ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA

DOI-MBD-514 Machine Learning I

SEMESTER: Fall

CREDITS: 6 ECTS

LANGUAGE: Spanish (documentation in English)

DEGREES: MBD

Course overview

The purpose of this course is to provide students with a fundamental understanding and an extensive practical experience of how to extract knowledge from an apparently unstructured set of data.

By the end of the course, students will:

- Understand the basic principles behind Machine Learning.
- Have practical experience with the most common Machine Learning algorithms.
- Have well-formed criteria to choose the most appropriate technique for a given application.

Prerequisites

Students willing to take this course should be familiar with linear algebra, basic probability and statistics, and R programming language.

Course contents

Theory

1. Introduction
   1.1. Data Mining and Machine Learning
   1.2. The learning process
   1.3. Types of Machine Learning

2. Classification methods
   2.1. The classification problem
   2.2. Logistic Regression
   2.3. Discriminant analysis
   2.4. K-Nearest Neighbors
   2.5. Decision Trees
   2.6. Support Vector Machines
   2.7. Multilayer Perceptrons for classification

3. Regression methods
   3.1. The regression problem
   3.2. Linear regression. Model selection and regularization.
   3.3. Polynomial regression
   3.4. Splines
   3.5. Generalized Additive Models
   3.6. Multilayer Perceptrons for regression
   3.7. Radial Basis Function Networks

4. Time series Forecasting
   4.1. Stochastic Processes
   4.2. Exponential Smoothing
   4.3. Decomposition methods
   4.4. ARIMA models
   4.5. Dynamic Regression models
   4.6. GARCH models
   4.7. Advanced methods for forecasting

5. Unsupervised Learning
   5.1. Probability Density estimation
   5.2. Dimensionality Reduction Methods
   5.3. Clustering and Vector Quantization
   5.4. Self-Organizing Feature Maps

Practice

Each session will be divided in two parts: an introduction of the theoretical concepts and a lab practice using R. Students will work in pairs and will be asked to deliver a report after each lab practice.

Textbook

- Notes prepared by the lecturer (available in Moodle)
- G. James *et al.* (2013), *An Introduction to Statistical Learning*, Springer, ISBN-13 978-1-4614-7137-0

Grading

- **Exams** will account for 50%, of which:
  - Mid-term exams: 15%
  - Final exam: 35%
- **Lab** will account for the remaining 50%, of which:
  - Student work at lab: 10%
  - Lab reports: 40%
- In order to pass the course, the mark of the final exam must be greater or equal to 4 out of 10 points.