Course guide
250443 - 250443 - Machine Learning and Models for Decision Making

Last modified: 28/03/2024

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

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN NUMERICAL METHODS IN ENGINEERING (Syllabus 2012). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: IRENE ARIAS VICENTE

Others: IRENE ARIAS VICENTE, ALBA MUIXÍ BALLONGA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
8559. 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.
8560. 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.

8561. 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.

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.

LEARNING OBJECTIVES OF THE SUBJECT

STUDY LOAD

Type	Hours	Percentage
Hours medium group	9,8	7.83
Self study	80,0	63.95
Hours large group	25,5	20.38
Hours small group	9,8	7.83

Total learning time: 125.1 h

CONTENTS

Stochastic modeling

Description:
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.

Full-or-part-time: 21h 36m
Theory classes: 6h
Laboratory classes: 3h
Self study : 12h 36m

Statistical learning

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

Full-or-part-time: 28h 47m
Theory classes: 3h
Practical classes: 6h
Laboratory classes: 3h
Self study : 16h 47m

Simulation

Description:
Monte-Carlo sampling and Stochastic FEM
Reduced order modeling

Full-or-part-time: 14h 23m
Theory classes: 3h
Laboratory classes: 3h
Self study : 8h 23m

Artificial Neural Networks

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

Full-or-part-time: 21h 36m
Theory classes: 3h
Practical classes: 3h
Laboratory classes: 3h
Self study : 12h 36m

Project presentations

Full-or-part-time: 7h 11m
Laboratory classes: 3h
Self study : 4h 11m

GRADING SYSTEM

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.

EXAMINATION 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.