

Machine Learning and Models for Decision Making (250443)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN MÈTODES NUMÈRICS EN ENGINYERIA (pla 2012) MÀSTER UNIVERSITARI EN MÈTODES NUMÈRICS EN ENGINYERIA (pla 2012) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
Course	2024/25

Main teaching language at each group

- Group 10EN2 English (Q2)

Faculty

Responsible Faculty: Pedro Diez Mejia

Faculty: Irene Arias Vicente, Pedro Diez Mejia, Alba Muixí Ballonga

Competencies

Transversal

ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.

SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Stochastic modeling

Elements in a decision making scheme: Decision Maker, Actions, Random States, Utility, Optimization Criteria. A priori schemes. A posteriori schemes. Probabilistic description of an experiment.

Bayes' updating. Pre-posterior schemes.
Applications of decision schemes.

Statistical learning

Algebraic SVD
Principal Components Analysis (PCA) and Karhunen-Loève theorem
Multidimensional Scaling (MDS)
Nonlinear dimensionality reduction

Simulation

Monte-Carlo sampling and Stochastic FEM
Reduced order modeling

Artificial Neural Networks

Introduction to machine learning
Feed-forward network mappings. Network training. Error Backpropagation. Error Functions. Learning and regularization.
Artificial Neural Networks for regression and classification

Project presentations

Activities

Project presentation of typologies to be optimized

Dedication

6h

Teaching Methodology

The course consists of 1,8 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,8 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,8 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

Grading Rules

() The evaluation calendar and grading rules will be approved before the start of the course.*

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

Test Rules

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Bibliography

Basic

- Lee, J.A.; Verleysen, M. [Nonlinear dimensionality reduction](#). New York: Springer, 2007. ISBN 9780387393506.
- Ghanem, R.G.; Spanos, P.D. [Stochastic finite elements: a spectral approach](#). Rev. ed. Minneola, New York: Dover, 2003. ISBN 0486428184.
- Bishop, C.M. [Pattern recognition and machine learning](#). New York: Springer, 2006. ISBN 0387310738.