Machine Learning

Lecture 11

Summary

Topics Covered

- Topic 1: Introduction
  - Learning and learning systems
  - Design of learning systems - 5 steps approach: training sample collection/preparation, data representation, choose a learning model/paradigm, learning, testing
  - Basic maths – vector, matrix, calculus

Topics Covered

- Topic 2: Neural networks
  - Perceptron – model operation, perceptron learning rule, decision boundary (surface), limitations, linearly separable classes
  - ADLINE – model operation, delta rule (gradient descent learning), batch mode, online mode
  - Multi-layer perceptron (MLP) - model operation, nonlinear unit (sigmoid function), principles of learning rule (back-propagation algorithm), model capability (solve linearly non-separable problems)
  - Generalization, over fitting, stopping criteria

Topics Covered

- Topic 3: Bayesian learning
  - Basic probability theory
  - Bayesian theorem
  - Estimation of probabilities
  - Maximum a posteriori (MAP)
  - Maximum Likelihood (ML)
  - Bayesian classifiers
  - Naïve Bayesian classifier

Topics Covered

- Topic 4: Instance based learning
  - K nearest neighbour classifier (K-NN) – feature space neighbourhood concept, classifier construction and operation, choose a suitable values of K

Topics Covered

- Topic 5: Clustering analysis
  - Basic concept of data clustering and why it is useful
  - How to do data clustering (K-means algorithm) – operation of the algorithm
  - Link between K-means algorithm and gradient descent (the concept of clustering cost function or objective function)
  - Limitations/weaknesses of the basic K-means algorithm – sensitive to initial cluster centres, local minima

Topics Covered

- Topic 6: Data processing and representation
  - Concepts of correlation and redundancy
  - Covariance matrix
  - Concepts of feature extraction/dimensionality reduction
  - Principle and application of Principal Component Analysis (PCA)

Topics Covered

- Topic 7: Support vector machines
  - Model operation (how it works)
  - Support vectors
  - Max margin classifier
  - Linear SVMs
  - Concept of Soft margin classification
  - Principle of Non-linear SVMs and the “Kernel Trick”

Topics Covered

- Topic 8: Decision tree learning
  - Information gain
  - Decision tree construction (design) – picking the root node, recursive branching