



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

**103000538 - Agent-based software development**

### DEGREE PROGRAMME

10AM - Master Universitario En Ingenieria Del Software

### ACADEMIC YEAR & SEMESTER

2018/19 - Semester 2

## Index

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### Learning guide

1. Description.....	1
2. Faculty.....	1
3. Prior knowledge recommended to take the subject.....	2
4. Skills and learning outcomes .....	2
5. Brief description of the subject and syllabus.....	3
6. Schedule.....	5
7. Activities and assessment criteria.....	8
8. Teaching resources.....	10

## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	103000538 - Agent-based software development
<b>No of credits</b>	6 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 2
<b>Tuition period</b>	February-June
<b>Tuition languages</b>	English
<b>Degree programme</b>	10AM - Master universitario en ingeniería del software
<b>Centre</b>	10 - Escuela Técnica Superior de Ingenieros Informaticos
<b>Academic year</b>	2018-19

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Ricardo Imbert Paredes (Subject coordinator)	D-5112	ricardo.imbert@upm.es	Tu - 15:00 - 18:00 W - 15:00 - 18:00
Angelica De Antonio Jimenez	D-3354	angelica.deantonio@upm.es	M - 11:00 - 13:00 W - 13:00 - 14:00 F - 10:30 - 13:30

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

## 3. Prior knowledge recommended to take the subject

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### 3.1. Recommended (passed) subjects

El plan de estudios Master Universitario en Ingeniería del Software no tiene definidas asignaturas previas recomendadas para esta asignatura.

### 3.2. Other recommended learning outcomes

- Programming (java)

## 4. Skills and learning outcomes \*

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### 4.1. Skills to be learned

CE13 - Tener una visión de los distintos aspectos específicos y emergentes de la ingeniería del software, y profundizar en algunos de ellos

CE14 - Comprender lo que pueden y no pueden conseguir las prácticas actuales de ingeniería del software, y sus limitaciones y su posible futura evolución.

### 4.2. Learning outcomes

RA2 - Facing a real problem, chooses an appropriate Software Engineering solution, analyzing its viability, what can and cannot be achieved from the current state of development of the selected solution, and what is expected to advance in the future

RA1 - Within an application field of Software Engineering, uses and designs the appropriate solution to solve some of its problems, describing the technical difficulties and the application limits

RA3 - Explains which are the Software Engineering limits and frontiers, and the base of new tendencies and developments and advanced topics and their possible application

\* 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

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### 5.1. Brief description of the subject

The continuous search for more powerful and of a higher level new abstraction mechanisms has lead nowadays towards a new development paradigm, based on software agents. This approach, which has been so many times referred as the final solution for all the previously unaffordable problems, far from being a "silver bullet", must be considered as another software development paradigm and, as such, subject to the Software Engineering discipline.

This subject will introduce the students into this new paradigm, settling the basic concepts of the technology, offering them a wide perspective of the current Software Engineering efforts in this area, always from a practical and applied perspective.

### 5.2. Syllabus

1. Introduction to agents
  - 1.1. General concepts
  - 1.2. Agent architectures
  - 1.3. Social nature of agents
2. Agent oriented software engineering
  - 2.1. Pitfalls of agent oriented development
  - 2.2. Standards
  - 2.3. Agent communication languages
  - 2.4. Development frameworks
  - 2.5. Methodologies
  - 2.6. Development notations
3. Agent oriented analysis
  - 3.1. Concepts for building agents
  - 3.2. Analysis according to different methodologies
  - 3.3. Goal identification
  - 3.4. Role modelling

- 3.5. Interface description
- 4. Agent oriented architectural design
  - 4.1. Architectural design according to different methodologies
  - 4.2. Agent type decision
  - 4.3. System architecture
  - 4.4. Interaction model
- 5. Agent oriented detailed design (part I)
  - 5.1. Detailed design according to different methodologies
  - 5.2. Detailed protocols
  - 5.3. Process specifications
  - 5.4. Ontology design
- 6. Agent implementation
  - 6.1. Introduction to an agent oriented development framework
  - 6.2. Administrative tools
  - 6.3. Execution of an agent
  - 6.4. Agent behaviors
  - 6.5. Agent messaging
- 7. Agent oriented detailed design (part II)
  - 7.1. Ontology construction
  - 7.2. Specification of ACL messages
  - 7.3. Packaging protocols
  - 7.4. Agent detailed desing
- 8. Development process
  - 8.1. Development scenario
  - 8.2. Development strategy
  - 8.3. Development team roles
  - 8.4. Project startup stage
  - 8.5. Project iteration stage

## 6. Schedule

### 6.1. Subject schedule\*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	<b>1. Introduction to agents</b> Duration: 02:00 Lecture  <b>2 Agent oriented software engineering</b> Duration: 00:15 Lecture			<b>Exercise about risks on agent based software engineering</b> Group work Continuous assessment and final examination Duration: 00:45
2	<b>2 Agent oriented software engineering</b> Duration: 00:30 Lecture  <b>3. Agent oriented analysis</b> Duration: 01:00 Lecture  <b>3. Agent oriented analysis</b> Duration: 01:30 Problem-solving class			
3	<b>8. Development process</b> Duration: 00:30 Cooperative activities		<b>Meeting in the classroom for the second practical assignment</b> Duration: 00:30 Cooperative activities	<b>Presentation in the classroom of the first practical assignment</b> Individual presentation Continuous assessment and final examination Duration: 02:00
4	<b>4 Agent oriented architectural design</b> Duration: 01:15 Lecture		<b>Project coordination</b> Duration: 03:00 Additional activities  <b>Project coordination</b> Duration: 03:00 Additional activities	<b>Exercise about systems topology</b> Group work Continuous assessment and final examination Duration: 00:45
5			<b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities  <b>Project coordination</b> Duration: 03:00 Additional activities	
6	<b>5. Agent oriented detailed design (part I)</b> Duration: 02:30 Lecture			<b>Exercise about agent communication protocols</b> Individual work Continuous assessment and final examination Duration: 00:30

7	<p><b>6. Agent implementation</b> Duration: 01:00 Lecture</p> <p><b>7. Agent oriented detailed design (part II)</b> Duration: 01:00 Lecture</p> <p><b>8. Development process</b> Duration: 00:20 Lecture</p>		<p><b>Meeting in the classroom for the second practical assignment</b> Duration: 00:40 Cooperative activities</p> <p><b>Project coordination</b> Duration: 03:00 Additional activities</p>	
8			<p><b>Integration test meeting in the classroom</b> Duration: 02:00 Cooperative activities</p> <p><b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities</p> <p><b>Project coordination</b> Duration: 03:00 Additional activities</p>	
9			<p><b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities</p> <p><b>Project coordination</b> Duration: 03:00 Additional activities</p>	
10			<p><b>Integration test meeting in the classroom</b> Duration: 02:00 Cooperative activities</p> <p><b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities</p> <p><b>Project coordination</b> Duration: 03:00 Additional activities</p>	
11			<p><b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities</p> <p><b>Project coordination</b> Duration: 03:00 Additional activities</p>	
12			<p><b>Integration test meeting in the classroom</b> Duration: 02:00 Cooperative activities</p> <p><b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities</p> <p><b>Project coordination</b> Duration: 03:00</p>	



			Additional activities	
13			<b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities  <b>Project coordination</b> Duration: 03:00 Additional activities	
14			<b>Integration test meeting in the classroom</b> Duration: 02:00 Cooperative activities  <b>Meeting in the classroom for the second practical assignment</b> Duration: 01:00 Cooperative activities  <b>Project coordination</b> Duration: 03:00 Additional activities	
15			<b>Integration test meeting in the classroom</b> Duration: 02:00 Cooperative activities	
16				<b>Presentation of the second practical assignment in the classroom</b> Group presentation Continuous assessment and final examination Duration: 02:00  <b>Exercise about agent based development</b> Group work Continuous assessment Duration: 01:00
17				<b>Exercise about comparison of agent based methodologies</b> Individual work Final examination Duration: 05:00  <b>Student implication and participation</b> Other assessment Continuous assessment Duration: 00:00

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

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 subject schedule is based on a previous theoretical planning of the subject plan and might go through experience some unexpected changes along throughout the academic year.

## 7. Activities and assessment criteria

### 7.1. Assessment activities

#### 7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Exercise about risks on agent based software engineering	Group work	Face-to-face	00:45	4%	0 / 10	CE14
3	Presentation in the classroom of the first practical assignment	Individual presentation	Face-to-face	02:00	15%	3 / 10	CE13 CE14
4	Exercise about systems topology	Group work	Face-to-face	00:45	4%	0 / 10	CE13
6	Exercise about agent communication protocols	Individual work	Face-to-face	00:30	3%	0 / 10	CE13
16	Presentation of the second practical assignment in the classroom	Group presentation	Face-to-face	02:00	60%	4 / 10	CE13 CE14
16	Exercise about agent based development	Group work	Face-to-face	01:00	4%	0 / 10	CE13
17	Student implication and participation	Other assessment	No Presential	00:00	10%	0 / 10	CE13

#### 7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Exercise about risks on agent based software engineering	Group work	Face-to-face	00:45	4%	0 / 10	CE14
3	Presentation in the classroom of the first practical assignment	Individual presentation	Face-to-face	02:00	15%	3 / 10	CE13 CE14
4	Exercise about systems topology	Group work	Face-to-face	00:45	4%	0 / 10	CE13
6	Exercise about agent communication protocols	Individual work	Face-to-face	00:30	3%	0 / 10	CE13
16	Presentation of the second practical assignment in the classroom	Group presentation	Face-to-face	02:00	60%	4 / 10	CE13 CE14
17	Exercise about comparison of agent based methodologies	Individual work	Face-to-face	05:00	14%	0 / 10	CE13 CE14

#### 7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Exercise about risks on agent based software engineering	Individual work	Face-to-face	03:00	4%	0 / 10	CE14
First practical assignment	Individual work	Face-to-face	03:00	15%	3 / 10	CE13 CE14
Exercise about systems topology	Individual work	Face-to-face	03:00	4%	0 / 10	CE13
Exercise about agent communication protocols	Individual work	Face-to-face	03:00	3%	0 / 10	CE13
Second practical assignment	Group work	Face-to-face	50:00	60%	4 / 10	CE13 CE14
Exercise about comparison of agent based methodologies	Individual work	Face-to-face	05:00	14%	0 / 10	CE13 CE14

## 7.2. Assessment criteria

The subject is marked following continuous assessment.

The student passes the subject only if 5 or more points on 10 are obtained at the end of the course, regarding the following criteria:

**FINAL GRADE = 3% Individual exercises in the classroom + 12% Group exercises in the classroom + 15% First practical assignment + 60% Second practical assignment + 10% Student participation**

The final grade will be obtained from five components: (1) individual exercises and (2) group exercises performed in the classroom; (3) a first practical assignment consisting in a brief document and a classroom presentation about applications of agents (proposed by the professor); (4) a second practical assignment about a group development of a multiagent system, with weekly classroom meetings and weekly software integration group activities, also in the classroom; and (5) participation and implication of the student in the subject.

The maximum grade for each of these components and the minimum mark needed to compensate non-passed parts are indicated in the following table.

	MAXIMUM GRADE  (and correspondence over the final grade)	MINIMUM GRADE TO COMPENSATE NON-PASSED PARTS  (and correspondence over the final grade)
Individual exercises in the classroom	10 (0,3)	-

(3%)		
Group exercises in the classroom (12%)	10 (1,2)	-
First practical assignment (15%)	10 (1,5)	3 (0,45)
Second practical assignment (60%)	10 (6)	4 (2,4)
Student participation (10%)	10 (1)	-

When failed, first and second practical assignment could be repeated in the extra exam period, using the new marks together to the ones obtained in individual and group exercises in the classroom and student participation in the previous period to calculate the final grade of the subject.

## 8. Teaching resources

### 8.1. Teaching resources for the subject

Name	Type	Notes
de Antonio, A. and Imbert, R. (2005) Combining Requirements Engineering and Agents. In A. Silva and J. L. Maté (eds.) Requirements Engineering for Sociotechnical Systems, pp. 68-83. Idea Group Publishing, Hersey, PA, USA.	Bibliography	Agent oriented analysis 
Bellifemine, F., Caire, G. and Greenwood, D. (2007) Developing Multi-Agent Systems with JADE. John Wiley & Sons Ltd, England.	Bibliography	Agent implementation
Bratman, M. E., Israel, D. and Pollack, M. (1988) Plans and Resource-Bounded Practical Reasoning. Computational Intelligence, 4(4): pp. 349-355.	Bibliography	Introduction to agents: concepts

Brooks, R. A. (1991) Intelligence without Representation. Artificial Intelligence, 47: p. 139-159.	Bibliography	Introduction to agents: reactive architectures
Franklin, S. and Graesser, A. (1996) Is It an Agent, or Just a Program?: A Taxonomy for Autonomous Agents. In Intelligent Agents III. Agent Theories, Architectures and Languages (ATAL-96), vol. 1193. Springer-Verlag, Berlin, Germany.	Bibliography	Introduction to agents: definition
Jennings, N. R., Sycara, K. and Wooldridge, M. (1998) A Roadmap of Agent Research and Development. Journal of Autonomous Agents and Multi-Agent Systems, 1(1): pp. 7-38.	Bibliography	Introduction to agents: general view
Müller, H. J. (1997) Towards Agent Systems Engineering. Data & Knowledge Engineering, 23: pp. 217-245.	Bibliography	Architecture conceptualization and design
Padgham, L. and Winikoff, M. (2004) Developing Intelligent Agent Systems. John Wiley & Sons Ltd, England.	Bibliography	Agent oriented development
Rao, A. S. and Georgeff, M. P. (1995) BDI Agents: From Theory to Practice. In V. Lesser (ed.), Proceedings of the First International Conference on Multi-Agent Systems, ICMAS-95, pp. 312-319. MIT Press, San Francisco.	Bibliography	Introduction to agents: BDI
Shoham, Y. and Leyton-Brown, K. (2009) Multiagent Systems. Algorithmic, Game-Theoretic, and Logical Foundations. Cambridge University Press, USA.	Bibliography	Design of multiagent systems

Sterling, L.S. and Taveter, K. (2009) The Art of Agent-Oriented Modeling. The MIT Press, Cambridge, Massachusetts, USA.	Bibliography	Modeling of multiagent systems
Sycara, K. (1998) Multiagent Systems. AI Magazine, 19(2): pp. 79-92.	Bibliography	Social nature of agents
Wooldridge, M. (2002) An Introduction to MultiAgent Systems. John Wiley & Sons Ltd. Chichester, England.	Bibliography	Introduction to agents: general view
Wooldridge, M., Jennings, N. R., Kinny, D. (2000) The Gaia Methodology For Agent-Oriented Analysis And Design. Autonomous Agents and Multi-Agent Systems, 3(3), pp. 285-312. Kluwer Academic publishers.	Bibliography	Agent oriented methodology: Gaia
Zambonelli, F., Jennings, N. R. and Wooldridge, M. (2003) Developing Multiagent Systems: The Gaia Methodology. ACM Transactions on Software Engineering and Methodology, 12(3): pp. 317-370.	Bibliography	Agent oriented methodology: Gaia
<a href="http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=1054">http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=1054</a>	Web resource	Subject Moodle site
Room 6202	Equipment	Lecture and group work room