

## Matrix multiplication

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$$A = \begin{bmatrix} 1 & 3 \\ -1 & 3 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 0 \\ -1 & 1 \end{bmatrix} \quad AB \neq BA$$

$2 \times 2$

$$(A \cdot B) = \left( \begin{array}{c|c} 1 & 3 \\ \hline -1 & 3 \end{array} \right) \cdot \left( \begin{array}{c|c} 2 & 0 \\ \hline -1 & 1 \end{array} \right) = \begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} \end{bmatrix}$$

$2 \times 2 \quad 2 \times 2$

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

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

$2 \times 2$

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$