

CS 479/679 Pattern Recognition

Spring 2024 – Dr. George Bebis

Catalog Description: pattern recognition systems, statistical methods, discrimination functions, clustering analysis, unsupervised learning, feature extraction, and feature processing.

Prerequisites: CS 202 with a "C" or better; STAT 352 or STAT 461.

Credit Hours: 3.0

Meets: MW 1:00 pm-2:15 pm (WPEB 200)

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

Instructor: Dr. George Bebis (see me for help with the course material)

- **Office:** 411 WPEB
- **E-mail:** bebis@unr.edu
- **Office Hours:** Monday/Wednesday 2:15 pm – 3:00 pm or by appointment

TA: Aminul Huq (see him for help with the programming assignments)

- **Office:** 414 WPEB (Computer Vision Lab)
- **E-mail:** aminul.huq@nevada.unr.edu
- **Office Hours:** Tuesday/Thursday 12:30 pm – 1:30 pm

Required Text

Pattern Classification, by Duda, Hart, and Stork, 2nd edition, John Wiley Inter-science, 2001.

Optional 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.

Probabilistic Machine Learning: An Introduction, by K. Murphy, MIT Press, 2022.

Objectives

This course will introduce the fundamentals of 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 support vector machines (SVMs). 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 Extraction, Feature Selection)
- Bayesian Estimation
- Linear Discriminant Functions
- Support Vector Machines (SVMs)
- Expectation-Maximization (EM) Algorithm (if time permits)

Student Learning Outcomes

- **(SLO1)** Identify, formulate, analyze, and solve complex computing or engineering problems by applying principles of computing, engineering, science, and mathematics.
- **(SLO3)** Communicate effectively in a variety of professional contexts, with a range of audiences.
- **(SLO8)** Acquire and apply new knowledge as needed, using appropriate learning strategies.

Exams and Assignments

Grading will be based on **quizzes**, **exams**, and **programming assignments**. Graduate students will also need to **present** a paper.

- There will be 7 quizzes during the semester which will be announced at least one class period in advance. The **lowest** quiz grade will be dropped.
- There will be a midterm and a final exam (comprehensive). The material covered in the exams will be drawn from the lectures and the quizzes.
- There will be 4 programming assignments which must be completed on an **individual** basis; details will be provided in class.
- Graduate students will be required to present a paper to the rest of the class. Each presentation should be **20 minutes** long and presented in a professional manner (i.e., slides). The instructor will provide potential topics for presentation, but

students are also welcome to propose their topics (subject to the instructor's approval). The presentations will be scheduled during the last 2-3 weeks of the semester.

Course Policies

- Lecture slides, assignments, and other useful information will be posted on the course's web page.
- Quizzes and exams will be closed books, and closed notes. If you are unable to take a quiz or exam at the designated date and time, you must inform me in advance. Quizzes and exams **cannot** be made up unless there is an extreme emergency.
- Programming assignments need to be submitted on **Canvas**.
- Discussion of your work with others is allowed and encouraged. However, each student should do his/her work. **Assignments that are too similar will receive a zero.**
- **No late** work will be accepted unless there is an extreme emergency. If you are unable to hand in your work by the deadline, you must discuss it with me **before** the deadline.
- **No incomplete** grades (INC) will be given in this course and a missed exam may be made up only if it was missed due to an extreme emergency.
- Students are expected to attend all lectures and be on time. Students who miss a class and/or are late for a class may experience an impact on their grades by missing course activities. If you miss a lecture, **you are responsible** for all material covered or assigned.
- The instructor **reserves** the right to add to, and/or modify any of the above policies as needed to maintain an appropriate and effective educational atmosphere. If this happens, all students will be notified in advance of the implementation of the new and/or modified policy.

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 filing a final grade of "F"; reducing the student's final course grade by one or two full grade points; awarding a failing mark on the coursework in question; or requiring the student to retake or resubmit the coursework. The University Academic Standards Policy defines academic dishonesty and mandates specific sanctions for violations. See the University Academic Standards policy: UAM 6,502.

Disability Services

Any student with a disability needing academic adjustments or accommodations is requested to speak with the Disability Resource Center (Pennington Student Achievement Center, Suite 230) 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 a sign of a responsible and successful student.

Please note that the Math Center is focused on helping students with mathematical and statistical concepts. While mathematics is used extensively in engineering, the Math Center does not have the resources to help students with engineering courses. Engineering students are encouraged to use the Math Center for help in their math classes, and they are welcome to use its computer lab and study area any time –regardless of course. However, Math Center tutors cannot answer questions regarding engineering courses.

Audio and Video Recording

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

Safe Learning Environment

UNR is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX Office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit: <http://www.unr.edu/equalopportunity-title-ix>

COVID-19 Training Policies

Students must complete and follow all guidelines as stated in the Student COVID-19 Training modules, or any other training or directives provided by the University.

COVID-19 Face Coverings

In response to COVID-19, and in alignment with State of Nevada Governor Executive Orders, Roadmap to Recovery for Nevada plans, Nevada System of Higher Education directives, the University of Nevada President directives, and local, state, and national health official guidelines face coverings are required at all times while on campus, except when alone in a private office. This includes the classroom, laboratory, studio, creative space, or any type of in-person instructional activity, and public spaces.

A “face covering” is defined as a “covering that fully covers a person’s nose and mouth, including without limitation, cloth face mask, surgical mask, towels, scarves, and bandanas” (State of Nevada Emergency Directive 024).

Students that cannot wear a face covering due to a medical condition or disability, or who are unable to remove a mask without assistance may seek accommodation through the Disability Resource Center.

COVID-19 Social Distancing

Face coverings are not a substitute for social distancing. Students shall observe current social distancing guidelines where possible in accordance with the Phase we are in while in the classroom, laboratory, studio, creative space (hereafter referred to as instructional space) setting, and in public spaces. Students should avoid congregating around instructional space entrances before or after class sessions. If the instructional space has designated entrance and exit doors students are required to use them. Students should exit the instructional space immediately after the end of instruction to help ensure social distancing and allow for the persons attending the next scheduled class session to enter.

COVID-19 Disinfecting Your Learning Space

Disinfecting supplies are provided for you to disinfect your learning space. You may also use your own disinfecting supplies.

COVID-19, COVID-19 Like Symptoms, and Contact with Someone Testing Positive for COVID-19

Students must conduct daily health checks in accordance with CDC guidelines. Students testing positive for COVID 19, exhibiting COVID 19 symptoms or who have been in direct contact with someone testing positive for COVID 19 will not be allowed to attend in-person instructional activities and must leave the venue immediately. Students should contact the Student Health Center or their health care provider to receive care and who can provide the latest direction on quarantine and self-isolation. Contact your instructor immediately to make instructional and learning arrangements.

Failure to Comply with Policy (including as outlined in this Syllabus) or Directives of a University Employee

In accordance with section 6,502 of the University Administrative Manual, a student may receive academic and disciplinary sanctions for failure to comply with policy, including this syllabus, for failure to comply with the directions of a University Official, for disruptive behavior in the classroom, or any other prohibited action. "Disruptive behavior" is defined in part as behavior, including but not limited to failure to follow course, laboratory or safety rules, or endangering the health of others. A student may be dropped from class at any time for misconduct or disruptive behavior in the classroom upon recommendation of the instructor and with approval of the college dean. A student may also receive disciplinary sanctions through the Office of Student Conduct for misconduct or disruptive behavior, including endangering the health of others, in the classroom. The student shall not receive a refund for course fees or tuition.

Grading Scheme

Quizzes: 20%

Midterm Exam: 20%

Final Exam: 20%

Prog. Assign: 40%

Presentation: 10% (grad students only)

A	>=90
B	[80-90)
C	[70-80)
D	[60-70)
F	<60

Important dates

February 19, 2024 – President's Day (no class)

March 23-31, 2023 – Spring Break

March 20, 2024 – Midterm exam

April 2, 2024 - Final day to drop classes and receive a "W"

May 8, 2024 – Prep Day

May 13, 2024 - Final exam (12:45 pm – 2:45 pm)