Logistics and Overview

Gautam Kamath

Course Info

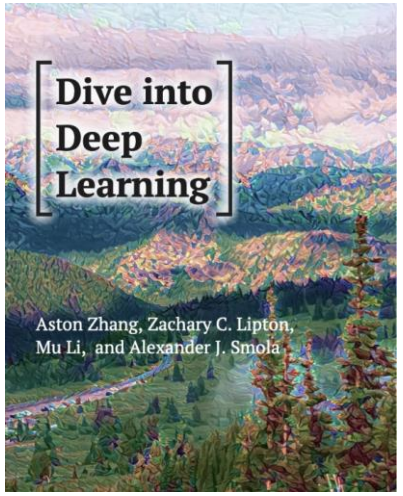
- Instructor: Gautam Kamath (gckamath@uwaterloo.ca)
  - Office Hours: TBD (or by appt)
- TAs: Zeou Hu, Argyris Mouzakis, Nanda Kishore Sreenivas
- Website: http://www.gautamkamath.com/courses/CS480-fa2023.html
  - Slides, notes, assignments, logistics
- Piazza: https://piazza.com/uwaterloo.ca/fall2023/cs480680
  - Announcements, questions and answers
- Learn and/or CrowdMark
  - Submissions and grades

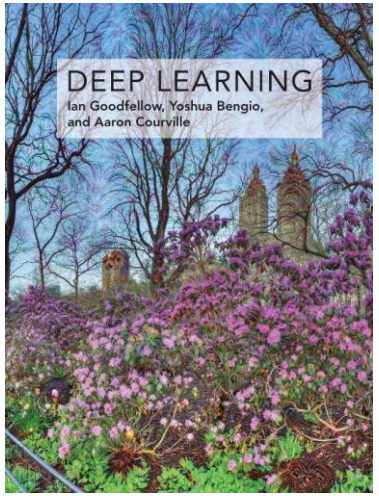
Waitlist

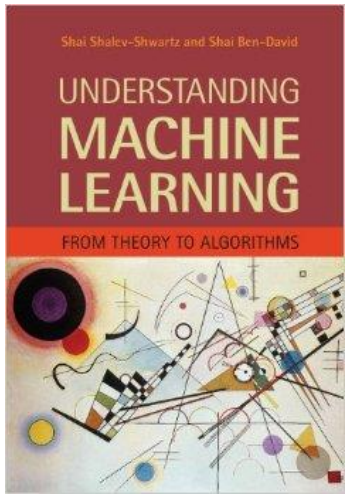
- Many are on the CS 680 waitlist
- 60 total slots (across both sections)
- 36 currently enrolled
- 36 people on the waitlist
- Attend class, permission numbers will be sent out within the first week

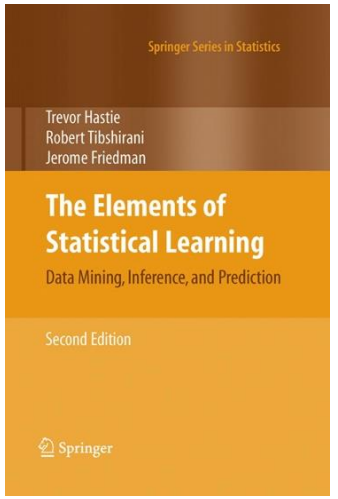
Textbook

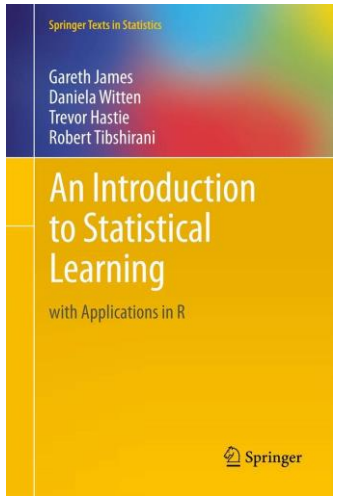
- No required textbook
- Materials will be linked from the website
- Some good reference books also listed

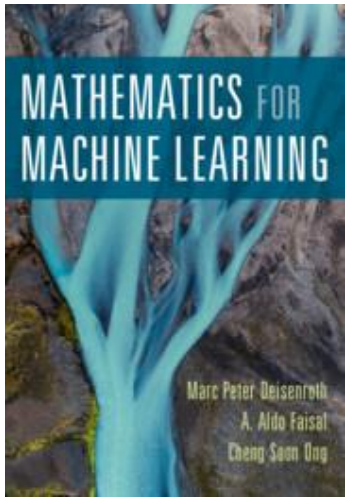












Course Prerequisites

- Officially:
  - Algorithms (CS 341 or SE 240)
  - Statistics (STAT 206 or STAT 231 or STAT 241)
- In reality:
  - Probability, statistics, linear algebra, calculus, programming (Python)
  - Mathematical maturity
- Be prepared to do multivariate calculus!
- This course will do enough math for you to understand ML
  - No more, no less

Workload

- Four assignments, roughly every other week
  - Submit on CrowdMark (writeup) and LEARN (code)
  - 30%
- Midterm exam (110 minutes): October 30, 4:30 PM – 6:20 PM
  - CS 480: 30%, CS 680: 15%
- Final exams (2.5 hours): date/time TBD
  - CS 480: 40%, CS 680: 30%
- Project (CS 680 only: 25%)

Final Project (CS 680 only)

- Research Project
  - Ideal: A novel and interesting project submittable to an ML conference
  - Project proposal (2-4 pages) worth 5%, Report (8 pages) worth 20%
  - Deadlines listed on website

Policies

- Do your own work!
  - High-level discussions: Great!
  - Copying/sharing code/solutions: Bad
  - Acknowledge sources
- Two 48-hour extensions for assignments. Read rules on website.
  - Email the instructor and the TA for the assignment at least 24 hours before the deadline to let us know that you're using it, and why. There will be no explicit email confirmation of an extension being granted, but at least 12 hours before the deadline, your deadline on LEARN will be adjusted appropriately. If your deadline has not been adjusted on LEARN 12 hours before the deadline despite asking 24 hours before the deadline, then (and only then) further contact the course staff to fix things. Any deviation from this protocol (including extra emails or Piazza posts inquiring whether the extension has been granted) may result in your request being (silently) ignored.
- Further extensions require justification + documentation (illness, etc.)
- Regrade requests: within 1 week of grades released

What is Machine Learning, and why should I care?

- Given data, learn something about it!
  - Find some structure that exists in the data
  - Learn something about the distribution that generated the data
  - Figure out the relationship between features and labels of datapoints
- Machine learning is ubiquitous!
  - Gmail, Netflix, Facebook, Apple, Amazon, …
- Essential topic for a student of Computer Science

Types of Learning (roughly)

- Supervised Learning
- Reinforcement Learning
- Unsupervised Learning

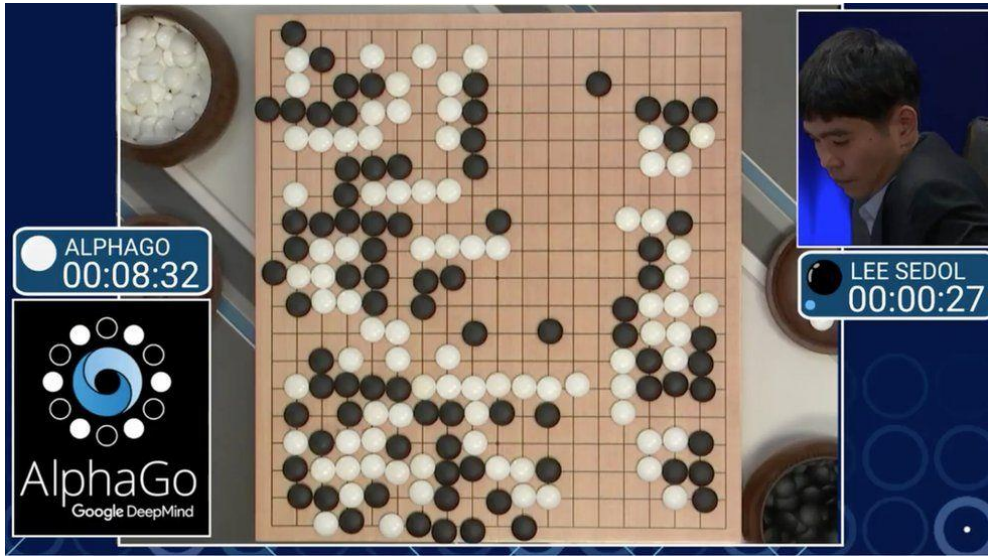
Supervised Learning

- Classification, Regression, Ranking

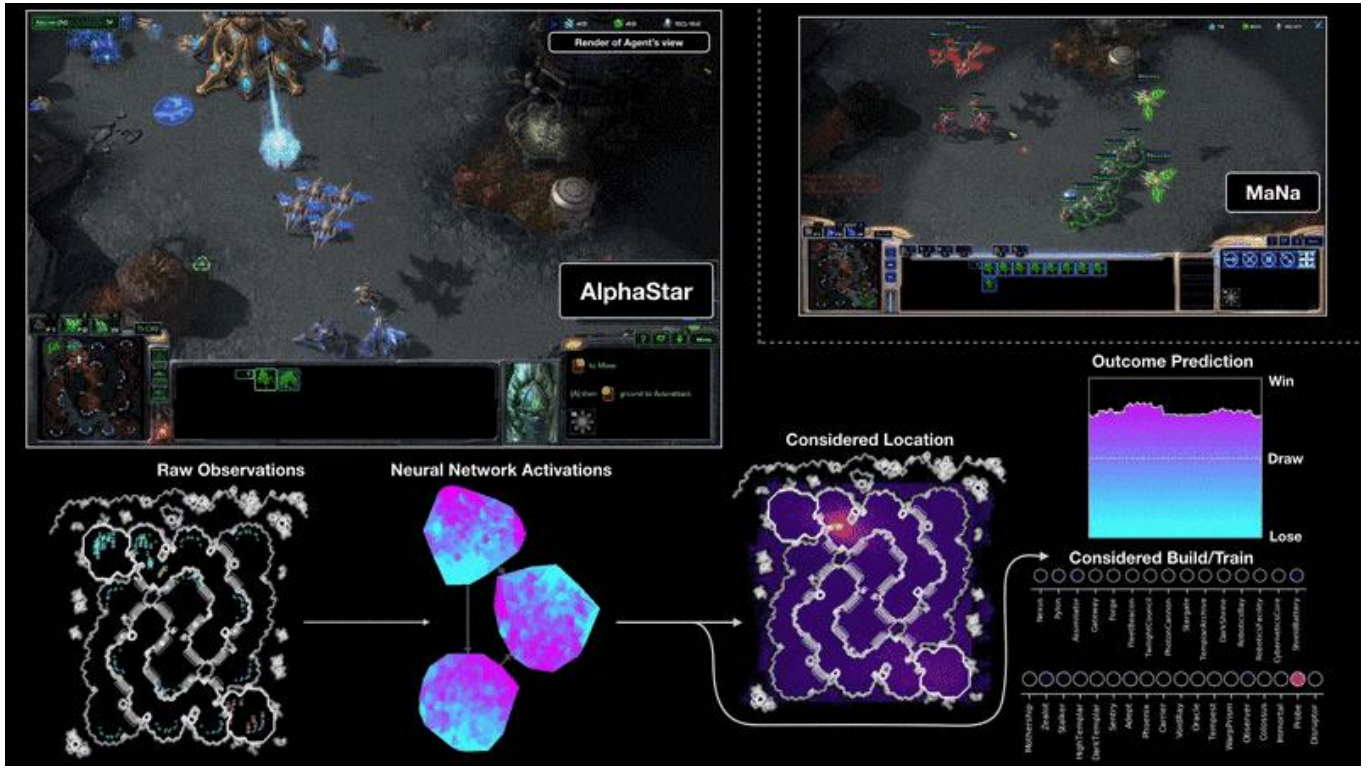
cat

Reinforcement Learning

- Control, Games



AlphaGo - The Movie



AlphaStar: Mastering the Real-Time Strategy Game StarCraft II

Unsupervised Learning

- Clustering, Visualization, Representation, Density Estimation

SYSTEM PROMPT (HUMAN-WRITTEN)	*In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.*
MODEL COMPLETION (MACHINE-WRITTEN, 10 TRIES)	The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science. Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved. Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow. Pérez and the others then ventured further into the valley. "By the time we reached the top of one peak, the water looked blue, with some crystals on top," said Pérez. Pérez and his friends were astonished to see the unicorn herd. These creatures could be seen from the air without having to move too much to see them – they were so close they could touch their horns.

Better Language Models and Their Implications

https://thispersondoesnotexist.com/

Course Topics

- Classic Machine Learning
  - Perceptron, Linear Regression, k-Nearest Neighbours, Logistic Regression, Support Vector Machines, Kernel Methods, Decision Trees, Boosting
- Neural Networks
  - Multilayer Perceptron, Deep Networks, Convolutional Neural Networks, Recurrent Neural Networks, Graph Neural Networks, Optimizers
- Generative Models
  - Mixture Models, GANs, VAEs
- Modern Topics in Neural Networks
  - Attention, Robustness, Privacy, Fairness