4.3 Multiplying Matrices

Objective: Multiply Matrices
Use the Properties of Matrix Multiplication

Multiply Matrices: You can multiply 2 matrices if and only if the # of columns in the 1st matrix is equal to the # of rows in the second matrix.

$$A_{m \times n} \text{ and } B_{n \times r} = AB_{m \times r}$$

*These have to be equal
inner dimensions

* These are the outer dimensions and give the product's dimensions (or size)

Ex1) Determine whether each product is defined. If so, then state the product's dimensions.

A) $A_{2\times5}$ and $B_{5\times4}$ yes, $AB_{2\times4}$
equal

B) $A_{3\times2}$ and $B_{4\times3}$ Can not multiply them
Not Equal
or
DNE

C) $A_{3\times4}$ and $B_{4\times2}$ $AB_{3\times2}$
Equal

Multiply Matrices

$$\begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix} \bullet \begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \end{bmatrix} = \begin{bmatrix} a_1x_1 + b_1x_2 & a_1y_1 + b_1y_2 \\ a_2x_1 + b_2x_2 & a_2y_1 + b_2y_2 \end{bmatrix}$$

2x2 2x2 2x2
equal

Ex2) Find RS if R= $\begin{bmatrix} 3 & 2 \\ -1 & 0 \end{bmatrix}$ and S= $\begin{bmatrix} -2 & 1 \\ 0 & -1 \end{bmatrix}$

2x2 2x2

$$RS = \begin{bmatrix} 3(-2)+2(0) & 3(1)+2(-1) \\ (-1)(-2)+0(0) & -1(1)+0(-1) \end{bmatrix} = \begin{bmatrix} -6 & 1 \\ 2 & -1 \end{bmatrix}$$

Ex3) Find KL and LK if K= $\begin{bmatrix} -3 & 2 & 2 \\ -1 & -2 & 0 \end{bmatrix}$ and L= $\begin{bmatrix} 1 & -2 \\ 4 & 3 \\ 0 & -1 \end{bmatrix}$

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

2x3 3x2

$$= \begin{bmatrix} 5 & 10 \\ -9 & -4 \end{bmatrix} = KL$$

$$LK = \begin{bmatrix} 1 & -2 \\ 4 & 3 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} -3 & 2 & 2 \\ -1 & -2 & 0 \end{bmatrix} = \begin{bmatrix} -3+2 & 2+4 & 2+0 \\ -12+3 & 8+-6 & 8+0 \\ 0+1 & 0+2 & 0+0 \end{bmatrix}$$

3x2 2x3

$$= \begin{bmatrix} -1 & 6 & 2 \\ -15 & 2 & 8 \\ 1 & 2 & 0 \end{bmatrix} = LK$$

Properties for Multiplication

*Associative of Matrix Mult: (AB)C = A(BC)

*Associative for Scalar Mult: k(AB) = (kA)B = A(kB)

*Left Distributive: C(A+B) = CA + CB

*Right Distributive: (A+B)C = AC + BC

True | False

Matrix Multiplication is <u>NOT</u> communtative