

CS 7545 Syllabus

Machine Learning Theory (3 credits)

Spring 2026

Instructor Information

Instructor

Edmond Chow

Instructor email

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General Course Information

Description

This course provides a basic arsenal of powerful mathematical tools for the analysis of learning algorithms.

Course Learning Outcomes

- State the mathematical conditions under which models can accurately predict outcomes for unseen data.
- Determine the amount of training data required for a machine learning algorithm to reach a target level of accuracy.
- Apply machine learning theory results to analyze machine learning algorithms.

Topics

- Empirical risk minimization
- Concentration inequalities

- PAC learning
- Generalization bounds
- VC dimension
- Linear predictor algorithms
- Boosting
- Convex learning problems
- Regularization
- Stochastic gradient descent

Textbook

We will focus on the first 14 chapters in

- *Understanding Machine Learning: From Theory to Algorithms*, Shai Shalev-Shwartz, Shai Ben-David

with less emphasis on Chapters 1, 7, 8, and 11.

References

- *Learning from Data: A Short Course*, Yaser Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin (a basic presentation of some topics written in a casual style)
- *Foundations of Machine Learning*, 2nd Edition, Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar (an alternative text with that treats our topics more concisely)
- *Learning Theory from First Principles*, Francis Bach (presents a heavily mathematical treatment of most of the topics we will cover)

Grading Policy

- Assignments (30%)
- Midterm exams (two exams totaling 30%) on Wed Sep 30 and Thur Nov 12
- Final exam (20%)
- Paper presentation (20%)

Description of Graded Components

The midterm and final exams are in-class and closed book and notes, but one cheat sheet (both sides of one page) is allowed. No electronic resources are allowed.

Each student will also make a presentation and answer questions on a research paper in the recent literature

Final Grade Assignment

Cutoffs: A (90 and above), B (80-89.9), C (70-79.9), D (60-60.9), F (below 60)

Course Policies

Attendance and/or Participation

Students are expected to attend and actively participate in-person.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Not applicable.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.