

Matrix Multiplication

rows ↑ *columns* ↗
3x3 multiplied by 3x3
Square *Square*

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Intro to ECSE

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

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

3×3

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

3×3

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

3×3



Example

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

$$B = \begin{bmatrix} 1 & 4 & -1 \\ -1 & 0 & 2 \\ 2 & -3 & 0 \end{bmatrix}_{3 \times 3}$$

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

$$= \begin{bmatrix} 2 & 4 & -3 \\ -3 & 14 & 0 \\ 2 & 0 & -4 \end{bmatrix}_{3 \times 3}$$