

3.6 Multiply Matrices

Matrix Review

$$A = \begin{bmatrix} 3 & -7 \\ 1 & 5 \end{bmatrix}, \quad B = \begin{bmatrix} -10 & 2 \\ 4 & -8 \end{bmatrix}, \quad C = \begin{bmatrix} 3 \\ -2 \end{bmatrix}$$

2×2 2×2 2×1

Find the following:

$$A + B$$

$$\begin{bmatrix} 3 + (-10) & -7 + 2 \\ 1 + 4 & 5 + (-8) \end{bmatrix}$$

$$\begin{bmatrix} -7 & -5 \\ 5 & -3 \end{bmatrix}$$

$$B - C$$

DNE

$$3B - 2A$$

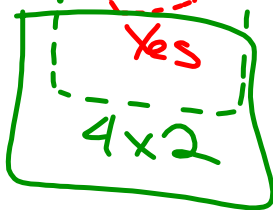
$$\begin{bmatrix} 3(-10) - 2(3) & 3(2) - 2(-7) \\ 3(4) - 2(1) & 3(-8) - 2(5) \end{bmatrix}$$

$$\begin{bmatrix} -36 & 20 \\ 10 & -34 \end{bmatrix}$$

EXAMPLE 1 Describe matrix products

State whether the product AB is defined. If so, give the dimensions of AB .

a. $A: 4 \times 3, B: 3 \times 2$



b. $A: 3 \times 4, B: 3 \times 2$

~~BA
 $3 \times 2 \cdot 4 \times 3$~~

EXAMPLE 2 Find the product of two matrices

$$\begin{matrix} A & B & AB \\ \begin{bmatrix} a & b \\ c & d \end{bmatrix} & \cdot \begin{bmatrix} e & f \\ g & h \end{bmatrix} & = \begin{bmatrix} ae + bg & af + bh \\ ce + dg & cf + dh \end{bmatrix} \end{matrix}$$

Find AB if $A = \begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix}$.

$$\begin{bmatrix} (1)(5) + (4)(9) & (1)(-7) + (4)(6) \\ (3)(5) + (-2)(9) & (3)(-7) + (-2)(6) \end{bmatrix} = \begin{bmatrix} 41 & 17 \\ -3 & -33 \end{bmatrix}$$

EXAMPLE 2 Find the product of two matrices

Find AB if $A = \begin{bmatrix} -3 & 3 \\ 1 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 5 \\ -3 & -2 \end{bmatrix}$

2×2 2×2

Yes

$r1c1$ $\frac{(-3)(1) + (3)(-3)}{}$	$r1c2$ $\frac{(-3)(5) + (3)(-2)}{}$	=
$\frac{(1)(1) + (-2)(-3)}{r2c1}$	$\frac{(1)(5) + (-2)(-2)}{r2c2}$	

$$\begin{bmatrix} -12 & -21 \\ 7 & 9 \end{bmatrix}$$

EXAMPLE 2 Find the product of two matrices

Find AB if $A = \begin{bmatrix} 3 & 2 & -5 \\ 7 & -6 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 8 & 9 \\ 11 & -4 \\ 2 & 6 \end{bmatrix}$

2×3 3×2
 Yes

r_1, c_1 r_1, c_2

$$(3)(8) + (2)(11) + (-5)(2) \quad (3)(9) + (2)(-4) + (-5)(6)$$

$$(7)(8) + (-6)(11) + (-1)(2) \quad (7)(9) + (-6)(-4) + (-1)(6)$$

r_2, c_1

$$\begin{bmatrix} 36 & -21 \\ -12 & 33 \end{bmatrix}$$

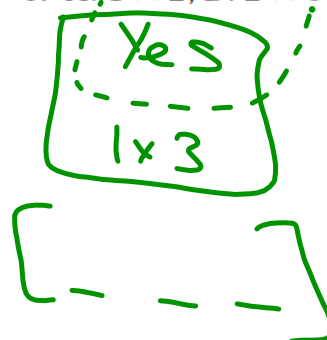
MATRIX PRODUCTS State whether the product AB is defined. If so, give the dimensions of AB .

5. $A: 2 \times 1, B: 2 \times 2$

DNE

6. $A: 1 \times 2, B: 2 \times 3$

Yes
 1×3



MULTIPLYING MATRICES Find the product. If the product is not defined, state the reason.

$$10. \begin{matrix} \underbrace{[3 \quad -1]}_{1 \times 2} \underbrace{\begin{bmatrix} 5 \\ 7 \end{bmatrix}}_{2 \times 1} = \underbrace{\left[(3)(5) + (-1)(7) \right]}_{=} = \underbrace{[8]}_{=} \end{matrix}$$

MULTIPLYING MATRICES Find the product. If the product is not defined, state the reason.

18.
$$\begin{bmatrix} 2 & 5 \\ -1 & 4 \\ 3 & -7 \end{bmatrix} \begin{bmatrix} 0 & 1 & 5 \\ -3 & 10 & -4 \end{bmatrix}$$

$\underbrace{\quad\quad}_{3 \times 2} \quad \underbrace{\quad\quad}_{2 \times 3}$

$\frac{(2)(0) + (5)(-3)}{r_1 c_1}$	$\frac{(2)(1) + (5)(10)}{r_1 c_2}$	$\frac{(2)(5) + (5)(-4)}{r_1 c_3}$	=	$\begin{bmatrix} -15 & 52 & -10 \\ -12 & 39 & -21 \\ -21 & -67 & 43 \end{bmatrix}$
$\frac{(-1)(0) + (4)(-3)}{r_2 c_1}$	$\frac{(-1)(1) + (4)(10)}{r_2 c_2}$	$\frac{(-1)(5) + (4)(-4)}{r_2 c_3}$		
$\frac{(3)(0) + (-7)(-3)}{r_3 c_1}$	$\frac{(3)(1) + (-7)(10)}{r_3 c_2}$	$\frac{(3)(5) + (-7)(-4)}{r_3 c_3}$		