Introduction


Justin Solomon
Instructor

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Course Assistants

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Section

Fridays, 11am-11:50am
Gates B3
On the Web

Course website: http://cs205a.stanford.edu

Piazza: https://piazza.com/stanford/spring2015/cs205a/

Online office hours: Google Hangout
Texts

- **Text:** *Numerical Algorithms*, Solomon (me!)
  - Printed as reader at the bookstore
  - Official book out (very?) soon
  - Check course web page...
  - Contact Justin with typos

- **Optional text:** *Scientific Computing*, Heath
Course Breakdown

- **Homeworks (approx. weekly):** 60%
- **Midterm:** 15%
- **Final exam:** 25%
- **Participation:** ±5%
  - Corrections or comments on text
  - Participation in lecture, office hours, and/or Piazza
  - Extra credit on homework
Quick Survey

- Program?
- Department?
- Math background?
Two Roles

- Client of numerical methods
- Designer of numerical methods
Course Topics I

1. **Numerics**
   - Stability and error analysis
   - Floating-point representations

2. **Linear algebra**
   - Gaussian elimination and LU
   - Column spaces and QR
   - Eigenproblems
   - Applications

3. **Root-finding and optimization**
   - Single-variable
   - Multivariable
   - Constrained optimization
Course Topics II

4. Interpolation and quadrature
   - Approximating integrals
   - Approximating derivatives

5. Differential equations
   - ODEs: time-stepping, discretization
   - PDEs: Poisson equation, heat equation, waves
   - Techniques: Differencing, finite elements (time-permitting)
Studying for 205A

Be creative!

- Try simple examples
- Write some code
- Re-derive on paper
- Draw pictures
- Ask questions
Official Prerequisites

Math 51 and CS 106B
Typical Linear Algebra

\[
\|Ax - \vec{b}\|_2^2 = (Ax - \vec{b}) \cdot (Ax - \vec{b}) \\
= (Ax - \vec{b})^\top (Ax - \vec{b}) \\
= (x^\top A^\top - \vec{b}^\top)(Ax - \vec{b}) \\
= x^\top A^\top Ax - x^\top A^\top \vec{b} - \vec{b}^\top A\vec{x} + \vec{b}^\top \vec{b} \\
= \|Ax\|_2^2 - 2(A^\top \vec{b}) \cdot \vec{x} + \|\vec{b}\|_2^2
\]
Necessary Calculus

- Gradient vector $\nabla f$ for $f : \mathbb{R}^n \rightarrow \mathbb{R}$
- Jacobian $Df$ for $f : \mathbb{R}^m \rightarrow \mathbb{R}^n$
- Lagrange multipliers:

$$\min_{\bar{x} \in \mathbb{R}^n} f(\bar{x})$$
$$\text{s.t. } g(\bar{x}) = 0$$
Homework 0

Due one week from today!

To review (Chapter 1):

- Linear algebra
- Calculus

Make ample use of Piazza & office hours.