



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Supervised Learning

2425-1-F9102Q045-F9102Q04501

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#### Aims

The aim of the course is to develop the skills for solving supervised learning problems.

#### Contents

In this course we will introduce and develop different machine learning algorithms for different types of data (images, videos, signals, texts, etc.) in different domains.

Course contents:

- Classification and regression frameworks: experiment definition, dataset split, metrics, augmentation, etc.
- Machine learning algorithms design and evaluation for classification and recognition tasks in the image domain such as consumer photos, fashion, medical images, etc.: image classification, image captioning, object detection, face recognition, image segmentation, quality control, etc.
- Machine learning algorithms design and evaluation for classification and recognition tasks in the signal domain such as audio, ecg: identity recognition, activity recognition, etc.
- Machine learning algorithms design and evaluation for regression tasks in different domains and applications such as: quality assessment, forecast, etc.

#### Detailed program

In detail the topics addressed are:

- Formulation of the learning process, popular learning algorithms (LDA, Decision Trees, NN, k-NN, SVM), evaluation and comparison

- Classification and regression frameworks: experiment definition, dataset split, metrics, augmentation, etc.
- Ensemble methods: Boosting, Bagging, Random Tree ensembles, Stacking
- Object detection with local descriptors: SIFT and BoW
- Viola-Jones Object detection Framework
- Convolutional Neural Networks (CNNs): convolution, training, famous architectures, transfer learning
- Recurrent and Recursive Neural Networks (RNNs): computational graph, training, gated RNNs (LSTM and GRU)
- Neural object detection: two-stage detection (R-CNN, fast R-CNN, faster R-CNN) and one-stage detection (YOLO)
- Transformers
- Self-supervised Learning

## Prerequisites

Basic programming skills.

Basic knowledge in statistics and mathematics.

## Teaching form

The course will be composed of frontal/theoretical classes concerning the methods and interactive practical classes concerning the case studies and applications using Matlab and/or Python.

The two parts will be based both on delivery mode and interactive mode.

## Textbook and teaching resource

Slides, articles, and notes given by the professor in addition to the textbooks:

- Hastie T., Tibshirani R., Friedman J. (2021). The Elements of Statistical Learning (2nd edition). Springer Verlag.
- Simon J.D. Prince (2023). Understanding Deep Learning. MIT Press.

## Semester

Second.

## Assessment method

The exam consists of a project, where students divided into small groups must design, implement and write a report about the chosen supervised learning task, and its oral presentation during which theoretical contents of the course can also be verified.

## **Office hours**

After the class or agreed by email.

## **Sustainable Development Goals**

QUALITY EDUCATION

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