TEXAS A&M UNIVERSITY

Course Syllabus

Course Information

Course Number:	CSCE 421
Course Title:	Machine Learning
Section:	500
Time:	Tuesday/Thursday 11:10-12:25
Location:	ZACH 350
Credit Hours:	3

Instructor Details

Instructor:	Dr. Theodora Chaspari
E-Mail:	chaspari@tamu.edu
Office hours:	Tuesday, 12.30pm-1.30pm, Peterson 326

Teaching Assistant/Grader Details

Teaching assistant:	Sheelabhadra Dey
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Office hours:	TBD

Grader:	Kangdong Yuan
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Course Description

Machine learning is a sub-field of Artificial Intelligence that gives computers the ability to learn and/or act without being explicitly programmed. Applications of machine learning have permeated many aspects of every-day life and can be found among others in self-driving cars, speech recognition, computer vision, and genomics. Topics include supervised and unsupervised learning (including parametric and non-parametric models, clustering, dimensionality reduction, deep learning), optimization procedures, and statistical inference.

Course Prerequisites

Students are expected to have knowledge on linear algebra (e.g., vectors, matrices, matrix-vector computations, vector and matrix norms, linear independence, matrix rank, singularity, positive definiteness, eigenvalues/eigenvectors, matrix decomposition, orthogonality), multivariate calculus (e.g., derivatives of univariate functions, derivatives of multivariate functions, chain rule, Taylor expansion) and probabilities (e.g., 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).

Special Course Designation

None.

Course Learning Outcomes

The objective of this course is to teach fundamental methods of machine learning with focus on the theoretical underpinnings, practical implementations, and experimentation. Upon completion of the course students will:
1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Gain an understanding of the strengths and weaknesses of many popular machine learning approaches.
3. Uncover the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning.
4. Be able to design and implement various machine learning algorithms in a range of real-world applications.

Textbook and/or Resource Materials

- *Introduction to Machine Learning, 3rd edition, MIT Press by Ethem Alpaydin*
- *Learning from Data, by Yaser S. Abu-Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin*

Grading Policy

- *Assignments (5) – 40 points (1 point penalty on late submission per assignment)*
- *Quiz (5) – 15 points*
- *Participation in in-class activities – 5 points*
- *Exams (2) – 40 points*
- *Total – 100 points*

Late Work Policy

- *Late submission is accepted up to 1 week after the deadline with 1 point penalty (i.e., 1 out of 100 points will be subtracted).*

Course Schedule

Week	Topic	Required Reading
1	Introduction	Alpaydin 1; Abu-Mostafa 1
2	Linear algebra review; K-Nearest Neighbor	Alpaydin 8 Homework 1 Out
3	Linear Perceptron	Abu-Mostafa 1
4	Linear Regression	Alpaydin 2; Abu-Mostafa 3 Homework 1 Due Homework 2 Out
5	Non-Linear Regression Coding and practice problems	
6	Logistic regression	Abu-Mostafa 3
7	Neural Networks	Alpaydin 11 Homework 2 Due
8	Neural Networks	Homework 3 Out Midterm Exam
9	Deep Learning	Alpaydin 13
10	Decision Trees and Random Forests	Alpaydin 9 Homework 3 Due
11	Boosting & Ensemble Learning	Alpaydin 17 Homework 4 Out
12	Unsupervised Learning & Dimensionality Reduction	Alpaydin 6, 7 Homework 4 Due
13	Special Topics on Trustworthy Machine Learning	Paper readings Homework 5 Out
14	Revision & Problem Solving	
15		Homework 5 Due Final Exam

Optional Course Information Items

Not applicable.

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).

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

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 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.

Title IX and Statement on Limits to Confidentiality

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 gender-based discrimination and sexual

harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

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.

Operational Details for Fall 2022 Courses

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.