response protocol
3.3.2 Semantics before failures
4 Distributed object system
4.1 - The object model
4.2 Remote method invocation of objects
4.3 Java RMI case study
4.4 CORBA case study
5 Web Services
6.1 SOAP Protocol
6.2 REST protocol
6 Time and Clocks
6.2. clock synchronization
6.3. Sorting and logic clocks.
7. Virtualization, distributed virtual networks, Hyper-V.

NOTE: Point 7 is taught throughout the semester in a systematic way.

19. Assessment Methods

Two written assessment tests.

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20. Didactic Resources

Whiteboard, multimedia projection, Moodle, IDE/networking tools, PC lab with Hyper-V, exercise lists.

21. Sustainability Objectives

SDG 4 Quality Education: Develops digital literacy and core skills in distributed systems, essential for basic computer engineering training.
SDG 9 Industry, Innovation, and Infrastructure: Provides training to design and operate efficient and reliable distributed digital infrastructures.
SDG 12 Sustainable Consumption and Production: Encourages computational efficiency (optimization of communication and resources), good practices, and component reuse.

22. Keywords

Distributed computing,
Distributed systems,
Virtualization

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23. Main Bibliography

Author(s): George Coulouris
Title: Distributed Systems: Concepts and Design
Edition: 5 Year: 2011
Local: New York
Publisher: Addison Wesley
ISBN Code:

Author(s): Andrew S. Tanenbaum
Title: Distributed Systems Principles and Paradigms
Edition: 3 Year: 2007
Local: New York
Publisher: Pearson International Edition
ISBN Code:

Author(s): Roberto Vitillo
Title: Understanding Distributed Systems, Second Edition: What every developer should know about large dist
Edition: Year: 2022
Local: Lisboa
Publisher: Roberto Vitillo
ISBN Code:

24. Complementary Bibliography

Author(s): Brendan Burns
Title: Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Systems Using Kubernete
Edition: 2n Year:
Local:
Publisher: O'Reilly Media
ISBN Code: 978-1098156350

Author(s):
Title:
Edition: Year:
Local:
Publisher:

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ISBN Code:

Ficha técnica MIP / MIP Datasheet	
Título / Title	Course Unit Program 'SISTEMAS DISTRIBUIDOS': Academic Year 2025/2026
Autor / Author	Prof. Doutor PEDRO RAMOS DOS SANTOS BRANDÃO
Classificação / Classification	-
Descritores / Descriptors	-
Colaborador(es) / Colaborator(s)	-
Data Hora / Date Time	
Formato de dados / Data Format	Texto / Text, PDF
Estatuto de utilização / Usage	Acesso público / Public Access
Relação / Relation	Version 1,0

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