

Syllabus

Course Information

Course Number: CSCE 421
Course Title: Machine Learning
Section: 501
Time: T&Th 9:35 am - 10:50 am
Location: HRBB 124
Credit Hours: 3

Instructor Details

Instructor: Shuiwang Ji
Office: Zoom (Link on Canvas) or PETR 305 upon request
Phone: (979) 458-1547
E-Mail: sji@tamu.edu (This is the ONLY email used for this course)
Office Hours: 4 pm – 5 pm, Monday & Wednesday

Course Description

Theoretical foundations of machine learning, pattern recognition and generating predictive models and classifiers from data; includes methods for supervised and unsupervised learning (decision trees, linear discriminants, neural networks, Gaussian models, non-parametric models, clustering, dimensionality reduction, deep learning), optimization procedures and statistical inference.

Course Prerequisites

Grade of C or better in MATH 304, MATH 311, or MATH 323; Grade of C or better in STAT 211, and STAT 404 or CSCE 221, or ECEN 303, and CSCE 121 or CSCE 120.

More specifically, students are expected to have some level of familiarity with basic linear algebra (including vectors, matrices, matrix-vector computations, vector and matrix norms, linear independence, matrix rank, singularity, positive definiteness, eigenvalues/eigenvectors, matrix decomposition, orthogonality), multivariate calculus (including derivatives of univariate functions, derivatives of multivariate functions, chain rule, Taylor expansion), and basic probability and statistics (including discrete and continuous probability distributions, sum rule, product rule, marginal probability distributions, conditional probability distributions, joint probability distributions, independence and conditional independence, Bayes Theorem, variance and covariance, expectation). Students need to have access to a GPU and be proficiency in Python programming. If you do not have access to GPU, please apply at <https://hprc.tamu.edu/> and use my NetID sji as the principal investigator.

Special Course Designation

Cross Listing: ECEN 427 and STAT 421.

Course Learning Outcomes

The objective of this course is to teach fundamental methods of machine learning with focus on the theoretical foundations and practical applications. Upon completion of the course students are expected to be able to:

- Formalize the fundamental techniques and methods of machine learning: methods, data processing, model selection, etc.
- Analyze and compare the strengths and weaknesses of commonly used machine learning approaches.
- Evaluate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
- Design, implement, and apply various machine learning algorithms in a range of real-world applications.

Textbook and Resource Materials

Main texts (required):

YS Abu-Mostafa, M Magdon-Ismail, HT Lin: Learning from Data (**LFD**)

<https://amlbook.com/>

e-Chapters at <https://amlbook.com/eChapters.html> (Need a copy of the book to access e-Chapters)

C. M. Bishop and H. Bishop: Deep Learning: Foundations and Concepts (**DL**)

<https://www.bishopbook.com/>

PDF downloadable from [Springer](#) via TAMU authentication

Students are encouraged to acquire the required course material from vendors that provide the best value and amenities for their selection.

Grading Policy

Grade items

1. Five Assignments. Most homework contains a written component and a programming component. Therefore, most homework submission should include a report and code. Submission instructions will be provided on each homework assignment. Most homework requires Python programming. Data and skeleton code will be provided in Python format.

2. Two exams (mid-term and final).

All homework assignments and exams are individual and collaboration among students is strictly prohibited.

Weights for grade items included in calculating the course grade

1. Assignments: 60%
2. Mid-term exam: 15%

3. Final exam: 25%

Grading Scale

Final letter grades will be based on absolute percentage as follows:

A = [90, 100]

B = [80, 90)

C = [70, 80)

D = [60, 70)

F = <60

[] denotes inclusive; () denotes exclusive;

Exam Policy

Exam 1 will be in class, and final exam schedule is determined by the University. All exams are closed-book, closed-notes, closed-Internet. You are allowed to use a calculator. You are also allowed to bring ONE sheet of letter-sized (8.5 x 11 inches) paper ("cheat sheet") on which you can write anything you wish to. Note that you can choose to use two-sided, typed or hand-written with any font size, and the only requirement on the cheat sheet is that it has to be one sheet of letter-sized paper. All exams are strictly closed to neighbors and other students, and any violations will be reported to Aggie Honor System Office.

Grading Disputes

Questions on assignment grading should be discussed with the TA. Questions on exam grading should be discussed with the instructor. Grading dispute period for the final exam will be determined and announced at the time of grade posting based on university deadline for submitting letter grades. Grading disputes for all other graded materials (other than the final exam) must be presented to the respective party within ONE week upon receiving grading results (timed as email notification for electronic ones or returning of graded materials for hard copies). All grades after the dispute time windows are considered final.

Late Work Policy

Late work constitutes submitting a deliverable after the established deadline. For homework assignment, 10% is deducted for each late day for up to three days (including weekends) after which submissions are not accepted.

Excused absence will not be counted towards late days. If an exam overlaps with an excused absence, the instructor will provide the student an opportunity to make up an exam by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university approved excuse.

Unexpected excused absences: In cases where prior notification of excused absence is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Student Rule 7 explains attendance policies and excused absences. <https://student-rules.tamu.edu/rule07/>

Course Schedule

Course Topics (LFD and DL refer to the respective textbooks)

Week	Topic	Reading	Key dates
1	Introduction and linear regression	LFD: 3.1, 3.2 (excluding 3.2.2)	
2	Logistic regression	LFD: 3.3	
3	Multi-class logistic regression	PDF notes	HW1
4	Overfitting and model selection A unified view of loss functions	LFD: 3.4.1 DL: 1.2 PDF notes	
5	Deep learning and multilayer networks	LFD: 7.1, 7.2, 7.4; DL: 6.4	
6	Deep learning and multilayer networks	LFD: 7.1, 7.2, 7.4; DL: 6.4	HW2
7	Convolutional neural networks	DL: Chapters 7, 9, and 10.1-10.2	
8	Convolutional neural networks	DL: Chapters 7, 9, and 10.1-10.2	Exam 1
9	Convolutional neural networks	DL: Chapters 7, 9, and 10.1-10.2	HW3
10	Attention, Transformers	DL: Chapter 12	
11	Attention, Transformers	DL: Chapter 12	
12	Large language models	DL: Chapter 12	HW4
13	Principal component analysis	PDF notes DL: 19.1	
14	Principal component analysis	PDF notes DL: 19.1	HW5
15	Advanced topics, final review		

Final exam schedule: 4/30/2026 (Thursday) 12:30 - 2:30 p.m.

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" ([Student Rule 7, Section 7.4.1](#)).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#).)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" ([Section 20.1.2.3, Student Rule 20](#)).

Texas A&M at College Station

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Texas A&M at Galveston

You can learn more about the Honor Council Rules and Procedures as well as your rights and responsibilities at tamug.edu/HonorSystem.

Texas A&M at Qatar

You can learn more about academic integrity and your rights and responsibilities at Texas A&M University at Qatar by visiting the [Aggie Honor System](#) website.

Notice of Nondiscrimination

Texas A&M University is committed to providing safe and non-discriminatory learning, living, and work environments for all members of the University community. The University provides equal opportunity to all employees, students, applicants for employment or admission, and the public regardless of race, color, sex (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, or veteran status. Texas A&M University will promptly, thoroughly, and fairly investigate and resolve all complaints of discrimination, harassment (including sexual harassment), complicity and related retaliation based on a protected class in accordance with System Regulation 08.01.01, University Rule 08.01.01.M1, Standard Administrative Procedure (SAP) 08.01.01.M1.01, and applicable federal and state laws. In accordance with Title IX and its implementing regulations, Texas A&M does not

discriminate on the basis of sex in any educational program or activity, including admissions and employment. The following person has been designated to handle inquiries and complaints regarding the non-discrimination policies: Jennifer M. Smith, TAMU Associate VP & Title IX Coordinator at YMCA Ste 108, College Station, TX 77843, 979-458-8407, or email civilrights@tamu.edu. For other reporting options, visit <https://ocrcas.ed.gov/contact-ocr> to locate the address and phone number of the office that serves your area, or call 1-800-421-3481.

Civil Rights, Free Speech, and Title IX Policies

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit discrimination and harassment based on an individual's race, color, sex, (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, veteran status, or any other legally protected characteristic. This includes forms of sex-based violence, such as sexual assault, sexual harassment, sexual exploitation, dating/domestic violence, and stalking.

Students can report discrimination/harassment, access supportive resources, or learn more about their options for resolving complaints on the [University's Civil Rights & Title IX webpage](#).

Students should be aware that all university employees (except medical or mental health providers) are mandatory reporters, which means that if they observe, experience or become aware of an incident that they reasonably believe to be discrimination/harassment alleged to have been committed by or against a person who was a student or employee at the time of the incident, the employee must report the incident to the university.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

To request academic accommodations, contact the designated ADA office based on your location:

- Texas A&M University, College of Nursing, College of Dentistry, Irma Lerma Rangel College of Pharmacy College Station, College of Medicine, School of Public Health, Institute of Biosciences and Technology, EnMed Program, Bush School in Washington DC, Mays Business School – CityCentre, TAMU Engineering Academies, Texas A&M University Higher Education Center at McAllen and Texas A&M University at Galveston should contact [Disability Resources](#) at (979) 845-1637 or disability@tamu.edu.
- Texas A&M University School of Law should contact the Office of Student Affairs at (817) 212-4111 or law-disability@law.tamu.edu to request accommodations.
- Irma Lerma Rangel College of Pharmacy in Kingsville should contact the Disability Resource Center at Texas A&M University - Kingsville at (361) 593-3024 or drc.center@tamuk.edu to request accommodations.

- Texas A&M University College of Veterinary Medicine & Biomedical Sciences in Canyon should contact the Office of Student Accessibility at West Texas A&M University – Canyon at (806) 651-2335 or osa@wtamu.edu.
- Texas A&M University at Qatar (TAMUQ) should contact the campus psychologist, Dr. Steve Wilson +974-4423-0047 or stephen.wilson@qatar.tamu.edu.

If you are experiencing difficulties with your approved accommodations, contact the office responsible for approving your accommodations or the Texas A&M ADA Coordinator Julie Kuder at ADA.Coordinator@tamu.edu or (979) 458-8407.

Pregnancy Accommodations

Texas A&M provides reasonable accommodations to students due to pregnancy and/or related conditions, such as childbirth, recovery and lactation. Students should contact the University's [Pregnancy Coordinator](#) as soon as they become aware of the need for accommodation. Depending on the circumstances, accommodations could include extended time to complete assignments or exams, changes in course sequence, or modifications to the physical classroom environment. Texas A&M will also allow a voluntary leave of absence, ensure the availability of lactation space, and maintain grievance procedures to provide for the prompt and equitable resolution of complaints of sex discrimination. For information regarding pregnancy accommodations, email TIX.Pregnancy@tamu.edu.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors influencing a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care practices by utilizing the resources and services available through [University Health Services](#) on its [mental health webpage](#). The [TELUS Health Student Support app](#) provides access to professional counseling in multiple languages anytime, anywhere by phone or chat, and the 988 Suicide & Crisis Lifeline offers 24-hour emergency support at 988 or 988lifeline.org.

Texas A&M College Station

Students needing a listening ear can contact University Health Services (979.458.4584) 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

Texas A&M at Galveston

Students who need someone to talk to can call (409) 740-4736 from 8:00 a.m. to 5:00 p.m. weekdays or visit tamug.edu/counsel for more information. For 24-hour emergency assistance during nights and weekends, contact the TAMUG Police Dept at (409) 740-4545. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

Texas A&M at Qatar

Texas A&M University at Qatar students wishing to discuss concerns in a confidential setting are encouraged to visit the [Health and Wellness](#) website for more information.

Statement on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings. Currently enrolled students wishing to withhold any or all directory information items can do so within howdy.tamu.edu using the Directory Information Withholding Form. The complete [FERPA Notice to Students](#) and the student records policy is available on the Office of the Registrar webpage.

Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR or class schedule. All efforts will be made in this class to protect your privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees honors and awards received, participation in officially recognized activities and sports, medical residence location and medical residence specialization.

Statement on Using Outside and Artificial Intelligence Tools

This course assumes that all work submitted by students will be generated by the students themselves. Students should not have another person/entity do the writing of any substantive portion of an assignment for them, which includes hiring a person or a company to write assignments and using artificial intelligence tools like ChatGPT.