



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Machine Learning

2021-1-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 new methods and tools that have become available in recent years 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. Applications include prediction, classification, fault detection, time series analysis, diagnosis, optimization, system identification and control, exploratory data analysis and many other problems in statistics, machine learning and data mining.

#### Detailed program

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## Concept learning

- Learning from observations
- Concept learning
- Features and feature selection.

## Decision trees

- Information Gain
- ID3 Algorithm

## Neural networks

- perceptron and convergence theorem
- delta rule
- multilayer perceptron and error backpropagation

## Support vector machines

- Optimal separation
- Kernels

## Bayesian Learning

- Bayes theorem
- Hypotheses MAP, ML, MDL
- Gibbs algorithm; weighted majority algorithm
- Optimal Bayes classifier
- Naive Bayes classifier
- EM algorithm

## Unsupervised learning techniques

- k-means algorithm

Neighbor Joining algorithm
Deep neural network (Deep Learning)
Introduction and examples

## Prerequisites

Basic knowledge of algorithms and data structures.

Elements of probability and statistics

## Teaching form

The course will consist of lectures and exercise sessions, resgistered or streamed online, occasionally in the lecture room.

The course is taught in Italian.

## Textbook and teaching resource

- S. Marsland, Machine Learning: An Algorithmic Perspective, CRC Press
- Kevin Gurney, An Introduction to Neural Networks. CRC Press

## Semester

First semester

## Assessment method

Overall the exam is split in a written test and a oral discussion, 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. the oral discussion is mainly dedicated to a project prepared by the student (or by a small group of students);
3. the project is evaluated based on its overall quality and on the quality of the individual contribution of the student;
4. during the oral discussion the student could be required to answer some questions about course's contents.

## **Office hours**

by requiring an appointment

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