



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



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

2022/23 - Semester 2

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Learning guide

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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 of 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 | 2022-23 |

2. Faculty

2.1. Faculty members with subject teaching role

| Name and surname | Office/Room | Email | Tutoring hours * |
|-------------------------|--------------------|--------------------|---|
| 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 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 |
| 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 |

* 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 |
|-------------------------|-----------------|---|
| Albert Rubio | alberu04@ucm.es | Facultad de Informática. Universidad Complutense de Madrid |
| Jesús Correas Fernández | jcorreas@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

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.

4.2. Learning outcomes

RA13 - Ability to develop static analysis for distributed systems

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

* 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 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 | Classroom activities | Laboratory activities | Distant / On-line | Assessment activities |
|------|--|---|-------------------|--|
| 1 | Semantics of Concurrent and Distributed Systems Duration: 01:30 | Guided practice Duration: 01:30 | | Practice Exam Semantics Continuous assessment and final examination Not Presential Duration: 01:30 |
| 2 | Static analysis of concurrent and distributed systems Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 3 | Static analysis of concurrent and distributed systems Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 4 | Static analysis of concurrent and distributed systems Duration: 01:30 | Guided practice Duration: 01:30 | | Practice Exam Static Analysis Continuous assessment and final examination Not Presential Duration: 01:30 |
| 5 | Analysis and Verification of smart contracts Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 6 | Analysis and Verification of smart contracts Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 7 | Analysis and Verification of smart contracts Duration: 01:30 | Guided practice Duration: 01:30 | | Practice Exam Smart Contracts Continuous assessment and final examination Not Presential Duration: 01:30 |
| 8 | Dynamic analysis of concurrent and distributed systems Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 9 | Dynamic analysis of concurrent and distributed systems Duration: 01:30 | Guided practice Duration: 01:30 | | |

| | | | | |
|----|--|---|--|---|
| 10 | Dynamic analysis of concurrent and distributed systems Duration: 01:30 | Guided practice Duration: 01:30 | | Practice Exam Dynamic Analysis Continuous assessment and final examination Not Presential Duration: 01:30 |
| 11 | Property-based testing Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 12 | Property-based testing Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 13 | Property-based testing Duration: 01:30 | Guided practice Duration: 01:30 | | |
| 14 | Property-based testing Duration: 01:30 | Guided practice Duration: 01:30 | | Practice Exam Property-based testing Continuous assessment and final examination Not Presential Duration: 01:30 |
| 15 | | | | Paper presentation Continuous assessment and final examination Presential Duration: 01:30 |
| 16 | | | | |
| 17 | | | | |

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.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

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 Exam Semantics | | No Presential | 01:30 | 5.73% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 4 | Practice Exam Static Analysis | | No Presential | 01:30 | 17.14% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 7 | Practice Exam Smart Contracts | | No Presential | 01:30 | 17.14% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |

| | | | | | | | |
|----|--------------------------------------|--|---------------|-------|--------|--------|--|
| 10 | Practice Exam Dynamic Analysis | | No Presential | 01:30 | 17.14% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 14 | Practice Exam Property-based testing | | No Presential | 01:30 | 22.85% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 15 | Paper presentation | | Face-to-face | 01:30 | 20% | 3 / 10 | CG05 CG07 CB06 CB07 CT01 CE02 CE03 |

7.1.2. Global examination

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|-------------------------|----------|---------------|----------|--------|---------------|--|
| 1 | Practice Exam Semantics | | No Presential | 01:30 | 5.73% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |

| | | | | | | | |
|----|--------------------------------------|--|---------------|-------|--------|--------|--|
| 4 | Practice Exam Static Analysis | | No Presential | 01:30 | 17.14% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 7 | Practice Exam Smart Contracts | | No Presential | 01:30 | 17.14% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 10 | Practice Exam Dynamic Analysis | | No Presential | 01:30 | 17.14% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |
| 14 | Practice Exam Property-based testing | | No Presential | 01:30 | 22.85% | 3 / 10 | CE05 CG05 CG07 CB06 CB07 CB10 CE04 CT01 CT02 CT03 CE02 CE03 |

| | | | | | | | |
|----|--------------------|--|--------------|-------|-----|--------|--|
| 15 | Paper presentation | | Face-to-face | 01:30 | 20% | 3 / 10 | CG05 CG07 CB06 CB07 CT01 CE02 CE03 |
|----|--------------------|--|--------------|-------|-----|--------|--|

7.1.3. Referred (re-sit) examination

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

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

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