



UNIVERSIDAD  
POLITÉCNICA  
DE MADRID

PROCESO DE  
COORDINACIÓN DE LAS  
ENSEÑANZAS PR/CL/001



E.T.S. de Ingeniería de  
Sistemas Informáticos

# ANX-PR/CL/001-01

## GUÍA DE APRENDIZAJE

### ASIGNATURA

**615001053 - Video Game Development and Artificial Intelligence**

### PLAN DE ESTUDIOS

61IW - Grado En Ingeniería Del Software

### CURSO ACADÉMICO Y SEMESTRE

2023/24 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	615001053 - Video Game Development and Artificial Intelligence
<b>No of credits</b>	6 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	Third year
<b>Semester of tuition</b>	Semester 5
<b>Tuition period</b>	September-January
<b>Tuition languages</b>	English
<b>Degree programme</b>	61IW - Grado en Ingeniería del Software
<b>Centre</b>	61 - Escuela Tecnica Superior De Ingeniería De Sistemas Informáticos
<b>Academic year</b>	2023-24

## 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>
Jesus Mayor Marquez (Coordinador/a)		jesus.mayor@upm.es	--

\* Tutoring hours are approximate and may be subject to change. Tutoring times should be confirmed with the teaching staff.

## 3. Prior knowledge recommended to take the subject

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### 3.1. Recommended (passed) subjects

- Programacion Concurrente Y Avanzada
- Programacion Orientada A Objetos
- Algebra

### 3.2. Other recommended learning outcomes

The subject - other recommended learning outcomes, are not defined.

## 4. Skills and learning outcomes

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### 4.1. Skills to be learned

CC15 - Knowledge and application of the fundamental principles and basic techniques of intelligent systems and their practical application.

CC17 - Ability to design and evaluate human-computer interfaces to ensure accessibility and usability of computer systems, services and applications.

CT13 - Communication in English: To be able to communicate in English in a professional environment.

CT8 - Teamwork: To be able to work as a member of an interdisciplinary team in order to contribute to the development of projects with pragmatism and a sense of responsibility, assuming commitments taking into account the available resources.

## 4.2. Learning outcomes

RA136 - Knows and applies basic algorithms and techniques to solve linear algebra problems: Gauss and Gauss-Jordan algorithms, matrix calculus, diagonalisation of matrices.

RA266 - Develop Intelligent Systems in complex environments

RA103 - Develops user interfaces for software

RA154 - Apply Dijkstra's algorithm to solve distance problems and Kruskal's algorithm to solve minimum weight spanning tree problems.

RA47 - Is able to work as a member of a team with the aim of contributing to the development of projects with pragmatism and a sense of responsibility, assuming commitments and taking into account available resources.

RA151 - Evaluate and construct recursive functions and use the principles of induction to prove properties of numbers and lists.

RA304 - Get to know the fundamentals and potential of Deep Learning

## 5. Brief description of the subject and syllabus

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### 5.1. Brief description of the subject

This course provides the learning bases for the development of video game engines. In addition, it will specialize in using artificial intelligence on them, trying to generate content, intelligent behaviors, and even simulations of realistic behaviors in three or two dimensions.

## 5.2. Syllabus

1. Introduction to computer graphics.
  - 1.1. Vector and matrix operations.
  - 1.2. Linear transformations and change of basis.
  - 1.3. Projective geometry and quaternions.
2. Game engine
  - 2.1. Rendering and Illumination.
  - 2.2. Sound and user experience.
  - 2.3. Game programming 3D
  - 2.4. Game programming 2D
3. Applied artificial intelligence to video games
  - 3.1. Path-finding algorithms.
  - 3.2. Decision making.
  - 3.3. Procedural content generation.
  - 3.4. Reinforcement Learning with agents.

## 6. Schedule

### 6.1. Subject schedule \*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	<p><b>1.-Introduction to computer graphics.;</b>  <b>1.1.-Vector and matrix operations</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p> <p><b>1.2.-Linear transformations and change of basis</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p>			
2	<p><b>1.3.-Projective geometry and quaternions.</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p>	<p><b>Rotations and movement. Simple collision solver.</b>            Duration 02:00            Laboratory assignments</p>		<p><b>Rotations and movement. Simple collision solver. Resultados de aprendizaje (RA136).</b>            Other assessment            Continuous assessment            No presential            Duration: 02:00</p>
3	<p><b>2.1.-Game engines.</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p>	<p><b>Prototyping a videogame.</b>            Duration: 02:00            Laboratory assignments</p>		<p><b>Prototyping a videogame. Resultados de aprendizaje (RA103)</b>            Other assessment            Continuous assessment            No presential            Duration: 02:00</p>
4	<p><b>2.2.-Rendering and Illumination.</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p> <p><b>2.3.-Sound and user experience</b>            Duración: 01:00            LM: Actividad del tipo Lección Magistral</p>	<p><b>Spatialized sound.</b>            Duration 01:00            Laboratory assignments</p>		<p><b>Spatialized sound. Resultados de aprendizaje (RA103)</b>            Other assessment            Continuous assessment            No presential            Duration: 01:00</p>
5	<p><b>2.4.-Game Programming.</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p>			
6	<p><b>2.4.-Game Programming</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p>	<p><b>Programming first game.</b>            Duration: 02:00            Laboratory assignments</p>		<p><b>Programming first game. Resultados de aprendizaje (RA151)</b>            Other assessment            Continuous assessment            No presential            Duration: 02:00</p>
7	<p><b>2.5.-Two dimensions game development.</b>            Duración: 02:00            LM: Actividad del tipo Lección Magistral</p>	<p><b>Project: sesion1.</b>            Duration: 02:00            Laboratory assignments</p>		<p><b>Exam 1</b>            Online test            Continuous assessment            Presential            Duration: 03:00</p>

8	<b>2.5.-Two dimensions game development.</b> Duration: 02:00 Lecture	<b>Programming game 2D.</b> Duration: 02:00 Laboratory assignments		<b>Programming game 2D. Resultados de aprendizaje (RA103)</b> Other assessment Continuous assessment No presential Duration: 02:00
9	<b>3.-Applied artificial intelligence to video games;3.1.-Path finding algorithms.</b> Duration: 02:00 Lecture			
10	<b>3.2.-Decision making.</b> Duration: 02:00 Lecture	<b>Programming path finding.</b> Duration: 02:00 Laboratory assignments		<b>Programming path finding. Resultados de aprendizaje (RA154)</b> Other assessment Continuous assessment No presential Duration: 02:00
11		<b>Decision making.</b> Duration: 02:00 Laboratory assignments  <b>Project: Sesion 2.</b> Duration: 02:00 Laboratory assignments		<b>Decision making. Resultados de aprendizaje (RA266)</b> Other assessment Continuous assessment No presential Duration: 02:00
12	<b>3.3.-Procedural content generation.</b> Duration: 02:00 Lecture	<b>Procedural generation.</b> Duration: 02:00 Laboratory assignments		<b>Procedural generation. Resultados de aprendizaje (RA266)</b> Other assessment Continuous assessment No presential Duration: 02:00
13	<b>3.4.-Reinforcement Learning with agents.</b> Duration: 02:00 Lecture			
14		<b>ML Agents practice.</b> Duration: 02:00 Laboratory assignments		<b>Agents in videogames. Resultados de aprendizaje (RA266, RA304)</b> Other assessment Continuous assessment No presential Duration: 02:00  <b>Project sesion 3. Resultados de aprendizaje (RA47)</b> Other assessment Continuous assessment No presential Duration: 02:00  <b>Project solo prueba final</b> Other assessment Assessment final test only No presential Duration: 02:00
15		<b>ML Agents practice.</b> Duration: 02:00 Laboratory assignments		<b>Agents in videogames. Resultados de aprendizaje (RA266, RA304)</b> Other assessment Continuous assessment No presential Duration: 02:00



16				
17				<b>Exam 2</b> Online test Continuous assessment Presential Duration: 03:00  <b>Exam Prueba final</b> Online test Assessment final test only Presential Duration: 03:00

For the calculation of the total values, it is estimated that for each ECTS credit the student will spend, depending on the study plan, between 26 and 27 hours of face-to-face and non-face-to-face work.

## 7. Activities and assessment criteria

### 7.1. Assessment activities

#### 7.1.1. Assessment (progressive)

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Rotations and movement. Simple collision solver. Resultados de aprendizaje (RA136).	Other assessment	No Presential	02:00	4%	/ 10	CT13
3	Prototyping a videogame. Resultados de aprendizaje (RA103)	Other assessment	No Presential	02:00	4%	/ 10	CT13
4	Spatialized sound. Resultados de aprendizaje (RA103)	Other assessment	No Presential	01:00	4%	/ 10	CT13
6	Programming first game. Resultados de aprendizaje (RA151)	Other assessment	No Presential	02:00	4%	/ 10	CT13
7	Exam 1	Online test	Presential	03:00	20%	4 / 10	CT13
8	Programming game 2D. Resultados de aprendizaje (RA103)	Other assessment	No Presential	02:00	4%	/ 10	CC17 CT13
10	Programming path finding. Resultados de aprendizaje (RA154)	Other assessment	No Presential	02:00	4%	/ 10	CC17 CT13
11	Decision making. Resultados de aprendizaje (RA266)	Other assessment	No Presential	02:00	4%	/ 10	CC17 CT13

12	Procedural generation. Resultados de aprendizaje (RA266)	Other assessment	No Presential	02:00	4%	/ 10	CC17 CT13
14	Agents in videogames. Resultados de aprendizaje (RA266, RA304)	Other assessment	No Presential	02:00	4%	/ 10	CC17 CT13
14	Project sesion 3. Resultados de aprendizaje (RA47)	Other assessment	No Presential	02:00	20%	4 / 10	CC15 CC17 CT8 CT13
15	Agents in videogames. Resultados de aprendizaje (RA266, RA304)	Other assessment	No Presential	02:00	4%	/ 10	CC15 CC17 CT13
17	Exam 2	Online test	Presential	03:00	20%	4 / 10	CC15 CC17 CT13

### 7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
14	Project solo prueba final	Other assessment	No Presential	02:00	50%	4 / 10	CT13 CC15 CC17
17	Exam Prueba final	Online test	Presential	03:00	50%	4 / 10	CC15 CC17 CT13

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

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Convocatoria extraordinaria proyecto	Other assessment	Presential	02:00	50%	4 / 10	CC15 CC17 CT13
Examen convocatoria extraordinaria	Written test	Presential	03:00	50%	4 / 10	CT13 CC15 CC17

## 7.2. Assessment criteria

### Ordinary call for progressive assessment:

A total of 10 practicals representing 40% of the total mark.

Two midterm exams involving 40% of the grade. Minimum mark in both exams is 4/10. In the second exam, the first exam can be made up, including extra questions for the make-up exam.

A project to be presented at the end of the course as a group, accounting for 20% of the total mark. Minimum mark is 4/10.

### Ordinary call for global assessment:

A comprehensive exam accounting for 50% of the mark. Minimum mark of 4/10.

An individual final project, accounting for 50% of the total mark. Minimum mark of 4/10.

### Extraordinary call for applications:

An exam involving 50% of the mark. Minimum mark of 4/10.

An individual project, accounting for 50% of the total mark. Minimum mark of 4/10.

### Clarifications:

- ♦ The mid-term exams are releasable, in the case of being passed, no further questions will be asked on those subjects. In the case of global assessment, the exam will be the same as the final progressive exam if the first part is not passed. As for the extraordinary exam, the liberatory parts will cease to be valid, and the whole subject will have to be assessed.
- ♦ In the event that a student passes the practicals or the exam and fails the course, this mark will not be saved for subsequent years.

## 8. Teaching resources

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### 8.1. Teaching resources for the subject

Name	Type	Notes
3D Math Primer for Graphics and Game Development	Bibliography	Fletcher Dunn
Programming Game AI By Example	Bibliography	Mat Buckland
Game Programming Patterns	Bibliography	Robert Nystrom
GPU Gems 3	Bibliography	Hubert Nguyen
Software	Web resource	Software de libre distribución aplicable al contenido de la asignatura.
Plataforma teleformación	Others	Moodle platform:  <a href="https://moodle.upm.es/titulaciones/oficiales">https://moodle.upm.es/titulaciones/oficiales</a> .  Contiene: programa detallado de la asignatura.
Equipamiento	Equipment	Aula equipada con ordenador, proyector de video y pizarra. Laboratorio con ordenadores con software adecuado para la realización de las prácticas.