Your Next Session with Macsyma 2.2 for Windows

Now that you have finished *Your First Session with Macsyma*, let's look at some of Macsyma's more specialized features for data handling, graphics, scientific visualization, word processing, and fast numerical linear algebra.

1. Starting Macsyma

After you have installed Macsyma, start the program by double-clicking with left-mouse on the Macsyma icon in the Macsyma folder or program group to open the Macsyma Front End window. Select File-New to choose a template notebook for Macsyma. The dialog looks something like:

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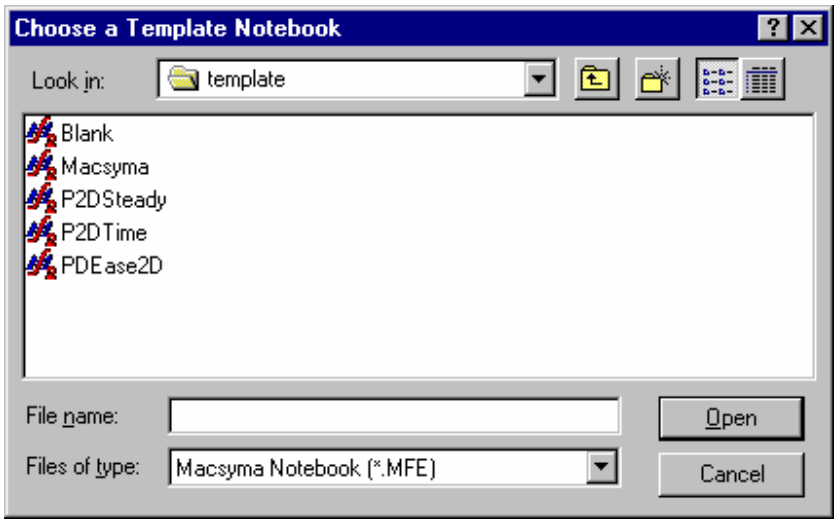
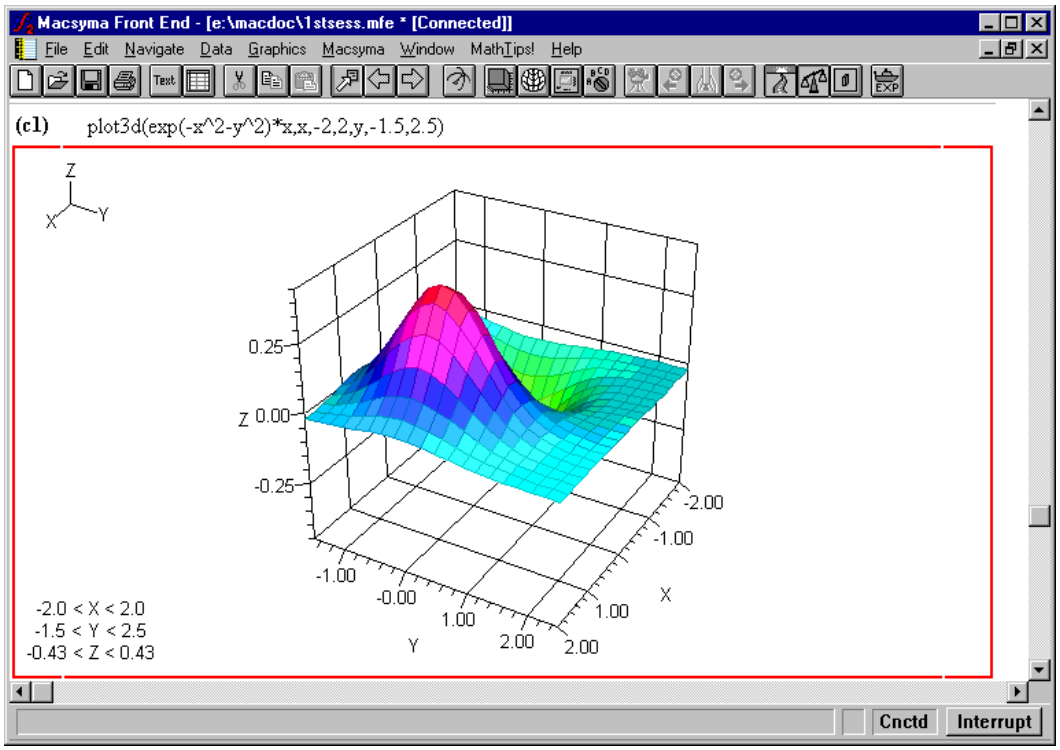


The Macsyma Front End program also serves as the Front End for PDEase2D. You can select PDEase2D, Macsyma or blank template notebooks. Right now, select Macsyma to open an empty Macsyma notebook document.

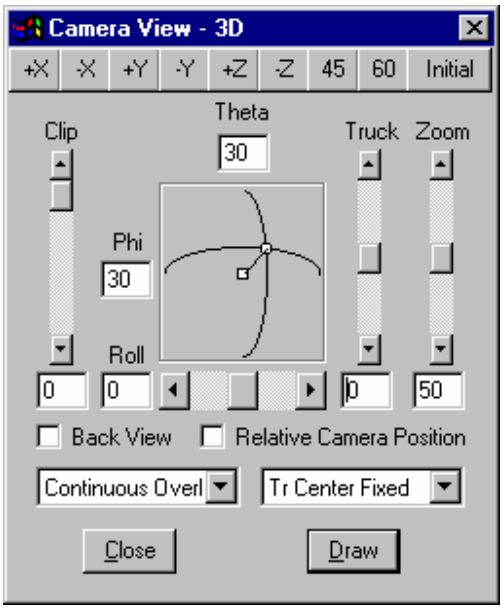
2. Manipulating Macsyma Graphics

To view a 3D plot, make sure you have selected a Macsyma notebook document that is connected to a Macsyma Math Engine. Type demo(plot3d);. When the first plot appears, exit the demo by pressing the Escape key. Select the plot by clicking on the frame of the plot (*not* on the object itself). A box like that in the example below appears around the plot:



2.1. Altering the View of a Plot

- Select a graphics section. Then click on the Graphics menu and choose Camera View.[1] A dialog box containing a camera gimbal icon, various sliders, and other view controls appears:



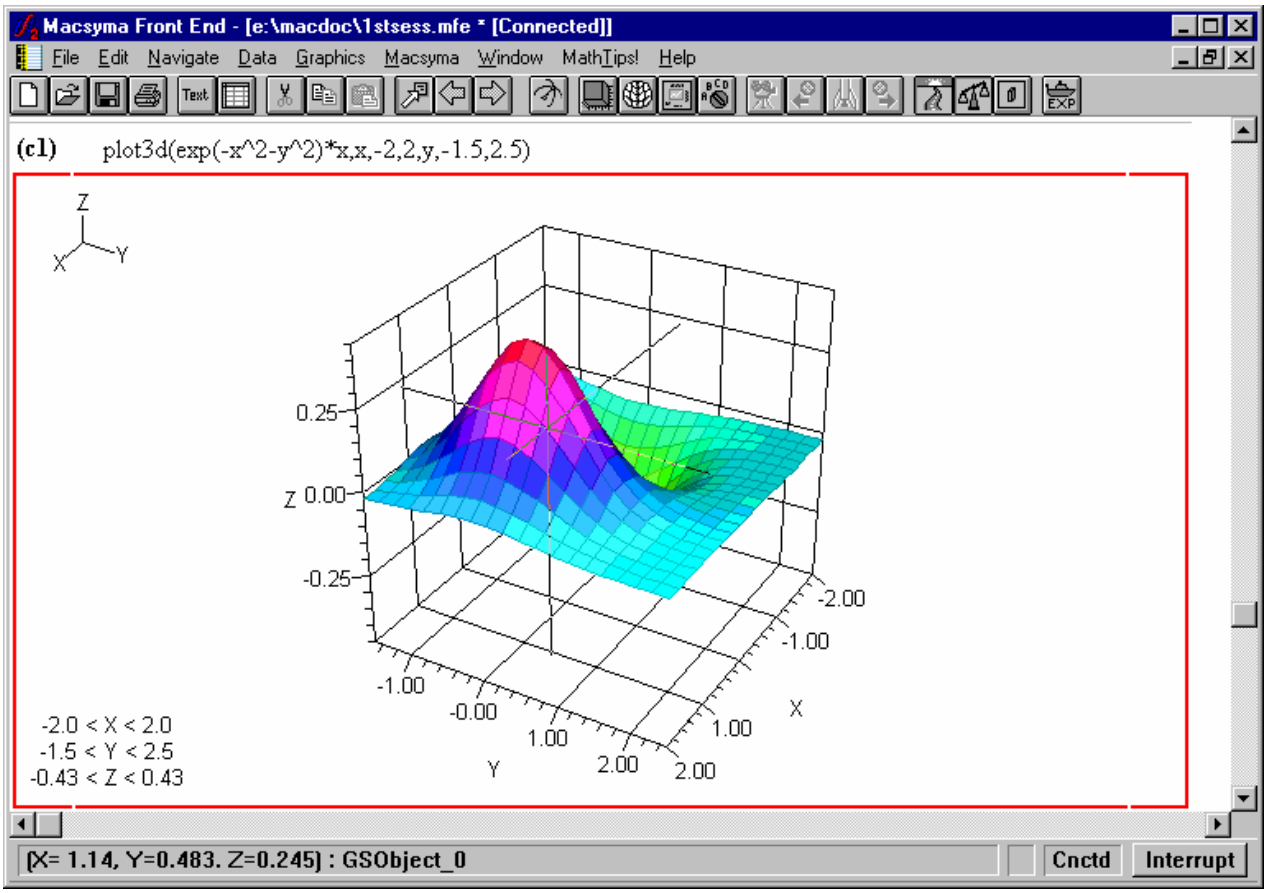
- Select the camera (the circle mounted on the gimbals). Drag it to a new position. You can now view the object from the new camera position. (Depending on the viewing option settings, you may need to hold the Draw button down to re-draw the plot.)
- Move the clipping slider part way down and release it. Adjust it until you see it clipping the plotted object. (Macsyma's 12 clipping planes can be adjusted from the Camera View - Edit Attributes dialog box, one of which is connected to the clipping slider.)
- You may also alter and rotate the plot view with the keyboard arrows. Turn the Scroll Lock key On and use the arrow keys to translate the plot. Using Shift with the arrow keys increases the size of moves.

2.2. Querying a Plot for Coordinates of a Point

- Click on the plotted object. Three numbers representing the 3D coordinates of the point on which you clicked appear in the status bar at the bottom of the document. You will also see some faint reference cursor lines connecting the point you selected to the coordinate axes. The resulting plot will look like the following:

---

[1] Notice that Macsyma dynamically changes the items on this menu bar depending upon the type of section you have currently selected.



- Click on the plot again and hold the left mouse button down while you drag the mouse across the plotted object. The x, y, z coordinates in the status bar change continuously as you move the mouse.
- Click again in the graphics section (but not on the plot) to turn the reference cursor lines off. Clicking with right-mouse offers a menu of other options.

2.2.1. Rearranging Sections in a Macsyma Notebook

- Select any input, output, graphics, text, or I/O section.
- Place the cursor on the outline box of the selected section. A square document icon will appear on the tail of the mouse cursor, indicating that you have selected the thin border line.
- Holding down the left mouse button, drag the mouse between two other sections where you want the selected section to appear. Release the mouse button; the section will move from its former location to the location specified by the mouse cursor.

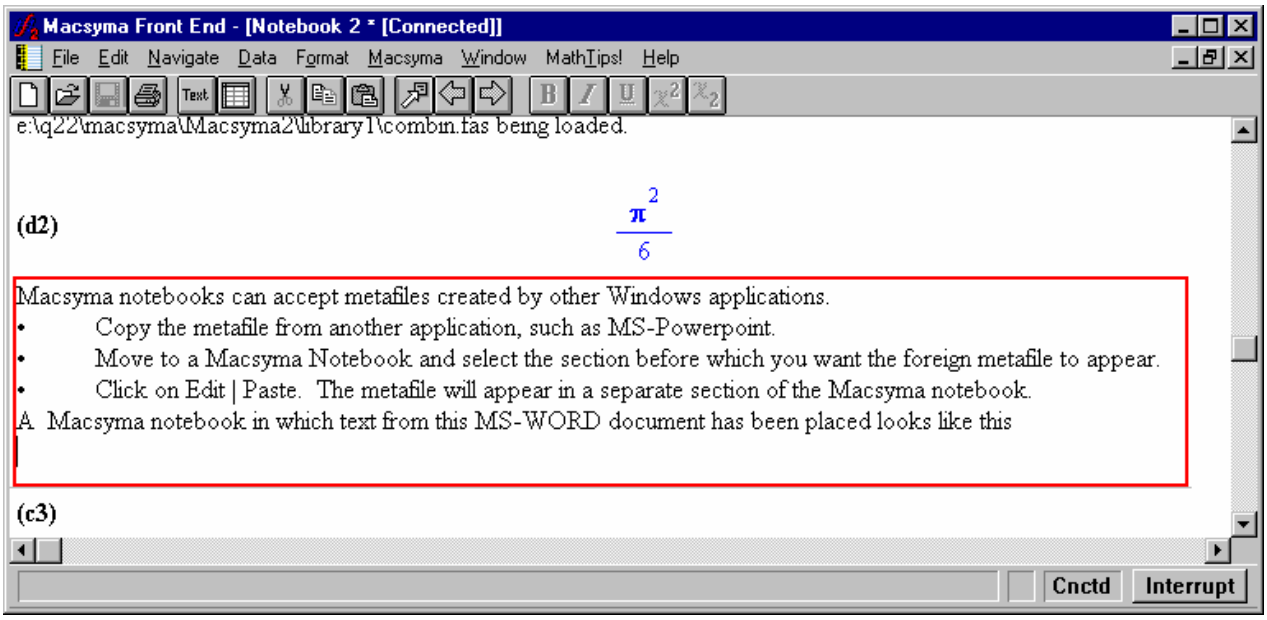
2.2.2. Inserting Other Graphic Objects into a Macsyma Notebook

Macsyma notebooks can accept metafiles created by other Windows applications.

- Copy the metafile from another application, such as MS-WORD.
- Move to a Macsyma Notebook and select the section before which you want the foreign metafile to appear.

- Click on Edit | Paste. The metafile will appear in a separate section of the Macsyma notebook.

A Macsyma notebook with placed text from this MS-WORD document looks like this:



2.2.3. Creating a Notebook of Input Commands Only

To create a notebook consisting only of input commands from a Macsyma session:

- Click on Edit - Select Input.
- Click on Edit - Copy Section.
- Move to an empty notebook (which you can create by clicking on File - New) and
- Click on Edit - Paste Section(s).

2.2.4. Saving and Viewing a Macsyma Notebook

- Save the new notebook by clicking on File - Save As; specify the file pathname as you do in all Windows applications, adding the extension “mfe.” (If you do not supply the .mfe extension, Macsyma appends it automatically.)
- View a notebook by clicking on File - Open and choosing the file pathname of the notebook you want to open. The notebook appears in the Macsyma Front End window.

2.2.5. Re-executing Individual Commands in Place

After you have executed a Macsyma expression, it is possible to edit the expression and re-execute it.

- Select the input section you wish to edit and re-execute.
- Make changes to the expression, and press Enter. Macsyma will re-execute the command.

On the current command line ((c10) in our example), type :

(c10) ((2+y)^10)

- When you press Enter, Macsyma will return a result.
- Go back to the same command line and edit the input to read:

  (c10) ((2+y)^10),expand
- Press Enter and note the result.
- Again, go back to the same command line and edit the input to read:

  (c10) float((2+y)^10),expand
- Press Enter and note the result.

2.2.6. Executing and Re-executing a Macsyma Notebook

To execute a Macsyma notebook:

You can execute a Macsyma notebook by:

- Viewing the notebook as a document in the Macsyma Front End window.
- Clicking on Edit - Select - Input. All of the input sections in the notebook are selected.
- Clicking on Edit - Reexecute. If the notebook is connected to a Macsyma Math Engine, the engine will re-execute the input commands in the notebook. If the notebook is not connected, Macsyma brings up a dialog box which gives you the choice of starting a new engine or attaching this notebook to a math engine that is currently connected to a different notebook.

Each section in a Macsyma Notebook is marked “replaceable” or “not replaceable” when the preceding Input Section re-executes. When you re-execute one or more Input Sections, new output section(s) appear, and all “replaceable” sections between the current location and the next “not replaceable” section disappear. The new sections appear immediately after the re-executed Input Section (the default) or at the end of the notebook.

By default, each Input Section, each Text Section and each Metafile Section are marked as “not replaceable,” and each Output Section and Graphics Section are marked “replaceable” when they are created. Replaceable notebook sections display an extra tick mark in the upper right hand edge of the section bracket.

3. Macsyma Graphics Styles

A graphic style is a group of assigned graphic display attributes. See the *Macsyma Scientific Notebook Interface Reference Manual* for a description of notebook attributes and decorations. Any attribute can be part of a given style.

Graphics attributes are grouped under various objects, such as a camera, a bounding box, or a data presenter. When you create a graphic style, the same object hierarchy is created as part of the style so that:

- Attributes are applied to relevant portions of the graphic;
- When several objects of the same type exist in a graphic (such as plots of 2 functions), the object hierarchy ensures that conflicting values are applied reasonably.

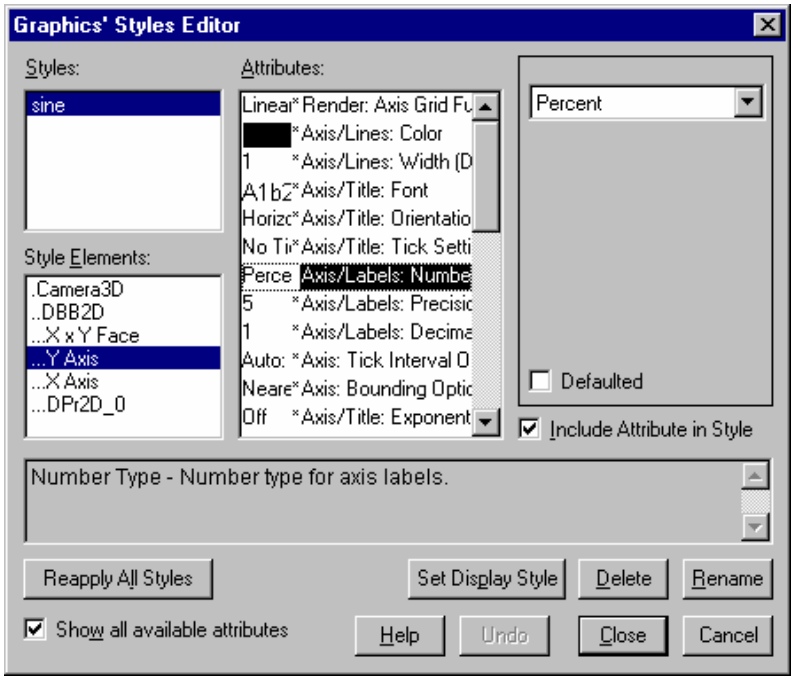
When you apply a style to a graphic, the attributes in the style overwrite the corresponding attributes in the graphic. However, you can change these individual attributes, even after you have applied a style.

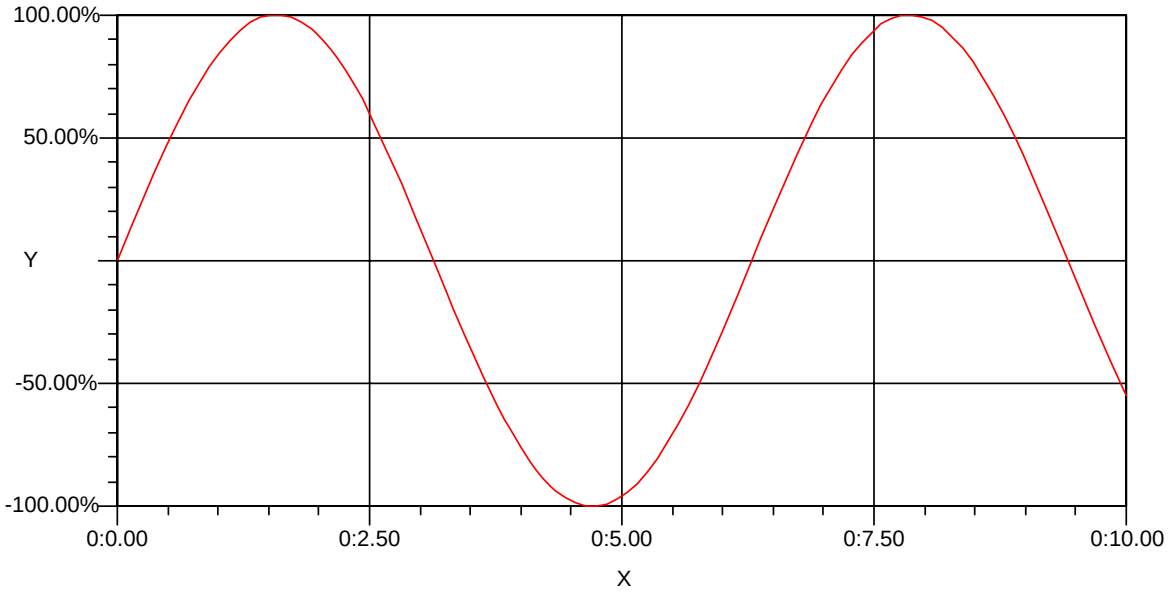
3.1. Creating a style

Follow these steps to create a style:

1. Create a graphic for which the style is relevant.
2. Edit the attributes to make the graphic appear as you want.
3. Choose "capture style," on the Styles submenu of the Graphics menu, or in the pop up menu in the given graphic section. Choose a name for the style. You may type a name, or choose the name of a current style from the pull-down list box. If you type or choose the name of an existing style, that style will be overwritten.

When you capture a style from a graphic, the name you enter becomes the name of the current style for that graphic section.

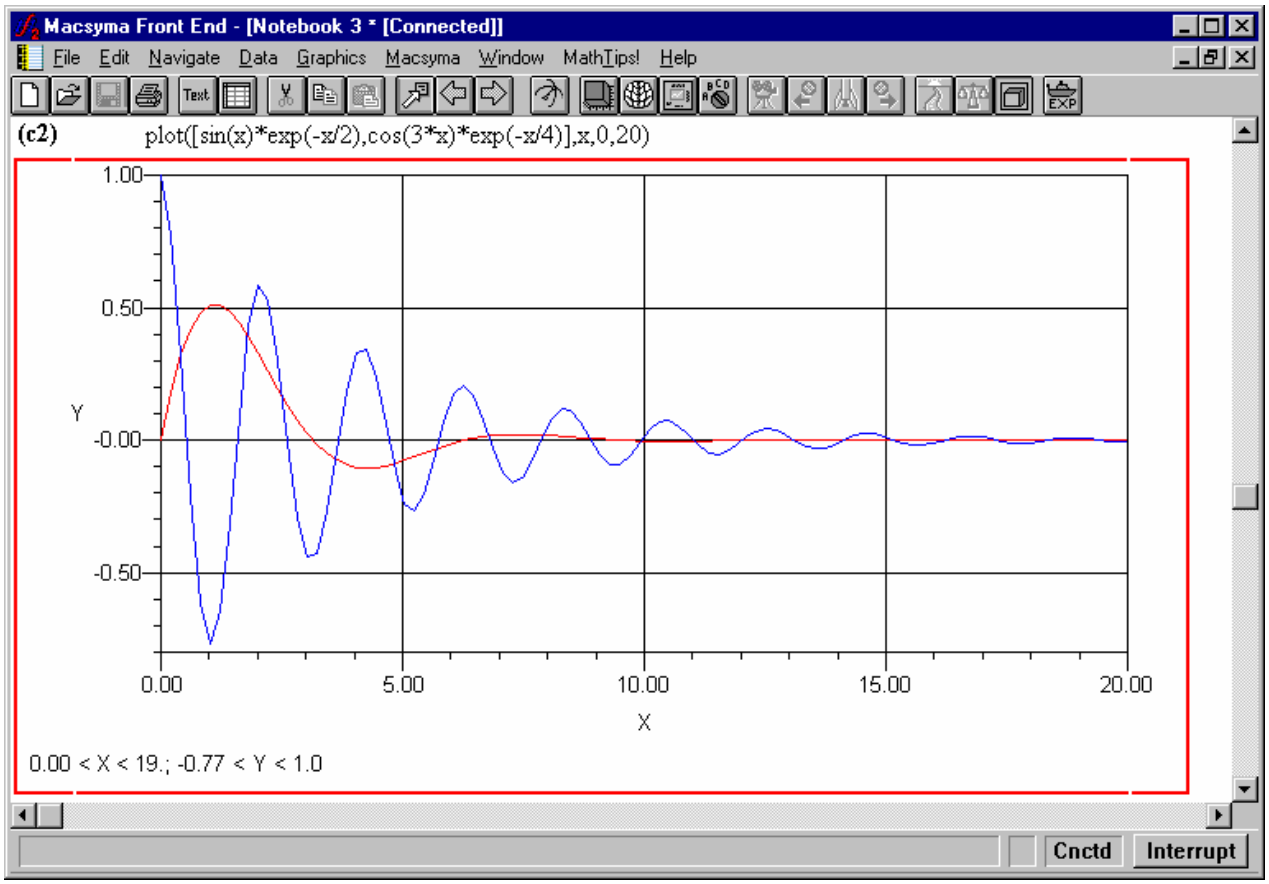


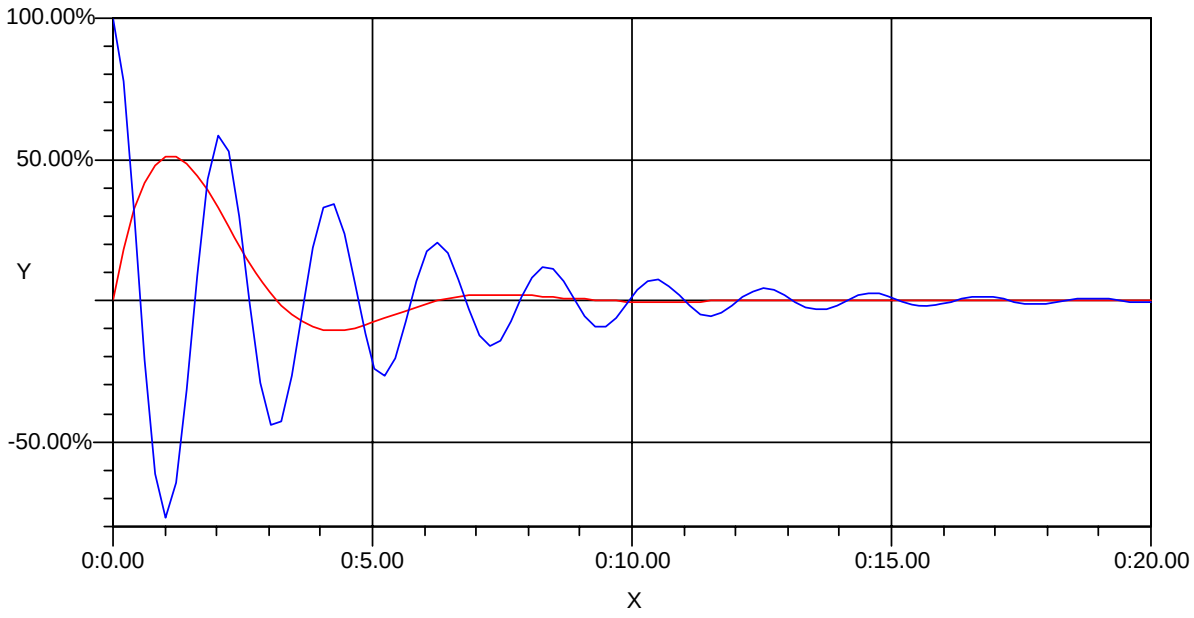


0.00 < X < 10.0; -1.00 < Y < 1.00

3.2. Applying a style

To apply a style, select the graphic section you want to modify. Choose “Edit/Apply Style” from the Styles submenu of the Graphics menu or from the pop up menu in that graphic section. The dialog box which appears lists the styles you have created. Choose the style you want and press the “Set Display Style button.” If the dialog comes up with a style already selected, that style is the one you selected most recently. If you want to keep that style for this graphics section, choose “Close.”





0.00 < X < 19.; -0.77 < Y < 1.0

3.2.1. Reapply All Styles

"Reapply All Styles" affects the entire notebook and reapplies the previously assigned style, if it still exists, to all graphics sections. "All" here means all graphics sections, not all styles.

3.3. Editing styles

Begin by selecting a style. Edit a style much as you altered the attributes of a graphic:

- The "Style Elements" list has various attributes attached to it.
- Changing the attributes of a style does not change existing graphics; you must reapply the changed style to change the graphic.
- The various buttons are described in Section "3.3.1. The buttons."
- The two check boxes, "Show all available attributes" and "Include Attribute in Style" are described in Sections "3.3.2. The "Show all available attributes" check box" and "3.3.3. The "Include Attribute in Style" check box."

3.3.1. The buttons

"Reapply All Styles" reapplies the assigned styles to all graphics in the notebook.
"Delete" removes a style.
"Rename" renames a style; if you use the name of an existing style, you automatically use the set of attributes assigned to that style.

3.3.2. The "Show all available attributes" check box

By default, Macsyma only displays attributes which are currently assigned to a style. When you check the "show all available attributes" box, you will see a list of all possible attributes. Information in the "Include Attribute in Style" check box changes as you check and uncheck attributes.

3.3.3. The "Include Attribute in Style" check box

When "Include Attribute in Style" is checked, the currently selected attribute will overwrite the similar attribute in any graphic to which you apply the style. Attributes which are not included in the style you are applying do not change.

3.4. General notes on graphic styles:

When you create a new graphic style, begin by copying a graphic with a similar style and make the changes you want immediately. It is harder to make certain changes in a created style. In particular,

1. Assign any background color when you create the style.
2. If you want the style to have multiple presenters, create them now.

If you do need to change the number of presenters at a later time, create a new graphic with the appropriate number of presenters, apply the style, make the changes you want, and recapture the style.

Styles captured from 2D graphics should be applied only to 2D graphics and not to 3D graphics. Similarly, styles captured from 3D graphics should be applied only to 3D graphics. Cross-applying a

style may not apply all attributes correctly to the axis attributes and Presenter attributes will not be applied at all.

4. Introduction to the DataViewer™ and MFE_DATA Package

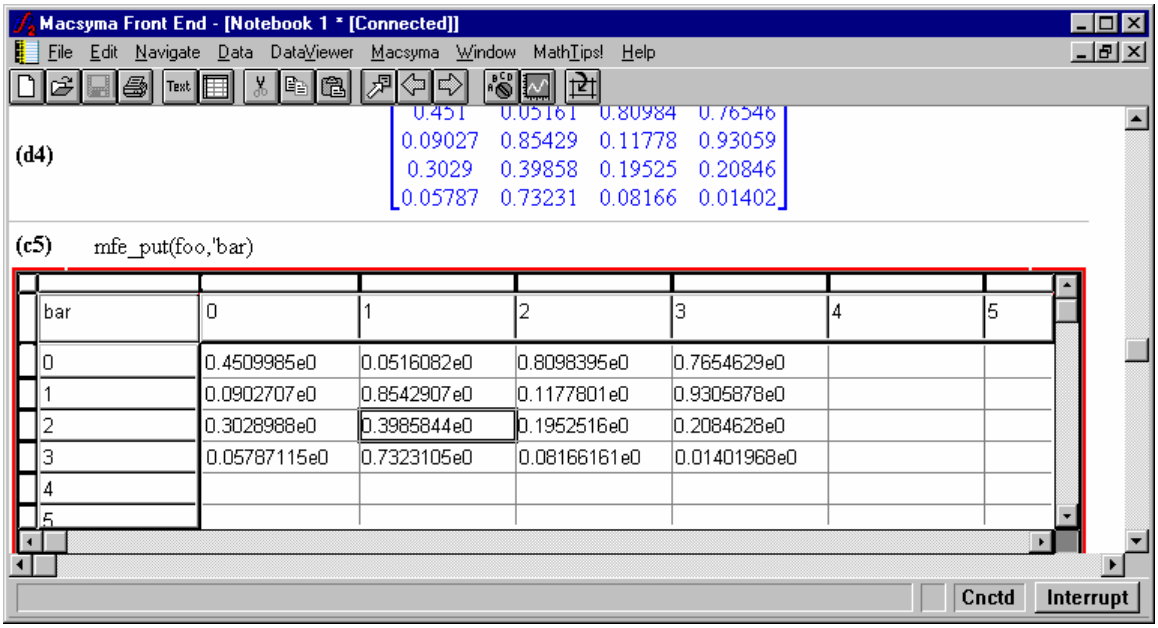
The DataViewer™ is a Macsyma Front End facility you can use to transfer numerical data in Macsyma to an MFE variable. You may also import data from an outside file to an MFE variable. The two basic commands for transferring data between the Macsyma Math Engine and the MFE Math Engine are **mfe_put** and **mfe_get.** The MFE_DATA package provides commands for moving data back and forth between the Macsyma math engine and the MFE math engine. If you try to create a new DataViewer section, a dialog will appear asking you for a math expression, which should be the name of an existing MFE math variable. See the *Scientific Notebook Interface Reference Manual* for more information.

First, load the MFE_DATA package with the Macsyma command load(mfe_data). Select Data | Import under the file menus. Or press the DataViewer button. A dialog will ask for the name of an MFE math expression, which is an MFE variable. If you want to view a Macsyma math object instead, you can use **mfe_put** to create an MFE variable. For example, you can make a Macsyma object, such as a 4 X 4 matrix of single precision random numbers, by saying

```
foo : sfloat(mat_rand(4,4))
mfe_put(foo,bar)
```

and then place bar in the DataViewer by clicking on the DataViewer button and selecting the MFE math expression bar.

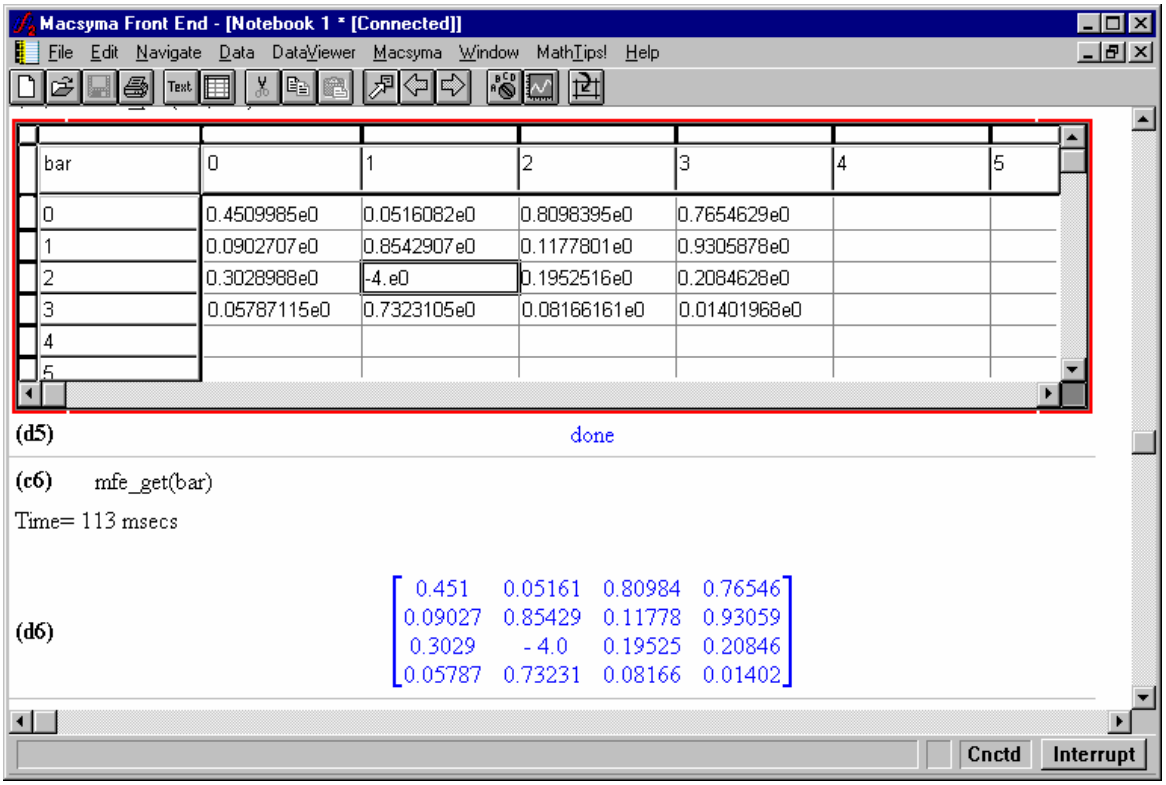
The DataViewer section which appears in your notebook will look something like:[2]



[2] All illustrations of Macsyma 2.2 screens were made using the Windows 95 Explorer interface. The essential characteristics of each screen are available across all Windows OS.

Note the single precision format of the numbers in the DataViewer. By default, the MFE Math Engine uses double precision numbers. When you use **sfloat** to create the matrix, the Macsyma Math Engine uses single-precision numbers, denoted with *e*-format, and the MFE Math Engine treats **bar** as a single precision array.

You can update the MFE variable **bar** by typing new numbers. Here, the [2, 1] cell of **bar** is highlighted. Note that indices of MFE 2D arrays start at 0, while Macsyma matrices have indices that start at 1. If you change the [2, 1] cell to, say, -4, and then get **bar** in Macsyma, you get a new matrix **mat1.** Your screen should look something like:



Note that the [3,2] element of the Macsyma matrix D6 is -4. You can export the MFE variable **bar** to a file by selecting the Menu item Edit - Export. If you choose to export **bar** to a CSV file format with default settings, you get a file that looks like:

0.4509985,0.05160820,0.8098395,0.7654629

0.09027070,0.8542907,0.1177801,0.9305878

0.3028988,-4.000000,0.1952516,0.2084628

0.05787115,0.7323105,0.08166161,0.01401968

You can choose the separator or select fixed format when exporting. Similarly, you can use the Menu item Edit - Import to import a data file in CSV or fixed-field format. You could prepare such a file with a spreadsheet, like Excel or Lotus 123, or use a spreadsheet to read a file exported from Macsyma.

See USAGE(MFE_DATA); for more information, and do DEMO(MFE_DATA); for a demonstration.

4.1. The MFE Math Engine and Variable Names

The separate math engine inside the Macsyma Front End operates on Macsyma Front End variables, which are separate from Macsyma Math Engine variables. You can access MFE variables from a Macsyma Math Engine by using the MFE function as shown above.

By default, the MFE Math Engine treats floating point numbers as double precision. To indicate that a number is single precision, use *e*-format. For example, 1.0 is treated as double precision 1.d0, while 1.e0 is single precision.

MFE variables are local to each notebook, while Macsyma variables are local to each Macsyma math engine.

The two basic Macsyma commands to exchange data between MFE and Macsyma are: mfe_put and mfe_get. You can move Macsyma variables to MFE variables with the Macsyma command mfe_put(mac_name, mfe_name). Here, mac_name is the name of a Macsyma variable, and mfe_name is the name of an MFE variable. You can retrieve MFE variables to Macsyma with the Macsyma command mfe_get(mfe_name).

Mac_name must evaluate to:

- a floating point number (*e.g.*, 1.0, 1.e-4, -1.d3); or
- an integer (*e.g.*, 4, -5 in the range -2^29 to 2^29-1); or
- a list of such numbers (*e.g.*, [1,2,4.d0]); or
- an array of such numbers; or
- a matrix of such numbers; or
- a Macsyma string (*e.g.*, “AbCdEfG”).

Symbolic expressions, atoms, rational numbers, big integers or bigfloats are not valid types for MFE variables. In particular, complex numbers are not valid.

mfe_get(mfe_name) will return the value of the MFE variable mfe_name as a number, a list, a string, or a matrix.

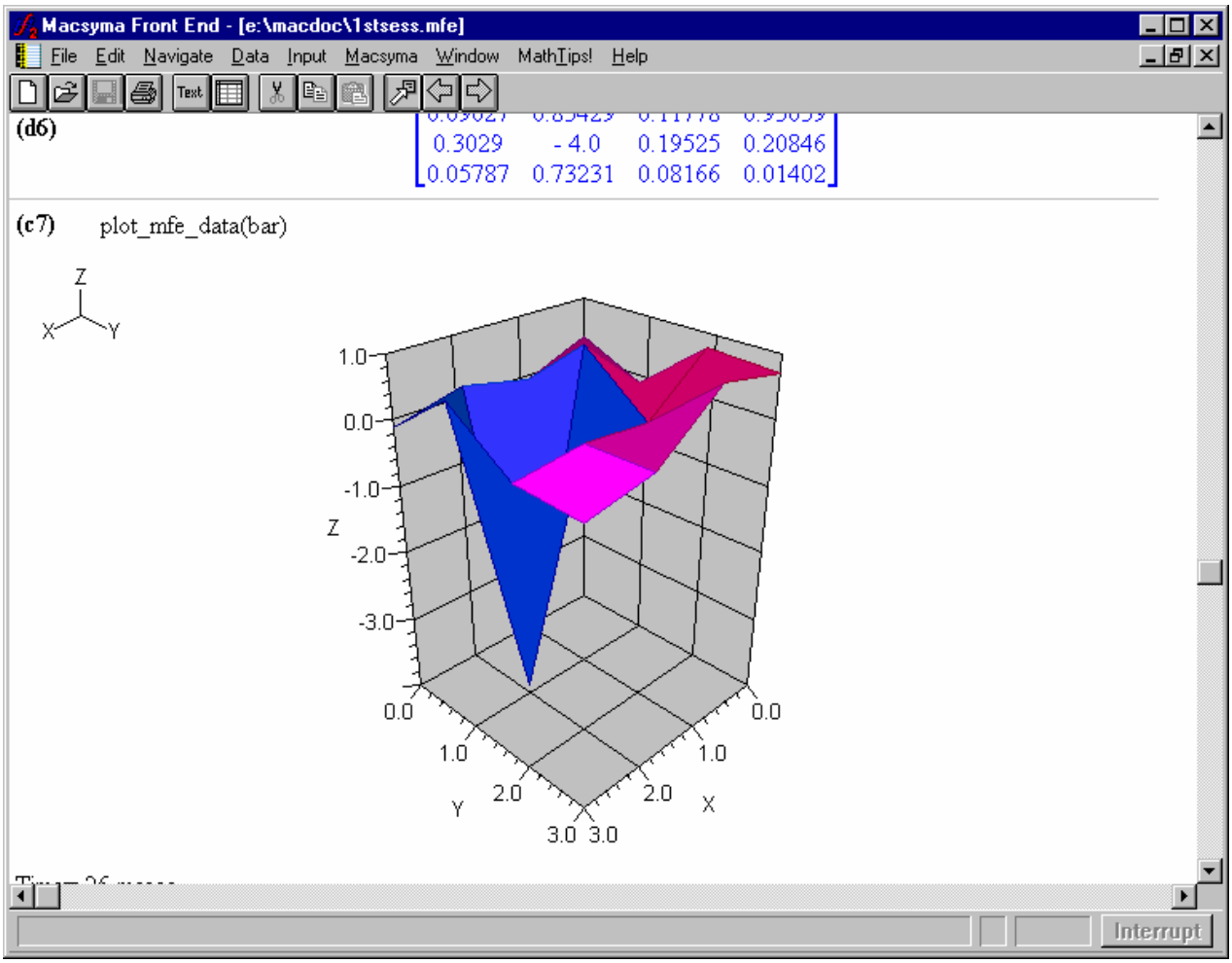
The Macsyma package MFE_DATA contains several Macsyma commands which make it easy to work with MFE variables. Do DEMO(MFE_DATA); for a demonstration. The source code for MFE_DATA is in the **macsyma:share;** directory.

4.2. Graphics Sections and MFE Variables

Use Data - Graph to make a graphics section from an MFE variable. A graphics section based on an MFE variable shares the graphics decorations and attributes of a Macsyma variable. However, the MFE graphic section updates automatically when the MFE variable changes. (In contrast, you need to recalculate the entire plot if you change even one number in a Macsyma list.

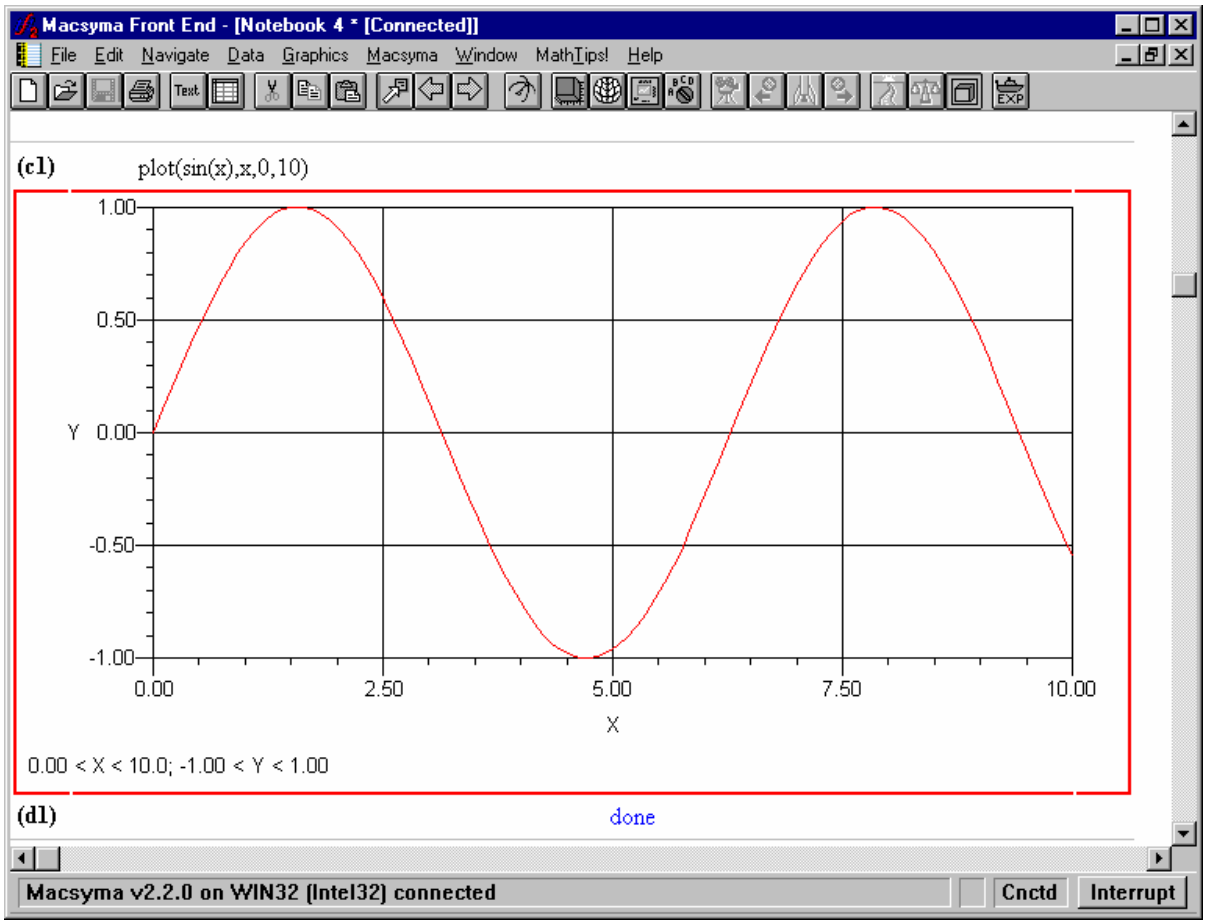
You can make graphics section from an MFE variable mfe_name with the Data - Graph menu item, from the Graph button, the DataViewer, or with the Macsyma command plot_mfe_data(*mfe_name*).

By default, if *mfe_name* is a 1D MFE variable, you get a plot of *mfe_name* vs. its integer index as seen in the DataViewer. If *mfe_name* is a 2D variable, you get a surface plot of *mfe_name* vs. its 2D integer indices. Try the command plot_mfe_data(bar). Your graphic section will look something like:



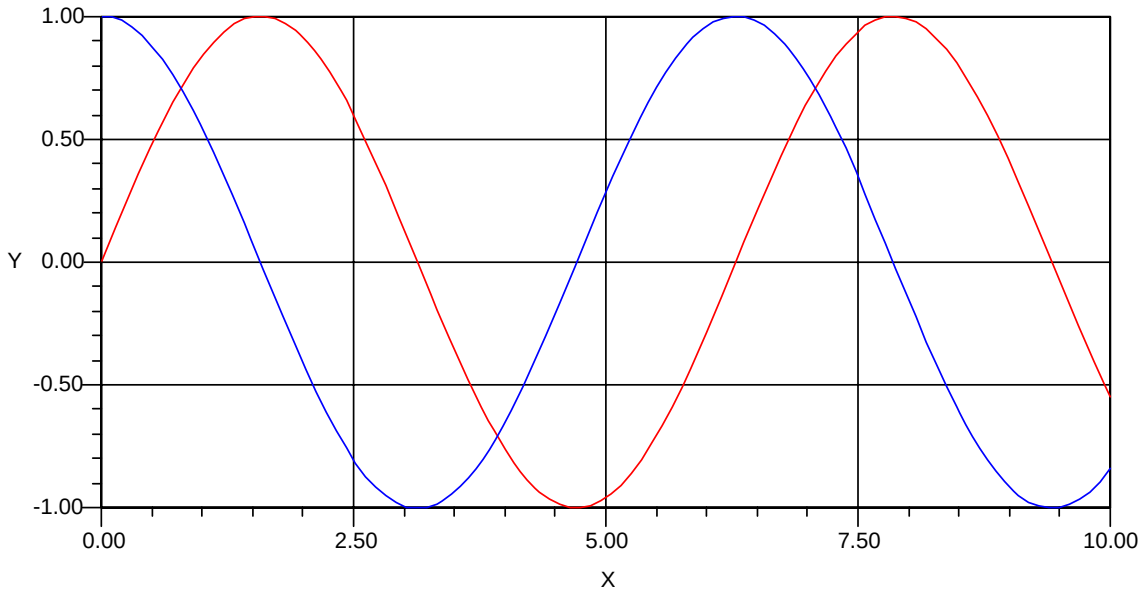
You can plot more than one MFE variable at a time with the menu command Data - Add Data to Graph.

You can save the values of the coordinates of the plot of a Macsyma expression to an MFE variable by choosing Graphics - Assign Data to Variable. For example, you can create a graphic from a Macsyma expression by saying plot(sin(x),x,0,10). You can then select Graphics - Assign Data to variable and assign the data to an MFE array variable called *sine*. When you look at *sine* in a DataViewer, the coordinates of the plot should look something like:



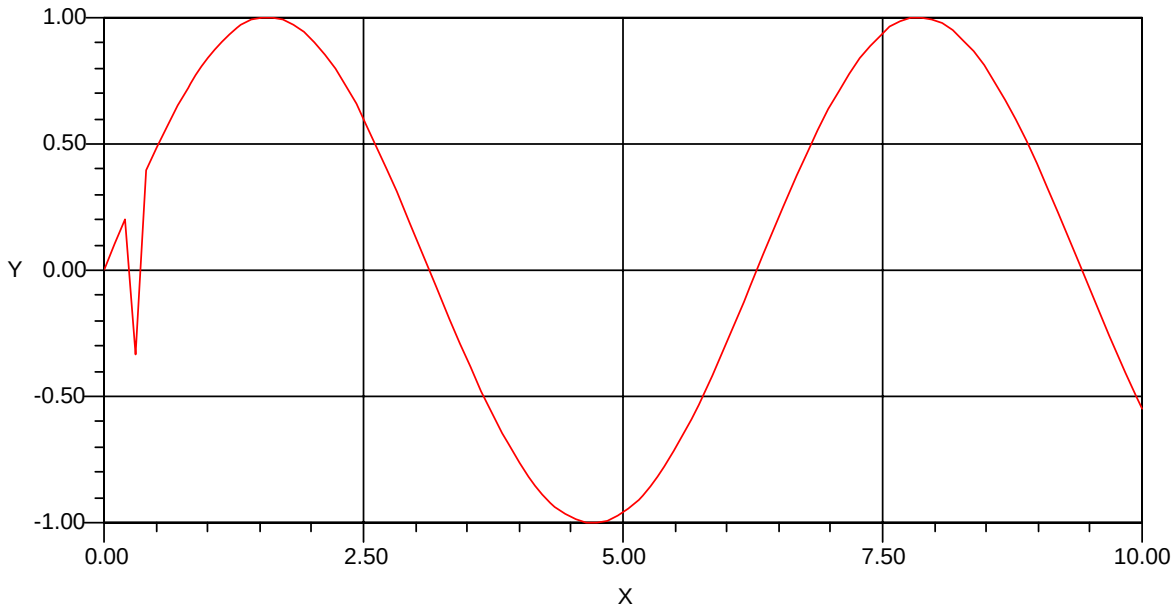
		sine	1	2	3
X Axis	0.e0	0.e0			
	0.1010101e0	0.1008384e0			
	0.2020202e0	0.2006488e0			
	0.3030303e0	0.2984138e0			
	0.4040403e0	0.3931365e0			
	0.5050504e0	0.4838516e0			
	0.6060605e0	0.569634e0			
	0.7070704e0	0.6496091e0			
	0.8080807e0	0.7229624e0			
	0.9090905e0	0.7889452e0			
	1.010101e0	0.8468854e0			
	1.111111e0	0.8961918e0			
	1.212121e0	0.9363625e0			
	1.313131e0	0.9669874e0			
	1.414141e0	0.9877546e0			
	1.515151e0	0.9984522e0			
	1.616161e0	0.998971e0			

	sine_DPr2D_0_X	sine_DPr2D_0	sine_DPr2D_1	3
0	0.e0	0.e0	1.e0	
1	0.1010101e0	0.1008384e0	0.9949026e0	
2	0.2020202e0	0.2006488e0	0.9796631e0	
3	0.3030303e0	0.2984138e0	0.9544365e0	
4	0.4040403e0	0.3931365e0	0.9194801e0	
5	0.5050504e0	0.4838516e0	0.87515e0	
6	0.6060605e0	0.569634e0	0.8218985e0	
7	0.7070704e0	0.6496091e0	0.7602682e0	
8	0.8080807e0	0.7229624e0	0.6908872e0	
9	0.9090905e0	0.7889452e0	0.6144633e0	
10	1.010101e0	0.8468854e0	0.5317752e0	
11	1.111111e0	0.8961918e0	0.4436663e0	
12	1.212121e0	0.9363625e0	0.3510342e0	
13	1.313131e0	0.9669874e0	0.2548237e0	
14	1.414141e0	0.9877546e0	0.1560156e0	
15	1.515151e0	0.9984522e0	0.05561659e0	



0.00 < X < 10.0; -1.00 < Y < 1.0

	sine_DPr2D_0_X	sine_DPr2D_0	sine_DPr2D_1	3
0	0.e0	0.e0	1.e0	
1	0.1010101e0	0.1008384e0	0.9949026e0	
2	0.2020202e0	0.2006488e0	0.9796631e0	
3	0.3030303e0	-0.33e0	0.9544365e0	
4	0.4040403e0	0.3931365e0	0.9194801e0	
5	0.5050504e0	0.4838516e0	0.87515e0	
6	0.6060605e0	0.569634e0	0.8218985e0	
7	0.7070704e0	0.6496091e0	0.7602682e0	
8	0.8080807e0	0.7229624e0	0.6908872e0	
9	0.9090905e0	0.7889452e0	0.6144633e0	
10	1.010101e0	0.8468854e0	0.5317752e0	
11	1.111111e0	0.8961918e0	0.4436663e0	
12	1.212121e0	0.9363625e0	0.3510342e0	
13	1.313131e0	0.9669874e0	0.2548237e0	
14	1.414141e0	0.9877546e0	0.1560156e0	
15	1.515151e0	0.9984522e0	0.05561659e0	



0.00 < X < 10.0; -1.00 < Y < 1.0

Replotting just picks up the first one.

Note that the Macsyma Math Engine uses single precision floats for graphics coordinates.

You cannot assign the data from the plot of an MFE variable because it is already an MFE variable.

Click on a 2D or 3D graphic of a Macsyma variable section and choose Assign Data to Variable. You can assign the graphical data to an MFE variable and view it in a DataViewer. You can replot the MFE variable and select the menu item Graphics - Add Data to Plot to add data.

In contrast to the dynamic behavior of an MFE variable plot, the plot of a Macsyma variable does not automatically update when data changes, and you cannot dynamically add new data to the plot of a Macsyma variable.

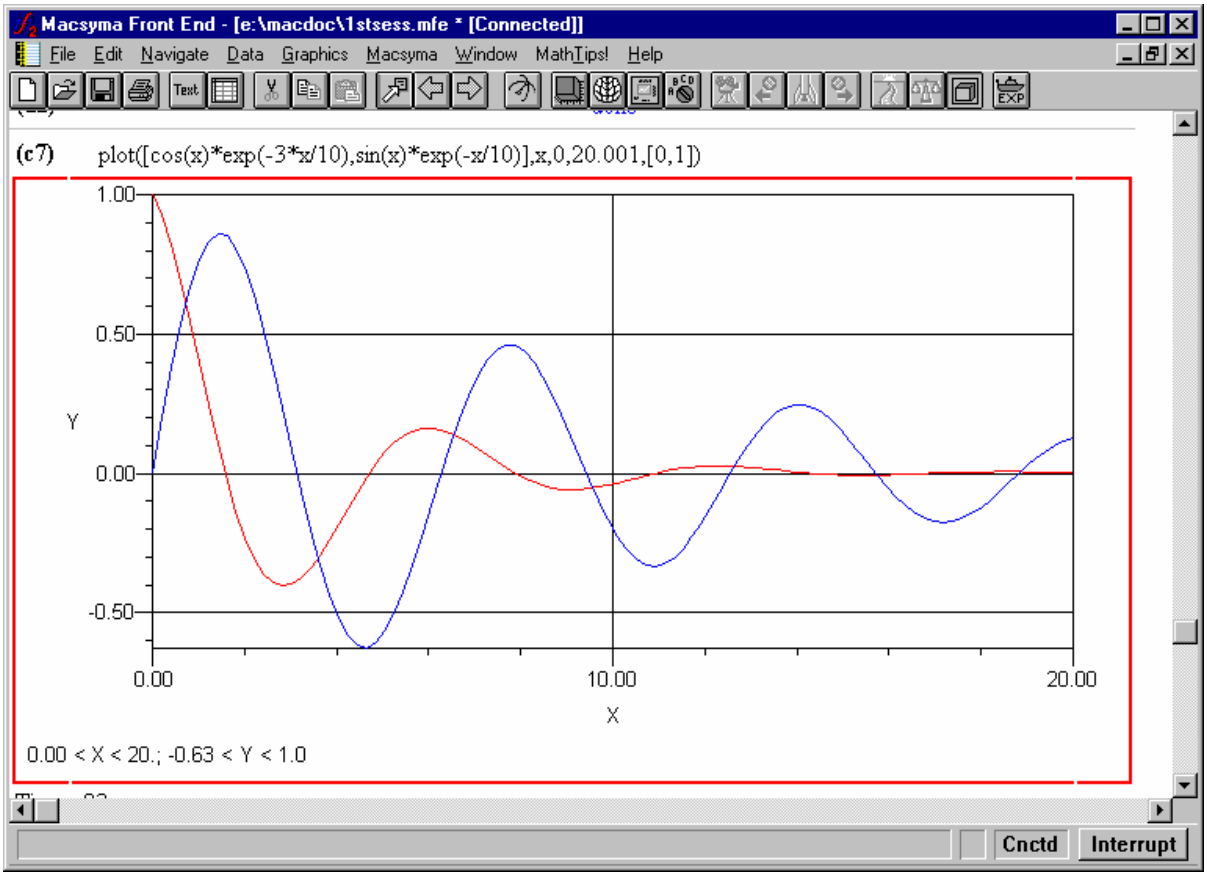
See USAGE(MFE_DATA); for more information, and do DEMO(MFE_DATA); for a demonstration.

5. Creating Finished Documents

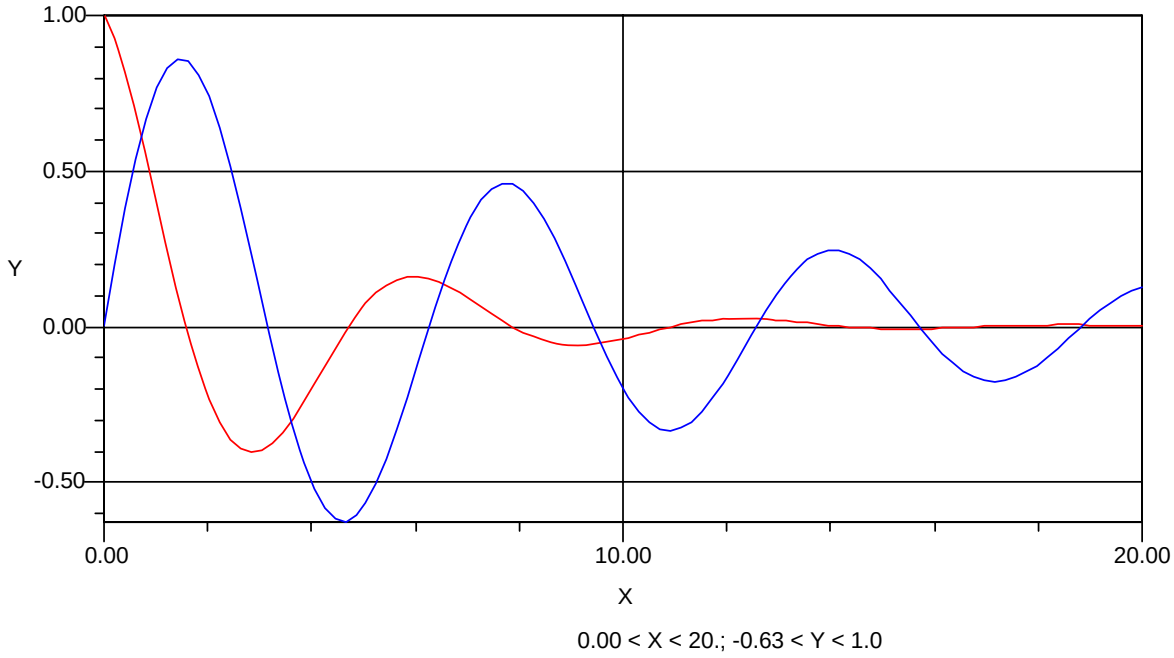
You may create good-looking mathematical documents with Macsyma in four different ways:

1. You can create a Macsyma notebook document in the Macsyma Front End window;
2. You can export Macsyma math and graphics to a word processor document using Windows Cut/ Copy and Paste;
3. You can export individual graphics with Graphics Export commands;
4. You can print individual notebook sections to a file so that you can put them in a word processor document later.

A graphic section, input section and formatted text section from a Macsyma notebook appear below. You can place the entire notebook or individual notebook sections, in another Windows application.



Moving the graphic section with standard Windows Cut and Paste techniques produces:



You can edit individual attributes of the plot or section, (such as axis labels or section brackets), and you can export the graphic section in several different graphical formats (BMP, RLE, PCX, GIF) or turn it into a Postscript or EPS file.

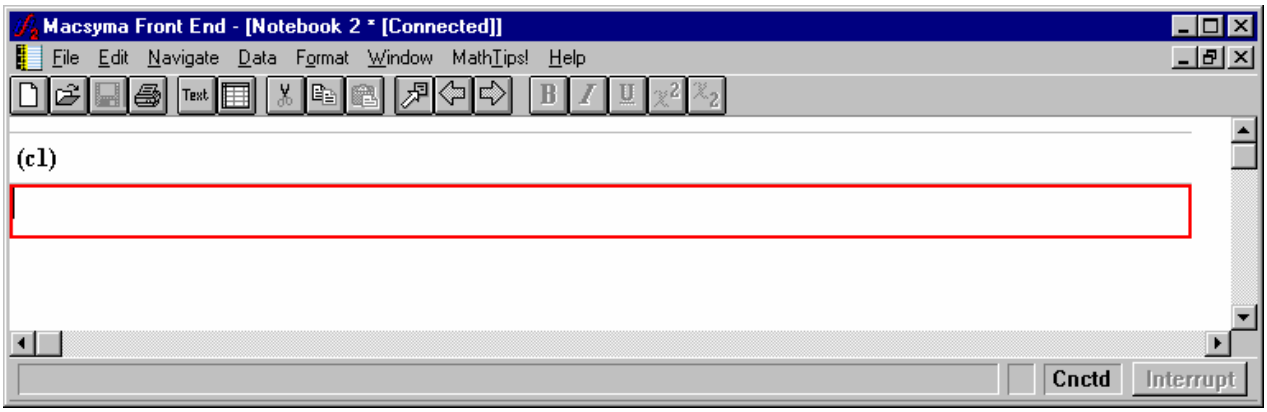
Copy, cut and paste techniques use the Windows Clipboard, which, in Windows 3.X is of limited size. Cutting and pasting large sections or very complicated graphics can result in Windows instability or rendering problems, even in Windows NT/95. Pasting notebooks with page breaks into other Windows applications may also cause problems.

5.1. Creating Macsyma Notebooks

When you type commands in Macsyma, you are creating a notebook consisting of input and output sections.

5.1.1. Adding Text in a Macsyma Notebook

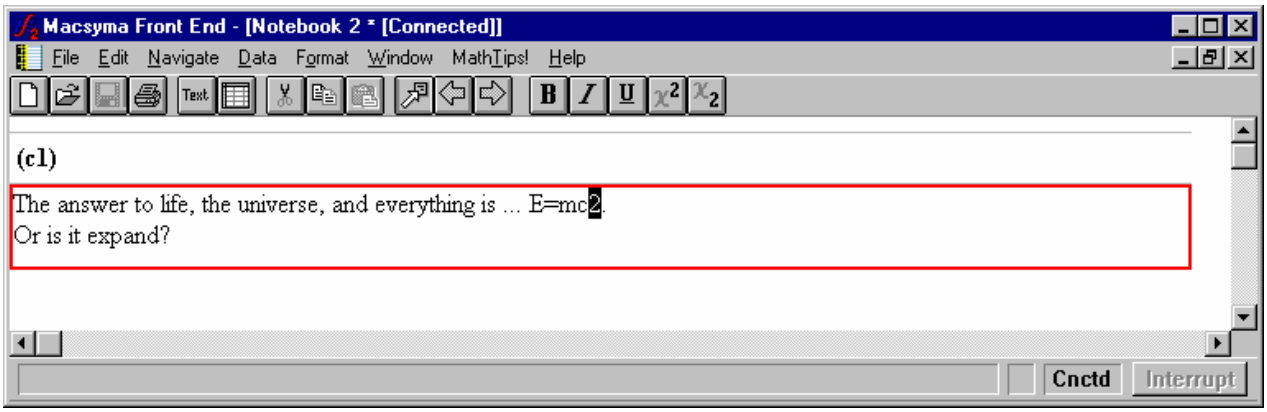
You can add a formatted text section anywhere by pressing the Text button or using Edit - Insert Text Section. In the illustration below, a formatted text section appears as a red outline box below the Expression Input Section labeled (c1).



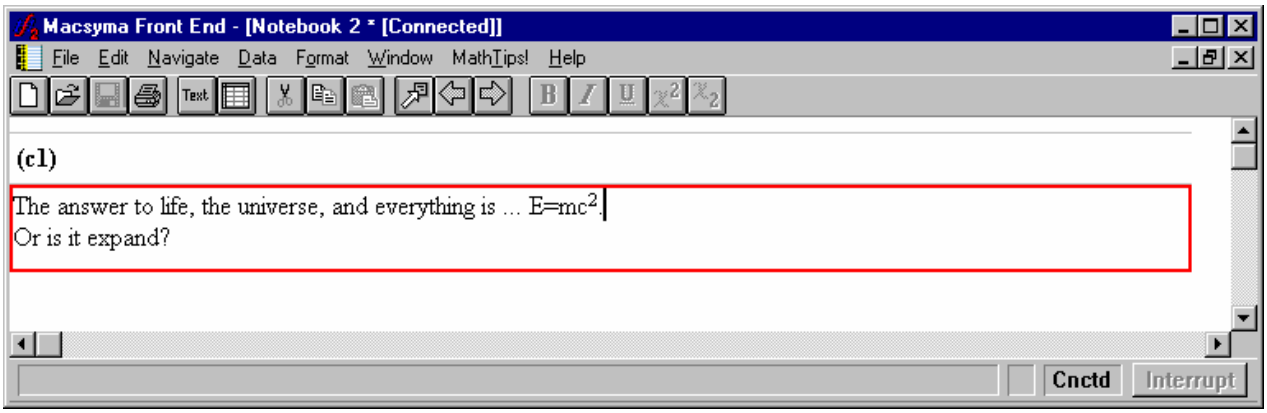
- Select the section which follows the point where you want the new text to appear. Choose Insert Section - Formatted Text under the Edit menu. An empty text section appears.
- Type

  The answer to life, the universe and everything is . . . E=mc2. <Shift Enter>
  Or is it expand? <Enter>

  Highlight the number 2. The buttons indicating font changes (bold, italic, underline) as well as superscript and subscript should light up.

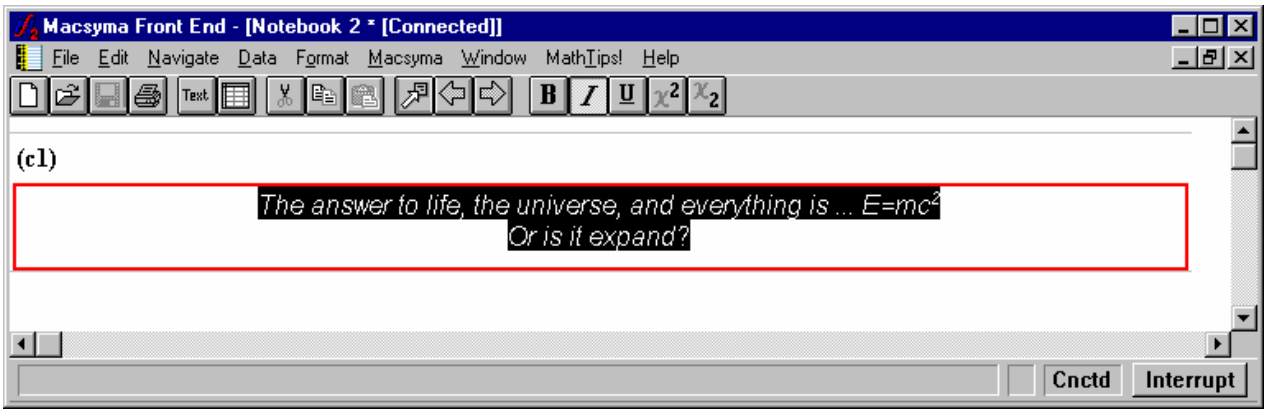


Press the superscript 2 button, or Format - Superscript. You will see something like:

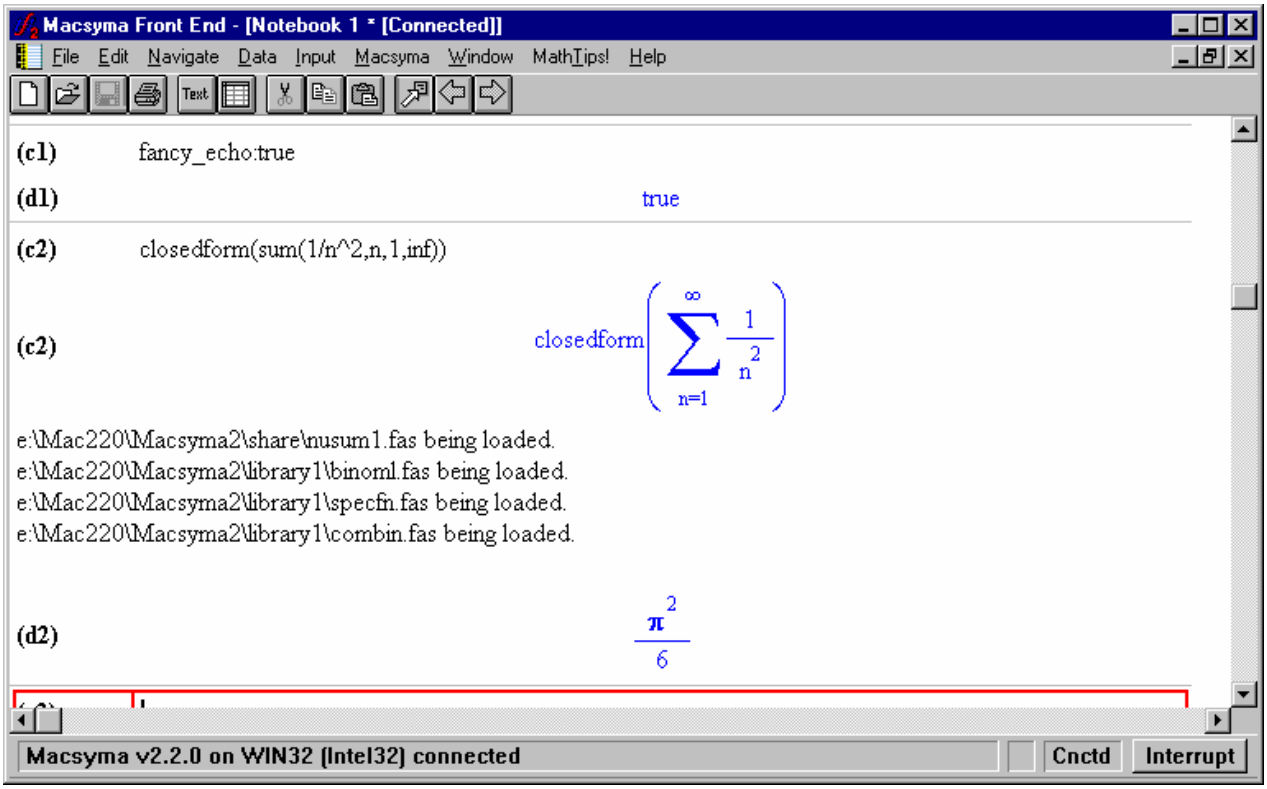


- Position the mouse on the word **expand** and press F1. Note that text lines also have context sensitive Help.

You can introduce line feeds (with the key combination Shift-Enter) and new paragraphs (with Enter).
You can change the font, font size, color and type style of text. Select a section of text and click on the Format menu. Paragraph alignment choices (None, Center, Left or Right) are also available. The notebook, with character formatting changed to Arial Italic, and center justification, looks something like:



Use Macsyma's fancy display facility (with fancy_echo:true) to create formatted text sections which turn input c-lines into formatted text. The following notebook was created just that way:



You can create the appearance of embedding formatted mathematical expressions in text by placing an input or output section between two text sections.

5.1.2. Rearranging Sections in a Macsyma Notebook

See Section “2.2.1. Rearranging Sections in a Macsyma Notebook.”

5.1.3. Inserting Other Graphic Objects into a Macsyma Notebook

See Section “2.2.2. Inserting Other Graphic Objects into a Macsyma Notebook.”

5.1.4. Creating a Notebook of Input Commands Only

See Section “2.2.3. Creating a Notebook of Input Commands Only.”

5.1.5. Saving and Viewing a Macsyma Notebook

See Section “2.2.4. Saving and Viewing a Macsyma Notebook.”

5.1.6. Re-executing Individual Commands in Place

Section “2.2.5. Re-executing Individual Commands in Place.”

5.1.7. Executing and Re-executing a Macsyma Notebook

Section “2.2.6. Executing and Re-executing a Macsyma Notebook.”

5.2. Creating Finished Documents Inside a Word Processor

A “notebook” is a document that combines mathematical expressions, graphics and formatted text. You can create a notebook using Macsyma and any Windows-compatible word processor, such as *MS-Word.*

5.2.1. Inserting Mathematical Expressions into a Word Processor Document

- Submit one or two commands to Macsyma so that you have one or more output display lines in the Macsyma Front End window to copy to a notebook document. Open your Windows-compatible word processor and a document.
- Use Windows Metafiles when copying. Macsyma will detect when a Windows Metafile is appropriate to use.
- Using your mouse, select one or more sections from the Macsyma notebook or mark some text in an input section or a text section. To select more than one section, hold down the Control key while you click on the sections you are choosing.
- Click on Edit - Copy Section or Edit - Copy on the top menu bar in the Macsyma Front End window. This action copies the selected sections or text as a Windows metafile and places it in the Windows Clipboard.
- Move to your word processor window. Position the cursor where you want the selected mathematical expression(s) to appear. Click on the Edit - Paste at the top of the word processor window. The mathematical expression(s) will appear in your word processing document at the cursor location.

For example,

(c25) sum(1/n^2,n,1,inf)

(d25)
$$\sum_{n=1}^{\infty} \frac{1}{n^2}$$

was produced just this way. (You may find it to be more esthetic to turn off Section Brackets or labels with File - Options before Cut and Paste)

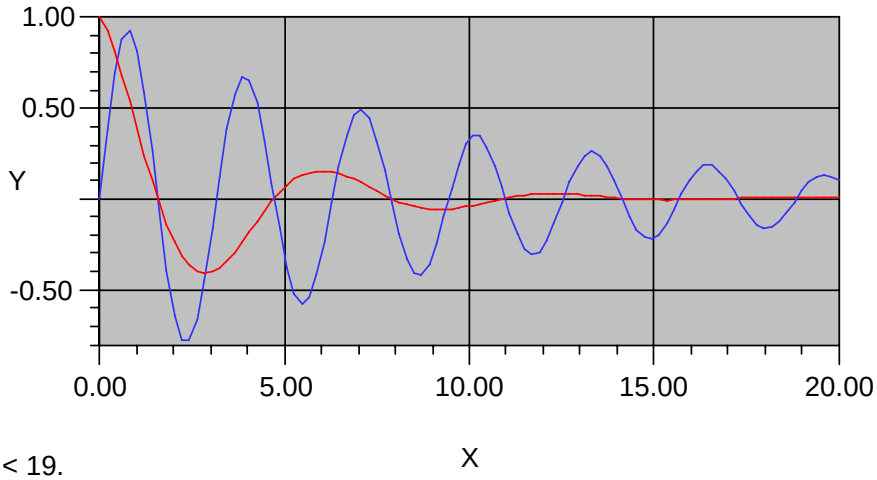
In some Windows word processors, you can scale and crop a pasted image. (For example in *MS-Word*, click on Format then on Picture. A dialog box appears with commands for scaling and cropping the image.)

Macsyma input commands (without the line labels) can be copied as text by using the menu command Edit - Copy in the Macsyma Front End window and Edit - Paste in the word processor or other application. Macsyma output expressions which are displayed with fancy_display:false can be copied and pasted as text.

5.2.2. Inserting Macsyma Notebook Sections into a Word Processor Document

Suppose you want to copy a section in a Macsyma notebook into a word processor document. You can:

- Select one or more sections from the Macsyma notebook or mark some text in an input section or a text section.
- Click on the item Edit - Copy Section or Edit - Copy on the top menu bar in the Macsyma Front End window. This action copies the selected sections or text as a Windows metafile and places it in the Windows Clipboard.
- Move to your word processor window. Position the cursor where you want the selected text to appear. Click on the item Edit - Paste at the top of the word processor window. The text will appear in your word processing document at the cursor location.



0.00 < X < 19.
-0.78 < Y < 1.0

This picture was produced just this way.

6. NUMKIT

Macsyma's NumKit™ is an add-on package for Windows 95/NT operating systems. NumKit is not available for Windows 3.X.

NumKit accesses the LAPACK linear algebra library for floating point calculations with numerical matrices. You can find detailed documentation on LAPACK in the LAPACK Users' Guide (1995, SIAM) and on the Internet at http://www.netlib.org/lapack/lug.

Macsyma's NumKit Tool package is a set of Macsyma and MFE routines for numerical evaluation of (complex or real) floating point problems. Most Macsyma routines, such as SVD or EIGENS_BY_SCHUR, now use NumKit for floating point operations. You may also use new Macsyma or MFE interface routines directly.

NumKit's operation for existing Macsyma routines, such as INVERT_BY_LU, is completely transparent. If you have NumKit enabled, INVERT_BY_LU will call the LAPACK versions of the LU decomposition for matrix inversion without any prompting. Some new Macsyma routines, such as LEFT_EIGENVECTORS that rely on NumKit (LAPACK) capabilities must have NumKit enabled to return numerical answers. Without NumKit, they return noun forms.

You may test the predicate: USE_NUMKIT_P(Func, Nrows, Ncols) to test if you have NumKit installed and can accelerate your problem. Select 'use_numkit='true or 'all and Macsyma will automatically use NumKit. Some Macsyma routines, like SVD_NUMERICAL_REAL and EIGENS_BY_SCHUR_REAL, work with real floating point matrices only (*i.e.*, not rational numbers or bigfloats).

Look at the notebook macsyma:demo;numkit.mfe, which contains examples of running NumKit. See also numkit.usage. Also do demo(numkit);

7. Answers to Some Common Questions

7.1. How do I Open a Macsyma Notebook?

You can open a new Macsyma notebook (a file with extension .mfe) in several ways.

Click on the Macsyma Icon, then on the MFE icon, and choose File - New to create a new notebook. Then use Edit - Insert to create an expression input section.

Macsyma 2.2 for Windows NT/95 supports the Drag and Drop technique. Select a Macsyma notebook file name, and drag it on to the Macsyma 2.2 icon or the MFE icon. This procedure opens the notebook with the Macsyma Front End.

Double-click on a notebook to start the Macsyma Front End and open the notebook.

7.2. How do I Save a Macsyma Notebook?

You can save a Macsyma notebook in several ways.

Use File - Save as to save the notebook with a default extension .mfe so that it can be opened with the Macsyma Front End later.

Save the notebook as a .mac file. The .mac extention creates an ASCII text file that consists of the input sections and text sections enclosed in Macsyma comments. The .mac file can be used as a Macsyma batch file.

Save the notebook as an ASCII text file with extension .txt. A .txt file contains input lines, labeled as c-lines, output lines labeled as d-lines and formatted text sections. You cannot turn a .txt file into a batch file.

7.3. Is Macsyma Case Sensitive?

Most Macsyma commands are not case-sensitive. You may type commands in upper, lower, or mixed case and still be understood. You do not have to copy the case used for command examples in this Guide. You can choose the case you want for output display. See **display_case** in *The Macsyma Reference Manual*.

7.4. What do I Press After Entering Commands?

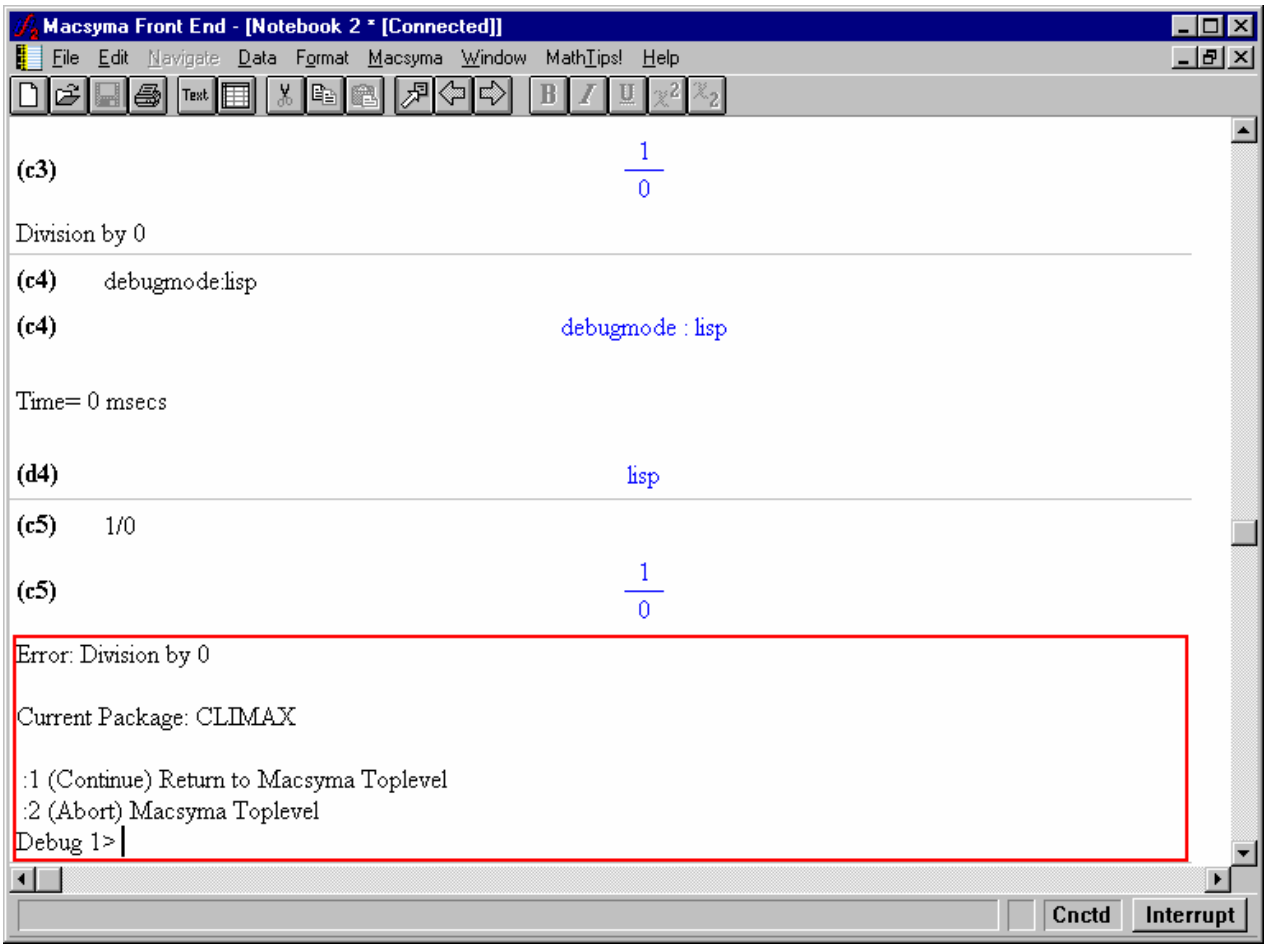
Macsyma commands end with the Enter key or dollar sign ($) followed by Enter.[3] The dollar sign suppresses display of output from executing the command line. You may also terminate command lines with a semicolon (;) followed by Enter, but the semicolon is not necessary. Typing Ctrl-Enter has the same effect as typing $.

If you encounter Lisp commands in the debugger use the right hand parenthesis to terminate an expression, rather than Enter.

7.5. What do I do if There is an Error or Break?

When an error occurs, or when you press Interrupt, you may wind up in a Macsyma Break. You may see something like:

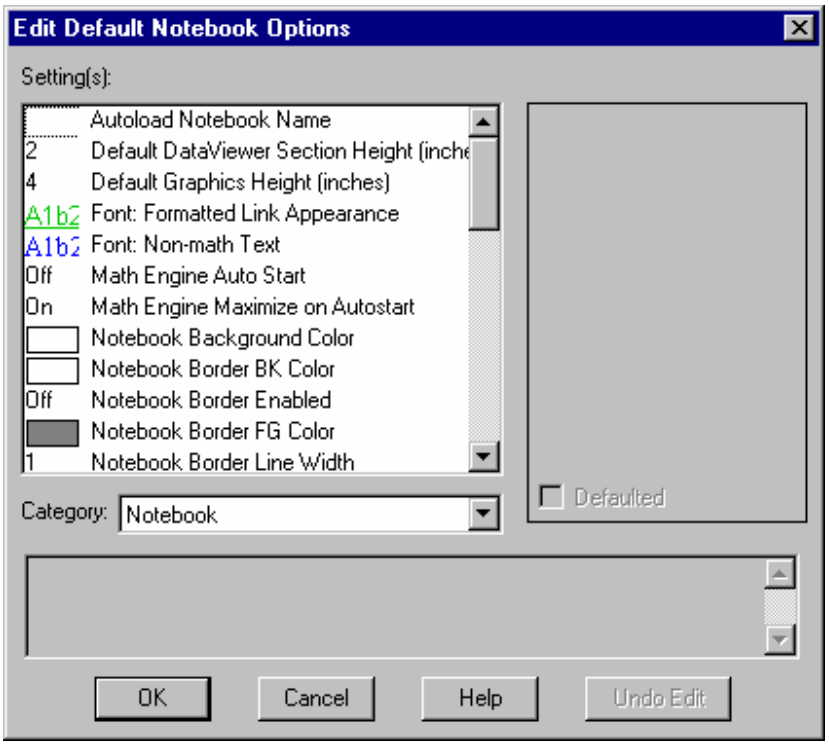
[3] Line feed is accomplished with the key combination Shift-Enter.



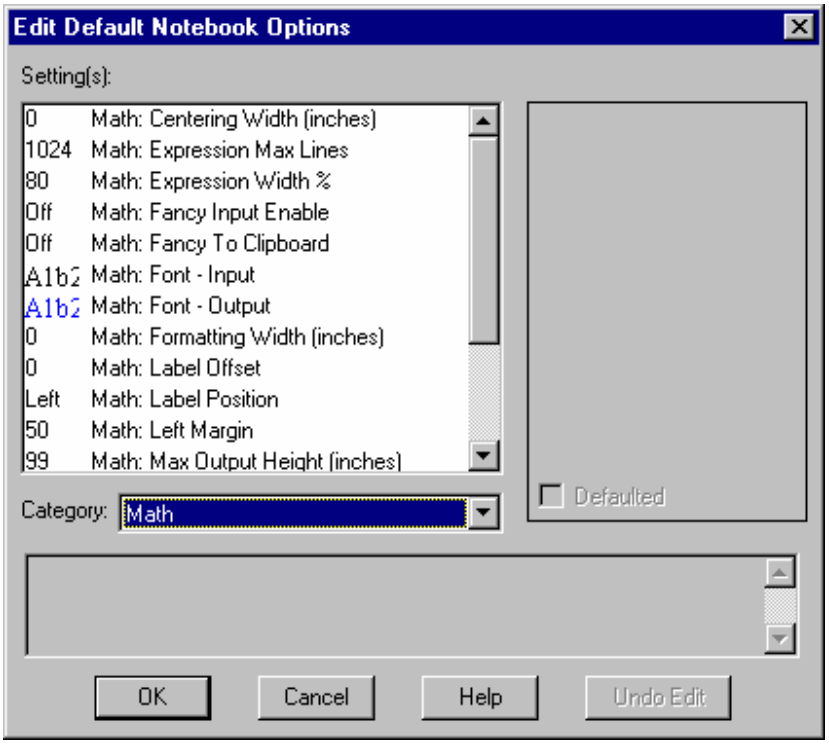
To continue, type :1 and ENTER. To return to a Macsyma c line, type 2 and ENTER.

7.6. How Do I Change Fonts?

Select File - Options or File - Options Default. Select Category Notebook to look for Notebook fonts. Select category Math for math fonts. A Notebook dialog box will look something like:



and a Math category dialog looks something like:



You cannot change the font attributes for command line labels, but you can change the label offsets. If you want a wider area to display labels, set the Math: Label Margin to, say, 75. You can experiment with other settings.

7.7. How do I Customize Macsyma?

The file **\macsyma2\mfe\mfe.ini** contains information about directories, variables and attribute settings the Macsyma Front End needs. You can change various setting by selecting File - Options or File - Options Default from the Macsyma Front End. Some attributes may be available only under Expert Mode.

Place Macsyma commands that affect the Macsyma Math Engine in the file **mac-init.mac,** which should be located in your home directory, specified by the Macsyma command user_homedir_pathname(). One common command is **`showtime:true.`** In Macsyma 2.2 for Windows NT, **mac-init.mac, \users\default** is usually the home directory. In Windows 95 or Windows 3.X, the home directory is usually **\macsyma2\user**.

7.8. How Can I Make a PostScript File From a Graphic?

You can make a PostScript file from a graphic by printing the graphic to a file with a PostScript printer driver. Install a standard Windows PostScript printer driver and configure it to print to a file. You need not have a PostScript printer physically attached to your PC or network. Windows will prompt you for a file name when you print.

You may need to configure the printer driver to print a PS file or an EPS file.

7.9. Is My Calculation Taking Too Long?

Sometimes, a calculation takes an unexpectedly long time. Delays may occur when you calculate large intermediate symbolic or numeric expressions, such as trying to invert a symbolic matrix. It is often useful to estimate the size of expressions that you expect to get in advance. For a symbolic matrix inversion, it is usually not practical to invert a matrix larger than about 7 x 7. Inverting numerical matrices is limited only by the resources on your machine.

Macsyma has a status line at the bottom of the screen. A flashing * on the status line indicates that garbage collection is in progress. If you see lots of rapid flashing, but no screen output, the math engine is still calculating.

Math calculations in Macsyma 2.2 may be interrupted, but the display of sections in the Macsyma Front End cannot be interrupted. Macsyma will not allow keyboard or mouse gestures to be processed until the display has finished. Large sections often take a while to display. Don't assume there is a problem with Macsyma or Windows if you must wait for a response. If you suspect a problem, please try to repeat the calculation by terminating the command line with a $ to suppress the display. Or you can set the Macsyma option variable **SHOWTIME:TRUE** to indicate a temporal boundary between the math computation and the display.

8. Further Assistance

There are several examples of notebooks in the macsyma2\demo directory. In particular, look at the notebook in orthcor3.mfe. It contains interactive examples of graphics that you can re-execute.

Macsyma's on-line documentation is very rich and can often pinpoint the information you need. Macsyma's printed documentation provides similar information in a hard copy format.

- The *Macsyma User's Guide* provides a tutorial introduction to Macsyma's most widely used capabilities.
- The *Macsyma Mathematics and System Reference Manual* provides a comprehensive summary of Macsyma's mathematical capabilities. It also describes the non-mathematical aspects of Macsyma, including programming facilities of the Macsyma environment.
- The *Scientific Notebook Interface Reference Manual* comprehensively describes non-mathematical aspects of Macsyma, including the user interface, and the programming facilities of the Macsyma environment.
- The *Scientific Graphics Reference Manual* comprehensively describes non-mathematical aspects of Macsyma graphics commands and data exchange facilities in the **mfe_data** package as well as graphical programming facilities of the Macsyma environment.
- The on-line documentation and release notes should provide information. Be sure to check the Macsyma web page http://www.macsyma.com for the very latest information, patches, etc.