Advanced machine learning

Summary
This course will present some of the core advanced methods in the field for structure discovery, classification and non-linear regression. This is an advanced class in Machine Learning; hence, students are expected to have some background in the field.

Content
The class will be accompanied by practical session on computer, using the mldemos software (http://mldemos.epfl.ch) that encompasses more than 30 state of the art algorithms.

- Introduction to the major mathematical principles of Machine Learning
- Structure Discovery: spectral and kernel methods, kernel PCA, CCA, X-means
- Advanced Nonlinear Regression Methods
- Stochastic Modeling: Particle Filters, Reinforcement Learning and Gradient Methods

Keywords
Machine learning, statistics

Learning Prerequisites

Required courses
Probability & Statistics, Linear Algebra

Recommended courses
Machine Learning, Pattern Recognition

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:
Choose an appropriate method
- Apply the method properly

Transversal skills
- Use a work methodology appropriate to the task.
- Write a scientific or technical report.

Teaching methods
Ex-cathedra lectures, exercises, computer-based practical sessions

Expected student activities
Each week, students should read the selected chapters of the Lecture Notes prior to class.
Students must attend the computer-based practice session and prepare regular reports that are graded.

Assessment methods
50% personal work during semester, 50% oral exam

Resources
Ressources en bibliothèque
- Machine Learning Technique / Billard

Notes/Handbook
Machine Learning Techniques, available at the Librairie Polytechnique. To be purchased before the class starts.

Prerequisite for
Students must be knowledgeable about machine learning and have taken a course in the area either at EPFL or elsewhere. Relevant courses at EPFL are:
Applied Machine Learning - MICRO-455
Pattern Classification and Machine Learning: CS-433
Data Analysis and Model Classification - EE-516