



## (\*)Escola Superior de Enxeñaría Informática

### Presentation

In 1991, the University School of Technical Engineering in Computer Management of the University of Vigo was created in the Campus of Ourense together with the degree of Technical Engineering in Computer Management, in order to respond to the needs of graduates in Computer Science demanded by the Galician society. In 1999, after the concession to this Centre of the second cycle of the degree in Computer Engineering, it changed its name to Escuela Superior de Enxeñaría Informática (ESEI).

Currently, the Centre offers the following degrees:

- **Degree in Computer Engineering:** A degree adapted to the EEES that incorporates two different professional profiles that are highly attractive in the Galician socio-economic environment:
  - Software Engineering
  - Information Technologies
- **Degree in Artificial Intelligence:** provides the broad, in-depth and multidisciplinary training required by professionals in this field and which is essential to successfully build the intelligent services and applications that are having such an important impact on our lives at all levels.

This is an inter-university degree in the Galician University System, of four courses (240 ECTS), in which the subjects of the first two courses are common to the three universities (A Coruña, Santiago and Vigo). In the third and fourth years, the University of Vigo develops the orientation in Intelligent Information Systems (SII).

- **University Master's Degree in Computer Engineering:** a degree linked to the profession of Computer Engineering, with 90 ECTS and one and a half years adapted to the EHEA. Its objective is to provide the graduate student with in-depth training in management and administration in the area of information technology, as well as solid knowledge in specific technologies associated with different professional profiles in this field. Graduates acquire technical, communication and leadership skills that enable them to start up their own business or to join management positions in the ICT area in companies and organisations.
- **Master's Degree in Artificial Intelligence:** an inter-university degree, offered by the Universities of A Coruña, Santiago de Compostela and Vigo, which is a complete programme for the training of professionals and entrepreneurs in this branch of knowledge.

All the information about the Centre and its degrees is available on the website [esei.uvigo.es](http://esei.uvigo.es).

### Organization chart

#### management team Director

: Arno Formella

- He is responsible for the running of the School, implementing the agreements of the collegiate bodies, executing the budget and representing the Centre both within the University and before institutions and society in general.
- Email: [formella\(at\)uvigo.es](mailto:formella(at)uvigo.es)
- Telephone: +34 988 387 002

#### Deputy Director of Planning

: Francisco Javier Rodríguez Martínez

- He is responsible for the planning, definition, implementation, evaluation and monitoring of the procedures and processes of the ESEI.
- Email: franjrm(at)uvigo.es
- Telephone: +34 988 387 022

#### **Deputy Director of Academic Organisation**

: Rosalía Laza Fidalgo

- She is responsible for the organisation of teaching at the School: timetables, exam calendars, teaching control, control of tutorials...
- Email: rlaza(at)uvigo.es
- Telephone: +34 988 387 013

#### **Deputy Director of Quality**

: Eva Lorenzo Iglesias

- She is in charge of ensuring compliance with the Internal Quality Assurance System.
- Email: eva(at)uvigo.es
- Telephone: +34 988 387 019

#### **Secretary of the Centre**

: María Encarnación González Rufino

- She is in charge of taking the minutes of the School's collegiate bodies, as well as certifying the agreements taken in them.
- Email: secretaria.esei(at)uvigo.es
- Telephone: +34 988 387 016

Within the management team, the secretary of the school, María Encarnación González Rufino, is the

#### **Equality Liaison Officer**

, and is responsible for the dynamisation and implementation of equality policies. This person is the liaison with the

#### **Equality Unit**

of the University of Vigo to contribute to the application and monitoring of the measures proposed in the I Plan for Equality between women and men of the University of Vigo, with a view to achieving a more balanced participation of women and men in our University.

In addition to the management team, there are several professors in charge of coordinating the degree courses:

#### **Coordinator of the Degree in Computer Engineering**

: Eva Lorenzo Iglesias

Email: eva(at)uvigo.es

Phone: +34 988 387 019

#### **Coordinator of the Degree in Artificial Intelligence**

: Lourdes Borrajo Diz

Email: lborrajo(at)uvigo.es

Phone: +34 988 387 028

#### **Coordinator of the Master's Degree in Computer Engineering**

: Alma Gómez Rodríguez

Email: alma(at)uvigo.es

Phone: +34 988 387 008

### **Coordinator of the Master's Degree in Artificial Intelligence**

: Francisco Javier Rodríguez Martínez

Email: franjrm(at)uvigo.es

Phone: +34 988 387 022

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#### **Location**

Escola Superior de Enxeñería Informática.

Campus de Ourense - Universidad de Vigo

Edificio Politécnico. As Lagoas s/n

32004 - Ourense (Spain)

Teléfonos: +34 988 387000, +34 988 387002

Fax: +34 988 387001

Web: [esei.uvigo.es](http://esei.uvigo.es)

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#### **Regulations and legislation**

Available on the Centre's website ([esei.uvigo.es](http://esei.uvigo.es))

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#### **Center services**

##### **teaching equipment**

14 computer laboratories with 24 individual workstations and different operating systems

1 Electronics Technology laboratory

1 Computer Architecture laboratory

1 end-of-degree project laboratory

6 theory classrooms

6 seminars for group tutorials

##### **added values**

Classes in English in various subjects

Guidance teacher in the first year.

E-mail for students.

Storage directory for students, accessible from the Internet.

E-learning platform.

Wireless Internet access from all over campus.

Campus library with 120,000 volumes.

Alumni Delegation.

Premises for student associations.

University residence.

Hall of Degrees and Assembly Hall.

Cafeteria.

## Máster universitario en Inteligencia artificial

### Subjects

#### Year 1st

Code	Name	Quadmester	Total Cr.
O06M193V01101	AI Fundamentals	1st	3
O06M193V01102	Data engineering	1st	3
O06M193V01103	Reasoning and planning	1st	6
O06M193V01104	Natural language understanding	1st	6
O06M193V01105	Machine learning I	1st	6
O06M193V01106	Computer vision I	1st	3
O06M193V01107	Intelligent robotics I	1st	3
O06M193V01201	Explainable and Trustworthy AI	2nd	3
O06M193V01202	Multiagent systems	2nd	6
O06M193V01203	Knowledge and reasoning under uncertainty	2nd	3
O06M193V01204	Language modelling	2nd	3
O06M193V01205	Web intelligence and semantic technologies	2nd	6
O06M193V01206	Deep learning	2nd	6
O06M193V01207	Machine learning II	2nd	3
O06M193V01208	Evolutionary computation	2nd	3
O06M193V01209	Computer vision II	2nd	6
O06M193V01210	Intelligent robotics II	2nd	6
O06M193V01211	AI project management	2nd	3
O06M193V01212	Process Mining	2nd	3
O06M193V01213	Intelligent real-time systems	2nd	3

**IDENTIFYING DATA****AI Fundamentals**

Subject AI Fundamentals

Code O06M193V01101

Study Máster  
programme universitario en  
Inteligencia  
artificial

Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st

Teaching  
language

Department

Coordinator García Lourenco, Analia María

Lecturers García Lourenco, Analia María

E-mail analia@uvigo.es

Web [http://guiadocente.udc.es/guia\\_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny\\_academic=2023\\_24](http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny_academic=2023_24)General  
description**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject

Training and  
Learning Results**Contents**

Topic

**Planning**

Class hours

Hours outside the  
classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description

Qualification

Training and Learning Results

**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

**IDENTIFYING DATA****Data engineering**

Subject	Data engineering			
Code	O06M193V01102			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	García Lourenco, Analia María			
Lecturers	García Lourenco, Analia María			
E-mail	analia@uvigo.es			
Web	<a href="http://http://moovi.uvigo.gal">http://http://moovi.uvigo.gal</a>			
General description	The aim of this course is to introduce the basics of data engineering, notably in the scope of Big Data. The acquired skills will allow the analysis and the efficient management of heterogeneous information, both structured and non structured, within the development of AI applications, whenever traditional methods show insufficiency.			

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A3	CB8 - the complexity of making judgments based on information that, while incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
B2	Successfully address all stages of an Artificial Intelligence project.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B4	Elaborate adequately and with certain originality written compositions or motivated arguments, write plans, work projects, scientific articles and formulate reasonable hypotheses in the field.
B5	Work in teams, especially multidisciplinary teams, and be skilled in time management, people management and decision making.
C16	Knowledge of the process and tools for data processing and preparation from data acquisition or extraction, cleaning, transformation, loading, organization and access.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D7	Develop the ability to work in interdisciplinary or transdisciplinary teams to offer proposals that contribute to sustainable environmental, economic, political and social development.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.
D9	Have the ability to manage time and resources: develop plans, prioritize activities, identify critical ones, set deadlines and meet them.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
RA1: Develop the capacity to analyse and model data for processing in intelligent systems.	A1 A2 C16 D3 D9
RA2: Know and understand the process of extraction, cleaning, transformation, load and preprocessing of data.	A3 B2 B3 C16 D3 D7 D9

RA3: Know and learn how to use multidimensional and NoSQL databases.	A2 B3 B4 D8
RA4: Know the foundations of data lakes and data warehouses.	A2 A3 B2 B5 D3 D7 D8

### Contents

Topic	
Concepts and foundations of Data Engineering	Concepts and basic definitions, problems of efficient data load in Big Data scenarios, massive data storage and access.
Techniques of data cleaning and preparation	Common techniques. Definition of processing flows. Quality metrics.
Efficient advanced structures and data warehouses for Big Data	Data warehouses and multidimensional databases, data lakes, NoSQL databases.

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	0	12
Laboratory practical	8	0	8
Project	0	50	50
Problem and/or exercise solving	5	0	5

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

### Methodologies

	Description
Lecturing	The teacher will introduce given subjects to the students with the aim to acquire information valuable within a specific scope. CONTINUOUS EVALUATION Mandatory character Facultative attendance GLOBAL EVALUATION Mandatory character
Laboratory practical	Problem or problems of practical character whose resolution requires the understanding and application of the theoretical and practical contents covered by the course. The students can work the solution to the proposed problems individually or in groups. CONTINUOUS EVALUATION Mandatory character Mandatory attendance (min. 75% of lab practices) GLOBAL EVALUATION Mandatory character

### Personalized assistance

Tests	Description
Project	Doubts related to the planning and development of the project will be addressed.
Problem and/or exercise solving	Doubts related to the cases to be analyzed will be answered.

### Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	Several tests aimed to evaluate the understanding of the knowledge exposed in theory and/or practical classes. Learning results evaluated: RA3, RA4	30	A2	B2 B5	C16	D3 D7

Project	Development of a project to evaluate the ability of the students to work autonomously, including their critical spirit and the ability to apply the acquired knowledge to real-world problems. At the end, the students must submit a detailed project report. Learning results evaluated: RA2, RA4	40	A2	B2 B4	C16	D8 D9
Problem and/or exercise solving	Defense of the solution proposed by the student before the teacher and the rest of the students. Learning results evaluated: RA1, RA2	30	A1 A2 A3	B2 B3	C16	D7 D8

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### Other comments on the Evaluation

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#### CONTINUOUS EVALUATION SYSTEM

##### TEST 1: Laboratory practical

**Description:** Several tests aimed to evaluate the understanding of the knowledge exposed in theory and/or practical classes.

**Methodology to be applied:** Laboratory practical.

**% Qualification:** 30%.

**Minimum %:** *To pass this part of the course the student has to obtain a grade equal or greater than 5 points (out of 10).*

**Training:** A2,B2,B5,C16,D3,D7.

**Learning results:** RA3, RA4

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##### TEST 2: Problem and/or exercise solving

**Description:** Defense of the solution proposed by the student before the teacher and the rest of the students.

**Methodology to be applied:** Problem and/or exercise solving.

**% Qualification:** 30%.

**Minimum %:** *To pass this part of the course the student has to obtain a grade equal or greater than 5 points (out of 10).*

**Training:** A1,A2,A3,B2,B3,C16,D7,D8

**Learning results:** RA1, RA2

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##### TEST 3: Project

**Description:** Development of a project to evaluate the ability of the students to work autonomously, including their critical spirit and the ability to apply the acquired knowledge to real-world problems. At the end, the students must submit a detailed project report.

**Methodology to be applied:** Project.

**% Qualification:** 40%.

**Minimum %:** *To pass this part of the course the student has to obtain a grade equal or greater than 5 points (out of 10).*

**Training:** A2,B2,B4,C16,D8,D9

**Learning results:** RA2, RA4

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#### GLOBAL EVALUATION SYSTEM

**Procedure for choosing the global evaluation modality:** students are considered to have chosen the global evaluation system if they do not take Test 1 of the continuous evaluation system.

##### TEST 1: Laboratory practical

**Description:** Several tests aimed to evaluate the understanding of the knowledge exposed in theory and/or practical



classes.

**Methodology to be applied:** Laboratory practical.

**% Qualification:** 30%.

**Minimum %:** To pass this part of the course the student has to obtain a grade equal or greater than 5 points (out of 10).

**Training:** A2,B2,B5,C16,D3,D7.

**Learning results:** RA3, RA4

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**TEST 2:** Problem and/or exercise solving

**Description:** Defense of the solution proposed by the student before the teacher and the rest of the students.

**Methodology to be applied:** Problem and/or exercise solving.

**% Qualification:** 30%.

**Minimum %:** To pass this part of the course the student has to obtain a grade equal or greater than 5 points (out of 10).

**Training:** A1,A2,A3,B2,B3,C16,D7,D8

**Learning results:** RA1, RA2

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**TEST 3:** Project

**Description:** Development of a project to evaluate the ability of the students to work autonomously, including their critical spirit and the ability to apply the acquired knowledge to real-world problems. At the end, the students must submit a detailed project report.

**Methodology to be applied:** Project.

**% Qualification:** 40%.

**Minimum %:** To pass this part of the course the student has to obtain a grade equal or greater than 5 points (out of 10).

**Training:** A2,B2,B4,C16,D8,D9

**Learning results:** RA2,RA4

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## **CRITERIA OF EVALUACION FOR EXTRAORDINARY AND END OF CAREER CALLS**

*The continuous and global evaluation systems described above will be used.*

### **MINUTES QUALIFICATION PROCESS**

Regardless of the evaluation system and the call, in case of failing any part of the evaluation, but the overall score is higher than 4 (out of 10), the grade in the minutes will be 4).

### **EVALUATION DATES**

**The dates of the tests corresponding to the continuous evaluation system will be published in the calendar of activities, available on the website of the ESEI <https://esei.uvigo.es/docencia/horarios/>. The official exam dates for the different calls, officially approved by the ESEI Xunta de Centro, are published on the ESEI website <https://esei.uvigo.es/docencia/exames/>.**

### **USE OF MOBILE DEVICES**

**All students are reminded of the prohibition of the use of mobile devices in exercises and practices, in compliance with Article 13.2.d) of the University Student Statute, regarding the duties of university students, which establishes the duty to "Refrain from the use or cooperation in fraudulent procedures in evaluation tests, in the work performed or in official university documents."**

**CONSULTATION/REQUEST FOR TUTORIALS** Tutorials can be consulted through the faculty member's personal page, accessible through <https://esei.uvigo.es/docencia/profesorado/>.

### **OTHER CONSIDERATIONS**

**If plagiarism is detected in any of the works (essays or project), the final grade will be "Suspenso" (0) and the situation will be notified to the School's Board to take the appropriate disciplinary actions. If translation errors cause any contradictions between the various versions of this syllabus, the English will be the prevailing version.**

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**Sources of information**

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**Basic Bibliography**

Sadalage, Fowler, **NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence**, 978-0321826626, 1, Addison-Wesley, 2012

Avi Silberschatz, Henry F. Korth, S. Sudarshan, **Database System Concepts**, 0-07-352332-1, 6, McGraw-Hill, 2010

Ihab F. Ilyas and Xu Chu, **Data Cleaning. Association for Computing Machinery**, <https://doi.org/10.1145/3310205>, Association for Computing Machinery, 2019

Alex Gorelik, **The Enterprise Big Data Lake: Delivering the Promise of Big Data and Data Science**, 9781491931554, O'Reilly Media, Inc., 2019

Matt Casters, Roland Bouman, Jos van Dongen,, **Pentaho Kettle Solutions: Building Open Source ETL Solutions with Pentaho Data Integration**, 978-0470635179, Wiley, 2013

**Complementary Bibliography**

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**Recommendations**

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**Other comments**

Follow the proposed methodology, class assistance and participation, devoting the necessary time to the study and the development of the proposed project and specific problems/case studies with the help of the teacher.

The virtual campus will be used to improve the communication between the students and the teachers, to store the necessary materials and to support in the processes of evaluation.

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**IDENTIFYING DATA****Reasoning and planning**

Subject Reasoning and planning

Code O06M193V01103

Study Máster  
programme universitario en  
Inteligencia artificial

Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st

Teaching language

Department

Coordinator Gómez Rodríguez, Alma María

Lecturers Gómez Rodríguez, Alma María  
Otero Cerdeira, Lorena

E-mail alma@uvigo.es

Web [http://guiadocente.udc.es/guia\\_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny\\_academic=2023\\_24](http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny_academic=2023_24)

General description

**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject

Training and Learning Results

**Contents**

Topic

**Planning**

Class hours

Hours outside the classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description

Qualification

Training and Learning Results

**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

**IDENTIFYING DATA****Natural language understanding**

Subject	Natural language understanding		
Code	O06M193V01104		
Study programme	Máster universitario en Inteligencia artificial		
Descriptors	ECTS Credits	Choose	Year
	6	Mandatory	1st
Teaching language	English		
Department			
Coordinator	Darriba Bilbao, Víctor Manuel		
Lecturers	Darriba Bilbao, Víctor Manuel		
E-mail	darriba@uvigo.es		
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>		
General description	The course introduces the basic concepts and techniques associated with natural language processing, the starting point for the design of information exploitation and dialogue environments based on human language, both at the lexical and syntactic, semantic and pragmatic levels. The objective is to introduce the student to the complexity inherent to the analysis of human natural language, mainly associated to the ambiguity and contextual dependencies it presents, and to the design of data structures and algorithms that allow its practical treatment.		

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A5	CB10 - That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.
B1	Maintain and extend sound theoretical approaches to enable the introduction and exploitation of new and advanced technologies in the field of Artificial Intelligence.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B4	Elaborate adequately and with certain originality written compositions or motivated arguments, write plans, work projects, scientific articles and formulate reasonable hypotheses in the field.
C1	Understanding and mastering techniques for text processing in natural language
C2	Understanding and mastery of the fundamentals and techniques of semantic processing of linked, structured, and unstructured documents, and of the representation of their content.
C3	Understanding and knowledge of the techniques of representation and processing of knowledge through ontologies, graphs, and RDF, as well as the tools associated with them.
D2	Master the oral and written expression and comprehension of a foreign language.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D7	Develop the ability to work in interdisciplinary or transdisciplinary teams to offer proposals that contribute to sustainable environmental, economic, political and social development.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
To know, understand and analyze the formal representation of diverse lexical, syntactic and semantic phenomena of natural language.	A1 A5 B1 B3 B4 C1 D2 D8

To know, understand and know how to use the technologies, frameworks and libraries for the construction of natural language processing systems.

A1  
A2  
A5  
B3  
B4  
C1  
C2  
D2  
D3  
D7

To design, implement and know how to use algorithms and data structures to treat and support the various phenomena characteristic of natural language.

A1  
A2  
A5  
B1  
B3  
B4  
C1  
C2  
C3  
D2  
D3  
D7  
D8

To know, understand and analyze natural language processing techniques for processing and disambiguation at the lexical, syntactic and semantic levels.

A1  
A2  
A5  
B1  
B3  
B4  
C1  
C2  
C3  
D2  
D3  
D7  
D8

To know and understand the problems posed by ambiguity and imprecision in natural language data sources and techniques to solve them.

A1  
A2  
A5  
B1  
B3  
B4  
C1  
C3  
D2  
D3  
D7  
D8

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**Contents**

Topic

Introduction.	Levels of analysis.
	Ambiguity and contextual dependencies.
Lexical analysis.	Segmentation.
	Dictionaries and thesauri.
Syntactic parsing.	Part-of-speech tagging.
	Algebraic grammars.
	Mildly context-sensitive grammars.
	Dependency grammars.
	Probabilistic grammars.

Semantic parsing.

Lexical semantics.

Semantic dependencies.

Semantic graphs.

## Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	21	21	42
Laboratory practical	14	48	62
Problem solving	9	25	34
Objective questions exam	3	9	12

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Lecturing	Theoretical classes, in which the content of each topic is exposed. The student will have copies of the slides beforehand and the professor will promote an active attitude, asking questions to clarify specific aspects and leaving open questions for the student's reflection.
Laboratory practical	Practical classes with the use of computers, which allow the student to familiarize himself/herself from a practical point of view with the issues presented in the theoretical classes.
Problem solving	Problem-based learning, seminars, case studies and projects.

## Personalized assistance

Methodologies	Description
Lecturing	The teachers will attend the students in individualized mentoring sessions, dedicated to the orientation in the study and to the resolution of doubts on the contents, duties and activities of the course.
Laboratory practical	The teachers will attend the students in individualized mentoring sessions, dedicated to the orientation in the study and to the resolution of doubts on the contents, duties and activities of the course.
Problem solving	The teachers will attend the students in individualized mentoring sessions, dedicated to the orientation in the study and to the resolution of doubts on the contents, duties and activities of the course.

## Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	The delivery of the practicals must be done within the deadline established in the virtual campus and must follow the specifications indicated in the statement for both presentation and defense.	50	A1 A2 A5	B3 B4	C1 C2 C3	D2 D3 D7 D8
Objective questions exam	Compulsory realization. The mastery of the theoretical and operative knowledge of the subject will be evaluated.	50	A1 A2	B1	C1 C2 C3	D2

## Other comments on the Evaluation

### EVALUATION CRITERIA FOR ALL STUDENTS IN ALL OPPORTUNITIES

Students must achieve at least 40% of the maximum grade for each part (theory, practice) and in any case the sum of both parts must reach a 5 to pass the course. If any of the above requirements is not met, the grade for the course will be established according to the lowest grade obtained.

In case of not reaching the minimum grade in one of the parts, the student will have a second opportunity in which only the delivery of that part will be required.

The delivery of the practicals must be done within the deadline established in the virtual campus and must follow the specifications indicated in the statement for both its presentation and defense.

The student who submits all the compulsory practicals or attends the objective test in the official evaluation period will be

considered "Presented".

In the case of fraudulent performance of exercises or tests, the Regulations for the evaluation of students' academic performance and review of qualifications will be applied. In application of the corresponding regulations on plagiarism, the total or partial copy of any practical or theory exercise will result in failure in both opportunities of the course, with a grade of 0.0 in both cases.

### **EXAM DATES**

The official exam dates for the different opportunities, will be published on the ESEI website: <https://esei.uvigo.es/docencia/exames/>

### **CONSULTATION/REQUEST OF TUTORING SESSIONS**

Tutoring sessions schedules can be consulted through the faculty's personal page, available at <https://esei.uvigo.es/docencia/profesorado/>

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### **Sources of information**

#### **Basic Bibliography**

Manning, C., & Schütze, H., **Foundations of statistical natural language processing**, 978-0262133609, 1, MIT Press, 1999

Goldberg, Y., **Neural network methods for natural language processing. Synthesis lectures on human language technologies**, 978-1627052986, 1, Morgan Claypool, 2017

Eisenstein, J., **Introduction to Natural Language Processing**, 978-0262042840, 1, MIT Press, 2019

Jurafsky, D. & Martin, J. H., **Speech and Language Processing**, 978-0131873216, 3 (draft), <https://web.stanford.edu/~jurafsky/slp3/>, 2022

Jurafsky, D. & Martin, J. H., **Speech and Language Processing**, 978-0131873216, 2, Prentice Hall, 2008

Indurkha, N. & Damerau, F.J. (Eds.), **Handbook of Natural Language Processing**, 978-1420085921, 2, Routledge, 2010

#### **Complementary Bibliography**

Chollet, F., **Keras: The python deep learning library**, Astrophysics Source Code Library, 2018

Russell, S., Norvig, P., **Artificial Intelligence: A Modern Approach**, 978-0134610993, 4, Pearson, 2022

Manning, C.D., Raghavan, P., Schütze, H., **Introduction to Information Retrieval**, 978-0521865715, 1, Cambridge University Press, 2008

Kübler, S., McDonald, R., & Nivre, J., **Dependency Parsing. Synthesis lectures on human language technologies**, 978-1598295962, 1, Morgan Claypool, 2009

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### **Recommendations**

#### **Subjects that continue the syllabus**

Web intelligence and semantic technologies/O06M193V01205

Language modelling/O06M193V01204

Text mining/O06M193V01302

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#### **Subjects that are recommended to be taken simultaneously**

Machine learning I/O06M193V01105

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### **Other comments**

All students are reminded of the prohibition of the use of mobile devices in exercises, practices and exams, in compliance with article 13.2.d) of the Statute of the University Student, regarding the duties of the university student body, which establishes the duty to "Refrain from using or cooperating in fraudulent procedures in assessment tests, in the work carried out or in official university documents."

**IDENTIFYING DATA****Machine learning I**

Subject	Machine learning I			
Code	O06M193V01105			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Darriba Bilbao, Víctor Manuel			
Lecturers	Darriba Bilbao, Víctor Manuel			
E-mail	darriba@uvigo.es			
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>			
General description	This course presents an overview of machine learning. The syllabus explains the different techniques and methods, including supervised and unsupervised learning. In the practical part, real cases will be solved.			

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A3	CB8 - the complexity of making judgments based on information that, while incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
A4	CB9 - Students should be able to communicate their conclusions and the ultimate knowledge and rationale behind them to specialized and non-specialized audiences in a clear and unambiguous manner.
B2	Successfully address all stages of an Artificial Intelligence project.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B4	Elaborate adequately and with certain originality written compositions or motivated arguments, write plans, work projects, scientific articles and formulate reasonable hypotheses in the field.
B5	Work in teams, especially multidisciplinary teams, and be skilled in time management, people management and decision making.
C10	Ability to build, validate and apply a stochastic model of a real system from observed data and the critical analysis of the results obtained
C11	Understanding and mastery of the main data analysis techniques and tools, both from a statistical and machine learning point of view, including those dedicated to the processing of large volumes of data, and the ability to select the most appropriate ones for problem solving.
C12	Ability to plan, formulate and resolve all stages of a data project, including understanding and mastery of basic fundamentals and techniques for searching and filtering information in large data collections.
C15	Knowledge of computer tools in the field of machine learning, and ability to select the most appropriate for solving a problem.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D4	To develop for the exercise of a citizenship respectful of democratic culture, human rights and gender perspective.
D7	Develop the ability to work in interdisciplinary or transdisciplinary teams to offer proposals that contribute to sustainable environmental, economic, political and social development.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.
D9	Have the ability to manage time and resources: develop plans, prioritize activities, identify critical ones, set deadlines and meet them.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
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Ability to identify if a problem can be solved using a machine learning technique.	A3 B2 B3 B4 C12 D4 D7 D8 D9
Obtain the ability to choose the most appropriate learning technique for a problem depending on the nature of the data.	A1 A2 A4 B2 C11 C15 D3 D8
Ability to design and develop a learning model in a real programming environment.	A1 A2 A3 A4 B5 C10 C15 D3 D7 D9
Master the different learning models and be able to apply them to real-world problems.	A2 B2 B3 C11 C15 D3 D8
Know and understand the difference between classification and regression problems.	A1 A3 B3 C10 C11
Understand how to compare the results of the different types of machine learning.	A2 A4 C10 C12 C15 D4 D8 D9

## Contents

Topic	
Supervised learning	Introduction to learning Artificial Neural Networks Support Vector Machines Decision trees Regression Instance-based learning
Ensemble modeling	Ensemble modeling
Preprocessing, evaluation and regularization	Preprocessing and feature extraction techniques. Model creation and evaluation. Complexity & Regularization.

Unsupervised learning	Unsupervised learning: clustering
	Unsupervised neural networks
Reinforcement learning	Markov decision processes
	Reinforcement learning

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	21	42	63
Laboratory practical	13	24	37
Project based learning	9	19	28
Objective questions exam	2	20	22

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

### Methodologies

	Description
Lecturing	Theoretical teaching of the subject matter of the course
Laboratory practical	Solve practical problems by using the different techniques that will be explained in the theory classes.
Project based learning	Writing, under the supervision of the teacher, of reports explaining the resolution of the problems carried out in the laboratory practices and the results obtained.

### Personalized assistance

Methodologies	Description
Laboratory practical	Practical work carried out with the advice of the teacher.
Project based learning	Writing of the explanatory report under the teacher's supervision.

### Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Resolution of real world problems using the methodology, for which several techniques explained in theory will be used, and the student will be stimulated to generate new ideas for the resolution of these problems.	20	A1 B2 C12 D3 A2 B3 C15 D7 B5
Project based learning	Writing of the report on the resolution of the real problems carried out in the laboratory practices. The writing of the report will include a bibliographic review of the most important works related, written in English for the most part, documentation on the problem to be solved, methodology used, and comparison of the results found in the application of the different techniques, as well as a critical evaluation of both the results obtained and the information used.	30	A3 B2 D4 A4 B3 D8 B4 D9 B5
Objective questions exam	Test questions about the contents of the course, based on the different machine learning techniques and their applications.	50	A2 B3 C10 D4 C11 D8 D9

### Other comments on the Evaluation

#### **EVALUATION CRITERIA FOR ALL STUDENTS IN ALL OPPORTUNITIES**

Students must achieve at least 40% of the maximum mark for each part (theory, practice) and in any case the sum of both parts must exceed 5 to pass the subject. If any of the above requirements is not met, the grade of the call will be established according to the lowest grade obtained.

In the second opportunity, the evaluation will be carried out with the same criteria, and a new term will be opened for the delivery of the practical works.

The deliveries of the practices must be made within the period established in the virtual campus and must follow the specifications indicated in the statement both for their presentation and their defense.

Students will have the condition of "Presented" if you attend the theoretical test in the official evaluation period.

In the case of fraudulent completion of exercises or tests, the Regulations for evaluating the academic performance of students and reviewing qualifications will be applied. In application of the corresponding regulations on plagiarism, the total or partial copy of any practice or theory exercise will suppose the suspense in the activity in which plagiarism has been

detected, with a grade of 0.

### **EXAM DATES**

The official exam dates for the different opportunities, will be published on the ESEI

website: <https://esei.uvigo.es/docencia/exames/>

### **CONSULTATION/REQUEST OF TUTORING SESSIONS**

Tutoring sessions schedules can be consulted through the faculty's personal page, available at

<https://esei.uvigo.es/docencia/profesorado/>

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### **Sources of information**

#### **Basic Bibliography**

D. Borrajo, J. González, P. Isasi, **Aprendizaje automático**, 978-8496094734, 1, Sanz y Torres, 2006

T.M. Mitchell, **Machine Learning**, 978-0070428077, 1, McGraw-Hill, 1997

B. Sierra, **Aprendizaje automático: conceptos básicos y avanzados. Aspectos prácticos utilizando el software WEKA**, 978-84-8322-318-5, 1, Pearson Education, 2006

S. Dzeroski, N. Lavrac, **Relational Data Mining**, 978-3540422891, 1, Springer, 2001

D. Aha, **Lazy Learning**, 978-9048148608, 1, Kluwer Academics Publishers, 1997/2013

R. Sutton, A. Barto, **Reinforcement Learning. An Introduction**, 978-0262039246, 2, MIT Press, 2018

A. Webb, **Statistical Pattern Recognition**, 978-0470682289, 3, Wiley, 2011

E. Alpaydin, **Introduction to Machine Learning**, 978-0262358064, 4, MIT Press, 2020

#### **Complementary Bibliography**

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### **Recommendations**

#### **Subjects that continue the syllabus**

Machine learning II/O06M193V01207

Deep learning/O06M193V01206

Evolutionary computation/O06M193V01208

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### **Other comments**

All students are reminded of the prohibition of the use of mobile devices in exercises, practices and exams, in compliance with article 13.2.d) of the Statute of the University Student, regarding the duties of the university student body, which establishes the duty to "Refrain from using or cooperating in fraudulent procedures in assessment tests, in the work carried out or in official university documents."

**IDENTIFYING DATA****Computer vision I**

Subject	Computer vision I		
Code	O06M193V01106		
Study programme	Máster universitario en Inteligencia artificial		
Descriptors	ECTS Credits	Choose	Year
	3	Mandatory	1st
Teaching language	English		
Department			
Coordinator	Formella , Arno		
Lecturers	Formella , Arno		
E-mail	formella@uvigo.es		
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>		
General description	(*) <a href="https://formella.webs.uvigo.es/doc/vci23">https://formella.webs.uvigo.es/doc/vci23</a>		

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A5	CB10 - That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.
B1	Maintain and extend sound theoretical approaches to enable the introduction and exploitation of new and advanced technologies in the field of Artificial Intelligence.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B5	Work in teams, especially multidisciplinary teams, and be skilled in time management, people management and decision making.
C23	Understanding and mastering the basic concepts and techniques of digital image processing.
C24	Ability to apply different techniques to computer vision problems.
C25	Knowledge and skills to design systems for detection, classification and tracking of objects in images and video.
C26	Understanding and mastery of the forms of representation of signals and images according to their data, as well as their fundamental characteristics and their forms of representation.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D4	To develop for the exercise of a citizenship respectful of democratic culture, human rights and gender perspective.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
New	A1
	A2
	A5
	B1
	B3
	B5
	C23
	C24
	C25
	C26
	D3
	D4
	D8

New

A1  
A2  
A5  
B1  
B3  
B5  
C23  
C24  
C25  
C26  
D3  
D4  
D8

New

A1  
A2  
A5  
B1  
B3  
B5  
C23  
C24  
C25  
C26  
D3  
D4  
D8

New

A1  
A2  
A5  
B1  
B3  
B5  
C23  
C24  
C25  
C26  
D3  
D4  
D8

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**Contents**

Topic

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**Planning**

Class hours

Hours outside the  
classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

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**Methodologies**

Description

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**Personalized assistance**

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**Assessment**

Description

Qualification

Training and Learning Results

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**Other comments on the Evaluation**

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**Sources of information**

Basic Bibliography

Complementary Bibliography

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**Recommendations**



**IDENTIFYING DATA****Intelligent robotics I**Subject Intelligent robotics  
I

Code O06M193V01107

Study Máster  
programme universitario en  
Inteligencia  
artificial

Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st

Teaching English  
language

Department

Coordinator Diaz-Cacho Medina, Miguel Ramón

Lecturers Diaz-Cacho Medina, Miguel Ramón

E-mail mcacho@uvigo.es

Web [http://guiadocente.udc.es/guia\\_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny\\_academic=2023\\_24](http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny_academic=2023_24)General  
description**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject

Training and  
Learning Results**Contents**

Topic

**Planning**

Class hours

Hours outside the  
classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description

Qualification

Training and Learning Results

**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

<b>IDENTIFYING DATA</b>				
<b>Explainable and Trustworthy AI</b>				
Subject	Explainable and Trustworthy AI			
Code	006M193V01201			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	2nd
Teaching language				
Department				
Coordinator	Olivieri Cecchi, David Nicholas			
Lecturers	Olivieri Cecchi, David Nicholas			
E-mail	dnolivieri@gmail.com			
Web	<a href="http://www.usc.gal/es/estudios/masteres/ingenieria-arquitectura/master-universitario-inteligencia-artificial">http://www.usc.gal/es/estudios/masteres/ingenieria-arquitectura/master-universitario-inteligencia-artificial</a>			
General description				

<b>Training and Learning Results</b>
Code

<b>Expected results from this subject</b>
Expected results from this subject
Training and Learning Results

<b>Contents</b>
Topic

<b>Planning</b>		
Class hours	Hours outside the classroom	Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

<b>Methodologies</b>
Description

<b>Personalized assistance</b>

<b>Assessment</b>		
Description	Qualification	Training and Learning Results

<b>Other comments on the Evaluation</b>

<b>Sources of information</b>
<b>Basic Bibliography</b>
<b>Complementary Bibliography</b>

<b>Recommendations</b>



<b>IDENTIFYING DATA</b>				
<b>Multiagent systems</b>				
Subject	Multiagent systems			
Code	O06M193V01202			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language				
Department				
Coordinator	González Moreno, Juan Carlos			
Lecturers	Gómez Rodríguez, Alma María González Moreno, Juan Carlos			
E-mail	jcmoreno@uvigo.es			
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=signatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=signatures&amp;ny_academic=2023_24</a>			
General description				

<b>Training and Learning Results</b>
Code

<b>Expected results from this subject</b>
Expected results from this subject
Training and Learning Results

<b>Contents</b>
Topic

<b>Planning</b>		
Class hours	Hours outside the classroom	Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

<b>Methodologies</b>
Description

<b>Personalized assistance</b>

<b>Assessment</b>		
Description	Qualification	Training and Learning Results

<b>Other comments on the Evaluation</b>

<b>Sources of information</b>
<b>Basic Bibliography</b>
<b>Complementary Bibliography</b>

<b>Recommendations</b>

**IDENTIFYING DATA****Knowledge and reasoning under uncertainty**

Subject	Knowledge and reasoning under uncertainty			
Code	O06M193V01203			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>			
General description				

**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
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**Contents**

Topic

**Planning**

Class hours	Hours outside the classroom	Total hours
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\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description	Qualification	Training and Learning Results
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**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

<b>IDENTIFYING DATA</b>			
<b>Language modelling</b>			
Subject	Language modelling		
Code	O06M193V01204		
Study programme	Máster universitario en Inteligencia artificial		
Descriptors	ECTS Credits	Choose	Year
	3	Optional	1st
Teaching language	English		
Department			
Coordinator	Darriba Bilbao, Víctor Manuel		
Lecturers	A0075-Ax2tc-1 A0075-Ax2tc-1, A0075-Ax2tc-1 A0075-Ax2tc-2 A0075-Ax2tc-2, A0075-Ax2tc-2 Darriba Bilbao, Víctor Manuel		
E-mail	darriba@uvigo.es		
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>		
General description	The course introduces the student to the modeling of human language, i.e. the generation of models that allow estimating the plausibility of a text, an essential phase in the design of any application based on the exploitation of its communicative mechanisms. The student will be trained to master the theoretical principles and techniques that allow their construction, both those based on discrete representations of the elements of the language and on continuous representations. Special attention will be given to modeling in contexts of scarce linguistic resources, whether this is motivated by the treatment of novel domains of knowledge or by the exploitation of languages of limited diffusion.		

<b>Training and Learning Results</b>	
Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A5	CB10 - That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.
B1	Maintain and extend sound theoretical approaches to enable the introduction and exploitation of new and advanced technologies in the field of Artificial Intelligence.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B4	Elaborate adequately and with certain originality written compositions or motivated arguments, write plans, work projects, scientific articles and formulate reasonable hypotheses in the field.
C1	Understanding and mastering techniques for text processing in natural language
C2	Understanding and mastery of the fundamentals and techniques of semantic processing of linked, structured, and unstructured documents, and of the representation of their content.
C3	Understanding and knowledge of the techniques of representation and processing of knowledge through ontologies, graphs, and RDF, as well as the tools associated with them.
D2	Master the oral and written expression and comprehension of a foreign language.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D7	Develop the ability to work in interdisciplinary or transdisciplinary teams to offer proposals that contribute to sustainable environmental, economic, political and social development.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.

<b>Expected results from this subject</b>	
Expected results from this subject	Training and Learning Results

To know how to use the techniques and methods of natural language processing to solve real problems of analysis of texts in natural language.

A2  
A5  
B1  
B3  
B4  
C1  
C3  
D2  
D3  
D7

To know, understand and analyze deep learning techniques applied to natural language processing.

A1  
A2  
A5  
B1  
B3  
C1  
C2  
D2  
D3  
D7  
D8

To know how to use deep learning techniques and methods to solve practical problems in natural language processing.

A1  
A2  
A5  
B1  
B3  
B4  
C1  
C2  
D2  
D3  
D7  
D8

To know and understand the environmental problems posed by the computational cost of deep learning techniques when applied to text analysis

A1  
B1  
C1  
C2  
D2  
D8

## Contents

### Topic

Language models	N-gram based language models Neural based language models
Distributional semantics models	Linguistic hypothesis about distributional meaning Classic models of distributional semantics Neural models representing static meaning (word embeddings) Neural models representing dynamic-contextual meaning Compositional models
Sequence labeling	Use and fine-tuning of models for sequence labeling
Text-To-Text models	Text-To-Text models

## Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	10	10	20
Laboratory practical	5	15	20
Project based learning	6	28	34
Objective questions exam	1	0	1

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Lecturing	Teachers present a topic to students with the aim of providing a set of information with a specific scope.

Laboratory practical	The teachers of the discipline present to the students one or more practical problems that require the comprehension and application of the theoretical and practical contents included in the syllabus of the subject. Students can work on solving problems individually or as a team. These activities may require autonomous work, although guided by the teacher of the subject.
Project based learning	Students are presented with practical projects that require an important part of their total dedication to the topic. In addition, and due to the scope of the work to be performed, it is necessary for the student to use not only management skills, but also technical skills.

### Personalized assistance

Methodologies	Description
Laboratory practical	The teachers will attend the students in individualized mentoring sessions, dedicated to the orientation in the study and to the resolution of doubts on the contents, duties and activities of the discipline.
Project based learning	The teachers will attend the students in individualized mentoring sessions, dedicated to the orientation in the study and to the resolution of doubts on the contents, duties and activities of the discipline.

### Assessment

	Description	Qualification	Training and Learning Results			
Lecturing	Continuous monitoring of class attendance and student participation	5	A1	B1 B4	C1 C2 C3	D2 D8
Project based learning	Deliveries of projects must be made within the period established in the virtual campus and must follow the specifications indicated in the assignment both for their presentation and their defense. Mandatory.	50	A1 A2 A5	B1 B3 B4	C1 C2 C3	D2 D3 D7 D8
Objective questions exam	Mastery of theoretical and operational knowledge of the subject will be assessed. Mandatory.	45	A1	B1 B4	C1 C2 C3	D2 D8

### Other comments on the Evaluation

#### EVALUATION CRITERIA FOR ALL STUDENTS IN ALL OPPORTUNITIES

Students must achieve a minimum of 40% of the maximum mark of the "Laboratory Practices" and "Objective Test" parts, and in any case the sum of the three parts must be greater than 5 to pass the subject. If any of the above requirements is not met, the grade for the course will be established according to the lowest grade obtained.

In case of not reaching the minimum score in the "Laboratory Practices" or "Objective Test" parts, the student will have a second opportunity in which only the delivery of the failed part will be required.

Grades will not be saved between academic years.

The delivery of the practicals must be done within the deadline established in the virtual campus and must follow the specifications indicated in the statement for both its presentation and defense.

The student who submits all the compulsory practicals or attends the objective test in the official evaluation period will be considered "Presented".

In the case of fraudulent completion of exercises or tests, the Regulations for the evaluation of the academic performance of students and review of grades will be applied. In application of the corresponding regulations on plagiarism, the total or partial copy of any practice or theory exercise will result in suspension on both occasions of the course, with a grade of 0.0 in both cases.

#### EXAM DATES

The official exam dates for the different opportunities, will be published on the ESEI

website: <https://esei.uvigo.es/docencia/exames/>

#### CONSULTATION/REQUEST OF TUTORING SESSIONS

Tutoring sessions schedules can be consulted through the faculty's personal page, available at

<https://esei.uvigo.es/docencia/profesorado/>

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## Sources of information

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### Basic Bibliography

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Jurafsky, Daniel & James H. Martin, **N-gram Language Models.**, <https://web.stanford.edu/~jurafsky/slp3/>, 2022

Jurafsky, Daniel & James H. Martin, **Vector Semantics and Embeddings**, <https://web.stanford.edu/~jurafsky/slp3/>, 2022

Jurafsky, Daniel & James H. Martin, **Neural Networks and Neural Language Models**, <https://web.stanford.edu/~jurafsky/slp3/>, 2022

Jurafsky, Daniel & James H. Martin, **Sequence Labeling for Parts of Speech and Named Entities**, <https://web.stanford.edu/~jurafsky/slp3/>, 2022

### Complementary Bibliography

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Baroni, Marco, Raffaella Bernardi & Roberto Zamparelli, **Frege in space: A program for compositional distributional semantics**, *Linguistic Issues in Language Technologies* 9(6): 5-110, University of Colorado Boulder, 2014

Baroni, Marco, Georgiana Dinu & Germán Kruszewski, **Don't count, predict! A systematic comparison of context-counting vs. context-predicting semantic vectors**, *Proceedings of the 52nd Annual Meeting of the ACL (Vol. 1)*, Association for Computational Linguistics, 2014

Church, Kenneth Ward, Zeyu Chen & Yanjun Ma, **Emerging trends: A gentle introduction to fine-tuning**, *Natural Language Engineering*, 27, Cambridge University Press, 2021

Devlin, Jacob, Ming-Wei Chang, Kenton Lee & Kristina Toutanova, **BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding**, *Proceedings of the 2019 Conference of the NACL-HLT (Vol. 1)*, Association for Computational Linguistics, 2019

Erk, Katrin, **Vector space models of word meaning and phrase meaning: A survey**, *Language and Linguistics Compass* 6.10, Wiley & Sons, 2012

Linzen, Tal, **Issues in evaluating semantic spaces using word analogies**, *Proceedings of the 1st Workshop on Evaluating Vector-Space Representations for NLP*, Association for Computational Linguistics, 2016

Hirschberg, Julia & Manning, Christopher D., **Advances in natural language processing**, Science 349.6245, AAAS, 2015

Mikolov, Tomas, Wen-tau Yih & Zweig Geoffrey, **Linguistic Regularities in Continuous Space Word Representations**, *Proceedings of the 2013 Conference of the NACL-HLT*, Association for Computational Linguistics, 2013

Taher Pilehvar, Mohammad & Jose Camacho-Collados, José, **Embeddings in Natural Language Processing: Theory and Advances in Vector Representations of Meaning**, *Computational Linguistics*, 47(3), MIT Press, 2021

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## Recommendations

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### Subjects that continue the syllabus

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Web intelligence and semantic technologies/O06M193V01205

Text mining/O06M193V01302

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### Subjects that are recommended to be taken simultaneously

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Machine learning II/O06M193V01207

Deep learning/O06M193V01206

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### Subjects that it is recommended to have taken before

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Machine learning I/O06M193V01105

Natural language understanding/O06M193V01104

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### Other comments

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All students are reminded of the prohibition of the use of mobile devices in exercises, practices and exams, in compliance with article 13.2.d) of the Statute of the University Student, regarding the duties of the university student body, which establishes the duty to "Refrain from using or cooperating in fraudulent procedures in assessment tests, in the work carried out or in official university documents."

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**IDENTIFYING DATA****Web intelligence and semantic technologies**

Subject	Web intelligence and semantic technologies			
Code	O06M193V01205			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Olivieri Cecchi, David Nicholas			
Lecturers	Olivieri Cecchi, David Nicholas			
E-mail	dnolivieri@gmail.com			
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>			
General description				

**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
------------------------------------	-------------------------------

**Contents**

Topic

**Planning**

Class hours	Hours outside the classroom	Total hours
-------------	-----------------------------	-------------

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description	Qualification	Training and Learning Results
-------------	---------------	-------------------------------

**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

<b>IDENTIFYING DATA</b>			
<b>Deep learning</b>			
Subject	Deep learning		
Code	O06M193V01206		
Study programme	Máster universitario en Inteligencia artificial		
Descriptors	ECTS Credits	Choose	Year
	6	Optional	1st
Teaching language			
Department			
Coordinator	Rodríguez Liñares, Leandro		
Lecturers	Olivieri Cecchi, David Nicholas Rodríguez Liñares, Leandro		
E-mail	leandro@uvigo.es		
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>		
General description			

<b>Training and Learning Results</b>
Code

<b>Expected results from this subject</b>
Expected results from this subject
Training and Learning Results

<b>Contents</b>
Topic

<b>Planning</b>	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

<b>Methodologies</b>
Description

<b>Personalized assistance</b>

<b>Assessment</b>		
Description	Qualification	Training and Learning Results

<b>Other comments on the Evaluation</b>

<b>Sources of information</b>
<b>Basic Bibliography</b>
<b>Complementary Bibliography</b>

<b>Recommendations</b>



<b>IDENTIFYING DATA</b>				
<b>Machine learning II</b>				
Subject	Machine learning II			
Code	O06M193V01207			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Olivieri Cecchi, David Nicholas			
Lecturers	Olivieri Cecchi, David Nicholas			
E-mail	dnolivieri@gmail.com			
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>			
General description				

<b>Training and Learning Results</b>
Code

<b>Expected results from this subject</b>
Expected results from this subject
Training and Learning Results

<b>Contents</b>
Topic

<b>Planning</b>	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

<b>Methodologies</b>
Description

<b>Personalized assistance</b>

<b>Assessment</b>		
Description	Qualification	Training and Learning Results

<b>Other comments on the Evaluation</b>

<b>Sources of information</b>
<b>Basic Bibliography</b>
<b>Complementary Bibliography</b>

<b>Recommendations</b>

**IDENTIFYING DATA****Evolutionary computation**

Subject	Evolutionary computation			
Code	O06M193V01208			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Formella , Arno			
Lecturers	Formella , Arno			
E-mail	formella@uvigo.es			
Web	<a href="http://formella.webs.uvigo.es/doc/ec23">http://formella.webs.uvigo.es/doc/ec23</a>			
General description	The course introduces the student to the modeling of systems capable of adapting to their environments and learning from their experience, imitating the evolutionary processes of nature. In this context, the student will be instructed not only in the use of different techniques for the search of solutions inspired by the prevalence or subsistence strategies of a population, but also in the application of meta-heuristics for their optimization.			

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A3	CB8 - the complexity of making judgments based on information that, while incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
B2	Successfully address all stages of an Artificial Intelligence project.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B4	Elaborate adequately and with certain originality written compositions or motivated arguments, write plans, work projects, scientific articles and formulate reasonable hypotheses in the field.
B5	Work in teams, especially multidisciplinary teams, and be skilled in time management, people management and decision making.
C10	Ability to build, validate and apply a stochastic model of a real system from observed data and the critical analysis of the results obtained
C11	Understanding and mastery of the main data analysis techniques and tools, both from a statistical and machine learning point of view, including those dedicated to the processing of large volumes of data, and the ability to select the most appropriate ones for problem solving.
C12	Ability to plan, formulate and resolve all stages of a data project, including understanding and mastery of basic fundamentals and techniques for searching and filtering information in large data collections.
C15	Knowledge of computer tools in the field of machine learning, and ability to select the most appropriate for solving a problem.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D7	Develop the ability to work in interdisciplinary or transdisciplinary teams to offer proposals that contribute to sustainable environmental, economic, political and social development.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.
D9	Have the ability to manage time and resources: develop plans, prioritize activities, identify critical ones, set deadlines and meet them.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
------------------------------------	-------------------------------

<p>RA1: Know the basic concepts of evolutionary computation, of classical evolutionary algorithms and of bioinspired algorithms.</p>	<p>A1 A2 A3 B2 B3 B4 B5 C10 C11 C12 C15 D3 D7 D8 D9</p>
<p>RA2: Have the ability to design bioinspired models of complex real systems.</p>	<p>A1 A2 A3 B2 B3 B4 B5 C10 C11 C12 C15 D3 D7 D8 D9</p>
<p>RA3: Know and apply techniques based on evolutionary systems, artificial neural networks and other bioinspired models.</p>	<p>A1 A2 A3 B2 B3 B4 B5 C10 C11 C12 C15 D3 D7 D8 D9</p>
<p>RA4: Identify the appropriate data-driven solution search techniques according to the type of problem. Understand the different possibilities of combination or hybridization between global evolutionary search methods and other local search metaheuristics.</p>	<p>A1 A2 A3 B2 B3 B4 B5 C10 C11 C12 C15 D3 D7 D8 D9</p>

RA5: Know different adaptive bioinspired models and handle tools and environments currently used in the field of the bioinspired algorithms.

A1  
A2  
A3  
B2  
B3  
B4  
B5  
C10  
C11  
C12  
C15  
D3  
D7  
D8  
D9

## Contents

Topic	
Introduction to algorithms of optimisation	General scheme of evolutionary algorithms. Basic concepts: search domain, constraints, penalties. No Free Lunch theorem. Basic concepts of multi-objective optimization.
Paradigms and meta-heuristic of nature-inspired algorithms	Bio-inspired metaheuristics. Swarm intelligence.
Specific algorithms of evolutionary computation	Genetic algorithms. Evolutionary strategies. Genetic programming. Examples of swarm intelligence: Particle Swarm Optimization, Artificial Bee Algorithm, Bacterial Colony Optimization, Ant Algorithms. Examples of other bio-inspired evolutionary algorithms.
Advances in the automatic adaptation of evolutionary algorithms	Automatic adaptation of the defining parameters of an evolutionary algorithm. Application of memetic algorithms (local search at individuals in population based algorithms). Use of hyper-heuristics.

## Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	10.5	10.5	21
Laboratory practical	10.5	31.5	42
Case studies	5	0	5
Essay	2	2	4
Objective questions exam	3	0	3

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Lecturing	Oral exhibition complemented with the use of audiovisual means and the introduction of some questions headed to the students, with the purpose to transmit knowledges and facilitate the learning. In addition to the time of oral exhibition by part of the professor, this formative activity requires of the student the dedication of a time to prepare and review by own account the material object of the class.
Laboratory practical	Classes devoted to that the students develop practical works that involve to tackle the resolution of complex problems, and the analysis and design of solutions that constitute a half for his resolution. This activity can require of the students the oral presentation of the works made. The works made by the students can done individually or in groups.
Case studies	Present to the students a state-of-the-art work, real or fictitious, that presents a specific topic. The students has to apply the theoretical knowledge of the subject to look for solution to the problem. Like general norm, case studies will make in groups. The distinct groups of work will present and share their solutions.

## Personalized assistance

Methodologies	Description
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Laboratory practical	The professor will attend the students in sessions of laboratory with the aim of orientation to the resolution of the exercises and practical works of the subject.
Case studies	The professor will attend the students in sessions of office hours dedicated to the orientation in the study and the resolution of doubts on the contents and works of the subject. Use a remote platform with capacity of forums of discussion both between the students and with the professor.
<b>Tests</b>	<b>Description</b>
Essay	The professor will attend the students in sessions of office hours dedicated to the orientation in the study and the resolution of doubts on the contents and works of the subject.

<b>Assessment</b>					
	Description	Qualification	Training and Learning Results		
Lecturing	Continuous evaluation: part of the evaluation of the students is based on the evolution and work in the frame of the subject and on the participation in the formative activities. (RA1, RA2, RA3, RA4, RA5)	5	A1 A2 A3	B3	D8
Laboratory practical	Continuous evaluation: part of the evaluation of the students is based on the evolution and work in the frame of the subject and on the participation in the formative activities. (RA1, RA2, RA3, RA4, RA5)	5	A1 A2 A3	B2 B4	C12 C15 D7 D8
Essay	Evaluation of practical works: evaluation of the solutions proposed by the students to the exercises. The evaluation of exercises is carried out by means of a correction by the professor, a defence of the solution done by the student in a written comment or in an oral presentation of the developed solution.	50	A1 A2 A3	B2 B3 B4 B5	C10 C11 C12 C15 D3 D7 D8 D9
Objective questions exam	Final examination: written evaluation at the end of the subject, oriented especially to evaluate the understanding of the theory and laboratory exercises. (RA1, RA2, RA3, RA4, RA5)	40	A1 A2 A3	B3 B4	C10 C11 C12 C15 D8

### **Other comments on the Evaluation**

#### CONTINUOUS ASSESSMENT SYSTEM

##### TEST 1: Evaluation in master class

Description: Active participation in theory classes.

Methodology(s) applied(s): Objective oral questions.

% Qualification: 5%

% Minimum (if any): there is no

Assessed skills: A1, A2, A3, B3, D8

Assessed learning outcomes: RA1, RA2, RA3, RA4, RA5

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##### TEST 2: Evaluation in laboratory practices

Description: Active participation in practical classes.

Methodology(s) applied(s): Objective oral questions.

% Qualification: 5%

% Minimum (if any): there is no

Assessed skills: A1, A2, A3, B2, B4, C12, C15, D7, D8

Assessed learning outcomes: RA1, RA2, RA3, RA4, RA5

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##### TEST 3: Work evaluation (part 1, at the end of the first half of the academic period)

Description: Objective test that will include evaluation of the application of theoretical concepts and resolution of exercises.

Methodology(s) applied(s): Delivery of solutions developed with report.

% Qualification: 25%

% Minimum (if any): there is no

Assessed skills: A1, A2, A3, B2, B3, B4, B5, C10, C11, C12, C15, D8

Assessed learning outcomes: RA1, RA2, RA3, RA4, RA5

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TEST 4: Work evaluation (part 2, at the end of the academic period)

Description: Objective test that will include evaluation of the application of theoretical concepts and resolution of exercises.

Methodology(s) applied(s): Delivery of solutions developed with report.

% Qualification: 25%

% Minimum (if any): there is no

Assessed skills: A1, A2, A3, B2, B3, B4, B5, C10, C11, C12, C15, D8

Assessed learning outcomes: RA1, RA2, RA3, RA4, RA5

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TEST 5: Objective questions exam (during exam period)

Description: Objective test that will include short questions and development questions.

Methodology(s) applied(s): Written exam.

% Qualification: 40%

% Minimum (if any): there is no

Assessed skills: A1, A2, A3, B3, B4, C10, C11, C12, C15, D8

Assessed learning outcomes: RA1, RA2, RA3, RA4, RA5

All students who take any of the tests 2 and 3 are understood to accept the continuous assessment procedure described above. If a student does not appear for any of the tests, a grade of 0 will be assigned to it.

#### GLOBAL EVALUATION SYSTEM

Procedure for choosing the global assessment modality: It is considered that the student opts for the global assessment system if they do not take Test 1 of the continuous assessment system).

TEST 1: Theoretical, practical and/or laboratory evaluation.

Description: Objective test that will include evaluation of theoretical concepts and resolution of exercises.

Methodology(s) applied(s): Problem solving, Examination of objective questions. They must appear in the top table.

% Rating: 100%

Minimum % (if applicable): reach 50%

Assessed skills: All of the subject.

Evaluated learning outcomes: All of the subject.

#### EVALUATION CRITERIA FOR EXTRAORDINARY CALL AND FINAL DEGREE

The global evaluation systems previously exposed will be used.

## RECORD QUALIFICATION PROCESS

The sum of the sections described above will appear in the minutes.

## EVALUATION DATES

The dates of the tests corresponding to the continuous assessment system will be published in the calendar of activities, available on the ESEI website <https://esei.uvigo.es/docencia/horarios/>.

The official exam dates of the different calls, officially approved by the Xunta de Centro of the ESEI, are published on the ESEI website <https://esei.uvigo.es/docencia/exames/>.

## USE OF MOBILE DEVICES

All students are reminded of the prohibition of the use of mobile devices in exercises and practices, in compliance with article 13.2.d) of the University Student Statute, regarding the duties of university students, which establishes the duty to "Refrain from using or cooperation in fraudulent procedures in the evaluation tests, in the works that are carried out or in official documents of the university."

## CONSULTATION/REQUEST FOR TUTORIALS

The tutorials can be consulted through the personal page of the teaching staff, accessible through <https://esei.uvigo.es/docencia/profesorado/>

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### Sources of information

#### Basic Bibliography

Dan Simon, **Evolutionary Optimization Algorithms.**, 978-0-470-93741-9, Wiley, 2013

A. E. Eiben, **Introduction to Evolutionary Computing (Natural Computing Series)**, 978-3-662-44874-8, Springer, 2010

#### Complementary Bibliography

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### Recommendations

**IDENTIFYING DATA****Computer vision II**

Subject	Computer vision II		
Code	O06M193V01209		
Study programme	Máster universitario en Inteligencia artificial		
Descriptors	ECTS Credits	Choose	Year
	6	Optional	1st
Teaching language	English		
Department			
Coordinator	Olivieri Cecchi, David Nicholas		
Lecturers	Formella , Arno García Lourenco, Analia María Olivieri Cecchi, David Nicholas		
E-mail	dnolivieri@gmail.com		
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>		
General description			

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A5	CB10 - That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.
B1	Maintain and extend sound theoretical approaches to enable the introduction and exploitation of new and advanced technologies in the field of Artificial Intelligence.
B3	Search and select useful information needed to solve complex problems, handling with fluency the bibliographic sources of the field.
B5	Work in teams, especially multidisciplinary teams, and be skilled in time management, people management and decision making.
C23	Understanding and mastering the basic concepts and techniques of digital image processing.
C24	Ability to apply different techniques to computer vision problems.
C25	Knowledge and skills to design systems for detection, classification and tracking of objects in images and video.
C26	Understanding and mastery of the forms of representation of signals and images according to their data, as well as their fundamental characteristics and their forms of representation.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D4	To develop for the exercise of a citizenship respectful of democratic culture, human rights and gender perspective.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
New	A1 A2 A5 B1 B3 B5 C23 C24 C25 C26 D3 D4 D8



New

A1  
A2  
A5  
B1  
B3  
B5  
C23  
C24  
C25  
C26  
D3  
D4  
D8

New

A1  
A2  
A5  
B1  
B3  
B5  
C23  
C24  
C25  
C26  
D3  
D4  
D8

New

A1  
A2  
A5  
B1  
B3  
B5  
C23  
C24  
C25  
C26  
D3  
D4  
D8

**Contents**

Topic

**Planning**

Class hours

Hours outside the  
classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance**

**Assessment**

Description

Qualification

Training and Learning Results

**Other comments on the Evaluation**

**Sources of information**

Basic Bibliography

Complementary Bibliography

**Recommendations**



**IDENTIFYING DATA****Intelligent robotics II**Subject Intelligent robotics  
II

Code O06M193V01210

Study Máster  
programme universitario en  
Inteligencia  
artificial

Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd

Teaching  
language

Department

Coordinator

Lecturers

E-mail

Web [http://guiadocente.udc.es/guia\\_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny\\_academic=2023\\_24](http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny_academic=2023_24)General  
description**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject

Training and  
Learning Results**Contents**

Topic

**Planning**

Class hours

Hours outside the  
classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description

Qualification

Training and Learning Results

**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

<b>IDENTIFYING DATA</b>				
<b>AI project management</b>				
Subject	AI project management			
Code	O06M193V01211			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	2nd
Teaching language				
Department				
Coordinator	Olivieri Cecchi, David Nicholas			
Lecturers	Olivieri Cecchi, David Nicholas			
E-mail	dnolivieri@gmail.com			
Web	<a href="http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24">http://guiadocente.udc.es/guia_docent/index.php?centre=614&amp;ensenyament=614544&amp;consulta=assignatures&amp;ny_academic=2023_24</a>			
General description				

<b>Training and Learning Results</b>
Code

<b>Expected results from this subject</b>
Expected results from this subject
Training and Learning Results

<b>Contents</b>
Topic

<b>Planning</b>	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

<b>Methodologies</b>
Description

<b>Personalized assistance</b>

<b>Assessment</b>		
Description	Qualification	Training and Learning Results

<b>Other comments on the Evaluation</b>

<b>Sources of information</b>
<b>Basic Bibliography</b>
<b>Complementary Bibliography</b>

<b>Recommendations</b>

**IDENTIFYING DATA****Process Mining**

Subject Process Mining

Code O06M193V01212

Study Máster  
programme universitario en  
Inteligencia  
artificial

Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd

Teaching  
language

Department

Coordinator

Lecturers

E-mail

Web [http://guiadocente.udc.es/guia\\_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny\\_academic=2023\\_24](http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614544&consulta=assignatures&ny_academic=2023_24)General  
description**Training and Learning Results**

Code

**Expected results from this subject**

Expected results from this subject

Training and  
Learning Results**Contents**

Topic

**Planning**

Class hours

Hours outside the  
classroom

Total hours

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

Description

**Personalized assistance****Assessment**

Description

Qualification

Training and Learning Results

**Other comments on the Evaluation****Sources of information****Basic Bibliography****Complementary Bibliography****Recommendations**

**IDENTIFYING DATA****Intelligent real-time systems**

Subject	Intelligent real-time systems			
Code	O06M193V01213			
Study programme	Máster universitario en Inteligencia artificial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	González Moreno, Juan Carlos			
Lecturers	González Moreno, Juan Carlos			
E-mail	jcmoreno@uvigo.es			
Web	<a href="http://https://moovi.uvigo.gal/">http://https://moovi.uvigo.gal/</a>			
General description	The main objective of this subject is to provide students with the minimum knowledge necessary for problem solving in the field of intelligent systems in real time, and the appropriate understanding of how to approach the resolution of these problems, but paying special attention to real time management.			

**Training and Learning Results**

Code	
A1	CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A4	CB9 - Students should be able to communicate their conclusions and the ultimate knowledge and rationale behind them to specialized and non-specialized audiences in a clear and unambiguous manner.
A5	CB10 - That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.
B1	Maintain and extend sound theoretical approaches to enable the introduction and exploitation of new and advanced technologies in the field of Artificial Intelligence.
B2	Successfully address all stages of an Artificial Intelligence project.
B5	Work in teams, especially multidisciplinary teams, and be skilled in time management, people management and decision making.
C19	Knowledge of different application areas of AI-based technologies and their capacity to offer a differentiating added value.
C20	Ability to combine and adapt different techniques, extrapolating knowledge between different fields of application.
C21	Knowledge of techniques that facilitate the organization and management of AI projects in real environments, resource management and task planning in an efficient way, taking into account concepts of knowledge dissemination and open science.
C22	Knowledge of techniques that facilitate the security of data, applications and communications and their implications in different AI application areas.
C30	Be able to pose, model and solve problems requiring the application of artificial intelligence methods, techniques and technologies.
D3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida.
D7	Develop the ability to work in interdisciplinary or transdisciplinary teams to offer proposals that contribute to sustainable environmental, economic, political and social development.
D8	Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society.
D9	Have the ability to manage time and resources: develop plans, prioritize activities, identify critical ones, set deadlines and meet them.

**Expected results from this subject**

Expected results from this subject	Training and Learning Results
RA1: Know the characteristics and functions of a real-time systems.	A1 A2 A4 B1 C20 D3 D8

RA2: Ability to design and program a real-time system.	A1 A2 A4 B1 B5 C20 D3 D7 D8
RA3: Know the most common programming languages for real-time systems, both synchronous and asynchronous.	A1 A2 A4 A5 B1 B5 C20 C21 D3 D7 D8 D9
RA4: Know the production of reliable software components, with special attention to fault tolerance and error recovery.	A1 A2 A4 A5 B1 B5 C20 C21 C22 D3 D7 D8 D9
RA5: Know the basics of concurrent programming, communication and synchronization in real-time systems.	A2 A5 B2 C21 C22 C30 D7 D9
RA6: Know the temporal requirements of the functionalities of the language and the strategies to satisfy them, both in the synchronous and asynchronous case.	A1 A2 A4 A5 B1 B5 C20 C22 D3 D7 D8 D9
RA7: Know the architectures of integration of artificial intelligence in real-time systems, with a view to an efficient treatment of planning.	A4 A5 B1 B2 C19 C21 C30 D3 D8 D9

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## Contents

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Topic

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Real-time systems.	Introduction. RTS design. Intelligent Systems in RT.
Determinism and reliability.	Determinism. Reliability. Fault tolerance. Exception handling.
Parallelism.	Concurrence. Synchronous and asynchronous hypothesis. Real time. Planning. Distribution.
Planning.	Strategies. Verification of behavior. Architectures.
Implementation languages.	General purpose languages. Agent-based languages. Simulation.

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	12	24
Laboratory practical	8	24	32
Case studies	1	2	3
Project based learning	0	16	16

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

### Methodologies

	Description
Lecturing	Presentation by the teacher of the main contents of the subject.  CONTINUOUS ASSESSMENT Mandatory character Attendance: Mandatory OVERALL ASSESSMENT Mandatory character
Laboratory practical	Presentation and supervision by the teacher of practical problems that complement the theoretical contents seen in the master classes and in the presentations.  CONTINUOUS ASSESSMENT Mandatory character Attendance: Mandatory OVERALL ASSESSMENT Mandatory character
Case studies	Teacher will present to Students a work scenario, real or fictitious, that exposes a certain problem. Students must solve it and present the solution through a video of about 10' in length; the solution will be elaborated by applying the knowledge acquired along the course.  CONTINUOUS ASSESSMENT Mandatory character Attendance: Mandatory OVERALL ASSESSMENT Mandatory character
Project based learning	The teacher will propose to the students a series of practical projects for their resolution using the contents seen both in theory and in the laboratory. The solution will be composed of an annotated code and a memory that adequately describes the solution provided.  CONTINUOUS ASSESSMENT Mandatory character Attendance: Mandatory OVERALL ASSESSMENT Mandatory character

### Personalized assistance

Methodologies	Description
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Case studies	Teacher will advise the student on how to organize the contents chosen for exposure to the rest of the students. Teacher will use as support the telematic means available.
Project based learning	Teacher will advise the student on how to approach the design and organization of the solution proposed by the student to the assigned project. Teacher will use as support the telematic means available.

<b>Assessment</b>						
	Description	Qualification	Training and Learning Results			
Lecturing	At the end of each topic, problems/exercises will be proposed that will be used for an evaluation through continuous monitoring of the subject. It allows the evaluation of RA1, RA3, RA4, RA5 and RA6  To release this assessment test, the student must get 5 points or more in their final grade.  In the case of opting for the global evaluation, on the date of the exam the students will be able to answer the exercises that are presented.	30	A1	B1	C19 C20 C21 C22 C30	
Case studies	Presentation of a video with its own solution to a proposed case study. It allows the evaluation of RA1, RA3, RA4, RA5, RA6 and RA7  This methodological test is compulsory, both in continuous and global evaluation.  To release this part of the evaluation, the student must get 5 points or more in their grade.  Late deliveries and those that are delivered in a different format than the order will be rated 0.	30	A4 A5	B1	C19 C20 C21 C22 C30	D8 D9
Project based learning	The solution (code + explanatory memory) to a practical project proposed and assigned will be evaluated. It allows the evaluation of RA2, RA4, RA6, and RA7  This test will be evaluated with the applications provided to be carried out in groups of 2 people.  This methodological test is compulsory, both in continuous and global evaluation.  The delivery must be made on the dates and in the manner indicated. Late deliveries and those that are delivered in a different format than asked will be rated with 0.  The delivery could require a defense by the members of the group on the date and in the manner indicated.  To release this assessment test, the student must get 5 points or more in their final grade	40	A1 A2 A4 A5	B2 B5	C19 C20 C21 C22 C30	D3 D7 D8 D9

## **Other comments on the Evaluation**

### **CONTINUOUS ASSESSMENT SYSTEM**

#### **TEST 1: Resolution of problems and/or exercises**

Description: Resolution of exercises and/or problems proposed at the end of each topic to evaluate the comprehension of the unit and carry out continuous monitoring of the subject. These exercises will be carried out and delivered offline.

Methodology(s) applied(s): Lecturing.

Qualification: 30%

Minimum: For the release of this part of the subject, the student must obtain a grade equal to or greater than 5 points (out of 10) in the final grade of the test, which will be calculated cumulatively by adding the points achieved in each installment.

#### **TEST 2: Elaboration of Memory and Video**

Description: Preparation of a video and a brief report that presents/defends the student's solution to the assigned case study. The work will be developed in pairs and delivered offline on the date to be determined.

Methodology(s) applied: Case studies

Qualification: 30%

Minimum: For the release of this part of the subject, the student must obtain a score equal to or greater than 5 points (out of 10) in the evaluation of both the memory and the video. Late deliveries and those that do not meet the parameters set for delivery will be scored with 0 points.

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**TEST 3: Development of a practice and a practice report**

Description: After the second week, a "Project" will be proposed to be developed and solved in pairs. The solution will evolve over the weeks with the support of laboratory classes in which doubts will be solved and the feasibility of the proposed solution will be continuously verified.

Methodology(s) applied: Project Based Learning

Qualification: 40%

Minimum: For the release of this part of the subject, the student must obtain a grade equal to or greater than 5 points (out of 10) in the evaluation, both in the code and in the report. Once the delivery has been made, a defense of the work carried out may be required in order to verify its authorship.

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- The final grade for the subject is calculated using the weighted average of the previous tests. In order to take said average, the student must achieve at least a 4 in each of the tests.
  - If, at the end of the course, a student presents a grade of less than 4, in two or more of the previous tests, his/her grade will be determined by the minimum value between the average of the grades and 4.
  - All the deliveries of the previous tests that are not carried out on time and in the requested form will be graded with a 0.

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**GLOBAL EVALUATION SYSTEM**

Procedure for choosing the global assessment modality: Since the default assessment system is CONTINUOUS ASSESSMENT, it is considered that all enrolled students opt for said system. In case of wanting to be evaluated through the GLOBAL EVALUATION system, "Once the period of one month from the beginning of the semester has passed, a period of 5 working days will be enabled for the students enrolled in the subject to formally state their intention to benefit from the GLOBAL EVALUATION system"

**TEST 1: Theory Exam**

Description: Objective test that will include the evaluation of the theoretical concepts seen throughout the course and resolution of exercises/problems proposed in the Continuous Assessment System.

Applied Methodology(s): Lecture

Qualification: 50%

Minimum: For the release of this part of the subject, the student must obtain a grade equal to or greater than 5 points (out of 10).

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**TEST 2: Elaboration of Memory and Video**

Description: Preparation of a video and a brief memory that presents/defends the student's solution to a determined case study. The work will be delivered on the date determined prior to the final exam.

Methodology(s) applied: Case study

Qualification: 10%

Minimum: For the release of this part of the subject, the student must obtain a score equal to or greater than 5 points (out of 10) in the evaluation of both the memory and the video. A late delivery or one that does not conform to the parameters set for the delivery will be qualified with 0 points.

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## **TEST 2: Development of a practice and a practice report**

Description: Delivery of a solution to a "Project" that will be proposed for students who use this system and that must be delivered on the date (prior to the exam date) and in a manner determined. The solution will consist of a code with the solution and a report that explains and defends the proposed solution.

Methodology(s) applied: Project Based Learning

Qualification: 40%

Minimum: For the release of this part of the subject, the student must obtain a grade equal to or greater than 5 points (out of 10) in the evaluation, both in the code and in the report. Once the delivery has been made, the defense of the work carried out may be required in order to verify its authorship on the examination date by answering several questions related to the assigned "Project".

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- The final grade for the subject is calculated using the weighted average of the previous tests. In order to take said average, the student must achieve at least a 4 in each of the tests.
- If, at the end of the course, a student presents a grade of less than 4, in one or more of the previous tests, their grade will be determined by the minimum value between the average of the grades of said tests and four.
- All the deliveries of the previous tests that are not carried out on time and in the requested form will be graded with a 0.

## **EVALUATION CRITERIA FOR EXTRAORDINARY CALL AND FINAL DEGREE**

The continuous and global evaluation systems described above will be used.

### **RECORD QUALIFICATION PROCESS**

*Regardless of the evaluation system and the call, if any part of the evaluation is not passed, but the overall score is greater than 4 (out of 10), the qualification in the minutes will be 4.*

### **EVALUATION DATES**

The dates of the tests corresponding to the continuous assessment system will be published in the calendar of activities, available on the ESEI website <https://esei.uvigo.es/docencia/horarios/>.

The official exam dates of the different calls, officially approved by the Xunta de Centro of the ESEI, are published on the ESEI website <https://esei.uvigo.es/docencia/horarios/>.

### **USE OF MOBILE DEVICES**

All students are reminded of the prohibition of the use of mobile devices in exercises and practices, in compliance with article 13.2.d) of the University Student Statute, regarding the duties of university students, which establishes the duty to "Refrain from using or cooperation in fraudulent procedures in the evaluation tests, in the works that are carried out or in official documents of the university."

### **CONSULTATION/REQUEST FOR TUTORIALS**

The tutorials can be consulted through the personal page of the teaching staff, accessible through <https://esei.uvigo.es/docencia/profesorado/>

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### **Sources of information**

#### **Basic Bibliography**

#### **Complementary Bibliography**

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Alan Burns, Andy Wellings, **Sistemas de tiempo real y lenguajes de programación**, 9788478290581, 3ª, Addison-Wesley, 2003

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Manuel I. Capel Tuñón, **Programación Concurrente y en tiempo real: Fundamentos y aplicaciones**, 9788417289362, Garceta, 2022

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Rafael H. Bordini, Jomi Fred Hübner, Michael Wooldridge, **Programming Multi-agent systems in Agent-Speak with Jason**, 10.1002/9780470061848, Wiley, 2007

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Olivier Boissier, Rafael H. Bordini, Jomi Hubner, Alessandro Ricci, **Multi-Agent Oriented Programming: Programming Multi-Agent Systems Using JaCaMo**, 9780262044578, MIT Press, 2020

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## **Recommendations**

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### **Subjects that it is recommended to have taken before**

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Multiagent systems/O06M193V01202

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