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, focusing on both statistical and computational aspects.

Course Learning Outcomes

- Analyze the mathematical conditions under which models can accurately predict outcomes for unseen data, utilizing concepts such as Rademacher complexity and VC dimension to quantify the gap between training and test error.
- Evaluate the theoretical properties of various optimization algorithms, including the conditions required for convergence to global or local minima in both convex and non-convex loss landscapes.
- Determine the amount of training data and computational power required for an algorithm to reach a target level of accuracy while minimizing potential errors.

Topics

- Mathematical preliminaries, concentration inequalities, convex optimization
- PAC learning, generalization bounds
- Uniform convergence, VC dimension, Rademacher complexity
- Online learning, multi-armed bandits, reinforcement learning

Textbook References

- *Learning Theory from First Principles*, Francis Bach
- *Understanding Machine Learning: From Theory to Algorithms*, Shai Shalev-Shwartz, Shai Ben-David
- *Foundations of Machine Learning*, 2nd Edition, Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar
- *Learning from Data: A Short Course*, Yaser Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin

Grading Policy

- Assignments (40%)
- Midterm exams (two exams totaling 30%)
- Final exam (20%)
- Paper presentation (10%)

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.