COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001

INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

E.T.S. de Ingenieros
Informaticos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000879 - Virtual Intelligent Systems

DEGREE PROGRAMME

10AZ - Master Universitario En Innovación Digital

ACADEMIC YEAR & SEMESTER

2021/22 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	103000879 - Virtual Intelligent Systems
No of credits	4 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	10AZ - Master Universitario en Innovación Digital
Centre	10 - Escuela Tecnica Superior De Ingenieros Informaticos
Academic year	2021-22

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Jaime Ramirez Rodriguez	5112	jaime.ramirez@upm.es	M - 16:00 - 18:00 Tu - 16:00 - 18:00 Th - 16:00 - 18:00 Previous appointment is recommended
Angelica De Antonio Jimenez (Subject coordinator)	5108	angelica.deantonio@upm.es	W - 10:30 - 14:00 Th - 09:30 - 12:00 Previous appointment is needed. Contact at

			angelica.deantonio @upm.es

* 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 *

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

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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.

RA99 - Understand tools and process needed to deploy virtual reality applications

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

* 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

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

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5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Subject Presentation** Duration: 02:00		**Subject Presentation** Duration: 02:00	
2	**Chapter 1 - VR and AR Concepts** Duration: 02:00		**Chapter 1 - VR and AR Concepts** Duration: 02:00	
3	**Chapter 1 - VR and AR Technologies** Duration: 02:00		**Chapter 1 - VR and AR Technologies** Duration: 02:00	**Reading test in Moodle** Continuous assessment and final examination Not Presential Duration: 04:00
4	**Chapter 1 - Specific Challenges in AR** Duration: 02:00		**Chapter 1 - Specific Challenges in AR** Duration: 02:00	**Definition of Research Work (this is a preliminary and non evaluated task)** Continuous assessment and final examination Not Presential Duration: 01:00
5	**Chapter 2 - Tasks for VE development** Duration: 02:00		**Chapter 2 - Tasks for VE development** Duration: 02:00	**Reading Test in Moodle** Final examination Not Presential Duration: 04:00 **Reading test in Moodle** Continuous assessment and final examination Not Presential Duration: 04:00
6	**Chapter 2 - 3D Interaction Tasks and Techniques** Duration: 02:00		**Chapter 2 - 3D Interaction Tasks and Techniques** Duration: 02:00	
7	**Chapter 2 - VE Development Tasks and Tools** Duration: 02:00		**Chapter 2 - VE Development Tasks and Tools** Duration: 02:00	**Preparation of Advance Presentation for Research Work (the result of this task will be evaluated with the Advance Presentation for Research Work)** Continuous assessment Not Presential Duration: 06:00

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8			Advance Presentation for Research Work Duration: 02:00	Advance Presentation for Research Work Continuous assessment Presential Duration: 00:20
9	Chapter 3 - Architecture and Components of a Virtual Human Duration: 02:00		Chapter 3 - Architecture and Components of a Virtual Human Duration: 02:00	
10	Chapter 3 - Perception in a VH Duration: 02:00		Chapter 3 - Perception in a VH Duration: 02:00	Review of the Advance Presentation of another student Continuous assessment Not Presential Duration: 01:00
11	Chapter 3 - The Mind of a VH Duration: 02:00		Chapter 3 - The Mind of a VH Duration: 02:00	
12	Chapter 3 - Actuation capabilities in a VH Duration: 02:00		Chapter 3 - Actuation capabilities in a VH Duration: 02:00	Reading Test in Moodle Continuous assessment Not Presential Duration: 04:00
13	Chapter 4 - Educational and other Applications of IVEs Duration: 02:00		Chapter 4 - Educational and other Applications of IVEs Duration: 02:00	
14				Preparation of Final Presentation for Research Work (the result of this task will be evaluated with the Final Presentation for Research Work) Continuous assessment Not Presential Duration: 08:00
15				
16	Final Presentations of Research Work Duration: 04:00		Final Presentations of Research Work Duration: 04:00	Participation in the classroom Continuous assessment Presential Duration: 02:00 **Delivery of Commented Bibliography** Continuous assessment and final examination Not Presential Duration: 04:00 **Review of the Research Work of another student (presentation and report)** Continuous assessment Presential Duration: 05:00 **Final Presentation of Research Work** Continuous assessment and final examination Presential

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				Duration: 00:20
				Delivery of Final Report of the Research Work
				Continuous assessment and final examination
				Not Presential
				Duration: 35:00
17				**Only Final Evaluation Exam**
				Final examination
				Presential
				Duration: 01:30

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.

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	00:20	10%	/ 10	CB09 CG03
10	Review of the Advance Presentation of another student		No Presential	01:00	10%	/ 10	CB08 CB09 CG03
12	Reading Test in Moodle		No Presential	04:00	5%	/ 10	CB06
14	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	
16	Delivery of Final Report of the Research Work		No Presential	35:00	30%	5 / 10	CE-DIPO02 CE-DIPO03 CB06 CB07 CB08 CB09 CG03
16	Delivery of Commented Bibliography		No Presential	04:00	5%	/ 10	CB06 CB08 CG06
16	Review of the Research Work of another student (presentation and report)		Face-to-face	05:00	10%	/ 10	CB08 CB09 CG03

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16	Final Presentation of Research Work		Face-to-face	00:20	15%	5 / 10	CB09 CG03
16	Participation in the classroom		Face-to-face	02:00	5%	/ 10	CB08 CB09 CG03

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
16	Delivery of Final Report of the Research Work		No Presential	35:00	30%	5 / 10	CE-DIPO02 CE-DIPO03 CB06 CB07 CB08 CB09 CG03
16	Delivery of Commented Bibliography		No Presential	04:00	5%	/ 10	CB06 CB08 CG06
16	Final Presentation of Research Work		Face-to-face	00:20	15%	5 / 10	CB09 CG03
17	Only Final Evaluation Exam		Face-to-face	01:30	35%	5 / 10	CB06 CB07 CB08

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	CB06 CB07 CB08
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	CE-DIPO02 CE-DIPO03 CB06 CB07 CB08 CB09 CG03 CG06

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	

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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	

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Sitio Moodle de la asignatura (http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=2580)	Web resource	
http://electronics.howstuffworks.com/gadgets/other-gadgets/virtual-reality.htm	Web resource	
http://computer.howstuffworks.com/augmented-reality.htm	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

8.1. Other information about the subject

The course is related to the Sustainable Development Goals SDG3, SDG4 and SDG9.

- SDG3 Good Health and Wellbeing - Ensuring healthy lives and promoting well-being at all ages is essential to sustainable development. Extended Reality is successfully being applied in the health domain, with interesting applications in rehabilitation, psychological treatment, improvement of physical and cognitive state in older people, and others. The course presents the potential of XR in this domain.
- SDG4 Quality Education - Education enables upward socioeconomic mobility and is a key to escaping poverty. Extended Reality can increase the opportunities to access high quality education and training. The course presents the potential of XR in this domain.
- SDG9 Industry, Innovation and Infrastructure - Least developed countries, in particular, need to accelerate

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the development of their manufacturing sector. Extended Reality can help to minimize the cost of training manufacturing personnel, planning and evaluating manufacturing processes. The course presents the potential of XR in this domain.