

ECE620: Pattern Recognition & Machine Intelligence
(3 Credits; Prerequisites EE420 and Engineering Probability)

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.

Grading: Homeworks (20%), Projects (40 %), and three Exams (40%). Total grade will be normalized to 100 points and the final grade will be assigned such that: $85 \leq A \leq 100$, $70 \leq B < 85$, and $60 \leq C < 70$.

Text Book: R. O. Duda, P. E. Hart and Stork, *Pattern Classification and Scene Analysis*, Wiley, New York, 2nd Edition 2001.

Course Learning Objectives:

By the end of this class, students would:

1. Derive and implement Bayes Decision Theory.
2. Perform Parametric and Non Parametric Density Estimation.
3. Design Linear Classifiers for separable and non-separable patterns.
4. Implement classifiers using neural networks.

COURSE OUTLINE

	WEEKS
I. INTRODUCTION	1
I.1 MATHEMATICAL FOUNDATION	
II. BAYES DECISION THEORY.....	1
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....	1
III.1 Maximum Likelihood Estimation	
III.2 Application to Bayesian Classification	

III.3 Learning the Mean of Gaussian Density Function

IV. NONPARAMETRIC TECHNIQUES2

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.....1

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 & CLUSTERING2

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

VII. COMPUTER PROJECTS (FOR ECE 645)

VII.1 Simulation of Class Distributions

VII.2 Bayesian Classifier Design

VII.3 Nonparametric techniques

VII.4 Clustering