Eigenvalues first?

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Special thanks to Ben Woodruff at BYU-Idaho

Goals

- emphasize fundamental concepts throughout the entire course
- concrete computation $\rightarrow$ intuition $\rightarrow$ formal generalization

Outline

Outline of Course

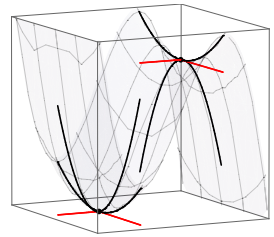
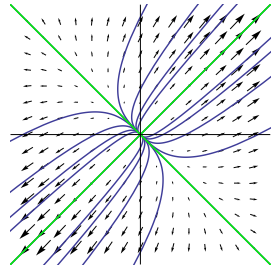
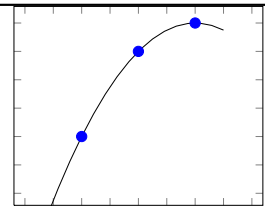
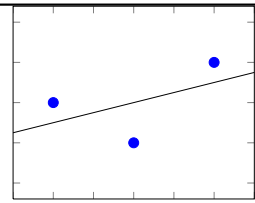
1. Computations and brief explanation
2. Application: motivation and practice
3. Theory and generalization

1. Computation and brief explanation

- matrix/vector operations
- RREF and solving systems
- determinants
- inverses
- linear dependence
- spans
- bases and coordinates
- rank
- eigenvalues/eigenvectors

2. Applications

Purpose: Motivation and practice

Concept / App	matrix mult.		solving systems	evals evecs	pretty pictures
	cols	rows			
Multivariable Optimization				X	
Vector Fields		X		X	
Markov Models	X			X	
Kirchoffs' Laws		X	X		
Interpolating Polynomials		X	X		
Least Squares	X	X	X		

Additional Application Concepts

- Practice
  - Cramer's rule: determinants, inverses
  - Least Squares: dot product, angle, projections, transpose, coordinates, bases
  - Finding standard bases: bases, coordinates, column space, row space, RREF
- New concepts
  - Least Squares: column, row, and null spaces

3. Theory and Generalization

- Vector Spaces and Matrix Theorems
- Inner Products (nice bases)
- Linear Transformations
- Changing Bases

Outline

Goals

- emphasize fundamental concepts throughout the entire course
- concrete computation $\rightarrow$ intuition $\rightarrow$ formal generalization

Emphasis: Eigenvalues and Eigenvectors

1. Computation: basic concepts and computation
2. Applications: 3 major applications (optimization, vector fields, Markov models)
3. Patterns and Vector Spaces: formal footing and relationships
4. Inner Products: inner products on $\mathbb{R}^n$
5. Linear Transformations: Geometry, connection to null space and determinants
6. Changing Bases: Diagonalization

Mindshare: entire course

Emphasis: Coordinate Vectors

1. Computation: basic concepts and computation
2. Applications: application and student project
3. Patterns and Vector Spaces: formal/generic context
4. Inner Products: orthogonal basis
5. Linear Transformations: Finding matrices for linear transformations
6. Changing Bases: Fundamental concept

Mindshare: entire course

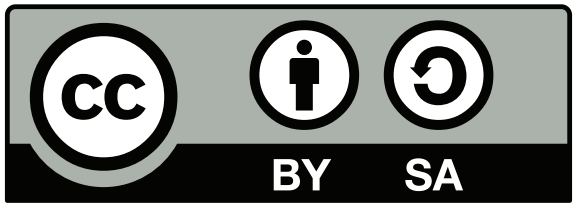
Building Concept of Vector Spaces

Goal: concrete computation $\rightarrow$ intuition $\rightarrow$ formal generalization

1. Introduce vector subspaces as spans of vectors in $\mathbb{R}^n$
2. Introduce row, column, and null space as vector subspaces
3. Patterns and Vector Spaces
   - Review subspaces as spans of vectors, cover subspace theorem
   - Generalize "vector": polynomial, matrix vector spaces
   - Generalize "vector addition" and "scalar multiplication": general vector spaces
4. Inner Products: Use function vector spaces

Outline

Open Textbook



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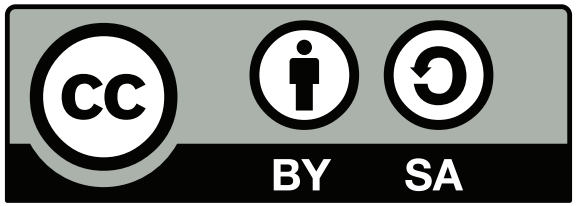

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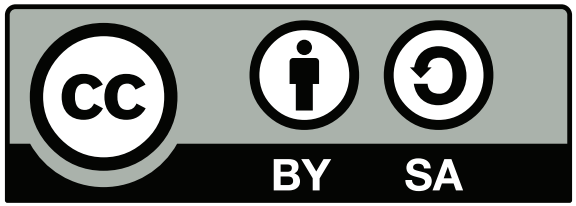

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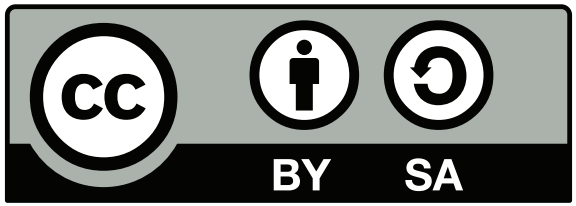

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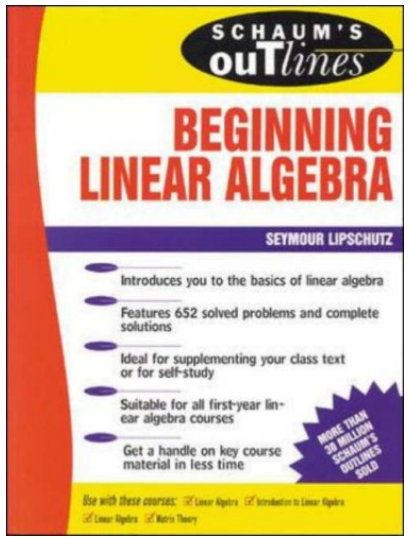
Homework

- Many homework problems and chapter projects written
- Not enough, though

Schaum's Beginning Linear Algebra

- $12.63 on Amazon
- Brief explanations and examples
- 652 fully-solved homework problems



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Creating a viable free open source alternative to Magma, Maple, Mathematica and Matlab.

- Introductory worksheets and classroom aids

Timeline

2009, 2010 Ben Woodruff, BYU-Idaho: Wrote initial textbook

Fall 2010 Jason Grout, Drake University:
Revised, reordered, corrected, augmented text

——————— We are Here ———————

Winter 2011 Jason Grout, Continue revising

- Revise order of some topics
- Continue to add new content and exercises
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Thank You!

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