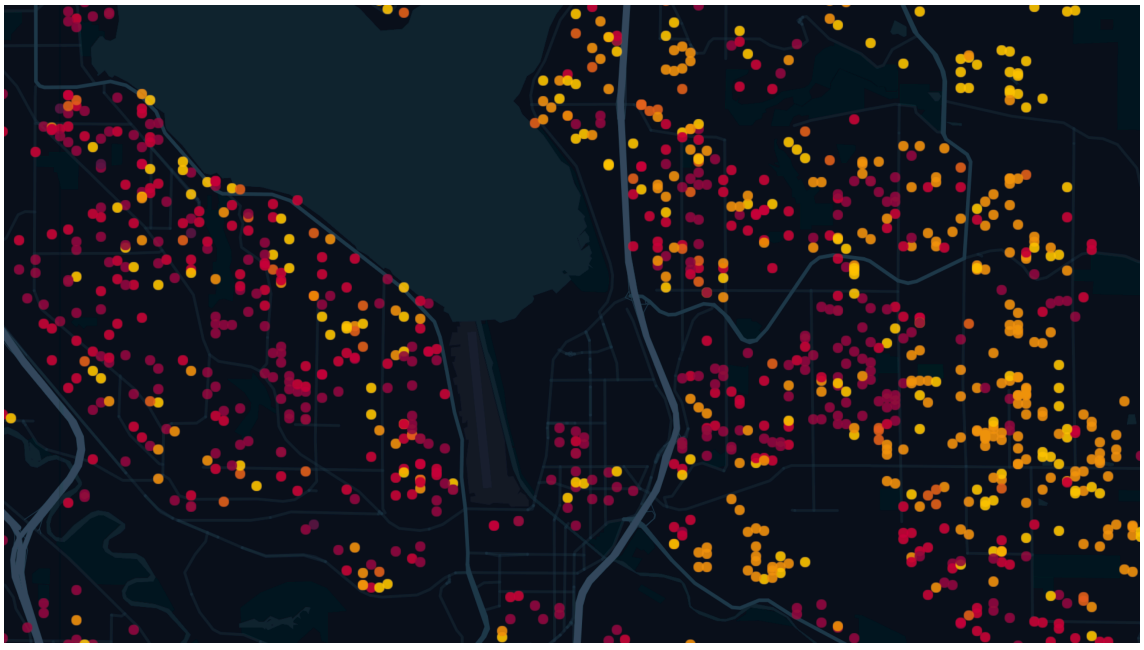
esade
RAMON LLULL UNIVERSITY

Introduction to Artificial Intelligence

Syllabus



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Barcelona, Sept 2025

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1. Course description

Artificial Intelligence (AI) has evolved into a well-established technology, significantly impacting our daily lives. From interacting with AI-driven systems while using email, shopping online, to navigating social networks, these technologies have become integral to our digital experiences. Remarkably, many digital companies have embraced AI and built innovative business models around it. One notable advancement in this field is Generative AI, a powerful technology that allows machines to create and generate content autonomously.

Amazon's founder Jeff Bezos aptly described Machine Learning and AI as a "horizontal enabling layer" with the potential to empower and enhance every business, organization, and philanthropic endeavor. The transformative impact of AI is evident, as demonstrated by Amazon's remarkable success in leveraging AI technology to optimize internal operations and offering AI capabilities as modular "lego bricks" through their Amazon Web Services cloud platform.

This course provides the mathematical foundations of AI models, specifically focusing on **supervised machine learning algorithms**. It covers the algorithms as well as the end-to-end machine learning methodology (including data preparation, variable selection, optimization and evaluation).

With this, students will acquire the basis to proceed with other types of AI models further in the program.

The course will start with two sessions covering an overview of AI and then the rest of the course will deep dive into the foundations of machine learning. The course will also include practical sessions to implement these models in the python programming language, using datasets and challenges akin to realistic business problems.

Contribution to program

The course is the first exposure of BAIB students to AI. The course will provide the basics of the fundamental AI models: supervised machine learning models that are the basis for the following course of the program.

- *Machine Learning (Year 3): unsupervised learning and ensembles*
- *Deep Learning (Year 4): neural networks and deep learning techniques*
- *Data and Business Ethics (Year 4): AI ethics and regulation*
- *AI for Sustainable Leadership (Year 4): AI applications for sustainability*
- *Electives: AI for healthcare, FinTech, Introduction to NLP, Generative AI, AI based products and services, Music Analytics, Sports Analytics, etc.*

2. Learning objectives and competencies

Upon successful completion of this course, you should be able to:

- Describe what is AI and machine learning, and provide examples of fields, types, and applications.
- Prepare data according to the needs of machine learning algorithms.
- Enumerate and apply different machine learning models to perform predictions in data sets.
- Implement optimization methods for machine learning models.
- Quantitatively evaluate machine learning models.
- Solve high-level problems collaboratively using machine learning as one of the tools.

Previous knowledge:

Students will be required to have an overall understanding of basics and advanced topics on calculus and algebra, including matrix operations, eigenvalues and eigenvectors, differentiation and integration. They should also have taken a previous course on optimization and topics in probability theory, including distributions and statistical measures. Proficiency in at least one programming language, preferably Python, will be expected alongside familiarity with libraries such as NumPy. Students should be comfortable with writing and debugging code and familiar with standard data structures and basic algorithms.

3. Course format and methodological approach

Methodology

The course has a mixture of expositive-participative lectures, practice sessions, group assingments, and individual study:

- Expositive / participatory sessions introducing theoretical concepts, technical concepts, discussing specific examples (including code), through expositions or class activities. Your active participation is expected.
- Practice sessions, where students perform hands-on work on a provided programming challenge.
- Group assignments to be completed outside of class hours, where groups of students are asked to complete a challenge autonoously and collaboratively.
- Individual study for exams or for own interest.

Workload distribution

This course is 6 ECTS, which implies 150 hours of work. A total of *50 hours* is devoted to lectures. It is recommended that the rest is split as follows:

- About ¾ (*~75 hours*) for individual study, including reviewing the lecture contents, redoing the python scripts, acquiring a full understanding of the theoretical concepts, and preparing exams.
- About 1/4 (*~25 hours*) for the group assignments.

Class expectations

- During the expositive-participative lectures, you are highly encouraged to contribute with questions, observations, and discussion. Fostering the discussion is essential in this course and has an impact in the grade (as explained below).
- During in-class activities and practice sessions, you are expected to be focused, and if applicable, be engaged with your group and contribute actively.
- After class, you are expected to revisit the class materials and complete the tasks assigned.
- During groupwork, it is expected that all members contribute positively to the group, respect the group diversity, and are responsible with their own share.
- **Mobile phones are not allowed during class**, except if there is an activity that requires so (in which case it will be announced by the professor). Unless otherwise

stated, **laptops are permitted only for activities related to class**, such as note taking, looking up documentation, completing class activities.

- It is expected that all students act professionally and according to Esade's regulation and code of conduct. Inappropriate or unethical behavior will not be tolerated and might impact the grade.
- Limitation of Generative AI tools like ChatGPT or MS Copilot will not be enforced in this course. However, they are not recommended for code generation as they can hinder learning by yourself. As the first course in machine learning, it is important to practice the process of writing ML code yourself. Once you'll have a proficient or moderate level, using these tools won't be an issue (in fact, they will be beneficial). A good mindset here is "use it while working, not while learning".

4. Course Contents

Below are the contents of the course, and the corresponding dates.

Tuesday	2/9	Intro to Course; Intro to AI
Thursday	4/9	From AI to Machine Learning
Tuesday	9/9	Overview of the Machine Learning Methodology
Thursday	18/9	Practice: Finding patterns in Data
Tuesday	*23/9*	Data exploration and preparation I
Thursday	25/9	Data exploration and preparation II
Tuesday	30/9	Practice: Data exploration and preparation
Thursday	2/10	Linear models I
Tuesday	7/10	Practice: Linear models
Thursday	9/10	QA Lecture
		Midterm exams
Tuesday	21/10	Optimizing ML models I
Thursday	23/10	Optimizing ML models II
Tuesday	28/10	Practice: Optimizing models
Thursday	30/10	Evaluating ML models
Tuesday	4/11	The Cross-Validation Method
Thursday	6/11	Practice: Evaluation with Cross-Validation
Tuesday	11/11	Tree-based models
Thursday	13/11	K-nearest neighbors
Tuesday	18/11	Practices: Tree-based models
Thursday	28/11	QA Lecture

5. Assessment

The elements of the assessment are:

- 10% Participation Activities
- 30% Group Assignments
- 30% Mid-term exam
- 30% Final exam

Participation Activities

In this course, participation is assessed through in-class activities. These can include in-class prompts where students are asked to answer a question related to the class content, small quizzes during a lecture, or other types of activities. In general, be prepared to expect activities in class that will count towards the participation grade.

Not completing the activity, for whatever reason (e.g. failure to submit, or being absent without justification), implies a grade of 0 in that activity.

Each activity counts for a certain number of points. At the end of the course all the points are added and proportionally translated to a grade.

In exceptional cases the grade can be modified by the professor to account for students active participation and attitude.

Group Assignments

Two group assignments will be announced during the course. Students will be assigned to random groups of 4-5 members and need to work on solving a realistic business challenge resorting to the techniques discussed in class and leaving some room for complexity and creativity. A rubric will be provided for each assignment. Assignments will be submitted to Moodle respecting the instructions and deadlines. No extensions will be granted.

Midterm exam

The midterm exam is in-class, on-paper and will consist of up to 20 open questions requiring short answers or short calculations. Esade exam regulations apply.

Final exam

The final exam is in-class, on-paper and will consist of up to 20 open questions requiring short answers or short calculations. The final exams covers all the content of the course, and not only the part since the mid-term exam. Esade exam regulations apply.

Absences

The student is expected to be familiar with the Esade regulations regarding absences. This course adheres strictly to those regulations.

Note that being absent without a justification implies not completing the participation activities for that class (see "Participation Activities" above), which has a small impact on the grade.

Regulations & integrity

We don't expect any inappropriate behaviors like dishonest submissions, lack of participation in group work or acting with an unrespectful attitude. However, in the exceptional event such situations occur, these could affect the grades of the related assignments. This would be in addition to any other consequences outlined in the course regulations. It's important to maintain integrity and active participation throughout the course.

6. Materials

The materials will be posted after each session in eCampus:

https://ecampus.esade.edu/course/view.php?id=32485

7. Faculty leading the course

José A. Rodríguez Serrano (PhD) joined Esade in September 2022. With 20 years of experience in the field of Artificial Intelligence (AI), his past background mixes academic research, industrial work, and management practice.

Before joining Esade, he held a Program Manager position at BBVA AI Factory, and prior to that a Machine Learning Manager position at Xerox, where he had developed a career as a corporate researcher in AI. His trajectory includes years of international experience in France and the United Kingdom.

Jose has published papers in top AI conferences and journals (such as CVPR, ICCV, NeurIPS, IEEE PAMI, IJCV), holds over 20 patents and has participated, both as a contributor and as manager, in delivering machine learning functionalities both into functioning prototypes as well as products that are commercially available.

Jose is passionate about innovation with machine learning and AI, and over the years has been involved in the different stages of that process, from research to business impact. Moreover, he is also interested in better understanding the challenges, complexities, and best practices of AI innovation cycles. He has participated in managing innovation strategies and likes to contribute to the public debate on innovation with machine learning.

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8. Timetable and sections
(information obtained from the Registrars' Office)

See Section 4, “Course Contents”.

Room: 108SC