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, learning and stability, PAC Bayes bounds.
- **Graphical models**: learning.
- **Non-negative matrix factorization, Tensor decompositions and factorization**.
- **Learning mixture models**.

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
Expected student activities

• Attend lectures
• Attend exercises sessions and do the homework

Assessment methods

Final exam and graded homeworks

Supervision

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