



CS-559B

(Machine learning, foundations & applications)
CS, Fall 2023

Instructor: Tian Han
Canvas Course Address: <https://sit.instructure.com/courses/68494>
Course Schedule: 3:00-5:30 PM Friday, Gateway North 204
Contact Info: than6@stevens.edu
Office Hours: 10:00-11:00AM Monday (via Canvas Zoom),
2:00PM-2:45PM Friday, GS 248
Prerequisite(s): MA222 probability theory
Credit: 3
TAs/CAs: Hanao Li (hli136@stevens.edu), Nan Cui (ncui@stevens.edu)

COURSE DESCRIPTION

This course introduces fundamental concepts, theories and algorithms for machine learning. Topics include: Bayesian decision theory, maximum likelihood estimation, latent variable model, EM algorithm, component analysis, clustering, support vector machine, boosting and deep learning with neural networks.

STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to understand:

- Decision Theory - Bayesian decision theory, the likelihood ratio, and minimum risk classification.
- Maximum Likelihood Estimation - Implement Maximum Likelihood Estimation for Logistic Regression.
- Dimensionality Reduction - Apply dimensionality reduction using Principal Component Analysis.

- Linear Discriminant Functions - Implement classifiers using linear discriminant functions and Fisher's Linear Discriminant Analysis.
- Non-parametric Learning - Implement k-nearest neighbors and perform non-parametric classification.
- Clustering – Implement k-means clustering and perform EM for Gaussian mixtures.
- Support Vector Machines - the advantages of Support Vector Machines and margin maximization.
- Boosting - boosting and decision tree models.
- Neural Networks – Implement backpropagation for basic neural networks and understand the concepts of deep neural networks.

COURSE FORMAT AND STRUCTURE

This course is on-campus (with online zoom options as needed or requested). To access the course, please visit stevens.edu/canvas. For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

- When assignments are due, they are due by 11:59 PM EST on the due date listed in the assignment PDF.
- Deadlines are an unavoidable part of being a professional, and this course is no exception. Course requirements must be completed and posted or submitted on or before the specified due date and delivery time deadline. Due dates and delivery time deadlines are in Eastern Time (as used in Hoboken, NJ). Please note that students living in distant time zones or overseas must comply with this course time and due date deadline policy. Avoid any inclination to procrastinate. Due dates have been established for each assignment to encourage you to stay on schedule.
- Assignments received after using up 4 late days will receive 0 points. Note that we have 4 late days in total to cover all assignments, NOT 4 late days for each assignment.

Instructor's Online Hours

I will be available via email and respond as soon as I am available. When emailing me, please place in the subject line the course number and the topic of the email (i.e., [CS559-b] Lecture 1 Question). This will help me tremendously in locating your emails more quickly when I scan the hundreds of emails that seem to make it into my box each day.

Virtual Office Hours are a synchronous session (through Canvas Zoom) to discuss questions related to lectures and/or assignments. Office hours will be held Monday mornings from 10:00-11:00 AM EST (except holidays). The link will be posted on Canvas before each meeting.

Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. No matter how different or controversial they may be perceived, all opinions and experiences must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you cannot attack an individual. Our differences, some of which are outlined in the University's

inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambiance. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Allow other students to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language as it could lead to misinterpretation.
- Keep an "open mind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

TENTATIVE COURSE SCHEDULE

Note: Topics and homework due dates listed below are tentative. Assignments will be posted on Canvas and students will be notified through Canvas Announcement.

Weeks	Topic(s)	Readings	Assignments
1	Introduction, probability & linear algebra review (Sep 1)		
2	Decision Theory (Sep 8)		
3	Maximum Likelihood Estimation & Bayesian estimation (Sep 15)		
4	Linear Model (Sep 22)		HW#1 Due
5	Linear Discriminant function, Perceptron (Sep 29)		
6	Fisher Linear Discriminant, PCA (Oct 6)		
7	Non-parametric Learning (Oct 13)		HW#2 Due
8	MIDTERM (Oct 20)		
10	Clustering, EM, GMM (Oct 27)		
11	EM and Latent Variable Model (Nov 3)		
12	Probabilistic Graphical Model, Bayesian Network (Nov 10)		
13	Neural Network (Nov 17)		
14	Support Vector Machine (Dec 1)		HW #3 Due
15	Decision Tree and Boosting (Dec 8)		

COURSE MATERIALS

Textbook is not mandatory but recommended.

Textbook(s):

- R. Duda et al., *Pattern Classification*, John Wiley & Sons Inc, 2001.
- C. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006
- I. Goodfellow et al., *Deep Learning*, MIT, 2016

COURSE REQUIREMENTS

Attendance

We will not take attendance for this course in general, and the attendance will not be counted toward students' grades. However, It is highly recommended to attend the lectures in person as I will emphasize the key points for homework and exams.

Noted that to comply with Federal Title IV Financial Aid regulations, we may take one attendance to verify that the registered student has been attending classes. We will make the corresponding announcement on the Canvas.

Homework

The homework shall be submitted online through Canvas. Email submissions will not be accepted. You are encouraged to discuss with your fellow students, but you need to write down your own solutions. Failing to do so will lead to plagiarism and failure of the course.

Exams

We will have two exams: midterm and Final. Both exams are in-person exams. The exam dates shall follow the above course schedule (same location, same lecture time), and will be announced in the lecture and Canvas announcement. Accommodation can be requested with supporting documents, such as doctor's notes, etc.

GRADING PROCEDURES

Grades will be based on:

Homework	50% (15%, 15%, 20%)
Midterm	20%
Final	30%

Late Policy

- You have in total of **4 late days** (excluding weekends) for the entire class, after 4 late days, NO credit will be given for the late submission.

Academic Integrity

Generative AI Technologies

You may use AI programs e.g. ChatGPT to help generate ideas and brainstorm. However, you should note that the material generated by these programs may be inaccurate, incomplete, or otherwise problematic. Beware that use may also stifle your own independent thinking and creativity.

You may not submit any work generated by an AI program as your own. If you include material generated by an AI program, it should be cited like any other reference material (with due consideration for the quality of the reference, which may be poor).

Any plagiarism or other form of cheating will be dealt with under relevant Stevens policies.

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/>.

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found on the [Office of Graduate Academics web page](#).

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an

investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Senior Vice Provost for Graduate Education or to the Honor Board, who will refer the report to the senior vice provost. The Honor Board Chairman will give the Senior Vice Provost for Graduate Education weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other disabilities to help students achieve their academic and personal potential. They facilitate equitable access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/student-diversity-and-inclusion/disability-services>. If you have any questions please contact the Office of Disability Services at disabilityservices@stevens.edu or by phone: 201.216.3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your pronouns and/or name, please inform the instructor of the necessary changes.

Religious Holidays

Stevens is a diverse community that is committed to providing equitable educational opportunities and supporting students of all ethnicities and belief systems. Religious observance is an essential reflection of that rich diversity. Students will not be subject to any grade penalties for missing a class, examination, or any other course requirement due to religious observance. In addition, students will not be asked to choose between religious observance and academic work. Therefore, students should inform the instructor at the beginning of the semester if a requirement for this course conflicts with religious observance so that accommodations can be made for students to observe religious practices and complete the requirements for the course.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments can be made by phone (201-216-5177), online at <https://stevensportal.pointnclick.com/confirm.aspx>, or in person on the 2nd Floor of the Student Wellness Center.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about your own safety or the safety of someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year-round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.