DEGREE CURRICULUM

DISTRIBUTED COMPUTING

Coordination: LERIDA MONSO, JOSEP LLUIS

Academic year 2017-18

DISTRIBUTED COMPUTING 2017-18

Subject's general information

Subject name	DISTRIBUTED COMPUTING
Code	102041
Semester	1st Q(SEMESTER) CONTINUED EVALUATION
Typology	<table><tr><th>Degree</th><th>Course</th><th>Typology</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></table>
ECTS credits	9
Groups	1GG
Theoretical credits	3.6
Practical credits	5.4
Coordination	LERIDA MONSO, JOSEP LLUIS
Department	INFORMATICA I ENGINYERIA INDUSTRIAL
Teaching load distribution between lectures and independent student work	9 ECTS = 90h face-to-face + 135h de autonomous work
Important information on data processing	Consult this link for more information.
Language	English
Office and hour of attention	Josep Lluís Lérida. Despatx 3.17. Edifici EPS. Contact by email with the teacher. Fernando Guirado Fernández. 3.17. Edifici EPS. Contact by email with the teacher. Santi Martinez Rodríguez. 1.05. Edifici EPS. Contact by email with the teacher.

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Professor/a (s/es)	Adreça electrònica professor/a (s/es)	Crèdits	Horari de tutoria/lloc
GERVÁS ARRUGA, JORGE	jordigervas@gmail.com	3,8	Arrange a meeting via email. (Office 1.06)
GUIRADO FERNANDEZ, FERNANDO	f.guirado@diei.udl.cat	3,6	Wednesday 18:00-20:00. (Office 3.17)
LERIDA MONSO, JOSEP LLUIS	jlerida@diei.udl.cat	3,4	Arrange a meeting via email. (Office 3.17)

Subject's extra information

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

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 What is distributed Computing?

1.3 Distributed System Architectures

1.4 Applications of Distributed Systems

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. Practicals

3.1 Overview and Concepts

3.2 Message-oriented applications: Client-Server and Group communication.

3.3 Object-oriented applications: RMI and Mobile Agents.

3.4 Internet applications: Web Services. Project.

4. Paralell Computing Applications

4.1 What is distributed parallel Computing?

4.2 Parallel Computing Models

4.3 Performance metrics

4.4 Performance metrics

4.5 MPI. Message Passing Interface.

4.6 Execution of Parallel applications in a real HPC Infrastructure

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 use of English in the classroom and in the reports to be submitted will be considered a significant section of the evaluation.

Development plan

Dates (Weeks)	Description	Face-to-Face Activity	FH (2) (Hours)	Autonomous Activity	AH (3) (Hours)
Week 1	Course Presentation	Exhibition events and methodology	1	Teaching Plan Review	2
	Evolution of Computing and Distributed Computing Definition	Lecture and Participatory classes	2		
	Activities 1 i 2	Problem Based Learning	3	Exercises resolution and study	8
Week 2	Distributed System Architectures and applications	Lecture and Participatory classes	3	Exercises resolution and study	8
	Activities 2, 3	Problem Based Learning and Study of cases	3	Exercises resolution and study	8
Week 3	Distributed Computing Paradigms: MP, C/S	Lecture and Participatory classes	2		
	Activities 4 (Statement)	Problem Based Learning and Study of cases	4		
Week 4	Distributed Computing Paradigms: P2P, MOM,RPC	Lecture and Participatory classes	2	Exercises resolution and study	8

	Activities 4 (Classroom)	Problem Based Learning and Study of cases	2		
	Activities 3 (Presentation)	Oral presentation	2		
Week 5	Distributed Computing Paradigms: RMI	Lecture and Participatory classes	3	Exercises resolution and study	8
	Activities 4 (Follow-up)	Problem Based Learning and Study of cases	2		
	Activities 5 (Statement)	Study of cases	1		
Week 6	Distributed Computing Paradigms: Advanced RMI	Lecture and Participatory classes	2	Exercises resolution and study	9
	Activities 4 (Presentation)	Problem Based Learning and Study of cases	4		
Week 7	Distributed Computing Paradigms: Object-Oriented, Mobile Agents.	Lecture and Participatory classes	3	Exercises resolution and study	8
	Activities 5 (Follow-up)	Study of cases	2		
	Activities 6 (Statement)	Study of cases	1		
Week 8	Distributed Computing Paradigms: Service-oriented	Lecture and Participatory classes	2	Exercises resolution and study	10
	Activities	Problem Based Learning	2		
Week 9	Test1. Evaluation Test	Individual written exam	2	Exercises resolution and study	4
Week 10	Distributed Computing Paradigms: Service-oriented	Lecture and Participatory classes	2	Exercises resolution and study	8
	Activities 6 (Follow-up) & Activities 7	Study of cases	4		
Week 11	Distributed Computing Paradigms: Service-oriented	Lecture and Participatory classes	2	Materials review and autonomous activity	8
	Activities 8	Study of cases	4		
Week 12	Distributed Computing Paradigms: Service-oriented	Lecture and Participatory classes	2	Exercises resolution and study	15
	Project WS	Problem Based Learning	2		
	Introduction to the Parallel Computing (1)	Lecture and Participatory classes	2		
Week 13	Introduction to the Parallel Computing (2)	Lecture and Participatory classes	2	Exercises resolution and study	8
Week 14	HPC Infrastructure Access - SGE	Lecture and Participatory classes	2	Exercises resolution and study	8
	MPI Introduction	Lecture and Participatory classes	2		
	MPI – Point to Point Communications	Lecture and Participatory classes	2		
Week 15	MPI – Performance Comparison	Lecture and Participatory classes	2	Exercises resolution and study	15
	MPI – Parallel I/O	Lecture and Participatory classes	2		
	MPI – Collective Communications	Lecture and Participatory classes	3		

Week 16 Week 17	Test2. Evaluation Test	Individual written exam	2
Week 18	Qualifications and Tutoring session		
Week 19	Recovery Test	Individual written exam	2

(2) FH = Face-to-Face Hours
(3) AH = Autonomous Hours

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 Activities	%	Dates	O/V (1)	I/G (2)	Remarks
Unit 1-3	**Test1.** Assesment Test	10	Week 9	O	I	
Unit 2-4	**Test2.** Assesment Test	15	Week 16	O	I	
Unit 1-4	**Oral.** Oral Activities	15	Week 6,8, 11	O	I	
Unit 1-4	**E.** Execises	30	Weeks 3, 6, 8, 11	O	G	
Unit 2-4	**P.** Projects	30	Weeks 14, 15	O	G	
	Participation and Involvement	5		V	I	
Units 1, 2, 3, 4	Recovery assesment	55	Week 19	V	I	Recoveries Week
Final = Test1+Test2+Oral+E+P						

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

(*) On the 19th week the student can recover with a writing exam the grade o the activites Test1 and Test2 (55%). Teachers can also request delivery or improvement of some activities **Exercises** (E) and / or **Projects** (P)

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

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Science/Engineering/Math; 1 edition (June 5th, 2003)