CSE 291 Syllabus

Fall 2023

Lecture: Monday, Wednesday, Friday 2:00-2:50pm in CENTR 207
Course Webpage: http://cseweb.ucsd.edu/~dakane/CSE291/

Professor: Daniel Kane
Email: dakane ”at” ucsd.edu
Office Hours: Wednesdays 3:00-4:30 in CSE 4212 or by appointment.

Course Description: Most standard statistical estimators fail badly when faced with even a few extreme outliers. While naive outlier removal techniques can often solve this problem in low dimensions, the performance of such techniques degrades badly for higher dimensional problems. Until recently all known techniques for solving even simple statistical problems either produced errors scaling polynomially in the dimension or runtimes that were exponential in it. CSE 291 covers some recent breakthroughs in the field of computational statistics for the first time leading to practical solutions to many of these problems.

Prerequisites: I will try to make this course accessible to anyone with a solid background in linear algebra (including vector spaces and subspaces, inner products, eigenvalues, positive definite matrices and the spectral theorem for self-adjoint operators), probability theory (including probability distributions, Gaussian distributions, expectation, variance, Chebyshev and Chernoff bounds) and algorithms (including linear programming and semi-definite programming). That said, the course will require a fairly high level of mathematical sophistication and will move fairly quickly.


Grades:
Homeworks: There will be homework assignments given roughly once every two weeks.
Reading Project: Students signed up for 4 units will also be asked to submit a reading project at the end of the quarter. This should be at most 10 pages long and summarize the key technical ideas of a paper whose results were not covered in class. Please talk to me to agree on a paper to cover sometime before November 17th.

Students signed up for 2 units will only be required to complete homeworks. Students signed up for 4 units will need to complete homeworks and reading projects. Students signed
up for 1 unit will need to complete two of the homeworks (their choice). Please do not sign up for this class for exactly 3 units.

**Commencement of Academic Activity:** If you need certification of commencement of academic activity for financial aid purposes, please fill of the Canvas quiz by the end of the day on October 13th.

**Schedule:** Below is a rough schedule for topics covered in the class (some may be skipped depending on timing):

- Chapter 1: Classical Robust Statistics
- Chapter 2: Stability and Basic Algorithms
- Chapter 3: Algorithmic Optimizations
- Chapter 4: Robust Covariance Estimation
- Chapter 5: List Decodable Learning
- Chapter 6: Use of Higher Moments in Robust Statistics
- Chapter 7: Robust Supervised Learning
- Chapter 8: Evidence for Lower Bounds and Information-Computation Tradeoffs