

Your First Session with Macsyma 2.2 for Windows

1. Starting Macsyma.....	1
2. Using The On-Line Help System.....	5
3. Further Assistance.....	15

Now that you have installed Macsyma 2.2 you can start your first session. These exercises and tips will pay off when you want to use the help system or other Macsyma Front End features later.

1. Starting Macsyma

You can start Macsyma by double-clicking with your left-mouse on the Macsyma icon in the Macsyma folder or program group. This action will open the Macsyma Front End window. Select File-New to choose a template notebook for Macsyma. The following dialog will appear:

This document corresponds to Macsyma Release 2.2 for Windows.

27 September, 2006

The technical documentation team at Macsyma Inc. prepared this document. The software described in this document is proprietary to, and comprises valuable trade secrets of, Macsyma Inc. It is given in confidence by Macsyma pursuant to a written license agreement, and may be used, copied, transmitted, and stored only in accordance with the terms of such license. This document may not be reproduced in whole or in part without the prior written consent of Macsyma Inc.

Copyright © 1982-1996 Macsyma Inc. All Rights Reserved. Portions Copyright © 1982 Massachusetts Institute of Technology. All Rights Reserved.

Macsyma®, and PDEase® are registered trademarks of Macsyma Inc. DataViewer™, MathTips™, NumKit™ and PDEase2D™ are trademarks of Macsyma Inc. All other trademarks are the property of their respective owners.

All product names used herein that are not the trademarks of Macsyma Inc. are the trademarks of their respective owners.

Restricted Rights Legend

Use, duplication, and disclosure by the Government are subject to restrictions as set forth in subdivision (c)(1)(ii) of the Rights in Technical Data and Computer Software Clause at FAR 52.227-7013.

Macsyma Inc.
20 Academy Street
Arlington, MA 02174
U.S.A.

TEL: 617-646-4550
FAX: 617-646-3161
Free: 1-800-macsyma

Electronic Mail:

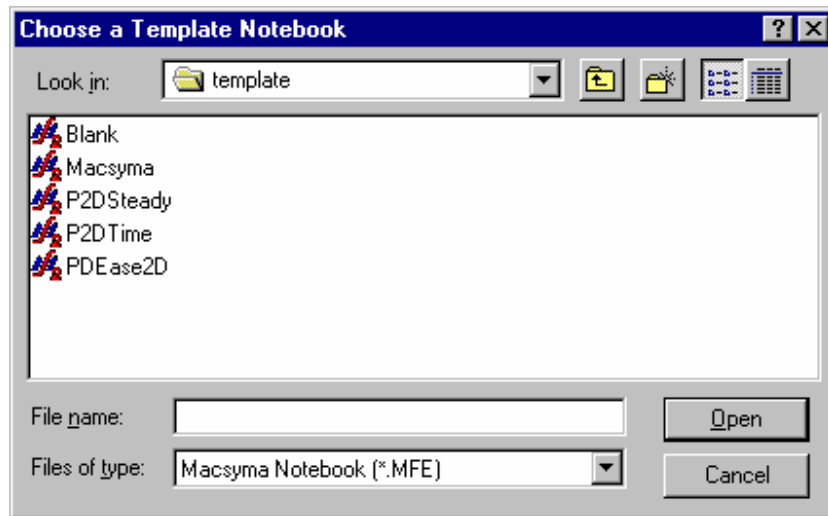
service@macsyma.com

info-macsyma@macsyma.com

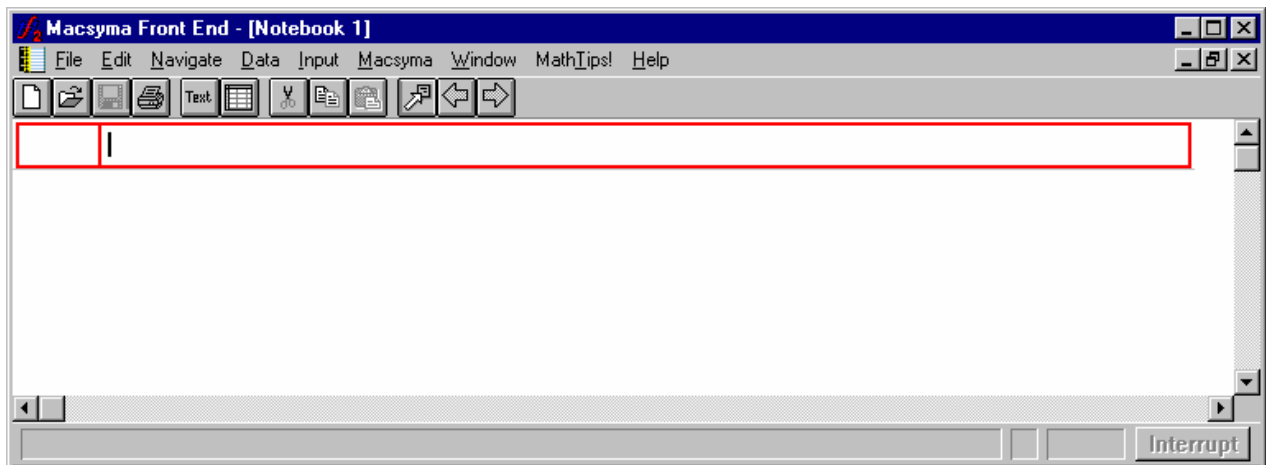
URL <http://www.macsyma.com>

Printed in the United States of America.

Print year and number: 97 2



The Macsyma Front End program also serves as the Front End for PDEase2D. You can select PDEase2D, Macsyma, or Blank template notebooks. Select the Macsyma template notebook to open an empty Macsyma notebook. You will see a notebook that looks like this:¹



The Macsyma notebook is structured as follows:

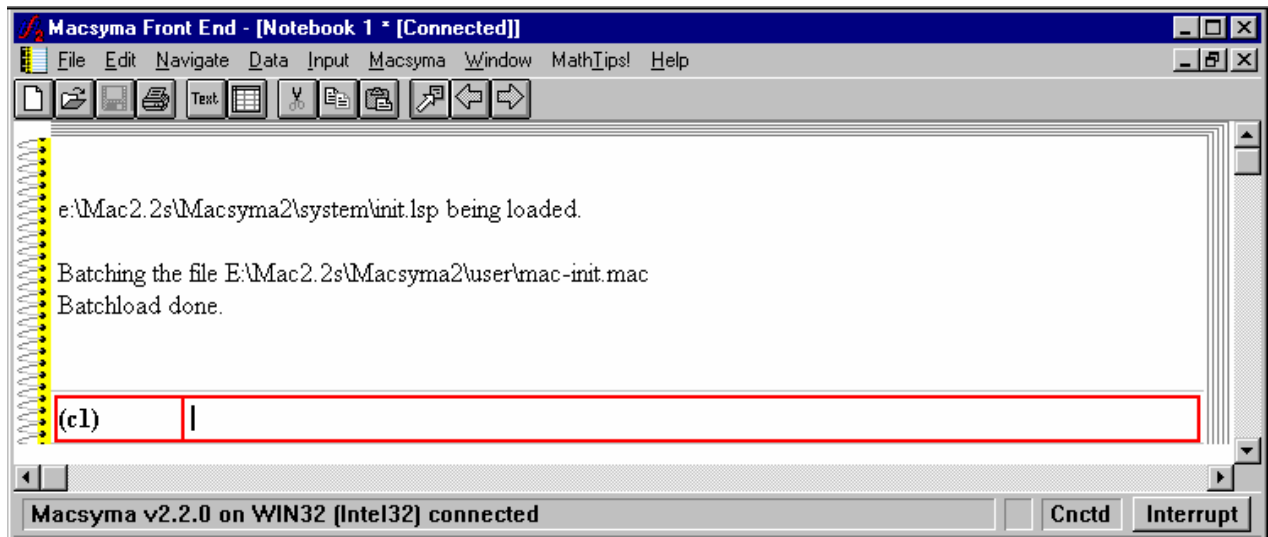
1. Window Title (Macsyma Front End)
2. Menu Bar (File Edit Navigate)
3. Button Bar, which offers context appropriate actions and adjusts automatically to each context
4. Macsyma notebook highlighting an expression input section
5. Horizontal and vertical scrolling, and
6. Blank status bar showing an Interrupt button.

¹ The screenshots use in this document were made using the Windows 95 interface. The specific appearance in your version of Macsyma may differ, but the essential features are the same across all Windows platforms.

You can connect to the Macsyma Math Engine by :

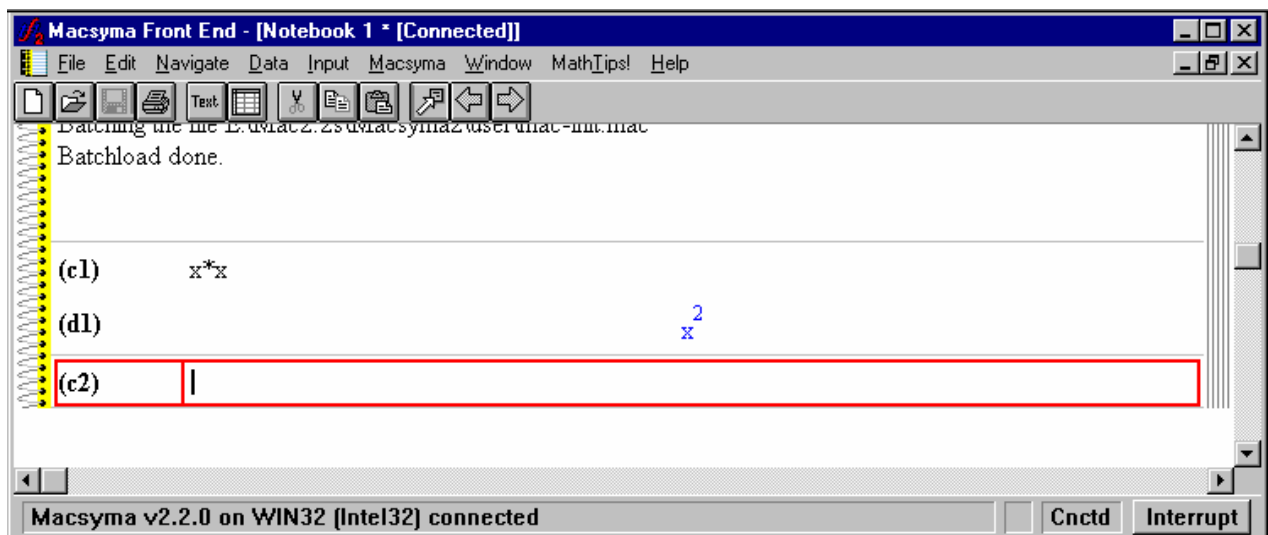
1. Typing an expression to evaluate (e.g., $x*x$ followed by Enter). Macsyma opens a dialog box to open a math server. You can select New Server.
2. Clicking on Macsyma. You can connect from the Menu Bar.

You will see the Math Engine connect and a (c1) input line:

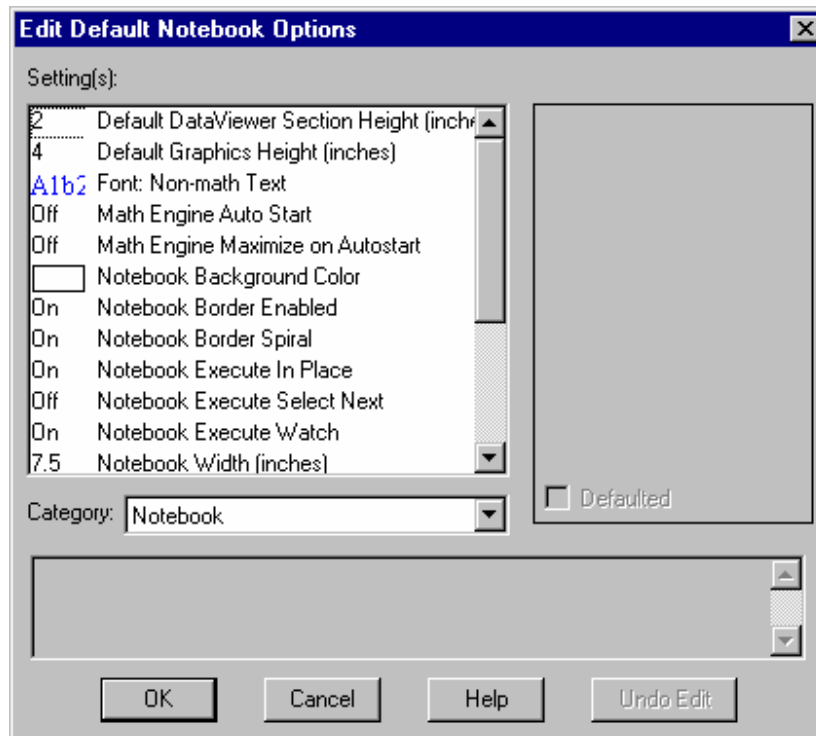


The status indicator Cnctd appears on the bar next to the Interrupt button.

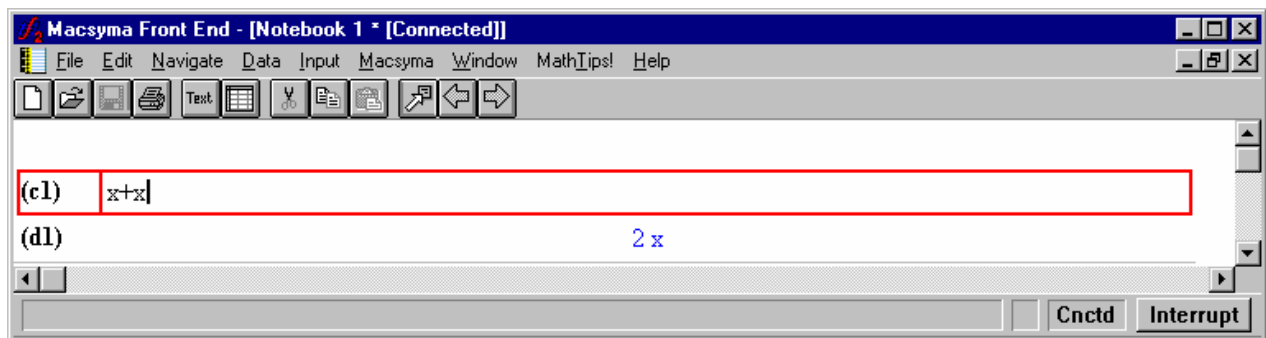
Macsyma notebooks display a default spiral border, section borders, and section brackets. Macsyma outlines the selected section and labels input lines (ci) and output lines (di). Type $x*x$ followed by Enter:



You can customize the notebook's appearance by selecting File-Options or File-Options Default. The Options Default dialog looks like:



Without the spiral border, section brackets, and borders, the notebook looks like:



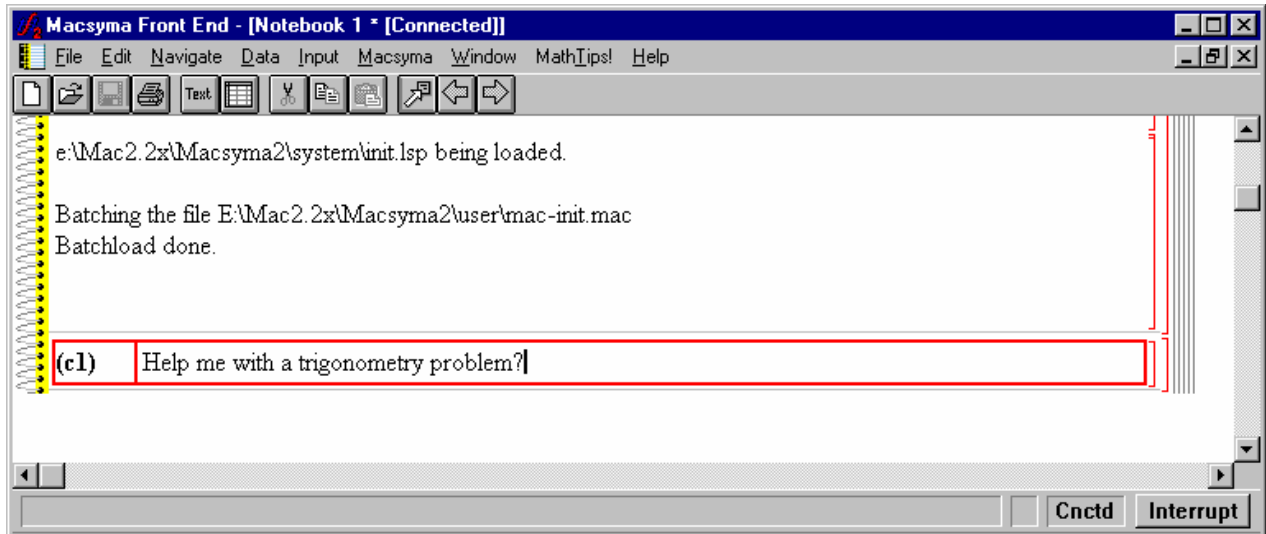
2. USING THE ON-LINE HELP SYSTEM

Macsyma is the most powerful software of its kind. Its excellent on-line help makes it easier to use than any other math software.

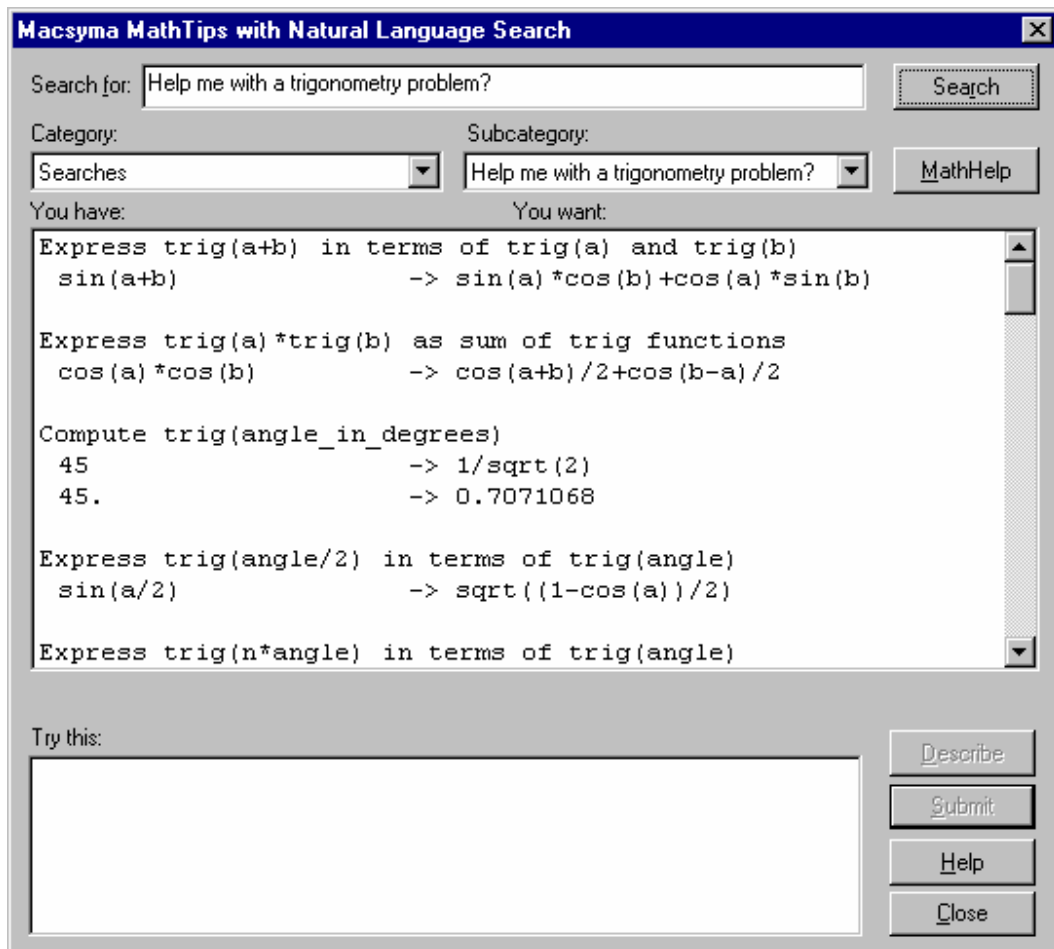
2.1. The MathTips™ Advisor

When you know the mathematical operation you want to perform, but don't know the correct command, you can use Help - MathTips natural language query to narrow your search and inspect the different topics and sub-topics to perform computations.

Suppose you want to solve a trigonometric problem. You can type on the input line “Help me with a trigonometry problem?”



and then hit Enter. MathTips will respond with



The main area of the advisor is filled with tips on common computations. Each tip consists of:

- A one-line verbal description of the computational task
- An example input to the computation, which appears on the left
- The desired output from the computational task, which appears on the right
- When you select a tip with your mouse, the command or short program that accomplishes the computational task appears in the area at the bottom of the tips advisor.

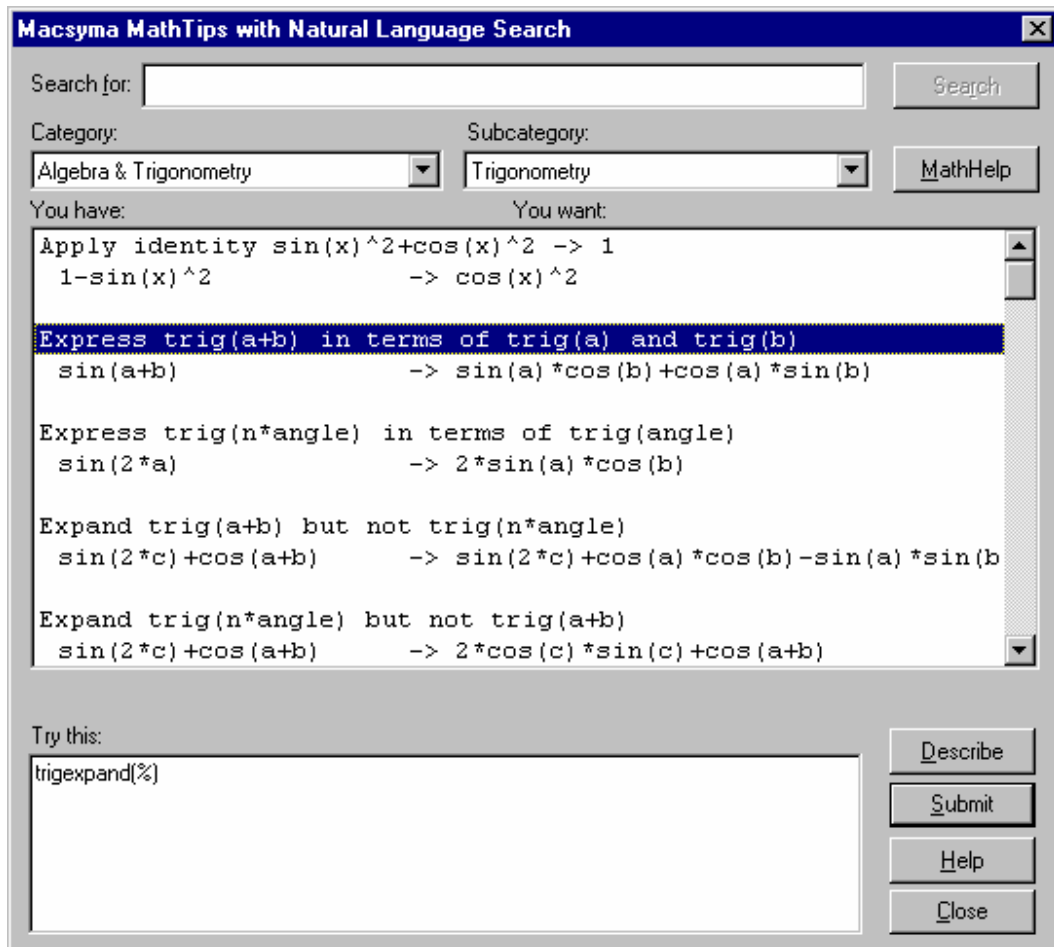
You can inspect each of the tips and find the commands that are relevant to the particular calculation you want to do. You can see several relevant tips. You can now return to your Macsyma screen and type the expression you want to solve, *e.g.* simplify $\cot(x+y)$.

You can now use the **MathTips** advisor to solve this trigonometric problem. To expand the trigonometric function $\cot(x+y)$, type the following expression on your current Macsyma command line and press the **Enter** key:

(c1) $\cot(x+y)$

(d1) $\cot(y+x)$

Now open the **MathTips** advisor by clicking on **Help - MathTips** in the **Help** menu. Click in the box in the upper left of the advisor, then on the topic **Algebra & Trigonometry**, and then on the subtopic **Trigonometry**. The **MathTips** advisor will look like this:



One of the tips says:

```
Express trig(a+b) in terms of trig(a) and trig(b)
sin(a+b)          -> sin(a)*cos(b)+cos(a)*sin(b).
```

When you click on this tip, the command for accomplishing this transformation appears in the bottom area of the advisor:

```
trigexpand(%)
```

where % refers to the left-hand expression in the tip, $\sin(a+b)$ and to the previous output line in Macsyma.

You can apply this command to your previous output, $\cot(y+x)$, without re-typing it. Click on the **Submit** button to submit the command `trigexpand(%)` to Macsyma. The new command line is selected in red, so pressing **Enter** executes this command, yielding the result:

(c2) `trigexpand(%)`

(d2)
$$\frac{\cot(x) \cot(y) - 1}{\cot(y) + \cot(x)}$$

Select a subtopic; the **MathTips** advisor presents you with a list of common computations in that area. The advisor also allows you to visit **MathHelp!** Topics browser. See Section “2.2. The **MathHelp!** Topic Browser.”

You can perform many computations using the **MathTips** advisor by copying and modifying the **MathTips** examples, so you rarely need to read command descriptions to determine which commands to use.

You can also open the **MathTips** advisor from **MathHelp!** browser inside the mathematics topic browser using the **Tips** button or by clicking **Help - MathTips** in the **Help** menu.

You can also click on the **Help** button for “**Tips on Tips**.”

If you try to follow the guidelines below while you compose your queries, you can improve the effectiveness of your interactions with the system:

- Avoid using the personal pronoun “I,” which the system sometimes interprets as $i = \sqrt{-1}$.
- Carefully select mathematically significant words, paying attention to the differences between: polynomials and equations, and mathematical constants and physical constants.
- Use verbs that describe the operation, such as “solve,” “simplify,” “factor,” or “expand.”
- Avoid mathematically imprecise words; they may inadvertently distort the relative ranking of the tips for reasons that have no relation to the problem you want to specify.

After **MathTips** supplies you with recommended tips, you can benefit from doing a little exploring:

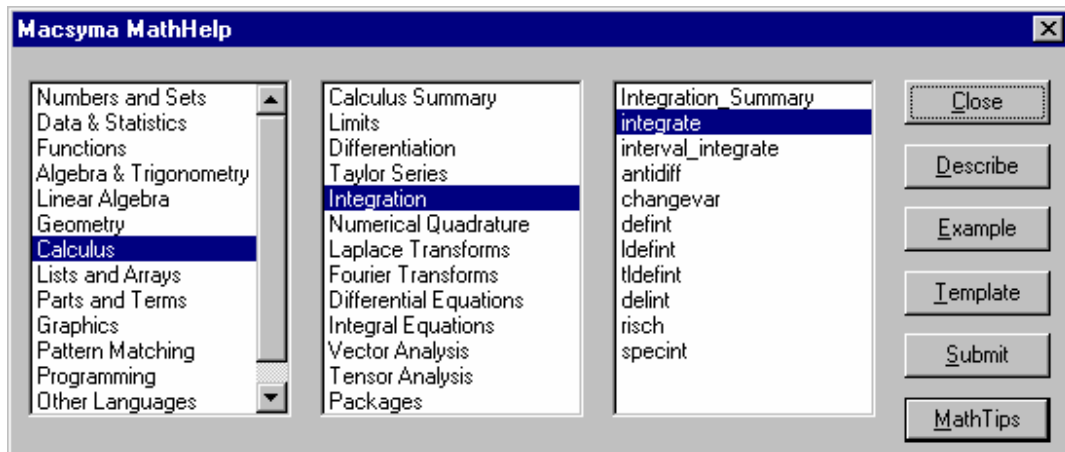
- Scroll through the tips. **Macsyma** tries to put the right tip in the first or second position, but you may find a better tip down 5-10 places on the list.
- Try variations on words and word endings. For example, you might ask for “simplify a product of complex expressions” or “write a product of complex expressions in rectangular form,” both of which work in the current **MathTips** Advisor.

2.2. The **MathHelp!** Topic Browser

The menu bar at the top of the **Macsyma** Front End window resembles the preceding illustration. With your mouse, click left on **MathHelp!**² (You can use the mouse gesture **left-mouse** unless otherwise directed.)

You will see a topic browser dialog box containing the items in the left-hand column in the figure below. Click on **Calculus**. A list of calculus subtopics appears in the second column. Click on **Integration**. The third column of the dialog box will be filled with a partial list of **Macsyma**'s integration commands.

² Throughout this document, click with the left mouse button unless the instructions explicitly state otherwise.

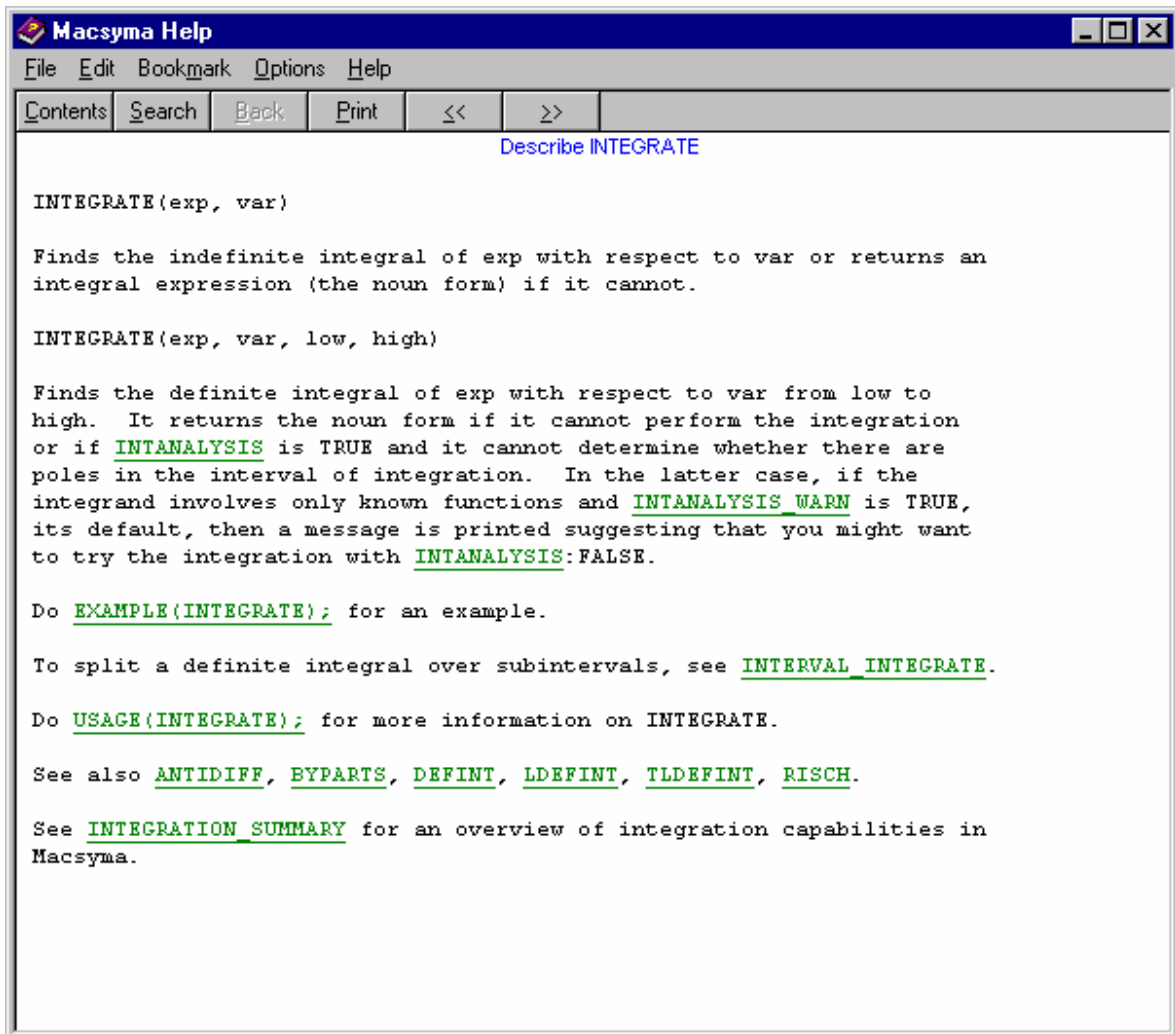


Scroll through the third column to expose more of Macsyma's integration commands. The first item is a summary of integration commands. The next command on the list, Integrate, is the most commonly used command in this group. Click on this command name now.

When you know the mathematical operation you want to perform, but don't know the correct command, you can choose **MathTips** to use the MathTips Advisor to help narrow your search by showing Macsyma commands and their behavior.

2.3. Hypertext Descriptions of Macsyma Commands

Click on the **Describe** button for a description of the command in the Macsyma Help window. The description includes the command's calling syntax, an explanation of what the command does, and cross references. This description is "hypertext;" some words (which are colored and/or underlined in the text) have hot links to other parts of the text. You will see a Help Window that looks like:



- Click on the phrase `USAGE(INTEGRATE)`; for a detailed discussion of the **integrate** command. After inspecting this screen, click on the **Back** button on the top menu bar of the Macsyma Help window to return to the previous screen, a description of **integrate**.
- At the end of the description of the **integrate** command, the phrase “See also” is followed by a list of related Macsyma commands and topics. You can access the description of any of these by selecting its name.
- Click on the phrase `EXAMPLE(INTEGRATE)`; to execute an example of the **integrate** command. When you start the example, the program exits the hypertext help system and moves to the Macsyma Front End window, where the example will run. After each line of the example, Macsyma prompts you to push **Enter** to move to the next line. (You may also use the space bar in place of the **Enter** key or click on **OK**.)

If you wish to terminate the executable example for **integrate** before it ends, push the **Escape** key when the system prompts you to push the **Enter** key.³

Some commands do not appear in the **MathHelp!** topic browser dialog box. You can access the description of the **integrate** command in the following three ways, without knowing where to locate it on the math topic menus:

1. You can click on **Help** at the top of the Macsyma Front End window, then click on **Index**. When the alphabetical index appears, click on the letter **I**. You will see an alphabetical list of all described topics that begin with the letter I. Click on the command **INTEGRATE** to access the description. Now return to the Macsyma Front End window by closing or minimizing the Macsyma Help window or by clicking on an exposed portion of the Macsyma Front End window.
2. You can access the description of **integrate** through the **Help Search...** menu by typing "integrate" in the Search dialog box or selecting it from the alphabetical list of topics.
3. You can go to the last command line of a connected Macsyma notebook, type `describe(integrate)`, and press **Enter**. The Macsyma Help window will appear with the hypertext description of the **integrate** command. (When you type, make sure the cursor is inside the last input section of a connected notebook.)

Macsyma also provides context sensitive help. It can display the description of a command that appears on a command line, on an output line, or in a text section. You can access context sensitive help using the following steps:

- At a command prompt (c#), type `integrate` and press the **F1** button. The description of **integrate** will be displayed. This feature is helpful when you are typing a Macsyma command and cannot remember all of its arguments. For context sensitive help, the cursor may be anywhere within the command name.
- With the mouse still on the **integrate** command, pull down the **Help** menu; notice that the first menu item is **Help On 'Integrate'**.

2.4. Hypertext Descriptions of the Macsyma Front End

You can obtain descriptions and on-line instructions for using features of the Macsyma Front End by clicking on **Help - Front End Browser** or **Help - Front End Contents**, where you will find explanations of how to control Macsyma's notebooks and graphics viewer.

2.5. Executable Examples

In the previous section you accessed an executable example of the **integrate** command:

- From inside the hypertext description of the **integrate** command
- By clicking on the **Example** button in the **MathHelp!** topic browser.

³ After escaping, you can continue executing the previous example, demo or batch file at the point of interruption by typing `batcon()` and pressing **Enter**.

You can also access executable examples without using the **MathHelp!** topic browser or the hypertext system. At the last command line in a connected Macsyma document, type `example(integrate)` and press **Enter**. The executable example for the **integrate** command will start. After each command in the example, proceed to the next command line by pressing **Enter** or the space bar, or click on **OK** in the status bar at the bottom of the Macsyma Front End window. To exit the example at any time, use **Escape** or click **Cancel** in the status bar at the bottom of your window.

2.6. Function Templates

You can use function templates to run a sample problem, such as doing an integral.

Click on the menu item **MathHelp!** at the top of your screen, then on the topic **Calculus**, then on the subtopic **Integration**, then on the Macsyma command **integrate**.

- Click on the **Example** button to run the executable example for the **integrate** command⁴ without entering the hypertext system, if you choose to, as in the earlier example with hypertext descriptions.
- Click on the **Template** button. You will see a dialog box that lists the four arguments to the **integrate** command and indicates that the last two arguments are optional. Use the template box to compose an integration command that performs the operation:

$$\int_a^b x^2 dx .$$

The cursor appears below the label “Expression to integrate.” Type `x^2` in this slot. Using the tab key place the cursor in the slot below the label “Variable of Integration,” and type `x`. Tab to the next slot and type `a`; tab to the last slot, and type `b`. Then click on **Submit**.

Action now moves to the Macsyma Front End window, where you will see the command:

```
integrate(x^2,x,a,b)
```

on the input line. When you press the **Enter** key, the command will execute and return:

$$\frac{b^3}{3} - \frac{a^3}{3} .$$

2.7. Executable Demonstrations

The executable examples illustrate individual Macsyma commands, while the executable demonstrations illustrate how to use an entire Macsyma package or combine Macsyma commands to solve a problem.

In the following, you will run a few executable demos.

- Click on **Help** at the top of the Macsyma Front End window, then on **Demos**. You will see a list of approximately eight topic areas. Macsyma includes over 200 executable demonstrations,

⁴ Some entries on the math topic menus do not have examples or function templates. These entries are usually “option variables,” which can take on different values to alter the behavior of Macsyma, but which are not themselves functions which take arguments. (“Fancy_display,” for example, is an option variable with the settings `TRUE` or `FALSE`.) While some option variables have executable examples, none has a template.

organized according to mathematical fields and application areas. General demonstrations are listed at the bottom of the topic.

- Click on DEMO(BEGIN); to start a brief, introductory demonstration. You can interact with a demonstration as you do an example. Press **Enter** or the **Space** bar to execute the next line. Press **Escape** to terminate the demonstration.
- Click on **Help - Demos** again, then on DEMOS_CALCULUS. Scroll down to **Integral Calculus**. Each demonstration focuses on a distinct aspect of Macsyma's integration capability, as noted to the right of each demo name. Click on DEMO(INTEGRATE); to see an executable demonstration of the **integrate** command that is over three times as long as the **integrate** example. If you wish to exit, type the **Escape** key when you are prompted to continue.

The DEMO(BALLISTICS); and DEMO(OSCILLATOR); introductory demonstrations model a cannon ball in flight and a linear harmonic oscillator, respectively. You may access these demonstrations from the list under **Help - Demos** or from the keyboard. To access a demonstration from the keyboard:

- Type demo(ballistics) or demo(oscillator). The problem and its solution appears, complete with graphics.

You can see a demonstration of animated graphics by clicking **File - Open** and opening the Macsyma notebook \macsyma2\demo\kleinani.mfe. Follow the instructions in the notebook to see animations of graphics.

You might want to see other demos:

- 3D graphics – demo(plotsurf);
- Analytic solutions of ordinary differential equations – demo(ode);
- Numerical solution of ordinary differential equations – demo(odensol); demo(odensol1); or demo(odensol2).

2.8. The Interactive Primer

The Interactive Primer is an elementary introduction to interactive commands in Macsyma. You can start the Primer by typing primer(); and selecting one of the displayed scripts.

2.9. Files of Macsyma Commands

You can evaluate Macsyma commands in a text file as a batch job. Each of the example and demonstration scripts is actually a special batch job that waits for you to press the **Enter** key, the **Space** bar, or the **OK** button (provided you are not currently using the batch() command) between commands.⁵

Type batch("begin.dem") and press **Enter**. You will see the demonstration “Begin” execute as a batch job, without waiting for you to type anything between the lines.

⁵ The demonstrations are packed in one large file, \macsyma\macsyma2\demo\demo.pck and the examples in another, \macsyma\macsyma2\demo\demo.pck. You may “unpack” any of them by typing, unpack_topic("begin.dem"); for example. This action creates a file in the **demo** or **example** directory.

You can execute any text file filled with Macsyma commands using the `batch` command. Execution of the commands is sequential. Input sections, output sections, and formatted text sections with comments are created in the Macsyma notebook.

You can also execute a text file of Macsyma commands with the `load` command, but in that case you will not see anything in the notebook except the load message.

To avoid uncertainty about a file's location, you can batch execute one of your command files by typing the complete file pathname as an argument to the `batch` command. Use Macsyma's logical pathname convention to describe files and directories below the main `\macsyma\macsyma2` directory. For example, you can batch the file `\macsyma\macsyma2\my_sub\my_file.mac` with the Macsyma command `batch("macsyma:my_sub;my_file.mac")` or `batch("c:\macsyma\macsyma2\my_sub\my_file.mac")`. All Macsyma commands using file names support both Windows NT/95 long file names and 8.3 format short file names. By convention, command files end with the extension `.mac`. The input editor looks for this extension first when seeking a file to load.

Note: When you give a file path name to Macsyma on a DOS-Windows PC, you must change each backslash to a double backslash, because backslash in Macsyma means "take the next character literally."

You can also turn a file of Macsyma commands into a Notebook. Select **File - Make Notebook**. All the executable commands will be placed on input lines. You can then execute them sequentially, or one at a time.

3. 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.