CSCE 5215 – Machine Learning

University of North Texas

Fall 2025

Class Information

- **Class:** Monday 11:30AM - 02:20PM - NTDP K150
- **Instructor:** Dr. Zhuqing Liu
- **Office:** F275
- **Email:** zhuqing.liu@unt.edu
- **Office hours:** Friday 2:00 to 3:00 PM

TA

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- **Office hours:** Mondays 5:00 PM to 6:00 PM

Communication Expectations

You are expected to check your university email regularly and attend all classes. If you are absent, you should review Canvas promptly after class for assignments and course materials. Brief questions may be addressed before or after class. For in-depth assistance with course content, please meet with the Teaching Assistant prior to contacting the instructor. Email inquiries will typically receive a response within 24–48 hours on weekdays (Monday–Friday). For matters not appropriate for the Teaching Assistant, the instructor's office hours are the preferred setting.

Course Description

This course provides a comprehensive introduction to machine learning, covering both foundational concepts and practical algorithms for supervised, unsupervised, and deep learning. Students will learn theoretical underpinnings, algorithmic techniques, and real-world applications of machine learning models. The course emphasizes hands-on experience through programming assignments, projects, and presentations. Topics include regression, classification, ensemble methods, clustering, dimensionality reduction, support vector machines, and neural networks, culminating with convolutional architectures and student-led research presentations.

Learning Outcomes

By the end of the course, students will:

1. Explain core concepts in machine learning.
2. Implement and train common machine learning models.

3. Evaluate and interpret model performance.
4. Compare different algorithms and their use cases.
5. Present machine learning projects and research clearly.

Primary Text

There is no required textbook for this course. Some useful reference books on machine learning include:

Introduction to Machine Learning, , Third Edition, Ethem Alpaydin, MIT Press, 2014. The book is available online at: link

Pattern Recognition and Machine Learning, Christopher M. Bishop The book is available online at: link.

Python Machine Learning - Second Edition: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow,Raschka, Sebastian; Mirjalili, Vahid. Available online at: link

Understanding machine learning: From theory to algorithms, Shai Shalev-Shwartz and Shai Ben-David. Available online at: link

Deep Learning, Ian Goodfellow et al. Available online at: link

Course Outline (Tentative Topics)

Below is an estimated class topics, which is subject to change depending on lecture progress and/or class interests.

No.	Date	Planned Topic	Due
1	08/18	Course overview; Introduction to Machine Learning; Supervised learning foundations; Linear regression	
2	08/25	Bias-variance trade-off; Logistic regression and classification basics; Evaluation metrics (accuracy, precision/recall, ROC)	HW1 out
3	09/01	**No class – Labor Day holiday**	
4	09/08	KNN; Decision trees	HW1 due; HW2 out
5	09/15	Support vector machines and kernel methods; Regularization in high-dimensional spaces	
6	09/22	Ensemble methods: bagging and random forests; Feature importance; Boosting methods (AdaBoost, Gradient Boosting, XGBoost)	HW2 due; HW3 out
7	09/29	Unsupervised learning; clustering; Dimensionality reduction	Project proposal due
8	10/06	Neural networks: perceptrons, activation functions, and backpropagation; Overfitting in deep models	HW3 due; HW4 out
9	10/13	Convolutional neural networks: architectures and applications	
10	10/20	Complex-structured Machine Learning	HW4 due
11	10/27	**Midterm Exam** (in-class, closed-book)	
12	11/03	Student presentations: related work papers (Round 1)	Slides due 11/02
13	11/10	Student presentations: related work papers (Round 2)	
14	11/17	Final project presentations (Round 1)	Slides due 11/16
15	11/24	**No class – Thanksgiving break**	
16	12/01	Final project presentations (Round 2)	
17	12/08	Project report due (No final exam/class meeting)	

Grading

- **Class Participation: 5%**
  - 5/5 points: Attend at least 90% of classes and actively participate in discussions or activities
  - 4/5 points: Attend 80–89% of classes with regular participation
  - 3/5 points: Attend 70–79% of classes with occasional participation
  - 2/5 points: Attend 60–69% of classes with minimal participation

  - 1/5 points: Attend less than 60% of classes or rarely participate
  - *Excused absences (will not be counted) include:*
    * Medical reasons with a doctor's note
    * University-sponsored events — e.g., athletic competitions, academic conferences, debate tournaments, or performances (must provide official documentation)
    * Family emergencies — require documentation

- **Homework Assignments: 30%** (4 assignments, each worth 7.5% of the course grade)
  - 2.5/7.5 points: Choice questions
  - 2.5/7.5 points: Coding questions
  - 2.5/7.5 points: Fill-in-the-blank questions

- **Midterm Exam: 30% of course grade**
  - 20/30 points: Choice questions
  - 10/30 points: Fill-in-the-blank questions

- **Final Project: 35% of course grade**, consisting of:
  - **Final Project Proposal: 5% of course grade** (5 points total)
    * 1/5 point: Submitted on time
    * 1/5 point: Clearly states project idea
    * 1/5 point: Specifies expected outcome
    * 1/5 point: Uses NeurIPS format
    * 1/5 point: Includes relevant references or prior work
  - **Related Work Paper Presentation: 10% of course grade** (10 points total)
    * 1/10 point: Uses clear, well-organized slides
    * 1/10 point: States paper title, authors, and venue
    * 1/10 point: Summarizes the problem addressed
    * 1/10 point: Explains the paper's main contributions
    * 1/10 point: Describes methodology and key technical details
    * 1/10 point: Highlights important experimental results
    * 1/10 point: Discusses paper's limitations
    * 1/10 point: Explains how the paper relates to the project
    * 2/10 points: Answers audience questions effectively
  - **Final Project Presentation: 10% of course grade** (10 points total)
    * 1/10 point: Uses clear, well-organized slides
    * 1/10 point: States project title and authors
    * 1/10 point: Provides clear motivation and background
    * 1/10 point: States challenges you have
    * 1/10 point: Explains method and technical approach
    * 1/10 point: Presents results
    * 1/10 point: Analyzes and interprets results
    * 1/10 point: Discusses limitations and improvements
    * 2/10 points: Answers audience questions effectively
  - **Final Project Report: 10% of course grade** (10 points total)
    * 1/10 point: Uses NeurIPS format correctly
    * 1/10 point: No less than 5 pages in total
    * 1/10 point: Provides abstract and introduction
    * 1/10 point: States problem and motivation
    * 1/10 point: Reviews relevant prior work

    - 1/10 point: Includes complete, properly formatted references
    - 1/10 point: Describes methodology in detail
    - 1/10 point: Presents results with figures/tables
    - 1/10 point: Analyzes and interprets results
    - 1/10 point: Discusses limitations and future work

Final Grades

- A: 90–100
- B: 80–89
- C: 70–79
- D: 60–69
- F: Below 60

Late Assignment Policy

- On time: No penalty
- 24–72 hours late: 20% deduction
- More than 72 hours late: No credit (0 points)

Exams

There will be one midterm exam on **October 27**. The exam will be *closed-book* and *closed-notes*, covering all lecture material up to that date.

A make-up midterm will be offered approximately one week later (date TBD) and will only be available to students with:

- A documented medical excuse, or
- An official university-sponsored event (with official documentation).

Exam Format:

- Computers are required for all exams — bring a laptop on exam days.
- Exams will be completed individually in class using the **Canvas quiz system**, with Lockdown Browser. Link

Academic Policies

No cheating or plagiarism is allowed. Academic dishonesty will result in an automatic F grade for the course.

Final Project Instructions

Students may choose to complete the final project either individually or in teams of up to two members.

Project Ideas

Potential project directions include (but are not limited to):

- Applying your machine learning knowledge to an application of personal or research interest.
- Exploring or extending a method from a research paper.
- Comparing multiple algorithms on a new or challenging dataset.
- Improving an existing machine learning model for performance, efficiency, or robustness.

Deadlines

- **Project Proposal Due:** September 29
- **Final Report Due:** December 8 (in **NeurIPS** format)

Presentations

At the end of the semester, each project requires:

- A **15-minute Related Work Presentation** Choose one research paper that most motivated your project and present it in class.
- A **15-minute Final Project Presentation** Present your project's problem, approach, experiments, and results.

Attendance at all classmates' presentations is mandatory and will contribute to your final grade.