

## Special Topics APPM 4720/5720 **Randomized Algorithms**

Instructor: Stephen Becker (Applied Math). Times: MWF 10-10:50 AM Fleming 102

Randomized methods have been a core part of computer science (CS) for a long time, but are only recently being used in scientific and numerical computing. This course focuses on these recent advances, and is distinguished from more traditional CS “randomized algorithm” courses by its focus on continuous (or at least floating point) math, as opposed to discrete math. The course will also discuss stochastic gradient methods and variance reduced versions like SVRG. Research in the field is ongoing and there is not yet a textbook, and it also means the course is not comprehensive but rather will present a biased selection of topics.

Homework will consist of both theory and programming (in Matlab/Python/Julia).

Prereqs: APPM 3310 "Matrix Methods" or similar, and background in probability

### Main topics:

- Sketches and compression
- Johnson-Lindenstrauss (JL) transformations
- Fast JL transformations, count sketch
- Selection via leverage scores
- Randomized Regression
- Low-rank decompositions (SVD, CUR, ID)
- Nystrom approximations
- PCA sketching
- Tensor sketching
- Randomized trace estimators
- Randomized covariance matrix estimators
- Stochastic gradient methods
- Variance reduction (SVRG, SAGA)

