

11. Tutorial: Using LyX and Xfig for Lab Reports

11.1. Introduction

The computer lab in BB2 33 will have a recent version of LyX and Xfig for your use. Both LyX and Xfig have extensive on line help. Please consult those two sites¹ to get an idea of what is available. LyX also has a tutorial and user guide installed and available under the Help menu. Your home directory on the BB2 33 computers will contain a copy of LyX Essentials.pdf to assist you.

The use of LyX for lab reports is a requirement of 74:275. It allows the creation of professional looking output with little effort. LyX is a very active project in terms of development. It excels at creating structured documents and large files containing many equations and figures (100+ pages) are handled easily:

- Table of Contents and Bibliography, Figure, Table and Section, Equation numbering are created and updated automatically.
- White space is generally not manipulated, and this is a major benefit over MS Word et al. You are thus freed from formatting with tabs, spaces, centering, etc.
- Exporting to plain text, postscript, pdf, html, latex, opendoc formats is supported.

Compatibility is a design goal of LyX. Your instructor has been using LyX for roughly 14 years, since v1.0.x. Documents created with older versions have been accessible through those years with very few difficulties, something that is not generally true with other software.

Since the LyX files are just plain text, it is even possible to troubleshoot and solve seemingly difficult issues inside the .lyx file with a text editor. This level of transparency is not available to MS Word users, as the the file format is binary. Your author has used many word processor programs² and stopped searching for a better one upon finding LyX.

Xfig is in a very mature state, with version 3.2 patchlevel 5b being released in 2009 and patchlevel 5d coming out July 2010. It is ideal for drawing diagrams of apparatus, simple schematics, etc, for inclusion in a LyX document. It will export to an eps file which is the standard format for diagrams to be included in latex files for journal papers.

11.2. Installation: LyX and Xfig

Please see chapter 12 and chapter 13. One of the best ways to run these programs is on linux. Using vmware or virtualbox to run linux and then installing LyX and Xfig is the most stable method as upgrading will be less problematic.

11.3. LyX Tutorial: Built in Introduction Document³

You will use two documents that come with LyX. Begin with the LyX tutorial document. After a page or two it sends you to the Introduction document, so that you get information required for the tutorial.

1. Use LyX type up your answers in an empty, new file *after* you have read some of the Introduction.

¹LyX: <http://www.lyx.org>, look for manuals, tutorials, etc; Xfig: <http://xfig.org/userman/contents.html>

²wordperfect, amipro, describe, star office and open office writer, various versions of MS Word.

³http://wiki.lyx.org/uploads/LyX/tutorials/essentials/LyX_Essentials.pdf is another an excellent document to read when learning how to use LyX.

2. Use “article” style which is set under Document, Settings. Use Section* or Subsection* as appropriate to label the subsections. Make them coincide as best as possible with this tutorial so that your marker can tell where you are. The enumerate environment will let you automatically number your answers.
3. Since this is a tutorial, don’t worry if things are not perfect. Our goal is to get you writing lab reports.

11.3.1. Tips

1. **You do not generally handle white space, L^AT_EX takes care of that for you. Just start typing and use the drop-down menu on the left to get L^AT_EX to change formatting environments.** This is the “what you mean” part of WYSIWYM.
2. Remember to save your changes often. **Use control-s lots!**
3. **View your pdf using ctrl-r and**
4. **NB: update that view often using ctrl-shift-r.** It is possible to create content that will not compile,⁴ meaning the latex command will not complete. L^AT_EX errors are not always easily understood, especially when you are using L^AT_EX to get around learning L^AT_EX. By updating the compiled view of your document often, you will know what you recently changed to cause the problem.

11.3.2. Questions on the Introduction

Answer the following question in a new L^AT_EX document of class “Article”. See Document, Settings, Document Class. You may have to consult online resources for some questions. Use either a Section, or Subsection for the a heading the same as above and the Enumerate environment for your answers. L^AT_EX will format⁵ the document for you.

1. What is the main difference between L^AT_EX and other word processors?
2. What type of documents is L^AT_EX good for creating. What is it not so good at creating?
3. What is T_EX? Who invented T_EX?
4. What offer/challenge did the author of T_EX make to the world for finding a bug in T_EX?
5. What is L^AT_EX and how is it related to T_EX?
6. Name another widely (very widely!) used document creation system that is similar to T_EX’s strategy.
7. What is a class file? What filename extension does it typically have?
8. What is a style file? What filename extension does it typically have?
9. What Internet site acts as the main host for the class and style files?
10. How many points (pt) are in one inch?
11. What programming language is L^AT_EX written in? What language is the importer inside L^AT_EX written in?

⁴Your author often triggers a problem by putting a forced return before a float.

⁵That is, you don’t change fonts, justification and spacing; this will be done for you and not controllable as it is directly in Word.

11.4. LyX Tutorial: Built in Tutorial Document

If not already doing so, open, read and execute the instructions in the tutorial. It consists of using LyX's features to correctly format a two page document.

Some instructions that require you to execute a task are inside the paragraphs of example raw.lyx. Other instructions are labeled “**Exercise(s)**” in the LyX tutorial document. Both need to be completed. Hand this correctly formatted document in after printing it.

- Section 3.6 on bibliographies is optional, however you may have references in your lab reports. Consult that section when needed.
- Page 4 of the tutorial mentions that: “The example files can be found in the `examples` directory of LyX's installation folder.” The example raw.lyx file is typically in the `/usr/share/lyx/examples` directory. That file is likely set read only, so you must copy and save it to your directory so that you can modify it. Use your file manager to copy it over, or open it in LyX and then save it to your home directory. This will provide an editable version.
- Once you have the example raw.lyx file open in LyX, view it with the pdf/ps/dvi viewer of your choice. Notice how poorly formatted it is. The notes contain hints at what should be done with the line they are on, in terms of correcting the formatting, and the tutorial document leads you through the LyX features needed to make the correct changes. Step through the example raw.lyx file as instructed.
- To see the changes, **update** your view of the pdf/ps/dvi file. It is helpful to set your viewer to automatically refresh the view when it sees a change has been made.
- Answer the following questions.

11.4.1. Questions for the Tutorial

Start another Section* or Subsection* after your first set of answers. Then answer the following:

1. What is the advantage or advantages of LyX over L^AT_EX?
2. What does WYSIWYM stand for?
3. Why does LyX not support the tab character for adding white space?
4. Are horizontal fills and vertical space controllable in LyX?
5. In LyX, what is an “environment”?
6. What are two ways of entering equations into a LyX document?
7. What is the keyboard shortcut for updating an open view of a
 - a) pdf document
 - b) postscript document
 - c) dvi document

11.4.2. Submission

Export your answer file to a pdf file for emailing to your marker. Use File, Export, PDF (pdflatex).

11.5. Math Equations

11.5.1. Math Panel

Chapter 4 of the tutorial explains the equation editing features of L^AT_EX. L^AT_EX makes math creation of equations convenient with the math panel. It contains many common math symbols in groups⁶. These groups are accessed by clicking on “View, Math Panels (auto)”. This tearoff toolbar⁷ contains math symbols which bring up a box of related symbols when clicked on.

11.5.2. T_EX codes for Math: Math.pdf and latex_math_symbols.pdf

Although initially convenient, the math panel becomes a bit tedious to use. Entering equations using the latex code when in math mode can be more productive. This is called T_EX mode and is explained in Section 5.2.1 of the L^AT_EX tutorial.

The file latex_math_symbols.pdf and the file “Math.pdf” should be in your home directory for your reference, in case you cannot find the symbol in the Math toolbar. The latter file is a document from the L^AT_EX team with everything you ever wanted to know about equations and L^AT_EX. For even more information consult <http://elyxer.nongnu.org/lyx/Math.html>.

The first document to consult for T_EX codes is one called “latex_math_symbols.pdf. This four page document contains a list of the common commands that latex uses to generate math symbols. For example, the Greek character γ can be produced using `\gamma`. A capital gamma is `\Gamma`. The names of each symbol are used with a “\” to produce the symbol needed.

11.5.3. Autocomplete

After typing a letter or two of the symbol name, L^AT_EX will display a short list of possible completions to choose from. If the first item of the list is correct, press the tab key to autocomplete the symbol name shown.

Remember to put a space after an inline equation of reference, it is easy to forget and you see $y = x^2$ instead. Notice the absent space before the word “instead”.

11.5.4. Questions Regarding Equation Input

Some reference material for general info in the Miscellaneous Chapter.

1. What is the difference between an inline equation and a display equation? What is the keyboard shortcut for each one?
2. Please add the following equations to your example raw.lyx file⁸.
3. Add a reference to the second equation such as this: See equation 11.1.

$$x = \sum_{i=1}^3 x_i e_i$$

$$F_C = \int_S T^n dS \tag{11.1}$$

$$\lambda^* = \frac{a * r}{D \times \sqrt{h^2 + k^2 + l^2}}$$

⁶If your L^AT_EX install does not show Greek characters inside L^AT_EX, you are missing a font. Greek characters, etc should be rendered in a blue math font.

⁷Clicking on the dashed line of this box allows the box of symbols to become a separate window which will stay on screen instead of disappearing after each use.

⁸Use Insert Math Display Formula to get the index i values above the Σ using superscript and subscript.

11.6. Tables, Figures and Floats

11.6.1. Tables exercise

Continue on with your example `raw.lyx` file.

Table 11.1 is inside a float⁹, something which we will cover later in subsection 11.10. For now just insert the table into a paragraph, we'll move it into a float later.

Tables may give you a bit of trouble compared to other word processors, such as cutting and pasting from other documents. Cutting and pasting within a LyX table works fine, but from other programs requires extra care as explained below.

Table Heading Test			
df		54	8907
	90b ff		

Table 11.1.: Practice table for LyX tutorial

1. Use the table button to create a 3 rows \times 4 columns table in your document like the table shown in 11.1.
2. Place the cursor in the top row. Right click on the table itself. Use multicolumn (in the “more” option) for the top row in the Settings dialog for the table. This will cause the top row to span all columns as shown in Table [tab:Practice table for].
3. A second text row in a single cell can be made using control return.
4. Enter some temporary data and cut'n paste it to various places in the table.
5. Create a Table Float (Insert, Float, Table). Cut and paste the table you have created.
6. Add a caption to the table, the same as Table 11.1.
7. Below or above the table float add a cross reference to the table using Insert, Cross Reference. This should be prefaced by a statement such as “See Table <name of your label> you chose is step 6.

11.6.2. Table data from a spreadsheet

If a lab requires reporting a substantial amount of data, importing that data into LyX will be required. Below is how to cut'n paste gnumeric data into a LyX table.

1. Open gnumeric, the spreadsheet program. Fill in a 2x4 table (two columns and four rows) with a set of made up data. Anything will do in terms of values.
2. In LyX, create a table of at least as many rows and columns as the 2x4 table.
3. In gnumeric, hilite the table's contents and copy it to the cut and paste buffer with ctrl c.
4. In LyX, place the cursor in a cell with enough room after it to hold the 2x4 table in the buffer.
5. Click on Edit, Paste Special, then Plain Text, Join Lines. Your data should¹⁰ now be copied into a table in LyX.

The previous exercise 1 will be useful in bring data into your lab reports, after the required calculations are completed on it in the spreadsheet program.

⁹(although you cannot tell this from the output)

¹⁰Your author has tested this in Linux only.

11.6.2.1. Importing tables to LyX

Here is a link to information regarding bringing values into lyx from a spreadsheet program:

<http://wiki.lyx.org/Tips/CopyTablesFromSpreadsheets>

11.7. Submission

Export your example raw file to a pdf file for emailing to your marker.

11.8. Xfig for Figures

Lab reports require diagrams to aid explanation and give the reader a sense of the equipment used and possibly results observed. The diagrams should show how the equipment was setup and connected and give some sense of what was measured if possible. They are not required to be complex; simple line and basic shapes will be adequate if labeled properly.

11.8.1. File considerations

If a graphic file is imported into a LyX document then

1. that files location must not change
2. the file must be available so that compiling to pdf etc, can complete.

Remember that putting a diagram into a LyX file does not put the file data directly, it simply puts an entry pointing to that file for the compiler to merge into the output file.

For lab manual diagrams, your author has used Xfig. Its interface shows some age owing to the use of the Xaw3d widget set, but its abilities are more than adequate, and has been very stable. After all, we are after decent output¹¹.

Xfig exists in the unix/linux world; WinFig is the close equivalent for windows. Its native file format (.fig) can be imported directly into LyX. Figure 11.1 shows two figures from the Xfig site which is at www.xfig.org.

11.8.2. Installation of Xfig

See Chapter 13.

11.8.3. Importing Diagrams to LyX

LyX can directly import .fig files using Alt, Insert, Graphics to bring up the appropriate dialogue and choose a diagram file. Xfig also exports to a .eps¹² file for inserting into a T_EX/L^AT_EX/LyX file.

An Xfig generated .fig or .eps file will automatically be updated in the LyX document if changed later in Xfig.

¹¹Here is a quote from Brian V. Smith, the main developer from the website for Xfig:

I became interested in Xfig while drawing schematics for my home brew computer project at coprolite.com in 1996. Xfig combined with GNU/Linux and the GIMP were the only combination of tools I could get to do everything I needed for my fairly complex schematic. I wanted the lines to curve a certain way and I wanted to put information on both sides of the border of the ICs in the schematic. I also needed to export the schematic into graphics format and tweak the presentation. I tried AutoCAD and Visio. AutoCAD didn't allow me to curve the lines correctly. At one point Visio told me that my drawing was too complicated and I should simplify it. I kid you not. That is when my love for Xfig fully blossomed.

¹²encapsulated postscript

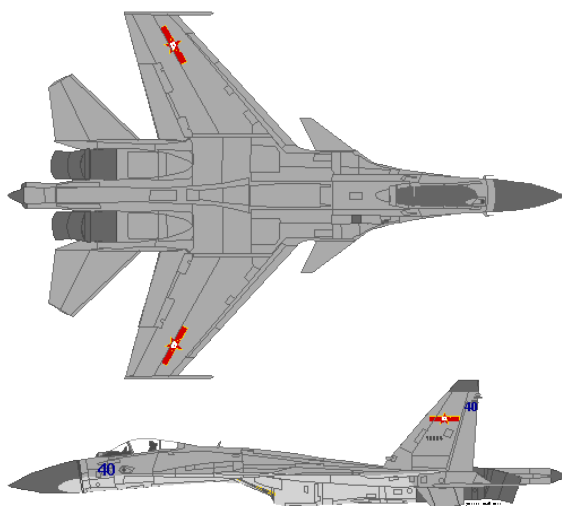


Figure 11.1.: Example xfig drawings

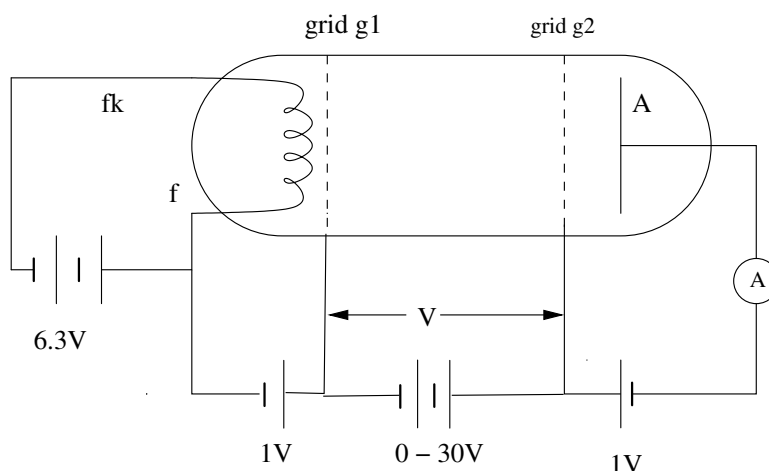


Figure 11.2.: Test figure for LyX tutorial: Franck Hertz apparatus.

11.9. Xfig exercise

1. Use xfig to generate the diagram similar to 11.2. This is the Franck Hertz experiment apparatus.
2. After drawing the figure, import it into your LyX tutorial file you are working on and view the compiled output.
3. Adjust the size in the compiled output by right clicking on the image in LyX and selecting Settings. Use the “Output Size” setting on the Graphics tab to scale the drawing. Note that this does not affect the diagram’s size in LyX which is changed on the “ \LaTeX and LyX options” tab.

11.10. Floats for Tables and Figures¹³

\TeX and \LaTeX style files are in control of the document’s final appearance. In most cases this is fine, the style file and \TeX manage to do a great job of formatting your output. However, it is advantageous to have *some* control over how the software places figures and tables so they make the most sense for

¹³Chapter 4 called Notes, Graphics, Tables, and Floats in the User Guide for LyX contains information on this topic. Please consult that if you have questions.

the reader. The float environment is how this is done: you place your figure or table inside a float, and now the software can move (or float) it around. Another advantage of the float is captions. The author can put in a caption below or above the figure or table, then add a label in the caption line to use as a reference.

- Floats are created using the “Insert, Float” command which presents a list of float types. Add a table float to your document and type in the same caption as shown in Table 11.1.
- Add a label on the same line as the caption line for your table using “Insert, Label”. You must leave the cursor in the caption line, preferably at the end or beginning of the caption itself. The label can be anything you want and LyX uses text that appears near the label insertion point as a first guess. Keeping your labels short (four words or less) but descriptive is a very good idea. As your document grows this helps you identify the correct label when putting in a reference.
- Cut and paste your practice table into the float. First cut or copy your table after highlighting it. Put your cursor at the start of the caption and press return and then paste the table. To center the table on the page, use, Edit, Paragraph Settings, Center, OK. Or alt e, alt p, alt e, alt o. The cursor must be outside the table and either on the right or left of the table so that LyX knows what paragraph’s alignment you are modifying.
- Use your label in a new paragraph. Type in **The data appears in Table “xxx”**, where xxx is filled in by LyX with a reference **as follows**. After the word Table (remember to put a space after Table), Use “Insert, Cross Reference” and pick out your label in the cross reference list. View your output after recompiling. You will now see that the table has been numbered and the same number appears in the reference. These numbers are automatically updated as tables and figures are added and deleted.
- Repeat for your diagram of the Franck Hertz apparatus: Insert a figure float and cut and paste your diagram into it. Put a caption into the figure float and a label. Complete the process by putting a cross reference to the figure in a new paragraph.

11.10.1. Getting floats where you want them

Floats may put your diagrams one or two pages away from the relevant text. This is done by L^AT_EX to conserve space but is not always convenient for the reader. To relocate table and image floats, use the float settings available by:

1. right clicking on the gray tab on the upper left of the float box.
2. Toggle “Use default placement” off, then activate “Top of page”, “Bottom of page”, “Here if possible”. This combination generally gives satisfactory results¹⁴.

11.10.2. Questions on Floats

1. Why are floats in LyX named floats?

Submission

After completing all the above requirements and questions, export your file to a pdf (use the option called pdf_latex) and email it to your marker.

¹⁴This can be made the default under “Document Settings, Float Placement. Note that other settings are available here, included “Rotate sideways” which can be used for a wide table or figure, and “Here definitely” (alt f shortcut with the settings dialogue open).

File name	content description
TRreport_text_only.txt	text without equations report
TRreport.pdf	correctly formatted report with equations, for your comparison
report_plot_only_data.txt	data for tables, text only file
report_plot_only_data.gnumeric	data for tables, gnumeric file
apparatus.jpg	labeled apparatus diagram exported from gimp
Copper and Thermistor .agr	xmgrace graphs of data. Use these to generate a .eps file for importing.

Table 11.2.: File names and content description.

11.11. Emailing LyX files

Unlike MS Word, etc, an image imported into a LyX file is not embedded into the .lyx file itself. When LyX generates a pdf file, the image files are encoded into the pdf; one file contains everything. However, if you want to email or work on a .lyx file with a different computer *you must also send those image files*. Otherwise you will see messages indicating that LyX cannot find the file when compiling. The location of the files must be the same (directories, names); if the image files are in a different location, the .lyx file will have to be modified¹⁵.

11.12. Exercise: Resistance Temperature Lab Report

At the completion of this exercise, you will email the .lyx file to your instructor, along with the .eps files that are the diagrams. This is the only time you will send a .lyx file in for marking. This is not how lab reports are to be submitted; for that you will email the pdf file only. In this case having the LyX file will assist your marker to identify mistakes.

This exercise is used to familiarize students with using some of the parts of the LyX software that make it so useful: the equation editor, the use of floats, captions, references and labels, without the burden of typing in the text.

11.12.1. Background to the Resistance-Temperature experiment

This experiment is very straight forward from a method point of view. There are two items which are heated; their resistance measured during heating. Graphs are plotted to see how changing the temperature affected resistance. One item is a piece of copper wire, the other is a semiconductor device called a thermistor.

11.12.2. Exercise: TR Lab Report

You are provided with the text and data from a report by Bailey Student. Table 11.2 indicates a file's name and describes what that file contains.

The file matt.dat, taken with the department's apparatus, contains two columns of values: the first column is the accelerating voltage and the second column is the current in micro amps. This current value rises and falls in a regular pattern. The second data file called matterr.dat has the error values for each voltage current point. Graphs of this data made using xmgrace are provided in eps form. The .txt file is all the text from the write up and serves the purpose of providing a starting point.

The goal of this exercise is to recreate the lab report by importing the figures and regenerating the tables and equations (with labels, references and captions) as needed. A pdf version of the completed lab is provided called TRreport.pdf. Use this as a guide; your .lyx file must generate a file very similar¹⁶ to it.

¹⁵This might seem like huge problem, but since a .lyx file is text, many tools can be employed to make changes to the location entries. For example: find and replace all in a text editor.

¹⁶It does not have to be identical, but should be very similar

11. Tutorial: Using L^AT_EX and Xfig for Lab Reports

1. Import the text file into L^AT_EX using File, Import, Plain Text. The Join Lines option may be required so that a carriage return linefeed issue is properly dealt with. Alternatively run dos2unix on the text file. Seek your instructors advice on this issue if you have trouble.
2. Use L^AT_EX to format the report so that it appears as shown in the file morrissette.pdf, This file resides in a subdirectory called “matt files” in your home directory.
3. The output format is selected by using the revtex4 document class, set in Settings, Document, Document Class: article (REVTeX4). Use this class, modified as per instruction 4.
4. A class file can take options that affect its appearance. To set the necessary ones, click on Document, Settings. In the Document Class section, uncheck predefined, and in the Custom field, type in "prl,aps"¹⁷ without quotes. A space after the comma is fine too. Click OK and your view should be very similar to the pdf.
5. You can see the L^AT_EX code that produces the equations as text. You can save time with the formulas¹⁸ by highlighting the text that make the equation and pressing ctrl m. This may not work for some greek letters, if not, put them in using the math panel or other means.
6. Insert the tables, figures, labels, references and captions as required. *Each diagram and table requires a label to be referred to in the text.*

11.13. Submissions for Marking

1. Submit all your example raw file in pdf format.
2. Submit your answers to the tutorial question by pdf also.
3. Submit your TRreport experiment report .pdf and .lyx files *along with* any required image files for marking by email. This time the .lyx and image files are required so that environment settings can be checked. For future labs, you will submit a paper copy of the pdf file.

¹⁷Physical Review Letters, American Physical Society

¹⁸The word formula has two possible plurals formulae and formulas. The “ae” in the final syllable of “formulae” is pronounced like the “ee” in “bees”.