Summary

Machine learning and data analysis are becoming increasingly central in many sciences and applications. This course concentrates on the theoretical underpinnings of machine learning.

Content

• Basics: statistical learning framework, Probably Approximately Correct (PAC) learning, learning with a finite number of classes, Vapnik-Chervonenkis (VC) dimension, non-uniform learnability, complexity of learning.
• Neural Nets: representation power of neural nets.
• Stochastic gradient descent, modern aspects: mean field approach, neural tangent kernel.
• Matrix factorization, Tensor decompositions and factorization, Jenrich's theorem, Alternating least squares, Tucker decompositions.
• Learning mixture models, topic modeling.

Learning Prerequisites

Recommended courses

• Analysis I, II, III
• Linear Algebra
• Machine learning
• Probability
• Algorithms (CS-250)

Learning Outcomes

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

• Explain the framework of PAC learning
• Explain the importance basic concepts such as VC dimension and non-uniform learnability
• Describe basic facts about representation of functions by neural networks
• Describe recent results on specific topics e.g., graphical model learning, matrix and tensor factorization, learning mixture models

Teaching methods
• Lectures
• Exercises

Expected student activities
• Attend lectures
• Attend exercises sessions and do the homework

Assessment methods
Final exam and graded homeworks

Supervision
Office hours  Yes
Assistants  Yes
Forum  Yes
Others  Course website

Resources
Moodle Link
• https://go.epfl.ch/CS-526