270651 - ML - Machine Learning

Degree competences to which the subject contributes

Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

Specific:
CEC1. Ability to apply scientific methodologies in the study and analysis of phenomena and systems in any field of Information Technology as well as in the conception, design and implementation of innovative and original computing solutions.
CEC2. Capacity for mathematical modelling, calculation and experimental design in engineering technology centres and business, particularly in research and innovation in all areas of Computer Science.

Generical:
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.
CG3. Capacity for mathematical modeling, calculation and experimental designing in technology and companies engineering centers, particularly in research and innovation in all areas of Computer Science.
CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

Transversal:
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

Teaching methodology

The topics exposed in the lectures are very well motivated (why is this important?) and motivating (why is this relevant nowadays?) and supplemented with many real examples. These lectures will introduce all the knowledge, techniques, concepts and results necessary to achieve a solid understanding of the fundamental concepts and techniques. The laboratory lectures will make the students develop their own solutions to practical problems in the discipline.

There is a practical work, which that collects and integrates the knowledge and skills of the course; the students will be offered to pick a real problem among a predefined list; exceptionally, some students will bring their own problem. In addition there is a written test of basic knowledge (both theoretical and applied); the course is oriented towards training the students to pass the test with relative ease.

Learning objectives of the subject

1. Formulate the problem of (machine) learning from data, and know the different machine learning tasks, goals and tools.
2. Organize the workflow for solving a machine learning problem, analyzing the possible options and choosing the most appropriate to the problem at hand.
3. Ability to decide, defend and criticize a solution to a machine learning problem, arguing the strengths and weaknesses.
of the approach. Additionally, ability to compare, judge and interpret a set of results after making a hypothesis about a machine learning problem.

4. Understand and know how to apply least squares techniques for solving supervised learning problems.

5. Understand and know how to apply techniques for single and multilayer neural networks for solving supervised learning problems.

6. Understand and know how to apply support vector machines for solving supervised learning problems.

7. Understand and formulate different theoretical tools for the analysis, study and description of machine learning systems.

8. Understand and know how to apply the basic techniques for solving unsupervised learning problems.

9. Understand and know how to apply basic techniques for solving reinforcement learning problems.

## Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 26h</th>
<th>17.33%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group: 26h</td>
<td>17.33%</td>
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<tr>
<td></td>
<td>Guided activities: 2h</td>
<td>1.33%</td>
</tr>
<tr>
<td></td>
<td>Self study: 96h</td>
<td>64.00%</td>
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</table>
## Introduction to Machine Learning

**Degree competences to which the content contributes:**

**Description:**
General information and basic concepts. Overview to the problems tackled by machine learning techniques. Supervised learning (classification and regression), unsupervised learning (clustering and density estimation) and semi-supervised learning (reinforcement and transductive). Examples.

### Supervised machine learning theory

**Degree competences to which the content contributes:**

**Description:**

### Linear methods for regression

**Degree competences to which the content contributes:**

**Description:**

### Linear methods for classification

**Degree competences to which the content contributes:**

**Description:**

### Artificial neural networks

**Degree competences to which the content contributes:**

**Description:**

### Kernel functions and support vector machines
Unsupervised machine learning

**Degree competences to which the content contributes:**

**Description:**

Reinforcement learning and control

**Degree competences to which the content contributes:**

**Description:**

Survey of advanced topics

**Degree competences to which the content contributes:**

**Description:**
Bagging and boosting. Notes on deep learning, transductive learning and other hot topics. Challenging applications.
## Planning of activities

| Development of topic 1 of the course | Hours: 8h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 4h |
<table>
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<tr>
<td>Specific objectives: 1</td>
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| Development of topic 2 of the course | Hours: 16h  
Theory classes: 4h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 8h |
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<tr>
<td>Specific objectives: 2</td>
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</table>

| Development of topic 3 of the course | Hours: 16h  
Theory classes: 4h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 8h |
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<tbody>
<tr>
<td>Specific objectives: 3</td>
<td></td>
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</table>

| Development of topic 4 of the course | Hours: 16h  
Theory classes: 4h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 8h |
<table>
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<tbody>
<tr>
<td>Specific objectives: 4</td>
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</table>
### Development of topic 5 of the course

**Hours:** 16h  
Theory classes: 4h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 8h

**Specific objectives:** 5

### Development of item 6 of the course

**Hours:** 16h  
Theory classes: 4h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 8h

**Specific objectives:** 6

### Development of topic 7 of the course

**Hours:** 8h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 4h

**Specific objectives:** 7

### Development of topic 8 of the course

**Hours:** 8h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 4h

**Specific objectives:** 8, 9
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<table>
<thead>
<tr>
<th>Development of item 9 of the course</th>
<th>Hours: 2h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Practical classes: 0h</td>
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<td>Laboratory classes: 0h</td>
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<td>Guided activities: 0h</td>
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<td>Self study: 0h</td>
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| Specific objectives:               | 9 |

<table>
<thead>
<tr>
<th>Comprehensive (theoretical and practical) final quiz</th>
<th>Hours: 12h</th>
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<tr>
<td></td>
<td>Guided activities: 2h</td>
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<td>Self study: 10h</td>
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| Description:                                      | This is a final quiz aimed at assessing the degree of acquisition of basic concepts and practical tools by the students |
| Specific objectives:                              | 1, 2, 3, 4, 5, 6, 7, 8 |

<table>
<thead>
<tr>
<th>Delivery of the practical work</th>
<th>Hours: 27h</th>
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<tbody>
<tr>
<td></td>
<td>Guided activities: 2h</td>
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<tr>
<td></td>
<td>Self study: 25h</td>
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</tbody>
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| Specific objectives:               | 1, 2, 3, 4, 5, 6, 7, 8 |

Qualification system

The course is graded as follows:

\[ \text{NFINAL} = 35\% \text{ NExam} + 50\% \text{ NPract} + 15\% \text{ NREAS} \]
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Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

http://www.academicearth.org/courses/machine-learning

http://cran.r-project.org/

http://videolectures.net/Top/Computer_Science/Machine_Learning/