UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Machine Learning

2122-1-F1801Q160

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

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

Unsupervised learning techniques

- k-means algorithm

· measuring the clustering
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 usual lectures and exercise sessions.

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 simpe exercises. To continue to the oral discussion this test

must earn a score >=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