Las clases de teoría introducen todo los conocimientos, las técnicas, conceptos y resultados necesarios para alcanzar un nivel bien fundamentado y comprensible. Estos conceptos se ponen en práctica en las clases de laboratorio. En estas se proporciona código R que permite resolver ciertos aspectos de un problema de análisis de datos con las técnicas correspondientes al tema en curso. Este laboratorio también sirve de guía para la parte correspondiente de la práctica, que desarrollan los alumnos a lo largo del curso. Algunas de las horas de laboratorio se podrán usar para resolver problemas (sin ordenador) en el aula de teoría.

Hay un trabajo práctico evaluable, que trabaja un problema real a elegir por el propio estudiante y que recoge e integra los conocimientos y las competencias de todo el curso. También se evalúa mediante el trabajo práctico la competencia genérica de comunicación eficaz escrita.

Learning objectives of the subject

1. Formulate the problem of automatic learning from data, and get to know the types of tasks that can be given.
2. Organize the resolution flow of a machine learning problem, analyzing the possible options and choosing the most suitable for the problem.
3. Decide, defend and criticize a solution to a machine learning problem, arguing the strong and weak points of the approach.
4. Know and know how to apply linear techniques to solve supervised learning problems.
5. Know and know how to apply mono and multilayer neural network techniques to solve supervised learning problems.
6. Know and know how to apply support vector machines to the resolution of supervised learning problems.
7. Know and know how to apply the basic techniques for the resolution of unsupervised learning problems, with emphasis on data clustering tools.
8. Know and know how to apply the basic techniques for solving reinforcement learning problems.
9. Know and know how to apply ensemble techniques to solve supervised learning problems.

### Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 150h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory classes:</td>
<td>30h</td>
<td>20.00%</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>30h</td>
<td>20.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
# Content

## Introduction to Machine Learning

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

**Description:**
General information and basic concepts. Description and approach of problems attacked by automatic learning. Supervised learning (regression and classification), non-supervised (clustering) and semi-supervised (reinforcement and transductive). Modern examples of application.

## Unsupervised machine learning: clustering

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

**Description:**

## Supervised machine learning (I): linear regression methods

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

**Description:**

## Supervised machine learning (II): linear methods for classification

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

**Description:**

## Hierarchical methods: decision trees

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

**Description:**

## Feed-forward shallow neural networks

**Degree competences to which the content contributes:**
Description:
Feed-forward shallow neural networks (one hidden layer). Activation functions. Multilayer perceptron with one hidden layer and RBF (radial basis function network) and their training algorithms.

Recurrent shallow neural networks

Degree competences to which the content contributes:
Description:

Kernel based learning methods

Degree competences to which the content contributes:
Description:

Ensemble methods

Degree competences to which the content contributes:
Description:

Reinforcement learning

Degree competences to which the content contributes:
Description:
### Planning of activities

#### Development of topic 1

| Hours: 5h 18m |
| Theory classes: 2h |
| Practical classes: 0h |
| Laboratory classes: 0h |
| Guided activities: 0h |
| Self study: 3h 18m |

**Specific objectives:**
1

#### Development of topic 2

| Hours: 12h 36m |
| Theory classes: 4h |
| Practical classes: 0h |
| Laboratory classes: 2h |
| Guided activities: 0h |
| Self study: 6h 36m |

**Specific objectives:**
1, 3, 7

#### Development of topic 3

| Hours: 18h |
| Theory classes: 6h |
| Practical classes: 0h |
| Laboratory classes: 2h |
| Guided activities: 0h |
| Self study: 10h |

**Specific objectives:**
1, 4

#### Development of topic 4

| Hours: 15h 18m |
| Theory classes: 5h |
| Practical classes: 0h |
| Laboratory classes: 2h |
| Guided activities: 0h |
| Self study: 8h 18m |

**Specific objectives:**
1, 2, 4
### Development of topic 6

**Hours:** 20h 36m  
Theory classes: 7h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 11h 36m

**Specific objectives:**  
1, 2, 5

### Development of topic 7

**Hours:** 9h  
Theory classes: 3h  
Practical classes: 0h  
Laboratory classes: 1h  
Guided activities: 0h  
Self study: 5h

**Specific objectives:**  
1, 2, 5

### Development of topic 8

**Hours:** 20h 36m  
Theory classes: 7h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 11h 36m

**Specific objectives:**  
1, 6

### Development of topics 5 and 9

**Hours:** 23h 18m  
Theory classes: 8h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 13h 18m

**Specific objectives:**  
1, 9
Qualification system

The subject is evaluated through a partial exam, a final exam and a practical work in which a real problem is attacked, writing the corresponding report.

The final grade is calculated as:

\[
\text{Grade} = 0.4 \times \text{Work} + 0.6 \times \max (\text{Final}, \frac{1}{3} \times \text{Partial} + \frac{2}{3} \times \text{Final})
\]

For those students who can and want to attend re-evaluation, the re-evaluation exam grade will replace \( \max (\text{Final}, \frac{1}{3} \times \text{Partial} + \frac{2}{3} \times \text{Final}) \).
Bibliography

Basic:


