3.2.3 Diagonal matrices

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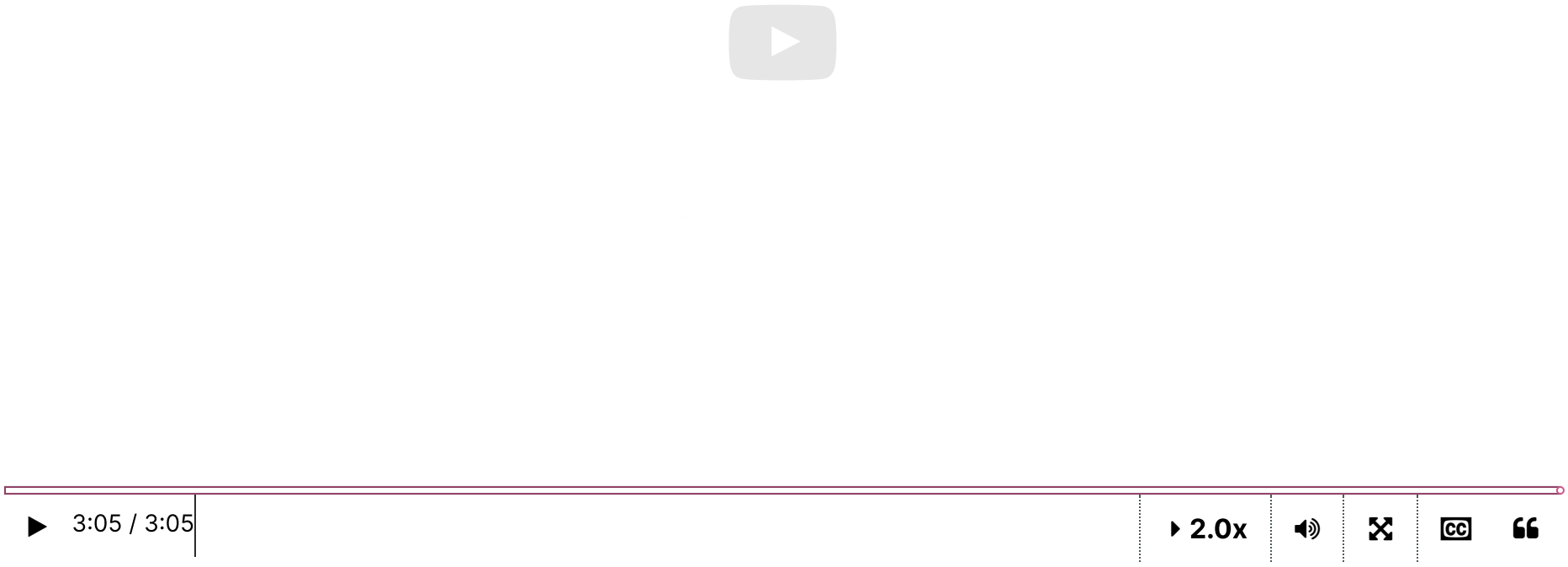
Week 3 due Oct 18, 2023 06:12 IST

3.2.3 Diagonal matrices



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Reading Assignment

0 points possible (ungraded)

Read Unit 3.2.3 of the notes. [LINK]

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Incorrect presentation script 2
At 2:21, the presentation should show **R^n → R^n** as the product matrix given below only show up to **n elements** instead of **m**

Another way of creating the diagonal matrix 2
The algorithm proposed in this unit does not actually create the diagonal of a given matrix but rather takes a vector and then transforms it in a d...

? Question on Homework 3.2.3.5 3
Greetings all, I was a bit confused about the second choice and the forth choice of our LAFF homework 3.2.3.5. Why after applying the diagonal...

Homework 3.2.3.1

1/1 point (graded)

Let $A = \begin{pmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 2 \end{pmatrix}$ and $x = \begin{pmatrix} 2 \\ 1 \\ -2 \end{pmatrix}$

$$Ax =$$

- $\begin{pmatrix} 2 \\ 1 \\ -2 \end{pmatrix}$
- $\begin{pmatrix} 6 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -4 \end{pmatrix}$
- ✔ $\begin{pmatrix} 6 \\ -1 \\ -4 \end{pmatrix}$
- $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$

Explanation

$$Ax = \begin{pmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 2 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \\ -2 \end{pmatrix} = \begin{pmatrix} (3)(2) \\ (-1)(1) \\ (2)(-2) \end{pmatrix} = \begin{pmatrix} 6 \\ -1 \\ -4 \end{pmatrix}$$

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Answers are displayed within the problem

Homework 3.2.3.2

8/8 points (graded)

Let $D = \begin{pmatrix} 2 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & 1 \end{pmatrix}$. What linear transformation, L, does this matrix represent? In particular, answer th

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$\begin{pmatrix} 0 & 0 & -1 \end{pmatrix}$

questions:

$L : \mathbb{R}^n \to \mathbb{R}^m$.

What is the value of n?

3 ✔ Answer: 3

3

What is the value of m?

3 ✔ Answer: 3

3

A linear transformation can be described by how it transform the unit basis vectors:

$$L(e_0) = \begin{pmatrix} \end{pmatrix}$$

- ◉ $\begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}$
- ○ $\begin{pmatrix} 0 \\ -3 \\ 0 \end{pmatrix}$
- ○ $\begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix}$

✔

$$L(e_1) = \begin{pmatrix} \end{pmatrix}$$

- ○ $\begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}$
- ◉ $\begin{pmatrix} 0 \\ -3 \\ 0 \end{pmatrix}$
- ○ $\begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix}$

✔

$$L(e_2) = \begin{pmatrix} \end{pmatrix}$$

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$$\begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ -3 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix}$$

$\begin{pmatrix} a \\ b \\ c \end{pmatrix} = L(\begin{pmatrix} \chi_0 \\ \chi_1 \\ \chi_2 \end{pmatrix})$:

a is χ_0 multiplied by what number?

2 ✔ Answer: 2

2

b is χ_1 multiplied by what number?

-3 ✔ Answer: -3

-3

c is χ_2 multiplied by what number?

-1 ✔ Answer: -1

-1

Explanation

- $L : \mathbb{R}^n \to \mathbb{R}^m$. What are m and n? $m = n = 3$
- A linear transformation can be described by how it transforms the unit basis vectors:

$$L(e_0) = \begin{pmatrix} \quad \\ \quad \\ \quad \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}; \; L(e_1) = \begin{pmatrix} \quad \\ \quad \\ \quad \end{pmatrix} = \begin{pmatrix} 0 \\ -3 \\ 0 \end{pmatrix}; \; L(e_2) = \begin{pmatrix} \quad \\ \quad \\ \quad \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix}$$

- $L(\begin{pmatrix} \chi_0 \\ \chi_1 \\ \chi_2 \end{pmatrix}) = \begin{pmatrix} \quad \\ \quad \\ \quad \end{pmatrix} = \begin{pmatrix} 2\chi_0 \\ -3\chi_1 \\ -1\chi_2 \end{pmatrix}$

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Answers are displayed within the problem

Homework 3.2.3.3

1/1 point (graded)

With the FLAME@lab API, write a function

```
function [ A_out ] = Set_to_diagonal_matrix( A, x )
```

that sets the diagonal entries of a given square matrix `A` to the entries in a given column vector `x` based on the following algorithm:

Algorithm: $[A] := \text{SET\_TO\_DIAGONAL\_MATRIX}(A, x)$

Partition $A \rightarrow \left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right)$, $x \rightarrow \left(\begin{array}{c} x_T \\ \hline x_B \end{array}\right)$

where A_{TL} is 0×0, x_T has 0 elements

while $m(A_{TL}) < m(A)$ **do**

Repartition

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|c|c} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ \hline A_{20} & a_{21} & A_{22} \end{array}\right), \left(\begin{array}{c} x_T \\ \hline x_B \end{array}\right) \rightarrow \left(\begin{array}{c} x_0 \\ \hline \chi_1 \\ \hline x_2 \end{array}\right)$$

where α_{11} is 1×1, χ_1 is a scalar

$a_{01} := 0$

$\alpha_{11} := \chi_1$

$a_{21} := 0$

Continue with

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right) \leftarrow \left(\begin{array}{c|c|c} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ \hline A_{20} & a_{21} & A_{22} \end{array}\right), \left(\begin{array}{c} x_T \\ \hline x_B \end{array}\right) \leftarrow \left(\begin{array}{c} x_0 \\ \hline \chi_1 \\ \hline x_2 \end{array}\right)$$

endwhile

Some links that will come in handy:

- Spark (alternatively, open the file `LAFF-2.0xM/Spark/index.html`)
- PictureFLAME (alternatively, open the file `LAFF-2.0xM/PictureFLAME/PictureFLAME.html`)

You will need these in many future exercises. Bookmark them!

Done/Skip

Answer:

- See below video
- View a document that we put together that has most algorithms and MATLAB implementations that are homework problems in this week:

  Week 3 algorithms and implementations .

  This document is best viewed two pages, side by side, so that you can see the algorithm on the left and its implementation on the right.

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Answers are displayed within the problem

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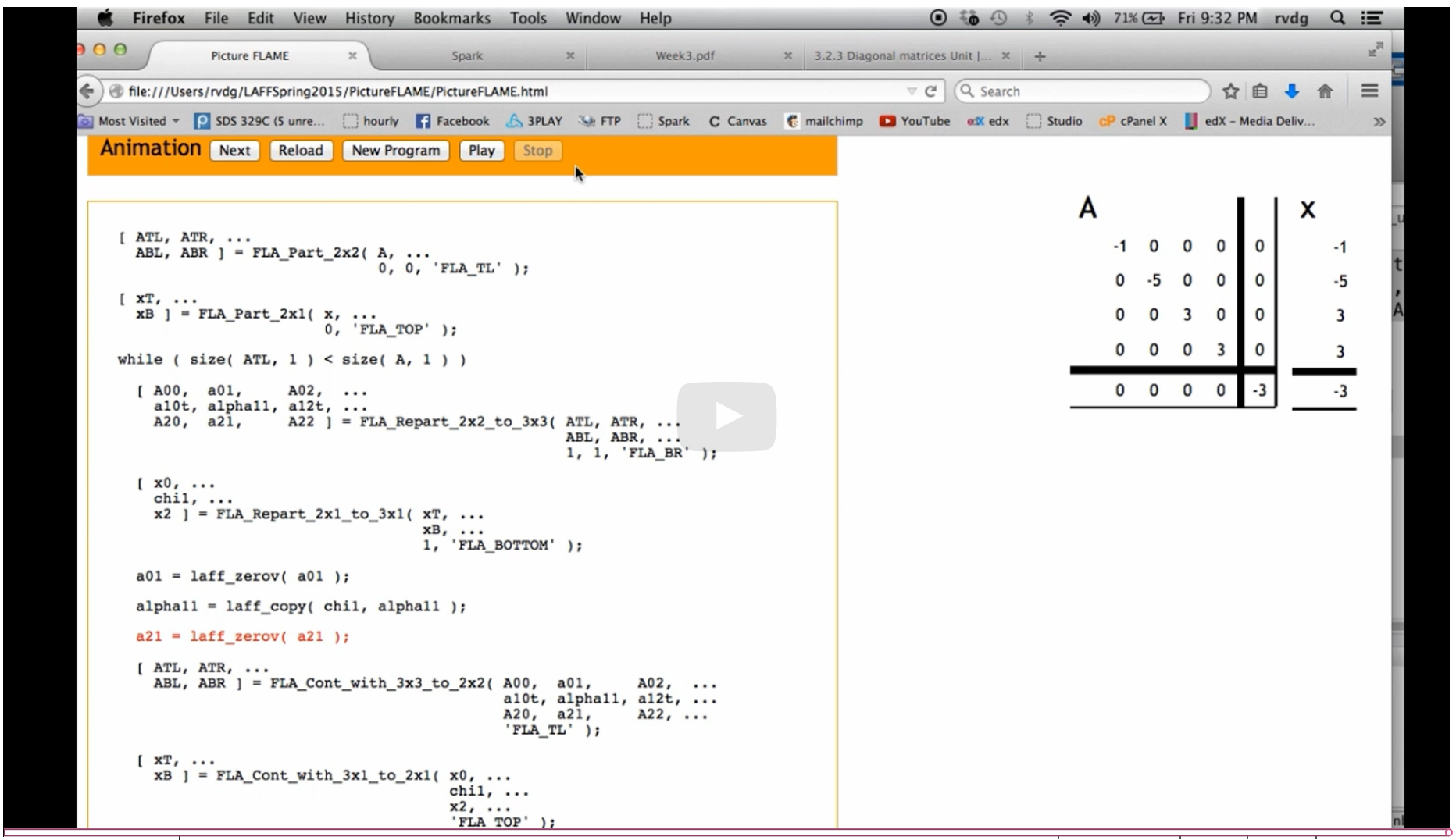
Homework 3.2.3.3 (Answer)



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Homework 3.2.3.4

1/1 point (graded)

In the MATLAB Command Window, type

```
x = [ -1; 2; -3 ]
A = diag( x )
```

Done

The result is

```
ans =

    -1     0     0
     0     2     0
     0     0    -3
```

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Answers are displayed within the problem

Homework 3.2.3.5

1/1 point (graded)

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Apply the diagonal matrix $\begin{pmatrix} -1 & 0 \\ 0 & 2 \end{pmatrix}$ to Timmy Two Space. What happens?

(Check all that apply)

- [ ] Timmy shifts off the grid.
- [ ] Timmy is rotated.
- [ ] Timmy does not change.
- [x] Timmy is flipped with respect to the vertical axis.
- [x] Timmy is stretched by a factor of two in the vertical direction.

✔

Explanation
Timmy is flipped with respect to the vertical axis and Timmy is stretched by a factor of two in the vertical direction.

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