ECE620: Pattern Recognition & Machine Intelligence
(3 Credits; Prerequisites EE420 and Engineering Probability, or equivalent; 3 hrs lect.)

Description: Fundamentals of Statistical, Structural, and Neural Pattern Recognition Approaches: Parametric and Nonparametric Classification, Feature Extraction, Clustering, Self-organizing Nets for Pattern Recognition, and Formal Languages Representation. Current medical and industrial applications.

Office hours: Tuesday and Thursday (4:00 - 5:00 p.m.), and/or by appointment. Place: Rm 412 Lutz Hall, Phone 852-7510.

Grading: homework (20%), computer projects (45%), three one-hour exams (35%). Total grade will be normalized to 100 and the final letter grade will be assigned such that: $85 \leq A \leq 100$, $70 \leq B \leq 84$, $60 \leq C \leq 70$. Note: A range means $A^+ \geq 95$, $90 \leq A \leq 95$, $85 \leq A^- \leq 90$. Similarly, the ranges for B and C are defined. Maximum allowed overlap will be 3 points, if warranted.


Other References:


References on Simulation


# COURSE OUTLINE

## I. INTRODUCTION

- I.1 Classification Approaches
- I.2 Mathematical Foundation (Reviewed in ECE645/(ECE600-01))
- I.3 ECE645/(ECE600-01) Laboratory Arrangement

## II. BAYES DECISION THEORY

- II.1 Bayes Classifier for Continuous Case
- II.2 The Gaussian Two-class classifier
- II.3 Bayes Classifier for Discrete Case
- II.4 Error Probability and Receiver Operating Characteristics

## III. MAXIMUM- LIKELIHOOD AND BAYESIAN PARAMETER ESTIMATION

- III.1 Maximum Likelihood Estimation
- III.2 Application to Bayesian Classification
- III.3 Learning the Mean of Gaussian Density Function
- III.4 Sufficient Statistics

## IV. NONPARAMETRIC TECHNIQUES

- IV.1 Probability Density Estimation
- IV.2 Parzen Windows Estimation
- IV.3 $k$ Nearest Neighbor Estimation
- IV.4 Nearest Neighbor Rule
- IV.5 $k$ Nearest Neighbor Rule

## V. LINEAR DISCRIMINANT FUNCTIONS

- V.1 Linear Discriminant Functions and Decision Surfaces
- V.2 The Two-Category Case
- V.3 Generalized Linear Discriminant Functions
- V.4 Relaxation Procedure
- V.5 Minimum Square Error Procedure
- V.6 Ho-Kashyap Procedure
- V.6 Linear Programming Procedure

## VI. UNSUPERVISED LEARNING & CLUSTERING

- VI.1 Mixture Densities & Identifiability
- VI.2 Maximum Likelihood Estimates
- VI.3 Applications to Normal Mixtures
- VI.4 Unsupervised Bayesian Learning
- VI.5 Clustering Techniques & Criterion
- VI.6 Examples

## VII. COMPUTER PROJECTS (FOR ECE 645)

- VII.1 Simulation of Class Distributions
- VII.2 Bayesian Classifier Design
- VII.3 Nonparametric techniques
- VII.4 Clustering