

Course Information

Course Number: ECEN 740

Course Title: Machine Learning Engineering

Section: 601

Time: Tuesday and Thursday 02:20 pm - 03:35 pm

Location: ETB 1037

Credit Hours: 3

Instructor Details

Instructor: Prof. Tie Liu

E-Mail: tieliu@tamu.edu

Office Hours: TBA

Course Description

This is a first graduate level course in machine learning, with an emphasis on the underlying statistical and optimization principles for some of the most basic and important machine learning algorithms. The main focus of this course is on generative and discriminative approaches to supervised classification, which includes naive Bayes (NB), linear discriminant analysis (LDA), learning via empirical risk minimization (ERM) and structural risk minimization (SRM), support vector machines (SVMs), convex learning principle and stochastic gradient descent (SGD), the kernel method, adaptive boosting (AdaBoost), feedforward neural networks, decision trees, random forest, nearest-neighbor classification, multiclass and complex prediction problems, Gaussian processes, and Bayesian neural networks. In addition, this course also covers representation learning, generative adversarial networks (GANs), variational auto-encoders (VAEs), and diffusion models.

Course Prerequisites

Familiarity with basic probability and optimization (at the undergraduate level and preferably at the graduate level) is required.

Course Learning Outcomes

The course aims to equip the students with strong basics in machine learning. The students will study different algorithms for supervised classification, representation learning, data generation, and probability modeling. The statistical and optimization principles underlying different algorithms will be emphasized. The students will obtain the background needed to study more advanced topics in machine learning, such as deep learning, reinforcement learning, and online learning. The course will be useful both for students wishing to build a career in industry using machine learning, as well as for students wishing to pursue research in machine learning.

Textbook and/or Resource Materials

The following textbooks are recommended but not required:

- Shai Shalev-Shwartz and Shai Ben-David: Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014.

Grading Policy

The requirements include homework assignments (75%) and an in-class exam (25%). The exam may be replaced by a term project, subject to instructor's approval.

Grading Scale: 90-100 A; 80-89 B; 70-79 C; 60-69 D; 0-59 F.

Homework needs to be submitted to the Google classroom by the respective deadlines. Late submissions within 24 hours are subject to 50% deductions. Late submissions for over 24 hours will not be accepted.

Course Schedule

Topics (24 lectures in total):

- Lecture 0: Introduction (0.5 lecture)
- Lecture 1: Bayesian Decision Theory (1 lectures)
- Lecture 2: Variational Inference (1.5 lectures)
- Lecture 3: Naive Bayes (NB) and Linear Discriminant Analysis (LDA) (1 lecture)
- Lecture 4: Learning via Empirical Risk Minimization (ERM) and Structural Risk Minimization (SRM) (2 lectures)
- Lecture 5: Support Vector Machines (SVMs) (2 lectures)
- Lecture 6: Convex Learning Principle and Stochastic Gradient Descent (SGD) (2 lectures)
- Lecture 7: The Kernel Method (2 lectures)
- Lecture 8: Adaptive Boosting (AdaBoost) (2 lectures)
- Lecture 9: Feedforward Neural Networks (1.5 lectures)
- Lecture 10: Decision Trees, Random Forest, and Nearest-Neighbor Classification (1.5 lectures)
- Lecture 11: Multiclass and Complex Prediction Problems (1 lecture)
- Lecture 12: Gaussian Processes and Bayesian Neural Networks (2 lectures)
- Lecture 13: Representation Learning (1 lecture)
- Lecture 14: Generative Adversarial Networks (GANs) (1 lecture)
- Lecture 15: Variational Auto-Encoders (VAEs) and Diffusion Models (2 lectures)

The in-class exam will be held at the conclusion of lecture 10.

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.