Pattern Recognition
(advanced course)

Abstract

This is a course on supervised machine learning and pattern recognition. The course focuses mainly on Bayesian decision theory, linear discriminant functions, and artificial neural networks. Some basic non-parametric techniques are also included

Pre-requisites

- Linear algebra
- Probability theory

Contents

1.- Introduction
      1.1.- Pattern recognition and related fields
      1.2.- Pattern recognition systems
      1.3.- Data collection and feature extraction
      1.4.- Training and evaluation
      1.5.- Types of classification problems

2.- Bayesian classification
      2.1.- Introduction
      2.2.- Bayesian decision theory for continuous features
      2.3.- Minimum error rate classification
      2.4.- Discriminant functions and decision surfaces
      2.5.- Discriminant functions for the normal density
      2.6.- Bayesian decision theory for discrete features

3.- Parametric estimation and supervised learning
      3.1.- Introduction
      3.2.- Maximum likelihood estimation
      3.3.- Bayesian estimation
      3.4.- Bayesian estimation for the Gaussian case
      3.5.- Recursive Bayesian learning
      3.6.- The curse of dimensionality
      3.7.- Hidden Markov Models

4.- Nonparametric techniques
  4.1.- Introduction
  4.2.- Density estimation
  4.3.- Parzen windows
  4.4.- K-Nearest Neighbors estimation
  4.5.- Estimation of posterior distributions
  4.6.- Nearest Neighbor classification rule
  4.7.- K-Nearest neighbors classification rule
  4.8.- Metrics for Nearest-Neighbor classification

5.- Linear discriminant functions
  5.1.- Linear discriminant functions and decision hyperplanes
  5.2.- Generalized linear discriminant function
  5.3.- Two-category linearly separable problems
  5.4.- Perceptron model
  5.5.- Relaxation methods
  5.6.- Non-separable case
  5.7.- Minimum Squared-Error procedures
  5.8.- Support vector machines
  5.9.- Generalizations to multiple categories

6.- Multilayer Neural Networks
  6.1.- Introduction
  6.2.- Feedforward neural networks
  6.3.- Classification using neural networks
  6.4.- The Backpropagation algorithm
  6.5.- Error surfaces
  6.6.- Backpropagation Feature Mapping
  6.7.- Techniques for improving Backpropagation
  6.8.- Other types of networks

Bibliography

- Pattern Classification. Duda, Hart and Stork. Second Edition. Wiley-Interscience, 2001.
- Pattern Recognition and Machine Learning. Bishop. Springer, 2006.