LyX for M442

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1 Introduction

1.1 A Brief History of LyX

In the late 1970’s a professor at Stanford University, Donald Knuth, was revising a multivolume set of books entitled The Art of Computer Programming, when he got back the galleys, looked at them, and said (according to him) “bleccch.” A computer scientist by trade, Knuth decided to write his own document processing program to improve the way mathematics is typeset. The result of this ten to fifteen year endeavor was \TeX, which rhymes with “bleccch.” It stands, according to Knuth, for the Greek letters tau, epsilon, and chi, though I’m not sure why he chose those letters. In the early 1980’s, Leslie Lamport developed \LaTeX, a document preparation system built for \TeX but with lots of bells and whistles designed to make your document-preparing life easier. Getting to the point, in the late 1990’s a group of slackers cum computer scientists developed a somewhat WYSIWYG document processor that creates \LaTeX documents. For reasons I’ve yet to fathom but can’t imagine are very subtle, they decided to call it LyX.

1.2 Why Use LyX

First, why use any document preparation system? If the back of an envelope was good enough for the Gettysburgh Address, why isn’t a sheet of notebook paper good enough for a project report? Let’s keep this simple: you ain’t Abe Lincoln. The fact of the matter is—for better or for worse—your work will always be judged partly, if not mostly, by its presentation. The more polished your reports are, the more impressed your boss and co-workers (and, more importantly here, your math professor) will be.

So why LyX? Certainly standard word processors like Wordperfect and Microsoft Word offer equation editors with which mathematics can be slapped onto the page. The big difference between these kinds of things and LyX is that while these are word processors, LyX is a full-blown document preparation system. What this means is that when using LyX you don’t have to worry about

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1. Yes, this is going somewhere, and yes, you have to read it. It may be on the midterm.
2. See, for example, MathType for Windows.
spacings between words, about margins, about how equations, tables and figures are going to look on the page. \textit{\LaTeX} does all this for you. So for scientific writing, which almost invariably involves a host of equations, tables, and figures, \textit{\LaTeX} is definitely the way to go. And did I mention that it’s free?

2 \textbf{Starting \textit{\LaTeX} at Texas A \& M University}

You should have a callab account assigned to you for M442 (I’ll pass these out on the first day of class, or as soon as I get them). Log in and click on the big K in the bottom left corner of your screen. Go to \textbf{Applications} and choose \textit{\LaTeX}. If it asks if you want to create appropriate directories or something, just let it. Otherwise, you’re there!

3 \textbf{\textit{\LaTeX} Basics}

3.1 \textbf{Creating a Simple Document}

After splashing up a nice little logo, \textit{\LaTeX} will settle into a screen of empty gray. To create a document click on \textbf{File, New}. \textit{\LaTeX} will start a document, giving you one strip in which to write your first line. Usually, this will be your title, so type \textit{Canon Fire Project}.\footnote{Whenever I mean for you to type something in, I will put it in italics on the page. This in no way indicates that you should type it in italics into your document. (Though see Section 3.2 about fonts.)} Once you’ve typed this in, click on the big downward directed arrow just below the t in \textit{Insert}, and choose \textbf{Title} from the menu. Notice that \textit{\LaTeX} centers your text and makes it look large and bold, like a title should. Hit \textbf{Enter} now and \textit{\LaTeX} will add a line for you to continue with. In this next line, type in the members of your group like the names appear at the top of this document: first initial, last name. After you’re all typed in, go back to the big black arrow and choose \textbf{Author}. Finally, let’s start the first section of our report. Hit \textbf{Enter} and then type \textit{Overview} on the new line. Use your menu again to designate this as a \textbf{Section}. Notice that you have two options when choosing a section, \textbf{Section} and \textbf{Section*}. Using \textbf{Section*} indicates that you want to suppress section numbering.

Before taking a look at our handiwork, let’s put at least a few words of text into our section. Hit \textbf{Enter} and type, \textit{In this project we study a projectile launched at various angles of inclination with fixed velocity}. To take a look at what you’ve done, choose \textbf{View, DVI}. This simple command does a whole lot of stuff, of which all you need to know right now is that a page containing \textit{\LaTeX}’s typeset version of your work should pop up onto the screen. Take a quick gander and then click on \textbf{Quit} to drop it back down. This might be a good time to save your work. Choose \textbf{File, Save As}, then type in the file name of your choice (typically with a .\texttt{lyx} extension) and click \textbf{Okay}.

Before moving on to equations, figures and tables, let’s take a look at a few optional document formats. Click on \textbf{Layout, Document}, then on the big
black arrow to the right of Class. You'll notice that the current document class is Article, which is the one I've been using for notes in this course. Click on the one just below it, Article (AMS). A box will pop up asking if LyX should set some parameters to the defaults of this document class. Click on Yes, then OK at the bottom of the screen. See what you think. To go back to your original document class, simply choose Layout, Document Again, then choose article. Feel free to experiment and turn in your reports in whatever style you think is best. One caveat here is that occasionally when you move back and forth from one class to another, something gets permanently changed. My advice is to always save your work just before trying a new document class, and if you don't like the new document class, just don't save the new result. In particular, Edit, Undo won't cut it here.\textsuperscript{4}

3.2 Changing Fonts

There are a number of ways to change the way your text will appear on the page. Hit Ctrl-e at the prompt (hold the Control key down while depressing e) and type \textit{emphasized words}. Notice how any text you type following Ctrl-e appears in italics. E is for emphasis, and on the printed page this text will be in italics like \textit{emphasized words} are here. If you type Ctrl-e again, your text will return to its basic font. To toggle back and forth, you can also click on the exclamation point at the top of the screen, under Documents. Another useful command to remember is Ctrl-b, which makes your text bold. For a much broader class of options, we'll go to the menu. Use your cursor to shade over some words in your document—how about with \textit{fixed}—and then choose Layout, Character. Notice that you can change the text’s attributes simply by clicking Apply, so it’s easy to experiment. Try things like different sizes and maybe underlining. Typically, you won’t want to use too much of this in a scientific report, but it’s good to know it’s there. When you finish experimenting, simply click on Close.

3.3 Inserting Equations

One of the main reasons we’re using LyX is because we plan to write lots and lots of equations. Let’s start off simple with something in-line, like, \( y = x^2 \). We might try the sentence, \textit{This project doesn’t actually use the equation} \( y = x^2 \). When you get to the equation, click on the button at the top of your screen with the blue \( \frac{x^2}{2} \) on it. You’ll notice that the cursor changes, beginning to sort of glow. Don’t worry, that just means you are now officially in equation-producing mode. Type \( y = x^2 \), and notice how LyX automatically typesets the 2 for you as a superscript. Hit your right arrow key twice now (once to get away from the superscript and once to get out of the equation editor), and LyX will exit its equation editor and let you get back to the text. Before moving on to display equations, let’s do something just a little fancier in-line. How about \( \sqrt{\cos^2 \theta} \)? First off, click on the in-line equation editor again to put LyX in the right frame.

\textsuperscript{4}So to speak.
of mind. (That’s the $\frac{a+b}{c}$ button.) Now, from the top menu, choose **Insert, Math, Math Panel.** A menu of math symbols should appear somewhere on your screen, quite possibly on the upper left-hand side. If this turns out to be in your way, you can always move it simply by clicking on its blue strip and dragging it. To get started on the square root, click on the square root sign in the upper left corner of the panel. Once you’ve got a square root in place, don’t just type $\cos$ underneath it—that will look tacky. On second thought, go ahead and type it in. See? Tacky. Okay, delete it and choose the word $\cos$ from the functions in your **Math Panel.** Notice how the letters appear like text instead of as variables. In order to square $\cos$, you will need to click on your equation again to get its attention (clicking on the blue strip at the top of your main document will suffice) and type “$2,” then the right arrow (to get out of superscript mode). Finally, go back to your Math Panel and click on the button for Greek numbers (the subtle code for this is that Greek is spelling out in Greek letters). Click on the theta ($\theta$) to finish off our expression and then use the right arrow key a few times to get out of the equation editor.

Often, equations are going to get so long for us that it will be unwieldy to include them in a line of text. These, we will separate out, like

$$\frac{x^2+1}{y^2} = \frac{z^3}{y^3}. \quad (1)$$

In order to do this, simply stop wherever you happen to be in a line and click on **Insert, Math, Display Formula.** Once you are in display equation mode, the rules are just like for in-line equations. If you can copy the one just above, you’re probably in pretty good shape. When you are finished with the equation, simply use your right arrow until your cursor is directly to the right of the equation box and the equation box is no longer lit. Now, you’re ready to get back to business. By the way, you can create subscripted expressions, like $a_1$ by typing $a_1$ in math mode.

If you’re going to refer back to your equation, you will want to label it. Do this by first clicking on your equation, then choosing **Insert, Label.** A box will appear on your screen, in which your label has already been started as $eq$: to remind you that this is an equation. Type in some label, say, *eqn.* Finally, if you want to refer to this equation, choose **Insert, Cross Reference,** and then select it from the list.

**Remark for \LaTeX{} experts:** If you happen to know a bunch of \LaTeX{} commands, you’ll certainly begrudge having to choose things like radical signs from pop-down menus. Not to worry. In equation mode, \LaTeX{} lets you use your \LaTeX{} expertise in a convenient way. Start an in-line equation by choosing again the button $\frac{a+b}{c}$ (if you get tired of that button, you can accomplish the same thing with Control-m). Now, instead of bringing up the Math Panel and choosing a radical sign, type simply $|sqrt$, followed by the space bar. \LaTeX{} will go ahead and create the radical for you, and set your cursor inside it. Try it with other \LaTeX{} commands until you get comfortable.
3.3.1 Aligning Equations

You may (read: better) find yourself writing a system of equations, one after the other, something like

\[ y''(t) = 2y(t) - x(t)y(t) \]
\[ x''(t) = 2x(t) + x(t)y(t). \]

Probably the easiest way to accomplish something like this (and the only thing \LaTeX{} offered in earlier versions) is to choose **Insert, Math, Display Formula**, and then simply type `Ctrl-Enter`. \LaTeX{} will add a second line to your equation and give you three boxes on each line to juggle for alignment. This may take a bit of practice to get used to; fortunately, M442 will offer ample opportunity. For now, see if you can knock down the one above.

A second method of alignment is to choose **Insert, Math, AMS Align Environment**, which automatically begins a display formula, with two boxes. As above, `Ctrl-Enter` serves to create a second line, giving you four boxes altogether. In the first box type $x$, and in the second $= a + b$, then on the second line type similarly $y$ and $= c + d + e + f$.

\[
\begin{align*}
x &= a + b \\
y &= c + d + e + f\
\end{align*}
\]

Notice how in this environment the equal signs are aligned, but the text is left-justified in each box. Had we aligned these two equations the first way, we would have obtained

\[
\begin{align*}
x &= a + b \\
y &= c + d + e + f,
\end{align*}
\]

significantly less satisfying.

3.4 Inserting Figures\(^5\)

Our main source of figures in M442 will be MATLAB graphics saved as encapsulated postscript files, so that’s what we will look at. Suppose you have the file `figure1.eps` lying around somewhere on your directory. In order to incorporate it into your document, first insert a *Figure Float*. To do this, choose **Insert, Floats**, and then **Figure** from the small pop-up window. A red rectangle should appear on your screen. Place your cursor inside this rectangle, and choose **Insert, Graphics**, then, under the **File** tab, select the **Browse** option and sift through your files until you find one that is encapsulated postscript.

Once you’ve selected your figure, \LaTeX{} will create a small black box within your figure float that represents the figure. To size your figure, click on this little

\(^5\)Before beginning this section, you will need an *encapsulated postscript file* (.eps) somewhere on your directory. If you don’t already have one, go to MATLAB and create one. You should be saving all of your MATLAB figures as .eps files.
black box representing it, then choose the \texttt{\LaTeX{} View} tab, then \texttt{Custom}, and choose, say, 4 cm by 4 cm. Next, click on the \texttt{\LaTeX{} size} tab, followed by the \texttt{Get \LaTeX{} size} button. Finally, choose \texttt{OK}. Before checking what it looks like, let’s add a caption. Set your cursor inside the red figure float, to the right of the black box representing your figure and hit \texttt{Enter}. Type something like \textit{This is our first figure}, and set this text as \texttt{Caption}. (Choose the \texttt{Caption} option from the same menu you’ve been using for \texttt{Section} etc., pulled down with the thick black arrow beneath the t in \texttt{Insert}.) One final thing you might want to do is center your figure. For this, simply use your mouse to shade the black box representing your figure, and choose \texttt{Layout, Paragraph, Center}.

![Figure 1: This is our first figure.](image)

In case we need to refer to this figure later on, let’s give it a label. Put your cursor at the end of your figure’s caption and click on \texttt{Insert, Label}. A window will pop up with a single line, allowing you to type in a name. Once you have done this and clicked on \texttt{OK}, a button will appear in your figure telling you what its label is. If you want to refer to your figure later in the document, don’t do the obvious thing: \textit{See Figure 1}. Write \texttt{See Figure 1}, (the space before the comma is \texttt{sic}) then click on \texttt{Insert, Cross Reference}, and choose Figure 1 from the list of possibilities (the list should be fairly short at this point). All that big gray box does it put a 1 in your document, so why have we gone to all this trouble. I’ll tell you why. If later, you decide to put a second figure before this one, you won’t have to go through your document rooting out all your Figure 1’s. \LaTeX{} will automatically make this one Figure 2 and update all your references. This trick is especially important with equations, for which there may be many and for which the labeling procedure is almost exactly the same. Give it a try.

3.4.1 Positioning Floats on the Page

One nice thing about using a figure float is that it makes it easy to position your figure on the page. Typically, you have four options for where to set your float:
For here, tells \LaTeX{} to try to set your float wherever the figure appears in your document.

For top, tells \LaTeX{} to try to set your float on top.

For bottom, tells \LaTeX{} to try to set your float on bottom.

For page, tells \LaTeX{} to try to give your float a page of its own.\footnote{I made this table, by the way, by defining is as a Description.}

To change the default setting, choose Layout, Document, click on the Extra tab and type hrbp into the Float Placement box. This tells \LaTeX{} to try here first, then if for some typesetting reason that’s an impossibility, try top next, bottom after that, and page last. If you don’t change this the \LaTeX{} default is hrbp. The bad news is that currently \LaTeX{} does not allow you to position each figure in your document separately. However you set one of them, you must set all others the same way. I would imagine this is something that will be changed in further versions. In any case, hit OK now, and let’s move on to inserting files.

### 3.5 Inserting Text Files

Your report will almost certainly include at least a few M-files and maybe some diary files as well.\footnote{If you’re not sure what these are, consult your notes, \textit{MATLAB for M\textdaggerdbl}.} Both types are in ASCII text format, which means they are extremely easy to incorporate into a document. Suppose, for example, you happen to have the file \texttt{mfile.m} lying around somewhere on your hard drive. To incorporate it into your document, simply click on Insert, Insert File, then from the pop-up menu Ascii as Paragraphs. Search through your drive until you come across the file and double click on it. The text should immediately appear on your screen. To set it off a little, use your mouse to select it all, and then from your options with the big black arrow, choose Quotation. The final product should look something like the file included below.

```matlab
function dprime = distance(o)

\%DISTANCE: Computes distance as a function of theta
v=10.36; \%Initial velocity (varies with approach)
g=9.81;
H=.18;
dprime=-v^2*sin(o)^2 - v^2*cos(o)^2*sqrt(v^2*sin(o)^2 + 2^2*H) + ...
  v^2*cos(o)^2 + (v^3*cos(o)^2*2^2*sin(o))/(sqrt(v^2*sin(o)^2 + 2^2*H))
```

Inserting diary files is just as easy; see the handout \textit{MATLAB for M\textdaggerdbl} for plenty of examples of how diary files should end up looking. By the way, when you start typing text underneath your M-file, \LaTeX{} will think you are still quoting. Simply click on the big black arrow again and choose Standard. Now you’re back in business.
3.6 Creating Tables

Especially if you are working with experimental data, you will want to tabulate certain values. Unfortunately, this is not LyX’s long suit. Nonetheless, let’s see how we can create a workable table. For example, suppose in this global economy, you decided to study trends in world migration. First, you might be surprised to find that only about 2.5% of the world’s population lives in a country other than the one they were born in. Next, you might want to tabulate, say, the average annual net migration between 1996 and 2001 for various countries.

In order to begin a table, hit Enter to start a new line, then choose Insert, Tabular Material, and select a table with two columns and five rows (like the one below). A matrix will appear in your screen, allowing you to type whatever data you have into the spots. Fill it in like Table 1 on this page, except don’t worry yet about the formatting. You will notice that your table doesn’t look quite like Table 1. To shape it up, set your cursor on any of the country boxes and select Edit, Tabular, then Align Left from the pop up menu. If you now click on each country box in sequence, they will all align to the left side of the box. Do the same thing with the numbers, aligning them on the right.

Now, let’s center the entire table. Select the entire table by shading it with your mouse and choose Layout, Paragraph, Center. If you don’t think it is set far enough away from the other text, choose Layout, Paragraph, and then under Vertical Spaces add a medskip above. If you’re still not satisfied, try a larger or smaller space. Finally, let’s add a caption. Notice that if we had used a Table Float like our figure float above, we would have gotten the caption for free. Annoyingly, there is currently something screwy going on with the Table Float option.\footnote{As of Spring 2002, I think this is fixed now.} Instead, let’s put the caption in with brute force. Set your cursor to the right of your table and hit Enter. Now, type Table 1: Most active countries in world immigration. Finally, select this line by shading it with your cursor and choose Layout, Paragraph, Center. For better or worse, your table should now look exactly like the one on this page.

<table>
<thead>
<tr>
<th>United States</th>
<th>960,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>-308,000</td>
</tr>
<tr>
<td>Germany</td>
<td>311,000</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>289,000</td>
</tr>
<tr>
<td>Mexico</td>
<td>-284,000</td>
</tr>
</tbody>
</table>

Table 1: Most active countries in world immigration.\footnote{Source: U.S. Bureau of the Census estimates and projections. A negative value indicates emigration. I should probably add that I don’t have any political agenda here. For reasons entirely unrelated to M442, these numbers just happened to be on my desk.}

3.7 Printing a LyX Document

We will print our LyX documents out as postscript files, then print the postscript files with \texttt{psprint}. Since signs all over Blocker tell you how to print using \texttt{psprint},
I’ll focus on the \LaTeX\ part. Once your document is finished and saved, choose **File, Print**, then under **Print To**, choose **File** and pick the directory and filename you want, making sure it ends `.ps`.

### 3.8 Getting Help

\LaTeX\ doesn’t yet have the absolute best Help file going. A good way to use what they do have is this: Click on **Help, User’s Guide**, then once the User’s Guide comes up type **Ctrl-f** to search it. Now just search for whatever topic it is you need help on.

### References

[LYX] The web page of the guys who created \LaTeX\ is: http://www.lyx.org

[SOL] Nope, seriously, that’s it.
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