MA 798: Special Topics in Numerical Analysis
Matrix Methods in Data Science and Scientific Computing

Fall 2023

Instructor Arvind K. Saibaba, **Contact**: asaibab@ncsu.edu, https://asaibab.math.ncsu.edu/
Time: MW 11:45-1:00 PM, **Location**: SAS 2102
Office: SAS Hall 3118, **Office Hours**: TBA

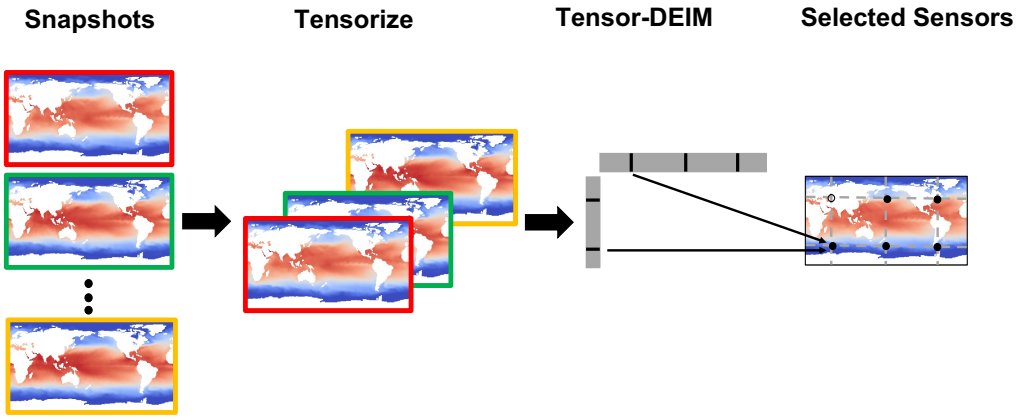

Figure 1: Schematic of a workflow to place sensors in an optimal way to reconstruct the flow fields. See preprint: `https://arxiv.org/abs/2208.09875` for details.

Course Description Large-scale matrix problems arise in a variety of applications in data science and scientific computing. This course will cover some recent developments that leverage the structure of the matrix to develop powerful algorithms. Topics that will be covered include

- Low-rank approximations: randomized algorithms, subset selection. Applications to PCA, model reduction.
- Tensor decompositions: applications to data compression, facial recognition.
- Gaussian processes: applications to Kriging, surrogate models.
- Graph-based methods: spectral clustering and network centrality.
- Least-squares: randomized and Krylov methods, applications to inverse problems.

Target audience The target audience of this course includes graduate students in applied mathematics, biomathematics, statistics and engineering with strong interests in numerical linear algebra and large-scale computation.

Prerequisites Graduate standing or consent of instructor. Background in linear algebra, and numerical analysis is necessary and basic probability is desirable. However, the necessary mathematical background will be covered when necessary. If in doubt, contact the instructor. Programming in MATLAB/Python (or equivalent languages) is necessary.

Required Work Grade will be determined based on three components (1) homework sets (4-5); (2) a final project and presentation based on the project; and (3) scribing lectures. Project topics can be tailored to students' research interests.

Textbook No textbook required. Reading materials will be periodically posted on the course webpage.