

ARTIFICIAL INTELLIGENCE (EMaCS-01-05)				
DEGREE PROGRAM:		Master in Computer Science for the Human-Centric and Sustainable Industry		
SEMESTER: First	TYPE: Basic	CREDITS: 6 ECTS	WORKLOAD: 150 hours	MENTORING: 4 hours/week
LANGUAGE: English				

OBJECTIVES	
General	The student will gain introductory knowledge to modern bio-inspired AI models, Neural Networks and Evolutionary Computing, including different types and existing variants of these techniques, their basic functioning and capabilities for solving different types of problems and the way they provide their results and should be interpreted.
Specific	<ul style="list-style-type: none"> • Explain the different techniques and languages used for extraction and representation of knowledge. • List and describe the different elements that allow managing uncertain knowledge and carrying out an approximate calculation. • List the characteristics of different intelligent models for learning, evidencing the differences between them. • Describe different advanced search techniques that allow finding the solution to different problems. • Explain the basic principles of agents and multi-agent systems and their operation. • Detail the circumstances and stages that define the verification and validation of intelligent systems.
SUSTAINABILITY	
The course "Artificial Intelligence" contributes to sustainability by addressing specific competencies and objectives related to the responsible use of artificial intelligence (AI) and reflection on ethical outcomes. Awareness of diversity and accurate representation in the datasets used to train AI algorithms highlights the concern to avoid biased and discriminatory results. Additionally, by integrating ethical aspects such as transparency, non-discrimination, and accessibility, the course fosters the development of AI solutions that adhere to ethical and social principles.	
RESILIENCE AND HUMAN-CENTRIC DEVELOPMENT	
The course emphasizes the application of artificial intelligence to co-design and co-create new products and services that enhance the capabilities of human workers and contribute to sustainable decision-making. The focus on understanding the functioning of AI algorithms and the importance of human supervision reinforces the willingness to acknowledge that algorithms are not perfect and require active human participation. Developing skills in the application of mathematical, statistical, and AI methods to model, design, and develop intelligent systems supports the training of professionals with technical competencies in the field of AI. Willingness to stay informed about AI and engage in collaborative processes underscores the importance of continuous learning and adaptability.	
SUBJECT MATTER	
<ol style="list-style-type: none"> 1. Knowledge representation 2. Uncertain knowledge and approximate reasoning 3. Learning 4. Advanced searching techniques 5. Multiagent systems 6. Verification and validation of intelligent systems 	
COMPETENCES	
C6. USING MACHINE LEARNING AND A.I. TECHNIQUES C7. PROTECTING PERSONAL DATA AND PRIVACY C8. PROTECTING HEALTH AND WELL-BEING C9. REFLECTING ON ETHICAL OUTCOMES	

C10. EXPLORATORY AND CRITICAL THINKING
 C14. SOLVING TECHNICAL PROBLEMS
 C16. WORKING WITH OTHERS

LEARNING OUTCOMES	
Knowledge	<ul style="list-style-type: none"> • Know how to apply mathematical, statistical and artificial intelligence methods to model, design and develop intelligent systems and knowledge-based systems. • Know how to detect issues in a sequence of instructions, and make changes to resolve them (e.g. to find an error in the program and correct it; to detect the reason why the execution time or output of the program is not as expected). • Know how to use digital technologies to help turn one’s idea into action. • Know how to engage in resolving problems through digital, hybrid and non-digital solutions for the problem (e.g. envisioning and planning preventive maintenance solutions, public reporting systems, resource sharing platforms...).
Skills	<ul style="list-style-type: none"> • Understand and be able to apply advanced knowledge of high-performance computing and numerical or computational methods to engineering problems. • Develop capacity for mathematical modeling, calculation and simulation in business technology and engineering centers, particularly in research, development and innovation tasks in all areas related to Computer Engineering. • Be able to identify input and output data in some simple programs using AI approaches. • Develop a program, being able to recognise the execution order of instructions, and how information is processed. • Be able to identify online platforms that can be used to design, develop and test AI enabled apps. • Develop effective search methods for professional purposes (e.g. to find scientific papers that explain how to solve technical problems). • Be able to make use of information presented as hyperlinks, in non-textual form (e.g. flowcharts, knowledge maps) and in dynamic representations (e.g. data).
Attitudes/values	<ul style="list-style-type: none"> • Weigh the benefits and disadvantages of using AI-driven search engines (e.g. while they might help users find the desired information, they may compromise privacy and personal data, or subject the user to commercial interests). • Worry about that AI algorithms and AI-enabled system are trained with a dataset that ensure diversity and accounting on the right representation of all its users, not incurring in biased results or assessments. • Be willing to accept that algorithms, and hence programs, may not be perfect in solving the problem that they aim to address. • Consider ethics (including but not limited to human agency and oversight, transparency, non-discrimination, accessibility, and biases and fairness) as one of the core pillars when developing or deploying AI systems. • Have a disposition to keep learning, to educate oneself and stay informed about AI (e.g. to understand how AI algorithms work; to understand how automatic decision-making can be biased; to distinguish between realistic and unrealistic AI; and to understand the difference between Artificial Narrow Intelligence, i.e. today’s AI capable of narrow tasks such as game playing, and Artificial General Intelligence, i.e. AI that surpasses human intelligence, which still remains science fiction). • Be open to engage in collaborative processes to co-design and co-create new products and services based on AI systems to support and enhance the capabilities of human workers on industrials settings, as well as improve services and help making better decisions for the sustainability of operations and respect of the environment.
TEACHING METHODS	

Method	Class Workload	Individual Workload	Total
Theoretical Sessions	24	24	58
Laboratory Sessions	24	42	66
Research and writing of an applied project	4	20	24
Written Examinations	2	0	2
TOTAL	54 hours	96 hours	150 hours

EVALUATION

Evaluation Procedure	Percentage on the subject grade
In-class Tests or Exercises	20%
Laboratory Programming Assignments and Reports	30%
Applied Project	20%
Written Examinations	30%
TOTAL	100%

In order to pass the course, it is necessary to obtain a minimum mark of 4 out of 10 in each of the three evaluation procedures and 5 out of 10 in their weighted average.

PRECONDITIONS

- Basic skills in programming.
- Knowledge of calculus and mathematics at a level of a graduate student (e.g. matrix and vector calculus, Boolean operations, etc.)

DEPARTMENT	Department of Digitalization
LECTURERS	<ul style="list-style-type: none"> • Daniel Urda Muñoz • Carlos Cambra Baseca
LITERATURE	<ul style="list-style-type: none"> • José Tomás Palma Méndez, Roque Marín Morales, (2008) Inteligencia artificial: métodos, técnicas y aplicaciones, McGraw Hill • Nils J. Nilsson, (2000) Inteligencia artificial - una nueva síntesis, McGraw Hill • Stuart Russell, Peter Norvig, (2004) Inteligencia Artificial: Un Enfoque Moderno, 2, Prentice Hall • Bayesian Methods for Hackers: Probabilistic Programming and Bayesian Inference, (2016) Bayesian Methods for Hackers: Probabilistic Programming and Bayesian Inference, Addison-Wesley Data & Analytics • Boden, M. A., (2018) Artificial Intelligence: A Very Short Introduction, Oxford University Press