Syllabus for Algorithmic Statistics (6.S896), MIT, Fall '25

Basics

- Instructor: Sam Hopkins
- TA: Ittai Rubinstein
- Lectures: Mondays and Wednesdays, 2:30-4:00
- Location: 32-124

Course Description (from the catalog)

Introduction to algorithms and computational complexity for high-dimensional statistical inference problems, with focus on provable polynomial-time guarantees. Covers modern algorithm design techniques via convex programming ~~and Sum of Squares method~~, graphical models as a language to describe complex but tractable high-dimensional learning problems and associated learning algorithms, and basics of complexity for statistical problems, including statistical query and low-degree lower bounds and reductions.

Prerequisites

A course in algorithms (6.046/18.410 or equivalent), probability (6.041/18.440 or equivalent) and linear algebra (18.06/18.C06 or equivalent). You will need a strong background in algorithms, probability and linear algebra.

Relation to 18.408, Algorithmic Aspects of Machine Learning

This course (6.S896) and 18.408 typically cover overlapping though not identical material. A plan is underway to merge the courses under a new and to-be-determined course number, but this plan will not come to fruition for a couple of years.

Relation to Other Courses at MIT

Algorithms for extracting useful conclusions from noisy and high-dimensional data are now extraordinarily important. It is therefore no surprise that we have several advanced courses at MIT on this subject. 6.S896 takes a *theoretical computer science* approach, focusing on *polynomial-time algorithms with provable guarantees*, as well as *computational complexity* of learning from high dimensional data.

Course Structure

The course will be lecture-based; at the end we will have project presentations by students.

The course readings will be a combination of textbook material and custom lecture notes.

We will have 4 problem sets and a course project. Projects can be individual or done in groups of 2. Problem sets can be discussed collaboratively; you must leave any meeting with your collaborators holding no notes, whiteboard pictures, etc., and write your own solutions. (Enforced by honor system.) You must declare your collaborators on your submission. Submissions must be typeset in LaTeX.

Grading:

- 40% final project
- 60% problem sets