Course guide
250COD009 - 250COD009 - Machine Learning and Artificial Intelligence

Last modified: 16/06/2026

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: MASTER'S DEGREE IN COMPUTATIONAL AND DATA-ASSISTED ENGINEERING (Syllabus 2026). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Garcia Gonzalez, Alberto

Others: Modesto Galende, David
Garcia Gonzalez, Alberto

TEACHING METHODOLOGY

The subject consists of 3 hours of classes per week.
They are dedicated, in a combined way, to i) theoretical sessions, in which the professor explains the basic concepts and materials of the subject, presents examples and carries out exercises, and to ii) the resolution of problems with specialized software and to greater interaction with the students. Practical exercises are carried out in order to consolidate the general and specific learning objectives.

LEARNING OBJECTIVES OF THE SUBJECT

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	64.00
Hours large group	45,0	36.00

Total learning time: 125 h

CONTENTS

Introduction and reminder of fundamental concepts

Description:
Data sets and basic concepts of probability and statistics.
Functional approximation and linear regression.
Overdetermined linear systems, eigenvalues â□□â□□and singular values.

Full-or-part-time: 11h
Theory classes: 6h
Self study : 5h

Data complexity. Dimensionality reduction

Description:
Large data sets, redundancy and optimal representation. Features that describe the phenomenon optimally.
Linear dimensionality reduction, PCA.
Nonlinear dimensionality reduction.
Stochastic field reduction, Karhunen-Loève
Applications.

Full-or-part-time: 38h
Theory classes: 13h
Self study : 25h

Response Functions and Surrogate Models

Description:
Advanced Linear Regression with Statistics
Gaussian Regression: Kriging
Neural Network Approximation
Applications

Full-or-part-time: 38h
Theory classes: 13h
Self study : 25h

Clustering and classification

Description:
Unsupervised and Supervised Learning methods
Classification Trees and Random Forests Clustering, k-means…
Logistic Regression.
Neural Networks.
Applications

Full-or-part-time: 38h
Theory classes: 13h
Self study : 25h

GRADING SYSTEM

Practical exercises proposed and solved in class (30% of the grade) Two Exams to evaluate the knowledge obtained (70%)

EXAMINATION RULES.

Will be announced at the beginning of the course.

BIBLIOGRAPHY

Basic:
- Bishop, Christopher M.. Pattern recognition and machine learning.. New York: Springer, 2006. ISBN 0387310738.
- Brunton, Steven L.; Kutz, J. Nathan. Data-driven science and engineering : machine learning, dynamical systems, and control. 2nd ed. Cambridge : Cambridge University Press, 2022. ISBN 9781009098489.