

## Basic Matrix Manipulation with a TI-Nspire

Often, a matrix may be too large or too complex to manipulate by hand. For these types of matrices, we can employ the help of graphing calculators to solve them.

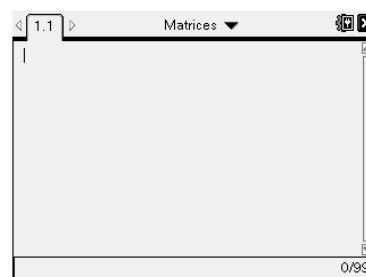
Throughout the directions, words appearing in **bold** indicate calculator buttons. To learn more about your TI-Nspire, consult the manufacturer's product manual.

I will be using a TI-Nspire CAS with Clickpad running software version 2.1 for these directions. The menus and buttons may differ slightly between the Clickpad, Touchpad, and different software versions.

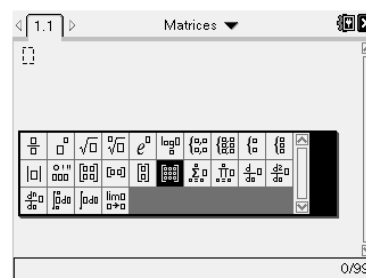
### ***Inputting/Editing Matrices:***

The TI-Nspire family of calculators provides a very easy way to input matrices directly onto the Calculator screen. This gives the advantage of not having to navigate through menus to enter and edit a matrix.

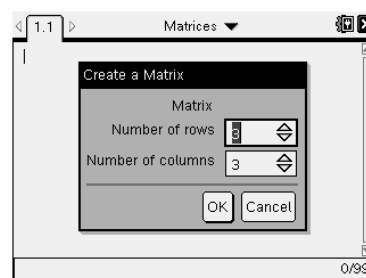
Begin by adding a calculator page to an existing document, or by creating a new document and choosing "Add Calculator".



Press **ctrl** → **mat** to display the Template window. If necessary, move the selection to the 3x3 matrix symbol and press **enter**. This template will allow us to create a matrix of any size.

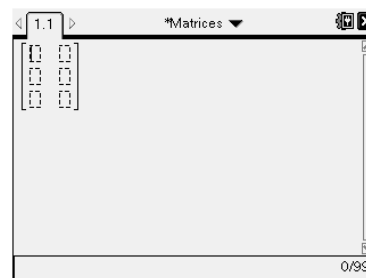


Since we are creating a new matrix, the calculator displays a default setting of three rows and three columns. Let's say we want a 3x2 matrix instead. Press **tab** to switch to the "Number of columns" box and type a "2". Press **enter**.

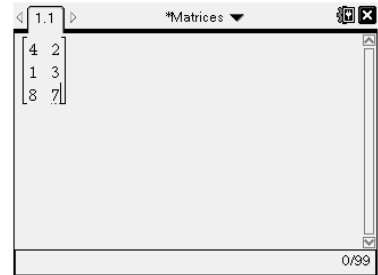


As you can see, we now have a 3x2 empty matrix waiting on the screen. Use a combination of numbers and arrow keys to fill the

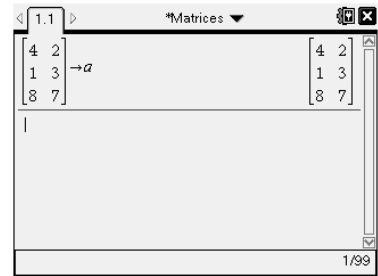
template with the matrix  $\begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 8 & 7 \end{bmatrix}$ .



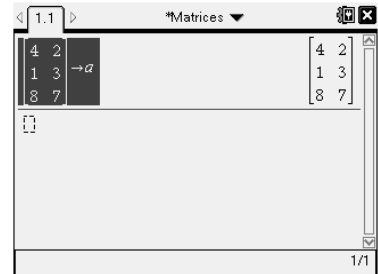
And this is what you should have. Now we can use this matrix as is, or we can store it for repeated use. To store it, move the cursor out all the way to the right side of the matrix, then press  $\text{ctrl} \rightarrow \text{sto} \rightarrow \text{var}$ . Type the letter “a” and press  $\text{enter}$ .



What we just did is to store the matrix into a variable titled “a”. When we need to use this matrix, we can now just use the variable “a” instead of having to retype the matrix again.



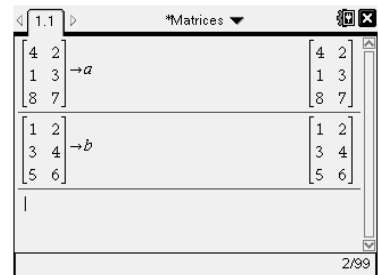
To edit this matrix, press the **UP** arrow key twice until the matrix with the arrow is selected, and then press  $\text{enter}$  to paste it to the next line. Edit the values in the matrix and press  $\text{enter}$  to store it as variable “a”. If a whole new matrix with a different dimension is needed, then create the matrix as shown above and store it as variable “a”.



### ***Adding and Subtracting Matrices:***

Enter two matrices into the calculator as shown above, one as “a” and

the other as “b”. For this example,  $a = \begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 8 & 7 \end{bmatrix}$  and  $b = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$ .

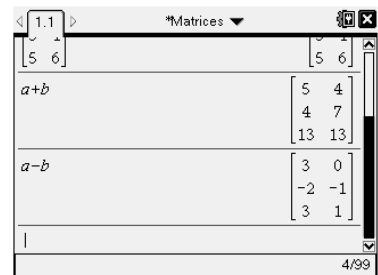


To add these two matrices together, do the following:

$\text{A} \rightarrow \text{+} \rightarrow \text{B} \rightarrow \text{enter}$

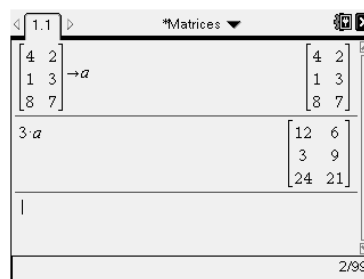
Subtracting matrices is similar, except type a subtraction sign instead of an addition sign.

(Remember, matrices must be the same dimension in order to add or subtract them. The calculator will return an error if the dimensions are not the same.)



## Multiplying Matrices:

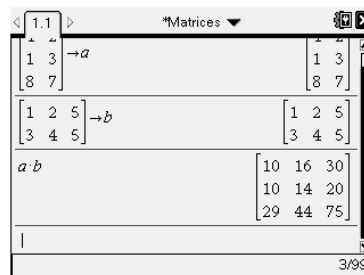
Matrix multiplication is easy on the TI-Nspire. For scalar multiplication, multiply the number times the matrix just like multiplying two numbers together. For example, to multiply 3 times the matrix “a”, type:  $\boxed{3}$  →  $\boxed{\frac{[a]}{x}}$  →  $\boxed{A}$  →  $\boxed{\text{enter}}$ .



Multiplying two matrices together is just as easy. However, remember to have the correct matrix dimensions, otherwise the calculator will

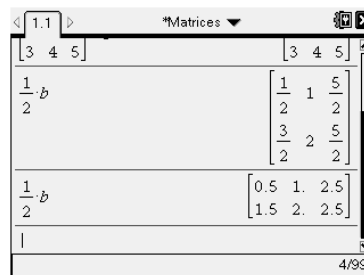
give a “Dimension” error. For this example,  $a = \begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 8 & 7 \end{bmatrix}$  and  $b =$

$\begin{bmatrix} 1 & 2 & 5 \\ 3 & 4 & 5 \end{bmatrix}$ . Try duplicating my screen by multiplying “a” and “b” together.



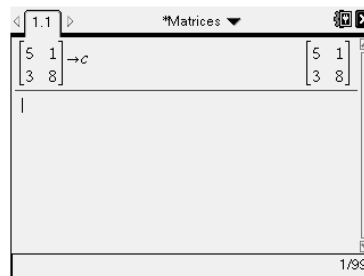
Notice that if the scalar is a fraction, the TI-Nspire will return fractions in the answer. If decimals are desired, press  $\boxed{\text{ctrl}}$  →  $\boxed{\text{enter}}$  after the initial multiplication.

Unlike some other TI graphing calculators with matrices, the TI-Nspire understands “b/2” to be the same as “(1/2)b”.

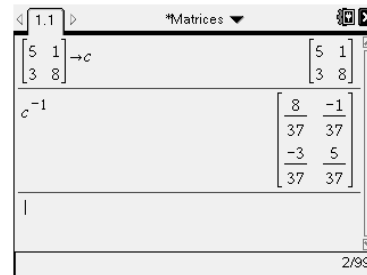


## Calculating the Inverse:

To calculate a matrix inverse, first input  $\begin{bmatrix} 5 & 1 \\ 3 & 8 \end{bmatrix}$  as matrix “c” into the TI-Nspire. (Of course the matrix must be square, otherwise the calculator will return a “Dimension” error).



Press  $\text{C}$   $\rightarrow$   $\sqrt{x}$   $\rightarrow$   $\frac{\square}{\square}$   $\rightarrow$   $1$   $\rightarrow$   $\frac{\square}{\square}$ .

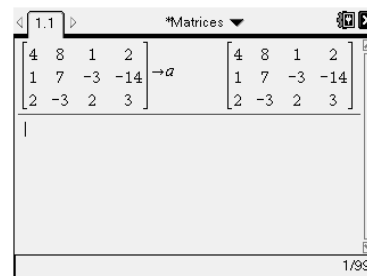


**Gaussian and Gauss-Jordan Elimination:**

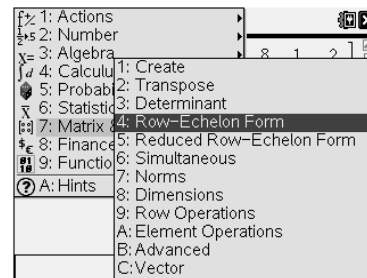
Let's use these two methods to solve the following system of equations:

$$\left. \begin{array}{l} 4x + 8y + z = 2 \\ x + 7y - 3z = -14 \\ 2x - 3y + 2z = 3 \end{array} \right\} \rightarrow \begin{bmatrix} 4 & 8 & 1 & 2 \\ 1 & 7 & -3 & -14 \\ 2 & -3 & 2 & 3 \end{bmatrix}$$

Store the augmented matrix as matrix "a".

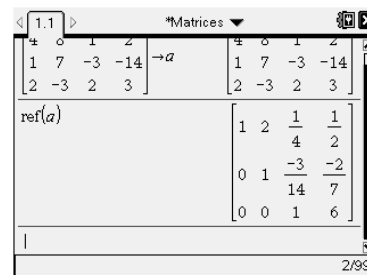


Let's first try solving the system using the Gaussian Elimination method. Press the  $\text{menu}$  button, scroll down to "Matrix & Vector", press  $\frac{\square}{\square}$  (or **RIGHT** arrow key), and scroll down to "Row-Echelon Form". Press  $\frac{\square}{\square}$ .



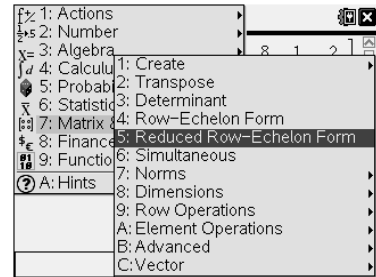
Press the  $\text{A}$  button and then  $\frac{\square}{\square}$ .

Note that if you swap rows, the matrix given by the "ref(" command may not match the matrix obtained by performing the Gaussian elimination by hand. That is fine; the final solution will be the same.

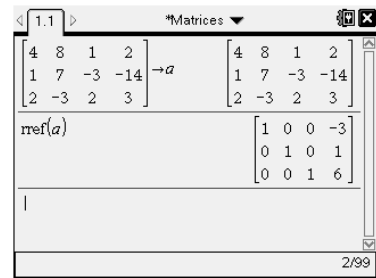


Now let's try the Gauss-Jordan elimination method. If you have calculated this method by hand, then you know that the answer will be obtained at the end. The same applies to the TI-Nspire.

Press the **(menu)** button, scroll down to “Matrix & Vector”, press **(enter)** (or **RIGHT** arrow key), and scroll down to “Reduced Row-Echelon Form”. Press **(enter)**.



Press the **(A)** button and then **(enter)**. There we go! The solution to our system of equations is (-3, 1, 6).



Now what if we have a dependent or inconsistent system? The “rref(” command will still work on the augmented matrices of these systems, but with different results than above. For a dependent system, a matrix with the last row all zeros would be returned (first picture on the right). For an inconsistent system, a matrix would be returned where the last row contains all zeros except for a final element of “1” (second picture on the right).

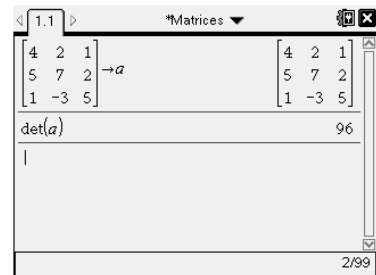


### Determinants:

Store this matrix as matrix “a” in the calculator:

$$\begin{bmatrix} 4 & 2 & 1 \\ 5 & 7 & 2 \\ 1 & -3 & 5 \end{bmatrix}$$

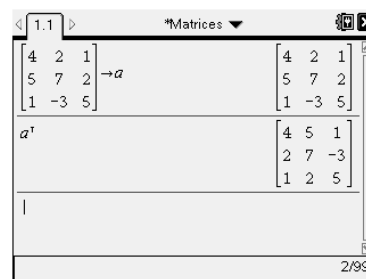
To calculate the determinant of “a”, press the **(menu)** button, scroll down to “Matrix & Vector”, press **(enter)** (or **RIGHT** arrow key), and scroll down to “Determinant”; press **(enter)**. Press the **(A)** button and then **(enter)**. That’s it! The determinant of this matrix is 96.



## Transpose:

Let's calculate the transpose of  $\begin{bmatrix} 4 & 2 & 1 \\ 5 & 7 & 2 \\ 1 & -3 & 5 \end{bmatrix}$ . If it is not there

already, input this matrix as "a" in the calculator. Press **(A)**, then **(menu)**, scroll down to "Matrix & Vector", press **(enter)** (or **RIGHT** arrow key), and scroll down to "Transpose"; press **(enter)**. Press **(enter)** to run the command.



## Deleting Matrices from the Calculator:

Deleting matrices is easy on the TI-Nspire. Press **(sto>var)** to display the list of variables stored in the document. Notice that the TI-Nspire identifies the matrix variables by displaying a little matrix icon beside the name. To delete one of these variables, press **(menu)**, select "Actions", then press **(enter)** (or **RIGHT** arrow key), and scroll down to "Delete Variable"; press **(enter)**. Press **(sto>var)** to display the variable list and select the matrix you want to delete; press **(enter)** to paste the name to the screen. Press **(enter)** to run the command.

