Introduction


Doug James
Instructor

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Course Assistants

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Section

Fridays, 11:30am-12:20pm
Hewlett Teaching Center 201
Optional, but useful.

This Friday’s section: “Introduction to Julia”
On the Web

**Course website:**
http://graphics.stanford.edu/courses/cs205a-17-spring

**Piazza:**
https://piazza.com/stanford/spring2017/cs205a/

**Gradescope:** (Registration code: MZXEBM)
https://gradescope.com/courses/7422

**Online office space:** Google Hangout
http://bit.ly/1M1nU9C
Texts

- **Text:** *Numerical Algorithms*, Justin Solomon
  - Book available online (PDF), in print, or as an electronic reader
  - Check course web page...
  - Contact Justin with typos

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

- **Homeworks** (approx. weekly): 60%
  Submit with gradescope
- **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

- Iterative linear solvers: Conjugate gradients and friends

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)
Programming in Julia

A powerful modern programming language.
Programming on each homework assignment!
JuliaBox: Web-based Julia programming.
  - https://juliabox.com
  - No installation necessary.

https://julialang.org
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

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

$$\min_{\bar{x} \in \mathbb{R}^n} f(\bar{x})$$

s.t. $g(\bar{x}) = 0$
Homework 0

Out Thursday.
Due one week later (Thurs midnight)

To review (Chapter 1):
  ▶ Linear algebra
  ▶ Calculus

Make **ample use** of Piazza & office hours.
Submit online using **gradescope**.