Syllabus

Instructor: Xiuyuan Cheng Email: xiuyuan.cheng@duke.edu
Time: TuTh 1:25-2:40PM
Classroom: Biological Sciences 155

Synopsis:

This course will introduce basic methods of numerical linear algebra, emphasizing both numerical analysis and implementation. After a review of linear algebra preliminaries such as matrix norm and singular value decomposition (SVD), we will start from numerical computation fundamentals (floating point, conditioning and stability) and then cover three main topics: (1) direct solvers for linear systems, (2) eigen-decomposition algorithms, and (3) iterative methods. Time permitting, we will go to selected content in randomized SVD, Fast Fourier Transform and numerical optimization. We will also introduce applications in solving differential equations and computational problems in data analysis and machine learning.

Textbook:

[TB] "Numerical Linear Algebra", by Lloyd Trefethen and David Bau.

References:

[DB] "Numerical Methods", by Germund Dahlquist and Åke Björck.
[D] "Applied Numerical Linear Algebra", by James Demmel.

Prerequisite:

Mathematics: The course assumes that the students already have a good understanding of linear algebra (e.g. eigen decomposition) and calculus, both univariate and multivariate (e.g. multivariate integration), and are comfortable with working on proofs.

Coding: The course assumes some coding experience with Matlab/Python/C. Homework assignments include numerical experiments, of which the submitted solution can be implemented in any coding language. Demo code in class will be in Matlab.

Grading Policy:

Evaluation will be based on (1) homework assignment (20%), (2) quiz (10%) (3) midterm (30%) and (4) final exam (40%). Homework will be assigned weekly, including numerical experiment questions. Discussion and collaboration on problem sets are encouraged, but all hand-in solutions, including homeworks and exams, must be independent work. Late hand-in will not be counted towards grades except for special excuses (following the academic rules of the school). If a reschedule of an exam is needed, please contact the instructor as early as possible. Lecture notes will be distributed as the class goes.