

Computational Foundations of Machine Learning

CX 4803 CML

Meeting Times: Mondays and Wednesdays, 2:00-3:15

Location: 201 Engr Science

Instructor: Edmond Chow

E-mail: echow@cc.gatech.edu

Course Description

This course is designed for students who want to better understand machine learning methods through looking at pseudocode and programming them. We will implement machine learning algorithms and experiment with how they work on different types of data. How to implement these algorithms efficiently on modern computer hardware will also be explored.

In addition, this 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.

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

This course is intended as a second course in machine learning in the sense that it is more abstract than a first course and applications of machine learning will not be discussed. However, the course is self-contained and it would be possible to take this course as a first course, especially for those who want more exposure to relevant mathematical ideas before taking other machine learning courses.

Prerequisites

Programming in any language (examples will be given in Python and Matlab). You should also be comfortable with multivariable calculus (MATH 2551/2552), linear algebra (MATH 1554, e.g., subspaces, rank, Gram-Schmidt, QR, least squares, eigenvalues, singular value decomposition), and concepts in probability and statistics.

Some Topics

- Statistics background
- Bayesian regression and classification
- Gaussian processes

- Regularization
- Support vector machines
- Kernel methods in general
- Neural networks
- Stochastic first and second order optimization
- Constrained optimization

Grading

100% Assignments

There will be a short assignment almost every week. Many assignments will build on previous assignments. Note that the final assignment will be due during final exam week.

References

There is no required textbook. Below are some texts that would be useful for this course. Several are freely available online from the Georgia Tech library website.

- James et al., An Introduction to Statistical Learning
- Hastie et al., The Elements of Statistical Learning
- Bishop, Pattern Recognition and Machine Learning
- Abu-Mostafa et al., Learning from Data
- Aggarwal, Neural Networks and Deep Learning