

# Numerical Linear Algebra, Optimization and Monte Carlo Simulation

Math 561 - Fall 2015

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## **An introduction to algorithms and computation for scientific applications**

Target audience: advanced undergraduate and graduate students in applied mathematics, computer science, engineering, computational physics and chemistry, confronted with computational problems, numerical ODE's and PDE's, statistical signal processing, optimization. Students in statistics, computational biology, computational humanities and social sciences where computation with large data sets is needed.

### Topics include:

- fundamentals of numerical computing, stability, accuracy;
- fundamental algorithms in numerical linear algebra, matrix factorizations including SVD, QR and their applications to the solution of linear systems, least squares problems, with examples from PDE's, data analysis and statistics;
- solution of linear systems with direct and iterative methods;
- eigensolvers, Lanczos and Arnoldi iteration, and their applications;
- nonlinear equations and optimization; basics of convex optimization and linear programs, and their applications;
- basics of Monte Carlo methods and their applications.

### Prerequisites

Mathematics 103 (multivariable calculus) and Mathematics 104 (linear algebra) or equivalents are needed for the mathematical background. Basic experience in programming, especially in C/C++ or FORTRAN or MATLAB or R.

