Fundamentals of inference and learning

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Summary
This is an introductory course in the theory of statistics, inference, and machine learning, with an emphasis on theoretical understanding & practical exercises. The course will combine, and alternate, between mathematical theoretical foundations and practical computational aspects in python.

Content
The topics will be chosen from the following basic outline:

• Statistical inference: Estimators, Bias-Variance, Consistency, Efficiency, Maximum likelihood, Fisher Information.
• Bayesian inference, Priors, A posteriori estimation, Expectation-Minimization.
• Statistical learning theory: VC Bounds and Uniform convergence, Implicit regularisation, Double-descent.
• Unsupervised learning: Mixture Models, PCA & Kernel PCA, k-means.
• Deep learning: multi-layer nets, convnets, auto-encoder, Gradient-descent algorithms.
• Basics of Generative models & Reinforcement learning.

Keywords
Statistics, Supervised and unsupervised learning

Learning Prerequisites

Required courses

• Basic probability theory.
• Basic knowledge of python programming.
• Basic linear algebra, and calculus.

Recommended courses

Probability and statistics.
Advance Python
Basic optimization

Important concepts to start the course
Students should be familiar with basic concepts of probability theory, calculus and linear algebra, and be familiar with python.

Learning Outcomes
By the end of the course, the student must be able to:
• Formulate statistical models and apply them to statistical learning
• Apply machine learning technics to data science problems
• Solve concrete data science problems
• Explain and understand the fundamental principle of learning theory

Assessment methods
* Homeworks during the lectures
* Final project,

Resources
Moodle Link
• https://go.epfl.ch/EE-411

Videos
• https://tube.switch.ch/channels/P21dFjFIZG