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4.4.3 Computing the Matrix-Matrix Product

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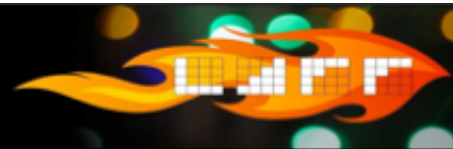
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Homework 4.4.3.1

9/9 points (graded)

Compute $Q = P \times P = \begin{pmatrix} .4 & .3 & .1 \\ .4 & .3 & .6 \\ .2 & .4 & .3 \end{pmatrix} \begin{pmatrix} .4 & .3 & .1 \\ .4 & .3 & .6 \\ .2 & .4 & .3 \end{pmatrix} =$

Hint: you may want to use MATLAB to do some of the computations.

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✓ Correct (9/9 points)

Homework 4.4.3.2

25/25 points (graded)

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

$$AB = \begin{bmatrix} 5 & 2 & 5 & 2 \\ -2 & 0 & -2 & 0 \\ 3 & 4 & 3 & 4 \\ -1 & 0 & -1 & 0 \end{bmatrix}$$

Each element in the matrix is followed by a green checkmark, indicating it is correct.

$$BA = \begin{bmatrix} 4 & 8 & 5 \\ -2 & 2 & 1 \\ 3 & 3 & 2 \end{bmatrix}$$

Each element in the matrix is followed by a green checkmark, indicating it is correct.

Submit

✓ Correct (25/25 points)

Homework 4.4.3.3

1/1 point (graded)

Let $A \in \mathbb{R}^{m \times k}$ and $B \in \mathbb{R}^{k \times n}$ and $AB = BA$.

A and B are square matrices.

Always

✓ Answer: Always

Explanation

Answer: Always

The result of AB is a $m \times n$ matrix. The result of BA is a $k \times k$ matrix. Hence $m = k$ and $n = k$. In other words, $m = n = k$.

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Homework 4.4.3.4

1/1 point (graded)

Let $A \in \mathbb{R}^{m \times k}$ and $B \in \mathbb{R}^{k \times n}$.

$AB = BA$.

Sometimes

✓ Answer: Sometimes

Explanation

Answer: Sometimes

If $m \neq n$ then BA is not even defined because the sizes of the matrices don't match up. But if A is square and $A = B$, then clearly $AB = AA = BA$.

So, there are examples where the statement is true and examples where the statement is false.

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Homework 4.4.3.5

1/1 point (graded)

Let $A, B \in \mathbb{R}^{n \times n}$.

$$AB = BA.$$

✓ Answer: Sometimes

Explanation

Answer: Sometimes

Almost any random matrices A and B will have the property that $AB \neq BA$. But if you pick, for example, $n = 1$ or $A = I$ or $A = 0$ or $A = B$, then $AB = BA$. There are many other examples.

The bottom line: Matrix multiplication, unlike scalar multiplication, does not necessarily commute.

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Homework 4.4.3.6

1/1 point (graded)

A^2 is defined as AA . Similarly $A^k = \underbrace{AA \dots A}_{k \text{ occurrences of } A}$. Consistent with this, $A^0 = I$ so

that $A^k = A^{k-1}A$ for $k > 0$.

A^k is well-defined only if A is a square matrix.

✓ Answer: TRUE

Explanation

Answer: True

Just check the sizes of the matrices.

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Homework 4.4.3.7

1/1 point (graded)

Let A, B, C be matrix "of appropriate size" so that $(AB)C$ is well-defined.

$A(BC)$ is well defined.

Always ▼

✓ Answer: Always

Explanation

Answer: Always

For $(AB)C$ to be well defined, $A \in \mathbb{R}^{m_A \times n_A}$, $B \in \mathbb{R}^{m_B \times n_B}$, $C \in \mathbb{R}^{m_C \times n_C}$, where $n_A = m_B$ and $n_B = m_C$. But then BC is well defined because $n_B = m_C$ and results in a $m_B \times n_C$ matrix. But then $A(BC)$ is well defined because $n_A = m_B$.

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