COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2024 - 2025

TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Foundations of Artificial Intelligence
Subject code	DTC-IMAT-213
Mainprogram	Bachelor's Degree in Mathematical Engineering and Artificial Intelligence
Involved programs	Grado en Ingeniería Matemática e Inteligencia Artificial [Second year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	4,5 ECTS
Type	Obligatoria (Grado)
Department	Department of Telematics and Computer Sciencies

Teacher Information	
Teacher	
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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

This subject presents a first approach to the mathematics and computation behind Artificial Intelligence. Using a modern approach to intelligent agents, this course incorporates elements of intelligence such as logical systems, inference under uncertainty, search algorithms, or adversarial games.

Prerequisites

Linear algebra. Basic algorithm. Programming in python.

Competencies - Objectives

Competences

GENERALES

CG06	Capacidad para utilizar el aprendizaje de manera estratégica y flexible en función del objetivo perseguido, a partir del reconocimiento del propio sistema de aprendizaje y de la conciencia del aprendizaje mismo, dentro de un contexto tecnológico que evoluciona rápidamente
CG07	Capacidad para integrarse en equipos de trabajo y colaborar de forma activa con otras personas, áreas y organizaciones en la consecución de los objetivos ligados a las actividades de extracción de valor de los datos e inteligencia artificial.
CG08	Capacidad para identificar, analizar y definir los elementos significativos que constituyen un problema vinculado a la explotación de datos e inteligencia artificial aplicada a las actividades empresariales para resolverlo con criterio y de forma efectiva
ESPECÍFICAS	
CE02	Capacidad para comprender y dominar los conceptos básicos de matemática discreta, lógica, algorítmica y complejidad computacional.
CE04	Capacidad para utilizar con habilidad y soltura software matemático, así como para implementar algoritmos y desarrollar programas informáticos que permitan resolver los problemas matemáticos planteados en el ámbito de la ingeniería y de la inteligencia artificial.
CE14	Dominio de los conceptos y técnicas más utilizadas de adquisición y transformación de la información localizada en local o en remoto en el ámbito del análisis de datos y la inteligencia artificial
CE25	Conocimiento y capacidad para aplicar técnicas de inteligencia artificial, aprendizaje automático, aprendizaje profundo y aprendizaje por refuerzo que permiten extraer conocimiento de grandes volúmenes de datos.
CE30	Capacidad para diseñar y aplicar métodos y algoritmos heurísticos de búsqueda para la toma de decisiones.

Learning outcomes	
RA1	Conocer los principios básicos de la Inteligencia Artificial, sus áreas de desarrollo, así como los tipos de técnicas más comúnmente utilizadas
RA2	Saber diseñar, desarrollar y aplicar sistemas basados en el conocimiento humano, así como el tratamiento de su incertidumbre
RA3	Saber diseñar y aplicar técnicas de tratamiento de la incertidumbre en sistemas basados en el conocimiento
RA4	Estar familiarizado con el uso de software que facilite la aplicación práctica de los fundamentos de la inteligencia artificial

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

1 Basic principles of Artificial Intelligence. Smart agents.

2. State-based agents. search-based systems. heuristics. adversarial games

3. Knowledge-Based Systems. logical inference. First-order logic.

4. Treatment of uncertainty. Bayesian inference. Bayesian networks.

5. Agents based on utilities. Markov decision processes

TEACHING METHODOLOGY

General methodological aspects of the subject

The teaching methodologies to follow in these activities will be:

- Master lesson
- Hands-on learning
- Collaborative learning
- Fipped class

In-class Methodology: Activities

The training activities will be: - Expository and participatory master classes: - The teacher will combine expositiothe n of the theoretical content with practical examples, both mathematical and programming. - The student will have some practical examples of code, generated inside and outside the classroom by the teacher. - Practical exercises and problem problem-solvingsolving: - The student will solve problems raised by the teacher in person during the second hour of class, promoting the dynamics of cooperative work. - Practical sessions with software use: - The practical sessions will be dedicated to answering questions about the weekly practice and for the students to finish their practice. - The practices will be graded by difficthe ulty that the students will implement as they complete each milestone. - Continuous performance evaluation activities: tests will be carried out, practices complementary to the weekly ones and gamified challenges will be developed.	CG06, CG07, CG08, CE02, CE04, CE14, CE25, CE30

Non-Presential Methodology: Activities

The training activities will be: - Practical exercises and problem-solving: - The student will have specific problems focused on assimilating the theoretical concepts explained in the previous theory session to develop remotely. - The solution to these problems will be uploaded to the platform the following week, before starting the new topic. - Practical sessions with software use: - Once the weekly practice is released after the corresponding theory session, the student will work on it remotely. The student must arrive at the face-to-face practice session with the objectives proposed in the statement at 80% - In the classroom, the statement will be extended incrementally and the milestones proposed will be covered progressively. - Personal study: the main objective of remote work is to come to understand and comprehend the theoretical concepts of the subject, as well as to be able to put this knowledge into practice to solve different types of	CG06, CG07, CG08, CE02, CE04, CE14, CE25, CE30

problems. After each theoretical explanation, the teacher will upload all the developed codes to the web and the student must review them and ask himself "What-if" questions to better assimilate the theoretical concepts.	

SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS				
Clases magistrales expositivas y participativas	Sesiones prácticas con uso de software	Tutorías para resolución de dudas	Ejercicios prácticos y resolución de problemas	Actividades de evaluación continua del rendimiento
17.00	11.00	5.00	14.00	3.00
NON-PRESENTIAL HOURS				
Sesiones prácticas con uso de software	Estudio personal	Ejercicios prácticos y resolución de problemas	Trabajos	
33.00	16.00	21.00	16.00	
ECTS CREDITS: 4,5 (136,00 hours)				

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Exams: - Inter-semester test. - Final exam.	- Inter-semester test (30%): understanding of the fundamental concepts of computer science and programming. - Final Exam (50%): computational and abstract thinking for problem-solving through programming will be evaluated.	80 %
• Collaborative work in class • Personal and in-group deliverables of exercises proposed, conducted at home • Weekly practices	- The attitude, participation and completion of the weekly practices and the challenges posed in collaborative and individual sessions.	10 %
Final project.	Final project of the subject that the student will deliver at the end of the course.	10 %

Ratings

The final grade in ordinary and extraordinary calls for the subject will depend on the evaluation of the following activities:

- Final Grade = 30% Intersemester Test + 50% Final Exam + 10% Weekly practices + 10% Final project.
- To pass the subject, students must obtain at least 5 points out of 10 in the final exam of the subject and in the final practice, both in the ordinary and extraordinary calls.
- In case a student fails the final project but passes the final exam, the possibility of offering an extraordinary delivery deadline for

the project in the extraordinary call will be considered.

- The absence of 15% or more of the contact hours of this subject may result in the impossibility of attending ordinary and extraordinary calls.
- The final practice will be INDIVIDUAL.
- The weekly practices are delivered individually, although you can/should work as a team in class.
- The extraordinary exam groups the marks of the intersemester exam and the final

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

- Russell, Stuart J., Norvig, P., "Artificial intelligence—a modern approach 4th ed", Pearson Education (2021).
- Gelman, A., Carlin, J. B., Stern, H. S., & Rubin, D. B. (1995). Bayesian data analysis. Chapman and Hall/CRC.
- Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. Vol. 1. Cambridge, MA, USA: MIT press, 2017.

Complementary Bibliography

- Jaynes, Edwin T. Probability theory: The logic of science. Cambridge university press, 2003.
- Haykin, Simon. "Neural networks: A guided tour." Soft computing and intelligent systems: theory and applications 71 (1999).
- Malpas, J., "Donald Davidson", The Stanford Encyclopedia of Philosophy (Winter 2012 Edition), Edward N. Zalta (ed.), URL = https://plato.stanford.edu/archives/win2012/entries/davidson/.