4.2- Matrix Multiplication

Matrix Multiplication

If matrix A has dimensions $m \times n$ and matrix B has dimensions $n \times r$, then the product AB has dimensions $m \times r$. $m \times n \quad n \times r \simeq m \times r$

Find the entry in row i and column j of AB by finding the sum of the products of the corresponding entries in row i of A and column j of B.

$$R=\begin{bmatrix}2 & -3\\ 0 & 5\\ -2 & 0\end{bmatrix} \quad W=\begin{bmatrix}5 & 0\\ 4 & 7\end{bmatrix}$$

$3\times2 \quad 2\times2 = 3\times2$

$$RW=\begin{bmatrix}10+(-12) & 0+(-21)\\ 0+20 & 0+35\\ -10+0 & 0+0\end{bmatrix}=\begin{bmatrix}-2 & -21\\ 20 & 35\\ -10 & 0\end{bmatrix}$$

$WR=$ $2\times2 \quad 3\times2$

Not Possible

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

$3 \times 1 \quad 1 \times 3 = 3 \times 3$

$$\begin{bmatrix} 2 & -6 & 8 \\ 0 & 0 & 0 \\ 6 & -18 & 24 \end{bmatrix}$$

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

$2 \times 2 \quad 2 \times 3 = 2 \times 3$

$$\begin{bmatrix} 20+0 & 10+3 & -5+9 \\ 0+0 & 0+1 & 0+3 \end{bmatrix} = \begin{bmatrix} 20 & 13 & 4 \\ 0 & 1 & 3 \end{bmatrix}$$

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2)

$$\begin{bmatrix} 2 & 5 & 0 \end{bmatrix} \begin{bmatrix} 8 & 1 \\ 0 & 4 \\ 2 & 5 \end{bmatrix}$$

$1 \times 3 \qquad 3 \times 2 \qquad 1 \times 2$

$$\begin{bmatrix} 16+0+0 & 2+20+0 \end{bmatrix} = \begin{bmatrix} 16 & 22 \end{bmatrix}$$

10) $\begin{bmatrix} 1 & 5 \\ -3 & 0 \end{bmatrix} -3 \begin{bmatrix} 3 & -2 \\ -4 & 6 \end{bmatrix} 5$

$2 \times 2 \qquad 2 \times 2 \qquad 2 \times 2$

$$\begin{bmatrix} 3+(-20) & -2+30 \\ -9+0 & 6+0 \end{bmatrix} = \begin{bmatrix} -17 & 28 \\ -9 & 6 \end{bmatrix}$$

20) $A=\begin{bmatrix} 4 & -2 & 8 & 0 \\ 1 & 3 & -6 & 9 \\ -5 & 7 & 2 & 1 \end{bmatrix}$ $B=\begin{bmatrix} 7 & 6 \\ 2 & -3 \\ -1 & 8 \\ 9 & 5 \end{bmatrix}$

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

$AB = \underset{3\times 4}{} \underset{4\times 2}{} = \underset{3\times 2}{}$

$\begin{bmatrix} 28+(-4)+(-8)+0 & 24+6+64+0 \\ 7+6+6+81 & 6+(-9)+(-48)+45 \\ -35+14+(-2)+9 & -30+(-21)+16+5 \end{bmatrix} = \begin{bmatrix} 16 & 94 \\ 100 & -6 \\ -14 & -30 \end{bmatrix}$

$(AB)C = \underset{3\times 2}{} \underset{2\times 2}{} = \underset{3\times 2}{}$

$\begin{bmatrix} 16 & 94 \\ 100 & -6 \\ -14 & -30 \end{bmatrix}\begin{bmatrix} 0 & 8 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 0+(-188) & 128+94 \\ 0+12 & 800+(-6) \\ 0+(60) & -112+(-30) \end{bmatrix}$

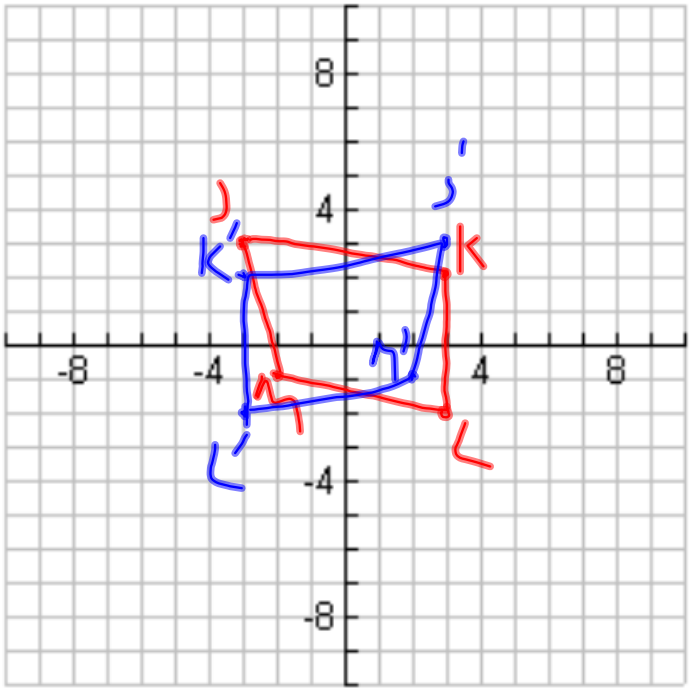
$\begin{bmatrix} -188 & 222 \\ 12 & 794 \\ 60 & -142 \end{bmatrix}$

22) $A = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$ 2×2 $\quad Q = \begin{bmatrix} -3 & 3 & 3 & -2 \\ 3 & 2 & -2 & -1 \end{bmatrix}$ 2×4 $\quad 2 \times 4$

a)

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

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



24) a) $\begin{bmatrix} .55 & .62 \\ .45 & .38 \end{bmatrix} \begin{bmatrix} 72 & 102 \\ 85 & 130 \end{bmatrix}$

b) $\begin{bmatrix} 93 & 137 \\ 65 & 96 \end{bmatrix}$

25) a)

$$\begin{bmatrix} 2 & 2 & 1 \\ 4 & 4 & 3 \\ 3 & 1 & 3 \\ 5 & 4 & 2 \end{bmatrix} \begin{bmatrix} 6 \\ 1 \\ 3 \end{bmatrix}$$

$4 \times 3 \qquad 3 \times 1 \qquad 4 \times 1$

$$\begin{bmatrix} 12+2+3 \\ 24+4+9 \\ 18+1+9 \\ 30+4+6 \end{bmatrix} = \begin{bmatrix} 17 \\ 37 \\ 28 \\ 40 \end{bmatrix}$$