250443 - Machine Learning and Models for Decision Making

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Optional)
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ECTS credits: 5 
Teaching languages: English

Teaching staff
Coordinator: IRENE ARIAS VICENTE
Others: IRENE ARIAS VICENTE, MARINO ARROYO BALAGUER, PEDRO DIEZ MEJIA

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.

Learning objectives of the subject
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Theory classes: 19h 30m 15.60%</th>
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<tbody>
<tr>
<td></td>
<td>Practical classes: 9h 45m 7.80%</td>
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<tr>
<td></td>
<td>Laboratory classes: 9h 45m 7.80%</td>
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<td>Guided activities: 6h 4.80%</td>
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<td>Self study: 80h 64.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Stochastic modeling</th>
<th><strong>Learning time:</strong> 21h 36m</th>
</tr>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Bayes' updating, Pre-posterior schemes.</td>
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<td>Applications of decision schemes.</td>
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<tr>
<th>Statistical learning</th>
<th><strong>Learning time:</strong> 28h 47m</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Algebraic SVD</td>
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<tr>
<td>Principal Components Analysis (PCA) and Karhunen-Loève theorem</td>
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<tr>
<td>Multidimensional Scaling (MDS)</td>
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<td>Nonlinear dimensionality reduction</td>
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<tr>
<th>Simulation</th>
<th><strong>Learning time:</strong> 14h 23m</th>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Monte-Carlo sampling and Stochastic FEM</td>
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<tr>
<td>Reduced order modeling</td>
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**Laboratory classes:**
- Stochastic modeling: 3h
- Statistical learning: 3h
- Simulation: 3h

**Self study:**
- Stochastic modeling: 12h 36m
- Statistical learning: 16h 47m
- Simulation: 8h 23m
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**Artificial Neural Networks**

**Description:**
Introduction to machine learning
Artificial Neural Networks for regression and classification

**Learning time:** 21h 36m
- Theory classes: 3h
- Practical classes: 3h
- Laboratory classes: 3h
- Self study: 12h 36m

**Project presentations**

**Learning time:** 7h 11m
- Laboratory classes: 3h
- Self study: 4h 11m

**Qualification 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.

**Regulations for carrying out activities**

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:**