ENEE759G: Advanced Topics in Computer Engineering - Unsupervised Learning

Fall 2015 (TuTh 12:30 – 1:45; ITV1100)
Instructor: Joseph JaJa
Course Syllabus

Course Objectives: The course will cover core topics in unsupervised learning with a focus on statistical and optimization techniques. Topics covered will include: density estimation, latent variable models, mixture models, clustering, directed and undirected graphical models and inference, learning graphical models, and association rules.

Relationship with ENEE 633: The focus of this course is not intended for those interested in taking ENEE633. It is strongly advised that students enroll in only one of ENEE633 and ENEE759G.

Course prerequisites: Graduate standing.

Prerequisite topics: A strong undergraduate background in probability and statistics, linear Algebra, advanced calculus, algorithms, and some familiarity with nonlinear optimization are required for this course.

Textbooks: No textbook is required for this course but the following can be used as references:


Core Topics:

1. Introduction
   - Basic framework and concepts
   - Probability density estimates for low-dimensional data
   - Maximum Likelihood Estimation and Bayesian Estimation.
   - Matrix Factorization and Nonlinear Optimization

2. Latent Variable Models
   - Principal Component Analysis
   - Introduction to Factor Analysis
   - Independent Component Analysis
   - The EM algorithm with application to Gaussian Mixture Models

3. Clustering
   - Proximity measures and evaluation methodologies
   - The k-means algorithm and its variant the k-medoid algorithm
   - Hierarchical clustering
   - Spectral clustering
   - Other type of clustering algorithms such as Self Organizing Maps
4. Directed Graphical Models
   - Basic definitions and properties
   - Naïve Bayesian networks
   - Inference: Exact and Approximate
   - Learning Bayesian networks

5. Undirected Graphical Models
   - Basic definitions and concepts
   - Markov properties
   - Factor graphs
   - Inference algorithms

6. Association Rules
   - Market Basket analysis and overall strategy
   - The Apriori Algorithm
   - Rule Generation

Midterm: October 22 – 40%; Final: Date TBA – 60%

Homeworks: Assignments will be given out throughout the semester and will be corrected but not graded. The assignments will provide a good technical background to the material covered in class, and some of the assignment problems may appear on the midterm or final exams.

Contact Information

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Joseph JaJa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office:</td>
<td>3433 A. V. Williams</td>
</tr>
<tr>
<td>Office Hours:</td>
<td>Tu and Th 3-5 or by appointment</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:Joseph@umiacs.umd.edu">Joseph@umiacs.umd.edu</a></td>
</tr>
<tr>
<td>Phone:</td>
<td>405-1925</td>
</tr>
</tbody>
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