



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Applicazioni di Machine Learning

2425-1-F1701Q141

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#### Aims

The aim of the course is to provide the theoretical concepts and basic programming exercises of the application of machine learning methods to data, signals and images of particle physics, space, biomedical, environmental, and in other applications.

#### Contents

Machine learning methods: principles and software applications to data, signals and images of particle physics, space, biomedical, environmental, and other applications.

#### Detailed program

- Pattern, task (classification / localization / detection / segmentation / improvement of image quality), learning methods, parameters, objective function
- Training / validation / testing, performance measurement metrics, convergence, generalization, unbalanced classes, underfitting / overfitting
- Pattern size reduction methods: Principal Component Analysis / Linear Discriminant Analysis
- Linear regression (simple / multiple)
- Clustering: criteria / algorithms, centroid-based clustering (k-means, fuzzy k-means, Expectation Maximization)

-Support Vector machines

- Multiple classifiers

-Decision trees / Random forests

- Neural networks

-Deep learning

-Transfer learning

- Exercises using software-applications to data, signals and images measured by particle physics, space physics, biomedical, environmental, and cultural heritage devices for classification / localization / detection / segmentation / image quality improvement tasks.

## **Prerequisites**

Good knowledge of Matlab or Python programming languages

Mandatory attendance as the teacher uses interactive teaching with programming exercises in group work on laptop PCs

## **Teaching form**

Lectures and exercises using programming codes.

The teacher gives many lessons in which he begins with a first part in which concepts are exposed (delivery method) and then an interaction opens with the students which defines the next part of the lesson (interactive mode).

- 12 frontal lessons of 3 hours carried out in the delivery mode in presence in the delivery mode in the initial part which is aimed at involving the students students interactively in the next part;
- 6 3-hour exercises carried out in person aimed at involving students interactively in the PROJECT WORKS;

All activities are carried out in person

## **Textbook and teaching resource**

Videos, data, programming codes and scientific articles provided to students during the course (lectures and laboratory activities).

## **Semester**

Second semester

## **Assessment method**

The exam consists of an oral interview aimed at verifying the student's level of knowledge of the topics covered during the course and in 2 PROJECT WORKS development projects of 2 programming codes based on the machine learning and deep learning methods presented during the course.

## **Office hours**

Normally 1 hour immediately at the end of the lessons, at the request of the students.

## **Sustainable Development Goals**

INDUSTRY, INNOVATION AND INFRASTRUCTURE

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