DELAWARE STATE UNIVERSITY

MTSC 852-PATTERN RECOGNITION

FALL 2015

Classes: ETV 134 (tentative), Tuesday, Thursday 16:30-17:45
Start date: Aug. 25, 2015 End date: Dec. 3, 2015

Instructor: Dr. Sokratis Makrogiannis
Department of Mathematical Sciences
Delaware State University
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Office Hours: Mon, Wed 13:00-14:30, Fri 13:00-14:00 and by appointment.

COURSE DESCRIPTION:

The student will learn the mathematical and statistical analysis techniques of pattern recognition and how to use these techniques to solve application-oriented problems. The student should become familiar with Bayesian Decision Theory, Parametric and Nonparametric Density Models, Linear Discriminants, Supervised and Unsupervised Learning, and Theory on Classifier Performance Estimation.

TEXT:

Required:
R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, 2nd ed., Wiley, 2001.
Recommended:
C. M. Bishop, Pattern Recognition and Machine Learning, 1st ed., Springer, 2006.

PREREQUISITES:

Advanced Probability Theory 25-541, or consent from instructor.

COURSE OBJECTIVES:

Upon completion of the course, students will be familiar with:

1. Classification Fundamentals,
2. Bayesian Decision Theory,
3. Maximum-Likelihood and Bayesian Estimation,
4. Nonparametric Density Estimation,
5. Linear Discriminant Analysis,
6. Classification Estimation and Comparison Techniques,
7. Unsupervised Clustering and Bayesian Learning.

HOMEWORK AND GRADES OVERVIEW:

1. There will be homework assignments assigned on a regular basis that will not be collected for grading. Homework solutions will be made available for each assignment.
2. There will be 5-6 project assignments -typically including problems and programming assignments- which will be done on an individual basis. For each project assignment, you are to turn in a brief report which should include a description of the problem, a description of your approach, and your evaluation of the results. Details on the deliverables will be given for each assignment respectively.
3. There will be a closed-book and closed-notes midterm examination.
4. There will be a closed-book and closed-notes comprehensive final examination. A portion of the final examination may also be a take-home examination.
5. There will be a term project assignment due toward the end of semester. It may be a literature study on a selected topic and/or include the design of a Pattern Recognition system to solve a specific problem. The term project will be presented in class following the standards of a scientific meeting (slide presentation followed by questions).
6. Your overall grade for the semester will be based upon the assignments and exams as defined below.

Type of Assessment	**Weight of Assessment**
Assignments and Projects	40%
Term Project	10 %
Midterm Exam	20%
Final Exam	25%
Participation/Attendance	5%

Percentage	**Grades**
90 – 100 %	**A**
80 – 89 %	**B**
70 – 79%	**C**
60 – 69%	**D**

READING ASSIGNMENTS:

Reading assignments will be given for each lecture period. Students are expected to complete the reading assignments prior to each lecture. Additional material will also be developed in class lectures, so missing class is not advisable.

ATTENDANCE POLICY:

Students are expected to attend all classes. Students are expected to arrive on time and be prepared for the class. Attendance may be taken at the beginning of each class. Please notify in advance if you are going to miss a class. Absence does not justify missed assignment due dates and missed tests/exams. If you miss a class, you are responsible for all material covered or assigned in class.

LATE WORK:

Project assignments are due on their due date at (or before) the start of class; late assignments lose 33% per day of delay; this implies a score of 0% for assignments delayed more than 2 days. If you are unable to hand in an assignment by the deadline, you must discuss it with me before the deadline.

MAKEUP EXAMS:

If any student misses an exam because of an extreme emergency, the student needs to make up the exam **within a week** to receive credit. Exams cannot be made up unless there is an extreme and documented emergency.

GROUP WORK AND ACADEMIC INTEGRITY:

While students are encouraged to discuss the assignments, each student is evaluated for individual effort in assignments and tests (i.e., sharing code is not allowed), unless there are specific instructions for group work. Individual assignments which are too similar will receive a zero. We should all strive to maintain academic integrity in graduate education and research efforts as stated in DSU's graduate student handbook.

(TENTATIVE) SCHEDULE:

Week #	Week Beginning Date	Description	Work Due	Text Reference
1	8/24/2015	Course Overview **Introduction** Pattern Recognition and Applications Linear Algebra		PC Ch. 1 PC A.2
2	8/31/2015	Probability and Statistics **Bayesian Decision Theory** Basic Principles and Terminology Minimum Error Rate Classification		PC A.4 PC Ch. 2
3	9/7/2015	Classifiers, Discriminant Functions, Decision Surfaces Normal Density	A1	
4	9/14/2015	Discriminant Functions for Normal Density Signal Detection Theory and Operating Characteristics		
5	9/21/2015	Bayesian Belief Networks (*) **Parametric Estimation Techniques** Maximum Likelihood Estimation Bayesian Estimation	A2	PC Ch. 3
6	9/28/2015	**Mid-Term Exam**	A3	
7	10/5/2015	Problems of Dimensionality Component Analysis and Discriminants (*) Expectation-Maximization (*)		

8	10/12/2015	**Nonparametric Estimation Techniques** Parzen Kernel Estimation k-NN Estimation k-NN Rule	A4	PC Ch. 4
9	10/19/2015	k-NN Classification Metrics **Linear Discriminant Functions** Linear Discriminant Functions Two-category Linearly Separable Case Nonseparable Behaviour		PC Ch. 5
10	10/26/2015	MSE methods Linear Programming (*) SVM **Algorithm-Independent Machine Learning** Lack of Superiority of Any Classifier Bias and Variance Resampling for Estimating Statistics	A5	PC Ch. 9
11	11/2/2015	Resampling for Classifier Design Classifier Estimation Combining Classifiers (*)		
12	11/9/2015	**Unsupervised Learning and Clustering** Mixture Densities Max-likelihood Estimates Normal Mixtures	A6	PC Ch. 10
13	11/16/2015	Unsupervised Bayesian Learning Similarity Measures Clustering Criterion Functions Hierarchical Clustering (*)		
14	11/23/2015	Component Analysis (*) **Advanced Topics in Pattern Recognition** (*) Kernel PCA/LDA Manifold Learning (ISOMAP, Laplacian Eigenmaps, LTSA, LLE, etc)		PC Ch. 10, PR literature
15	11/30/2015	**Case studies (*)** Diagnostics in Medicine Computer Vision Biometrics	TP	PR literature
16	12/7/2015	Review and **Final Exam**		

(*) Pending on time availability and class interest

NOTE:

If you have a disability which is documented with the Student Accessibility Services Office and wish to discuss academic accommodations with me, please contact me as soon as possible.