CIS 625
Theory of Machine Learning
Prof. Michael Kearns

Outline/Agenda:
• MK background
• Course overview/topics
• Course mechanics
• A toy learning problem: model, algo, analysis
Nature of the Course

- Formal, mathematical models of ML problems
- Generally match implicit assumptions in practice
- Probabilistic/stat frameworks
- Course will be rigorous and proof-based
- Emphasis on general principles/methods, algorithmic/statistical building blocks - i.e. theory.
Sample Questions/Topics

- What are some good general models for Mh problems?
- What do learning algos look like in those models?
- What are the computation time & sample size required for learning?
- What are the computational & probabilistic limitations to efficient ML?
• Relationships & reductions between models/problems

• Types/categories of ML problems (e.g. supervised, unsupervised, adversarial, reinforcement learning...)}
Sample Tools/Methods

- Algorithms & complexity
- Probability & stats
- Optimization & approximation
- Game theory
- Touch briefly on many others: e.g. control, cryptography...
(Very) Rough Outline

• First half of course: deep-dive into “PAC” model of ML & variants

• Answer many basic questions & develop algo & prob. tools

• Based on K&V textbook (will provide chapters electronically)
• Second half: other models & topics:
  • online adversarial learning & game theory
  • ML & fairness
  • ML & differential privacy
  • reinforcement learning
  • query models, active & semi-supervised learning
  • theory of deep learning
Course Mechanics

- Lectures Tue Thu 10:30 ET on Zoom
- Encourage “live” attendance with video on
- Course website for announcements/materials
- Readings: KV textbook chapters & papers from ML literature
- May create course chat forum
- TAs: Hua Wang & (Stats) Sheng Gao
Course Requirements:
- Keep up with lectures & readings
- 3-4 problem sets
- Final project/paper
- Group work allowed, details TBA
- Grading will be "doctoral style"

(class is 2/3 grad, 1/3 undergrad; CS, stats, math, eng., econ, ...
Questions?
Comments?
Let's get started...