TEXAS A&M UNIVERSITY

SYLLABUS

Course title and number	CSCE 421: Machine Learning
Term	Fall 2023
Meeting times and location	T&Th 9:35 am-10:50 am, HRBB 124
Credit hours	3

Course Description and Prerequisites

This course aims at teaching the technical foundations of machine learning and learning from data. Topics include methods for supervised and unsupervised learning (Bayes learning, decision trees, linear models, support vector machines and kernel methods, neural networks and deep learning, unsupervised learning).

Prerequisites: MATH 304 and STAT 211, and (CSCE 221 or STAT 404)

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.

Learning Outcomes or Course Objectives

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 (1) have a good understanding of the fundamental techniques and methods of machine learning: methods, data processing, model selection, etc; (2) have an understanding of the strengths and weaknesses of many popular machine learning approaches; (3) appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and un-supervised learning; (4) be able to design and implement various machine learning algorithms in a range of real-world applications.

Instructor Information

Name	Shuiwang Ji
Telephone number	(979) 458-1547
Email address	sji@tamu.edu (This is the ONLY email used for this course)
Office hours	T&Th 11:10 am – 12:10 pm
Office location	Zoom (Link on Canvas)

TA Information

Name: Limei Wang
Email address: limei@tamu.edu
Office Hours: T&Th 3:30 pm - 4:30 pm
Office Location Zoom (Link on Canvas)

Name: Cong Fu
Email address: congfu@tamu.edu
Office Hours: W&F 3:30 pm - 4:30 pm

Office Location Zoom (Link on Canvas)

Textbook and/or Resource Material

Main text (required):

YS Abu-Mostafa, M Magdon-Ismail, HT Lin: Learning from Data (**LFD**) https://www.amazon.com/Learning-Data-Yaser-S-Abu-Mostafa/dp/1600490069 e-Chapters at https://amlbook.com/eChapters.html (Need a copy of the book to access e-Chapters)

Additional materials:

Tom Mitchell: Machine Learning, McGraw Hill, 1997 (**ML**) PDF at http://www.cs.cmu.edu/~tom/files/MachineLearningTomMitchell.pdf
Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola: Dive into Deep Learning (**D2L**) PDF at https://d2l.ai/d2l-en.pdf
Christopher Bishop: Pattern Recognition and Machine Learning, 2006 (**PRML**) PDF at https://www.microsoft.com/en-us/research/uploads/prod/2006/01/Bishop-Pattern-Recognition-and-Machine-Learning-2006.pdf

Course Delivery and Management

This course will be managed via Canvas (https://canvas.tamu.edu/). All hand-outs will be distributed via Canvas, including assignments, lecture materials, etc.

Assignments and Exams

1. Six 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 assignments. Most homework requires Python programming. Data and skeleton code will be provided in Python format.

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

Grading

1. Assignments: 60%
2. Mid-term exam: 15%
3. Final exam: 25%

Final exam schedule: 12/7/2023 (Thursday) 12:30 - 2:30 p.m.

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

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 paper ("cheat sheet") on which you can write anything you wish to. Note that 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 Policies

For homework assignment, 15% 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/

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;

Course Topics (ML, LFD, D2L, PRML refer to the respective textbooks)

Week	Topic	Reading	Key dates
1	Introduction and decision trees	ML: 3.1-3.4, 3.7.2	
2	Naïve Bayes classifiers	ML: 6.1-6.2, 6.9-6.10; PRML: Pages 12-17	HW1
3	Linear regression	LFD: 3.1, 3.2 (excluding 3.2.2)	
4	Logistic regression	LFD: 3.3; PDF handout	HW2
5	Overfitting and model selection	LFD: 3.4.1; PRML: 1.1, 1.3	
6	Support vector machines	LFD: 8.1.1, 8.1.3, 8.2	
7	Kernel methods	LFD: 8.3, 8.4	HW3
8	A unified view of loss functions	PDF handout	Exam 1
9	Deep learning and multilayer networks	LFD: 7.1, 7.2, 7.4	
10	Convolutional neural networks	D2L: 7.1-7.5, 8.5, 8.6	HW4
11	Kernel methods and deep learning	PDF handout	
12	Clustering and density estimation	LFD: 6.3.3, 6.4	HW5
13	Mixture models and expectation-maximization	LFD: e-Appendix C (first 4.5 pages) PRML: 1.2.1-1.2.4; 2.3.4	

14	Principal component analysis	PDF handout	
15	Autoencoders	PDF handout	HW6

Americans with Disabilities Act (ADA)

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 Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. 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.

Academic Integrity

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).

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

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

Statement on COVID-19

To help protect Aggieland and stop the spread of COVID-19, Texas A&M University urges students to be vaccinated and to wear masks in classrooms and all other academic facilities on campus, including labs. Doing so exemplifies the Aggie Core Values of respect, leadership, integrity, and selfless service by putting community concerns above individual preferences. COVID-19 vaccines and masking — regardless of vaccination status — have been shown to be safe and effective at reducing spread to others, infection, hospitalization, and death.