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5.2.2 Properties

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■ Calculator

Week 5 due Nov 6, 2023 22:42 IST Completed

5.2.2 Properties

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Reading Assignment

0 points possible (ungraded) Read Unit 5.2.2 of the notes. [LINK]



Done



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✓ Correct

Homework 5.2.2.1

4/4 points (graded)

Let
$$A=egin{pmatrix}0&1\\1&0\end{pmatrix}$$
 , $B=egin{pmatrix}0&2&-1\\1&1&0\end{pmatrix}$, and $C=egin{pmatrix}0&1\\1&2\\1&-1\end{pmatrix}$. Compute

AB =

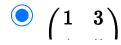
$$\bigcirc \begin{pmatrix} 1 & 3 \\ 1 & 5 \end{pmatrix}$$

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

$$\begin{array}{c} \bigcirc \ \begin{pmatrix} 1 & 5 \\ 1 & 3 \end{pmatrix}$$



(AB)C =





 $\backslash 1 5/$

 $\begin{array}{cccc} \begin{pmatrix} 1 & 1 & 0 \\ 0 & 2 & -1 \end{pmatrix}$

 $\begin{pmatrix} 1 & 5 \\ 1 & 3 \end{pmatrix}$

~

BC =

 $\begin{array}{c} \bigcirc \ \begin{pmatrix} 1 & 3 \\ 1 & 5 \end{pmatrix}$

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

 $\begin{pmatrix} 1 & 5 \\ 1 & 3 \end{pmatrix}$

~

A(BC) =

 $\begin{pmatrix} 1 & 3 \\ 1 & 5 \end{pmatrix}$

 $\begin{array}{ccc} \begin{pmatrix} 1 & 1 & 0 \\ 0 & 2 & -1 \end{pmatrix}$

 $\begin{array}{c} \bigcirc \begin{pmatrix} 1 & 5 \\ 1 & 3 \end{pmatrix}$

~

Explanation

 $\bullet \ AB = \left(\begin{array}{ccc} 1 & 1 & 0 \\ 0 & 2 & -1 \end{array} \right)$

• $(AB)C = \begin{pmatrix} 1 & 3 \\ 1 & 5 \end{pmatrix}$

• $BC = \begin{pmatrix} 1 & 5 \\ 1 & 3 \end{pmatrix}$

 $\bullet \ A(BC) = \begin{pmatrix} 1 & 3 \\ 1 & 5 \end{pmatrix}$

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Answers are displayed within the problem

Homework 5.2.2.2

1/1 point (graded)

Let $\Lambda \subset \mathbb{R}^{mxn}$ $R \subset \mathbb{R}^{nxk}$ and $C \subset \mathbb{R}^{kxl}$ then $(\Lambda R) C = \Lambda (RC)$

✓ Answer: Always **Always**

Explanation

Answer:

Proof 1:

Two matrices are equal if corresponding columns are equal. We will show that (AB)C = A(BC)by showing that, for arbitrary j, the jth column of (AB)C equals the jth column of A(BC). In other words, that $((AB)C)e_j = (A(BC))e_j$.

$$((AB)C)e_j$$

= < Definition of matrix-matrix multiplication >
 $(AB)Ce_j$

= < Definition of matrix-matrix multiplication >
 $A(B(Ce_j))$

= < Definition of matrix-matrix multiplication >
 $A((BC)e_j)$

= < Definition of matrix-matrix multiplication >
 $(A(BC)e_j)$

Proof 2 (using partitioned matrix-matrix multiplication):

$$(AB)C$$

$$= \langle \text{Partition by columns} \rangle$$

$$(AB) \left(\begin{array}{c|c} c_0 & c_1 & \cdots & c_{n-1} \end{array} \right)$$

$$= \langle \text{Partitioned matrix-matrix multiplication} \rangle$$

$$\left(\begin{array}{c|c} (AB)c_0 & (AB)c_1 & \cdots & (AB)c_{n-1} \end{array} \right)$$

$$= \langle \text{Definition of matrix-matrix multiplication} \rangle$$

$$\left(\begin{array}{c|c} A(Bc_0) & A(Bc_1) & \cdots & A(Bc_{n-1}) \end{array} \right)$$

$$= \langle \text{Partitioned matrix-matrix multiplication} \rangle$$

$$A \left(\begin{array}{c|c} Bc_0 & Bc_1 & \cdots & Bc_{n-1} \end{array} \right)$$

$$= \langle \text{Partitioned matrix-matrix multiplication} \rangle$$

$$A(B \left(\begin{array}{c|c} c_0 & c_1 & \cdots & c_{n-1} \end{array} \right))$$

$$= \langle \text{Partitioned matrix-matrix multiplication} \rangle$$

$$A(BC)$$

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Homework 5.2.2.3

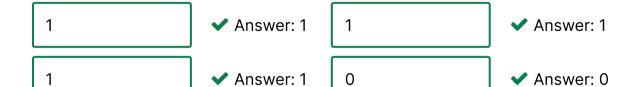
16/16 points (graded)

Let
$$A=egin{pmatrix} 0 & 1 \ 1 & 0 \end{pmatrix}$$
 , $B=egin{pmatrix} 2 & -1 \ 1 & 0 \end{pmatrix}$, and $C=egin{pmatrix} -1 & 1 \ 0 & 1 \end{pmatrix}$

• A(R+C)



• AB + AC



• (A+B)C

• AC + BC

$$\bullet \ A(B+C) = \left(\begin{array}{cc} 1 & 1 \\ 1 & 0 \end{array}\right).$$

$$\bullet \ AB + AC = \left(\begin{array}{cc} 1 & 1 \\ 1 & 0 \end{array}\right).$$

$$\bullet \ (A+B)C = \left(\begin{array}{cc} -2 & 2 \\ -2 & 2 \end{array} \right).$$

$$\bullet \ AC + BC = \left(\begin{array}{cc} -2 & 2 \\ -2 & 2 \end{array} \right).$$

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Answers are displayed within the problem

Homework 5.2.2.4

1/1 point (graded)

Let $A \in \mathbb{R}^{m imes k}, B \in \mathbb{R}^{k imes n},$ and $C \in \mathbb{R}^{k imes n}$ then $A\left(B+C
ight) = AB + AC.$

Always

Answer: Always

Explanation

Answer: Always

$$= \langle \text{ Partition } B \text{ and } C \text{ by columns } \rangle$$

$$A\left(\left(\begin{array}{c|c} b_0 & b_1 & \cdots & b_{n-1} \end{array}\right) + \left(\begin{array}{c|c} c_0 & c_1 & \cdots & c_{n-1} \end{array}\right)\right)$$

$$= \langle \text{ Definition of matrix addition } \rangle$$

$$A\left(\begin{array}{c|c} b_0 + c_0 & b_1 + c_1 & \cdots & b_{n-1} + c_{n-1} \end{array}\right)$$

$$= \langle \text{ Partitioned matrix-matrix multiplication } \rangle$$

$$\left(\begin{array}{c|c} A(b_0 + c_0) & A(b_1 + c_1) & \cdots & A(b_{n-1} + c_{n-1}) \end{array}\right)$$

$$= \langle \text{ Matrix-vector multiplication distributes } \rangle$$

$$\left(\begin{array}{c|c} Ab_0 + Ac_0 & Ab_1 + Ac_1 & \cdots & Ab_{n-1} + Ac_{n-1} \end{array}\right)$$

$$= \langle \text{ Defintion of matrix addition } \rangle$$

$$\left(\begin{array}{c|c} Ab_0 & Ab_1 & \cdots & Ab_{n-1} \end{array}\right) + \left(\begin{array}{c|c} Ac_0 & Ac_1 & \cdots & Ac_{n-1} \end{array}\right)$$

$$= \langle \text{ Partitioned matrix-matrix multiplication } \rangle$$

$$A\left(\begin{array}{c|c} b_0 & b_1 & \cdots & b_{n-1} \end{array}\right) + \left(\begin{array}{c|c} Ac_0 & Ac_1 & \cdots & Ac_{n-1} \end{array}\right)$$

$$= \langle \text{ Partition by columns } \rangle$$

$$AB + AC.$$

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Answers are displayed within the problem

Homework 5.2.2.5

1/1 point (graded)

If $A \in \mathbb{R}^{m imes k}, B \in \mathbb{R}^{m imes k}, ext{ and } C \in \mathbb{R}^{k imes n}, ext{ then } (A+B) \, C = AC + BC$

True ✓ Answer: True

Explanation

Answer: True

$$(A+B)C = \langle \text{Partition } C \text{ by columns.} \rangle$$

$$(A+B) \left(\begin{array}{c|c} c_0 & c_1 & \cdots & c_{n-1} \end{array} \right)$$

$$= \langle DE \text{ means } D \text{ multiplies each of the columns of } E \rangle$$

$$\left(\begin{array}{c|c} (A+B)c_0 & (A+B)c_1 & \cdots & (A+B)c_{n-1} \end{array} \right)$$

$$= \langle \text{Definition of matrix addition} \rangle$$

$$\left(\begin{array}{c|c} Ac_0 + Bc_0 & Ac_1 + Bc_1 & \cdots & Ac_{n-1} + Bc_{n-1} \end{array} \right)$$

$$= \langle D + E \text{ means adding corresponding columns} \rangle$$

$$\left(\begin{array}{c|c} Ac_0 & Ac_1 & \cdots & Ac_{n-1} \end{array} \right) + \left(\begin{array}{c|c} Bc_0 & Bc_1 & \cdots & Bc_{n-1} \end{array} \right)$$

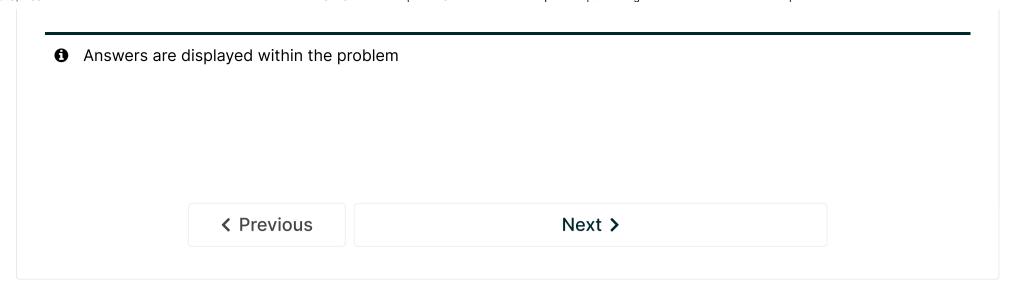
$$= \langle DE \text{ means } D \text{ multiplies each of the columns of } E \rangle$$

$$A\left(\begin{array}{c|c} c_0 & c_1 & \cdots & c_{n-1} \end{array} \right) + B\left(\begin{array}{c|c} c_0 & c_1 & \cdots & c_{n-1} \end{array} \right)$$

$$= \langle \text{Partition } C \text{ by columns} \rangle$$

$$AC + BC.$$

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