

Ţ <u>Help</u>

sandipan\_dey ~

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★ Course / Week 8: More on Matrix Inversion / 8.3 (Almost) Never, Ever Invert a Matrix

(1)

8.3.1 Solving Ax = b

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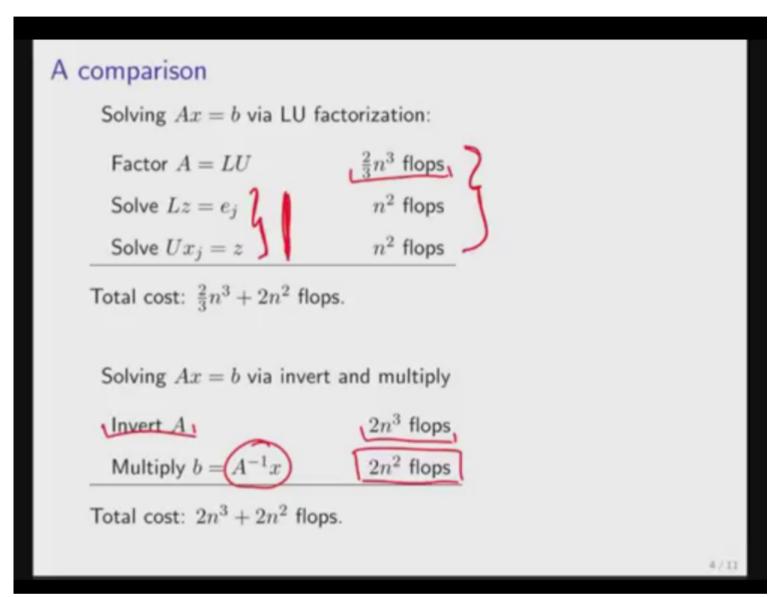
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**■** Calculator

Week 8 due Nov 26, 2023 15:12 IST

# 8.3.1 Solving Ax = b via LU Factorization

Around minute 1:30 there a few problems...



 $\overline{Lz=e_j}$  should be Lz=b.

 $Ux_j=z$  should be Ux=z.

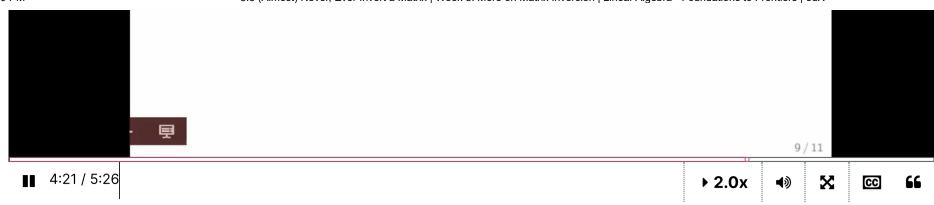
 $b=A^{-1}x$  should be  $x=A^{-1}b$ .

(This video was made during a busy time last spring...)

Thanks to "bzeckel" for pointing this out.

# Summary

- Usually, you don't invert a matrix!
- ▶ If someone talks about inverting a matrix, be suspicious!
- Some people use the term "inverting a matrix" interchangeably with "solving Ax = b".
- ▶ These comments may not apply for small matrices.
- ▶ There is also an issue with numerical stability.



#### **Video**

▲ Download video file

#### **Transcripts**

## Reading Assignment

0 points possible (ungraded)
Read Unit 8.3.1 of the notes. [LINK]



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Answers are displayed within the problem

## Discussion

**Topic:** Week 8 / 8.3.1

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	Question  Hi! I just took an algorithm course last semester, and the algorithm analysis here is a bit different from what I learned in the algorithm course. Fr	2
	nverting flops Why does inverting matrix A cost 2n^3? flops?	2

#### Homework 8.3.1.1

1/1 point (graded)

Let  $A \in \mathbb{R}^{n \times n}$  and  $x, b \in \mathbb{R}^n$ . What is the cost of solving Ax = b via LU factorization (assuming there is nothing special about A)? You may ignore the need for pivoting.

 $\bigcirc$  approximately  $rac{2}{3}n^4+2n^2$  flops

 $\bigcirc$  approximately  $2n^3+2n^2$  flops

 $igoreal{igoreal}$  approximately  $rac{2}{3}n^3+2n^2$  flops

**/** 

LU factorization requires approximately  $rac{2}{3}n^3$  flops and the two triangular solves require approximately  $n^2$  flops each, for a total cost of

$$rac{2}{3}n^3+2n^2 ext{ flops}.$$

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Answers are displayed within the problem

### Homework 8.3.1.2

1/1 point (graded)

Let  $A\in\mathbb{R}^{n imes n}$  and  $x,b\in\mathbb{R}^n$ . What is the cost of solving Ax=b if you first invert matrix A and than compute  $oldsymbol{x} = oldsymbol{A}^{-1} oldsymbol{b}$ ? (Assume there is nothing special about  $oldsymbol{A}$  and ignore the need for pivoting.)

approximately  $rac{2}{3}n^4+2n^2$  flops



approximately  $rac{2}{3}n^3$  flops



Inverting the matrix requires approximately  $2n^3$  flops and the matrix-vector multiplication approximately  $2n^2$  flops, for a total cost of, approximately,

$$2n^3 + 2n^2$$
 flops.

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