DEGREE CURRICULUM

DISTRIBUTED COMPUTING

Coordination: LERIDA MONSO, JOSEP LLUIS

Academic year 2023-24

DISTRIBUTED COMPUTING 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>DISTRIBUTED COMPUTING</td></tr>
<tr><td>Code</td><td>102041</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>4</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>9</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
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<tr><th>Activity type</th><td>PRALAB</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>4.5</td><td>4.5</td></tr>
<tr><th>Number of groups</th><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>LERIDA MONSO, JOSEP LLUIS</td></tr>
<tr><td>Department</td><td>COMPUTER ENGINEERING AND DIGITAL DESIGN</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>9 ECTS = 90h face-to-face + 135h de autonomous work</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
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DISTRIBUTED COMPUTING 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
GABALDON PONSA, ELOI	eloi.gabaldon@udl.cat	3,24	
GERVAS ARRUGA, JORGE	jordi.gervas@udl.cat	3,6	
LERIDA MONSO, JOSEP LLUIS	joseplluis.lerida@udl.cat	3,96	

Subject's extra information

It is recommended to have good knowledge of object-oriented programming for taking this course.

Specialized software used in the course:

- Dockers
- MQTT
- Kafka
- MongoDB
- InfluxDB
- Other tools: Web Services protocols, hosting, deployment and testing tools.
- Programming Languages: Java, Python, etc.

Learning objectives

1. Understanding the scope of distributed computing, their usefulness and potential applications.
2. Ability to categorize distributed systems based on its key features.
3. Know and use the main technologies for the design and implementation of distributed and parallel applications.
4. Ability to design and develop parallel and distributed applications to solve problems with high computational requirements, access to large amounts of data, high availability, etc.
5. Ability to evaluate and analyze the behavior of applications and distributed systems from the point of view of performance, efficiency, scalability, interoperability, fault tolerance, etc.
6. Integrate the knowledge and fundamental concepts of distributed computing in order to contextualize the technological advances in this field and their impact on scientific and technological innovation.

Competences

University of Lleida strategic competences

CT2. Mastering a foreign language, especially English.

CT3. Training Experience in the use of the new technologies and the information and communication technologies.

Cross-disciplinary Competences EPS

EPS6. Capacity of analysis and synthesis.

Specific competences. Module of training of specific technology. Computing

GII - C1. Capacity to have a deep knowledge of the basic principles and models for computation and to know how to apply them in order to interpret, select, value, model, and create new concepts, theories, uses and technological developments related with the informatics.

GII - C3. Capacity to evaluate the computational complexity of a problem, to know the algorithmic strategies that can drive to its solving and recommend, develop and implement the one which guarantee the best performance in accordance with the requirements.

Subject contents

1. Introduction

1.1 Evolution of Computing.

1.2 Distributed Computing challenges

1.3 Distributed System Architectures

1.4 Distributed applications, recent technologies and future trends

2. Distributed Computing Paradigms

2.1 Message-oriented

2.2 Method-oriented

2.3 Object-oriented

2.4 Component-based

2.5 Service-oriented

2.6 Collaborative o Groupware applications

3. Applications and technologies. Practical

3.1 Applications Deployment: Dockers

3.2 Message-oriented applications. Message protocols for IoT: MQTT and Kafka

3.3 No-SQL databases: MongoDB, InfluxDB

3.4 Service-oriented distributed applications. Web Services

4. Distributed Computing Project

Methodology

Master class (3.6 credits)

- Theoretical lectures: lectures supported by transparencies and/or notes. Discussion with students applying theoretical concepts in real life.
- Study of specific cases for strengthen then new concepts.
- It is recommended to review the materials prior to the lectures to facilitate discussion and improve the quality of learning.

Laboratory Classes (5.4 credits)

- Introduction of necessary technologies and libraries to address the proposed cases.
- Problem-based methodology that allow students to apply the concepts, evaluate performance and identify pros and cons of the design decisions.
- In most of cases the student must solve the proposed practical cases supported by the teacher interaction and feedback.
- It is recommended the active participation of students in order to reinforce learning concepts and make the most of the available technologies.

Autonomous work:

- The autonomous work is essential to acquire an optimal use the ICT tools used during this course.
- It is recommended that the student meets all practical cases and problems posed by teachers in the different thematic units.

The first three weeks (Topic 1) are interspersed theoretical lectures with resolution activities. In subsequent weeks (Topics 2, 3 and 4) are introduced more practical sessions. In theoretical sessions (2h) new concepts are exposed and in the practical sessions (4h) students constructed the solution of one or more cases raised by the teacher. We also introduce Follow up meetings to check the development of solutions and give appropriate feedback and put together (sometimes with oral presentations) the solutions and discussing different design decisions from the point of view of performance.

The participation is considered essential and will be taken into account in assessing the different activities. The vehicular language is English, so its use in the classroom and in the writing of reports and exams will be considered relevant in the evaluation of the subject.

Development plan

Check the development plan in the following document: https://cv.udl.cat/access/content/group/102041-2324/DevelopmentPlan2324.pdf

Evaluation

The course is approved with a final mark greater or equal to 5. The final mark will be obtained from the weighted sum of the two Assessment Test, Oral Activities, Exercises, Projects and Individual Participation. The copy of any practice will involve not passing the course.

Objectives	Assesment Blocks	%	Dates	O/V (1)	I/G (2)	Remarks
Unit 1-2	**Exam block.** Assesment Test	10	Week 9	O	I	
Unit 3-4	**Project Validation block**		Week 16/17	O	I	
Unit 1-3	**Oral block.** Oral Presentations	10		O	I	
Unit 1-3	**Activities block (A).** Activities & Quizzes	30		O	I/G	
Unit 3-4	**Project block (P)** * Project 01 * Project 02	50 20 30	Weeks 11 & 15	O	G	
	Participation and Involvement block	5		V	I	extra points
Units 1, 2, 3, 4	Re-assesment	80	Week 19	V	I	Referred examinations

Objectives	Assesment Blocks	%	Dates	O/V (1)	I/G (2)	Remarks
Final = Exam1+ Oral + Activities + Project						

(1) Mandatory / Voluntary
(2) Individual / Group

(*) On week 19th the student can recover with an **Exam** or by delivering or improving some **Activities (A)** the marks on topics 1 and 2; and with a **validation exam** and the delivery or improvement of the **Project (P)** the Project mark.

Detecting plagiarism during the evaluation of an activity (exam, work, practice, etc.) will mean for all involved the failure grade in the activity. Besides, It can cause the student to lose the right to be evaluated and recover the subject as established in the UdL Assessment Regulations.

Alternative assessment

The student who has the approval to be evaluated by alternative evaluation (see requirements and procedure on the faculty website) must present, in the examination period established by the school's academic calendar, a written work and a questionnaire to be evaluated on topics 1 and 2, and carry out the two activities of the Project (P) block within the periods indicated in the teaching guide, to be evaluated on topics 3 and 4. The student will be able to recover the subject in the same terms as the rest of the students in the course.

Bibliography

Basic Bibliography

- Distributed Computing: Principles and Applications. M.L. LIU. 978-0201796445. Addison-Wesley; 1 edition (June 12th, 2003).
- Parallel Programming with MPI. P.S. Pacheco. 978-1558603394. Morgan Kaufmann Publishers , 1997.

Complementary Bibliography

- Distributed Systems: Principles and Paradigms. Andrew S. Tanenbaum, Maarten Van Steen. 978-0132392273. Prentice Hall; 2 edition (October 12th, 2006).
- Distributed Systems: Concepts and Design. George Coulouris, Jean Dollimore, Time Kindberg, Gordon Blair. 978-0132143011. Addison-Wesley; 5 edition (May 7th, 2011).
- Parallel Programming in C with Mpi and Openmp. Michael J. Quinn. 978-0072822564. McGraw-Hill Science/Engineering/Math; 1 edition (June 5th, 2003)