COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001

INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

E.T.S. de Ingenieros
Informáticos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000805 - Analysis Of Concurrent And Distributed Systems

DEGREE PROGRAMME

10AR - Master Interuniversitario En Métodos Formales En Ingeniería Informática

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 2

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1. Description

1.1. Subject details

Name of the subject	103000805 - Analysis Of Concurrent And Distributed Systems
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	10AR - Master Interuniversitario en Métodos Formales en Ingeniería Informática
Centre	10 - Escuela Tecnica Superior De Ingenieros Informaticos
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Guillermo Roman Diez (Subject coordinator)	2304	guillermo.roman@upm.es	M - 12:00 - 15:00 W - 12:00 - 15:00 Please send an e-mail to set up an appointment
Clara Benac Earle	2307	clara.benac@upm.es	Tu - 12:00 - 14:00 Th - 12:00 - 14:00 F - 12:00 - 14:00 Please send an e-mail to set up an

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			appointment
Lars-ake Fredlund	2309	larsake.fredlund@upm.es	M - 10:00 - 13:00 Th - 10:00 - 13:00 Please send an e-mail to set up an appointment

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

2.3. External faculty

Name and surname	Email	Institution
Pablo Gordillo	pabgordi@ucm.es	Facultad de Informática. Universidad Complutense de Madrid
Albert Rubio	alberu04@ucm.es	Facultad de Informática. Universidad Complutense de Madrid

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Programming (moderate to advanced skills)

- Basic notions of Concurrent and Multi-threaded Programming

- First-order Logic

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4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB07 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE02 - Capacidad para utilizar de forma competente las herramientas existentes de demostración automática y asistida de teoremas y de propiedades matemáticas.

CE03 - Capacidad para utilizar técnicas y herramientas avanzadas, automáticas y asistidas, para verificar formalmente que un programa o sistema informático satisface las propiedades lógicas previamente especificadas.

CE04 - Capacidad para utilizar y desarrollar herramientas que analizan automáticamente propiedades de los programas, utilizando tan solo el texto fuente de los mismos.

CE05 - Capacidad para utilizar y desarrollar herramientas que analizan propiedades de los programas, mediante su ejecución en un conjunto de casos cuidadosamente seleccionado.

CG05 - Capacidad para la aplicación de los conocimientos adquiridos para resolver problemas en entornos nuevos o poco conocidos dentro de contextos amplios y multidisciplinares, siendo capaces de integrar dichos conocimientos.

CG07 - Capacidad para comprender trabajos de investigación y para crear nuevo conocimiento en el área de los métodos formales aplicados a la Ingeniería Informática.

CT01 - Capacidad para trabajar en equipo, ya sea como un miembro más o realizando la labor de dirección del mismo, promoviendo el libre intercambio de ideas.

CT02 - Capacidad para fomentar la creatividad tanto propia como la de los restantes miembros del equipo.

CT03 - Capacidad de razonamiento crítico como vía para mejorar la generación y desarrollo de ideas en un contexto profesional o de investigación.

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4.2. Learning outcomes

RA11 - Ability to specify the formal semantics of a distributed systems

RA12 - Ability to specify safety and liveness properties of distributed systems

RA14 - Ability to competently use tools for analyzing and validating distributed systems

RA13 - Ability to develop static analysis for distributed systems

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

Concurrent and distributed programming consists in designing software as collections of interacting computing processes, each following its flow of instructions. The use of concurrent and distributed programming is not new, but it has has intensified recently and now is an integrated part of many programming languages. This kind of programs pose a collection of challenging problems that require specific analysis techniques. In this course we will see the basics of semantics of concurrent and distributed programs, identify properties specific to these programs, and present both static and dynamic analysis techniques for analyzing them.

5.2. Syllabus

1. Semantics of Concurrent and Distributed Programs

2. Static analysis of concurrent and distributed systems

3. Analysis and verification of smart contracts

4. Dynamic analysis of concurrent and distributed systems

5. Property-based testing of concurrent systems

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Semantics of Concurrent and Distributed Systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			**Practice exercise Semantics** Individual work Progressive assessment and Global Examination Not Presential Duration: 01:30
2	**Static analysis of concurrent and distributed systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
3	**Static analysis of concurrent and distributed systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
4	**Static analysis of concurrent and distributed systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			**Practice exercise Static Analysis** Individual work Progressive assessment and Global Examination Not Presential Duration: 01:30
5	**Analysis and Verification of smart contracts** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
6	**Analysis and Verification of smart contracts** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			

7	**Analysis and Verification of smart contracts** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			**Practice exercise Smart Contracts** Individual work Progressive assessment and Global Examination Not Presential Duration: 01:30
8	**Dynamic analysis of concurrent and distributed systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
9	**Dynamic analysis of concurrent and distributed systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
10	**Dynamic analysis of concurrent and distributed systems** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			**Practice exercise Dynamic Analysis** Individual work Progressive assessment and Global Examination Not Presential Duration: 01:30
11	**Property-based testing** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
12	**Property-based testing** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
13	**Property-based testing** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			
14	**Property-based testing** Duration: 01:30 Lecture **Guided practice** Duration: 01:30 Laboratory assignments			**Practice exercise Property-based testing** Individual work Progressive assessment and Global Examination Not Presential Duration: 01:30

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15				
16	**Paper presentation** Duration: 01:00 Additional activities			**Paper presentation** Individual presentation Progressive assessment and Global Examination Presential Duration: 01:00
17	**Paper presentation** Duration: 01:00 Additional activities			

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

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7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Practice exercise Semantics	Individual work	No Presential	01:30	5%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
4	Practice exercise Static Analysis	Individual work	No Presential	01:30	15%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
7	Practice exercise Smart Contracts	Individual work	No Presential	01:30	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05

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Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
10	Practice exercise Dynamic Analysis	Individual work	No Presential	01:30	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
14	Practice exercise Property-based testing	Individual work	No Presential	01:30	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
16	Paper presentation	Individual presentation	Face-to-face	01:00	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Practice exercise Semantics	Individual work	No Presential	01:30	5%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05

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4	Practice exercise Static Analysis	Individual work	No Presential	01:30	15%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
7	Practice exercise Smart Contracts	Individual work	No Presential	01:30	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
10	Practice exercise Dynamic Analysis	Individual work	No Presential	01:30	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
14	Practice exercise Property-based testing	Individual work	No Presential	01:30	20%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05

| 16 | Paper presentation | Individual presentation | Face-to-face | 01:00 | 20% | 3 / 10 | CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05 |

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Practice Exam Semantics	Individual work	Face-to-face	01:30	5.73%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
Practice Exam Static Analysis	Individual work	Face-to-face	01:30	17.14%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05

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Practice Exam Smart Contracts	Individual work	Face-to-face	01:30	17.14%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
Practice Exam Dynamic Analysis	Individual work	Face-to-face	01:30	17.14%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
Practice Exam Property-based testing	Individual work	Face-to-face	01:30	22.85%	3 / 10	CB06 CB07 CB10 CG05 CG07 CT01 CT02 CT03 CE02 CE03 CE04 CE05
Paper presentation	Individual presentation	Face-to-face	00:20	20%	3 / 10	CB06 CB07 CG05 CG07 CT01 CT02 CT03

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7.2. Assessment criteria

Progressive evaluation and global evaluation:

The grade of all practice exams will consider the attendance and participation. The minimum grade required for the practice exams is 3/10 and the minimum grade for passing the course is 5/10 in the final grade.

Referred evaluation:

All practice exercises can be submitted again to pass the course in the referred evaluation.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Moodle	Web resource	All material will be available online at https://www.ucm.es/campusvirtual

9. Other information

9.1. Other information about the subject