



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

**103000879 - Virtual Intelligent Systems**

### DEGREE PROGRAMME

10AZ - Master Universitario en Innovación Digital

### ACADEMIC YEAR & SEMESTER

2019/20 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	103000879 - Virtual Intelligent Systems
<b>No of credits</b>	4 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 1
<b>Tuition period</b>	September-January
<b>Tuition languages</b>	English
<b>Degree programme</b>	10AZ - Master Universitario en Innovación Digital
<b>Centre</b>	10 - Escuela Tecnica Superior de Ingenieros Informaticos
<b>Academic year</b>	2019-20

## 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>
Angelica De Antonio Jimenez (Subject coordinator)	3354	angelica.deantonio@upm.es	Th - 12:00 - 14:30 F - 10:30 - 14:00
Jaime Ramirez Rodriguez	5112	jaime.ramirez@upm.es	M - 11:00 - 12:00 Tu - 12:00 - 14:00 F - 11:00 - 14:00

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

## 3. Skills and learning outcomes \*

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### 3.1. 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

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CE-DIPO02 - Capacidad para evaluar la interacción persona-ordenador de productos y servicios de alto valor innovador

CE-DIPO03 - Habilidad para hacer conexiones entre los deseos y necesidades del consumidor o cliente y lo que la tecnología puede ofrecer

CG03 - La capacidad de usar la lengua inglesa de manera competente, es decir, con capacitación para tareas complejas de trabajo y estudio.

CG06 - Capacidad para gestionar la información.

## 3.2. Learning outcomes

RA31 - Be able to sketch a project for the development of an intelligent virtual environment, establishing the process to be followed, the technologies to be used, the interaction possibilities to offer, and the role to be played by intelligent virtual agents, selecting the most appropriate technologies, architectures and tools for the development.

RA32 - Be able to design and conduct a research process in the área of technologies, architectures, intelligent agent capabilities, or human-computer interaction, in the context of an intelligent virtual environment

RA17 - Acquire specialized knowledge from innovative fields of studies

\* 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.

## 4. Brief description of the subject and syllabus

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### 4.1. Brief description of the subject

This subject allows deepening into Intelligent Virtual Environments as a specific kind of computer systems:

- with very peculiar characteristics regarding human computer interaction (three dimensional environments in which the user is immersed and interacts with the objects, other users and autonomous agents)
- with specific technologies that support their construction and use (Virtual Reality and Augmented Reality devices)
- with very important and promising applications that demand more research and development efforts (such as educational or design applications)
- and still with many open challenges and research opportunities for the future

The main research and development trends in the area of Intelligent Virtual Environments will be presented, with a special focus on the peculiarities of 3D interaction, the challenges associated with the design of intelligent virtual agents, and educational applications.

## 4.2. Syllabus

1. Virtual Reality and Augmented Reality Technologies
  - 1.1. Basic Concepts in Virtual and Augmented Reality
  - 1.2. Devices and Technologies for Virtual and Augmented Reality
  - 1.3. Specific Challenges in Augmented Reality
2. Virtual Environment Development
  - 2.1. Tasks and Tools for the Development of a Virtual Environment
  - 2.2. 3D Interaction Tasks and Techniques
3. Virtual Humans
  - 3.1. Architecture and Components of a Virtual Human
  - 3.2. Perception in a Virtual Human
  - 3.3. The Mind of a Virtual Human
  - 3.4. Actuation Capabilities in a Virtual Human
4. Virtual Reality and Augmented Reality Applications
  - 4.1. Educational Applications: Virtual Tutors
  - 4.2. Industrial Applications: Design and Verification
  - 4.3. Applications in Culture and Entertainment

## 5. Schedule

### 5.1. Subject schedule\*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	<b>Subject Presentation</b> Duration: 02:00			
2	<b>Chapter 1 - VR and AR Concepts</b> Duration: 02:00			
3	<b>Chapter 1 - VR and AR Technologies</b> Duration: 02:00			<b>Reading test in Moodle</b>  Continuous assessment and final examination Duration: 04:00
4	<b>Chapter 1 - Specific Challenges in AR</b> Duration: 02:00			<b>Definition of Research Work (this is a preliminary and non evaluated task)</b>  Continuous assessment and final examination Duration: 01:00
5	<b>Chapter 2 - Tasks for VE development</b> Duration: 02:00			<b>Reading Test in Moodle</b>  Final examination Duration: 04:00  <b>Reading test in Moodle</b>  Continuous assessment and final examination Duration: 04:00
6	<b>Chapter 2 - 3D Interaction Tasks and Techniques</b> Duration: 02:00			
7	<b>Chapter 2 - VE Development Tasks and Tools</b> Duration: 02:00			<b>Preparation of Advance Presentation for Research Work (the result of this task will be evaluated with the Advance Presentation for Research Work)</b>  Continuous assessment Duration: 06:00
8				<b>Advance Presentation for Research Work</b>  Continuous assessment Duration: 02:00

9	<b>Chapter 3 - Architecture and Components of a Virtual Human</b> Duration: 02:00			
10	<b>Chapter 3 - Perception in a VH</b> Duration: 02:00			<b>Review of the Advance Presentation of another student</b>  Continuous assessment Duration: 01:00
11	<b>Chapter 3 - The Mind of a VH</b> Duration: 02:00			
12	<b>Chapter 3 - Actuation capabilities in a VH</b> Duration: 02:00			<b>Reading Test in Moodle</b>  Continuous assessment Duration: 04:00
13	<b>Chapter 4 - Educational and other Applications of IVEs</b> Duration: 02:00			<b>Preparation of Final Presentation for Research Work (the result of this task will be evaluated with the Final Presentation for Research Work)</b>  Continuous assessment Duration: 08:00
14	<b>Final Presentations of Research Work</b> Duration: 02:00			
15	<b>Final Presentations of Research Work</b> Duration: 02:00			<b>Final Presentation of Research Work</b>  Continuous assessment and final examination Duration: 02:00  <b>Review of the Research Work of another student (presentation and report)</b>  Continuous assessment Duration: 05:00  <b>Delivery of Commented Bibliography</b>  Continuous assessment and final examination Duration: 04:00  <b>Delivery of Final Report of the Research Work</b>  Continuous assessment and final examination Duration: 35:00  <b>Participation in the classroom</b>  Continuous assessment Duration: 02:00



16				
17				<b>Only Final Evaluation Exam</b>  Final examination Duration: 01:30

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.

## 6. Activities and assessment criteria

### 6.1. Assessment activities

#### 6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Reading test in Moodle		No Presential	04:00	5%	/ 10	CB06
4	Definition of Research Work (this is a preliminary and non evaluated task)		No Presential	01:00	%	/ 10	
5	Reading test in Moodle		No Presential	04:00	5%	/ 10	CB06
7	Preparation of Advance Presentation for Research Work (the result of this task will be evaluated with the Advance Presentation for Research Work)		No Presential	06:00	%	/ 10	
8	Advance Presentation for Research Work		Face-to-face	02:00	10%	/ 10	CB09 CG03
10	Review of the Advance Presentation of another student		No Presential	01:00	10%	/ 10	CB09 CG03 CB08
12	Reading Test in Moodle		No Presential	04:00	5%	/ 10	CB06
13	Preparation of Final Presentation for Research Work (the result of this task will be evaluated with the Final Presentation for Research Work)		No Presential	08:00	%	/ 10	
15	Final Presentation of Research Work		Face-to-face	02:00	15%	5 / 10	CB09 CG03
15	Review of the Research Work of another student (presentation and report)		Face-to-face	05:00	10%	/ 10	CB09 CG03 CB08
15	Delivery of Final Report of the Research Work		No Presential	35:00	30%	5 / 10	CB09 CG03 CB07 CB08 CB06 CE-DIPO02 CE-DIPO03

15	Delivery of Commented Bibliography		No Presential	04:00	5%	/ 10	CB06 CG06 CB08
15	Participation in the classroom		Face-to-face	02:00	5%	/ 10	

### 6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Reading test in Moodle		No Presential	04:00	5%	/ 10	CB06
4	Definition of Research Work (this is a preliminary and non evaluated task)		No Presential	01:00	%	/ 10	
5	Reading Test in Moodle		No Presential	04:00	5%	/ 10	CB06
5	Reading test in Moodle		No Presential	04:00	5%	/ 10	CB06
15	Final Presentation of Research Work		Face-to-face	02:00	15%	5 / 10	CB09 CG03
15	Delivery of Final Report of the Research Work		No Presential	35:00	30%	5 / 10	CB09 CG03 CB07 CB08 CB06 CE-DIPO02 CE-DIPO03
15	Delivery of Commented Bibliography		No Presential	04:00	5%	/ 10	CB06 CG06 CB08
17	Only Final Evaluation Exam		Face-to-face	01:30	35%	5 / 10	CB07 CB08 CB06

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

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final exam		Face-to-face	02:00	35%	5 / 10	CB07 CB08 CB06
Reading tests in Moodle		Face-to-face	09:00	15%	/ 10	CB06
Research work (report and commented bibliography)		Face-to-face	25:00	50%	5 / 10	CB09 CG03 CG06 CB07 CB08 CB06 CE-DIPO02 CE-DIPO03

## 6.2. Assessment criteria

The course has a theoretical and a practical side.

The theoretical part will be dealt with through lectures and the established mandatory readings. This part will be evaluated via Moodle tests.

The practical part will be evaluated via an individual work that consists on an initiation to research. Each pupil will deepen into one of the following topics:

- - Virtual Reality and Augmented Reality technologies
- - Interaction in Virtual Environments
- - Virtual Humans and their capabilities
- - Virtual Learning Environments. Virtual Tutors
- - Virtual Environment Applications

Each pupil will produce a report as a result of the research work. This report should have a minimum length of 15 pages, not counting references. The report should offer a historical perspective (what has been done, and when) as well as a technical perspective (description of the main results in the area, viewpoints, contributions...). A critical approach and the identification of research opportunities will be positively valued.

The work can also consist on the design of an experimental work. In this case, an application area will be chosen, one or more interesting hypotheses should be posed, and a procedure to test the hypotheses should be designed.

For each document or paper that has been read in the preparation of the report (even if finally it was not relevant and cited in the report) a brief summary paragraph should be written. The report should include an appendix with all these summaries.

In the classroom, each pupil should perform an intermediate advance presentation of their work, aimed to describe the approach selected, the degree of advance, and the plan for the future work.

Also, at the end of the semester, each pupil should perform a final presentation of the work and the results obtained.

On the other hand, each pupil will act as a reviewer for another pupil, being responsible for the evaluation of the

written report and both oral presentations. The review work performed will also be evaluated by the instructor.

The weights for the assessment of the different activities are as follows (evaluated competences are indicated in parentheses):

- Moodle Tests: 15%
- Research Work: 60%, que se descompone en:
  - Intermediate advance presentation: 10%
  - Final report: 30%
  - Final Presentation: 15%
  - Bibliographic Analysis: 5%
- Reviewer Work: 20%
- Participation in the classroom: 5%

For students in Final Exam mode, the evaluation criteria are as follows:

Moodle Tests: 15%

Research Work: 50%, que se descompone en:

- Final report: 30%
- Final Presentation: 15%
- Bibliographic Analysis: 5%

Final Exam: 35

## 7. Teaching resources

### 7.1. Teaching resources for the subject

Name	Type	Notes
Understanding Virtual Reality: Interface, Application, and Design, William R. Sherman, Alan Craig, Morgan Kaufmann, 2003	Bibliography	
3D User Interfaces: Theory and Practice, Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, Ivan Poupyrev, Addison-Wesley Professional, 2004	Bibliography	
Cassell, J. (2001) Embodied conversational agents: representation and intelligence in user interfaces, AI Magazine, Volume 22, Issue 4, pp. 67 - 83	Bibliography	
Designing Virtual Worlds, Richard Bartle, New Riders Games, 2003	Bibliography	
Animated agents for procedural training in virtual reality: Perception, cognition and motor control. Rickel, J., Johnson, W. L. Applied Artificial Intelligence 13, 343-382, 1999	Bibliography	
Dehn, D., van Mulken, S. (2000) The impact of animated interface agents: a review of empirical research, Int. J. Human-Computer Studies, 52, 1-22	Bibliography	
Gratch, J.; Rickel, J. et al ?Creating Interactive Virtual Humans: some assembly required? IEEE Intelligent systems july/august 2002, pp.2-11.	Bibliography	

Greenhalgh, C., Benford, S. and Reynard, G., A QoS Architecture for Collaborative Virtual Environments, ACM Multimedia (MM'99), Orlando, Florida, November, 1999, ACM Press	Bibliography	
M.R. Macedonia, and M. J. Zyda: ?A Taxonomy for Networked Virtual Environments?, IEEE Multimedia, Jan-Mar, 1997, pp. 48-56.	Bibliography	
D.A. Bowman, L.F. Hodges (1997). An Evaluation of Techniques for Grabbing and Manipulating Remote Objects in Immersive Virtual Environments. Proceedings of the ACM Symposium on Interactive 3D Graphics, pp. 35-38.	Bibliography	
Sitio Moodle de la asignatura ( <a href="http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=2580">http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=2580</a> )	Web resource	
<a href="http://electronics.howstuffworks.com/gadgets/other-gadgets/virtual-reality.htm">http://electronics.howstuffworks.com/gadgets/other-gadgets/virtual-reality.htm</a>	Web resource	
<a href="http://computer.howstuffworks.com/augmented-reality.htm">http://computer.howstuffworks.com/augmented-reality.htm</a>	Web resource	
Ronald T. Azuma. A survey of augmented reality. Presence: Teleoperators and Virtual Environments, 6(4):355-385, August 1997	Bibliography	
"A Taxonomy of Mixed Reality Visual Displays." IEICE Transactions on Information Systems E77-D (12): 1321-1329	Bibliography	

## 8. Other information

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### 8.1. Other information about the subject

The course is related to the Sustainable Development Goals SDG3, SDG4 and SDG9 (La asignatura se relaciona con los objetivos ODS3, ODS4 y ODS9).

The following specific outcomes are also addressed by this course:

CE-DIPO01: Ability to conceptualise, design and develop the human computer interaction and design of innovative products and services

CE-DIPO03: Ability to make connections between the wishes and needs of the consumer or client and what technology can offer