TEXAS
The University of Texas at Austin

INF385T Introduction to Machine Learning

Fall 2024

CLASS MEETS:

Every Tuesday from 5:00p – 6:30p at UTA 1.210A
&
Every Thursday from 5:00p – 6:30p Online via Zoom or MS Teams.

Instructor: ***Jyothi Vinjumur***
Email: ***jyothi.vinjumur@ischool.utexas.edu***
Appointments: If you wish to make an appointment, the best way to do this is by email. Please note that I typically need at least 24 hours' notice. If you prefer to email me a question, please note that I typically respond to emails on weekday early mornings.

Academic Assistant: ***Yiwei Wu***
Email: yw25689@utexas.edu
Office Hours: TBD

Course Description

The field of Machine learning focuses on discovering patterns in data to enable and teach machine learning models to solve complex problems. In this course, we will explore various machine learning algorithms that enhance a machine's learning performance on specific tasks. Rather than explicitly programming computers to perform tasks, machine learning allows them to learn from examples and improve over time, with or without human intervention. A key challenge in this field is how to generalize beyond the examples provided during training to new examples encountered during testing. This course will demonstrate how this generalization process can be formalized and implemented.

The course covers fundamental concepts in Machine Learning (ML), offering in-depth conceptual knowledge of a broad range of modern machine learning algorithms.

Topics include:

- Supervised Learning: Multiple linear regression, logistic regression, neural networks, and decision trees.
- Unsupervised Learning: Clustering, dimensionality reduction, and recommender systems.
- Reinforcement Learning & Deep Learning Models: Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Autoencoders, and Transformers and
- Large Language Models (LLMs), Prompt Engineering and Retrieval Augmented Generation.

To excel in this course, students are encouraged to gain practical expertise that extends beyond the practical labs covered. The final class grade is split between quizzes, mid-term, coding assignments, and course project. The learning objective for each student is to understand the basics of machine learning technology, and the close connection between theory and practice and build the ability to apply it to a wide range of applications in multiple fields. The goal is for students to be comfortable in the concepts and learn to build data-driven ML solutions to challenging real-world problems. If you're looking to break into AI or build a career in machine learning, this is a great place to start.

PRE-REQUISITES FOR THE COURSE

A background in programming is strongly recommended.

Preferably Python Programming. Please work through the following tutorial if you do not have programming experience:

Python Tutorial

LEARNING OUTCOMES

1. Understand the key concepts in machine learning. By the end of this course, students will be able to:
   - Identify potential applications of machine learning in practice.
   - Describe the core differences in ML models that solve for regression, classification, deep learning models & LLMs.
   - Select the appropriate machine learning task for a potential application.
   - Have the skills to apply regression, classification, clustering, retrieval, recommender systems, and deep learning techniques to make data-driven decisions.
   - Represent your data as features to serve as input to machine learning models.
   - Assess the model quality in terms of relevant error metrics for each task.
   - Implement techniques in Python.
2. Propose machine learning solutions to perform various artificial intelligence tasks. Towards this goal, students will:
   - Develop programming skills by writing code in Python
   - Experiment with machine learning libraries, including scikit-learn and TensorFlow
   - Evaluate machine learning algorithms for tasks in various application domains, including for analyzing text and analyzing images
3. Conduct and communicate original research. Towards this aim, students will:
   - Propose a novel research idea (this will be an iterative process)
   - Design and execute experiments to support the proposed idea
   - Optional: Write a course/research paper about the project (and possibly submit it for publication)
   - Present the course project idea and its solution to the class.

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How Will You Learn?

STATEMENT OF LEARNING SUCCESS

Your success in this class is important to me. We all learn differently, and everyone struggles sometimes. You are not, ever, the only one having difficulty! If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. Together we will develop strategies to meet both your needs and the requirements of the course. I also encourage you to reach out to the student resources available through UT and I am happy to connect you with a person or Center if you would like.

TEACHING MODALITY INFORMATION

This course will be placed on learning the breadth of the field for all the topics covered under this course. This course will be offered in Hybrid capacity. It is intended to provide a foundation for all individuals who wish to pursue a career in the field of applied Machine Learning or Data Science. There will be no alternative to in-person attendance. In case of any emergency please contact the instructor for other accommodations.

COMMUNICATION

The course Canvas site can be found at utexas.instructure.com. Please email me through Canvas. You are responsible for ensuring that the primary email address you have recorded with the university is the one you will check for course communications because that is the email address that Canvas uses.

ASKING FOR HELP

If you wish to talk to me, the best way to do this is by email. Please note that I typically need at least 24 hours' notice. If you prefer to email me a question, please note that I typically respond to emails on weekday early mornings.

DIVERSITY, EQUITY AND INCLUSION

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed, and that the diversity that students bring to this class can be comfortably expressed and be viewed as a resource, strength and benefit to all students. Please come to me at any time with any concerns.

SERVICES FOR STUDENTS WITH DISABILITIES

The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Services for Students with Disabilities (SSD). Please refer to SSD's website for contact and more information: http://diversity.utexas.edu/disability/. If you are already registered with SSD, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this course.

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Course Requirements and Grading

MATERIALS (OPTIONAL)

SUGGESTED TEXTBOOK (S) and/or MATERIALS:

- Hands-on Machine Learning with Scikit-Learn & TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurelien Geron

Programming experience is strongly recommended for this course. Please work through the following tutorial if you do not have programming experience:

- Python Tutorial

ASSIGNMENTS & QUIZZES

Students will have a total of 5 assignments in the first half of this course. Each assignment description will be posted on the Canvas. The assignments aim to test students' practical coding skills to build, tune and evaluate ML algorithms discussed in class. Each assignment must be submitted before its due date.
The following table represents how you will demonstrate your learning and how we will assess the degree to which you have done so.

Students will have a total of 11 in-class quizzes in this course. The best 10 quizzes will be considered toward the final grade.

% Breakdown of Quiz and Assignments grade	
Assignments (4 total)	40% (10% each)
Quizzes (10 total)	20% (2% each)

% Breakdown of Final class Grade	
Quiz	20%
Assignments	40%

Take Home Exam	10%
Project	30%

GRADING POLICY

Final course scores represent the following grades (scores are rounded to the nearest integer):

For detailed information about what grade is required for you to receive credit for this class, please refer to UT's Graduate Catalog. For example, students in the School of Information (iSchool) are required to receive a grade of B or higher in order to include this course in their program of work toward graduation. In addition, the UT Graduate School requires a minimum grade of C or higher to count a course for credit.

Final class Grade	
Grade	**Percentage**
A, A-	94-100%, 90-93%
B+, B, B-	84%-89%, 80%-83%, 75%-79%
C+,C, C-	72%-74%, 70%-71%,65%-69%

LATE WORK AND MAKING UP MISSED WORK

Each student will have 4 free "late days" to use during the semester. You can use these late days to submit any assignment after the due date without any penalty. Assignments that are submitted late, after exhausting the quota of late days will not be graded. A score of zero will be given to that missing submission.

Course Outline

All instructions, assignments, readings, rubrics and essential information will be on the Canvas website at utexas.instructure.com. Check Canvas regularly. **Changes** to the schedule may be made at my discretion if circumstances require. I will announce any such changes in class and will also communicate them via a Canvas announcement. It is your responsibility to note these changes when announced, and I will do my best to ensure that you are notified of changes with as much advance notice as possible.

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W	Date	Topics	Assignments/Quiz due dates
1	Aug 27th	Course Introduction	Assignment 0 (Ungraded)
1O	Aug 29th	Introduction to Machine Learning- Applications & Taxonomy	
2	Sep 3rd	Statistics for Machine Learning	Quiz 1
2O	Sep 5th	Introduction to Regression Models	Assignment 1 posted.
3	Sep 10th	Regression Models - Part 2	Quiz 2
3O	Sep 12th	ML Model Evaluation	Assignment 1 submission.
4	Sep 17th	Classification Models	Quiz 3
4O	Sep 19th	Unsupervised Machine Learning	Assignment 2 posted.
5	Sep 24th	Reinforcement Learning	Quiz 4
5O	Sep 26th	Recommendation Systems	Assignment 2 submission. Assignment 3 posted.
6	Oct 1st	Introduction to Deep Learning	Quiz 5
6O	Oct 3rd	Shallow Neural Networks	Assignment 3 submission Assignment 4 posted.
7	Oct 8th	Optimization of Neural Networks	Quiz 6
7O	Oct 10th	Deep Reinforcement Learning & Course Project Discussion	Assignment 4 submission Course Project Details Posted
8	Oct 15th	No class: Take Home Exam begins @ 5:00p	Take home Exam Posted
8O	Oct 17th	Exam Ends 6:30pm	Take home Exam submission
9	Oct 22nd	Convolutional Neural Networks	Quiz 7 Course Project Proposal Submission
9O	Oct 24th	Language Models & Recurrent Neural Networks	
10	Oct 29th	Autoencoders, Transformer Architecture & LLMs	Quiz 8
10O	Oct 31st	Prompt Engineering using LLMs	

11	Nov 5th	Project Checkpoint: Workshop & Viva – in class	Project in-class Viva
11O	Nov 7th	RAG & Fine Tuning LLMs with RLHF	
12	Nov 12th	Generative Adversarial Network (GANs)	Quiz 9
12O	Nov 14th	Place holder: Visiting Lecture	
13	Nov 19th	AI Ethics & ML models in Production	Quiz 10
13O	Nov 21st	No Class (Prepare for Course Project Presentations)	
14	Dec 3rdth	Course Project Presentations (10 minutes per team)	In-class Course Project Presentation
15	Dec 12th	No Exams ONLINE: Final Course Project Report Submission	Project Report, Code, and other project deliverables due by 5pm CT.

Course Policies and Disclosures

ACADEMIC INTEGRITY EXPECTATIONS

Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information, please visit the Student Conduct and Academic Integrity website at: http://deanofstudents.utexas.edu/conduct.

CONFIDENTIALITY OF CLASS RECORDINGS

Class recordings (if recorded and made available) are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings.

GETTING HELP WITH TECHNOLOGY

Students needing help with technology in this course should contact the ITS Service Desk or [insert contact information for your local support unit(s) and for course materials, software, hardware, or other technology used in your course].

CONTENT WARNING

Our classroom provides an open space for the critical and civil exchange of ideas. Some readings and other content in this course will include topics that some students may find offensive and/or traumatizing. I'll aim to forewarn students about potentially disturbing content and I ask all students to help to create an atmosphere of mutual respect and sensitivity.

[Best practice discussions around content warnings also suggest including tags or other warnings on the Course Outline (above) next to the assigned material. Further discussion of content warning can be found at this page.]

SHARING OF COURSE MATERIALS IS PROHIBITED

No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class without explicit, written permission of the instructor. Unauthorized sharing of materials promotes cheating. The University is well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure of the course.

RELIGIOUS HOLY DAYS

By UT Austin policy, you must notify me of your pending absence as far in advance as possible of the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

NAMES AND PRONOUNS

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. I will gladly honor your request to address you by your chosen name and by the gender pronouns you use. Class rosters are provided to the instructor with the student's chosen (not legal) name, if you have provided one. If you wish to provide or update a chosen name, that can be done easily at this page, and you can add your pronouns to Canvas.

University Resources for Students

SERVICES FOR STUDENTS WITH DISABILITIES (SSD)

[This required syllabus content is repeated from above. It may be included in either place, or both.]

The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Services for

Students with Disabilities (SSD). Please refer to SSD's website for contact and more information: http://diversity.utexas.edu/disability/. If you are already registered with SSD, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this course.

COUNSELING AND MENTAL HEALTH CENTER (CMHC)

All of us benefit from support during times of struggle. Know you are not alone. If you or anyone you know is experiencing symptoms of stress, anxiety, depression, academic concerns, loneliness, difficulty sleeping, or any other concern impacting your wellbeing – you are strongly encouraged to connect with CMHC. The Counseling and Mental Health Center provides a wide variety of mental health services to all UT students including crisis services, counseling services with immediate support and well-being resources. Additionally, CARE Counselors are located within the academic schools and colleges. These counselors get to know the concerns that are unique to their college's students. For more information on CMHC, visit https://cmhc.utexas.edu or call 512-471-3515.

UNIVERSITY HEALTH SERVICES (UHS)

Your physical health and wellness are a priority. University Health Services is an on-campus high-quality medical facility providing care to all UT students. Services offered by UHS include general medicine, urgent care, a 24/7 nurse advice line, women's health, sports medicine, physical therapy, lab and radiology services, COVID-19 testing and vaccinations and much more. For additional information, visit https://healthyhorns.utexas.edu or call 512-471-4955.

SANGER LEARNING CENTER

Did you know that more than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance? All students are welcome to take advantage of Sanger Center's classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit https://ugs.utexas.edu/slc or call 512-471-3614 (JES A332)."

STUDENT EMERGENCY SERVICES (SES)

Student Emergency Services in the Office of the Dean of Students helps students and their families during difficult or emergency situations. Assistance includes outreach, advocacy, intervention, support, and referrals to relevant campus and community resources. If you need to be absent from class due to a family emergency, medical or mental health concern, or academic difficulty due to crisis or an emergency situation, you can work with Student Emergency Services. SES will document your situation and notify your professors. Additional information is available at https://deanofstudents.utexas.edu/emergency/ or by calling 512-471-5017.

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Important Safety Information

If you have concerns about the safety or behavior of fellow students, TAs or professors, contact BCCAL (the Behavior Concerns Advice Line) at https://safety.utexas.edu/behavior-concerns-advice-line or by calling 512-232-5050. Confidentiality will be maintained as much as possible, however the university may be required to release some information to appropriate parties.

CARRYING OF HANDGUNS ON CAMPUS

Texas' Open Carry law expressly prohibits a licensed to carry (LTC) holder from carrying a handgun openly on the campus of an institution of higher education such as UT Austin. Students in this class should be aware of the following university policies:

- Students in this class who hold a license to carry are asked to review the university policy regarding campus carry.
- Individuals who hold a license to carry are eligible to carry a concealed handgun on campus, including in most outdoor areas, buildings and spaces that are accessible to the public, and in classrooms.
- It is the responsibility of concealed-carry license holders to carry their handguns on or about their person at all times while on campus. Open carry is NOT permitted, meaning that a license holder may not carry a partially or wholly visible handgun on campus premises or on any university driveway, street, sidewalk or walkway, parking lot, parking garage, or other parking area.
- Per my right, I prohibit carrying of handguns in my personal office. Note that this information will also be conveyed to all students verbally during the first week of class. This written notice is intended to reinforce the verbal notification, and is not a "legally effective" means of notification in its own right.

TITLE IX DISCLOSURE

[If this disclosure is included in the syllabus, the Title IX office has specificed the following wording.]
Beginning January 1, 2020, TexasSenate Bill 212 requires all employees of Texas universities, including faculty, to report any information to theTitle IX Office regarding sexual harassment, sexual assault, dating violence and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be report it. If you would liketo speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit http://www.titleix.utexas.edu/, contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419. Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as sexual misconduct, including the types of sexual misconduct covered under Texas Senate Bill 212.The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.

Faculty members and certain staff members are considered “Responsible Employees” or “Mandatory Reporters,” which means that they are required to report violations of Title IX to the Title IX Coordinator. **I am a Responsible Employee and must report any Title IX-related incidents** that are disclosed in writing, discussion, or one-on-one. Before talking with me or with any faculty or staff member about a Title IX-related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email advocate@austin.utexas.edu For more information about reporting options and resources, visit the Title IX Office or email titleix@austin.utexas.edu.

CAMPUS SAFETY

The following are recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767,

- Students should sign up for Campus Emergency Text Alerts at the page linked above.
- Occupants of buildings on The University of Texas at Austin campus must evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.
- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- For more information, please visit emergency preparedness.