

# Machine Learning / Aprendizagem Automática (APRAU)

- 2025/2026
- Elsa Ferreira Gomes

## Team

- Elsa Ferreira Gomes (EFG)
- Marcelo Nogueira (DEN)

## Purposes and Objectives

By the end of this course the student should be able to:

- Explain the main machine learning methods and algorithms.
- Select and apply technics, methods, and concepts of machine learning.
- Implement machine learning processes and analyse the results obtained.
- Evaluate and compare and judge different models.

## Working method

- This course unit introduces important concepts in **machine learning** and its most relevant techniques (with math foundation).
- All concepts are explained with examples and code using open-source libraries.
  - Theoretical classes (T) introduce the concepts.
  - During the TP and PL classes students will see many examples on how to apply the methods and theory learned, as well as code their own solutions to exercises proposed by the teacher.
  - In PL classes, students also develop a course project (and also outside of classes...).

## Previous knowledge

- Programming knowledge preferably in Python.
- Knowledge of statistical inference.
- Knowledge of basic linear Algebra and calculus.

## Program

- Introduction to Machine Learning.
- Supervised, non-supervised and reinforcement learning.

- Linear Regression. Multiple Linear Regression.
- Classification.
  - Logistic Regression (LR).
  - Linear Discriminant Analysis (LDA).
- Resampling methods: Cross validation and the Bootstrap.
- Regularization methods: Ridge regression and LASSO.
- Non-linear models:
  - Splines.
  - Generalized Additive Models (GAM).
- Tree based methods: Decision trees and Random Forests.
- Support vector machines (SVM).
- Unsupervised machine learning techniques.
  - Principal Component Analysis (PCA).
  - Clustering algorithms: k-means and Hierarchical clustering.
- Introduction to Reinforcement Learning.

## Most important studying material and tools

- Notes, presentations, and articles available on the website of the course in Moodle.
  - G. James et al. (2023) An Introduction to Statistical Learning, Springer Texts in Statistics. Springer  
[https://doi.org/10.1007/978-3-031-38747-0\\_11](https://doi.org/10.1007/978-3-031-38747-0_11)
  - Sutton & Barto, Reinforcement Learning: An Introduction, 2nd edition. Available for free from  
<http://incompleteideas.net/book/the-book.html>
  - Bishop, C.M. Pattern recognition and machine learning. Springer, 2006. ISBN 0387310738.
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- Always check the Moodle (<https://moodle.isep.ipp.pt>)
- Programming Language: Python
- Development Environment: Jupyter Notebook
- Code Repository (e.g. Bitbucket, GitHub)

## Evaluation

See the COURSE SYLLABUS at portal of ISEP and Moodle!

([https://portal.isep.ipp.pt/intranet/educacao/ver\\_edicoes\\_disciplina.aspx?id=76702](https://portal.isep.ipp.pt/intranet/educacao/ver_edicoes_disciplina.aspx?id=76702))

- Distributed evaluation with final exam
  - $F = 0.30E + 0.70P$ 
    - $E$ : Exam (Min = **7.0**)
    - $P$ : Project (Min = **9.5**)
      - Part1 (**0.25**), delivery day: **02/11**
      - Part2 (**0.45**), delivery day: **28/12**

Note: The project is developed by a **team of 3 students** (or 2, if necessary)

