

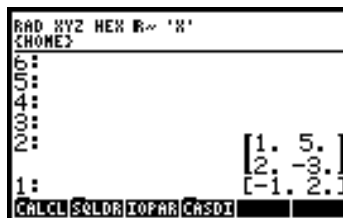
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Calculator Lesson 30

The Matrix Writer and Matrix Arithmetic

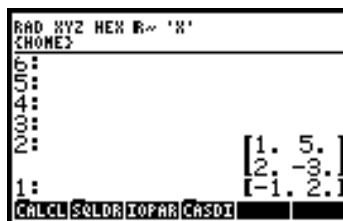
As promised in Lesson 25, this lesson contains a complete discussion of the Matrix Writer. You may wish to review the introduction to the Matrix Writer in Lesson 25 before continuing with this lesson.

Press LS MTRW to get into the Matrix Writer. The function F1-EDIT was discussed in Lesson 25. The command F2-VEC is important only if you are using the Matrix Writer to create a vector or a matrix with only 1 row. When used as described in Lesson 25 it will produce a vector. If VEC is not active (the black square not showing in the menu) the procedure given in Lesson 25 will produce a matrix with one row. Although these will look almost the same on the stack, they are, in fact, very different. The calculator shows a vector as a row but it is actually treated as a column vector. Thus, to find the



product $\mathbf{A}\mathbf{v}$ where \mathbf{A} is a 2 x 2 matrix and \mathbf{v} is a 2

dimensional vector we would expect to have \mathbf{A} on level 2 of the stack and \mathbf{v} on level 1 as shown in the top figure on the right. This looks like the dimensions are wrong and should not work, but it does. Pressing the multiplication key will give the correct answer. On the other hand, if the item on level 1 is a 1 x 2 matrix as shown in the lower figure to the right, the dimensions are wrong and the multiplication will not work. Note that the difference between the vector and the 1 x 2 matrix is that the matrix has brackets that seem to be in bold face. This view is with the calculator display set to "Textbook." To see the difference between a vector and a matrix more clearly go to MODE F4-DISP and uncheck "Textbook."



Note that the difference between the vector and the 1 x 2 matrix is that the matrix has brackets that seem to be in bold face. This view is with the calculator display set to "Textbook." To see the difference between a vector and a matrix more clearly go to MODE F4-DISP and uncheck "Textbook."

To create a matrix of more than one row, it doesn't matter if VEC is active or not. Suppose we want to enter a 4 x 5 matrix using the Matrix Writer. The matrix can be entered by rows or by columns depending on which of F5-GO→ or F6-GO↓ is active respectively. Let us assume we have F5-GO→ active so that we will enter by rows. When you enter the Matrix Writer the cursor is set at the 1-1 position. Key in the first number and press ENTER. The cursor moves to the next location to the right. Continue entering the remaining elements of the first row and stop with the cursor in the 1-6 position. Press DA to move the cursor to the 2-6 position, then press RS LA to move the cursor to the beginning of the second row. (Note: Pressing RS followed by one of the arrow keys will move the cursor as far as possible in the direction of the selected arrow.) Now enter the elements of the second row as the first row was entered. Note, however, that this time the cursor automatically returns to the beginning of the next row when the last element of a row is entered. If F6-GO↓ is active, a similar procedure will enter the matrix a column at a time. When the matrix is complete, press ENTER to put it on the stack.

It is also possible to do arithmetic as values are entered into the matrix. For example, suppose you want the current cell to have the value $\sqrt{2}$. Press 2 \sqrt{x} ENTER,

and the square root of 2 will be entered into the cell. As another example, suppose you want the value in the current cell to be $8/3$. Press 8 SPC 3 \div ENTER.

The commands F3- \leftarrow WID and F4-WID \rightarrow in the Matrix Writer control the width of the columns. Create a matrix with elements that have several digits then try these two commands and observe the results.

Now press NXT and find 6 more commands. The first four of these are used to insert or delete a row or column. For example, to insert a new row between existing rows 2 and 3 place the cursor anywhere in row 3 and press F1-+ROW. A new row 3 of all zeros will be added and the old row 3 and any rows that follow it will move down one row in the matrix. To delete column 3, place the cursor anywhere in column 3 and press F4--COL. Column three will be removed and the old column 4 and all those that follow will be moved one column to the left. The command F5- \rightarrow STK will copy the value in the current cell location of the cursor to the stack. The command F6-GOTO is useful when working with a large matrix. Pressing F6-GOTO opens a dialog box. Enter the row and column number of where you want to the cursor to go then press ENTER.

Press NXT again and you will find one more command. F1-DEL will change the content of the current cursor location to zero.

Assuming the matrices on levels 1 and 2 of the stack have compatible dimensions, the +, - and \times keys do exactly what you would expect them to do. Division of matrices is generally not defined, but the \div key also does something on the calculator. If matrices **A** and **B** are on levels 2 and 1 on the stack respectively, if **B** is nonsingular, and if the dimensions of the two matrices are compatible, pressing \div will compute $\mathbf{B}^{-1}\mathbf{A}$. In particular, a system of equations $\mathbf{Ax} = \mathbf{b}$ where A is a nonsingular square matrix can be solved by placing the vector **b** on level 2, **A** on level 1 and pressing \div . It should also be noted that the $1/x$ key will find the inverse of a nonsingular square matrix and LS x^2 will square a matrix.

NOTE: The paragraph below applies only to the HP-49g+. Pressing 3 Y^3 works correctly to find the cube of a matrix on the HP-50g, but not on its predecessors.

Finding higher powers of a matrix, however, does present a small problem. Pressing 3 Y^x , for example, will not compute the cube of the matrix on level 1. The problem is that the calculator interprets the 3 as a real number, not as an integer. To force it to an integer press 3 LS CONVERT F4-REWRI NXT NXT F1-R \rightarrow I. The three is now an integer (note that there is no decimal point) and pressing Y^x will do the job.

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