

CS 559 Machine Learning

Lecture 13: Final Review

Ping Wang

Department of Computer Science

Stevens Institute of Technology



Today's Lecture

- Topics Covered
- Top Machine Learning Algorithms
- Final Exam
- Course Evaluation
- Q&A

Topics Covered in This Course (1)

- Decision Theory - Explain Bayesian decision theory, the likelihood ratio, and minimum risk classification.
- Linear Regression - Optimize using gradient descent methods; model evaluation.
- Linear Classification - Implement classifiers using linear discriminant functions, Fisher Linear Discriminant Analysis, Perceptron Algorithm.
- Maximum Likelihood Estimation - Implement Maximum Likelihood Estimation for Logistic Regression.
- Dimensionality Reduction - Apply dimensionality reduction using Principal Component Analysis.

Topics Covered in This Course (2)

- Support Vector Machines - Explain the advantages of Support Vector Machines and margin maximization.
- Decision tree models; Ensemble methods, including Bagging, Boosting, and Random Forests.
- Non-parametric Learning - Implement k-nearest neighbors, and perform non-parametric classification.
- Clustering – Implement k-means clustering, and perform EM for Gaussian mixtures.
- Neural Networks – Backpropagation for basic neural networks.

Top Machine Learning Algorithms

- Linear Regression
- Logistic Regression
- Linear Discriminant Analysis
- Support Vector Machines (SVM)
- K-Nearest Neighbors (KNN)
- Naive Bayes
- Decision Tree
- Random Forest
- AdaBoost

Other Important Algorithms

- K-means Clustering
- Expectation-Maximization
- Graphical Models
- Deep Neural Networks
- And many others ...

Final Exam

- Time: 3:30-6:00 PM on May 11, 2023
- Location: Howe 102
- Closed-book exam; one A4 cheatsheet is allowed.
- Calculator is allowed, but phones, laptops, and other devices are not allowed.
- Work on the exam independently.
- You cannot share the calculator or cheatsheet during the exam.

Final Exam

Coverage: Focuses on the **content after the mid-term exam**

- **Decision trees and Ensemble methods:**
 - How to perform classification based on decision trees; how to measure the node impurity; how to find the best split.
 - What is the motivation of ensemble methods? What are the two basic decisions when designing ensembles and what are the corresponding strategies in the three ensemble methods we discussed?
- **Nonparametric methods:**
 - How to estimate the density value at a single data point based on Parzen window?
 - KNN classification (both weighted and unweighted version)
 - Different distance metrics

Final Exam

- **Clustering:**
 - How to perform k-means; properties of k-means
 - Challenges in Gaussian Mixtures Model and the corresponding solution
 - EM for Gaussian Mixtures model
- **Graphical models:**
 - Classification with naïve bayes and Bayesian Network and their differences
 - How to represent the joint distribution of variables based on Bayesian network.
- **Neural Networks:**
 - Forward propagation and backpropagation;
 - Vanishing gradient problem; activation functions;
 - CNN, convolution, max-pooling;
 - Word2Vec

Course Evaluation On AEFIS

<https://assess.stevens.edu/>

Q&A

Thank You!