UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Machine Learning

2324-2-F8203B040

Learning objectives

To gain knowledge about Machine Learning algorithms, and to apply them to solve problems. The student will master machine learning methodologies to deal with classification and regression problems. The student will acquire the critical thinking to evaluate which problems can be solved using machine learning techniques.

Knowledge and understanding. This course will provide knowledge and understanding about: machine learning algorithms; machine learning problem categories and the algorithms best suited for their solutions; main methodologies and related issues.

Ability to apply knowledge and understanding. At the end of the course, students will be able to: apply machine learning algorithms to tackle classification, regression problems, and to extract information from data. The students will be able to design and implement both feasibility tests and complete solutions.

Contents

- Statistical methods for machine learning
- Beyong linear models
- Feature Engineering and Machine Learning Algorithms Tuning
- Artificial Neural Networks and Deep Learning

Detailed program

- Statistical methods for machine learning
    - Supervised and unsupervised learning

    - Recall to regression analysis
    - Classification analysis
    - Cross validation and bootstrap
    - Model selection and regularization
    - Beyond linear models
    - Tree-based methods
    - Support vector machines
- Feature Engineering and Machine Learning Algorithms Tuning
    - Feature Engineering and Selection (Bag of Words, Embeddings, Tensors, ...)
    - Data Observability and Model existence issues
    - Hyperparameters optimization (Grid-Search, Random-Search, Advanced Search methodologies)
- Artificial Neural Networks and Deep Learning
    - Artificial Neural Networks (ANNs) and Feed Forward Neural Network introduction
    - Training Algorithm: Gradient Descent, Optimization Methodology
    - Deep learning and Artificial Neural Networks types (Fully Connected networks, Feed Forward networks, Convolutional networks, Recurrent networks, …)
    - Industrial applications and open research issues

The teachers may decide to change the program or to focus on specific topics based on the students' previous knowledge.

Prerequisites

Linear Algebra, Foundation of descriptive and inferential statistics, Foundation of coding (knowledge of a programming language).

Nice to have: Python language and the R language knowledge

Teaching methods

Lectures will be given in a computer laboratory

Assessment methods

Oral examination. The student may partially replace the examination with a project (to be agreed in advance with the teachers)

Textbooks and Reading Materials

Further information will be given during the first lesson.

Gareth James, Daniela Wittens, Trevor Hastie and Robert Tibshirani (2013). An Introduction to Statistical Learning. Springer. Available at

C.M. Bishop (2006), Pattern Recognition and Machine Learning. Springer (New York)

Semester

3rd Cycle (1st part of the 2. Semester)

Teaching language

English

Sustainable Development Goals