

CS 479/679 Pattern Recognition

Spring 2016 – Dr. George Bebis

Prerequisites: CS 302 with a "C" or better; MATH/STAT 352. *Credit hours:* 3.0

Course Webpage: <http://www.cse.unr.edu/~bebis/CS479>

Meets: MW 1:00pm-2:15pm (SEM 257)

Instructor: Dr. George Bebis

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Office Hours: MW 2:30pm - 4:00pm and/or by appointment

Texts

Pattern Classification, by Duda, Hart, and Stork, 2nd edition, John Wiley Interscience, 2001.

Useful Texts

The Elements of Statistical Learning, by T. Hastie et al., Springer-Verlag, 2001.

Machine Learning: A probabilistic Perspective, by K. Murphy, MIT Press, 2012.

Objectives

This course will introduce the fundamentals of statistical pattern recognition. First, we will focus on *generative* methods such as those based on Bayes decision theory and related techniques of parameter estimation and density estimation. Next, we will discuss *discriminative* methods such as nearest-neighbor classification and support vector machines. Methods of pattern recognition are useful in many applications such as information retrieval, data mining, document image analysis and recognition, computational linguistics, forensics, biometrics and bioinformatics. In this course, we will emphasize computer vision applications.

Course Outline (tentative)

- Introduction
- Bayesian Decision Theory
- Bayesian Networks
- Maximum Likelihood Estimation
- Dimensionality Reduction
- Feature Selection
- Bayesian Estimation
- Linear Discriminant Functions

- Support Vector Machines (SVMs)
- Expectation-Maximization (EM) Algorithm
- Non-parametric Estimation
- Selected Topics

Exams and Assignments

Grading will be based on two exams, several quizzes, and 4-5 programming assignments and a paper presentation. Details are provided below:

- Homework problems will be assigned but will **NOT** be collected for grading. Homework solutions will be made available for each assignment.
- There will be 2 exams: a midterm and a final. The material covered in the exams will be drawn from the lectures and the homework.
- There will be several quizzes during the semester which will be announced at least one class period in advance.
- There will be 4-5 programming assignments which will be done in groups of two students. For each assignment, the group would need to turn in a report; details will be provided for each assignment.
- Graduate students will be required to present a research paper to the rest of the class. Each presentation should be professional as if it was presented in a formal conference (i.e., slides/projector). Students can choose a paper from those listed on the course's webpage or can suggest other papers to the instructor for possible presentation. Presentations should be 20 minutes long and will take place at the end of the semester.

Course Policies

- Lecture slides, project assignments and other useful information will be posted on the course's web page.
- Regular attendance is highly recommended. If you miss a class, you are responsible for all material covered or assigned in class.
- A missed exam may be made up **only** if it was missed due to an extreme emergency.
- **No** late assignments will be accepted unless there is an **extreme emergency**.
- Discussion of the assignments is allowed and encouraged. However, each student should do his/her own work. **Assignments which are too similar will receive a zero.**

- **No** incomplete grades (INC) will be given in this course unless there is an extreme emergency.

Academic Dishonesty

Cheating, plagiarism or otherwise obtaining grades under false pretenses" constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include canceling a student's enrollment without a grade, giving an F for the course or for the assignment. For more details, see the UNR General Catalog.

Disability Statement

Any student with a disability needing academic accommodations is requested to speak with me or contact the Disability Resource Center (Thompson Building, Suite 101), as soon as possible to arrange for appropriate accommodations.

Academic Success Services

Your student fees cover usage of the Math Center (784-443 or www.unr.edu/mathcenter/), Tutoring Center (784-6801 or www.unr.edu/tutoring/), and University Writing Center (784-6030 or http://www.unr.edu/writing_center/). These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign a responsible and successful student.

Audio and Video Recording

Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

Grading Scheme

Midterm exam: 25%

Final exam: 25%

Quizzes: 10%

Programming Assignments: 40%

Paper presentation: 10% **(grad students only)**

A 90 and above

B 80-89

C 70-79

D 60-69

F<59

Important dates

February 15, 2016 - President's day (no classes)

March 16, 2016 – Midterm exam

March 19-27, 2016 - Spring Break

March 29, 2016 - Last day to drop classes

May 4, 2016 – Prep Day

May 9, 2016 - Final exam (10:15am – 12:15pm)

Course Assessment Matrix

CS 479 Pattern Recognition

Program Outcomes	Course Outcomes	Assessment Methods/Metrics	CSE Program Objectives Impacted
1	Students demonstrate a thorough understanding of fundamental concepts in pattern recognition (bayesian decision theory, maximum likelihood estimation, bayesian estimation, feature extraction and selection, EM algorithm, SVMs, non-parametric estimation).	Quizzes and exams	1, 2
7	Students improve their communication skills.	Class presentation and project reports	4
9	Students recognize the need for, and develop an ability to engage in life-long learning in the area of pattern recognition.	Specific exam questions (case studies)	4
11	Students are familiar with current techniques and skills for practical pattern recognition applications (e.g., face recognition, gender classification)	Specific programming assignments	3
12	Students demonstrate the ability to apply mathematical and algorithmic principles in designing pattern recognition systems while understanding the tradeoffs involved in design choices (e.g., optimize the parameters of a classification system).	Specific programming assignments	3

Program Outcomes:

Our graduates will have achieved:

1. an ability to apply knowledge of computing, mathematics, science, and engineering.
2. an ability to design and conduct experiments, as well as to analyze and interpret data.
3. an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs, within realistic constraints specific to the field.
4. an ability to function effectively on multi-disciplinary teams.
5. an ability to analyze a problem, and identify, formulate and use the appropriate computing and engineering requirements for obtaining its solution.
6. an understanding of professional, ethical, legal, security and social issues and responsibilities.
7. an ability to communicate effectively with a range of audiences.
8. the broad education necessary to analyze the local and global impact of computing and engineering solutions on individuals, organizations, and society.
9. a recognition of the need for, and an ability to engage in continuing professional development and life-long learning.
10. a knowledge of contemporary issues.
11. an ability to use current techniques, skills, and tools necessary for computing and engineering practice.
12. an ability to apply mathematical foundations, algorithmic principles, and computer science and engineering theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
13. an ability to apply design and development principles in the construction of software systems or computer systems of varying complexity.

Computer Science and Engineering Program Objectives:

Within 3 to 5 years of graduation our graduates will:

1. be employed as computer science and engineering professionals beyond entry level positions or be making satisfactory progress in graduate programs.
2. have peer-recognized expertise together with the ability to articulate that expertise as computer science and engineering professionals.
3. apply good analytic, design, and implementation skills required to formulate and solve computer science and engineering problems.
4. demonstrate that they can function, communicate, collaborate and continue to learn effectively as ethically and socially responsible computer science or computer engineering professionals.