UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Machine Learning

2122-1-F9101Q005-F9101Q005M

Aims

To train the *data analysis expert* according to the *machine learning methodology*.
The goal is achieved by;

- teaching how to *design*, *develop* and *present* machine learning projects,
- exploiting *open source* platforms, languages and software,
- stimulating the *team working* methodology.

The student will be able to *design*, *develop*, *document*, and *present* machine learning projects *solving real world problems*.

Contents

The course contents are the following;

- **Data Exploration** to inspect and summarize the available data and to design and develop a pre-processing workflow,
- **Supervised Classification**, to learn a mapping from input attributes to output or target attributes to be classified or predicted,
- **Unsupervised Classification**, to form homogeneous groups of observations and/or attributes using a given proximity measure,

- **Association Rules**, to automatically extract rules hidden in the data with specific reference to transaction data.

You will learn how to develop machine learning workflows using the **KNIME open source software platform**. You are *not required to code any programs* while if you want KNIME allows to use powerful and professional open source programming languages and commercial software environments; R, Weka, Matlab, Python, Java, ...

Detailed program

- **Data Exploration and Preprocessing**
  - Data types and attributes
  - Graphical and tabular data exploration
  - Missing data treatment
  - Data Pre-Processing
- **Supervised Classification**
  - Introduction
  - Techniques, models and algorithms; artficial neural nets, Bayesian classifiers, decision trees, …
  - Performance measures to evaluate and compare classifiers
  - Unbalanced classes and non binary classification
- **Unsupervised Classification**
  - Introduction
  - Proximity measures for nominal, ordinal and continuous attributes
  - Techniques, models and algorithms; partitioning, hierarchical, graph based, density based, …
  - Performance measures to evaluate and compare clustering solutions
- **Association Rules**
  - Introduction and basic definitions
  - Item and itemsets
  - Apriori, principle and algorithm
  - Performance measures to evaluate and compare association rules

Prerequisites

Basic knowledge on; informatics, probability calculus and statistics.

Teaching form

Teaching is achieved by *classes*. The entire course is also available in *digital* form consisting of *video lectures* for theory and *hands-on*. The course material is organized through *learning paths* where *lecture modules* consist of theoretical lecture, hand-on lecture and *self-evaluation sessions*. Self-evaluation session offers a powerful and

effective resource to *online learning*, i.e. after the class has taken place, The course makes available 170 quizzes to allow students to fairly assess their understanding level and to train for the exam.

Textbook and teaching resource

Video-lectures, slides, datasets and workflows designed and developed by the teacher.

- http://www.uokufa.edu.iq/staff/ehsanali/Tan.pdf
- http://dsd.future-lab.cn/members/2015nlp/Machine_Learning.pdf
- http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470276800.html

Semester

Fall Semester

Assessment method

Assessment is based on two components, a *machine learning project* and a *methodology exam* which is performed in the laboratory by using a computer. Students and encouraged to *work in small teams* to design, develop and document their data and/or text mining project. The data and/or text mining project is usually *selected by the students team* by exploiting the *Kaggle platform* (**https://www.kaggle.com/**) where *Data Science* requests and offers meet.
The *machine learning project* gives a maximum of 21 points, assigned according to six criteria as follows:

- Technical merit: notably rigour, accuracy and correctness (maximum 5 points)
- Clarity of expression and communication of ideas; including readability and discussion of concepts (maximum 5 points)
- Appropriate referencing and the context of the present work (maximum 2 points)
- Overall balance and structure of report (maximum 3 points)
- Repetition; have significant parts of the manuscript already been published by other authors? (maximum 3 points)
- Diagrams, tables, captions; are they clear and essential (maximum 3 points)

The *methodology exam* gives a maximum of 11 points. according to the following; 6 points for 6 quizzes, one point for each quiz (*each quiz concerns concepts presented in the course*) and a maximum of 5 points for an open ended question having the goal to evaluate the *critical point of view of the candidate*. The candidate can also ask to undergo *oral examination*, consisting of questions *about reasoning and deduction about the concepts presented in the course*, which gives a maximum of 3 points.

Office hours

On dating