POLITÉCNICO DE SANTARÉM

Artificial Intelligence

Code: ERAGT52 Acronym: AI
Scientific Area: Computer Sciences

Occurrence: 2025/26 - 1S

Teaching Area: *Informática*

Courses

Acronym	Nº de Estudantes	Plano de Estudos	Academic Year	Credits	Horas Contacto	Total Hours
ERSGT	1	Curso Erasmus	1º	7	75	75

Hours Actually Taught

ERA-1-D

Theoretical and Practical: 0,00

Teaching - Weekly Hours

Theoretical and Practical: 0,00

Type	Teacher	Classes	Hours
Theoretical and Practical	Totals	1	0,00
	Maryam Abbasi - ESGT		0,00

Teaching - Responsabilities

Teacher	Responsabilidade
Maryam Abbasi - ESGT	Responsável

Learning outcomes and their compatibility with the teaching method (knowledge, skills and competencies to be developed by students)

(LO1) Conceptual Understanding: Articulate the fundamental concepts of Artificial Intelligence and machine intelligence, trace their historical evolution and major paradigms, and critically evaluate ethical and responsible AI considerations in contemporary applications.

(LO2) Technical Proficiency: Identify and utilize established programming languages, frameworks, and development tools commonly employed in AI solution design and implementation.

(LO3) Problem-Solving Application: Design and implement AI-based solutions for real-world problems by applying appropriate techniques in search algorithms, knowledge representation, and machine learning methodologies.

(LO4) Critical Analysis and Integration: Effectively leverage existing AI solutions and pre-trained models while demonstrating the ability to interpret their outputs, understand underlying theoretical foundations, and assess their suitability for specific problem contexts.

Syllabus

1. Foundations of Artificial Intelligence

Definition, history, and evolution of AI
AI paradigms: symbolic vs. sub-symbolic approaches
Ethics, bias, and responsible AI principles

2. Problem-Solving and Search

Problem formulation and state-space representation
Uninformed search: breadth-first, depth-first, uniform-cost
Informed search: A*, heuristic functions, greedy search
Local search and optimization algorithms

3. Knowledge Representation and Reasoning

Logic-based representation: propositional and first-order logic
Semantic networks and ontologies
Rule-based systems and inference engines
Uncertainty: probability theory and Bayesian networks

4. Machine Learning Fundamentals

Supervised learning: regression and classification
Model evaluation and validation techniques
Unsupervised learning: clustering and dimensionality reduction
Introduction to neural networks and deep learning

5. Practical AI Development

Working with pre-trained models and APIs
Project development

Demonstration of the syllabus coherence with the curricular unit¿s learning objectives

The syllabus is systematically designed to ensure progressive achievement of all learning objectives:

LO1 (Conceptual Understanding) is addressed through **Module 1 (Foundations of AI)**, which provides comprehensive coverage of AI concepts, historical context, paradigmatic approaches, and ethical considerations, establishing the theoretical foundation required for responsible AI practice.

LO2 (Technical Proficiency) is developed throughout **Module 5 (Practical AI Development)**, where students gain hands-on experience with industry-standard Python libraries (NumPy, Pandas, scikit-learn) and tools essential for AI implementation.

LO3 (Problem-Solving Application) is systematically built across **Modules 2, 3, and 4**, progressing from search algorithms for problem-solving, through knowledge representation techniques, to machine learning methodologies¿providing comprehensive coverage of the three core AI domains mentioned in the objective.

LO4 (Critical Analysis) is integrated throughout the entire syllabus, particularly in **Modules 4 and 5**, where students learn to leverage pre-trained models while developing deep understanding of underlying algorithms, evaluation metrics, and theoretical principles necessary for critical assessment of AI solutions.

Teaching and learning methodologies specific to the curricular unit articulated with the pedagogical model

The Artificial Intelligence course adopts a hybrid pedagogical approach combining different methodologies to maximize student learning, articulating with a student-centered and active learning pedagogical model.

1. Theoretical Lectures (30% of contact time) Presentation of fundamental concepts, algorithms and underlying AI theory. Use of practical examples, live demonstrations and discussion of real cases to contextualize content. Active student participation is promoted through questions and debates on ethical and social implications of AI.

2. Laboratory Practical Classes (40% of contact time) Hands-on sessions where students implement studied algorithms and techniques using Python and specialized libraries. Exercises progress gradually in complexity, enabling incremental skill consolidation. Students work individually or in pairs with personalized teaching support.

3. Project-Based Learning (20% of contact time) Development of an integrative team project (2-3 students) addressing a real problem using multiple AI techniques. This methodology promotes collaborative work skills, project management, critical thinking and technical communication. Students present proposals, progress reports and a final presentation.

4. Autonomous Learning and Flipped Classroom (10% of contact time) Provision of complementary materials (videos, tutorials, articles) for prior study, allowing face-to-face classes to be more interactive and focused on problem-solving and doubt clarification. Independent exploration of advanced topics is encouraged.

Assessment

The Artificial Intelligence course assessment is continuous and diversified, reflecting different learning objectives and promoting progressive development of knowledge and skills.

Assessment Components:

1. Written Tests (2 × 4 points = 8 points) Two individual written exams assessing theoretical concept comprehension, algorithms and ability to apply acquired knowledge.

Test 1 (4 points): Covers Topics 1-3 (Introduction to AI, Search and Knowledge Representation)
Test 2 (4 points): Covers Topics 4-5 (Machine Learning and Neural Networks)

Tests include multiple-choice questions, essay questions and problem-solving, evaluating objectives (o1) and (o4).

2. Individual Practical Assignment (4 points) Development of practical programming exercises demonstrating ability to implement AI algorithms and use appropriate tools. Students submit functional code and a brief technical report explaining the developed solution.

Primarily assesses objectives (o2) and (o3), verifying mastery of programming languages and practical application of AI techniques to specific problems.

3. Final Team Project (8 points) Development of an integrative project (teams of 2-3 students) addressing a real-world problem using multiple AI techniques studied in the course.

Project evaluation criteria:

Technical solution quality (3 points): Correct implementation, efficiency and appropriate technique usage
Analysis and theoretical foundation (2 points): Understanding of algorithms used and justification of choices
Innovation and creativity (1 point): Originality in problem approach
Documentation and presentation (1.5 points): Clear technical report and effective oral presentation
Ethical and responsible considerations (0.5 points): Reflection on ethical implications of the solution

The project integrates all learning objectives (o1-o4), promoting collaborative work skills, critical thinking and technical communication.

Final Formula: Final Grade = Test1 (4) + Test2 (4) + Practical Assignment (4) + Project (8)

Demonstration of the coherence of teaching and evaluation methodologies between the learning objectives of the curricular unit

The teaching and assessment methodologies adopted in the Artificial Intelligence course are strategically aligned with the learning objectives, ensuring an integrated and coherent approach.

Coherence with Objective (o1) - AI concept, origins and ethics:

Teaching methodologies: Theoretical lectures systematically introduce AI history, evolution and paradigms, complemented by discussions on ethical and responsible implications. Autonomous learning through complementary materials deepens critical understanding of the field.

Assessment: Written tests include theoretical questions assessing conceptual understanding of AI. The final project requires reflection on ethical considerations (0.5 points), ensuring students demonstrate awareness of responsible approaches.

Coherence with Objective (o2) - Languages and tools:

Teaching methodologies: Laboratory practical classes (40% of contact time) provide hands-on experience with Python and specialized libraries (scikit-learn, TensorFlow, PyTorch). Gradual exercise progression ensures increasing familiarization with tools.

Assessment: The individual practical assignment (4 points) directly verifies mastery of languages and tools through concrete implementations. The project (3 points for technical quality) confirms ability to use appropriate tools in complex contexts.

Coherence with Objective (o3) - Practical application to specific problems:

Teaching methodologies: Project-based learning and laboratory sessions focus on solving real problems in search, knowledge and learning areas. Practical exercises simulate real challenges students will face professionally.

Assessment: The practical assignment (4 points) evaluates ability to develop solutions for specific problems. The final project (8 points) is the most significant assessment of this objective, requiring integrated application of multiple techniques to a real-world problem, demonstrating area competence.

Coherence with Objective (o4) - Abstraction and theoretical understanding:

Teaching methodologies: The balance between theory (lectures) and practice (laboratories) ensures students not only use tools but understand fundamentals. The flipped classroom methodology promotes prior study facilitating deeper discussions on underlying theory.

Assessment: Written tests (8 total points) include questions requiring demonstration of theoretical understanding of algorithms, their limitations and applicability. The project assesses analysis and theoretical foundation (2 points), verifying whether students adequately justify technical choices based on solid theoretical knowledge.

Bibliography (Mandatory resources)

- Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson. [Manual de referência fundamental cobrindo todos os tópicos principais]
- Géron, A. (2022). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (3rd ed.). O'Reilly Media. [Abordagem prática com Python]
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press. [Referência essencial para redes neuronais profundas]