

Course guide

270531 - CC - Cloud Computing

Last modified: 02/02/2024

Unit in charge:	Barcelona School of Informatics		
Teaching unit:	701 - DAC - Department of Computer Architecture.		
Degree:	MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Optional subject).		
Academic year: 2023	ECTS Credits: 3.0	Languages: Catalan, Spanish	

LECTURER

Coordinating lecturer:	JORDI TORRES VIÑALS
Others:	Segon quadrimestre: JORDI TORRES VIÑALS - 10

PRIOR SKILLS

Python is the programming language of choice for the labs' sessions of this course. It is assumed that the student has a basic knowledge of Python prior to starting classes. Also, some experience with Linux basics will be necessary.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CDG1. Capability to integrate technologies, applications, services and systems of Informatics Engineering, in general and in broader and multidisciplinary contexts.

CTE6. Capability to design and evaluate operating systems and servers, and applications and systems based on distributed computing.

CTE9. Capability to apply mathematical, statistical and artificial intelligence methods to model, design and develop applications, services, intelligent systems and knowledge-based systems.

Generical:

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.

CG7. Capacity for implementation, direction and management of computer manufacturing processes, with guarantee of safety for people and assets, the final quality of the products and their homologation.

CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

Transversal:

CTR5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.

Basic:

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY

Class attendance and participation: Regular and consistent attendance is expected and to be able to discuss concepts covered during class. The theoretical activities include participatory lecture classes, which explain the basic contents of the course. Attendance in class is mandatory unless you have a reason to miss class that is acceptable to the instructor.

Students are responsible for all material and projects are given in class whether they are present or not. It is the responsibility of the student to obtain handouts, assignments, projects, etc. for any missed class from a fellow student.

Hands-on: Activities focused on the acquisition of knowledge through experimentation by "learn by doing" approach mixing theory and practice. Part of the hands-on will be conducted during a regular class sessions and part will be done out of the class sessions. All the hands-on will involve writing a report with all the results to be delivered to the "Racó"

Homework Assignments: Homework will be assigned weekly that includes reading the documentation that expands the concepts introduced during lectures, and periodically will include reading research papers related with the lecture of the week, and prepare presentations (with slides). Some students/groups randomly chosen will present their presentation.

Assessment: There will be 2 short midterm exams along the course.

Student presentation: Students/groups randomly chosen will present the homework (presentations/projects).

Final exam: At the end of the term the student will have an optional exam.

LEARNING OBJECTIVES OF THE SUBJECT

- 1.Cloud Computing Basics
- 2.Cloud Computing technologies
- 3.New relate paradigms
- 4.Cloud Computing and Big Data Analytics disruptive technologies
- 5.Cloud Computing role in Artificial Intelligence
- 6.Learn by doing

STUDY LOAD

Type	Hours	Percentage
Hours large group	13,5	18.00
Hours small group	13,5	18.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Cloud Computing paradigm

Description:

1.1 The evolution of the Cloud Computing | 1.2 Cloud deployment and services models

Cloud Computing technologies

Description:

2.1 Containers and orchestrators | 2.2 APIs: the doors in the Cloud



New relate paradigms

Description:

3.1 Serveless computing | 3.2 Edge computing

Cloud Computing and Big Data Analytics

Description:

4.1 Current Cloud computing software stack | 4.2 Current Cloud computers Hardware: the Paradigm shift

AI & DL: The next wave of Cloud

Description:

5.1 Programming DL | 5.2 Scaling DL applications

Midterm 1

Midterm 2

Attendance

Presentation 1

Presentation 2

Presentation 3

Presentation 4

Hands-on 1

Hands-on 2

Hands-on 3

Hands-on 4

Hands-on 5

Hands-on 6

ACTIVITIES

Cloud Computing paradigm

Specific objectives:

1

Related competencies :

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CTE6. Capability to design and evaluate operating systems and servers, and applications and systems based on distributed computing.

CDG1. Capability to integrate technologies, applications, services and systems of Informatics Engineering, in general and in broader and multidisciplinary contexts.

CTR5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h

Cloud Computing technologies

Specific objectives:

2

Related competencies :

CG7. Capacity for implementation, direction and management of computer manufacturing processes, with guarantee of safety for people and assets, the final quality of the products and their homologation.

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 6h

Theory classes: 2h

Self study: 4h

New relate paradigms

Specific objectives:

3

Related competencies :

CDG1. Capability to integrate technologies, applications, services and systems of Informatics Engineering, in general and in broader and multidisciplinary contexts.

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 5h

Theory classes: 1h

Self study: 4h

Cloud Computing and Big Data Analytics

Specific objectives:

4

Related competencies :

CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

CTE9. Capability to apply mathematical, statistical and artificial intelligence methods to model, design and develop applications, services, intelligent systems and knowledge-based systems.

CTE6. Capability to design and evaluate operating systems and servers, and applications and systems based on distributed computing.

Full-or-part-time: 5h

Theory classes: 1h

Self study: 4h

AI & DL: The next wave of Cloud

Specific objectives:

5

Related competencies :

CDG1. Capability to integrate technologies, applications, services and systems of Informatics Engineering, in general and in broader and multidisciplinary contexts.

CTE9. Capability to apply mathematical, statistical and artificial intelligence methods to model, design and develop applications, services, intelligent systems and knowledge-based systems.

CTE6. Capability to design and evaluate operating systems and servers, and applications and systems based on distributed computing.

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 11h 30m

Theory classes: 3h 30m

Self study: 8h

Hands-on

Specific objectives:

6

Related competencies :

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CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

CDG1. Capability to integrate technologies, applications, services and systems of Informatics Engineering, in general and in broader and multicisciplinary contexts.

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

Full-or-part-time: 22h 30m

Laboratory classes: 13h 30m

Guided activities: 1h

Self study: 8h

Homeworks (& Presentations)

Specific objectives:

6

Related competencies :

CG7. Capacity for implementation, direction and management of computer manufacturing processes, with guarantee of safety for people and assets, the final quality of the products and their homologation.

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

CDG1. Capability to integrate technologies, applications, services and systems of Informatics Engineering, in general and in broader and multicisciplinary contexts.

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

Full-or-part-time: 11h

Theory classes: 2h

Guided activities: 1h

Self study: 8h

Midterms

Specific objectives:

1, 2, 3, 4, 5, 6

Related competencies :

CG7. Capacity for implementation, direction and management of computer manufacturing processes, with guarantee of safety for people and assets, the final quality of the products and their homologation.

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

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CTE6. Capability to design and evaluate operating systems and servers, and applications and systems based on distributed computing.

CTR5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 10h

Theory classes: 2h

Self study: 8h

Attendance

Specific objectives:

1, 2, 3, 4, 5, 6

Related competencies :

CG7. Capacity for implementation, direction and management of computer manufacturing processes, with guarantee of safety for people and assets, the final quality of the products and their homologation.

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.

CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.

CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.

CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

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GRADING SYSTEM

The evaluation of this course can be obtained by continuous evaluation. This evaluation will take into account different items:

In-class exams will account for 10% of the grade:

Midterm 1: 5%

Midterm 2: 5%

Attendance & participation in class will account for 14% of the grade:

Each day: 1%

Homework, reading papers, and presentations will account for 25% of the grade:

Presentation 1: 13%

Presentation 2: 2%

Presentation 3: 5%

Presentation 4: 5%

Hands-on (+reports) will account for 51% of the grade:

Hands-on 1: 5%

Hands-on 2: 2%

Hands-on 3: 12%

Hands-on 4: 2%

Hands-on 5: 15%

Hands-on 6: 15%

Requirements for continuous evaluation is:

Minimum of 80% of attendance in class sessions

Minimum of 50% of Homework and presentations

Minimum of 50% of Hands-on

Course Exam, for those students who have not benefited from the continuous evaluation, will be announced during the course. This exam includes the evaluation of the knowledge of the entire course (practical part, theoretical part, and self-learning part of homework). During this exam, the student is not allowed to use any type of documentation (neither on paper nor digital).

BIBLIOGRAPHY

Basic:

- Torres, J. Hand-on sessions at GitHub.
- Torres, J. Slides of the course.
- Bond, J. The enterprise cloud : best practices for transforming legacy IT. Sebastopol: O'Really Media, Inc., 2015.
- Bagghi S., Siddiqui M., Wood P. and Zhang H., "Dependability in Edge Computing". Communications of the ACM [on line]. [Consultation: 15/03/2021]. Available on: <https://doi.org/10.1145/3362068>.
- Castro P., Ishakian V., Muthusamy V. and Slominsky A. "The rise of serverless computing". Communications of the ACM [on line]. november 2019 [Consultation: 15/03/2021]. Available on: <https://dl.acm.org/doi/pdf/10.1145/3368454>.

Complementary:

- Zaharia M, Xin R., Wendell P., Das T., Armbrust M., Dave A., Meng X., Rosen J.. "Apache Spark: a unified engine for big data processing". Communications of the ACM [on line]. [Consultation: 15/03/2021]. Available on: <https://dl.acm.org/doi/10.1145/2934664>.
- Russo B., Valle L., Bonzagni G., Locatello D., Pancaldi M. Tosi D. "Cloud computing and the new EU General Data Protection Regulation". IEEE Cloud Computing [on line]. Volume: 5, Issue: 6, Nov./Dec. 2018 [Consultation: 15/03/2021]. Available on: <https://ieeexplore-ieee-org.recurtos.biblioteca.upc.edu/document/8552651>.

RESOURCES

Hyperlink:

- <https://torres.ai/docencia/cc-mei-2019/>