1. OVERVIEW

Subject area	Concurrent and Distributed Programming
Degree	Bachelor's Degree in Computer Engineering
School/Faculty	Architecture, Engineering and Design
Year	Second
ECTS	6 ECTS
Type	Compulsory
Language(s)	Spanish
Delivery mode	On campus / Online
Semester	First semester
Year	2022/2023
Coordinating professor	Christian V. Sucuzhanay Arévalo
Teacher	Christian V. Sucuzhanay Arévalo

2. INTRODUCTION

The main aim of this subject area is to introduce students to the programming of concurrent applications, as well as knowledge of distributed systems and notions in the development of applications in cloud environments. This course introduces the basic concepts of concurrent programming and complex implementations that solve problems arising from concurrent processes.

The theoretical explanation is complemented by practical solutions to classic problems. It is also complemented by other programming problems and their expression and implementation using the programming languages **Java, C++ and Python.** It also aims to bring students closer to the world of research through reading scientific documents related to the subject area. The subject area is partly dedicated to the students' initial contact with cloud computing services and applications, using the computing platforms **Google Cloud** and/or **AWS** as a support.

On the other hand, largely due to the rapid evolution of technologies in the field of computer science, it is quite common for new professionals to interact with computers without acquiring the full power that a concurrent, distributed programming model can provide. This module fills this gap of knowledge, giving the students an in-depth view of the workings of concurrent, distributed and cloud applications and their possible use in current topics such as the Internet of Things (IoT) or Big Data.

3. SKILLS AND LEARNING OUTCOMES

- **Basic skills (CB, by the acronym in Spanish):** CB1: Students have demonstrated knowledge and understanding of a study area originating from general secondary school education, and are usually at the level where, with the support of more advanced textbooks, they may also demonstrate awareness of the latest developments in their field of study.
- CB2: Students know how to apply their knowledge to their work or vocation professionally and have the skills that are usually demonstrated by forming and defending opinions and solving problems within their study area.

- CB3: Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.
- CB4: Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
- CB5: Students have developed the necessary learning skills to undertake further studies with a high degree of independence.

Transversal skills (CT, by the acronym in Spanish):

- CT2: Self-confidence: Ability to evaluate one's own results, performance and skills with the self-determination necessary to complete tasks and meet any objectives.
- CT7: Awareness of ethical values: Ability to think and act in line with universal principles based on the individual's value, contributing to his/her full development and involving commitment to certain social values.
- CT8: Information management: Ability to seek, choose, analyse and integrate information from diverse sources.
- CT9: Interpersonal relationship skills: Ability to maintain positive relationships with other people through assertive verbal and non-verbal communication. This means being able to express or communicate what you want, think or feel without discomforting, offending or harming the feelings of other people.
- CT11: Planning and time management: Ability to set objectives and choose the right means to fulfil them through efficient use of time and resources.
- CT15: Responsibility: Ability to fulfil commitments to themselves and others when undertaking a task and try to meet a range of objectives within the learning process. Ability to face and accept the consequences of actions taken freely.
- CT16: Decision-making: Ability to choose between different options or methods to effectively solve varied situations or problems.
- CT17: Teamwork: Ability to integrate and collaborate actively with other people, areas and/or organizations to reach common goals.

Specific skills (CE, by their acronym in Spanish):

- CE3. Ability to understand and master the basic concepts of discrete mathematics, logic, algorithmics and computational complexity and how they are used to solve engineering problems.
- CE12. Knowledge and application of the basic algorithmic procedures of computer technologies to develop solutions to problems, analysing the suitability and complexity of the proposed algorithms.
- CE13. Knowledge, design and efficient use of the most appropriate data types and structures to solve a problem.
- CE27. Ability to assess the computational complexity of a problem, know algorithmic strategies that help to solve it, and recommend, develop and implement the strategy that guarantees the best performance according to the established requirements.

Learning outcomes (RA, by the acronym in Spanish):

- RA1. Explain how several processes are carried out concurrently on a single processor by means of time multiplexing.
- RA2. Describe the problems linked to concurrent programming and the solution to the problem of mutual exclusion.

- RA3. Identify the architecture of n-tier and client-server systems and the inherent communication mechanisms.
- RA4. Know the difference between the current distributed computing and cloud computing models. The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CE3, CE12, CT27, CT16, CT17	7. ASSESSMENT
CE3, CE12, CE27, CT16, CT17	7. ASSESSMENT
CE13, CT11, CT17	7. ASSESSMENT
CE13, CT11, CT17	7. ASSESSMENT

4. CONTENTS

The subject is organised into units in which the acquired theoretical knowledge will be applied:

- Synchronisation and communication mechanisms (mutual exclusion, locks, semaphores and monitor, message passing).
- Development of n-tier applications
- Development of C/S Applications using sockets
- Multithreading programming
- Remote procedure calls
- Distributed management of processes

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- **MD1. Survey on aims and interests.** This survey is used to establish the aims of the subject and gather the student's interests on the subject. We will then make reference to it throughout the year for the students to evaluate the achievement of the aims and interests.
- **MD2. Lectures, subjects of study and seminars.** The "lectures" taught in the on-campus delivery mode are called subjects of study and seminars in the online delivery mode, and are conducted through readings on the topic, technical notes and webinars (which are recorded for students to access), followed by a question forum on the topic with assistance from the professor.
- **MD3. Laboratory work**: the laboratories will mainly be used in the on-campus delivery mode.
- **MD4. a) Group research** and/or **b) group problem-solving.** This learning method will be used for the development of both declarative and procedural knowledge. In method type a), a different topic will be assigned to each group to be investigated. Later, new groups will be formed with students who have all studied a different topic, and these new groups will be proposed comprehension and problem-solving activities. In method type b), a series of short question and problem activities will be proposed to be solved in groups.
- **MD5. Designs**, understood as practical proposals for solving specific problems (unlike the study of practical cases, it is not a question of delving deeper into the analysis and the real problems. Instead, it is based on this knowledge, and the aim is to provide new solutions in accordance with engineering standards). These will be used for the development of procedural knowledge. They will

be used in all delivery modes and will help to develop creative potential and technical skills in the field of engineering.

- **MD8. Fieldwork, conferences, visits to companies and institutions.** These will be used for the development of conditional knowledge. In the on-campus delivery mode, all learning methods may be used, while only conferences can be used in the online delivery mode, as they will be available for remote access in real time (via *streaming* technologies) or recorded and broadcast afterwards.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity (AF, by the acronym in Spanish)	Number of hours
AF1: Lectures, reading on complementary topics and materials, implementation of activities carried out independently and in groups.	50 h
AF2: Group work, debates and seminars with group participation	25 h
AF3: Independent working	50 h
AF4: Tutorials, academic monitoring and assessment	25 h
TOTAL	**150 h**

Online:

Learning activity (AF, by the acronym in Spanish)	Number of hours
AF6: Lectures, reading on complementary topics and materials, implementation of activities carried out independently and in groups.	50 h
AF7: Group work, debates and seminars with group participation	25 h
AF3: Independent working	50 h
AF8: Tutorials, academic monitoring and assessment	25 h
TOTAL	**150 h**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject areas are listed below:

On campus:

Assessment system	Weighting
Exams (midterm and final)	30
Development of articles, reports or design briefs. (Practices)	30
Peer assessment, class participation (continuous evaluation), knowledge tests.	30
Case study, designs, simulations and research (Final Project)	10

Online:

Assessment system	Weighting
Exams (midterm and final)	60
Development of articles, reports or design briefs. (Practices)	20
Peer assessment, class participation (continuous evaluation), knowledge tests.	15
Case study, designs, simulations and research (Final Project)	5

On the Campus Virtual, when you open the subject area, you will find all the details of your assessable tasks and the deadlines and assessment procedures for each task.

7.1. Ordinary exam period

To pass the subject area in the ordinary exam period, you will need a final grade of at least 5 out of 10. In order for this to be possible, the following conditions must be met:

- In each midterm and final exam, you must achieve a grade higher than or equal to the minimum grade indicated as "passed" in each case (normally 5 out of 10).
- In each practical activity, you must achieve a grade higher than or equal to the minimum grade indicated as "passed" in each case (normally 5 out of 10).

You must have an average grade higher than or equal to the specified minimum (normally 5 out of 10) in the seminar activities, alternative activities and class participation activities.

If any of the above points are not met, the maximum possible grade in the ordinary exam period after applying the percentages will be 4 out of 10.

7.2. Extraordinary exam period (resits)

To pass the subject area in the extraordinary exam period, you will need a final grade of at least 5.0 out of 10.0 (weighted average) for the subject area.

You must retake activities that were failed or not delivered in the ordinary exam period, achieving a "passed" grade in each of them, with the same criteria indicated for the previous exam period. For this reason, the alternative activities proposed in the ordinary exam period will be put forward.

If any of the above points are not met, the maximum possible grade in the ordinary exam period after applying the percentages will be 4 out of 10.

7. ASSESSMENT

The timeline with submission dates for the assessable tasks in this subject area will be indicated in this section:

Assessable tasks	Date
Activity 1. Practical test 1 (topics 1, 2, 3) (Midterm exam)	Weeks 01–06
Activity 2. Practical test 2 (topics 4, 5, 6) (Final exam)	Weeks 16–18
Activity 3. Theoretical test 1 (Midterm exam) (topics 1, 2, 3)	Weeks 01–06
Activity 4. Theoretical test 2 (Final exam) (topics 4, 5, 6)	Weeks 16–18

The timeline may be subject to change for logistical reasons related to the activities. Students will be informed of any changes in due time and course.

9. BIBLIOGRAPHY

The recommended bibliography is indicated below:

- MARTLEY, S. Concurrent Programming: The Java Programming Language. Nueva York. Oxford. 1998 SZNAJDLEDER, Pablo Augusto. Java a fondo: estudio del lenguaje y desarrollo de aplicaciones. Alfaomega grupo editor, México, 2013
- LEA, Douglas. Programación concurrente en Java. Addison-Wesley, México, 2000.
- MARTLEY, S. Concurrent programming: the Java programming language. Oxford Univ Press, New York, 1998
- OAKS, Scott y WONG, Henry. Java Threads. 3rd. ed. 2004.
- Rajan, Legorie P. S, Google Cloud Platform cookbook, Packt Publishing, 2018, disponible en la biblioteca CRAI.

10. DIVERSITY AWARENESS UNIT

Students with special educational needs:

To ensure equal opportunities, curricular adaptations or adjustments for students with special educational needs will be outlined by the Diversity Awareness Unit (UAD, Spanish acronym).

As an essential requirement, students with special educational needs must obtain a report about the curricular adaptations/adjustments from the Diversity Awareness Unit by contacting unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. STUDENT SATISFACTION SURVEYS

Your opinion matters!

Universidad Europea encourages you to complete our satisfaction surveys to identify strengths and areas for improvement for staff, degrees and the learning process.

These surveys will be available in the survey area of your campus virtual or by email.

Your opinion is essential to improve the quality of the degree.

Many thanks for taking part.