UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Supervised Learning

2324-1-F9102Q031-F9102Q033M

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

The lectures will cover the theoretical aspects of the diffent topics and the study of real use cases derived from the teacher's experience in numerous industrial projects (http://www.ivl.disco.unimib.it/people/simone-bianco/)
The practical classes will permit the students to implement and test the topics of the course on real data.

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. Lectures will be held in presence, unless further COVID-19 related restrictions are imposed.

Textbook and teaching resource

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

- 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