INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Distributed Systems			Field of study	Computer Engineering		
Bachelor in	Informatics Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9119-706-3203-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Rui Pedro Sanches de Castro Lopes, Luis Filipe Rodrigues Corredeira Lobo

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Distinguish a distributed system and understand the reasons for its implementation;
2. Understand the challenges of constructing distributed systems;
3. Differentiate between various models and architectures for distributed systems;
4. Identify problems inherent in concurrent execution of tasks in centralized and distributed environments and implement measures to address them;
5. Implement distributed systems using simple basic communication primitives;
6. Implement distributed systems using existing middleware.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Know and have experience in object-oriented programming;
2. Know the fundamental concepts of computer architectures;
3. Know the fundamental concepts of operating systems;
4. Know the fundamental concepts of computer networks.

Course contents

Characterization of distributed systems. Models of distributed systems. Java language. Programming with threads. Inter-process communication. Indirect communication. Architecture and middleware for distributed systems. Distributed coordination.

Course contents (extended version)

1. Characterization of distributed systems.
   - Definition.
   - Characteristics.
   - Examples.
   - Challenges.
2. Models of distributed systems.
   - Physical models.
   - Architectural models.
   - Fundamental models.
3. Java language.
   - Characteristics of the language.
   - Concepts of object-oriented programming.
   - Data types, operators, expressions, statements and blocks, flow control.
   - Classes and objects. Interfaces and inheritance. Definition and use of generics.
   - Collections framework.
   - Exception handling and streams manipulation.
4. Programming with threads.
   - Threads and Processes.
   - Advantages and applications of multi-threading.
   - Problems associated with multi-threading: Deadlock, livelock and starvation.
   - Parallelization of problems, producer-consumer, thread pools.
5. Inter-process Communication.
   - Request-response protocols.
   - UDP and TCP Protocols. Datagrams and Sockets in Java.
   - Distributed objects. Remote Method Invocation (RMI).
6. Architecture and Middleware for Distributed Systems.
   - Distributed objects systems.
   - Component based middleware.
   - Web Services.
   - Peer-to-peer networks.
7. Distributed coordination.
   - Clock synchronization.
   - Election.

Recommended reading

1. Couloris, G, Dollimore, J. and Kinberg, T, Distributed Systems - Concepts and Design, 5th Edition, Addison-Wesley, Pearson Education, 2011
2. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems: Principles and Paradigms, 2nd Edition, Prentice Hall, Pearson Education, 2007
3. Rogers Cadenhead, Laura Lemay, Sams teach yourself java 6 in 21 days, Sams, 2007
4. Jorge Cardoso, Programação de Sistemas Distribuídos em Java, FCA, 2008
5. Manuais de referências e tutoriais na Internet

Teaching and learning methods

Lectures using the the expositive method. Problem-solving classes with demonstration of concepts by solving small practical exercises, with periods of resolution in the classroom and autonomous routing of additional tasks for non-presencial work hours. Use of the e-learning platform for the delivery of materials and submission of projects.

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Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Projects - 50%
  - Final Written Exam - 50%

Language of instruction

1. English
2. Portuguese

Electronic validation

Rui Pedro Sanches de Castro Lopes	José Luís Padrão Exposto	Luísa Maria Garcia Jorge	José Carlos Rufino Amaro
16-02-2023	23-02-2023	08-03-2023	10-03-2023

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