# Essentials of L<sub>Y</sub>X

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This document is intended to provide an overview of the essential features and functions of LyX, to give you a basic working knowledge of the software, and to enable you to begin typesetting beautiful documents with the powerful LATEX system. It also discusses some of the more advanced topics and potential issues that you will invariably encounter when creating LyX documents.

Any errors that appear are entirely our own. Please contact shwolff-san@gmail.com or landronimirc@gmail.com with corrections, comments, and expansions.

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## 1 What Is LyX?

"LyX combines the power and flexibility of TEX/IATEX with the ease of use of a graphical interface. This results in world-class support for creation of mathematical content (via a fully integrated equation editor) and structured documents like academic articles, theses, and books."

— From the L<sub>Y</sub>X homepage

In brief, LYX is an easy-to-use typesetting environment that uses the power of LATEX to produce beautiful documents. Like Microsoft Word, LYX provides an intuitive graphical-user interface that automatically takes care of the LATEX "programming". However, LYX then uses the underlying LATEX software to produce professional-quality output that Microsoft Word can only dream of. LYX is also similar in scope to Scientific WorkPlace, but is accessible at a price that no commercial rival can beat: it's free.

MS Word comes with the concept of WYSIWYG, literally meaning that what you see on the screen is what you get printed on the paper. LyX (and LATEX) cannot do this by design, and can only give you a hint of how the printed output *would* look like. Hence the "almost WYSIWYG" concept. The actual output depends on the chosen document class and various options, and you need to generate the PDF to get a clear idea of the final output.

#### 1.1 How to Obtain LyX

LyX is available for Windows, Mac OS X, and Linux. You can download the version corresponding to your operating system from the LyX Download page:

http://www.lyx.org/Download

If you are using a Mac, you will also have to install a LATEX distribution (the LyX Download page provides a link to MacTeX). The LyX versions for Windows and Linux already come bundled with a LATEX distribution, so in most cases you do not need to worry for that.

**LyX 2.0** The latest stable version is being released this week and is recommended for most users. It provides several new features (real-time spell checking, support for R, XeTEX, etc.) that many of you may find useful. Binaries for Windows and Mac OS X will shortly be available on this page:

ftp://ftp.lyx.org/pub/lyx/bin/2.o.o/

Windows users, when installing L<sub>Y</sub>X for the first time, prefer the "Bundle" installer, since it will also install a LAT<sub>E</sub>X distribution and some additional software that is used by L<sub>Y</sub>X. Mac users, don't forget to also install a LAT<sub>E</sub>X distribution. For Linux users, the source code is already available here:

ftp://ftp.lyx.org/pub/lyx/stable/2.o.x/

#### 1.2 How to Create and Compile a Document

To create a new LyX document, launch the LyX program, and from the menu at the top of the screen click File  $\rightarrow$  New (if you have a template you wish to use, select File  $\rightarrow$  New from Template...). A LyX document window will appear; let the writing begin! Note, however, that what you see in the LyX document window is not quite what the final output will look like (cf "almost WYSIWYG").

To see your document in all of its finalized  $\LaTeX$  glory, you will have to compile your document. This, in  $\LaTeX$  consists of clicking a single icon: the  $\LaTeX$  PDF (pdflatex) icon at the top left of the  $\LaTeX$  document window¹. When you want to view what the final output will look like, save your document (File  $\rightarrow$  Save, or the appropriate hot keys), click on the  $\LaTeX$  icon, and  $\LaTeX$  will compile your document and display the final PDF output in a separate window.

The View icon is practical for *previewing* your final output, but it is generally a good habit to use File  $\rightarrow$  Export  $\rightarrow$  PDF (pdflatex) to actually export your final PDF document.

#### 1.3 The Value of Backups

As a general rule, LYX is rock-solid and works like a Swiss watch. However, the very nature of LATEX files means that sometimes something can get messed up and render your document un-compilable (this can happen with MS Word too, when your document gets corrupted).

To avoid any such surprises, especially just before the deadline, it is strongly recommended to use a general purpose file backup programme such as Dropbox or SpiderOak. Both are free to use, cross-platform and *very* easy to set up. They are also extremely easy to use in your day-to-day computer work.

The effort is minimal, and the benefits could be highly rewarding (as in: 'you managed to submit the thesis in time'). Thus, when something strange happens and you can no longer compile your document and cannot find the root cause, you can simply (and easily) revert to an older version of your document using one of these tools.

## 2 Document Settings

LyX automatically takes care of most of the formatting aspects of a document (layout, spacing, etc.), allowing the user to focus on the content of the document. However, there may be times you want to change the general appearance of your document, and for these times it is useful to be acquainted with the Document toolbar.

When starting a new document, first you will want to decide on the type of the document and the appropriate LATEX class, and on several general aspects of the document layout.

<sup>&</sup>lt;sup>1</sup>You can switch the viewing format to either DVI or PostScript, but do so only if you are familiar with differences between these formats. For most uses PDF is the optimal choice.

#### 2.1 Document Classes

LyX comes with numerous pre-defined document classes, or "types" of documents. The most commonly used document classes include

- article
- report
- book
- letter
- presentation (slides)

Document classes differ in their available headings (for example, you can use "chapter" in the book class, but not in the article class) and their layout. For most shorter papers, the "article" class will serve us perfectly. To see the full list of document classes, or to change the type of your document, click on the Document tab in the toolbar (at the top of the window or screen) and click on Settings... in the dropdown menu.

#### 2.2 Text Layout, Page Layout, and Page Margins

Within the Document Settings window, you can alter several settings.

- The Text Layout tab allows you to change the separation between paragraphs and the spacing between lines (single spaced, double spaced, etc.).
- The Page Layout tab allows you to change the paper format (A4, US letter, etc.), orientation (portrait versus landscape), and headers.
- The Page Margins tab allows you to change certain spacing parameters.

#### 2.3 Fonts

The Document Settings window also contains a Fonts tab that allows you to change the default fonts and font size used in your document.

To obtain professional looking and stylish results, one should use as few fonts as possible in any given document. For consistency,  $L_YX$  (and  $L^AT_EX$ ) allow the use of only three types of fonts: Serif (also called Roman, used for most of the text in a document), Sans Serif (used sometimes for headings) and Typewriter (used mostly for code).

Please note that the default font in LyX is hardly suitable for printed output (long story!), and you will always want to use some other font. "Latin Modern" seems a reasonable choice to begin with, but you are free to experiment with the various fonts available (for example, "Palatino" as used in this document).

You can also use "Old Style Figures" (0123456789), as you can notice in this document, by clicking the relevant checkbox.

#### 2.4 Language

One of the first things that you want to set in a new document is the Language in Document Settings. However, this defaults to English so it should suit most of us for the mémoire.

## 3 Section, Subsections, etc.

LyX greatly simplifies the writing of "structured" documents, that is, documents with chapters, sections, subsections, etc.

To add a new section, subsection, etc. to your document, simply go to the menu bar at the top right of your document window, which probably contains the word "Standard" (referring to the current environment). Click on this menu bar, and then select the section level you want (section, subsection, etc.) from the "Section" part of the dropdown menu. Notice that LyX automatically takes care of the numbering for you! Furthermore, if you decide you want to move a certain section, subsection, etc. to a different part of your document, just cut and paste; again LyX will automatically adjust of the numbering! (N.B. This automatic renumbering applies equally well to other numbered objects: list items, equations, etc.)

If you don't want a section numbered, choose the appropriate section level under the "Unnumbered" part of the dropdown menu (section\*, subsection\*, etc.).

If you decide you want to change a section level (e.g. upgrade a subsection into a full-blown section), simply select the relevant section text in your document (or just click somewhere in the relevant section text) and select the new desired section level from the dropdown menu at the top of the LyX document window. You can also use the "Tab" key to perform such changes.

To easily make two Sections switch places, you can use  $\mathtt{Document} \to \mathtt{Outline}$ , and then Right-click to access context-menu  $\to \mathtt{Move}$  section up / down. It is generally a good idea to use Outline to browse your LyX document.

## 4 Table of Contents

To add a table of contents to your document, go to the toolbar at the top of the screen and click on

 ${\tt Insert} \to {\tt List/TOC} \to {\tt Table} \ \, {\tt of} \ \, {\tt Contents}.$ 

The words "Table of Contents" will appear where you left your cursor. Note that the full table of contents only appers in the compiled version your document. If the links in your ToC are not activated (if you cannot click on them), then you may want to enable Document Settings  $\rightarrow$  PDF Properties  $\rightarrow$  hyperref.

## 5 Typesetting Basics

The standard typesetting commands—bold, *italic* (also called "emphasis" in LyX), SMALL CAPS (also called "noun"), font color—can be found under the Text style tab (the icon with the image "ab") at the top of the LyX document window. (If you have sized your document window very small, you may have to click on the two "right arrows" at the far right of the window to reveal more options and see this icon.) The bold option can be found under the Series menu, italics and small caps under Shape, and standard font colors under (surprise) Color. To apply these typesetting options to a particular part of your document, simply highlight the text you want to adjust, then select the desired action from the Text style menu, and click the "Apply" button. You can also bring up the Text style menu by highlighting the relevant text and right-clicking (or control-clicking); a dropdown menu will appear, from which you can select Text style  $\rightarrow$  Customize..., and then select the desired style.

Another neat feature of LyX is the Apply last icon (containing the word "Font" above a downward-pointing arrow, right next to the Toggle emphasis and Toggle noun buttons) at the top of the LyX document window. If you highlight some text and click this icon, the text will be formatted with the style that you used last.

#### 5.1 Justification of Text

To change the justification (center, right-justify, etc.) or spacing between lines (single, double, etc.), select the relevant text in your document, then click on the Paragraph settings icon at the top of the LyX document window. This is also the icon to click when you wish to specify whether a paragraph should start with or without an indent (important when you have text following a math environment; see section 7 below); this is done by checking or unchecking the Indent Paragraph box in the Paragraph settings window.

#### 5.2 Horizontal and Vertical Spacing

To manually add horizontal or vertical space at a particular point in your document, click on Insert from the toolbar at the top of the screen, then Formatting, then the appropriate command.

LyX (and LATEX) gently prohibit the use of multiple spaces or new lines, which is almost always a bad idea. If you really need to have multiple spaces, you can use Insert  $\rightarrow$  Formatting  $\rightarrow$  Protected Space. If you really need to have multiple empty lines, you can use Insert  $\rightarrow$  Formatting  $\rightarrow$  Vertical Space.

#### 5.3 Page Breaks

Also within the Insert  $\rightarrow$  Formatting menu, you can find the New Page and Page Break commands.

#### 5.4 Footnotes, Marginal Notes, and Comments

To add a footnote, put your cursor where you want the superscript number linking to the footnote to appear, then either click the Insert footnote icon at the top of the LyX document window, or click Insert and select Footnote from the dropdown menu. You can add a marginal note the same way, via either the Insert margin note icon or the Insert tab.

Lastly, if you want to make a note to yourself that doesn't appear in the actual document (what is commonly called a "comment" in computer programming lingo), put your cursor where you want the note to appear and click the Insert note icon at the top of the LyX document window.

Here is an example of a sentence that uses a footnote,<sup>2</sup> margin note, and comment (what L<sub>Y</sub>X calls Note). Within the L<sub>Y</sub>X document window, you can expand or collapse the text of a footnote, margin note, and comment/note by clicking the word "foot#", "margin", or "Note" appearing at the beginning of the note.

#### 5.5 Quotation Marks

Note that LyX distinguishes between the left-quotation mark key ' and the right-quotation mark key ' found on the keyboard. If you use the double-quotation mark key " to type the quotation marks on both sides of a word or phrase, LyX will automatically correct the orientation of the first set of quotation marks. For example, "This phrase is surrounded by double-quotation marks".

However, L<sub>Y</sub>X does not autocorrect single-quotation marks. For example, 'This phrase is surrounded by two right single-quotation marks'. Note that the left-quotation mark, appearing at the start of this phrase, is oriented incorrectly. Use instead the left single-quotation mark at the beginning; 'The preceding is a left single-quotation mark; what follows is a right single-quotation mark'.

Marginal notes appear in the outer margin of the final document; by default, the first line of the margin note is level with the line in which the text-body word preceding the margin note appears.

#### 5.6 Hyphenation

LATEX is usually good at hyphenating your text and does so automatically. But sometimes it can fail spectacularly and generate curious results.

Here's an example: bababadalgharaghtakamminarronnkonnbronntonnerronntuonnthunntrovarrhounawnskawntoohoohoordenenthurnuk.

This is a genuine English word (representing the thunderclap associated with the fall of Adam and Eve), albeit one that you will probably not use in your master's thesis. But you get the idea.

One way to work around this issue is to  $Insert \rightarrow Formatting \rightarrow Hyphenation Point$  at the exact spot in a problematic word where you think that the hyphenation should occur.

Here's an example: bababadalgharaghtakamminarronnkonnbronntonner-ronntuonnthunntrovarrhounawnskawntoohoohoordenenthurnuk.

<sup>&</sup>lt;sup>2</sup>N.B. It is customary to start the footnote *after* any punctuation following the word after which you wish the footnote to begin.

The nice thing about hyphenation points is that they are activated only when actually hyphenating a word. Otherwise, you can insert asmanyasyouwant, and they won't get printed in the final PDF (unless the one between "you" and "want", which actually does some job there).

#### 5.7 Spellchecker

To enable real-time Spellchecking, as you're probably used to in MS Word, you need to Tools  $\rightarrow$  Preferences  $\rightarrow$  Language  $\rightarrow$  Spellchecker  $\rightarrow$  Spellcheck continuously (only available in LyX 2.0). In this dialogue, you may also need to change the Engine to Aspell.

If the Spellchecker doesn't work, you may need to install Aspell and the necessary dictionaries for Windows or for Mac. Linux users should be able to install Aspell using the package manager of your Linux distribution.

#### 6 Lists

LyX provides four pre-programmed list environments.

#### 6.1 Itemize

The Itemized list icon creates a "bullet-point" type list. Example:

- Item 1.
  - Subitem a.
    - \* Subsubitem i.
- Item 2.

#### 6.2 Numbered List (Enumerate)

The Numbered list icon creates (surprise!) a numbered list. Example:

- 1. Item 1.
  - (a) Subitem a.
    - i. Subsubitem i.
- 2. Item 2.

#### **6.3** List

The List icon creates a list environment in which you customize the delimiter for each item. Example:

First Point. Item 1.

First Sub-Point. Subitem a.

Second Point. Item 2.

#### 6.4 Description

The Description icon creates a list environment that is identical to that of List, but the customized delimiters for each item are in bold. Example:

First Point. Item 1.

First Sub-Point. Subitem a.

Second Point. Item 2.

Note that for the list and description environments, L $\chi$ X interprets the first word you type as the custom delimiter, and everything after the first space as the item. If you want to use multiple words in the delimiter for an item, you will have to separate these words with "protected spaces", which you can insert anywhere in the document by clicking Insert  $\rightarrow$  Formatting  $\rightarrow$  Protected Space. Compare the following two items in the "description" environment; the first uses a protected space, the second does not.

**First Point.** The space between the words "First" and "Point" is a "protected space".

**Second** Point. The space between the words "Second" and "Point" is just a normal space.

If you want to insert additional horizontal space that is not an explicit "single space" between words, it is recommended that you use the  $Insert \rightarrow Formatting \rightarrow Horizontal Space...$  command.

## 7 Math Basics

LATEX was designed to typeset mathematical expressions, and to typeset them beautifully. A mathematical expressions can appear either (1) within the text of a line or paragraph, which is referred to as "inline"; or (2) on its own line, separate from the text. To insert a mathematical expression in your document, move the cursor to the point in the document at which you want the expression to appear, then go to the menu at the top of the screen and click

$$\mathtt{Insert} \to \mathtt{Math}.$$

The dropdown list that appears contains several options.

The first group of options are the various math environments.

- The Inline Formula environment is used for mathematics appearing in the text body (paragraphs, section headings, etc.) of your document. For example, we can write  $x = \sqrt[3]{\exp(y)} \Longrightarrow y = \ln x^3$  in the middle of this sentence using the Inline Formula environment.
- The Display Formula environment is used to write a single-line mathematical expression on a separate line from the body text. For example,

$$\sum_{j=1}^{n} j^2 = 1^2 + 2^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}.$$

• The Numbered Formula environment puts a single line of mathematics on a separate line, along with an equation number. LATEX makes referring to these equation numbers later in the document very easy; see 8. The Numbered Formula environment looks like

$$e^{x} = \lim_{n \to +\infty} \left( 1 + \frac{x}{n} \right)^{n}. \tag{1}$$

• To display mathematical formulae spanning multiple lines, use AMS align Environment. For example,

$$\begin{aligned} \mu_{Y|X} = & \mathbb{E}\left[Y|X\right] \\ = & \mathbb{E}\left[\theta X^2|X\right] \\ = & X^2 \mathbb{E}\left[\theta|X\right]. \end{aligned}$$

After creating an AMS align environment, you will notice that only a single line of math environment appears. To add additional lines, click the Add row icon in the math palette. Note: Eqnarray Environment, also found in the Insert  $\rightarrow$  Math dropdown menu, does the same thing, but LATEX purists assure me that Eqnarray suffers from irregular spacing issues, and therefore AMS align Environment is preferable.

The second group of options in the Insert  $\rightarrow$  Math dropdown menu allow you to create various mathematical objects (array, matrix, piecewise function definitions, etc.) within a math environment. However, these objects are perhaps easier to create using the math palette that automatically appears when you work within a math environment, so we discuss this math palette in the remainder of the section.

After you select a math environment from the  $\mathtt{Insert} \to \mathtt{Math}$  dropdown menu,  $\mathtt{L}_{Y}\!X$  automatically places your text cursor within the environment, and a math palette pops up at the bottom of the  $\mathtt{L}_{Y}\!X$  document window. This math palette appears whenever you move your text cursor into a math environment. We briefly illustrate some of the many features of this math palette, whose extensiveness and flexibility you will appreciate more and more as you continue to use  $\mathtt{L}_{Y}\!X$ .

**Math spacings.** The Math spacings icon allows you to insert (and remove) horizontal space within a math environment. For example, you may want to add space on either side of the implications arrow in a statement such as

$$X \Rightarrow Y$$
.

To add this horizontal space, simply put your text cursor where you want the extra space to appear and click the Math spacings icon, then select the size of the spacing you want. Adding a quadratin space, for example, to either side of the implication arrow produces

$$X \Rightarrow Y$$
.

**Fonts.** As its name suggests, the Fonts icon provides a dropdown list of various fonts you can apply to compatible symbols appearing in a math

environment. A few commonly used fonts, illustrated in the following expression, are Boldsymbol (used for X and  $\theta$  below), Blackboard (used for the  $\mathbb{E}$ ), Calligraphic (used for the  $\mathcal{N}$ ), and Normal text mode (used to so that the variance operator displays as Var, rather than the default appearance Var):

$$X \sim \mathcal{N}\left(\mathbb{E}\left[\theta\right], \operatorname{Var}\left(\theta\right)\right)$$
.

**Functions.** Clicking the Functions icon brings up a dropdown list with several commonly used functions: exp, lim, max, etc. N.B. To add a subscript and/or superscript to compatible functions, first use the Functions icon to write the function, then click the Subscript icon and type the subscript. For example,  $\lim_{x\to +\infty} \sin^2(x)$ . Another potentially useful fact to note is that certain mathematical expressions display slightly differently when used in inline versus separate-line math environments. Writing the same limit expression in the Display Formula environment, for example, results in

$$\lim_{x \to +\infty} \sin^2(x).$$

Note that the subscript appears directly underneath the limit function, rather than to the right as it does in the inline math environment.

**Frame decorations.** The Frame decorations icon allows you to add embellishments such as hats, tildes, arrows, etc. to compatible characters. For example:  $\theta \sim [\underline{\theta}, \overline{\theta}]$  such that  $E[\theta] = \hat{\theta}$ .

**Big operators.** The Big operators icon contains such symbols as  $\int$ ,  $\iiint$ ,  $\sum$ ,  $\prod$ ,  $\bigcup$ ,  $\bigcap$ , etc.

**Miscellaneous.** The Miscellaneous icon contains the very useful symbols  $\nabla, \partial, \infty, \emptyset, \exists, \forall$ , among others.

**Dots.** The Dots icon allows you to use ellipses-type dots in math environments. The dots in the following matrix were all obtained via the Dots icon:

$$\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}.$$

**Parentheses.** The various parentheses icons allows you to add paired parentheses (round parentheses, square brackets, curly braces) to math environments. Note that the parentheses provided by these icons automatically adjust to the size of the expression contained within the parentheses; in contrast, parentheses you type using the keyboard will not self-adjust! While a fast reader may not notice the difference between the keyboard parentheses in  $f(\frac{1}{2})$  and the parentheses from the Insert () icon in  $f(\frac{1}{2})$  for inline math environments, she will certainly notice a difference in separate-line math environments,

$$f(\frac{1}{2})$$
 versus  $f(\frac{1}{2})$ ,

especially if you are displaying a large mathematical object like a matrix,

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$
 versus  $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ .

The keyboard parentheses simply look risible. Use the power of LATEX that LYX makes available with one click of the various parentheses icons! If you need to mix-and-match parentheses-types, as illustrated by the expression

$$x \in \left[\frac{\alpha}{\underline{\theta}}, +\infty\right)$$
,

use the Insert delimiters icon, uncheck the Keep matched checkbox, select the left- and right-parenthesis type you want to use, and finally click "Insert".

**Insert matrix.** The **Insert matrix** icon, as you can guess, allows you to easily construct matrices, such as

$$I = \left(\begin{array}{cc} 1 & 0 \\ 0 & 1 \end{array}\right).$$

The Alignment options at the bottom of the Insert matrix window allow you to specify the vertical alignment for the matrix, as well as the horizontal alignment in each column. For the horizontal alignment, write one of the letters l, c, r (for left, center, right) for each column in your matrix. For example, for the two-column matrix above, we typed "cc". Note that by default, matrices do not have surrounding parentheses. To put parentheses around the matrix, highlight the matrix and click the Insert () or Insert [] icon, according to the parenthesis type you desire. (You can also first click the desired parenthesis, then the Insert matrix icon, to put the matrix inside the parentheses.) You can add or delete rows or columns of a matrix by placing your text cursor in the row or column you want to delete and clicking the Delete row or Delete column icon in the math palette.

**Insert cases environment.** The Insert cases environment icon is used for statements such as the following:

$$\mathbb{I}_{A}(x) = \begin{cases} 1 & \text{if } x \in A, \\ 0 & \text{otherwise.} \end{cases}$$

When you create a cases environment, only one line to enter math and text will appear:

$$\mathbb{I}_{A}(x) = \begin{cases} 1 & \text{if } x \in A. \end{cases}$$

To add additional lines (which is, after all, why you are using the cases environment!), place your text cursor within the cases environment and click the Add row icon in the math palette. As with matrices, you can also delete unwanted rows by clicking the Delete row icon.

#### 8 Labels and References

A powerful feature of LATEX is its ability and flexibility in allowing internal (and external!) referencing. You can reference almost anything that is numbered: sections, subsections, etc., as well as equations and figures.

Referencing works in two steps: labeling and referencing. We provide two illustrations.

#### 8.1 Referencing Sections

Let's suppose we want to add a reference here directing the reader to the section "Math Basics". To do so, first put your text cursor at the end of the section title, go to the top of the LyX document window, and click the Insert label icon (the icon with the picture of a label). A Label window will appear, with a suggested label name automatically filled in. You can type another label name if you prefer. After you click OK, a grey box with the label name will appear next to the section you have labeled.

To reference this label somewhere in your document, simply click the Insert cross-reference icon (the icon with the picture of the open book) at the top of the LyX document window. A Cross-reference window will appear, displaying the list of available labels you can reference, along with some formatting options. Click the label you want to reference, choose your desired reference format, then click OK. A grey box with the name of the label being referenced will then appear in your LyX document; when you compile your document, LATEX will convert this reference into the appropriate number.

For example, referencing the label we added to the section "Math Basics" produces the result: 7. This is the section number corresponding to the section "Math Basics". Clearly, the number by itself is a bit ambiguous (your reader will almost surely think, "What the heck is 7?"). When calling references, try to write some appropriate context for the reference. For example, we might write "Read about the essential math features in section 7."

#### 8.2 Referencing Equations

Referencing numbered equations works exactly the same way. Let's say we want to reference the following equation, which we have written in a Numbered Formula environment so the equation is numbered:

$$e^{\pi i} - 1 = 0. (2)$$

To reference this equation in your text, we follow the same label-reference approach. One important note: When you go to add a label to an equation, make sure your text cursor is *inside* the math environment. If it is, the letters "eq:" will appear in the Label window when you click the Insert label icon, and you can fill in the name you want to give your equation. After naming your equation and clicking OK, a small box with the name of the equation will appear beside the equation number. If your text cursor is not inside the math environment when you click the Insert label icon, the tell-tale sign is that the letters "eq:" will *not* appear in the Label window. In this case, LyX

will associate your label with the beginning of the paragraph in which the equation is found, so be careful — look for those green-light letters "eq:"!

To reference the equation in your document, click the Insert cross-reference icon, find the equation in the list of labels, choose your desired reference format, then click OK. For example: Equation (2) is one of the most beautiful relations in mathematics. Don't forget to write relevant context about the reference as appropriate!

N.B. In many settings it is customary, when referencing equations, to include the equation number within parentheses. This option can be found in the Label window, in the Format dropdown menu. Clicking the option "(<reference>)" will cause the number associated with the selected label to appear within parentheses.

#### 8.3 Hyperlinks

Related to references is LATEX's handling of hyperlinks (links to websites, e-mails, or files). Insert a hyperlink by clicking the Insert hyperlink icon at the top of the LyX document window. A Hyperlink window will appear; select the link type (website, e-mail address, or file) and fill in the Target (the URL in the case of a website, the e-mail address in the case of an e-mail, or the file extension in the case of a file) and Name (the linked text that will appear in your document) fields. Note that if you leave the Name field blank, LyX will use whatever you have entered in the Target field as the linked text that appears in your document. Also note that, when you click OK in the Hyperlink window, what appears in your LyX document is a grey box containing the Name of the hyperlink; the actual hyperlink is generated only in the compiled document.

For example, click the Insert hyperlink icon and enter the following information:

- Link type: Web
- Target: https://sites.google.com/site/tsewiki/
- Name: https://sites.google.com/site/tsewiki/

The resulting link will appear as https://sites.google.com/site/tsewiki/. If we leave the Name field blank, the resulting link is the same. Finally, if we change the Name to TSE Wiki, the resulting link will appear as TSE Wiki.

As another example, suppose you want to add a link that, when clicked by a reader, will open a mail window addressed to your e-mail address, say example@fakemail.com. Click the Insert hyperlink icon and enter

- Link type: Email
- Target: example@fakemail.com
- Name: example@fakemail.com

The resulting link will appear as example@fakemail.com. If you compile your LyX document and click on this link, a mail window of your default mail browser will open with "example@fakemail.com" filled in as the recipient. Try it out!

## 9 Figures

To insert a figure, click the Insert graphics icon at the top of the LyX document window. A Graphics window will appear that allows you to select the image file on your computer and to set several image attributes. Here is an example:



Note: To compile this document you will also need to download 'TSE\_Logo.jpg' and put it in the same folder as the LyX file.

If you want to change the graphic or its attributes at any time, simply click on the graphic in your L<sub>Y</sub>X document. Note that L<sub>Y</sub>X loads the specified image file each time you compile the document. Thus if you change the attributes of the image (e.g. resize the image), the graphic in your L<sub>Y</sub>X document will change accordingly the next time you compile. If you move the image file to another location on your computer, the graphic box in your L<sub>Y</sub>X document will display the words "No file found". For this reason, it is often most convenient to save all graphics used by your L<sub>Y</sub>X document into a "Graphics" folder within the folder for your L<sub>Y</sub>X document.

Finally, note that the Insert graphics icon does not number the graphic. For numbered figures, use the Insert figure float icon; see section 11.

#### 10 Tables

To insert a table, click the Insert table icon at the top of the LyX document window. After clicking the icon, drag your mouse to indicate the desired number of rows and columns; note that you can move your mouse beyond the initial  $5 \times 5$  grid, to create larger tables.

Once you have inserted the table, move your cursor into the table and fill in the cells. Note that when your text cursor is within the table environment, a table palette pops up at the bottom of the LyX document window, providing you with several options: add or delete rows or colums, put lines between rows or columns, align the text (left, center, right) within columns, "merge" multiple cells within a row.

By default, tables are set "inline" with your body text, as with the following table: 100 200 300 4 5 6. This is usually not what you want. To put the table on a separate line, simply move your text cursor to just before the table and hit Return on your keyboard. You can then adjust the justification of the table (left, center, right) as desired by clicking the Paragraph settings icon at the top of the LyX document window. For example, we have centered the following table, as well as set the text alignment of the columns, added border lines, and merged the two cells above "Female" and "Male":

Age Group	Number of Visitors		Price	Total Revenue	
	Female	Male			
0-11	12	8	Free	0	
12-25	7	8	4	60	
26+	4	6	8	80	

Tables in default border style are more often than not ugly (and certainly *not* what your adviser would expect). In academic papers and books authors usually use a "formal" style for the table borders (Table Context Menu  $\rightarrow$  Settings  $\rightarrow$  Borders).

Age Group	Number of Visitors Female Male		Price	Total Revenue	
0-11	12	8	Free	0	
12-25	7	8	4	60	
26+	4	6	8	80	

"Normal" tables cannot span over several pages. If you have a long table that risks spanning over two or more pages, you need to enable the appropriate setting in Table Context Menu  $\rightarrow$  Settings  $\rightarrow$  Longtable.

Table 1: Longtable with caption and numbering (see section 11)

Age Group	Number o Female	of Visitors Male	Price	Total Revenue
0-11	12	8	Free	0
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60

12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
12-25	7	8	4	60
26+	4	6	8	8o

As with graphics, the Insert table icon produces tables that are not numbered. To produce a table as a numbered figure, use the Insert table float icon; see section 11.

#### 11 Floats

As already mentioned in the text, one should use floats in order to get numbering and captions associated with figures or tables. For example, below is a numbered and captioned version of the figure above (Insert Figure Float).



Figure 1: TSE logo

Floats are often unruly beasts that have a life of their own, and have their own ideas on their own placement in the final output. If default placement style doesn't suit you (very possible), then you should try Right-Click on the float label  $\rightarrow$  Settings  $\rightarrow$  Uncheck Default placement, and then experiment with the available options. For example, you could try asking LATEX to place floats Here if possible (and even to additionally Ignore its own rules) or Here definitely. You should experiment and see what works best for your document. You can also alter the defaults in Document Settings  $\rightarrow$  Float placement.

The above holds for tables, too, with one gotcha: longtables cannot live in floats, since floats cannot span over several pages. If you want to get caption and numbering in a longtable, you need to leave an empty line either at the beginning or the end of the table, place the cursor in it, and access Table Context Menu  $\rightarrow$  Settings  $\rightarrow$  Longtable  $\rightarrow$  Caption.

## 12 Bibliography

It is very easy to insert citations in L<sub>Y</sub>X using BibT<sub>E</sub>X. First you need to have a BibT<sub>E</sub>X bibliography database, which is a fancy name for a simple text file containing references entered in BibT<sub>E</sub>X format. (You can easily find on-line BibT<sub>E</sub>X references for just about any paper or book.) Then you would need to follow several steps, in the right order:

1. In Document Settings  $\to$  Bibliography choose Natbib and then select the style that you prefer.

- 2. Put the cursor in the precise place of the document where you want the list of references to appear and access Insert → List/TOC → BibTeX → Add → Browse and select your BibTeX database. See Page 24 in the Appendix.
- 3. In the same dialogue select a style for the bibliography (it's different from the one above), although you could readily stick with the default, and check the Add Bibliography to ToC option (if you wish so). Note that not all bibliography styles are compatible with a given set-up, so if the document stops compiling after changing this style, then revert to defaults ('plain' or 'plainnat').
- 4. Now you can access your citation references using the Insert citation button. There you Add one or more citations and select a formatting style (Abbey and Hyde, 1987). Here's a second example citing Abbey (1968). See Page 24 for the resulting list of references.
- 5. With default settings you may get square brackets in the in-line references. One way to work around is to insert \setcitestyle{round} in Document Settings → Preamble.

Check the LyX wiki for more resources on BibTeX.

## 13 Advanced Features

#### 13.1 LATEX code

It is very easy to insert  $\LaTeX$  code into your  $\LaTeX$  document, effectively allowing you to mix features supported natively by  $\LaTeX$  with advanced features available only in  $\LaTeX$ . To do so, access  $\texttt{Insert} \to \texttt{T}\LaTeX$  Code.

You can also easily view the LATEX source of any document by accessing View  $\rightarrow$  Source. (This should give you yet another incentive to learn LyX instead of LATEX! Just click on Complete source checkbox.)

#### 13.2 Graphics

It is not very difficult to get very nice and precise graphics (nothing that you could ever achieve in MS Paint or Word!) into LyX documents, but you would need to use either LaTeX code or an external tool. Below are several pointers that you should investigate:

**TikZ** A powerful package for graphics and charts. See their website and the comprehensive documentation.

**Xy-pic** A tool for constructing simple graphs using nodes and arcs. Check the L $\gamma$ X-specific documentation in Help  $\rightarrow$  Specific  $\rightarrow$  Xy-pic.

**feyn** A package to create Feynman Diagrams. Check the L<sub>Y</sub>X-specific documentation in Help → Specific → Feynman-Diagram.

**PSTricks** A package for making graphics. Check this example on the LyX wiki. (You may need to use XeTeX to compile documents containing such code, so experiment to see if it works in your case.)

Sweave See end of Section 13.3.

For an overview (and examples) of some of these tools, check this presentation (and it's LyX source).

#### 13.3 Sweave

With LyX 2.0 it is very easy to embed R code into your LyX documents. You need to have R installed (and on Windows, Rtools). As soon as your system is properly configured, you should enable Document Settings  $\rightarrow$  Modules  $\rightarrow$  Sweave.

Then to perform inline computations you need to use Insert  $\rightarrow$  Custom Insets  $\rightarrow$  S/R Expression. To evaluate code blocks you would need to respect the Sweave syntax as used in LATEX: access Insert  $\rightarrow$  TEX Code and then insert something similar to the following:

```
«echo=TRUE, results="verbatim"»=
x <- 1:10
mean(x)
@</pre>
```

For a complete list of options, check the ?RweaveLatex manual in R. In short, you can do in LyX any computation that you can do in R (which is a lot!). You can also use the Sweave mechanism to import your R workspace and thus access and display the results that you've stored within it. (If you want to print R objects into LyX, you will want to investigate two R packages: xtable and Hmisc:::latex().)

As a bonus, you can also insert (almost) any type of graph that R can produce (which, surprise, is a lot!); you'd need to insert in figure floats something similar to the following:

```
«echo=FALSE,fig=TRUE»=
x <- 1:10
plot(x)
</pre>
```

## 13.4 Unicode and System Fonts

If you are ever in a position to mix different scripts in a single L<sub>Y</sub>X document (say, English, French, Greek, Cyrillic and Chinese), you may want to consider changing the encoding of the document to 'utf8x' (or similar) in the Language tab in Document Settings. But this may generate strange results.

Alternatively, try compiling the document using View PDF (XeTeX), which internally uses Unicode encoding, and is much more reliable in mixing exotic scripts. Remember, though, that you need to find a font that actually supports all the glyphs needed.

As a bonus, in addition to supporting LATEX fonts, XeTEX also supports system fonts (access Document Settings  $\rightarrow$  Fonts  $\rightarrow$  Use non-TEX fonts). Mind you, though: do not select "Times New Roman", "Arial" or "Comic Sans"! If you do so, then there's little point in using Lat (and LATEX) in the first place! Keep in mind that the LATEX fonts are high-quality fonts designed for professional looking printed output; simply select a non-default font.

## 14 Getting Help

The best way to grow familiar with L<sub>Y</sub>X is to use it! We hope we have convinced you that the essential functions of L<sub>Y</sub>X are extremely intuitive and easy-to-use; you will discover additional features the more you use L<sub>Y</sub>X. Still, when you find yourself stumped by something, it can be nice to have some references on hand. The following is a list of internet references that may be helpful in your journey with L<sub>Y</sub>X.

- The Help menu. This should be your main source of documentation!
   Whenever you want to learn more about a specific topic (Tables, Formatting, Equation, etc.), inspect this menu and open User's Guide or Math, or any other document that seems relevant to your inquiry.
- http://wiki.lyx.org/LyX/LyX The LyX Wiki page. About halfway down this webpage you will find the phrase "Here is an automatically generated list of pages in this group", followed by a lengthy list. Browse this list for the topic you seek. Or use the search facilities!
  - http://wiki.lyx.org/LyX/Tutorials— A page containing links to several LyX introductions and tutorials.

  - http://wiki.lyx.org/BibTeX/BibTeX A page explaining how to use BibTeX within LyX.
- LaTeX WikiBook A wonderful collection of LATeX tips and tricks, useful to inspect whenever you need to do something that LyX doesn't support natively.
- http://www.youtube.com/watch?v=m4cEAVmLegg The first of a five-part video introduction to LγX and LATEX (on YouTube).
- http://www.google.com/— Or your favorite search engine. Searching
  "lyx how to ..." (fill in the blank as the time demands) can be a very
  fast and efficient way to find answers to questions that arise during your
  writing.
- When nothing else works, send an e-mail to the very helfpul lyx-users mailing list (you should better subscribe first).

Happy, beautiful typesetting!

# A Appendix

To start an appendix, you need to go to the end of your document and select  $\mathtt{Document} \to \mathtt{Start}$  Appendix. Notice how Sections start being "numbered" with letters. Here you can continue working on your document as before.

# References

Edward Abbey. Desert Solitaire. Ballantine, 1968.

Edward Abbey and Philip Hyde. Slickrock. Peregrine Smith, 1987.