

# Chapter 2: Lecture 7

## Linear Algebra, Course 124B, Fall, 2008

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# Outline

Ch. 2: Lec. 7

Review for Exam 1

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# Basics:

Review for Exam 1

## Sections covered on first midterm:

- ▶ Chapter 1 and Chapter 2 (Sections 2.1–2.7)

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# Basics:

## Sections covered on first midterm:

- ▶ Chapter 1 and Chapter 2 (Sections 2.1–2.7)
- ▶ Chapter 2 is our focus
- ▶ Knowledge of Chapter 1 as needed for Chapter 2 = solving  $A\vec{x} = \vec{b}$ .
- ▶ Want ‘understanding’ and ‘doing’ abilities.

# Stuff to know:

## Row, Column, & Matrix Pictures of Linear Systems ( $A\vec{x} = \vec{b}$ )

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Review for Exam 1

## Row, Column, & Matrix Pictures of Linear Systems ( $A\vec{x} = \vec{b}$ )

- ▶ What dimensions of  $A$  mean:
  - ▶  $m$  = number of equations
  - ▶  $n$  = number of unknowns ( $x_1, x_2, \dots$ )

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Review for Exam 1

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- ▶ Be able to identify row picture (e.g., as representing 2 planes in 3-d).

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- ▶ Be able to identify row picture (e.g., as representing 2 planes in 3-d).
- ▶ How to convert between the three pictures.

# Solving $A\vec{x} = \vec{b}$ by elimination

Solve four equivalent ways:

Review for Exam 1

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  - ▶ Systematically transform  $A\vec{x} = \vec{b}$  into  $U\vec{x} = \vec{c}$
  - ▶ Solve by back substitution

Review for Exam 1

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3. Row operations with  $E_{ij}$  and  $P_{ij}$  matrices
4. Factor  $A$  as  $A = LU$ 
  - ▶ Solve two triangular systems by forward and back substitution
  - ▶ First  $L\vec{c} = \vec{b}$  then  $U\vec{x} = \vec{c}$ .

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  - ▶ Solve two triangular systems by forward and back substitution
  - ▶ First  $L\vec{c} = \vec{b}$  then  $U\vec{x} = \vec{c}$ .

## Understand number of solutions business:

- ▶ 0, 1, or  $\infty$ : why, when, ...

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Review for Exam 1

More on  $A = LU$ :

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# Stuff to know:

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More on  $A = LU$ :

- ▶ Be able to find the pivots of  $A$  (they live in  $U$ )

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## More on $A = LU$ :

- ▶ Be able to find the pivots of  $A$  (they live in  $U$ )
- ▶ Understand how elimination matrices ( $E_{ij}$ 's) are constructed from multipliers ( $L_{ij}$ 's)

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- ▶ Understand how  $L$  is made up of inverses of elimination matrices
  - ▶ e.g.:  $L = E_{21}^{-1} E_{31}^{-1} E_{32}^{-1} A$ .

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- ▶ Understand how  $L$  is made up of the  $l_{ij}$  multipliers.
- ▶ Understand how inverses of elimination matrices are simply related to elimination matrices.

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# Stuff to know:

## Matrix algebra



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- ▶ Understand matrix multiplication

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- ▶ Understand  $AB = BA$  is rarely true

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- ▶ Find  $A^{-1}$  with Gauss-Jordan elimination



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- ▶ Perform row reduction on augmented matrix  $[A | I]$ .

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- ▶  $(AB)^{-1} = B^{-1}A^{-1}$

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## Transposes

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- ▶ Definition: flip entries across main diagonal

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- ▶  $A = A^T$ :  $A$  is symmetric

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- ▶  $A = A^T$ :  $A$  is symmetric
- ▶ Important property:  $(AB)^T = B^T A^T$

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- ▶ If  $A\vec{x} = \vec{0}$  has a non-zero solution,  $A$  has no inverse

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- ▶ If  $A\vec{x} = \vec{0}$  has a non-zero solution, then  $A\vec{x} = \vec{b}$  always has infinitely many solutions.

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- ▶  $(A^{-1})^T = (A^T)^{-1}$