Introduction

0.1   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).