Lab 1: The NeXT and Mathematica

This first lab will introduce you to the NeXT computer and the Mathematica software that we will be using this semester.

Step 1

Sit down in front of one of the NeXT computers. It should be displaying the standard log-in panel where you can enter your user name and password. Log in as described in class.

After entering your user name and password, you will see a tiny spinning disk. This indicates that some of the NeXT software is being loaded from the disk into the main memory of your computer. Then after a few seconds your screen should look like this:

Figure 1.1 The NeXT screen after logging in.

The screen shows the Workspace menu in the upper left corner, the File Viewer window next to it, a sequence of seven icons along the upper right edge, and the Recycler icon in the lower right corner.

Each icon is a picture of a software application. The eight applications depicted here are the Workspace Manager, the Preferences application, the NeXTmail application, the Webster on-line dictionary and thesaurus, the Digital Librarian application, the WriteNow word processor, Mathematica, and the Recycler.

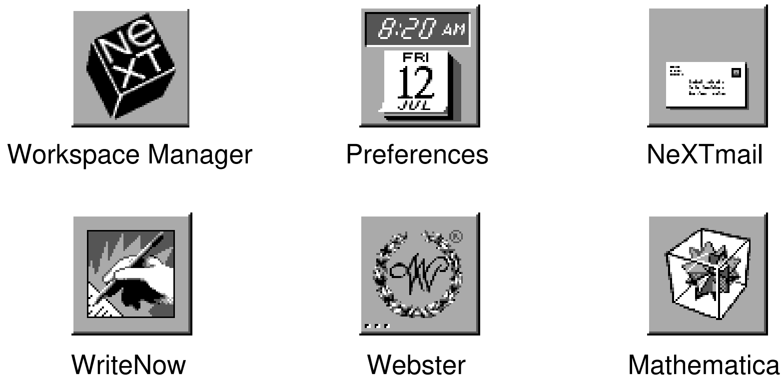


Figure 1.2 Icons for applications on the dock

The NeXT computer is a true multitasking system. This means that you can have many applications running concurrently. However, at any one time only one application is *active*. You can always tell which application is active: its menu will appear in the upper left corner of the screen. Right now, the active application is the Workspace Manager.

The Workspace Manager serves to help you keep track of all your work on the computer. This work is stored in files, analogous to the paper file folders people keep in filing cabinets. Each file has a unique filename which can be seen in the File Viewer window.

The File Viewer window is a powerful tool that we will explore in more detail later. For now, just notice that your user name is highlighted in the left column, and it appears under the two little house icons above.[1]

Step 2

The column of icons at the right edge of the screen is called the *dock*. You can *launch* an application simply by double-clicking[2] on its icon. Do this now on the Mathematica icon.

The Mathematica menu in the upper left corner tells you that Mathematica is now the active application. The other change on the screen is the new window lying in front (on top) of the File Viewer. This is the active Mathematica window.

[1] Throughout these Lab writeups, the user name shown will be **ghwb**.
[2] This means use the mouse to move the arrow pointer over the icon and then push the left button on the mouse twice in rapid succession.

Figure 1.3 After launching Mathematica

All work done on the NeXT is done within windows. You can have many applications running concurrently, and each application can have many windows open on the screen. But at any one time, there is only one *active* application, and it has only one *active* window. The active application is identified by its main menu in the upper left corner of the screen. Its active window is identified by its black title bar at the top of the window. The title bars of all the other windows will be gray. In Figure 1.1, the Workspace Manager is the active application and its File Viewer window is the active window. In Figure 1.3, Mathematica is the active application and the window named Untitled-1 is the active window. The title bar on the File Viewer window (partially hidden) has changed to gray, indicating that it is now *inactive*.

Step 3

Each window has its own title which appears on its title bar. The title of the active window (Fig. 1.4) is Untitled-1. This is the *default* title given automatically when Mathematica was launched. To change its title, you have to save the window as a separate file. This is done with the Save command.

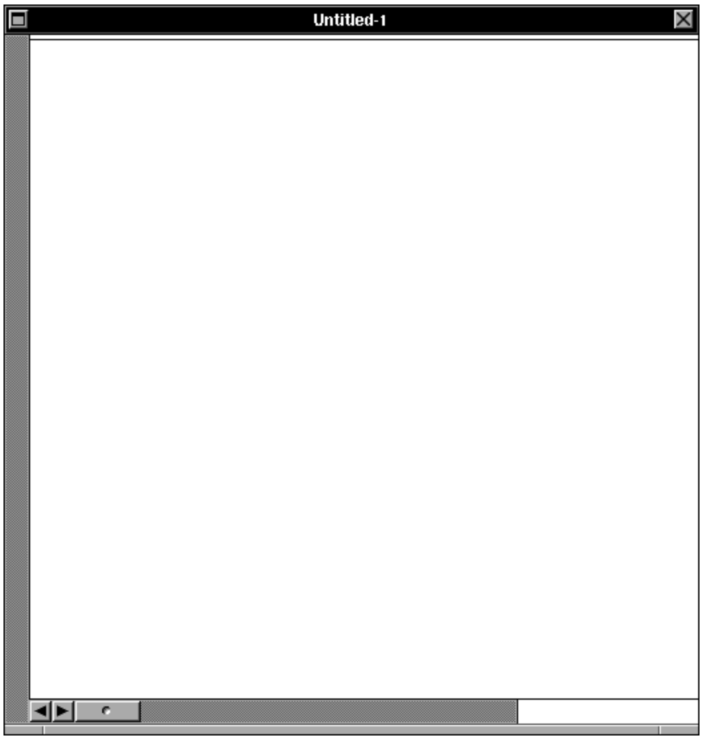


Figure 1.4 The active window

Look at the Mathematica menu (Fig. 1.5) in the upper left corner of the screen. It lists 15 commands. Click[3] on its Window command. The Window submenu (Fig. 1.6) appears immediately to the right of the main menu. It has 11 commands. Click on its Save command. This immediately brings up the Save panel (Fig. 1.7).

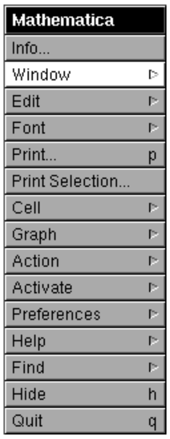


Figure 1.5

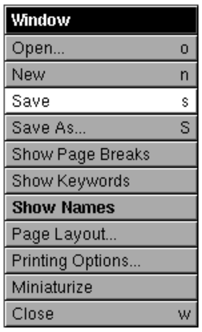


Figure 1.6

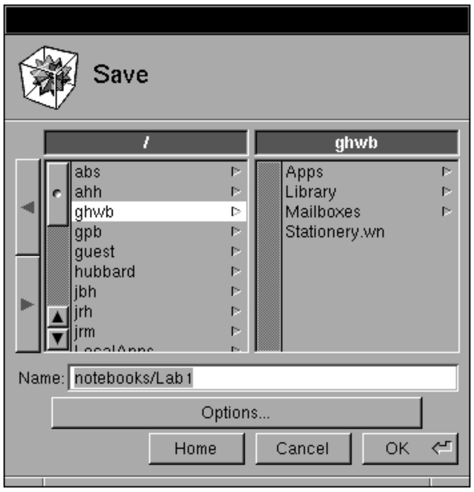


Figure 1.7 The Save panel

3 This means use the mouse to move the arrow pointer over the option and then press the left button on the mouse.

On the NeXT, a *panel* is like a window, except that its function is to obtain immediate information from the user. Consequently, the active application will not allow you to do anything else until you provide the information required by the panel.

A *Save panel* requires you to enter the name of the file that you want to save. The panel (Fig. 1.7) has a white text field labeled Name. The text field contains the file's current title (Untitled-1) highlighted in reverse video.

Type **notebooks/Lab1** and notice that what you type replaces the text in the text field. This will tell the NeXT to store your **Lab1** file in a *directory* named **notebooks**. (The slash character / is required punctuation.)

Now click on the OK button (or press the Return key) to execute the Save command. This brings up a Nonexistent path panel, asking you if you want to create the new path named /ghwb/notebooks (except your user name appears in place of **ghwb**).

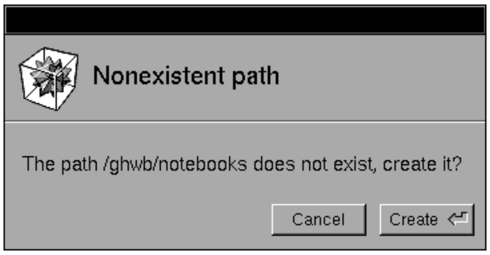


Figure 1.8 The Nonexistent path panel

Click on the Create button (or press the Return key) to create the new path.

This makes the Nonexistent path panel and the Save panel disappear. The new directory **notebooks** has been created, the new file **Lab1** has been created, and the contents of your Mathematica window have been place in it. Notice now that the title in the title bar on your Mathematica window has been changed to /**ghwb**/**notebooks**/**Lab1** (except that your user name appears in place of **ghwb**).

To see that your file really has been saved, double-click on the NeXT icon at the top of the dock. This makes the Workspace Manager the active application and its file Viewer window the current window.

Click on the **notebooks** item in the second column to reveal the contents of this new directory. Your **Lab1.ma** and **Lab1.mb** files are listed in the third column.

Notice that these file names are have **.ma** and **.mb** appended to them. In both cases, the **m** stands for Mathematica. The NeXT uses both an **a** file and a **b** file together to save each Mathematica window. The **a** file contains the text that you type, and the **b** file contains the binary code needed to generate the graphical images.

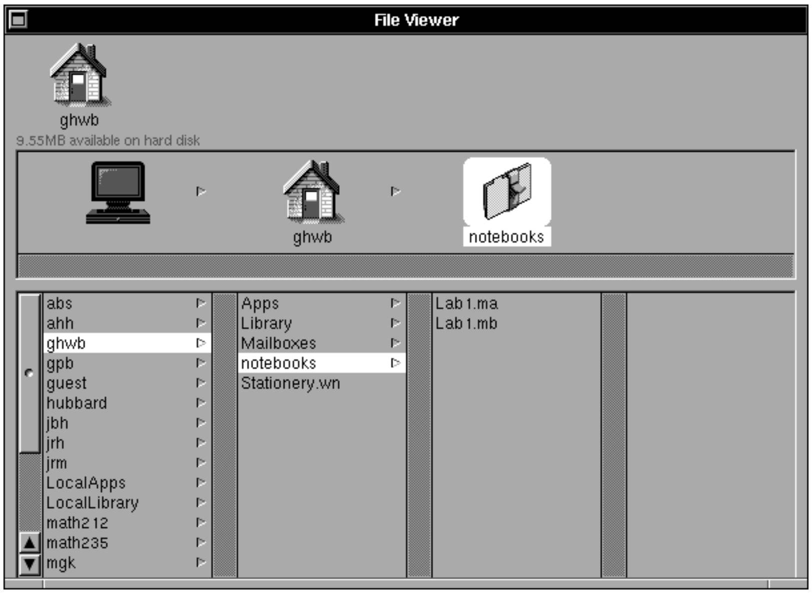


Figure 1.9 The files **Lab1.ma** and **Lab1.mb** have been saved

Step 4

Now that you have learned how to launch an application and save a file, you are ready to begin using Mathematica. If the Mathematica menu is not in the upper left corner of the screen, double-click on the Mathematica icon to activate it. Your Lab1 file should now be in the active window.

Type **`2+2`** in the window. As soon as you begin typing, you should see a small vertical bar blinking in the window. This vertical bar marks the *insertion point*. That is where the next character you type will appear. In any text field on the NeXT, you can set the insertion point simply by clicking with the mouse.

Now press the Enter key (not the Return key) at the extreme lower right corner of your keyboard. This is how all commands are sent to Mathematica.

The part that you typed is automatically labeled *`In[1]:=`* and the output `4` is labeled *`Out[1]`* (Fig. 1.10). As you give Mathematica more commands, your input and the NeXT's output will be labeled automatically this way.

Step 5

Next type **`3+1/7`** and press the Enter key. Mathematica interprets your input as a request to compute 3 + 1/7. If you did this on a calculator, it would respond with 3.14286. But that is only a decimal approximation. The exact answer is 22/7, as Mathematica has reported. This is an example of *symbolic computation* as opposed to *numeric computation*. It is one of the features that makes Mathematica so powerful.

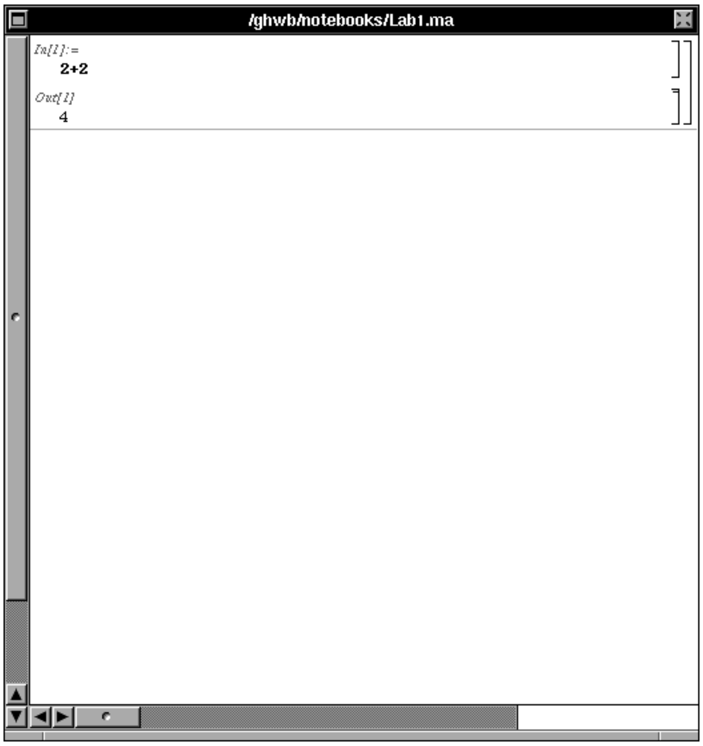


Figure 1.10 Mathematica's computation of 2+2

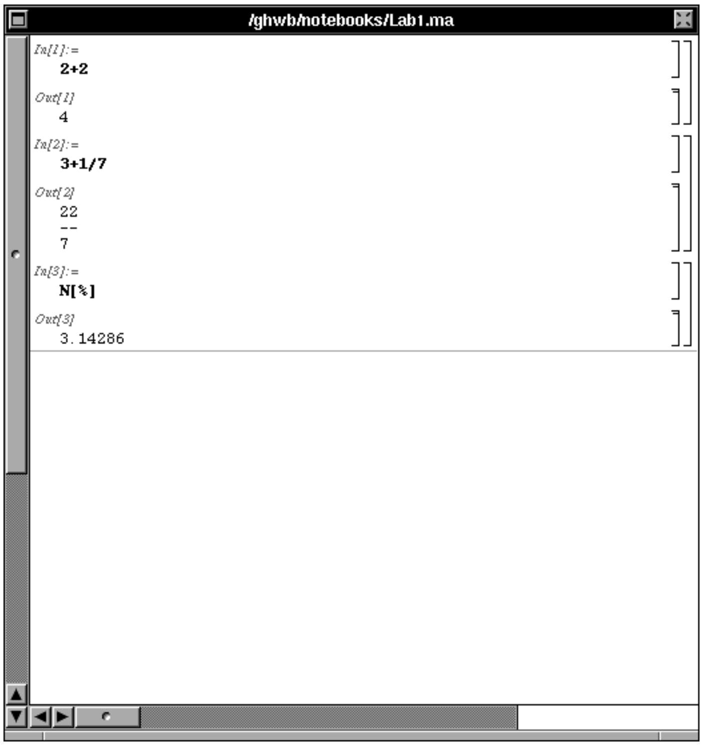


Figure 1.11

Notice that your input was labeled `In[2]:=` and the output is labeled `Out[2]` (Fig. 1.11).

Also notice how Mathematica formats fractions: it writes 22, a double dash, and 7 on three separate lines.

Step 6

If you want a numeric answer (i.e. a decimal approximation) instead of the exact (i.e. symbolic) form, use Mathematica's Numeric function, denoted by **`N[ ]`**. To get a numerical approximation to the last answer, type **`N[%]`** and press Enter (Fig. 1.11).

The percent sign refers to the previous answer.

Step 7

Now enter each of the following Mathematica commands:

```
N[5/9]
N[%3]
N[%3,10]
N[Pi,10]
N[Pi,100]
```

The notation **`%3`** refers to the answer in *`Out[3]`*. The **`10`** tells Mathematica to produce 10 digits.

Step 8

At this point, there is more input and output in your window than can be displayed. When this happens in any text window in any application on the NeXT, the window begins to *scroll*. That will be apparent from the appearance of the vertical scroller on the left edge of the window. This is the long thin gray rectangle containing the *scroll knob* and the two little *scroll buttons* at the bottom. As the quantity of text grows within the window, its scroll knob will shrink, so that its length is always proportional to the amount of text that is currently visible. At this point, your scroll knob should be about 40% as long as the scroller (i.e. about 40% as tall as the window); this indicates that your window is showing about 40% of all the text space accessible through the window.

To view the parts that are not currently visible, *mouse down*[4] on the scroll button that is labeled with a little black triangle pointing up. As you do, the scroll knob moves up and the text scrolls down, thereby revealing what is at the top of the file. To view the bottom parts, mouse down on the other scroll button. Practice this scrolling technique.

There are two other ways to scroll your text file. You can click anywhere within the scroller to position. For example, if you click at the top of the scroll slot, the file will shift abruptly revealing its top part. The other way to scroll is to *drag*[5] the scroll knob up or down.

Your Lab1 window also has a horizontal scroller at the bottom of the window. This allows you to shift the window to the right or left in the same way that the vertical scroller allows you to shift the window up or down.

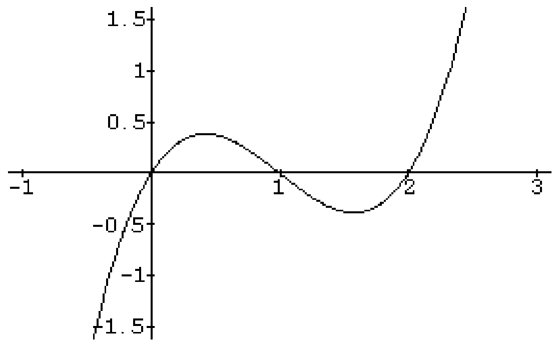
[4] This means use the mouse to move the arrow pointer over the Up Button and then hold the left button on the mouse down until the text region begins to scroll.
[5] This means use the mouse to move the arrow pointer over the Scroll Bar and then hold the left button on the mouse down while moving the mouse in the direction that you want to drag.

Step 9

In addition to performing both numerical and symbolic computation, Mathematica can display graphical images. Give the **`Plot`** command as shown in Fig. 1.12.

In[11]:=

`Plot[x(x-1)(x-2),{x,-1,3}]`



Out[11]

`-Graphics-`

Figure 1.12 The **`Plot`** command

This graphs the curve **`y = x(x-1)(x-2)`** for **x** ranging from **-1** to **3**. The square brackets **`[ ]`** and the braces **`{ }`** are necessary.

Step 10

Enter the following commands:

```
Plot[x(x-1)(x+1)(x+2),{x,-3,2}]
Plot[x(x^2-1)(x+2),{x,-3,2}]
Plot[2x/(1+x^2),{x,-2,4}]
```

Step 11

At the very bottom of each NeXT window is a thin horizontal rectangle that stretches the width of the window (Fig. 1.13). This is called the window's *resize bar*. It is used to change the size of the window.

Figure 1.13 The Resize Bar

The resize bar has one long middle section and two short sections at each end. The middle section is used to lengthen the window vertically. The two short sections can be used to stretch the window horizontally.

First change the vertical length of the window by dragging the middle section up and down. As you drag, a phantom window border moves to show you where the actual window border will appear when you release the mouse button.

Next, drag the left short section to the left and to the right to change the window's horizontal size. This works the same way as resizing vertically. Do the same with the right short section.

Finally, drag one of the short sections *first* downwards and then to the left. By moving vertically first, the two short sections can be used this way to resize both horizontally and vertically with a single drag of the mouse.

Step 12

To move your window around the screen without changing its size or shape, simply drag its title bar.

Figure 1.14 The title bar of an unsaved window

The title bar has two little squares at each end. The one on the left is called its *miniaturize button*. Click on it to compress you window into an icon. These icons are placed automatically along the bottom of the screen. Notice (Fig. 1.15) that the icon for a Mathematica file has the same white cube that the Mathematica icon on the dock has. The upper right corner of the cube is cut off to indicate that the icon represents a file window instead of the Mathematica application itself. Also notice that your file's name is shown across the top of the icon.

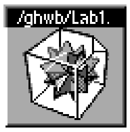


Figure 1.15

To restore your window from its miniaturization, simply double click on the icon.

The little square button at the right end of the window's title bar is called its *close button*. If the file in the window has been modified since the file was last saved, then its close button will contain an X with the middle missing (Fig. 1.14) so that it looks like four slanted dashes.

Now execute the Save command by clicking on the Save command in the Window menu (Fig. 1.6). After saving the file, the close button contains the complete X.

Figure 1.16 The title bar of an saved window

Finally click on the close button. The window disappears from the screen as the file is closed.

Step 13

Now you are ready to submit your Lab1 file for grading. This will be done through the NeXTmail application.

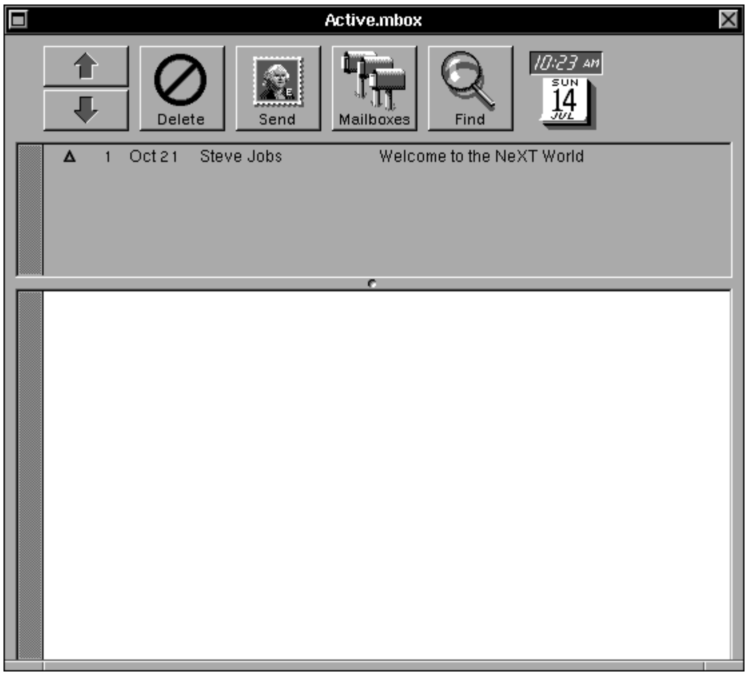


Figure 1.17 The main **NeXTmail** window

Launch the NeXTmail application by double-clicking on its icon. (See Fig. 1.2.) The Mail menu will appear in the upper left corner of the screen, and the main NeXTmail window will appear on top of your other open windows. Its title is Active.mbox .

This window shows that you already have received one message. It is from Steve Jobs, the primary owner and C.E.O. of NeXT Inc. You can read it later.

To submit your Lab1 file for grading, you need to send a message to the math235 account. To do that, click on the Send button at the top of the window.

Figure 1.18 The Send button

This causes the Send Window (Fig. 1.19) to appear in front of the other windows. It is used to send messages to other users.

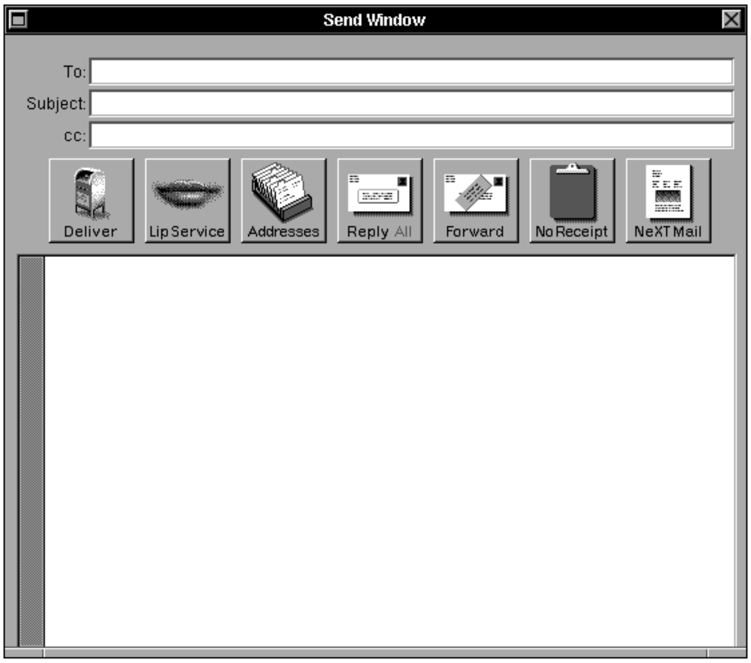


Figure 1.19 The Send Window

You need to send your **Lab1** file to the **math235** account, so type **math235** in the **To:** text field.[6] Then press the Tab key to move the insertion point to the **Subject:** text field, and type **Lab 1** there.

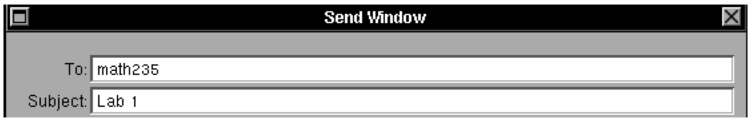


Figure 1.20 Addressing your message

Now press the Tab key two more times to advance the insertion point to the large text field in the Send Window . Then type **Here is our Lab1 report:** and press Return.

Figure 1.21 Your written message

Now you need to include your Lab1 file in your message. Double-click on the Workspace Manager icon (the NeXT cube at the top of the dock) to bring up the File Viewer. Then click on the file name Lab1.ma in the second column of the File Viewer . (Be sure to select the **a** file— not the **b** file.) This makes the file's icon appear above the third column in the File Viewer . Notice that it is the same icon (Fig. 1.15) that appeared when you miniaturized your file in Step 12.

[6] Recall that the insertion point is set by clicking with the mouse at the place where you want to begin typing.

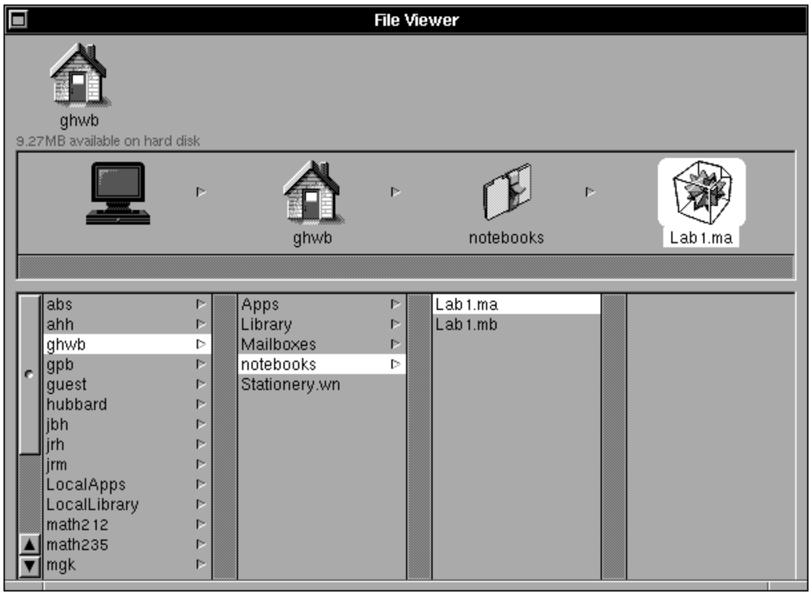


Figure 1.22 The File Viewer with the **Lab1.ma** file selected

Now all you have to do is drag that icon over to the large text field in your Send Window . When you release the mouse button, a copy of the icon should snap in to place in the text field (Fig. 1.23).

Now your Lab1 file is included into your Mail message.

To send your message, simply click on the Deliver button.

After your work has been graded, it will be returned to you the same way through NeXTmail.

Figure 1.23 The message ready to be sent

Figure 1.24