

Matrix Multiplication

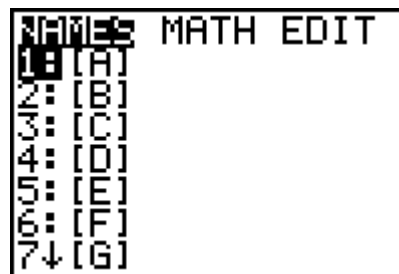
(Using a TI-83 Plus Graphing Calculator)

Getting Started!

Step 1: Turn the calculator on – press **ON**

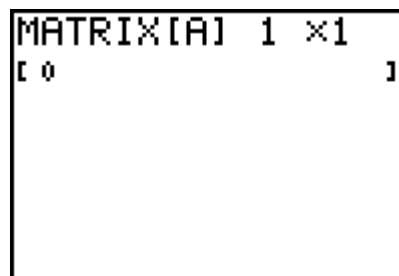
Step 2: Go to the matrix menu – press **2nd****[x⁻¹]**

The screen should look like this:



Step 3: Move to the edit command by pressing **▶▶**. To edit matrix A, press **ENTER**.

The screen should look like this:



Step 4: Edit the matrix. To make matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$, do the following steps:

To set the dimensions first, press **3****ENTER** **2****ENTER**

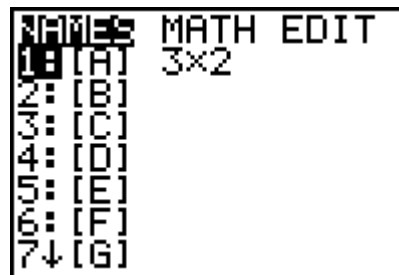
To put entries into the matrix, press

1**ENTER** **2****ENTER** **3****ENTER** **4****ENTER** **÷****ENTER** **6****ENTER**

The screen should look like this:



Step 5: To edit matrix B, press $\boxed{2\text{nd}}\boxed{[x^{-1}]}$, which will take you back to the following screen:



To edit matrix B, move your cursor to EDIT by pressing $\boxed{\rightarrow}\boxed{\rightarrow}$ and then to matrix B by pressing $\boxed{\downarrow}$.

Notice that the cursor is on 2: which is matrix B

To display matrix B, press $\boxed{\text{ENTER}}$.

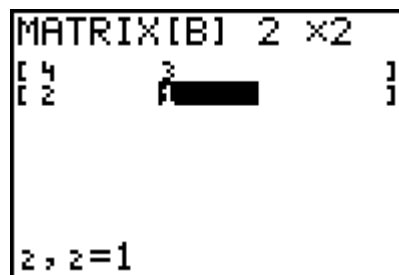
Step 6: Edit the matrix. To make matrix $B = \begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix}$, do the following steps:

To set the dimensions first, press $\boxed{2}\boxed{\text{ENTER}}\boxed{2}\boxed{\text{ENTER}}$

To put entries into the matrix, press

$\boxed{4}\boxed{\text{ENTER}}\boxed{3}\boxed{\text{ENTER}}\boxed{2}\boxed{\text{ENTER}}\boxed{1}\boxed{\text{ENTER}}$

The matrix should look like this:



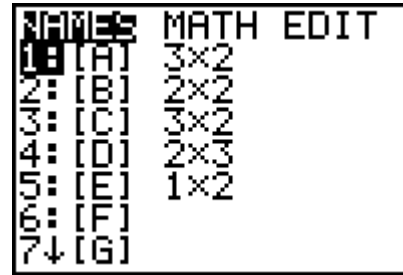
Matrix A and B are now done.

Step 7: Use the above procedure to make the following matrices:

$$C = \begin{bmatrix} 3 & 4 \\ 5 & 2 \\ 1 & 6 \end{bmatrix} \quad D = \begin{bmatrix} 6 & 3 & 1 \\ 5 & 2 & 4 \end{bmatrix} \quad E = \begin{bmatrix} 1 & 2 \end{bmatrix}$$

Note: If a mistake is made when entering the data, just highlight the mistake using the arrow keys and re-enter the correct data.

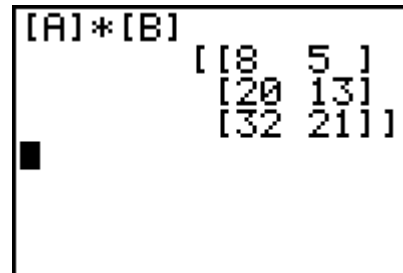
When all of the matrices have been entered, press $\boxed{2\text{nd}}\boxed{x^{-1}}$ and the following screen should be displayed:



Multiplying Matrices

- Step 1: Press $\boxed{2\text{nd}}\boxed{\text{MODE}}$ which will produce a blank screen.
- Step 2: To multiply matrix A times matrix B, press $\boxed{2\text{nd}}\boxed{x^{-1}}$. Since matrix A is already highlighted, press $\boxed{\text{ENTER}}$. [A] will then be displayed on the screen. Press $\boxed{\times}$ and then $\boxed{2\text{nd}}\boxed{x^{-1}}$ to get to the matrix screen. To get to matrix B, press $\boxed{\downarrow}$ and then $\boxed{\text{ENTER}}$. To get the new matrix press $\boxed{\text{ENTER}}$.

The screen should look like this:



Then fill in the following:

$$\begin{matrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} & \cdot & \begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} & = & \begin{bmatrix} 8 & 5 \\ 20 & 13 \\ 32 & 21 \end{bmatrix} \\ \text{Dim. of A} & & \text{Dim. of B} & & \text{Dim. of Resulting Matrix} \\ 3 \times 2 & & 2 \times 2 & & 3 \times 2 \end{matrix}$$

- Step 3: Using the same procedure above (step 2), multiply matrix D times matrix C.

$$\begin{bmatrix} 6 & 3 & 1 \\ 5 & 2 & 4 \end{bmatrix} \cdot \begin{bmatrix} 3 & 4 \\ 5 & 2 \\ 1 & 6 \end{bmatrix} = \begin{bmatrix} & & & & & \\ & & & & & \\ & & & & & \end{bmatrix}$$

Dim. of D Dim. of C Dim. of Resulting Matrix
 ___x___ ___x___ ___x___

Step 4: Now multiply matrix E times matrix D.

$$\begin{bmatrix} 1 & 2 \end{bmatrix} \cdot \begin{bmatrix} 6 & 3 & 1 \\ 5 & 2 & 4 \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix}$$

Dim. of E Dim. of D Dim. of Resulting Matrix
 ___x___ ___x___ ___x___

Step 5: Multiply matrix B times matrix A.

$$\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix}$$

Dim. of B Dim. of A Dim. of Resulting Matrix
 ___x___ ___x___ ___x___

*If you receive "ERR: DIM MISMATCH," select "1:Quit" by pressing **ENTER**. Put "Error" in the Resulting Matrix, but fill in the dimensions of the original matrices.*

Step 6: Multiply matrix B times matrix C.

$$\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \cdot \begin{bmatrix} 3 & 4 \\ 5 & 2 \\ 1 & 6 \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix}$$

Dim. of B Dim. of C Dim. of Resulting Matrix
 ___x___ ___x___ ___x___

Step 7: Multiply matrix E times matrix E.

$$\begin{bmatrix} 1 & 2 \end{bmatrix} \cdot \begin{bmatrix} 1 & 2 \end{bmatrix} = \begin{bmatrix} \end{bmatrix}$$

Dim. of E Dim. of E Dim. of Resulting Matrix
 ___x___ ___x___ ___x___

Questions:

1. Why do you think you were able to multiply the matrices in steps 2, 3, and 4? Do you notice a pattern? What do the original and the resulting matrices have in common in reference to their dimensions?

2. What do you notice about the dimensions of the resulting matrix?

3. Why do you think you were not able to multiply the matrices in steps 5, 6, and 7? Hint: look at the dimensions

Extended Discovery:

Looking back at the matrices that were multiplied together, how do you think the new entries in the matrix were created? What numbers were multiplied and added together to create the new entry?

For example, look at the following:

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \quad B = \begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \quad A \cdot B = \begin{bmatrix} 8 & 5 \\ 20 & 13 \\ 32 & 21 \end{bmatrix}$$

Using matrix A and B , how did you get the entries in matrix $A \cdot B$?
