Matrix product AB WORKSHEET.

9/23/03
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$$A = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 4 & 3 & 0 \\ 1 & -3 & 3 \end{bmatrix}$$

a) Compute AB using the rule $C = [A\vec{b}_1 \; A\vec{b}_2 \cdots A\vec{b}_p]$:
(write numbers over the dots)

$$\left.\begin{aligned} A\vec{b}_1 &= \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} \cdot \\ \cdot \end{bmatrix} = \begin{bmatrix} \cdot \\ \cdot \end{bmatrix} \\ A\vec{b}_2 &= \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} \cdot \\ \cdot \end{bmatrix} = \begin{bmatrix} \cdot \\ \cdot \end{bmatrix} \\ A\vec{b}_3 &= \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} \cdot \\ \cdot \end{bmatrix} = \begin{bmatrix} \cdot \\ \cdot \end{bmatrix} \end{aligned}\right\} \text{ so } C = \begin{bmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{bmatrix}$$

b) Compute AB using the row-column dot product rule :

$$c_{11} = \underbrace{\begin{bmatrix} \cdot & \cdot \end{bmatrix}}_{\text{1st row of } A} \cdot \underbrace{\begin{bmatrix} \cdot \\ \cdot \end{bmatrix}}_{\text{1st column of } B} = \cdot$$

$$C = \begin{bmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{bmatrix}$$

Now do the same for c_{21}, c_{12}, c_{22}, c_{13}, c_{23}.

c) what is BA ?

d) $A = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}$

What is $AB = \begin{bmatrix} \cdot & \cdot \\ \cdot & \cdot \end{bmatrix}$?

What is $BA = \begin{bmatrix} \cdot & \cdot \\ \cdot & \cdot \end{bmatrix}$?

are they equal?

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~ SOLUTIONS ~

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

a) Compute AB using the rule $C = [A\vec{b}_1 \ A\vec{b}_2 \cdots A\vec{b}_p]$:
(write numbers over the dots)

$$A\vec{b}_1 = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 4 \\ 1 \end{bmatrix} = \begin{bmatrix} 11 \\ 4 \end{bmatrix}$$

$$A\vec{b}_2 = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 3 \\ -3 \end{bmatrix} = \begin{bmatrix} -3 \\ 3 \end{bmatrix}$$

$$A\vec{b}_3 = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 \\ 3 \end{bmatrix} = \begin{bmatrix} 9 \\ 0 \end{bmatrix}$$

so $C = \begin{bmatrix} 11 & -3 & 9 \\ 4 & 3 & 0 \end{bmatrix}$

b) Compute AB using the row-column dot product rule :

$$c_{11} = \underbrace{\begin{bmatrix} 2 & 3 \end{bmatrix}}_{\text{1st row of } A} \cdot \underbrace{\begin{bmatrix} 4 \\ 1 \end{bmatrix}}_{\text{1st column of } B} = \cdot$$

$$C = \begin{bmatrix} 11 & -3 & 9 \\ 4 & 3 & 0 \end{bmatrix}$$

Now do the same for $c_{21}, c_{12}, c_{22}, c_{13}, c_{23}$

gets same, of course

c) What is BA ?

doesn't exist.

$$\overset{3}{\longleftrightarrow} \begin{bmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{bmatrix} \ 2\updownarrow \begin{bmatrix} \cdot & \cdot \\ \cdot & \cdot \end{bmatrix}$$

sizes don't match, can't do.

d) $A = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}$

What is $AB = \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}$?

What is $BA = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$?

are they equal?

No: doesn't commute