Matrix in calculator TI-83

For other models of calculators, please refer to the Guidebook under the index of Matrix

A. Define a Matrix

1. Pick up a name for the matrix.
   Press \text{[MATRIX]} . You may see the following on screen:

   \begin{center}
   \begin{tabular}{ccc}
   \text{NAME} & \text{MATH} & \text{EDIT} \\
   A & \text{} & \text{} \\
   B & \text{} & \text{} \\
   C & \text{} & \text{} \\
   \vdots & \text{} & \text{}
   \end{tabular}
   \end{center}

   Then move arrow $\text{\text{\textdownarrow},\uparrow\uparrow}$ twice to \text{EDIT}, press \text{ENTER} . Move the arrow $\text{\textdownarrow}$ to Choose a name for the matrix to be defined, say, $A$.

2. Input the entries of the matrix
   
   \begin{itemize}
   \item 1. Type, say, $3\text{[ENTER]} \times 4\text{[ENTER]}$ for a matrix of the size $3 \times 4$.
   \item 2. Type all data entries, one by one, followed each time by the \text{ENTER}. You may move the $\text{\textdownarrow}$, $\text{\textuparrow}$ to revise the data at every entry of the matrix $A$. In this example, You should input a total $3 \times 4 = 12$ of entries.
   \item 3. Having done that, press \text{2nd} followed by \text{QUIT}.
   \end{itemize}

B. Display a matrix

Press \text{[MATRIX]} and move $\text{\textdownarrow}, \text{\textuparrow}$ to the name of the matrix, say, $A$. The press the \text{ENTER} twice. You can now see the matrix on screen for double check.

Example. Enter the $3 \times 4$ matrix

$\begin{bmatrix}
2 & 1 & 3 & -1 \\
-1 & 1 & 3 & 8 \\
2 & -2 & -6 & -16
\end{bmatrix}$. 

1
C. Solve linear system

The purpose of this section is to show how to use calculator solve linear system with method of reduction.

Example. Solve the system

\[
\begin{align*}
2x + y + 3z &= -1 \\
-x + y + 3z &= 8 \\
2x - 2y - 6z &= -16
\end{align*}
\]

1. Define the augmented matrix. Following the steps in A, B to enter and define the augmented matrix (AUG) (it is the one you got on page 1:)

\[
A = \begin{bmatrix}
2 & 1 & 3 & -1 \\
-1 & 1 & 3 & 8 \\
2 & -2 & -6 & -16
\end{bmatrix}.
\]

(In your screen you might not be able to see the vertical bar |)

2. Solving.

- 1. Press [MATRIX], move \(\rightarrow\) to [MATRX]. Move arrow \(\triangle\) until you can click on B : \(\text{ref}\). You should see the \(\text{ref}\) on the screen. Click at [ENTER].
- 2. Press again [MATRIX], move \(\triangledown\), \(\triangle\) to click on the item under the NAME, say, A, of the matrix you want to recall.

Then press [ENTER]. You may see now “ \(\text{ref}\) (A” on screen. type then the sign “)”. Finally press [ENTER].

You can see the result on screen that

\[
\begin{bmatrix}
1 & 0 & 0 & -3 \\
0 & 1 & 3 & 5 \\
0 & 0 & 0 & 0
\end{bmatrix}.
\]

(Does this matrix remind you of something? Look at the 3rd row of this matrix, all entries are zero: the linear system has infinitely many solutions!)

The calculator has done the job of its part. You have to do your own job for the remainder. All you need to do is to translate the above resulting matrix into a system of equations:

\[
\begin{align*}
x &= -3 \\
y + 3z &= 5.
\end{align*}
\]

this \(\implies\) \(x = -3\)

\(y = 5 - 3z\)

where \(z\) can take arbitrary value of number.

Example Solve the linear system

\[
\begin{align*}
x + y + z + w &= 4 \\
-x + 2y + z &= 0 \\
2x + 3y + z - w &= 6 \\
-2x + y - 2z + 2w &= -1
\end{align*}
\]

\((x = 2, y = 1, z = 0, w = 1.\)
D. Other operations

Compute the determinant $\det(A)$.

- 1. Following the steps in $A$, $B$ to define the matrix $A$
   Say let
   
   \[
   A = \begin{bmatrix}
   1 & 1 & 1 & 1 \\
   -1 & 2 & 1 & 0 \\
   2 & 3 & 1 & -1 \\
   -2 & 1 & -2 & 2
   \end{bmatrix}.
   \]

- 2. Press $\text{MATRX}$ and move $\triangleright$ to $\text{MATH}$. Click on the item $1$: $\text{det}$). Press $\text{ENTER}$. You should see “det (”) on screen.

- 3. Press $\text{MATRX}$. Move $\triangledown$, $\triangle$ and click on the NAME, say, $A$, of the matrix you want to manipulate. The screen should display the “det([A])” to you. You will get the result by typing “)’” and pressing $\text{ENTER}$ to have

   \[\det(A) = -35.\]

Find the transpose $A^T$.

- 1. Recall the pre-defined matrix $A$ on screen as described in $A$, $B$.
- 2. Press $\text{MATRX}$, move $\triangleright$ to the $\text{MATH}$, lower down the $\triangledown$ clicking on the $2$: $\text{T}$. Finally press $\text{ENTER}$.

Compute the the inverse $A^{-1}$.

- 1. Recall the pre-defined matrix $A$ as described in sections $A$, $B$.
- 2. You may see the $A$ on screen, then press the key $x^{-1}$ and enter the $\text{ENTER}$

   \[
   A^{-1} = \begin{bmatrix}
   0.2 & -0.4 & 0.2 & 0 \\
   -0.057 & 0.114 & 0.229 & 0.143 \\
   0.314 & 0.371 & -0.257 & -0.286 \\
   0.543 & -0.086 & -0.171 & 0.143
   \end{bmatrix}.
   \]

Compute the multiplication $A * B$.

- 1. Recall the pre-defined matrix $A$ on the screen.
- 2. Press the multiplication key $\times$.
- 3. Recall the pre-define matrix $B$ on the screen. Press then the ket $\text{ENTER}$.

Compute the power of $A^n$.

- 1. Recall the pre-defined matrix $A$ on the screen.
- 2. Press the key $\wedge$ and the number of the exponent $n$. Then press the key $\text{ENTER}$.
On Calculator TI-82

TI-82 can do almost the same jobs, except for solving system of equations, as that of model TI-83:

<table>
<thead>
<tr>
<th>TI-83</th>
<th>TI-82</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define a matrix</td>
<td>Yes</td>
</tr>
<tr>
<td>Display matrix</td>
<td>Yes</td>
</tr>
<tr>
<td>Transpose $A^T$</td>
<td>Yes</td>
</tr>
<tr>
<td>Inverse $A^{-1}$</td>
<td>Yes</td>
</tr>
<tr>
<td>Power $A^n$</td>
<td>Yes</td>
</tr>
<tr>
<td>$k \cdot A$</td>
<td>Yes</td>
</tr>
<tr>
<td>$A \cdot B$, $A \pm B$</td>
<td>Yes</td>
</tr>
<tr>
<td>Solve linear system</td>
<td>Yes and No</td>
</tr>
</tbody>
</table>

In case that you want to solve a system of linear equations using a calculator TI-82, say

$$\begin{align*}
a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n &= b_1 \\
a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n &= b_2 \\
\vdots & \vdots & \vdots & \vdots & \vdots \\
a_{n1}x_1 + a_{n2}x_2 + \cdots + a_{nn}x_n &= b_n.
\end{align*}$$

Denote the $n$ by $n$ matrix $A$ and $n$ by $1$ matrix $B$

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix}, \quad B = \begin{pmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{pmatrix}. $$

Case 1. $A$ is non-singular. That is, the inverse $A^{-1}$ exists. Then the solution is $A^{-1} \cdot B$.

To do this,

- 1. Press [MATRIX] to recall the pre-defined matrix $A$ on screen. Then press the key $[x^{-1}]$ to get the matrix $A^{-1}$.
- 2. Press the key $\times$.
- 3. Press [MATRIX] to recall the pre-defined matrix $B$. Finally press [ENTER].

Example. Solve the system of linear equations:

$$\begin{align*}
x + y + z + w &= 4 \\
-x + 2y + z &= 0 \\
2x + 3y + z - w &= 6 \\
-2x + y - 2z + 2w &= -1
\end{align*}$$

$A = \begin{pmatrix} 1 & 1 & 1 & 1 \\ -1 & 2 & 1 & 0 \\ 2 & 3 & 1 & -1 \\ -2 & 1 & -2 & 2 \end{pmatrix}$, $B = \begin{pmatrix} 4 \\ 0 \\ 6 \\ -1 \end{pmatrix}$, $A^{-1} \cdot B = \begin{pmatrix} 2 \\ 1 \\ 0 \\ 1 \end{pmatrix}$.

$(x = 2, y = 1, z = 0, w = 1.)$

Case 2. $A^{-1}$ does not exist.

In such case, you have to be very patient to perform the method of row reduction to get the reduced matrix using row operations. See Matrix Math Menu, Items 7-10 & A, Duidebook, p.10-12.