



# Matrix Multiplication

3x3 multiplied by 3x1

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# Multiply matrices $A_{3 \times 3}$ and $B_{3 \times 1}$

$$A = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix}$$

$$B = \begin{bmatrix} B_{11} \\ B_{21} \\ B_{31} \end{bmatrix}$$

$3 \times 3$

$3 \times 1$

$$\underline{A \cdot B} = \begin{bmatrix} A_{11}B_{11} + A_{12}B_{21} + A_{13}B_{31} \\ A_{21}B_{11} + A_{22}B_{21} + A_{23}B_{31} \\ A_{31}B_{11} + A_{32}B_{21} + A_{33}B_{31} \end{bmatrix}$$

$3 \times 1$

$$= \begin{bmatrix} \sum_{i=1}^3 A_{1i}B_{i1} \\ \sum_{i=1}^3 A_{2i}B_{i2} \\ \sum_{i=1}^3 A_{3i}B_{i3} \end{bmatrix}$$

$3 \times 1$



# Example

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

3x3

$$B = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}$$

3x1

$$A \cdot B = \begin{bmatrix} 1 \cdot (2) + (-1) \cdot (-1) + 0 \cdot (3) \\ \frac{2 \cdot (2)}{4} + \frac{3 \cdot (-1)}{-3} + \frac{(-2) \cdot (3)}{-6} \\ 0 \cdot \frac{(2)}{0} + \frac{(-2) \cdot (-1)}{2} + \frac{4 \cdot (3)}{12} \end{bmatrix} = \begin{bmatrix} 3 \\ -5 \\ 14 \end{bmatrix}$$

3x1