

Logistics and Overview

Gautam Kamath

Course Info

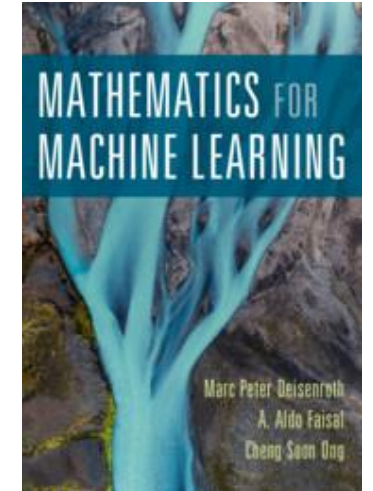
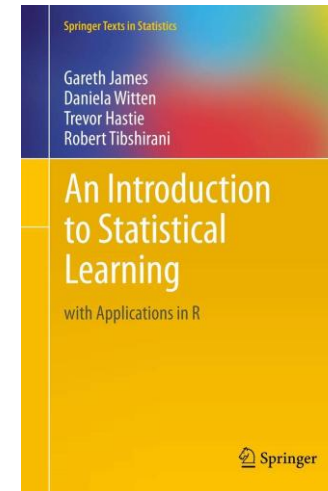
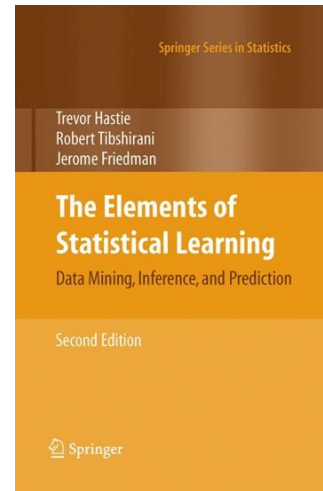
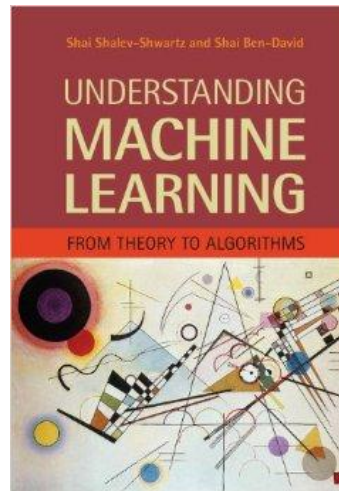
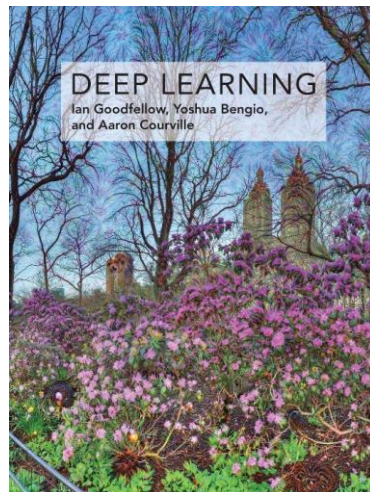
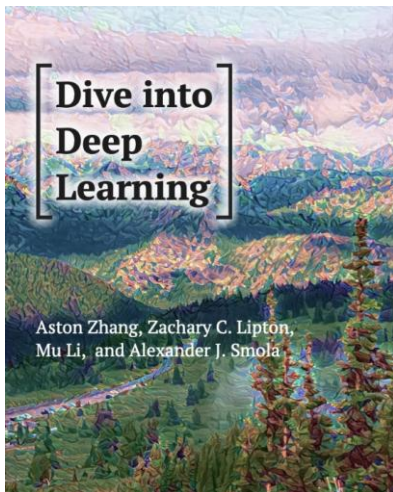
- Instructor: Gautam Kamath (gk2860@nyu.edu)
 - Office Hours: TBD (or by appt)
- TAs: ??
- Website: <https://www.gautamkamath.com/courses/CSCI-GA3033-fa2026.html>
- Slides, notes, assignments, logistics
- Discussion board: ??
 - Announcements, questions and answers
- Submissions and grades: ??

New Course (for me, and for NYU)

- Targeted at Computer Science ML PhD students
 - “Everything a ML PhD student should *definitely* know”
 - Not all of you are, but I will treat you as if you are
- In Fall 2026, CSCI-GA 2565 - Machine Learning is also offered by the Department of Computer Science. Although there is a significant degree of overlap in the content of these courses, CSCI-GA 3033 is designed to target PhD students in computer science who will specialize and conduct research in machine learning, while CSCI-GA 2565 is designed for general PhD and MSc level students in computer science regardless of their specializations.
- Foundation for technical ML research and prereq for advanced ML courses
 - Not a theory class, but you will have to do math
- Feedback always very welcome!
 - Email, anonymous feedback form (on website), or just talk to me

Textbook

- No required textbook
- Materials will be linked from the website
- Some good reference books also listed



Course Prerequisites

- “Officially”: none
- In practice:
 - Linear programming
 - Python programming
 - Probability
 - Vector calculus
 - Elementary statistics
 - Discrete math

Workload

- Three assignments
 - 10%
- Midterm exam: October 20, in class
 - 30%
- Final exam: date/time TBD
 - 30%
- Project
 - 30%

Final Project

- This class is intended to prepare you for PhD level research on ML
- Consequently: in terms of scope and quality, your research project should be appropriate for a strong ML conference
- Should technically engage with ML topics at methodological or low level (i.e., do more than just call APIs)
- Project proposal (2-4 pages) worth 5%, Report (8 pages) worth 25%
- Deadlines will be listed on website

Some thoughts on AI

- Use it to help you learn
- Don't use it for homework assignments
- Use it on the final project as much as you like
- You are responsible for everything submitted with your name on it

What is Machine Learning, and why should I care?

- Given data, learn something about it!
 - Find some interesting patterns in the data
 - Learn some probability distribution that generates the data
 - Figure out relationships between features and values of datapoints
- Machine Learning is ubiquitous
 - Gmail, Netflix, Facebook, Apple, etc.
- Essential tool for a student of Computer Science

Course Topics

- Machine Learning Fundamentals
 - Loss functions, empirical risk minimization, overfitting, regularization, maximum likelihood estimation, maximum a posteriori
- Optimization Fundamentals (GD, SGD, etc.)
- Classical supervised learning methods
 - Linear regression, k-nearest neighbors, logistic regression, support vector machines, kernels, decision trees, boosting and bagging
- Unsupervised learning methods
 - PCA, k-means clustering, Gaussian mixture models
- Neural networks
 - Multilayer perceptrons, deep networks, convolutional neural networks, GANs