

CX 4803-CML Syllabus

Computational Foundations of Machine Learning (3 credits)

Georgia Institute of Technology

Spring 2027

Instructor Information

Instructor

Edmond Chow

Instructor email

echow@cc.gatech.edu

General Course Information

Description

This course gives an introduction to the field of machine learning from a computational and mathematical point of view. The course will provide the mathematical background needed to develop intuition for deeply understanding machine learning algorithms. Statistics, numerical optimization, and linear algebra will be covered at a fundamental level necessary for quickly grasping and extending the main ideas behind machine learning.

In addition, we will implement machine learning algorithms and experiment with how they work on different types of data, to understand how to choose one algorithm over another. Students will implement their own algorithms from scratch, and we will not be using machine learning software frameworks.

This course is of interest to students who wish to build a foundation to pursue research in machine learning, as well as students wishing to pursue careers as algorithm designers and software framework developers for machine learning.

Prerequisites

Programming in any language, multivariable calculus (MATH 2551/2552), linear algebra (MATH 1554), and concepts in probability and statistics.

Course Learning Outcomes

- Demonstrate a deep understanding of linear algebra, statistics, and numerical optimization to analyze the principles and mechanics behind machine learning algorithms.
- Code functional machine learning algorithms from first principles using standard programming techniques without relying on existing software frameworks or libraries.
- Analyze and compare the performance of different machine learning models across various types of data to make informed decisions on algorithm selection.

Topics

- Statistics background
- Regularization
- Kernel methods
- Bayesian regression and classification
- MCMC and sampling algorithms
- Gaussian processes
- Multi-class classification
- Constrained optimization and duality
- Support vector machines
- Neural networks and stochastic gradient descent

Textbook

- *A First Course in Machine Learning*, E. Chow

A discount code will be provided to students for ordering the book here:
<https://epubs.siam.org/doi/10.1137/1.9781611979145>

Grading Policy

- Assignments (50%)
- Midterm exam (20%)
- Final exam (30%)

Description of Graded Components

There will be assignment about every two weeks. Students are expected to read announcements sent via Canvas. Canvas will be used for posting, submitting, and grading assignments. The late penalty is 1 percent per hour, automatically deducted by Canvas.

The midterm and final exams are closed book and notes. No electronic resources are allowed in the exams.

Final Grade Assignment

Letter grade thresholds for A, B, C, D are 90, 80, 70, 60 percent. Pass/fail threshold is 60 percent. For audit credit, the threshold is 20 percent.

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.

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.