MICRO-455

Applied machine learning

Billard Aude

Cursus	Sem.	Type
Civil & Environmental Engineering		Opt.
Data and Internet of Things minor	H	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Energy Science and Technology	MA1, MA3	Opt.
Financial engineering	MA1, MA3	Opt.
Mechanical engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Neuro-X minor	H	Opt.
Neuro-X	MA1	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA1, MA3	Obl.
Systems Engineering minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	4 weekly
Number of positions	

Summary

Real-world engineering applications must cope with a large dataset of dynamic variables, which cannot be well approximated by classical or deterministic models. This course gives an overview of methods from Machine Learning for the analysis of non-linear, highly noisy and multi dimensional data

Content

Because machine Learning can only be understood through practice, by using the algorithms, the course is accompanied with practicals during which students test a variety of machine learning algorithm with *real world data* . The courses uses matlab libraries for machine learning, as well as the MLDEMOS TOOLBOX that entails a large variety of Machine Learning algorithms.

- Pattern recognition and clustering: PCA, kNN, K-means, DBSCAN.
- Binary and multi-class classifiers: LDA, GMM with Bayes, SVM, Boosting, Neural Networks.
- Non-linear Regression: SVR, GMR, Neural Networks

Keywords

Machine Learning, Statistics

Learning Prerequisites

Required courses

Linear Algebra, Probability & Statistics

Important concepts to start the course

Linear Algebra: Eigenvalue and singular value decomposition
Statistics: Definitions of probability density function, marginal, likelihood, covariance, correlation
Optimization: Lagrange multipliers, gradient descent, local and global optima

Learning Outcomes

By the end of the course, the student must be able to:

Transversal skills

- Use a work methodology appropriate to the task.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Write a scientific or technical report.
- Make an oral presentation.

Teaching methods

The format of the course is that of a Split-Class: The theory of the course is presented through a video which students must watch prior to class. One hour of the course is allocated for this. This is following by an ex-cathedra lecture that consists of a one-hour interactive lecture session. The interactive lecture takes place on campus, but students who need it can also attend through zoom. An electronic polling system is used to engage students during the lecture.
A two-hour exercise sessions is given each week after the lecture. 4 of the weeks of the course are dedicated to computer-based practical sessions, during which students learn to use the algorithms seen in class for processing real data.
Exercise sessions and computer-based practice session are done on site only. No remote connection possible.

Expected student activities

Students are expected to watch the videos prior to the interactive lecture, as the interactive lecture will not repeat the video but go in more depth in the concepts presented in the videos.
Students are expected to attend the exercise sessions and the computer-based practice sessions. They should revise the class notes prior to going to practical session to be on top of the the theoretical material prior to applying it.
Students who are no longer up to date with the pre-requisites should work on these in parralel to taking the class.

Assessment methods

Final written exam (100% grade), in-class assessment through a quiz (0% grade).

Supervision

Office hours	No
Assistants	No
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Notes/Handbook

The course is accompanied with lecture notes entitled: *Machine Learning Techniques*, available as a pdf posted on the class's website.

Moodle Link

- https://go.epfl.ch/MICRO-455

Videos

- https://tube.switch.ch/channels/7e86d16d

Prerequisite for

MICRO-570 Advanced Machine Learning, spring semester
MICRO-462 Learning and adaptative control for robots