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3.2.3 Diagonal matrices

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Week 3 due Oct 18, 2023 06:12 IST

3.2.3 Diagonal matrices



▶ 3:05 / 3:05

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Reading Assignment

0 points possible (ungraded)
Read Unit 3.2.3 of the notes. [\[LINK\]](#)

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Calculator

 Incorrect presentation script	2
At 2:21, the presentation should show $\mathbb{R}^n \rightarrow \mathbb{R}^n$ 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 the

 Calculator

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

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

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:

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

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

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

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



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

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

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

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



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

$\sim (2)$

$\left(\right)$

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

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

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



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

a is χ_0 multiplied by what number?

✓ Answer: 2

b is χ_1 multiplied by what number?

✓ Answer: -3

c is χ_2 multiplied by what number?


✓ Answer: -1

Explanation

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

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

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

 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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Homework 3.2.3.3 (Answer)

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```
[ ATL, ATR, ...
  ABL, ABR ] = FLA_Part_2x2( A, ...
                           0, 0, 'FLA_TL' );

[ xT, ...
  xB ] = FLA_Part_2x1( x, ...
                     0, 'FLA_TOP' );

while ( size( ATL, 1 ) < size( A, 1 ) )

    [ A00, a01, A02, ...
      a10t, alpha11, a12t, ...
      A20, a21, A22 ] = FLA_Repart_2x2_to_3x3( ATL, ATR, ...
                                              ABL, ABR, ...
                                              1, 1, 'FLA_BR' );

    [ x0, ...
      chil, ...
      x2 ] = FLA_Repart_2x1_to_3x1( xT, ...
                                  xB, ...
                                  1, 'FLA_BOTTOM' );

    a01 = laff_zerov( a01 );
    alpha11 = laff_copy( chil, alpha11 );
    a21 = laff_zerov( a21 );

    [ ATL, ATR, ...
      ABL, ABR ] = FLA_Cont_with_3x3_to_2x2( A00, a01, A02, ...
                                              a10t, alpha11, a12t, ...
                                              A20, a21, A22, ...
                                              'FLA_TL' );

    [ xT, ...
      xB ] = FLA_Cont_with_3x1_to_2x1( x0, ...
                                       chil, ...
                                       x2, ...
                                       'FLA_TOP' );
```

A						X
-1	0	0	0	0	0	-1
0	-5	0	0	0	0	-5
0	0	3	0	0	0	3
0	0	0	3	0	0	3
0	0	0	0	-3		-3

▶ 4:27 / 4:27

▶ 2.0x 🔊 🔍 CC “

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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)

Calculator

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.
- ☒ Timmy is flipped with respect to the vertical axis.
- ☒ 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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