Linear Algebra Workbook

Operations on two matrices

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MATRIX ADDITION AND SUBTRACTION

■ 1. Add the matrices.

$$\begin{bmatrix} 7 & 6 \\ 17 & 9 \end{bmatrix} + \begin{bmatrix} 0 & 8 \\ -2 & 5 \end{bmatrix}$$

■ 2. Add the matrices.

$$\begin{bmatrix} 8 & 3 \\ -4 & 7 \\ 6 & 0 \\ 1 & 13 \end{bmatrix} + \begin{bmatrix} 6 & 7 \\ 2 & -3 \\ 9 & 11 \\ 7 & -2 \end{bmatrix}$$

■ 3. Subtract the matrices.

$$\begin{bmatrix} 7 & 9 \\ 4 & -1 \end{bmatrix} - \begin{bmatrix} 3 & 8 \\ 12 & -3 \end{bmatrix}$$

■ 4. Subtract the matrices.

$$\begin{bmatrix} 8 & 11 & 2 & 9 \\ 6 & 3 & 16 & 8 \end{bmatrix} - \begin{bmatrix} 6 & 11 & 7 & -4 \\ 5 & 8 & 1 & 15 \end{bmatrix}$$

■ 5. Solve for M.

$$\begin{bmatrix}6 & 5\\9 & -9\end{bmatrix}+\begin{bmatrix}3 & 7\\1 & 6\end{bmatrix}=M+\begin{bmatrix}7 & 12\\-3 & -1\end{bmatrix}-\begin{bmatrix}1 & 8\\4 & -7\end{bmatrix}$$

■ 6. Solve for N.

$$\begin{bmatrix}4 & 12\\9 & 8\end{bmatrix}-\begin{bmatrix}0 & 3\\9 & 9\end{bmatrix}=N-\begin{bmatrix}6 & 3\\5 & 11\end{bmatrix}+\begin{bmatrix}7 & -4\\-18 & 1\end{bmatrix}$$

SCALAR MULTIPLICATION

■ 1. Use scalar multiplication to simplify the expression.

$$\frac{1}{4}\begin{bmatrix} 12 & 8 & 3 \\ 2 & -16 & 0 \\ 1 & 5 & 7 \end{bmatrix}$$

■ 2. Solve for Y.

$$4\begin{bmatrix} 2 & 9 \\ -5 & 0 \end{bmatrix} + Y = 5\begin{bmatrix} 1 & -3 \\ 6 & 8 \end{bmatrix}$$

■ 3. Solve for N.

$$-2\begin{bmatrix} 6 & 5 \\ 0 & 11 \end{bmatrix} = N - 4\begin{bmatrix} 2 & 4 \\ -1 & 9 \end{bmatrix}$$

■ 4. Solve the equation for M.

$$-4M = \begin{bmatrix} -5 & 0 & 4 \\ 1 & -8 & -2 \\ -4 & 12 & 3 \end{bmatrix}$$

5. Use scalar multiplication to simplify the expression.

$$-5A+\frac{1}{3}B$$

$$A=\begin{bmatrix}\frac{2}{5} & -\frac{1}{5}\\ 3 & 0\end{bmatrix}$$

$$B=\begin{bmatrix}-\frac{1}{3} & 0\\ 6 & -2\end{bmatrix}$$

6. Solve the equation for X.

$$2X-\frac{1}{2}\begin{bmatrix}0 & -2 & 6\\ 4 & -1 & 2\\ 8 & 6 & 0\end{bmatrix}=\begin{bmatrix}6 & 3 & 7\\ 0 & -\frac{3}{2} & 1\\ 6 & 5 & 4\end{bmatrix}$$

ZERO MATRICES

1. Add the zero matrix to the given matrix.

$$\begin{bmatrix} 8 & 17 \\ -6 & 0 \end{bmatrix}$$

2. Find the opposite matrix.

$$\begin{bmatrix} 6 & 8 & 0 \\ 2 & -3 & 11 \\ 4 & 12 & 9 \end{bmatrix}$$

3. Multiply the matrix by a scalar of 0.

$$\begin{bmatrix} 14 & -1 & 7 & 5 \\ 3 & 7 & 18 & -4 \end{bmatrix}$$

4. Add the opposite of A to A.

$$A = \begin{bmatrix} 1 & -5 & 7 \\ -3 & 2 & 8 \end{bmatrix}$$

5. Solve the equation for X.

$$X+\begin{bmatrix}-1 & 2 & 5\\ 7 & -4 & 3\\ 1 & -2 & 4\end{bmatrix}=\begin{bmatrix}1 & 0 & -5\\ 0 & 7 & 3\\ -4 & 0 & -1\end{bmatrix}+\begin{bmatrix}-1 & 0 & 5\\ 0 & -7 & -3\\ 4 & 0 & 1\end{bmatrix}$$

■ 6. Solve the equation for A.

$$\begin{bmatrix}-1 & 5 & 4\\ -2 & 0 & -3\\ 5 & 7 & -9\end{bmatrix}-A=0\begin{bmatrix}-2 & 3 & 0\\ -1 & 5 & -2\\ -7 & 0 & 4\end{bmatrix}+\begin{bmatrix}2 & 4 & -7\\ 8 & 0 & -5\\ -1 & 4 & 3\end{bmatrix}-\begin{bmatrix}3 & -1 & -11\\ 10 & 0 & -2\\ -6 & -3 & 12\end{bmatrix}$$

MATRIX MULTIPLICATION

■ 1. If matrix A is 3×3 and matrix B is 3×4, say whether AB or BA is defined, and give the dimensions of any product that's defined.

■ 2. Find the product of matrices A and B.

$$A = \begin{bmatrix} 2 & 6 \\ -3 & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} -2 & 0 \\ 5 & -4 \end{bmatrix}$$

■ 3. Find the product of matrices A and B.

$$A = \begin{bmatrix} 5 & -1 \\ 0 & 11 \\ 7 & -2 \end{bmatrix}$$

$$B = \begin{bmatrix} 6 & 1 & 8 \\ -3 & 0 & 4 \end{bmatrix}$$

■ 4. Find the product of matrices A and B.

$$A = \begin{bmatrix} 3 & -2 \\ 1 & 8 \\ 0 & 3 \end{bmatrix}$$

$$B = \begin{bmatrix} 5 & 2 \\ 4 & 8 \end{bmatrix}$$

■ 5. Use the distributive property to find $A(B+C)$.

$$A = \begin{bmatrix} 2 & 0 \\ 4 & -2 \end{bmatrix}$$

$$B = \begin{bmatrix} 3 & 1 \\ 5 & 4 \end{bmatrix}$$

$$C = \begin{bmatrix} 6 & 1 \\ 3 & -1 \end{bmatrix}$$

■ 6. Find the product of matrices A and B.

$$A = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 6 & -2 & 8 & 1 \\ 7 & 3 & 5 & 2 \end{bmatrix}$$

IDENTITY MATRICES

■ 1. Write the identity matrix I_4.

■ 2. If we want to find the product IA, where I is the identity matrix and A is 4×2, then what are the dimensions of I?

■ 3. If we want to find the product IA, where I is the identity matrix and A is a 3×4, then what are the dimensions of I?

■ 4. If we want to find the product IA, where I is the identity matrix and A is given, then what are the dimensions of I? What is the product IA?

$$A = \begin{bmatrix} 2 & 8 \\ -2 & 7 \\ 3 & 5 \end{bmatrix}$$

■ 5. If we want to find the product IA, where I is the identity matrix and A is given, then what are the dimensions of I? What is the product IA?

$$A = \begin{bmatrix} 7 & 1 & 3 & -2 \\ 5 & 5 & 2 & 9 \end{bmatrix}$$

■ 6. If A is a 2×4 matrix, what are the dimensions of the identity matrix that make the equation true?

$$AI = A$$

THE ELIMINATION MATRIX

■ 1. Find a single 2×2 elimination matrix E that accomplishes the given row operations.

1. $(1/3)R_1 \to R_1$

2. $-2R_1 + R_2 \to R_2$

■ 2. Find a single 3×3 elimination matrix E that accomplishes the given row operations.

1. $-3R_1 + R_3 \to R_3$

2. $5R_2 + R_1 \to R_1$

3. $-R_3 \to R_3$

■ 3. Find a single 2×2 elimination matrix E that accomplishes the given row operations.

1. $-R_1 \to R_1$

2. $5R_1 + R_2 \to R_2$

3. $-(1/7)R_2 \to R_2$

4. $R_2 + R_1 \to R_1$

■ 4. Find the single elimination matrix E that puts A into reduced row-echelon form, where E accounts for the given set of row operations.

$$A = \begin{bmatrix} -3 & 6 \\ 1 & 2 \end{bmatrix}$$

1. $-\frac{1}{3}R_1 \to R_1$

2. $-R_1 + R_2 \to R_2$

3. $\frac{1}{4}R_2 \to R_2$

4. $2R_2 + R_1 \to R_1$

■ 5. Find the single elimination matrix E that puts X into reduced row-echelon form, where E accounts for the given set of row operations.

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

1. $-3R_1 + R_2 \to R_2$

2. $2R_1 + R_3 \to R_3$

3. $R_2 + R_3 \to R_3$

4. $4R_3 + R_2 \to R_2$

■ 6. Find the single elimination matrix E that puts B into reduced row-echelon form, where E accounts for the given set of row operations.

$$B = \begin{bmatrix} 1 & 0 & -5 \\ 3 & 2 & -9 \\ 1 & -2 & -10 \end{bmatrix}$$

1. $-3R_1 + R_2 \to R_2$

2. $-R_1 + R_3 \to R_3$

3. $\frac{1}{2}R_2 \to R_2$

4. $2R_2 + R_3 \to R_3$

5. $-3R_3 + R_2 \to R_2$

6. $5R_3 + R_1 \to R_1$

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