



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Machine Learning

2425-1-F1801Q160

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#### Aims

The course aims to introduce the basic elements and provide the basic concepts and tools based on computational methods, to represent the learning, knowledge and reasoning under uncertainty.

The student will be able to design and develop software systems based on machine learning techniques to solve simple problems of data analysis, knowledge discovery and decision support in the presence of uncertain or incomplete information.

Acquired skills are the basis for the development of advanced data mining and knowledge discovery and application specific software systems in decision support.

#### Contents

The course will provide an in-depth discussion of the large collection of methods and tools that have become available for developing autonomous learning systems and for aiding in the analysis of complex multivariate data. These tools include decision trees, neural networks, belief networks, as well unsupervised clustering algorithms and increasingly sophisticated combinations of these architectures. Examples of recent applications will be introduced.

#### Detailed program

Introduction and terminology

Concept learning  
- Decision trees

- ID3 Algorithm

#### Neural networks

- perceptron; linear separability
- perceptron learning algorithm
- delta rule and gradient descent
- multilayer perceptron
- error backpropagation

#### Support vector machines

- Optimal separation
- Computation in SVM
- Kernels

#### Bayesian Learning

- Introduction
- Bayes theorem
- Naive Bayes classifier

#### Unsupervised learning techniques

- k-means algorithm

#### Performance evaluation

- evaluation for supervised techniques
- evaluation for clustering

#### Deep neural network (Deep Learning)

- Introduction
- Main reference models

## **Prerequisites**

Basic knowledge of algorithms and data structures.

Elements of probability and statistics

## **Teaching form**

- 8 frontal lessons of 2 hours each held by the teacher in presence;
- 10 sessions for exercises of 2 hours each held by the teacher in presence, 50% frontal 50% interactive;
- 8 interactive laboratory lessons of 3 hours each held by the teacher in presence;

## **Textbook and teaching resource**

References on the elearning page of this course

## **Semester**

First semester

## **Assessment method**

Overall the exam is split in a written test and a oral discussion, each determining 50% of the score, along the following rules:

1. Written test with open questions on theory and simple exercises. To continue to the oral discussion this test must earn a score  $\geq 6$ ;
2. Oral discussion mainly dedicated to a project prepared by the student (or by a small group of students);
  - 2-1. the project is evaluated based on its overall quality and on the quality of the individual contribution of the student;
  - 2-2. during the oral discussion the student could be required to answer some questions about course's contents.

## **Office hours**

by requiring an appointment

## **Sustainable Development Goals**

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