CMPE 562 PATTERN RECOGNITION

FALL 2018-2019

Lecturer:

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Goals:

This course is mainly an introduction to pattern recognition. The contents of the course are mainly the basic concepts of this field. Instead of a detailed theoretical investigation, a description of the problem and some well-known and most frequently used techniques are going to be presented. Some typical pattern recognition problems like face recognition and text categorization will be described. The graduate students, who are going to take this course will be introduced into a wide engineering field where the engineering techniques learned from the other graduate courses can also be applied.

Text books:

R. O. Duda and P. E. Hart, “Pattern classification”, John Wiley and Sons, 2000.
S. Theodoridis and K. Koutroumbas, “Pattern recognition”, Academic press, 4th edition 2009.
E. Alpaydin, "Introduction to Machine Learning", MIT press, 2004.

Course outline:

1. *A review of probability and random variables*. Axioms of probability, conditional probability, Bayes rule, definition of a random variable, distribution and density functions (2 hours).
2. *Introduction to pattern classification*. Definition of pattern, feature and pattern classes. Noise in pattern recognition. Decision rules, decision boundaries, discriminant functions, classifiers. (4 hours)
3. *Bayes decision theory*. Bayes classifiers, Bayes decision rules, Bayes discriminant function, minimum-error classification, Bayes discriminant functions for Normal distributions. Performance measures for classification.(6 hours)
4. *Maximum likelihood and Bayesian parameter estimation*. Estimation of unknown probabilities and densities, Normal distribution as a special case. (3 hours)
5. *Nonparametric density estimation*. Estimation of arbitrary distributions without any assumption about underlying densities. (3 hours)
6. *Neighborhood based classification*. Classification using similarities and distances to labeled samples. (3 hours)
7. *Dimensionality reduction*. Reducing the feature space using PCA and LDA. Feature selection. (4 hours)
8. *Linear discriminant functions*. Two-category classification. Perceptron as a linear classifier. Multi-category piecewise linear discriminant functions. Generalized discriminant functions. Training discriminant functions. (4 hours)
9. *Nonlinear discrimination*. Designing nonlinear architectures for classification. Multilayer perceptron as a special case (4 hours)
10. *Clustering techniques*. Definition of clustering. Similarity measures. Clustering with known or unknown number of classes. K-Means clustering and ISODATA algorithms. (4 hours)

Grading policy:

- Midterm Examination (25%)

- Final Examination (30%)
- Term project - Will cover implementing a pattern classification system using a dataset provided by the instructor that requires making a survey in that field, preprocessing, feature selection/extraction, modeling and performance evaluation.
    - Survey (15%)
    - Implementation and discussions about the results (25%)
    - Report + Presentation of the results (5%)