

Introduction

Programme of the course

Arguments treated:

1. **Motivation:** components of the learning problem and applications of Machine Learning. Supervised and unsupervised learning.
2. **Introduction:** the supervised learning problem, data, classes of models, losses.
3. **Probabilistic models and assumptions on the data:** the regression function. Regression and classification.
4. **When is a model good?:** model complexity, bias variance tradeoff/generalization (VC dimension, generalization error).
5. **Models for regression:** linear regression (scalar and multivariate), subset selection, linear-in-the-parameters models, regularization.
6. **Simple models for classification:** logistic regression, perceptron, naïve bayes classifier.
7. **Kernel methods:** Support Vector Machines.
8. **Neural Networks.**
9. **Deep Learning:** Convolutional Neural Networks.
10. **Validation and model selection:** generalization error, bias-variance tradeoff, cross validation. Model complexity determination.
11. **Unsupervised learning:** cluster analysis, K-means clustering, EM estimation.
12. **Dimensionality reduction:** Principal Component Analysis (PCA).