

# Using L<sup>A</sup>T<sub>E</sub>X to Write a PhD Thesis

Version 1.3

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## ABSTRACT

This book is aimed at PhD students who want to use  $\text{\LaTeX}$  to typeset their PhD thesis. If you are unfamiliar with  $\text{\LaTeX}$  I recommend that you first read Volume 1:  *$\text{\LaTeX}$  for Complete Novices* [15].

# 1. INTRODUCTION

Many PhD students in the sciences are encouraged to produce their PhD thesis in  $\text{\LaTeX}$ , particularly if their work involves a lot of mathematics. In addition, these days,  $\text{\LaTeX}$  is no longer the sole province of mathematicians and computer scientists and is now starting to be used in the arts and social sciences (see, for example, some of the topics listed in the  $\text{\TeX}$  online catalogue [3]). This book is intended as a brief guide on how to typeset the various components that are usually required for a thesis. If you have never used  $\text{\LaTeX}$  before, I recommend that you first read Volume 1:  *$\text{\LaTeX}$  for Complete Novices* [15], as this book assumes you have a basic knowledge of  $\text{\LaTeX}$ . As with Volume 1, I'll be using PDF $\text{\LaTeX}$  and TeXWorks. If you are creating a DVI file or you are using a different editor, you'll have to adapt the instructions.



If you are unfamiliar with terms such as “preamble”, read **Volume 1** [15, §2]. If you don't know how to find package documentation, read **Volume 1** [15, §1.1].

Throughout this document there are pointers to related topics in the **UK**

## 1 Introduction

List of TeX Frequently Asked Questions<sup>1.1</sup> (UK FAQ). These are displayed in the margin in square brackets, as illustrated on the right. You may find these resources useful in answering related questions that are not covered in this book.

[FAQ: What is LaTeX?]

On-line versions of this book, along with associated files, are available at: <http://www.dickimaw-books.com/latex/thesis/>. The links in this document are colour-coded: internal links are blue, external links are magenta.

To refresh your memory or for those who haven't read Volume 1, throughout this book source code is illustrated in a typewriter font with the word *input* placed in the margin, and the corresponding output (how it will appear in the PDF document) is typeset with the word *Output* in the margin.

### EXAMPLE:

A single line of code is displayed like this:

This is an `\textbf{example}`.

*Input*

The corresponding output is illustrated like this:

This is an **example**.

*Output*

Segments of code that are longer than one line are bounded above and below, illustrated as follows:

---

<sup>1.1</sup><http://www.tex.ac.uk/faq>

## 1 Introduction

```
Line one\par
Line two\par
Line three.
```

↑ Input

↓ Input

with corresponding output:

```
Line one
Line two
Line three.
```

↑ Output

↓ Output

(Commands typeset in blue, such as `\par`, indicate a hyperlink to the command definition in the [summary](#).)

Command definitions are shown in a typewriter font in the form:

```
\documentclass[options]{class file}
```

Definition

In this case the command being defined is called `\documentclass` and text typed *<like this>* (such as *<options>* and *<class file>*) indicates the type of

## 1 Introduction

thing you need to substitute. (Don't type the angle brackets!) For example, if you want the `scrbook` class file you would substitute `<class file>` with `scrbook` and if you want the `letterpaper` option you would substitute `<options>` with `letterpaper`, like this:

```
\documentclass[letterpaper]{scrbook}
```

Input

When it's important to indicate a space, the visible space symbol `\`  is used. For example:

```
A\sentence\consisting\of\six\words.
```

Input

When you type up the code, replace any occurrences of `\`  with a space.

### NOTE:



Be careful of the dangers of obsolete code propagation. It often happens that students pass on their  $\LaTeX$  code to new students who, in their turn, pass it on to the next lot of students, and so on. You're told "use this magic bit of code to format your thesis" without knowing what it does. Ancient buggy code that's 20 years out-of-date festers in university departments refusing to die. But if it worked for previous students, what's the problem? The problem is that it may stop working a week before your submission date and when you go for help, you may be told you're using obsolete packages and there's nothing for it but to rewrite your thesis using the modern alternatives.

## 1 Introduction

How do you know if a package is obsolete? Some of the obsolete packages and commands are listed in l2tabu [18], or you can check to see if a package is listed in the Comprehensive TeX Archive Network<sup>1,2</sup> (CTAN)'s obsolete tree (<http://mirror.ctan.org/obsolete/>). Stefan Kottwitz also has a list of obsolete classes and packages in his TeXblog. The other thing to do is check the package's entry on CTAN [2] to see if it has been deprecated. For example, suppose someone tells you to use the glossary package. If you go to <http://ctan.org/pkg/glossary> it will tell you that the glossary package is no longer supported and that it's been replaced by the glossaries package. Similarly, if you go to <http://ctan.org/pkg/epsfig> it will tell you that the epsfig package is obsolete and you should use graphicx instead.

### 1.1 Building Your Document

To “typeset”, “build”, “compile” or “LaTeX” your document means to run the pdf<sub>l</sub>atex (or latex) executable on your document source code. If you are using a front-end, such as TeXworks, WinEdt, TeXstudio, or TeXnicCenter, this usually just means clicking on the appropriate button or selecting the appropriate menu item. (See Volume 1 [15, §3] for further details.)


---

<sup>1,2</sup><http://mirror.ctan.org/>

## 1 Introduction

It's important to remember that a front-end is an *interface*. It's not, for example, TeXworks that is creating your PDF. When you click on the “typeset” button, TeXworks tells the operating system to run the required executable. This is usually `pdflatex`, but there are other executables that may need to be used to help create your document, such as `bibtex` or `biber` (discussed in [Chapter 5](#) (Generating a Bibliography)) and `makeindex` or `xindy` (discussed in [Chapter 6](#) (Generating Indexes and Glossaries)).

For example, if your document has a bibliography and you are using TeXworks, you first need to make sure the drop-down menu is set to “pdfLaTeX” (see [Figure 1.1](#)) and click on the green “Typeset” button. Then you need to select “BibTeX” from the drop-down menu (see [Figure 1.2](#)) and click on the green “Typeset” button. Then again select “pdfLaTeX” ([Figure 1.1](#)) and click the “Typeset” button. Finally, to ensure your cross-references are all up-to-date, you need to click on the “Typeset” button again. If you are using `biber` instead of `bibtex` (see [Section 5.3](#)), then you have to replace the above “BibTeX” step with “Biber” instead.

If the tool you require isn't listed in the drop-down box, you will have to add it. For example, to add `makeglossaries` to the list of available tools in TeXworks, you need to select Edit→Preferences, which will open the “TeXworks Preferences” dialog. Make sure the “Typesetting” tab is selected and click on the lower  button next to the “Processing tools” list. This will open the “Tool Configuration” dialog. Set the “Name” field to the name

# 1 Introduction

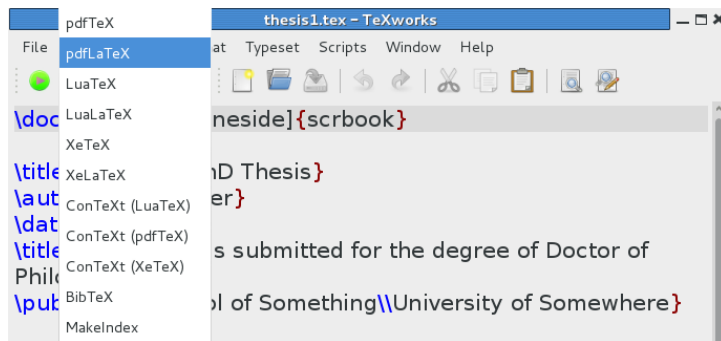


Figure 1.1 Selecting pdfLaTeX from the Drop-Down Menu

# 1 Introduction

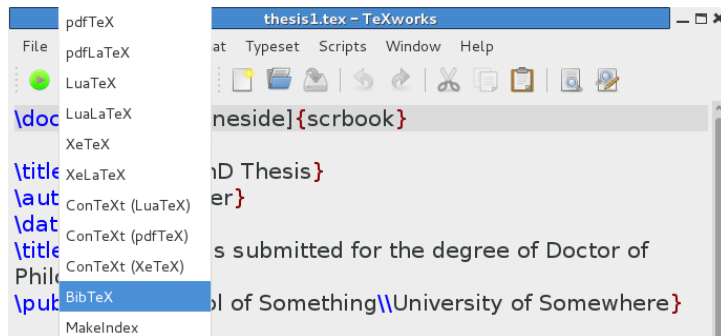



Figure 1.2 Selecting BibTeX from the Drop-Down Menu

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of the application, as you want it to appear in the tool list (for example “MakeGlossaries”). Then click on the “Browse” button to find the application on your computer. Next you need to click on the  button next to the “Arguments” list. Set the argument to `$basename`. Since `makeglossaries` doesn’t modify the PDF, uncheck the “View PDF after running” box (see [Figure 1.3](#)).

This is a bit of a hassle (if not downright confusing for a beginner) and even more so when you have glossaries and an index in your document as well as a bibliography. Fortunately there are ways of automating this process so that you only need one button press to perform all those different steps. There are several applications available to do this for you, and I strongly recommend you try one of them, if possible, to reduce the complexity involved in building a document.

[Volume 1](#) [[15](#), §5.5] mentioned `latexmk`, which is available on [CTAN](#) [[2](#)]. This is a Perl script, so it will run on any operating system that has Perl installed (see [Volume 1](#) [[15](#), §2.20]). Since [Volume 1](#) was published, a Java alternative called `arara` has arrived on [CTAN](#) [[2](#)]. Java applications will run on any operating system that has the [Java Runtime Environment](#) installed, so both `latexmk` and `arara` are multi-platform solutions to automated document compilation. [Section 1.1.1](#) gives a brief introduction to `latexmk`, and [Section 1.1.2](#) gives a brief introduction to `arara`.

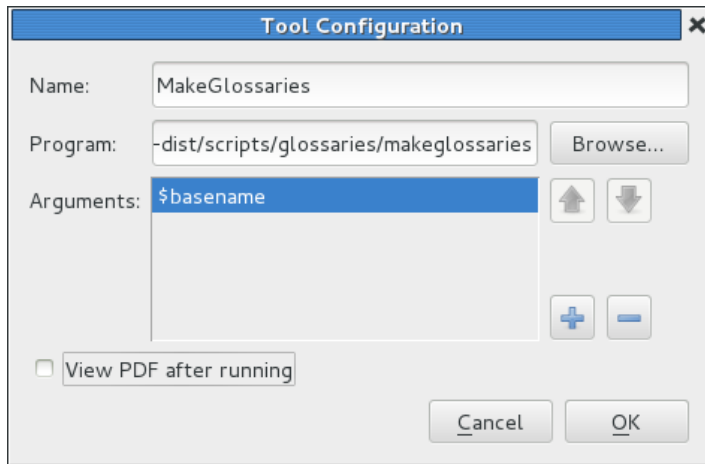



Figure 1.3 Adding Makeglossaries to the list of tools in TeXworks


## 1 Introduction

### 1.1.1 LaTeXmk

As mentioned above, `latexmk` is a Perl script that automates the process of building a  $\text{\LaTeX}$  document. In order to use `latexmk`, you must have Perl installed (see [Volume 1](#) [15, §2.20]). Both TeX Live and MikTeX come with `latexmk` but, if for some reason you don't have it installed, you can use the TeX Live or MikTeX update manager to install it. Alternatively, you can download <http://mirror.ctan.org/support/latexmk.zip> and install it manually.

Once `latexmk` is installed, you then need to add it to the list of available tools in TeXworks<sup>1.3</sup>. This is done via the Edit→Preferences menu item. This opens TeXwork's Preferences dialog box. Make sure the "Typesetting" tab is selected ([Figure 1.4](#)).

To add a new tool, click on the lower  button next to the list of processing tools. This opens the tool configuration dialog box ([Figure 1.5](#)).

Type "LaTeXmk" in the "Name" box, then use the "Browse" button to locate `latexmk` on your computer. Next you need to click on the  button to add each argument. The argument list should consist of the following (in the order listed):

```
-e  
$pdflatex=q/pdflatex $synctexoption %0 %S/
```

<sup>1.3</sup>If you are using a different front-end, you will have to consult your front-end's manual.

# 1 Introduction

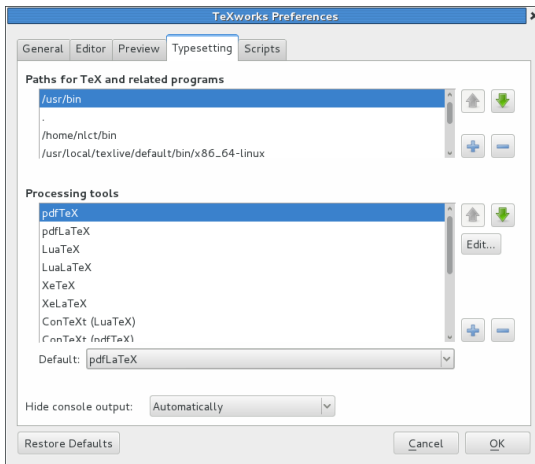


Figure 1.4 TeXwork's Preferences Dialog Box

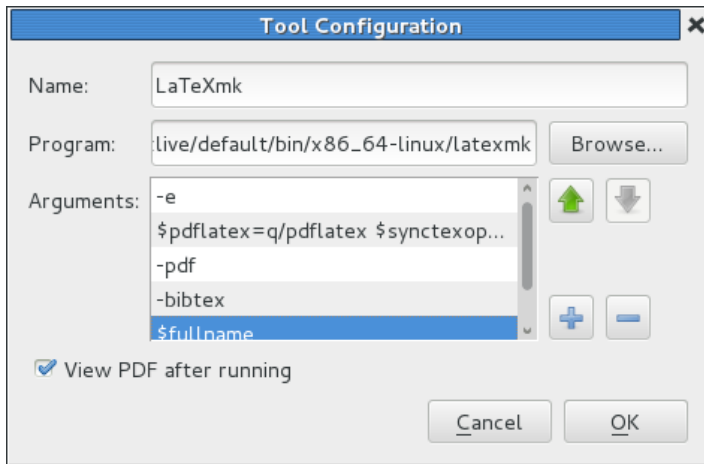


Figure 1.5 Adding LaTeXmk in the TeXWorks Tool Configuration Dialog

## 1 Introduction

```
-pdf  
-bibtex  
$fullname
```

Once you’ve done this, click “Okay” to close the tool configuration dialog, and click “Okay” to close the Preferences dialog box. LaTeXmk should now be listed in the drop-down menu next to the green “Typeset” button. Now, if you have LaTeXmk selected and you click on the “Typeset” button pdf<sub>l</sub>atex and bibtex/biber will be run as necessary to create an up-to-date PDF.

Unfortunately, adding makeindex, texindy or makeglossaries to LaTeXmk’s set of rules is more complicated. For this you need to create a configuration/initialisation (RC) file<sup>1.4</sup>. The name and location of this file depends on your operating system. For example, on a Unix-like operating system, this may be \$HOME/.latexmkrc. You will need to consult the latexmk manual [1] for further details.

Once you’ve found out the name and location of the RC file for your operating system, you can use the text editor of your choice to create this file. To add makeglossaries, you need to type the following in the RC file:

```
add_cus_dep('glo', 'gls', 0, 'makeglossaries');
```

---

<sup>1.4</sup>There are some example RC files available at: [http://mirror.ctan.org/support/latexmk/example\\_rcfiles/](http://mirror.ctan.org/support/latexmk/example_rcfiles/).

## 1 Introduction

```
add_cus_dep('acn', 'acr', 0, 'makeglossaries');
sub makeglossaries{
  system( "makeglossaries \"$_[0]\"" );
}
```

To add makeindex, you need to type the following:

```
add_cus_dep('idx', 'ind', 0, 'makeindex');
sub makeindex{
  system("makeindex \"$_[0].idx\"");
}
```

If you prefer to use texindy instead of makeindex, you will need to replace the above lines with (change the language as appropriate):

```
add_cus_dep('idx', 'ind', 0, 'texindy');
sub texindy{
  system("texindy -L english \"$_[0].idx\"");
}
```

Now select “LaTeXmk” from the drop-down menu next to the green “Typeset” button in TeXworks ([Figure 1.6](#)), and you’re ready to build your documents.

# 1 Introduction

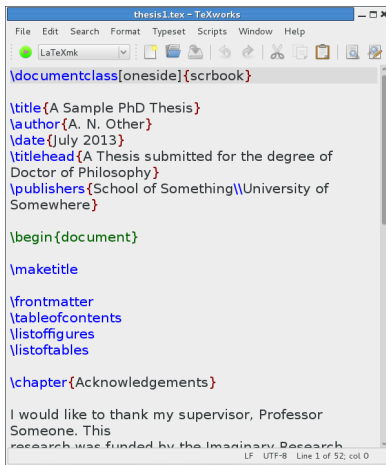


Figure 1.6 LaTeXmk Tool Selected in TeXworks

## 1 Introduction

### 1.1.2 Arara



As mentioned in [Section 1.1](#), arara is a Java application that automates the process of building a  $\text{\LaTeX}$  document. In order to use arara, you must have the **Java Runtime Environment** installed. The latest TeX Live distribution includes arara, so you can install it via the TeX Live package manager.

Alternative, you can install arara manually as follows: fetch the installer `arara-3.0-installer.jar` (or `arara-3.0-installer.exe`) from <https://github.com/cerada/arara/tree/master/releases>. On Windows, run `arara-3.0-installer.exe`. On other operating systems run `arara-3.0-installer.jar` in privileged mode. For example, on a Unix-based system:

```
sudo java -jar arara-3.0-installer.jar
```

(If you are doing a manual install make sure you check the box to add the predefined rules, as shown in [Figure 1.7](#).)

Once arara has been installed, you can add it to the list of tools in TeXworks. As [before](#), open the TeXwork's Preferences dialog box using Edit→Preferences and select the "Typesetting" tab ([Figure 1.4](#)).

To add a new tool, click on the lower  button next to the list of processing tools. This opens the tool configuration dialog box ([Figure 1.8](#)). Type "Arara" in the "Name" box and use the "Browse" button to find the arara application on your computer. Use the  button to add \$basename to the list of arguments, as shown in [Figure 1.8](#).

## 1 Introduction

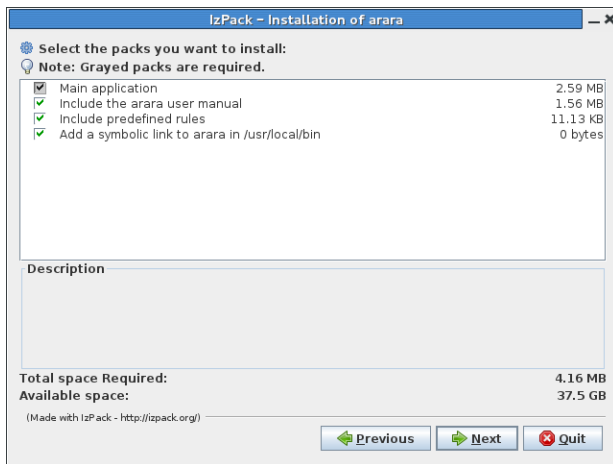


Figure 1.7 Arara Installer

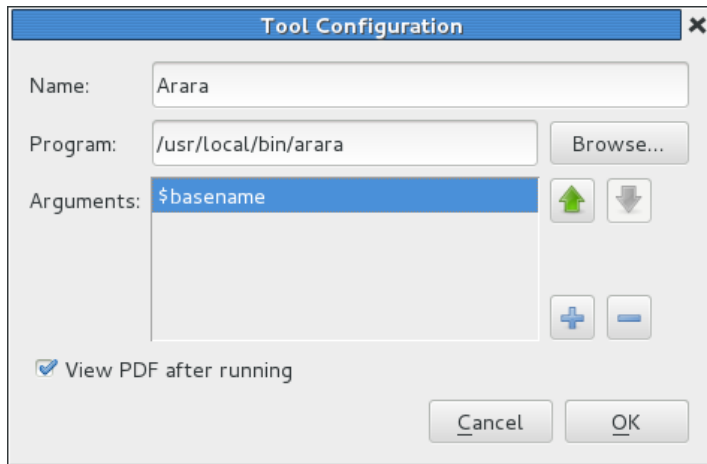


Figure 1.8 Adding Arara in the TeXWorks Tool Configuration Dialog

## 1 Introduction

Unlike `latexmk`, `arara` doesn't read the log file to determine what applications need to be run. Instead, you tell `arara` how to build your document by placing special comments in your source code. For example, if your document contains the following:

```
% arara: pdflatex: { synctex: on }
% arara: bibtex
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass{scrbook}
```

↑ Input

↓ Input

Then running `arara` on the document will run `pdflatex`, `bibtex`, `pdflatex` and `pdflatex` on your document. `Arara` knows the rules “`pdflatex`” and “`bibtex`”. It also knows the rules “`biber`”, “`makeglossaries`” and “`makeindex`”. So, if your document has a bibliography, an index and glossaries, you need to put the following comments in your source code (replace `bibtex` with `biber` if required):

```
% arara: pdflatex: { synctex: on }  
% arara: bibtex  
% arara: makeglossaries  
% arara: makeindex  
% arara: pdflatex: { synctex: on }  
% arara: pdflatex: { synctex: on }  
\documentclass{scrbook}
```

↑ Input

↓ Input

Now you just need to select “Arara” from the drop-down list in TeXworks (Figure 1.9) and click the green “Typeset” button, and arara will do all the work for you.

### NOTE:



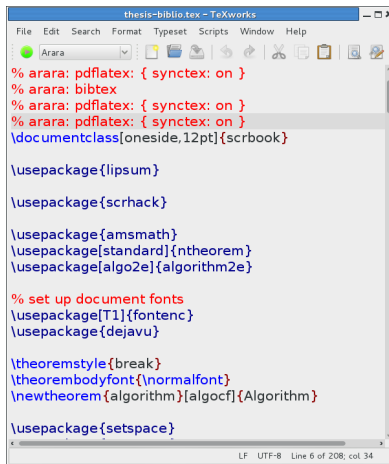
If you don’t add these arara comments to your source code, nothing will happen when you run arara on your document! You must remember to provide arara with the rules to build your document.

Unfortunately arara (v3.0) doesn’t have a rule for texindy, but you can add one by creating a file called texindy.yaml that contains the following:<sup>1.5</sup>

---

<sup>1.5</sup>Thanks to Paulo Cereda for supply this.

# 1 Introduction



The screenshot shows the TeXworks editor window titled "thesis-biblio.tex - TeXworks". The menu bar includes File, Edit, Search, Format, Typeset, Scripts, Window, and Help. The toolbar contains icons for opening files, saving, undo, redo, and other editing functions. The main text area displays LaTeX code with Arara commands highlighted in red. The code includes Arara commands for pdflatex, bibtex, and pdflatex, followed by standard LaTeX document structure commands like \documentclass, \usepackage, and \newtheorem. The status bar at the bottom indicates "LF UTF-8 Line 6 of 208; col 34".

```
thesis-biblio.tex - TeXworks
File Edit Search Format Typeset Scripts Window Help
Arara
% arara: pdflatex: { synctex: on }
% arara: bibtex
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass[oneside,12pt]{scrbook}

\usepackage{lipsum}

\usepackage{scrhack}

\usepackage{amsmath}
\usepackage[standard]{ntheorem}
\usepackage[algo2e]{algorithm2e}

% set up document fonts
\usepackage[T1]{fontenc}
\usepackage{dejavu}

\theoremstyle{break}
\theorembodyfont{\normalfont}
\newtheorem{algorithm}[algocf]{Algorithm}

\usepackage{setspace}
```

LF UTF-8 Line 6 of 208; col 34

Figure 1.9 Using Arara in TeXworks

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```
!config
# TeXindy rule for arara
# requires arara 3.0+
identifier: texindy
name: TeXindy
command: <arara> texindy @{{german}} @{{language}} @{{codepage}} @{{module}}
@{{input}} @{{options}} "@{{getBasename(file)}}.idx"
arguments:
- identifier: german
  flag: <arara> @{{isTrue(parameters.german,"-g")}}
- identifier: language
  flag: <arara> -L @{{parameters.language}}
- identifier: codepage
  flag: <arara> -C @{{parameters.codepage}}
- identifier: module
  flag: <arara> -M @{{parameters.module}}
- identifier: input
  flag: <arara> -I @{{parameters.input}}
- identifier: options
  flag: <arara> @{{parameters.options}}
```

(The symbol  $\leftarrow$  above indicates a line wrap. Don't insert a line break at that point.) This file should be saved in the rules subdirectory of the arara in-

## 1 Introduction

stallation directory. (For example, on Unix-like systems `/usr/local/arara/rules/texindy.yaml`.)

So if you'd rather use `texindy` instead of `makeindex` you can replace the

```
% arara: makeindex
```

directive with

```
% arara: texindy: { language: english, codepage: latin1 }
```

(Change the language and encoding as appropriate.)

## 2. GETTING STARTED

There are many different thesis designs, varying according to university or discipline [5]. If you have been told to use a particular class file, use that one. If not, there are a selection of thesis class files available on [CTAN](#) [2] and listed in the [OnLine T<sub>E</sub>X Catalogue's Topic Index](#) [3]. Since there are so many to choose from, I'm just going to follow on from [Volume 1](#) of this series and use one of the KOMA-Script class files. But which one? The `scrreprt` class is the one usually recommended for a report or thesis. It defaults to one-sided and has an `abstract` environment, but it doesn't define `\frontmatter`, `\mainmatter` or `\backmatter`. The `scrbook` class does define those commands, but it doesn't provide an `abstract` environment and defaults to two-sided layout. So, you can either do:

```
\documentclass{scrreprt}
\title{A Sample Thesis}
\author{A.N. Other}
```

↑ Input

## 2 *Getting Started*

```
\begin{document}
\maketitle

\pagenumbering{roman}
\tableofcontents

\chapter*{Acknowledgements}

\begin{abstract}
This is the abstract
\end{abstract}

\pagenumbering{arabic}

\chapter{Introduction}
...
\end{document}
```

 [Input](#)

or you can do:

```
\documentclass[oneside]{scrbook}
\title{A Sample Thesis}
\author{A.N. Other}

\begin{document}
\maketitle

\frontmatter
\tableofcontents

\chapter{Acknowledgements}

\chapter{Abstract}
This is the abstract

\mainmatter

\chapter{Introduction}
...
\end{document}
```

## 2 Getting Started

I'm going to use the second approach simply out of personal preference. The KOMA-Script options mentioned in this book are available for both `scrreprt` and `scrbook`, so choose whichever class file you feel best suits your thesis.

Unless you have been told otherwise, I recommend that you start out with a skeletal document that looks something like the following:

### Listing 1

↑ Input

```
\documentclass[oneside]{scrbook}

\title{A Sample Thesis}
\author{A.N. Other}
\date{July 2013}
\titlehead{A Thesis submitted for the degree of Doctor of Philosophy}
\publishers{School of Something\\University of Somewhere}

\begin{document}
\maketitle

\frontmatter
\tableofcontents
```

## 2 *Getting Started*

`\listoffigures`

`\listoftables`

`\chapter{Acknowledgements}`

I would like to thank my supervisor, Professor Someone. This research was funded by the Imaginary Research Council.

`\chapter{Abstract}`

A brief summary of the project goes here.

% A glossary and list of acronyms may go here

% or may go in the back matter.

`\mainmatter`

`\chapter{Introduction}`

`\label{ch:intro}`

`\chapter{Technical Introduction}`

`\label{ch:techintro}`

## 2 Getting Started

```
\chapter{Method}  
\label{ch:method}
```

```
\chapter{Results}  
\label{ch:results}
```

```
\chapter{Conclusions}  
\label{ch:conc}
```

```
\backmatter
```

```
% A glossary and list of acronyms may go here  
% or may go in the front matter after the abstract.
```

```
% The bibliography will go here
```

```
\end{document}
```

[↓ Input](#)

If you do this, it will help ensure that your document has the correct structure before you begin with the actual contents of the document. (Note that the chapter titles will naturally vary depending on your subject or

## 2 Getting Started

institution, and you may need a different paper size if you are not in Europe. I have based the above on my own PhD thesis which I wrote in the early to mid 1990s in the Department of Electronic Systems Engineering at the University of Essex, and it may well not fit your own requirements.)

If you haven't started your thesis yet, go ahead and try this. Creating a skeletal document can have an amazing psychological effect on some people: for very little effort it can produce a document several pages long, which can give you a sense of achievement that can help give you sufficient momentum to get started (but of course, it's not guaranteed to work with everyone). Remember that if you want to use arara (see [Section 1.1.2](#)) you must add the build rules to the document:

```
% arara: pdflatex: { synctex: on }  
% arara: pdflatex: { synctex: on }  
\documentclass[oneside]{scrbook}
```

↑ Input

↓ Input

(I'll add the arara rules to sample listings, in the event that you want to use arara. Since they are comments, they will be ignored if you use pdflatex explicitly or if you use another automation method, such as latexmk.)

Now think about other requirements. What font size have you been told to use?

## 2 Getting Started

10pt Use the 10pt class option:

```
\documentclass[oneside,10pt]{scrbook}
```

Input

11pt Use the 11pt class option:

```
\documentclass[oneside,11pt]{scrbook}
```

Input

12pt Use the 12pt class option:

```
\documentclass[oneside,12pt]{scrbook}
```

Input

Have you been told to have a blank line between paragraphs and no paragraph indentation? If so, use the `parskip=full` class option:

```
\documentclass[oneside,12pt,parskip=full]{scrbook}
```

Input

Have you been told to have certain sized margins? If so, you can use the geometry package. For example, if you have been told you must have 1 inch margins, you can do

[FAQ: [Changing the margins in L<sup>A</sup>T<sub>E</sub>X](#)]

```
\usepackage[margin=1in]{geometry}
```

Input

Changing the default fonts is covered in [Volume 1](#) [15, §4.5.3]. Other possible formatting requirements, such as double-spacing, are covered in [Chapter 4](#) (Formatting).

### 3. SPLITTING A LARGE DOCUMENT INTO SEVERAL FILES

Some people prefer to place each chapter of a large document in a separate file and then input the file into the main document.

There are two basic ways of including the contents of an external file:

`\input{<filename>}`

Definition

and

`\include{<filename>}`

Definition

where `<filename>` is the name of the file. (The `.tex` extension may be omitted in both cases.) The differences between the two commands are as follows:

`\input` acts as though the contents of the file were typed where the `\input` command was. For example, suppose my main file contained the

### 3 Splitting a Large Document into Several Files

following:

[↑ Input](#)

Here is a short paragraph.

```
\input{myfile}
```

[↓ Input](#)

and suppose the file `myfile.tex` contained the following lines:

[↑ Input](#)

Here is some sample text.

[↓ Input](#)

then the `\input` command behaves as though you had simply typed the following in your main document file:

### 3 Splitting a Large Document into Several Files

Here is a short paragraph.

Here is some sample text.

↑ Input

↓ Input

`\include` does more than just input the contents of the file. It also starts a new page (using `\clearpage`) and creates an auxiliary file associated with the included file. It also issues another `\clearpage` once the file has been read in. Using this approach, you can also govern which files to include using

`\includeonly{<file list>}`

Definition

in the preamble, where `<file list>` is a comma-separated list of files you want included. This way, if you only want to work on one or two chapters, you can only include those chapters, which will speed up the document build.  $\text{\LaTeX}$  will still read in all the cross-referencing information for the missing chapters, but won't include

### 3 Splitting a Large Document into Several Files

those chapters in the PDF file. There is a definite advantage to this if you have, say, a large number of images in your results chapter, which you don't need when you're working on, say, the technical introduction. You can still reference all the figures in the omitted chapter, as long as you have previously **L<sup>A</sup>T<sub>E</sub>X**ed the **document** without the `\includeonly` command.

The `exludeonly` package provides the logically opposite command:

```
\excludeonly{<file list>}
```

Definition

The **previous example** can now be split into various files:

Listing 2 (**thesis.tex**)

↑ Input

```
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass[oneside]{scrbook}

\title{A Sample Thesis}
\author{A.N. Other}
```

### 3 *Splitting a Large Document into Several Files*

```
\date{July 2013}  
\titlehead{A Thesis submitted for the degree of Doctor of Philosophy}  
\publishers{School of Something\\University of Somewhere}
```

```
\begin{document}  
\maketitle
```

```
\frontmatter  
\tableofcontents  
\listoffigures  
\listoftables
```

```
\chapter{Acknowledgements}
```

I would like to thank my supervisor, Professor Someone. This research was funded by the Imaginary Research Council.

```
\chapter{Abstract}
```

A brief summary of the project goes here.

```
\mainmatter
```

### 3 Splitting a Large Document into Several Files

```
\include{intro}
```

```
\include{techintro}
```

```
\include{method}
```

```
\include{results}
```

```
\include{conc}
```

```
\backmatter
```

```
\end{document}
```

↓ Input

Listing 3 (intro.tex)

```
\chapter{Introduction}
```

```
\label{ch:intro}
```

↑ Input

↓ Input

### 3 Splitting a Large Document into Several Files

#### Listing 4 (techintro.tex)

```
\chapter{Technical Introduction}  
\label{ch:techintro}
```

↑ Input

↓ Input

#### Listing 5 (method.tex)

```
\chapter{Method}  
\label{ch:method}
```

↑ Input

↓ Input

#### Listing 6 (results.tex)

```
\chapter{Results}  
\label{ch:results}
```

↑ Input

↓ Input

#### Listing 7 (conc.tex)

```
\chapter{Conclusions}  
\label{ch:conc}
```

↑ Input

### 3 *Splitting a Large Document into Several Files*

↓ Input

If you only want to work on, say, the Method and Results chapters, you can place the following command in the preamble:

```
\includeonly{method,results}
```

Input

## 4. FORMATTING

It used to be that in order to change the format of chapter and section headings, you needed to have some understanding of the internal workings of classes such as report or book. Modern classes, such as memoir and the KOMA-Script classes, provide a much easier interface. However, I recommend that you first write your thesis, and then worry about changing the document style. The ability to separate content from style is one of the advantages of using  $\text{\LaTeX}$  over a word processor. Remember that writing your thesis is more important than the layout. Whilst it may be that your school or department insists on a certain style, it should not take precedence over the actual task of writing.

### 4.1 Changing the Document Style

If you are using a custom thesis class file provided by your department or school, then you should stick to the styles set up in that class. If not, you may need to change the default style of your chosen class to fit the re-

## 4 Formatting

quirements. **Volume 1** [15, §5.3] described how to change the fonts used by chapter and section headings for the KOMA-Script classes. For example, if the chapter headings must be set in a large, bold, serif font you can do:

```
\addtokomafont{\large\bfseries\rmfamily}
```

Input

The headings in the KOMA-Script classes default to ragged-right justification (recall `\raggedright` from §2.12 of Volume 1) which is done via

```
\raggedsection
```

Definition

This can be redefined as required. For example, suppose you are required to have centred headings, then you can do:

```
\renewcommand*{\raggedsection}{\centering}
```

Input

## 4.2 Changing the Page Style

**Volume 1** [15, §5.7] described the command

```
\pagestyle{<style>}
```

Definition

## 4 Formatting

which can be used to set the page style. The `scrbook` class defaults to the `headings` page style, but if this isn't appropriate, you can use the `scrpage2` package, which comes with the KOMA-Script bundle. This package provides its own versions of the `plain` and `headings` page styles, called `scrplain` and `scrheadings`.

For simplicity, I'm assuming that your thesis is a one-sided document. If this isn't the case and your odd and even page styles need to be different, you'll need to consult the KOMA-Script documentation [8].

With the `scrheadings` page style, the page header and footer are both divided into three areas (Figure 4.1): the inner (left) head/foot, the centre head/foot and the outer (right) head/foot.

These elements can be set using:

```
\ihead[⟨scrplain inner head⟩]{⟨scrheadings inner head⟩}  
\chead[⟨scrplain centre head⟩]{⟨scrheadings centre head⟩}  
\ohead[⟨scrplain outer head⟩]{⟨scrheadings outer head⟩}  
\ifoot[⟨scrplain inner foot⟩]{⟨scrheadings inner foot⟩}  
\cfoot[⟨scrplain centre foot⟩]{⟨scrheadings centre foot⟩}  
\ofoot[⟨scrplain outer foot⟩]{⟨scrheadings outer foot⟩}
```

Definition

In each case, the optional argument indicates what to do if the `scrplain` page style is in use and the mandatory argument indicates what to do if the

## 4 Formatting

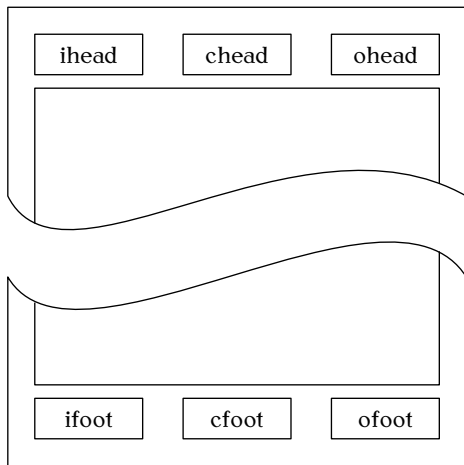


Figure 4.1 Page Header and Footer Elements

## 4 Formatting

`scrheadings` page style is in use. (If the optional argument is missing, no modification is made to the `scrplain` style.) Within both types of argument, you can use

`\pagemark`

Definition

to insert the current page number and

`\headmark`

Definition

to insert the running heading. For example, suppose you are required to put your registration number on the bottom left of each page and the page number on the bottom right, and you are also required to put the current chapter or section heading at the top left of each page, unless it's the first page of a chapter. Then you can do:

### Listing 8

```
\usepackage{scrpage2}
```

```
\pagestyle{scrheadings}
```

```
\newcommand{\myregnum}{123456789}% registration number
```

↑ Input

## 4 Formatting

```
\ihead{}  
\chead{}  
\ohead[]{\headmark}  
\ifoot[\myregnum]{\myregnum}% registration number  
\cfoot[]{}  
\ofoot[\pagemark]{\pagemark}
```

↓ Input

Note that the above don't use any font changing commands. If you want to change the font for the header and footer, you need to redefine `\headfont`. The page number style is given by `\pnumfont`. So for italic headers and footers with bold page numbers, you can redefine these commands as follows:

```
\renewcommand*{\headfont}{\normalfont\itshape}  
\renewcommand*{\pnumfont}{\normalfont\bfseries}
```

↑ Input

↓ Input

### 4.3 Double-Spacing

Whilst double-spacing is usually frowned upon in the world of modern typesetting, it is usually a requirement for anything that may need hand-written annotations, which can include theses. This extra space gives the examiners room to write comments.<sup>4.1</sup>

Double-spacing can be achieved via the `setspace` package. You can either set the spacing using the package options `singlespacing`, `onehalfspacing` or `doublespacing`, or you can switch via the declarations:

```
\singlespacing  
\onehalfspacing  
\doublespacing
```

Definition

So, if your thesis has to be double-spaced, you can do:

Listing 9

```
\usepackage[doublespacing]{setspace}
```

↑ Input

↓ Input

---

<sup>4.1</sup>Despite the current digital age, many people still use hand-written annotations on manuscripts. It's unlikely that your examiners have pens that are incompatible with your paper.

## 4.4 Changing the Title Page

**Volume 1** [15, §5.1] described how to lay out the title page using `\maketitle`. If this layout isn't appropriate for your school or department's specifications, you can lay out the title page manually using the `titlepage` environment instead of `\maketitle`. Within this environment, you can use `\hspace{<length>}` and `\vspace{<length>}` to insert horizontal and vertical spacing. (The unstarred versions are ignored if they occur at the start of a line or page, respectively. The starred versions will insert the given spacing, regardless of their location.) You can also use `\hfill` and `\vfill`, which will expand to fill the available space horizontally or vertically, respectively.

### EXAMPLE:

#### Listing 10

```
\begin{titlepage}
\centering
\vspace*{1in}
\begin{Large}\bfseries
  A Sample PhD Thesis\par
\end{Large}
\vspace{1.5in}
\begin{large}\bfseries
```

↑ Input

## 4 Formatting

```
A. N. Other\par
\end{large}
\vfill
A Thesis submitted for the degree of Doctor of Philosophy
\par
\vspace{0.5in}
School of Something
\par
University of Somewhere
\par
\vspace{0.5in}
July 2013
\par
\end{titlepage}
```

 [Input](#)

The result is shown in [Figure 4.2](#). (If you require [double-spacing](#), you may need to wait until after the title page before switching to double-spacing.)

### 4.5 Listings and Other Verbatim Text

There may be times when you want to include text exactly as you have typed it into your source code. For example, you may want to include

[FAQ: [Code listings in L<sup>A</sup>T<sub>E</sub>X](#)]



Figure 4.2 Sample Title Page

## 4 Formatting

a short segment of computer code. This can be done using the [verbatim](#) environment.

### EXAMPLE:

Note how I don't need to worry about [special characters](#), such as <#>, within the [verbatim](#) environment:

```
\begin{verbatim}
#include <stdio.h> /* needed for printf */

int main()
{
    printf("Hello World\n");

    return 1;
}
\end{verbatim}
```

↑ Input

↓ Input

This just produces:

## 4 Formatting

↑ Output

```
#include <stdio.h> /* needed for printf */

int main()
{
    printf("Hello World\n");

    return 1;
}
```

↓ Output

A more sophisticated approach is to use the listings package. With this package, you first need to specify the programming language. For example, the above code is in C, so I need to specify this using:

```
\lstset{language=C}
```

Input

Now I can use the [lstlisting](#) environment to typeset my C code:

## 4 Formatting

```
\begin{lstlisting}
#include <stdio.h> /* needed for printf */

int main()
{
    printf("Hello World\n");

    return 1;
}
\end{lstlisting}
```

↑ Input

↓ Input

The resulting output looks like:

```
#include <stdio.h> /* needed for printf */

int main()
{
    printf("Hello World\n");
}
```

↑ Output

## 4 Formatting

```
    return 1;
}
```

[↓ Output](#)

I can also have inline code snippets using:

```
\lstinline[<options>]<char><code><char>
```

[Definition](#)

This is different syntax to the usual forms of command argument. You can chose any character *<char>* that isn't the open square bracket [ and that doesn't occur in *<code>* to delimit the code, but the start and end *<char>* must match. (The optional argument is discussed below.) So the following are all equivalent:

1. *<char>* is the exclamation mark character:

```
\lstinline!#include <stdio.h>!
```

[Input](#)

2. *<char>* is the vertical bar character:

```
\lstinline|#include <stdio.h>|
```

[Input](#)

## 4 Formatting

3. `<char>` is the double-quote character:

```
\lstinline"#include <stdio.h>"
```

Input

4. `<char>` is the plus symbol:

```
\lstinline+#include <stdio.h>+
```

Input

And so on, but `<char>` can't be, say, `#` as that occurs in `<code>`. Example:

The `stdio` header file (required for the `\lstinline+printf+` function) is loaded using the directive `\lstinline!#include <stdio.h>!` on the first line.

↑ Input

↓ Input

Result:

The `stdio` header file (required for the `printf` function) is loaded using the directive **`#include`** `<stdio.h>` on the first line.

↑ Output

↓ Output

## 4 Formatting

Another alternative is to input the code from an external file. For example, suppose my C code is contained in the file `helloworld.c`, then I can input it using:

```
\lstinputlisting[⟨options⟩]{helloworld.c}
```

Input

(Remember to use a forward slash / as the directory divider, even if you are using Windows.)

All the above (`\lstinline`, `\lstinputlisting` and the `lstlisting` environment) have an optional argument `⟨options⟩` that can be used to override the default settings. These are `⟨key⟩=⟨value⟩` options. There are a lot of options available, but I'm only going to cover a few. If you want more detail, have a look at the listings documentation [6].

**title=**`{⟨text⟩}` is used to set an unnumbered and unlabelled title. If `⟨text⟩` contains a comma or equal sign, make sure you enclose `⟨text⟩` in curly braces `{` and `}`.

**caption=**`{[⟨short⟩]⟨text⟩}` is used to set a numbered caption. The optional part `⟨short⟩` is an alternative short caption for the list of listings, which can be produced using

```
\lstlistoflistings
```

Definition

## 4 Formatting

As above, if the caption contains a comma or equal sign, make sure you enclose it in curly braces { and }.

**label**={<text>} is used to assign a label to this listing so the number can be referenced via `\ref`.

**numbers**={<setting>} The value <setting> may be one of: none (no line numbers), left (line numbers on the left) or right (line numbers on the right).

**mathescape** This is a boolean key that can either be true (dollar \$ character acts as the usual math mode shift) or false (deactivates the usual behaviour of \$).

**basicstyle**={<declaration>} The value (one or more declarations) is used at the start of the listing to set the basic font style. For example, <declaration> could be `\ttfamily` (which actually makes more sense for a listing).

### NOTE:

If you set `basicstyle` to `\ttfamily` and you want bold keywords, make sure you are using a typewriter font that supports bold, as not all of them do. (Recall from [Volume 1 \[15, §4.5.3\]](#) how to change the font family.) This



## 4 Formatting

book uses `txtt` (see [Volume 1 \[15, §8.2\]](#)). Other possibilities include `beramono`, `tgcursor`, `courier`, `DejaVuSansMono` (or `dejavu` to load the serif and sans-serif DejaVu fonts as well), `lmodern` and `luximono`.

### KOMA AND listings

If you want to use the `listings` package with one of the KOMA-Script classes, you need to load `scrhack` *before* `listings`, otherwise you will get a warning that looks like:



```
Class scrbook Warning: Usage of deprecated \float@listhead!
(scrbook)              You should use the features of package 'tocbasic'
(scrbook)              instead of \float@listhead.
(scrbook)              Definition of \float@listhead may be removed from
(scrbook)              'scrbook' soon, so it should not be used on input
line 57.
```

### EXAMPLE:

#### Listing 11

```
\begin{lstlisting}[language=C,basicstyle=\ttfamily,
mathescape=true]
#include <stdio.h> /* needed for printf */
```

↑ Input

## 4 Formatting

```
#include <math.h> /* needed for sqrt */

int main()
{
    double x = sqrt(2.0); /*  $x = \sqrt{2}$  */

    printf("x = %f\n", x);

    return 1;
}
\end{lstlisting}
```

↓ Input

Result:

```
#include <stdio.h> /* needed for printf */
#include <math.h> /* needed for sqrt */

int main()
{
    double x = sqrt(2.0); /*  $x = \sqrt{2}$  */
```

↑ Output

## 4 Formatting

```
printf("x_=%f\n", x);

return 1;
}
```

↓ Output

If you are using [double-spacing](#), you may need to temporarily switch it off in the listings. You can do this by adding [\singlespacing](#) to the `basicstyle` setting.

```
\lstset{basicstyle={\ttfamily\singlespacing}}
```

Input

(Check with your supervisor to find out if listings should be double- or single-spaced.)

### NOTE:

It is not usually appropriate to have reams of listings in your thesis. It can annoy an examiner if you have included every single piece of code you have written during your PhD, as it comes across as padding to make it look as though your thesis is a lot larger than it really is. (Examiners are not easily fooled, and it's best not to irritate them as it is likely to make them less sympathetic towards you.) If you want to include listings in your thesis, check with your supervisor first to find out whether or not it is appropriate.



## 4 Formatting

Be careful when you use verbatim-like environments or commands, such as `verbatim`, `lstlisting`, `\lstinline` and `\lstinputlisting`. In general, they can't be used in the argument of another command.

[FAQ: Why doesn't verbatim work within ...?]

### 4.6 Tabbing

The `tabbing` environment lets you create tab stops so that you can tab to a particular distance from the left margin. Within the `tabbing` environment, you can use the command `\=` to set a tab stop, `\>` to jump to the next tab stop, `\<` to go back a tab stop, `\+` to shift the left border by one tab stop to the right, `\-` to shift the left border by one tab stop to the left. In addition, `\\` will start a new line and `\kill` will set any tabs stops defined in that line, but will not typeset the line itself.

#### NOTE:

You may recall two of the above commands from Volume 1: `\-` was described as a discretionary hyphen in §2.14 and `\=` was described as the macron accent command in §4.3. These two commands take on different meanings when they are used in the `tabbing` environment. If you want accents in your `tabbing` environment, either use the `inputenc` package (see [Volume 1](#) [15, §4.3.1]) or use `\a<accent symbol>{\<c>}`, for example `\a"u` instead of `\"u`.



[FAQ: Accents misbehave in tabbing]

## 4 Formatting

### EXAMPLE:

```
\begin{tabbing}
Zero \=One \=Two \=Three\\
\>First tab stop\\
\>A\>\>B\\
\>\>Second tab stop
\end{tabbing}
```

↑ Input

↓ Input

This produces the following output:

```
Zero One Two Three
      First tab stop
      A         B
      Second tab stop
```

↑ Output

↓ Output

## 4 Formatting

### ANOTHER EXAMPLE:

This example sets up four tab stops, but ignores the first line:

```
\begin{tabbing}
AAA \=BBBB \=XX \=YYYYY \=Z \kill
\>\>\>Third tab stop\\
\>a \>b \> \>c
\end{tabbing}
```

↑ Input

↓ Input

This produces the following output:

```

          Third tab stop
a      b          c
```

↑ Output

↓ Output

## 4.7 Theorems

A PhD thesis can often contain theorems, lemmas, definitions etc. The  $\text{\LaTeX}$  kernel comes with the command:

```
\newtheorem{<name>}[<counter>]{<title>}[<outer counter>]
```

Definition

which can be used to create an environment called  $\langle name \rangle$  that has an optional argument. Each instance of the environment starts with  $\langle title \rangle$  followed by the associated counter value. If  $\langle counter \rangle$  is present, the new environment uses that counter instead of having a new counter defined for it. If  $\langle outer counter \rangle$  is present, the environment counter is reset every time  $\langle outer counter \rangle$  is incremented. The optional arguments are mutually exclusive.

In the example below, I've use `\newtheorem` to define a new environment called theorem, which has an associated counter, also called theorem, that is dependant on the chapter counter.

---

```
% in the preamble:
```

```
\newtheorem{theorem}{Theorem}[chapter]
```

↑ Input

## 4 Formatting

% later in the document:

```
\begin{theorem}
```

If proposition  $P$  is a tautology  
then  $\sim P$  is a contradiction,  
and conversely.

```
\end{theorem}
```

↓ Input

Resulting output:

↑ Output

**Theorem 4.1** *If proposition  $P$  is a tautology then  $\sim P$  is a contradiction, and conversely.*

↓ Output

The optional argument to the new environment can be used to add a caption. Modifying the above example (changes shown **like this**):

↑ Input

% in the preamble:

```
\newtheorem{theorem}{Theorem}[chapter]
```

## 4 Formatting

% later in the document:

```
\begin{theorem}[Tautologies and Contradictions]
```

If proposition  $P$  is a tautology  
then  $\sim P$  is a contradiction,  
and conversely.

```
\end{theorem}
```

↓ Input

Resulting output:

↑ Output

**Theorem 4.2 (Tautologies and Contradictions)** *If proposition  $P$  is a tautology then  $\sim P$  is a contradiction, and conversely.*

↓ Output

Here's an example that uses the first optional argument of `\newtheorem`:

↑ Input

% in the preamble:

```
\newtheorem{exercise}{Exercise}
```

```
\newtheorem{suppexercise}[exercise]{Supplementary Exercise}
```

## 4 Formatting

% later in the document:

```
\begin{exercise}
```

This is an example of how to create a theorem-like environment.

```
\end{exercise}
```

```
\begin{suppexercise}
```

This is another example of how to create a theorem-like environment.

```
\end{suppexercise}
```

↓ Input

Result:

**Exercise 1** *This is an example of how to create a theorem-like environment.*

↑ Output

**Supplementary Exercise 2** *This is another example of how to create a theorem-like environment.*

↓ Output

Unfortunately there isn't a great deal of flexibility with the environment appearance. However there are various packages available that provide enhancements to this basic command, allowing you to adjust the appearance to suit your requirements. There seem to be two main contenders:

[FAQ: Theorem bodies printed in a roman font]

## 4 Formatting

`amsthm` and `ntheorem`. Both have advantages and disadvantages. For example, `ntheorem` is more flexible but `amsthm` is more robust. Therefore I'm going to describe both, and you will have to decide which one you prefer.

### NOTE:

If you are using either packages with `amsmath`, you must load `amsmath` first:



```
\usepackage{amsmath}  
\usepackage{ntheorem}
```

↑ Input

↓ Input

or

```
\usepackage{amsmath}  
\usepackage{amsthm}
```

↑ Input

↓ Input

With both `amsthm` and `ntheorem`, you can still define new theorem-like environments using `\newtheorem`, but there is also a starred version of that command, which can be used to define unnumbered theorem-like environments.

## 4 Formatting

### EXAMPLE:

Suppose I want to have an unnumbered remark environment, I can define the environment like this:

```
% in the preamble:  
\newtheorem*{note}{Note}
```

```
% later in the document:  
\begin{note}  
This is a note about something.  
\end{note}
```

↑ Input

↓ Input

Result:

**Note** *This is a note about something.*

↑ Output

↓ Output

## 4 Formatting

### 4.7.1 The amsthm Package

The amsthm package provides three predefined theorem styles: plain, definition and remark. When you define a new theorem-like environment with `\newtheorem`, it is given the style *currently in effect*. You can change the current style with:

```
\theoremstyle{<style name>}
```

Definition

where *<style name>* is the name of the theorem style.

#### EXAMPLE:

This example defines six theorem-like environments: theorem, lemma, defn, conj, note and remark. The note environment is unnumbered as it's defined using the starred version of `\newtheorem`. The definitions have been arranged according to the required theorem style.

```
\theoremstyle{plain}
\newtheorem{theorem}{Theorem}
\newtheorem{lemma}{Lemma}

\theoremstyle{definition}
```

↑ Input

## 4 Formatting

```
\newtheorem{defn}{Definition}  
\newtheorem{conj}{Conjecture}
```

```
\theoremstyle{remark}  
\newtheorem*{note}{Note}  
\newtheorem{remark}{Remark}
```

[↓ Input](#)

The amsthm package also provides the `proof` environment, which can be used for typesetting proofs.

```
\begin{proof}[\langle title \rangle]
```

Definition

The optional argument  $\langle title \rangle$  is a replacement for the default title. This environment automatically inserts a QED symbol at the end of it, but if the default location isn't appropriate (which can happen if the proof ends with an equation) then use

```
\qedhere
```

Definition

where you want the QED symbol to appear. The symbol is given by

```
\qedsymbol
```

Definition

## 4 Formatting

This defaults to an unfilled square  $\square$ , but you can redefine `\qedsymbol` to something else if you prefer. (Recall redefining commands from [Volume 1 \[15, §8.2\]](#).)

### Listing 12

↑ Input

% in the preamble:

```
\usepackage{amsthm}
\theoremstyle{plain}
\newtheorem{theorem}{Theorem}

\theoremstyle{definition}
\newtheorem{defn}{Definition}
\newtheorem{xmpl}{Example}[chapter]

\theoremstyle{remark}
\newtheorem{remark}{Remark}
```

% later in the document:

```
\begin{defn}[Tautology]\label{def:tautology}
A \emph{tautology} is a proposition that is always true for any
```

## 4 Formatting

value of its variables.

```
\end{defn}
```

```
\begin{defn}[Contradiction]\label{def:contradiction}
```

A `\emph{contradiction}` is a proposition that is always false for any value of its variables.

```
\end{defn}
```

```
\begin{theorem}
```

If proposition  $P$  is a tautology then  $\sim P$  is a contradiction, and conversely.

```
\begin{proof}
```

If  $P$  is a tautology, then all elements of its truth table are true (by Definition~\ref{def:tautology}), so all elements of the truth table for  $\sim P$  are false, therefore  $\sim P$  is a contradiction (by Definition~\ref{def:contradiction}).

```
\end{proof}
```

```
\end{theorem}
```

```
\begin{xmpl}\label{ex:rain}
```

“It is raining or it is not raining” is a tautology, but “it is not raining and it is raining” is a contradiction.

## 4 Formatting

```
\end{xmpl}
```

```
\begin{remark}
```

Example~\ref{ex:rain} used De Morgan's Law  $\sim (p \vee q)$

$\equiv \sim p \wedge \sim q$ .

```
\end{remark}
```

↓ Input

Result:

**Definition 1** (Tautology). A *tautology* is a proposition that is always true for any of its variables.

↑ Output

**Definition 2** (Contradiction). A *contradiction* is a proposition that is always false for any value of its variables.

**Theorem 4.3.** If proposition  $P$  is a tautology then  $\sim P$  is a contradiction, and conversely.

*Proof.* If  $P$  is a tautology, then all elements of its truth table are true (by Definition 1), so all elements of the truth table for  $\sim P$  are false, therefore  $\sim P$  is a contradiction (by Definition 2).  $\square$

## 4 Formatting

**Example 1.** “It is raining or it is not raining” is a tautology, but “it is not raining and it is raining” is a contradiction.

*Remark 1.* Example 1 used De Morgan’s Law  $\sim (p \vee q) \equiv \sim p \wedge \sim q$ .

[↓ Output](#)

A new theorem style can be created using

```
\newtheoremstyle{<name>}{<space above>}{<space below>}{<body font>}{<indent>}{<head font>}{<post head punctuation>}{<post head space>}{<head spec>}
```

Definition

This defines a new theorem style called  $\langle name \rangle$ , which can later be set using `\theoremstyle`. The other arguments are as follows:

$\langle space\ above \rangle$	the amount of space above the theorem-like environment
$\langle space\ below \rangle$	the amount of space below the theorem-like environment
$\langle body\ font \rangle$	the font to be used in the main theorem body

## 4 Formatting

$\langle indent \rangle$	the amount of indentation (empty means no indent or use <code>\parindent</code> for normal paragraph indentation)
$\langle head font \rangle$	the font to be used in the theorem header
$\langle post head punctuation \rangle$	the punctuation to be inserted after the theorem head
$\langle post head space \rangle$	the space to put after the theorem head (use <code>{_}</code> for a normal interword space or <code>\newline</code> for a linebreak)
$\langle head spec \rangle$	the theorem head spec

### EXAMPLE:

This example creates a new style called `note` that inserts a space of `2ex` above the theorem and `2ex` below.<sup>4.2</sup> The body font is just the normal font. There is no indent, the theorem header is in small caps, a full stop is put after the theorem head and a line break is inserted between the theorem head and body:

---

<sup>4.2</sup>Recall the `ex` unit from [Volume 1](#) [15, §2.17].

## 4 Formatting

```
\newtheoremstyle{note}% style name
{2ex}% above space
{2ex}% below space
{}% body font
{}% indent amount
{\scshape}% head font
{.}% post head punctuation
{\newline}% post head punctuation
{}% head spec
```

↑ Input

↓ Input

Once you have defined the style, you can now use it. For example (in the preamble):

```
\theoremstyle{note}
\newtheorem{scnote}{Note}
```

↑ Input

↓ Input

This defines a theorem-like environment called scnote. You can now use it later in the document:

## 4 Formatting

```
\begin{scnote}
```

This is an example of a theorem-like environment.

```
\end{scnote}
```

↑ Input

↓ Input

This produces:

NOTE 1.

This is an example of a theorem-like environment.

↑ Output

↓ Output

### 4.7.2 The ntheorem Package

The ntheorem package provides nine predefined theorem styles, listed in [Table 4.1](#). The default is plain. When you define a new theorem-like environment with `\newtheorem`, it is given the style *currently in effect*. You can change the current style with:

## 4 Formatting

`\theoremstyle{style name}`

Definition

where *style name* is the name of the theorem style.

Table 4.1 Predefined Theorem Styles Provided by ntheorem

plain	Like the original L <sup>A</sup> T <sub>E</sub> X style
break	Header is followed by a line break
change	Like plain but header and number interchanged
changebreak	Combination of change and break
margin	Number is set in the margin
marginbreak	Like margin but header followed by a line break
nonumberplain	Like plain but without the number
nonumberbreak	Like break but without the number
empty	No number and no name. Only the optional argument is used in the header.

In addition to these styles, you can also use

`\theoremheaderfont{declarations}`

Definition

to set the header font to *declarations*, which should consist of font dec-

## 4 Formatting

laration commands such as `\normalfont`,

`\theorembodyfont{<declarations>}`

Definition

to set the body font to `<declarations>`, and

`\theoremnumbering{<style>}`

Definition

to set the appearance of the theorem number, where `<style>` may be one of: arabic, roman, Roman, alph, Alph, greek, Greek or fnsymbol. Remember that the above commands all need to be used before the new theorem-like environment is defined. For additional commands that affect the style of the theorems, see the ntheorem documentation [10].

### EXAMPLE:

% in the preamble:

```
\theoremstyle{marginbreak}
\theorembodyfont{\normalfont}
\newtheorem{note}{Note}[chapter]
```

↑ Input

## 4 Formatting

% later in the document:

```
\begin{note}
```

This is a sample note. The number is in the margin.

```
\end{note}
```

↓ Input

Result:

↑ Output

### 4.1 Note

This is a sample note. The number is in the margin.

↓ Output

If you use the standard package option to `ntheorem`, it will automatically define the following environments: Theorem, Lemma, Proposition, Corollary, Satz, Korollar, Definition, Example, Beispiel, Anmerkung, Bemerkung, Remark, Proof and Beweis.



Unlike `amsthm`'s `proof` environment, `ntheorem`'s `Proof` environment appends its optional argument in parentheses, if present, to the proof title. (Recall from [earlier](#) that `amsthm`'s `proof` environment uses its optional argument as a replacement for the default proof title.)

## 4 Formatting

### EXAMPLE:

#### Listing 13

↑ Input

% in the preamble:

```
\usepackage[standard]{ntheorem}
```

% later in the document:

```
\begin{Definition}[Tautology]\label{def:tautology}
```

A `\emph{tautology}` is a proposition that is always true for any value of its variables.

```
\end{Definition}
```

```
\begin{Definition}[Contradiction]\label{def:contradiction}
```

A `\emph{contradiction}` is a proposition that is always false for any value of its variables.

```
\end{Definition}
```

```
\begin{Theorem}
```

If proposition `$P$` is a tautology then `$\sim P$` is a contradiction, and conversely.

## 4 Formatting

```
\begin{Proof}
```

If  $\mathcal{P}$  is a tautology, then all elements of its truth table are true (by Definition~\ref{def:tautology}), so all elements of the truth table for  $\sim \mathcal{P}$  are false, therefore  $\sim \mathcal{P}$  is a contradiction (by Definition~\ref{def:contradiction}).

```
\end{Proof}
```

```
\end{Theorem}
```

```
\begin{Example}\label{ex:rain}
```

“It is raining or it is not raining” is a tautology, but “it is not raining and it is raining” is a contradiction.

```
\end{Example}
```

```
\begin{Remark}
```

Example~\ref{ex:rain} used De Morgan’s Law  $\sim (p \vee q)$

$\equiv \sim p \wedge \sim q$ .

```
\end{Remark}
```

↓ Input

Result:

**Definition 3 (Tautology)** A *tautology* is a proposition that is always true for any value of its variables.

**Definition 4 (Contradiction)** A *contradiction* is a proposition that is always false for any value of its variables.

**Theorem 4.4** If proposition  $P$  is a tautology then  $\sim P$  is a contradiction, and conversely.

PROOF If  $P$  is a tautology, then all elements of its truth table are true (by Definition 3), so all elements of the truth table for  $\sim P$  are false, therefore  $\sim P$  is a contradiction (by Definition 4).

**Example 2** “It is raining or it is not raining” is a tautology, but “it is not raining and it is raining” is a contradiction.

**Remark 2** Example 2 used De Morgan’s Law  $\sim (p \vee q) \equiv \sim p \wedge \sim q$ .

## 4.8 Algorithms

If you want to display an algorithm, such as pseudo-code, you can use a combination of the [tabbing](#) environment (described in [Section 4.6](#)) and a theorem-like environment (described above in [Section 4.7](#)).

### EXAMPLE:

```
% in the preamble:
\theoremstyle{break}
\theorembodyfont{\normalfont}
\newtheorem{algorithm}{Algorithm}

% later in the document:
\begin{algorithm}[Gauss-Seidel Algorithm]
\begin{tabbing}
1. \=For $k=1$ to maximum number of iterations\\
\>2. For \=$i=1$ to $n$\\
\>\>Set
\begin{math}
x_i^{(k)} =
\frac{b_i - \sum_{j=1}^{i-1} a_{ij} x_j^{(k)}}{a_{ii}}
\end{tabbing}
\end{algorithm}
```

↑ Input

## 4 Formatting

```
        -\sum_{j=i+1}^na_{ij}x_j^{(k-1)}}%
    {a_{ii}}
\end{math}
\\
>3. If  $\|\vec{x}^{(k)} - \vec{x}^{(k-1)}\| < \epsilon$ ,
where  $\epsilon$  is a specified stopping criteria, stop.
\end{tabbing}
\end{algorithm}
```

↓ Input

Result:

### Algorithm 1 (Gauss-Seidel Algorithm)

1. For  $k = 1$  to maximum number of iterations
2. For  $i = 1$  to  $n$

$$\text{Set } x_i^{(k)} = \frac{b_i - \sum_{j=1}^{i-1} a_{ij}x_j^{(k)} - \sum_{j=i+1}^n a_{ij}x_j^{(k-1)}}{a_{ii}}$$

3. If  $|\vec{x}^{(k)} - \vec{x}^{(k-1)}| < \epsilon$ , where  $\epsilon$  is a specified stopping criteria, stop.

↑ Output

↓ Output

(See [Volume 1](#) [15, §9.4.11] to find out how to redefine `\vec` to display its argument in bold.)

## 4 Formatting

If you want a more sophisticated approach, there are some packages available on CTAN [2], such as `alg`, `algorithm2e`, `algorithms` and `algorithmicx`. I'm going to briefly introduce the `algorithm2e` package here. This provides the `algorithm` floating environment. Like the `figure` and `table` environments described in Volume 1 [15, §7], the `algorithm` environment has an optional argument that specifies the placement.

```
\begin{algorithm}[\langle placement \rangle]
```

Definition

If you are using a class or package that already defines an algorithm environment, you can use the `algo2e` package option:

```
\usepackage[algo2e]{algorithm2e}
```

Input

This will define an environment called `algorithm2e` instead of `algorithm` to avoid conflict.

Within the body of the environment, you must mark the end of each line with `\;` regardless of whether you want a semi-colon to appear. To suppress the default end-of-line semi-colon, use

```
\DontPrintSemicolon
```

Definition

To switch it back on again, use

## 4 Formatting

### `\PrintSemicolon`

Definition

There are a variety of commands that may be used within the `algorithm` environment. Some of the commands are described below, but for a complete list you should consult the `algorithm2e` documentation [4].

First there are the commands for the algorithm input, output and data:

`\KwIn{<input>}`

`\KwOut{<output>}`

`\KwData{<input>}`

`\KwResult{<output>}`

Definition

Next there are commands for basic keywords:

`\KwTo`

`\KwRet{<value>}`

`\Return{<value>}`

Definition

There are a lot of conditionals, but here's a selection:

## 4 Formatting

```
\If{<condition>}{<then block>}  
\uIf{<condition>}{<then block without end>}  
\ElseIf{<else-if block>}  
\uElseIf{<else-if block without end>}  
\Else{<else block>}
```

Definition

Similarly there are a lot of loops, but here's a selection:

```
\For{<condition>}{<body>}  
\While{<condition>}{<body>}
```

Definition

### EXAMPLE:

The above algorithm can be written using the [algorithm2e](#) environment as follows (this document has used the `algo2e` package option):

#### Listing 14

```
\begin{algorithm2e}  
\caption{Gauss-Seidel Algorithm}\label{alg:gauss-seidel}  
\KwIn  
{%  
  scalar  $\epsilon$ ,  
  matrix  $\mathbf{A} = (a_{ij})$ ,  
}
```

↑ Input

#### 4 Formatting

```
vector  $\vec{b}$ 
and initial vector  $\vec{x}^{(0)}$ 
}
\For{$k \leftarrow 1$ \KwTo maximum iterations}
{
  \For{$i \leftarrow 1$ \KwTo $n$}
  {
    $
    
$$x_i^{(k)} = \frac{b_i - \sum_{j=1}^{i-1} a_{ij} x_j^{(k)} - \sum_{j=i+1}^n a_{ij} x_j^{(k-1)}}{a_{ii}}$$

    $
  }
  \If{$\lvert \vec{x}^{(k)} - \vec{x}^{(k-1)} \rvert < \epsilon$}
  {Stop}
}
```

```
\end{algorithm2e}
```

[↓ Input](#)

## 4 Formatting

The result is shown in Algorithm 2.

**Input:** Scalar  $\epsilon$ , matrix  $\mathbf{A} = (a_{ij})$ , vector  $\vec{b}$  and initial vector  $\vec{x}^{(0)}$

```
for  $k \leftarrow 1$  to maximum iterations do  
  for  $i \leftarrow 1$  to  $n$  do  
     $x_i^{(k)} = \frac{b_i - \sum_{j=1}^{i-1} a_{ij}x_j^{(k)} - \sum_{j=i+1}^n a_{ij}x_j^{(k-1)}}{a_{ii}};$   
  end  
  if  $|\vec{x}^{(k)} - \vec{x}^{(k-1)}| < \epsilon$  then  
    Stop  
  end  
end
```

**Algorithm 2:** Gauss-Seidel Algorithm

The [algorithm](#) environment (as defined by `algorithm2e` without the `algo2e` option) or [algorithm2e](#) environment (as defined with the `algo2e` option) uses the `algocf` counter. So in this document, to ensure that the algorithm environment defined with `\newtheorem` used the same counter as [algorithm2e](#), I had the following in my preamble:

## 4 Formatting

```
\usepackage{ntheorem}  
\usepackage[algo2e]{algorithm2e}  
  
\theoremstyle{break}  
\theorembodyfont{\normalfont}  
\newtheorem{algorithm}[algocf]{Algorithm}
```

↑ Input

↓ Input

### 4.9 Formatting SI Units

If you need to typeset numbers and units then I strongly recommend that you use the `siunitx` package. This section just provides a brief introduction to that package. You will need to read the `siunitx` package documentation [20] if you want further details.

```
\num{⟨number⟩}
```

Definition

This command typesets  $\langle number \rangle$ , adding appropriate spacing between number groups where necessary. It also adds a leading zero if omitted

## 4 Formatting

before the decimal point and identifies exponents. Note that the command recognises both “.” and “,” as the decimal marker. If you want one of these characters between number groups (instead of the default space) you can change the settings, but it’s best to stick to the default settings unless instructed to do otherwise.

### EXAMPLE:

Out of `\num{12890}` experiments, `\num{1289}` of them had a mean squared error of `\num{.346}` and `\num{128}` of them had a mean squared error of `\num{1.23e-6}`.

↑ Input

↓ Input

Result:

Out of 12890 experiments, 1289 of them had a mean squared error of 0.346 and 128 of them had a mean squared error of  $1.23 \times 10^{-6}$ .

↑ Output

↓ Output

`\ang{<angle>}`

Definition

## 4 Formatting

This command typesets an angle. The argument  $\langle angle \rangle$  may be a single number or three (some possibly empty) values separated by semi-colons.

### EXAMPLE:

The result formed an arc from `\ang{45}` to `\ang{60;2;3}`.

Input

Result:

The result formed an arc from  $45^\circ$  to  $60^\circ 2' 3''$ .

Output

`\si{\unit}`

Definition

This command typesets a unit. The  $\langle unit \rangle$  can be formed from commands like `\metre`, `\gram`, `\second` or `\kilo`. (See the siunitx documentation [20] for the full list.)

### EXAMPLE:

The distance was measured in `\si{\kilo\metre}` and the area in `\si{\kilo\metre\squared}`. The acceleration was given in `\si{\metre\per\square\second}`.

Input

Input

## 4 Formatting

Result:

The distance was measured in km and the area in  $\text{km}^2$ . The acceleration was given in  $\text{m s}^{-2}$ .

↑ Output

↓ Output

`\SI{<number>}{<unit>}`

Definition

This combines the functionality of `\num` and `\si` so that you can typeset both a number and a unit.

**EXAMPLE:**

The acceleration was approximately  
`\SI{9.78}{\metre\per\square\second}`.

↑ Input

↓ Input

Result:

The acceleration was approximately  $9.78 \text{ m s}^{-2}$ .

Output

## 5. GENERATING A BIBLIOGRAPHY

Volume 1 [15, §5.6] introduced the [thebibliography](#) environment. While it is possible to write this environment yourself, as was done in Volume 1, it's not practical with a large number of citations.

Instead, the preferred method is to create an external database of bibliographic data and use an application that fetches the relevant information from that database and writes a file containing the [thebibliography](#) environment, which can then be input into your document. This means that:

1. Only the references that you cite are included in the bibliography. (Examiners tend to fault uncited references<sup>5.1</sup>.)
2. References are displayed in a consistent manner.
3. Entries can be sorted in order of citation or alphabetically.

---

<sup>5.1</sup>When your examiners read through your thesis, they can check off each citation they encounter against your bibliography. When they reached the end of the thesis, they can then look through the bibliography for unchecked entries. One or two may appear the result of carelessness, whereas a large quantity will look like padding and may lead the examiners to suspect a certain amount of duplicity on your part.

Traditionally the `bibtex` application is used to generate the `thebibliography` environment. It comes with  $\text{\LaTeX}$  distributions and most books on  $\text{\LaTeX}$  cover `bibtex`. Unfortunately `bibtex` has some drawbacks, most notably the complexity of creating your own custom style. UTF-8 has also been a problem, although newer versions of `bibtex` apparently fix this.

In 2006, Philipp Lehman brought out the `biblatex` package to provide a more flexible way of typesetting bibliographies. This originally used `bibtex` to just sort the entries and used  $\text{\LaTeX}$  macros to deal with the actual formatting, but it is now moving over to using `biber` instead of `bibtex`.

Since some journals, conferences or other types of scientific publishers require you to use `bibtex`, [Section 5.2](#) provides a brief introduction to `bibtex` and then [Section 5.3](#) discusses `biblatex` and `biber`. But first [Section 5.1](#) covers creating the actual database, which is required for both methods.

### 5.1 Creating a Bibliography Database

This section covers creating a `.bib` file that contains the bibliographic information you want to cite in your documents. You can use an ordinary text editor to create a bibliographic database (as described in [Section 5.1.2](#)) but it can be difficult to remember the names of the required fields and it's easy to make syntactic mistakes. It can also be hard to keep track of

entries in a large database. To make life easier, there are a number of bibliography reference managers available that provide a convenient graphical interface. One such application is JabRef and is described [next](#).

### 5.1.1 JabRef

I've chosen to describe JabRef here because it's an open source Java application that can run on any operating system that has the [Java Runtime Environment](#) installed (at least version 1.5). You can download JabRef from <http://jabref.sourceforge.net/download.php>. Linux users may also be able to install it via their “Add/Remove Software” tool. (If you have successfully been using [arara](#), you already have Java installed.)

Once you have installed it, run JabRef and select File→New database to create a new database (see [Figure 5.1](#)). When you save your data, it's saved as a BibTeX (.bib) file.

Note that if you use the inputenc package in your thesis (see [Volume 1](#) [15, §4.3.1]) you'll have to make sure JabRef is using the same encoding as your document. You can do this by selecting Options→Preferences to open the Preferences dialog box and set the default encoding as appropriate. For example, I use UTF-8 so I've set that as the default encoding (see [Figure 5.2](#)). I also need to change the database encoding in the “Database properties” dialog, [Figure 5.3](#), which can be opened using File→Database properties.

## 5 *Generating a Bibliography*

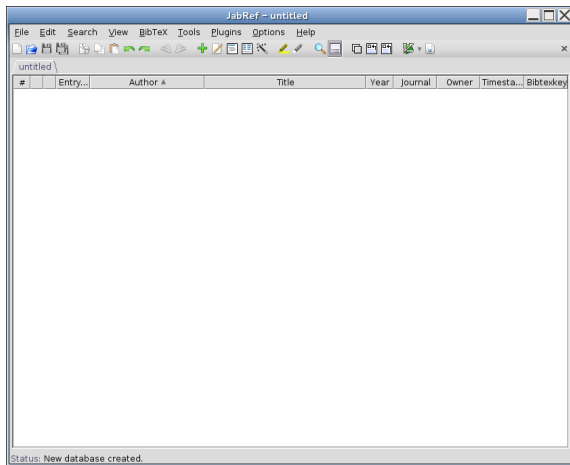


Figure 5.1 JabRef

## 5 Generating a Bibliography

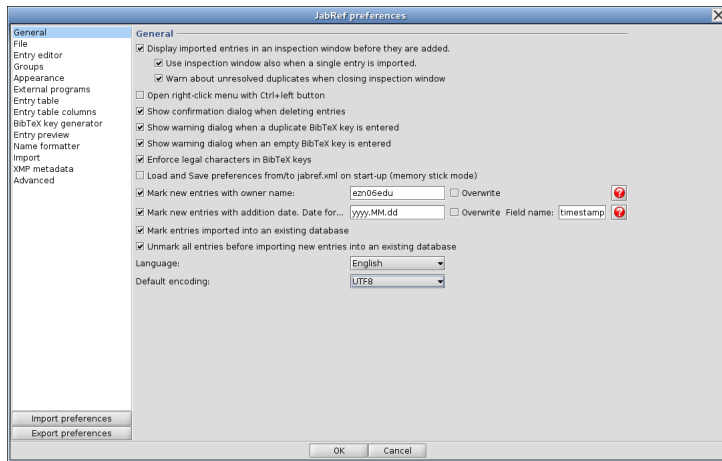


Figure 5.2 JabRef Preferences

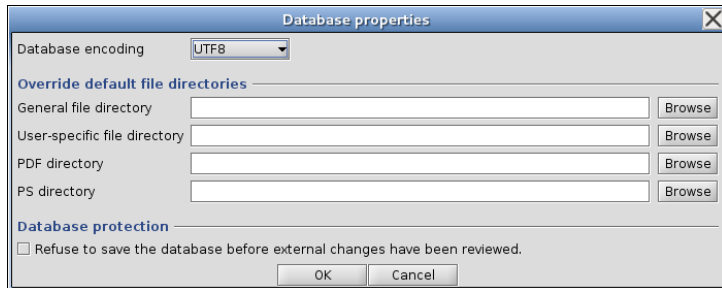


Figure 5.3 JabRef Database Properties

## 5 Generating a Bibliography

To create a new entry you can select BibTeX→New entry, which will open the dialog box shown in [Figure 5.4](#). Now you need to click on the button appropriate to the entry. For example, click on “Article” for an article in a journal or click on “Inproceedings” for a paper in a conference proceedings.

### EXAMPLE (BOOK):

Suppose I want to enter information about a book. I need to select BibTeX→New entry and then click on the button labelled “Book”. This now displays fields in which I can enter the relevant information (see [Figure 5.5](#)).

Next I need to enter information in the “Required fields” tab. This will usually include the title and the author. I also need to specify a key that uniquely identifies this entry. If you have read [Volume 1](#) [[15](#), §5.6] this key corresponds to the mandatory argument of `\bibitem` and is also used in `\cite`. [Figure 5.6](#) shows the details for my new entry. I’ve set the key to the author’s surname followed by the year to make it easy to remember. This key won’t appear anywhere in the document, it’s just used to identify the entry, just like the `\label/\ref` mechanism. Alternatively, I can click

on the “Generate BibTeX Key” button



to automatically insert a unique key.

There are also optional fields you can specify as well. In [Figure 5.7](#), I’ve

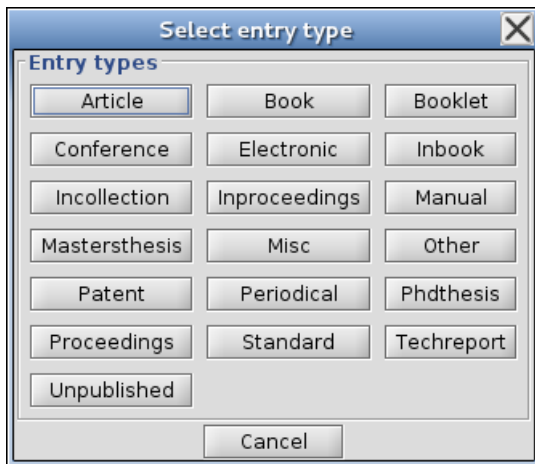


Figure 5.4 JabRef (Select Entry Type)

## 5 Generating a Bibliography

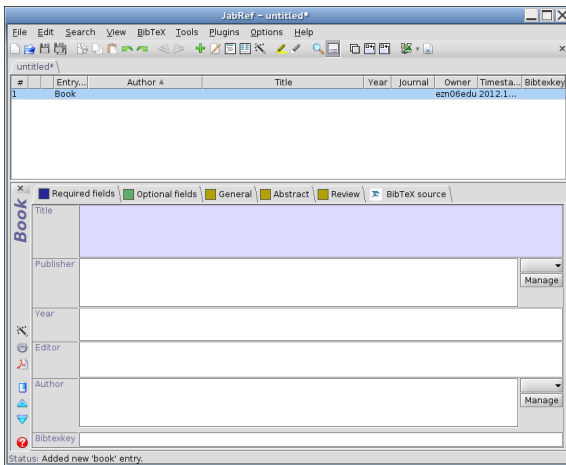


Figure 5.5 JabRef (New Entry)

## 5 *Generating a Bibliography*

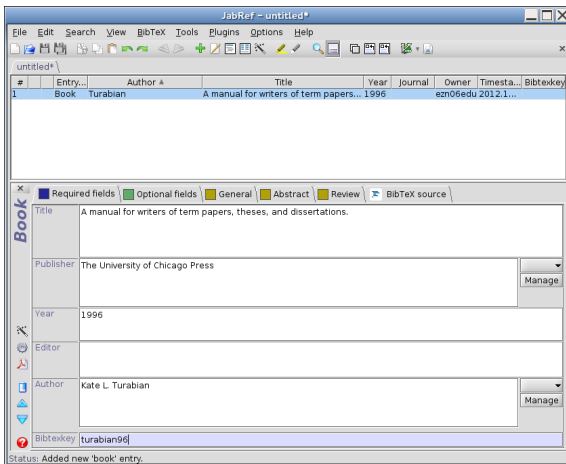



Figure 5.6 JabRef (Entering the Required Fields)

added the book's edition.

### EXAMPLE (JOURNAL ARTICLE):

Now I want to enter an article in a journal. So I need to go back to BibTeX → New entry and click on “Article”. This time I've used the “Generate BibTeX Key” button to generate the key to save me typing. (See [Figure 5.8](#).) I've also used the “General” tab to enter the DOI for this article. The entry now has an icon  next to it. I can click on this button to direct my web browser to the article's entry on the Internet.

BibTeX uses the European assumption that names are composed of forenames, an optional “von” part which starts with a lower case letter, a surname and an optional “jr” part. In order to enable BibTeX to correctly identify these components, names in the author or editor fields must be entered in one of the formats listed in [Table 5.1](#).

[FAQ: [BibTeX sorting and name prefixes](#)]

Table 5.1 Name Formats for Bibliographic Data

$\langle \text{forenames} \rangle \langle \text{von} \rangle \langle \text{surname} \rangle$   
 $\langle \text{von} \rangle \langle \text{surname} \rangle, \langle \text{forenames} \rangle$   
 $\langle \text{von} \rangle \langle \text{surname} \rangle, \langle \text{jr} \rangle, \langle \text{forenames} \rangle$

## 5 *Generating a Bibliography*

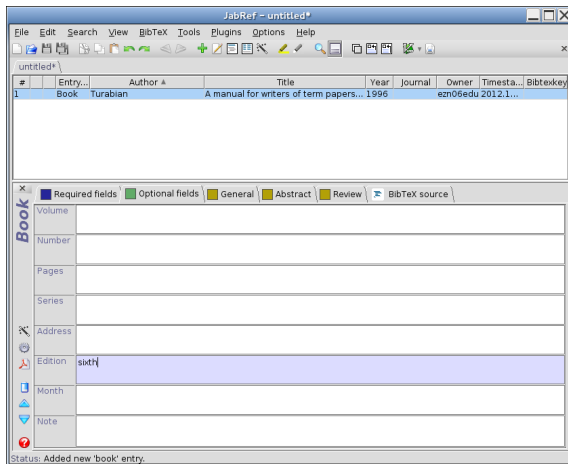


Figure 5.7 JabRef (Entering Optional Fields)

## 5 Generating a Bibliography

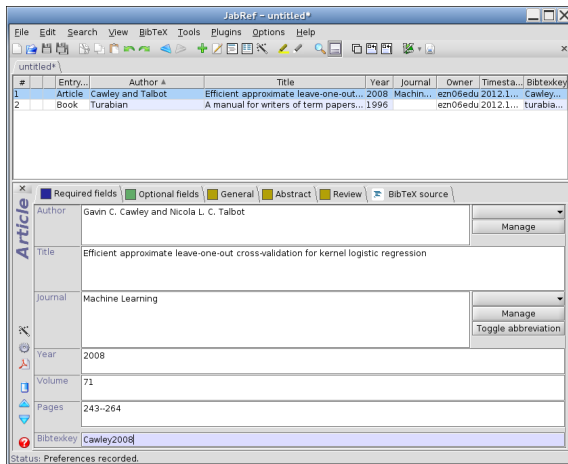


Figure 5.8 JabRef (Adding an Article)

**EXAMPLES:**

Entry	Abbreviated as
Alex Thomas von Neumann	A.T. von Neumann
John Chris {Smith Jones}	J.C. Smith Jones
van de Klee, Mary-Jane	M.-J. van de Klee
Smith, Jr, Fred John	F.J. Smith, Jr
Maria {\MakeUppercase{d}e La} Cruz	M. De La Cruz

Compare the last example with: Maria De La Cruz which would be abbreviated to: M. D. L. Cruz, which is incorrect. Let's analyse this last example in more detail: BibTeX always expects the "von" part to start with a lower case letter, but "De" and "La" both start with an upper case letter, so BibTeX will assume that these form part of the forenames. However, BibTeX will ignore any `\LaTeX` commands such as `\MakeUppercase` in `\MakeUppercase{d}e` since it assumes that the command is an accent command. So when it parses `\MakeUppercase{d}e` it will skip `\MakeUppercase` and look at the following letter. In this case it is "d" which is lower case, so from BibTeX's point of view the word `\MakeUppercase{d}e` starts with a lower case letter ("d"), so it is therefore the "von" part. You can either do the same with the "La" part, or, as in the above example, you can place it in the same group as `\MakeUppercase{d}e`.

Multiple authors should be separated by the keyword "and". **Don't use**

[FAQ: [Case-changing oddities](#)]

[FAQ: [Accents in bibliographies](#)]

**a comma to separate the authors.** Here is an example with three authors:

Gavin C. Cawley and Nicola L. C. Talbot and Mark Girolami

Input

If the author is an institution or company that happens to have the word “and” in its name, such as “Smith and Jones Inc”, then you need to group the “and” to indicate that you mean the word “and” rather than the keyword:

Smith {and} Jones Inc

Input

Figure 5.9 shows the entry for a paper in a conference proceedings, so for that one I used BibTeX→New entry and clicked on the “Inproceedings” button.

Notice the way I’ve written the title for this entry:

Sparse multinomial logistic regression via {Bayesian} {L1}  
regularisation

↑ Input

↓ Input

BibTeX automatically converts the title to lower case (apart from the initial letter) but here both “Bayesian” and “L1” should begin with a capital. I therefore need to enclose those words in braces to instruct BibTeX not to convert their case.

Multiple editors must also be separated by the “and” keyword, as shown in Figure 5.10. For that entry, the editors are listed as:

## 5 Generating a Bibliography

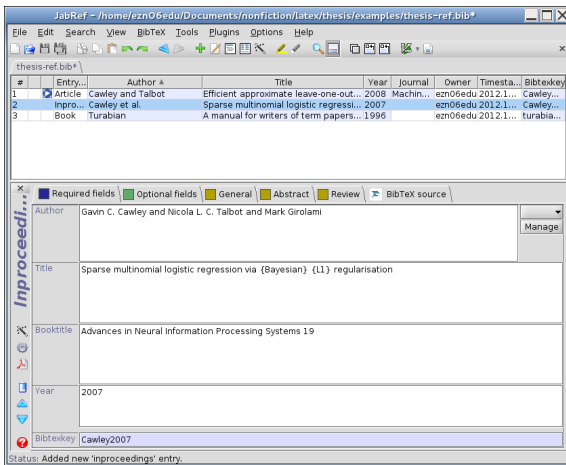


Figure 5.9 JabRef (Adding a Conference Paper)

## 5 Generating a Bibliography

Bernhard Schölkopf and John Platt and Thomas Hofmann

Input

Note that if I don't use the inputenc package, I need to change this to:

Bernhard Sch\{"o}lkopf and John Platt and Thomas Hofmann

Input

It's also possible to import entries from other formats, such as Copac or ISI, using File→Import into new database or file→Import into current database. Alternatively, you can copy and paste a plain text reference using BibTeX→New entry from plain text. This again opens the dialog box where you need to click on the entry type, but then it opens the "Plain text import" window.

### EXAMPLE:

Suppose I want to add an entry for an article whose DOI is 10.1007/s10994-008-5055-9. First, I direct my browser to <http://dx.doi.org/10.1007/s10994-008-5055-9>, which takes me to the article's web page. In this case, it's in a journal published by Springer, so my browser is redirected to the SpringerLink cite. There I can use the export as text only option, then copy and paste the reference into JabRef's import window, as shown in [Figure 5.11](#).

Next, I need to select text, for example an author's name, and select the appropriate field in the "Work options" list. Then click on the "Insert" button. For example, in [Figure 5.12](#) I have selected an author's name then I selected the "author" field in the "Work options" list.

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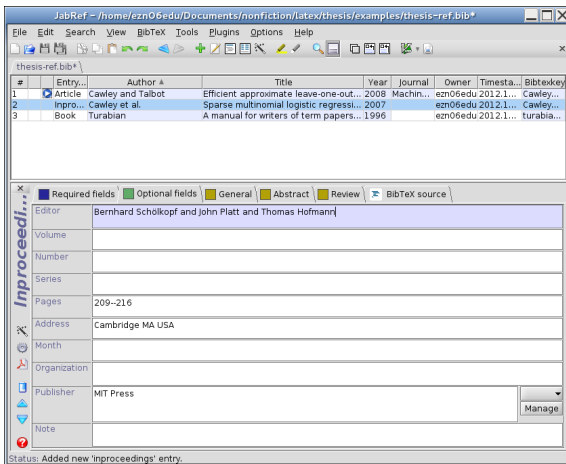


Figure 5.10 JabRef (Adding Editor List)

## 5 *Generating a Bibliography*

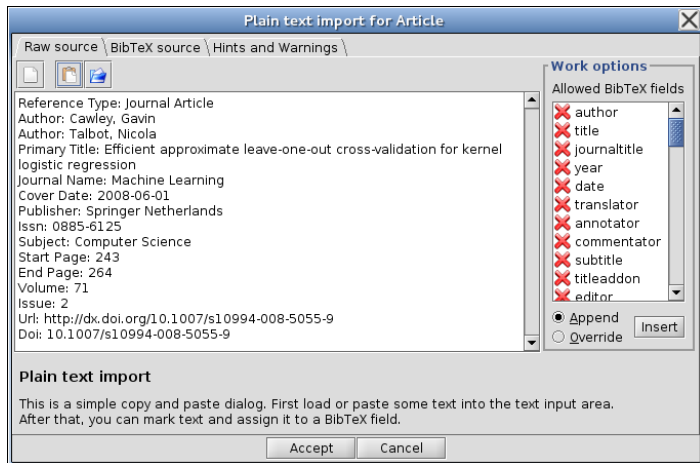


Figure 5.11 Importing a Plain Text Reference

## 5 Generating a Bibliography

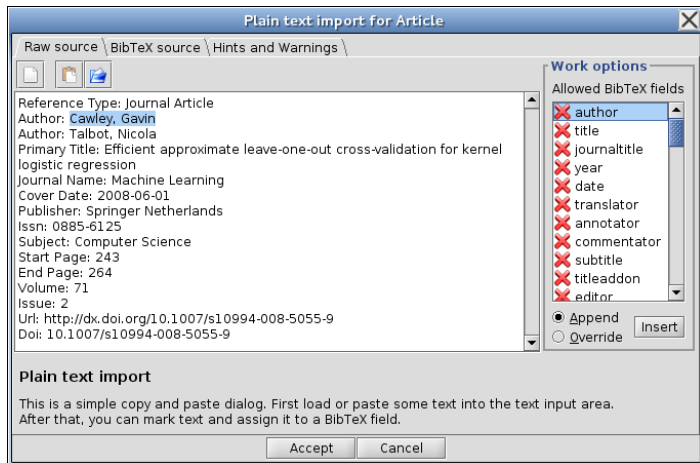


Figure 5.12 Importing a Plain Text Reference (Selecting a Field)

## 5 *Generating a Bibliography*

Next I clicked on the “Insert” button. Now the author’s name is highlighted in red and the author field has a tick next to it (see [Figure 5.13](#)). I can repeat this process for the next author. (Just make sure the “Append” rather than “Override” radio button is selected.)

I can repeat this for all the different fields. Each time, I select the text in the raw source panel, then select the appropriate field from the “Work options” list and then click “Insert”. Once I have finished, I then need to click “Accept”.

### 5.1.2 Writing the .bib File Manually

It may be that you don’t want to or can’t use a bibliography management application, such as [JabRef](#). In which case, you can create the .bib file in an ordinary text editor, such as the one you use to write your  $\text{\LaTeX}$  documents. When you save the file, make sure you give it the extension .bib. Entries in this file should have the following form:

[FAQ: [Creating a BibTeX bibliography](#)]

## 5 Generating a Bibliography

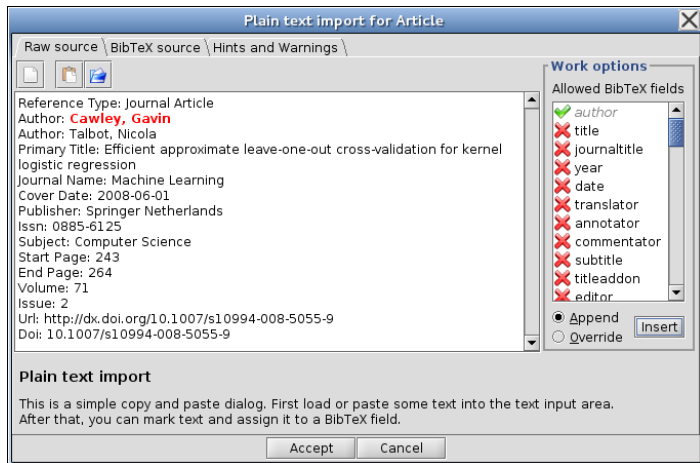


Figure 5.13 Importing a Plain Text Reference (Field Selected)

## 5 Generating a Bibliography

```
@<entry type>{<keyword>,  
  <field name> = "<text>",  
  :  
  <field name> = "<text>"  
}
```

where *<entry type>* indicates the type of entry (e.g. book or article). Standard entry types are listed in [Table 5.2](#).

Within an entry, *<keyword>* is a short label that is used to cite this work with the `\cite` command. If you have written bibliographies with the `thebibliography` environment, it's the same as the argument to `\bibitem`. There then follows a comma-separated list of fields of the form *<field name>* = *<value>*. The *<field name>* indicates what kind of field it is, e.g. title or author. [Table 5.3](#) lists the standard fields. Note that some bibliography styles may define additional non-standard fields, such as `email` or `url`. See the BibTeX documentation [\[11\]](#) for information about other fields not listed in [Table 5.3](#).

[FAQ: [URLS in BibTeX bibliographies](#)]

The required and optional fields for the standard entry types are listed in [Table 5.4](#). If an entry has a field that is neither required nor optional, BibTeX will ignore it. This means that you can have a field called, say,

Table 5.2 Standard BiBTeX entry types

Entry Name	Description
article	Article from a journal
book	Published book
booklet	Printed work without a publisher
conference	Identical to inproceedings
inbook	Part, chapter, section etc of a book
incollection	A chapter of a book with its own author and title
inproceedings	An article in a conference proceedings
manual	Technical documentation
mastersthesis	A master's thesis
misc	Non-standard work
phdthesis	PhD thesis
proceedings	Conference proceedings
techreport	Report published by an institution
unpublished	Unpublished work with an author and title

Table 5.3 Standard BiBTeX fields

address	Publisher/Institution's address
author	Author names
booktitle	Title of book where only a part of the book is being cited
chapter	Chapter or section number
edition	The edition of the book
howpublished	How a non-standard work was published
institution	The institute sponsoring the work
journal	The name of the journal
month	The month the work was published
note	Any additional information
number	The number of the journal, technical report etc
organization	Organization sponsoring conference or manual
pages	Page number or page range
publisher	Publisher's name
school	Academic institution where thesis was written
series	Name of a series
title	The title of the work
type	The type of technical report
volume	The volume number.

## 5 *Generating a Bibliography*

abstract, which will be ignored by the standard bibliography styles, but will be included if you use a bibliography style that has an abstract field. So you can store additional information in the database that won't appear in the bibliography.

Table 5.4 Required and Optional Fields

Entry Type	Required Fields	Optional Fields
article	author, title, journal, year	volume, month, note, number, pages
book	author or editor, title, publisher, year	address, edition, volume or number, month, note, pages, series
booklet	title	author, address, howpublished, month, note, year
inbook	author or editor, chapter or pages, title, publisher, year	address, edition, volume or number, month, note, series, type
incollection	author, title, booktitle, publisher, year	address, chapter, editor, edition, volume or number, month, note, pages, series, type
inproceedings	author, title, booktitle, year	address, editor, volume or number, month, note, organization, pages, publisher, series, type
manual	title	author, address, edition, month, note, organization, year
mastersthesis	author, title, school, year	address, month, note, type
misc	—	author, howpublished, month, note, title, year

### Required and Optional Fields Cont.

Entry Type	Required Fields	Optional Fields
phdthesis	author, title, school, year	address, month, note, type
proceedings	title, year	editor, organization, address, volume or number, series, month, publisher, note
techreport	author, title, institution, year	type, number, address, month, note
unpublished	author, title, note	month, year

## 5 Generating a Bibliography

The author and editor fields have the same format as described in [Section 5.1.1](#). That is, each name should be in one of the forms listed in [Table 5.1](#), and multiple authors or editors must be separated with the keyword “and”.

### EXAMPLE (MULTIPLE AUTHORS):

This example uses the book entry:

```
@book{goossens97,  
  author = "Goossens, Michel and Rahtz, Sebastian and  
           Mittelbach, Frank",  
  title = "The \LaTeX\ graphics companion: illustrating  
           documents with \TeX\ and {\PostScript}",  
  publisher = "Addison Wesley Longman, Inc",  
  year = 1997  
}
```

↑ Input

↓ Input

In this example, the  $\langle$ keyword $\rangle$  is goossens97. That is the identifying key used in [\cite](#), described [below](#). The standard bibliography styles usually convert titles to lower case, so the name PostScript is enclosed in curly braces to prevent this from happening.

## 5 Generating a Bibliography

Note that curly braces {} can be used instead of double quotes. The above example can just as easily be written:

```
@book{goossens97,  
  author = {Goossens, Michel and Rahtz, Sebastian and  
           Mittelbach, Frank},  
  title = {The \LaTeX\ graphics companion: illustrating  
           documents with \TeX\ and {PostScript}},  
  publisher = {Addison Wesley Longman, Inc},  
  year = 1997  
}
```

↑ Input

↓ Input

Numbers (such as the year 1997) don't need to be delimited with quotes or braces. So you can have

```
pages = 10
```

Input

but a page range would need to be delimited:

```
pages = "10--45"
```

Input

Bibliography styles always have three-letter abbreviations for months: jan, feb, mar, etc. These should be used instead of typing them in explicitly,

## 5 Generating a Bibliography

as their format depends on the bibliography style. These abbreviations should be entered without quotes. For example:

```
@inproceedings{talbot97,  
  author    = "Talbot, Nicola and Cawley, Gavin",  
  title     = "A fast index assignment algorithm for  
              robust vector quantisation of image data",  
  booktitle = "Proceedings of the I.E.E.E. International  
              Conference on Image Processing",  
  address   = "Santa Barbara, California, USA",  
  month     = oct,  
  year      = 1997  
}
```

↑ Input

↓ Input

### 5.2 BibTeX

Now that we've created a .bib file (as described [above](#)) we next need to look at how to incorporate the information in the database into a  $\text{\LaTeX}$

## 5 Generating a Bibliography

document. As mentioned in [Volume 1 \[15, §5.6\]](#), entries are cited in the document using:

```
\cite[⟨text⟩]{⟨key list⟩}
```

Definition

where  $\langle key\ list \rangle$  is a comma-separated list of keys. Each key uniquely identifies an entry in the database. If you used JabRef ([Section 5.1.1](#)), this is the key you entered in the “Bibtexkey” field. If you wrote the .bib file in a text editor ([Section 5.1.2](#)) it’s the  $\langle keyword \rangle$  bit at the start of the list of fields for the entry.

Next you need to specify what type of bibliography style you want to use. There are many available, but the basic ones are:

[FAQ: [Choosing a bibliography style](#)]

**abbrv** Entries sorted alphabetically with abbreviated first names, months and journal names.

**alpha** Entries sorted alphabetically with the citation represented by abbreviated author surname and year instead of a number.

**plain** Entries sorted alphabetically, with the citation represented by a number.

**unsrt** Entries sorted according to citation with the citation represented by a number.

## 5 Generating a Bibliography

The style is specified in your  $\text{\LaTeX}$  document with the command:

```
\bibliographystyle{<style>}
```

Definition

where  $\langle\textit{style}\rangle$  is the name of the style. Some people put this command in the document's preamble and some people put it near their bibliography, but wherever you choose to put it, this command should only be used once.

The actual bibliography itself is input into the document using

```
\bibliography{<database>}
```

Definition

where  $\langle\textit{database}\rangle$  is the name of the database *without the .bib extension*. In fact, this argument can be a comma-separated list of databases if your entries are stored across multiple files.

Recall the example thesis in [Listing 1](#) ended with:

```
% The bibliography will go here
```

```
\end{document}
```

↑ Input

↓ Input

## 5 Generating a Bibliography

If my references are stored in the file `thesis-ref.bib`, then I can replace the above comment as follows:

### Listing 15

```
\bibliographystyle{plain}  
\bibliography{thesis-ref}  
  
\end{document}
```

↑ Input

↓ Input

Elsewhere in my document I need some citations. For example:

```
See Turabian~\cite{turabian96} for a comprehensive guide on  
preparing a thesis.
```

↑ Input

↓ Input

If you are using `arara` (see [Section 1.1.2](#)) you need the following lines in your source code:

↑ Input

## 5 Generating a Bibliography

```
% arara: pdflatex: { synctex: on }  
% arara: bibtex  
% arara: pdflatex: { synctex: on }  
% arara: pdflatex: { synctex: on }
```

↓ Input

If you are using `latexmk` (see [Section 1.1.1](#)) make sure you are using the `-bibtex` argument ([Figure 1.5](#)).

If you are not using either `latexmk` or `arara`, you will need to run `PDFLATEX`, then run `BibTEX`, then run `PDFLATEX` twice more (see [Section 1.1](#)).

If your citations appear as two question marks ?? in your PDF, then the citation key you used hasn't been recognised. This could be that you've forgotten the `BibTEX` and subsequent *two* `PDFLATEX` calls, or it could be that the key hasn't been defined, or you have misspelt it.

Recall from [Volume 1](#) [[15](#), §5.6] that the bibliography doesn't usually get added to the table of contents for most class files, but the KOMA-Script classes provide the options `bibliography=totocnumbered` and `bibliography=totoc`, that add a numbered or unnumbered bibliography to the table of contents.

You can add backlinks from your bibliography back to the section or page where the entries were cited using the `backref` option of the `hyperref`

## 5 Generating a Bibliography

package. (The hyperref package should usually be loaded last.) For example, to have backreferences to the pages on which the citation occurs:

```
\usepackage[backref]{hyperref}
```

Input

The hyperref package is covered in more detail in [Volume 4](#) [14].

### 5.2.1 Author–Year Citations

The default behaviour of citations with bibliography styles such as plain is to produce a numerical reference in square brackets. If you're using bibtex (rather than biblatex, described [below](#)) you can override this using a number of packages. One such package is natbib. This comes with some drop-in replacements for the standard bibliography styles: plainnat, unsrnat and abbrvnat. The natbib package comes with a variety of package options, but I'm just going to mention a few of them: `authoryear` for author–year citations (default), `numbers` for numerical citations, `super` for superscripted numerical citations, `round` for round parentheses, `square` for square parentheses and `sort&compress` which sorts multiple citations and compresses consecutive numbers into a range. For example, [4,2,8,3] will become [2–4,8].

So for citations that give the author and year rather than a number, you need to load natbib in the preamble:

## 5 Generating a Bibliography

`\usepackage[round]{natbib}`

Input

and specify one of the natbib bibliography styles:

`\bibliographystyle{plainnat}`

Input

There are two main replacements for `\cite`:

`\citet[⟨pre⟩][⟨post⟩]{⟨key⟩}`

Definition

for textual citations and

`\citep[⟨pre⟩][⟨post⟩]{⟨key⟩}`

Definition

for parenthetical citations.

Unlike `\cite`, these commands have two optional arguments. The second `⟨post⟩` is a suffix, the same as `\cite`'s only optional argument. The first optional argument `⟨pre⟩` is a prefix. If only one optional argument is present, it is assumed to be `⟨post⟩`, so if you only want a prefix and no suffix, you have to specify an empty argument for `⟨post⟩`.

### EXAMPLE:

(Using the same `thesis-ref.bib` database as earlier.)

### Listing 16

A textual citation `\citet{turabian96}` and a parenthetical citation `\citep[see][Chapter 9]{goossens97}`.

↑ Input

↓ Input

Result:

A textual citation Turabian (1996) and a parenthetical citation (see Goossens et al., 1997, Chapter 9).

↑ Output

↓ Output

### 5.2.2 Troubleshooting

- `BIBTEX` writes the `thebibliography` environment to a `.bbl` file, which is then input into the document by `\bibliography`. If you have made a `LATEX` error in the `.bib` file, this error will be copied to the `.bbl` file. If you have corrected the error in the `.bib` file, but you are still getting an error when you `LATEX` your document, try deleting the `.bbl` file. (In `TeXworks`, you can use the menu item `File`→`Remove Aux Files`.)

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- Remember to use double quotes or braces to delimit the field names in your .bib file.
- Remember to put a comma at the end of each field entry (except the last).
- It is better to only use alphanumerical characters in the keywords. Some punctuation characters such as . (full stop) should be fine (unless you're using a package such as babel that makes them active), but spaces are not recommended, and commas should definitely be avoided.
- If you have entered a field in the .bib file, but it doesn't appear in the bibliography, check to make sure that the field is required or optional for that type of entry, and check the spelling. (You can avoid this problem by using a bibliography management system such as [JabRef](#).)
- Check the BibTeX log file (.blg) for messages.
- If you get an error that looks something like:

ERROR - Cannot find control file 'thesis-ref.bcf'! - did you pass the "backend=biber" option to BibLaTeX?

then you have inadvertently used `biber` (see [below](#)) instead of `bibtex`.

- If you get an error that looks something like:

```
I found no \citation commands---while reading file thesis1.aux
I found no \bibdata command---while reading file thesis1.aux
I found no \bibstyle command---while reading file thesis1.aux
```

then you probably forgot to use the `\bibliography` and `\bibliographystyle` commands in your document.

### 5.3 Biblatex

The `biblatex` package is a reimplementaion of  $\text{\LaTeX}$ 's bibliographic facilities. The formatting of the bibliography is governed by  $\text{\LaTeX}$  commands instead of selecting a BibTeX style (as was done with `\bibliographystyle` described [above](#)). This package uses `biber` instead of BibTeX to process the bibliographic database and sort the entries. Legacy BibTeX is also supported, but with a reduced feature set. The `biblatex` package also supports multiple bibliographies, for example a bibliography for each chapter in the document. The `biblatex` package requires  $\text{e-TeX}$ , so make sure you have a recent  $\text{\TeX}$  distribution. Biber comes with the latest version of  $\text{\TeX}$  Live.

## 5 Generating a Bibliography

If you are using JabRef (described in [Section 5.1.1](#)) there is a BibLaTeX mode option in the Advanced tab of the JabRef preferences dialog, illustrated in [Figure 5.14](#). (Use Options→Preferences to open the dialog.) You will have to quit and restart JabRef after enabling this option. When you restart, you should find extra fields when you edit an entry or create a new entry, as illustrated in [Figure 5.15](#). You should also find that there are more entry types available (see [Figure 5.16](#)).

With BibTeX, there was a month and year field. BibLaTeX provides a replacement date field, although if this field is missing it will fall back on the month and year fields. In [Figure 5.17](#), I've edited my earlier example to use the new date field. Note that the date should be specified as `<year>-<month>-<day>` where `-<day>` or `-<month>-<day>` maybe omitted. A slash `/` should be used to indicate a range, for example `2002-01/2002-02`.

Recall from [Figure 5.2](#) and [Figure 5.3](#) that I set the default encoding to UTF-8. With BibLaTeX and biber, my UTF-8 bibliography can be correctly sorted, but I need to make sure that I load the inputenc package before biblatex in my document:

```
\usepackage[utf8]{inputenc}  
\usepackage{biblatex}
```

↑ Input

↓ Input

## 5 Generating a Bibliography

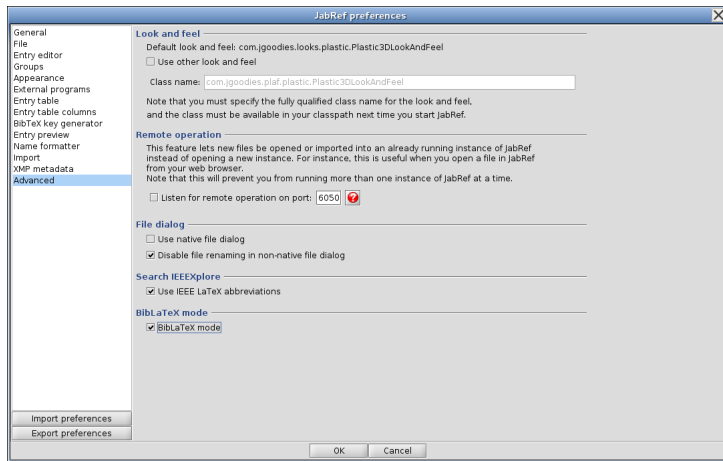


Figure 5.14 JabRef Advanced Preferences

## 5 Generating a Bibliography

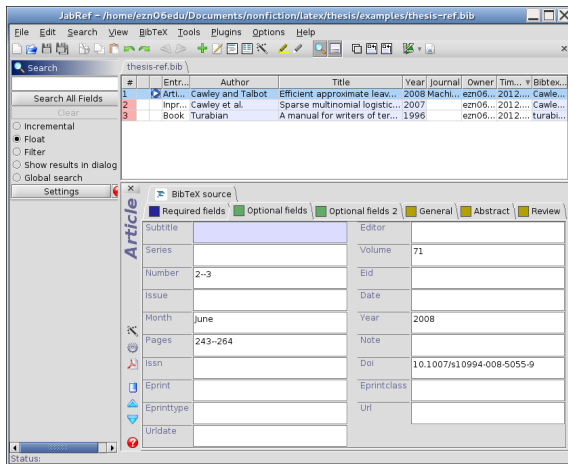


Figure 5.15 JabRef in BibLaTeX Mode

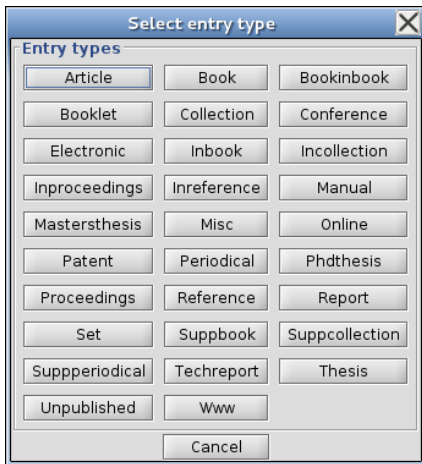


Figure 5.16 JabRef in BibLaTeX Mode (Select Entry Type)

## 5 Generating a Bibliography

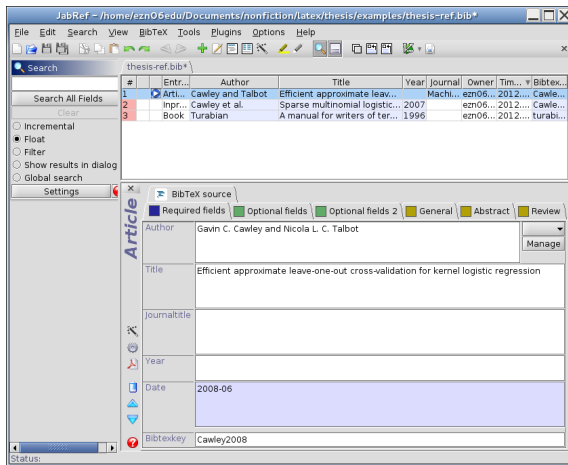


Figure 5.17 JabRef in BibLaTeX Mode (Setting the Publication Date)

## 5 Generating a Bibliography

Section 5.2.1 described the natbib package. BibLaTeX has a compatibility module:

```
\usepackage[natbib]{biblatex}
```

Input

This provides the same commands (such as `\citet` and `\citep`) that natbib provides.

The default sorting order is name, title and year. This can be changed using the `sorting` package option. For example, to sort by name, year and title:

```
\usepackage[sorting=nyt]{biblatex}
```

Input

Or you can suppress the sorting, so that all entries are in citation order:

```
\usepackage[sorting=none]{biblatex}
```

Input

For other possible values, see the biblatex documentation [9].

If you want a list of back-references in the bibliography, referring to the pages on which the entries were cited, you can use the `backref` option:

```
\usepackage[backref]{biblatex}
```

Input

The default database backend is biber, which is recommended, but if for some reason you want to stick to using bibtex you can use the `backend` option to switch to bibtex:

## 5 Generating a Bibliography

```
\usepackage[backend=bibtex]{biblatex}
```

Input

There are also options that govern whether certain fields are printed in the bibliography, such as `isbn`, `url` or `doi`. For example:

```
\usepackage[isbn,url,doi]{biblatex}
```

Input

The style can be set using the `style` option. The default is `numeric`, which produces a numeric citation, such as [1]. There is also `numeric-comp`, which is like `natbib`'s `sort&compress` option, described in [Section 5.2.1](#), or `authoryear` which displays *author* *year* citations.

There are many other citation styles. For these and for other package options, see the `biblatex` documentation [9].

With BibLaTeX, you don't use the `\bibliography` command, described in [Section 5.2](#). Instead, you add the bib file as a resource *in the preamble* using:

```
\addbibresource[⟨options⟩]{⟨resource⟩}
```

Definition

where *⟨resource⟩* is the name of the bib file *including the file extension*. However, the resource doesn't have to be a bib file. You can only add one resource at a time:

```
\addbibresource{bibfile1.bib}  
\addbibresource{bibfile2.bib}
```

↑ Input

↓ Input

The resource can be a remote one, in which case you need to use the `location` option with the value `remote` and specify the URL:

```
\addbibresource[location=remote]  
{http://www.somewhere.com/bibfile2.bib}
```

↑ Input

↓ Input

This is only available if you use `biber` as the backend. Another option is `datatype` which specifies the format of the resource. The default is `bibtex`, but it can also be `ris`, `zoterordfxm` or `endnotexml`. See the `biblatex` and `biber` documentation [7] for further details.

The bibliography itself is displayed using

```
\printbibliography[options]
```

Definition

This should go in the document where you want the bibliography to be displayed.

Like the `natbib` commands described in [Section 5.2.1](#), the `biblatex` commands generally have two optional arguments, indicating the prenote and

## 5 Generating a Bibliography

postnote, and a mandatory argument specifying the key or a comma-separated list of keys. If you want a prenote but not a postnote, you need to give an empty second optional argument. The basic commands are:

```
\cite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}  
\Cite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}
```

Definition

These are bare citation commands. The latter is provided if the citation occurs at the start of a sentence.

```
\parencite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}  
\Parencite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}
```

Definition

These commands are like `\cite` and `\Cite` but enclose the citation in parentheses (square if the numeric style is used).

```
\textcite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}  
\Textcite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}
```

Definition

These commands are used for citations in the flow of text. The latter is provided if the citation occurs at the start of a sentence. For other citation commands, see the biblatex documentation [9].

## 5 Generating a Bibliography

So, the example document from [Listing 1](#), can now be edited so that the preamble looks like:

### Listing 17

```
% arara: pdflatex: { synctex: on }
% arara: biber
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass[oneside]{scrbook}

\usepackage[backend=biber]{biblatex}

\addbibresource{thesis-refs.bib}
```

(where `thesis-refs.bib` is the name of my bibliography database, see [Section 5.1](#)) and the end of the document looks like:

```
\printbibliography

\end{document}
```

↓ Input

Elsewhere in the document, I need to cite some of the entries in my bibliography database:

↑ Input

```
First of all, let's cite a book~\parencite{wainwright93} now  
let's cite a journal paper and a conference  
proceedings~\parencite{cawley96,talbot97}. Finally, let's cite  
a chapter in a book~\parencite[Chapter 9]{goossens97}.
```

↓ Input

If you want to build the document using arara ([Section 1.1.2](#)) remember to include the `% arara:` comments (as shown above). If you are using latexmk ([Section 1.1.1](#)) remember to use the `-bibtex` option as illustrated in [Figure 1.5](#).

If you're not using an automated method, such as arara or latexmk, you need a PDF $\LaTeX$  run, a biber run (or bibtex if you've chosen that as your backend) followed by two more PDF $\LaTeX$  runs.

### 5.3.1 Troubleshooting

Most of the comments from the [BibTeX troubleshooting section](#) also apply here. If you get an error that looks like:

```
I found no \citation commands---while reading file thesis-biblatex.aux
I found no \bibdata command---while reading file thesis-biblatex.aux
I found no \bibstyle command---while reading file thesis-biblatex.aux
```

then you have inadvertently used bibtex instead of biber. If you actually want to use bibtex with the biblatex package remember that you have to specify bibtex using:

```
\usepackage[backend=bibtex]{biblatex}
```

Input

## 6. GENERATING INDEXES AND GLOSSARIES

Most theses will need a glossary of terms or a list of acronyms or notation. It's less likely that you'll need an index in your thesis, but since the same mechanism is used to generate glossaries and indexes, both topics are covered in this chapter. There are two basic methods of generating a glossary or index:

1. The glossary or indexing information is written to a temporary file by  $\text{\LaTeX}$  while the document is being built. An external application is then used to collate and sort the entries defined in that temporary file and  $\text{\LaTeX}$  code to display the result is written to another file. You then need to run (PDF) $\text{\LaTeX}$  on your document to ensure the sorted and collated glossary or index is displayed. (You may then need an additional  $\text{\LaTeX}$  run to ensure the table of contents is up-to-date.) This is similar to the way you had to use `bibtex` or `biber` between LaTeX runs in the [previous chapter](#).
2. The glossary or indexing information is collated and sorted by  $\text{\LaTeX}$

during the document build. (At least two runs are required, but no external indexing application is needed.)

The first approach (see [Section 6.1](#)) is more efficient, but a lot of users, especially beginners, have difficulty with the intermediate step where the external indexing application is run. The second approach (see [Section 6.2](#)) is slower, but you don't need to worry about running an indexing application. If you're not writing in English (in particular if you are not using the Latin alphabet) you're better off using the first approach with xindy. In this chapter I'll describe both approaches and you can choose which you prefer.

### 6.1 Using an External Indexing Application

This section describes how to create indexes ([Section 6.1.1](#)) or glossaries ([Section 6.1.2](#)) using an external indexing application. There are two popular indexing applications: `makeindex` and `xindy`. All  $\text{\TeX}$  distributions should come with `makeindex`. The  $\text{\TeX}$  Live distribution also comes with `xindy`, but if you have a different  $\text{\TeX}$  distribution (such as MikTeX) you may need to fetch `xindy` from <http://www.xindy.org/>.

### NOTE:

You must have Perl installed in order to use xindy as it's a Perl script. (See §2.20 from Volume 1.) If you have successfully been using `latexmk`, you already have Perl installed.

### 6.1.1 Creating an Index (makeidx package)

Volume 1 [15, §8] introduced the command:

`\index{<text>}`

Definition

to index the word given in `<text>`. For example, if `\index{circuit}` occurs on page 42, then “42” will be added to the *location list* for the term “circuit”.

### NOTE:

`\index` doesn't display any text. It just adds a line to the index file with the information required by `makeindex` or `xindy` to sort and collate the information.



The default action of `\index` simply ignores its argument. To ensure the indexing mechanism works, you must activate it by placing

`\makeindex`

Definition

## 6 Generating Indexes and Glossaries

in the document preamble.

Finally, you need to use

`\printindex`

Definition

(defined in the `makeidx` package) to display the index.

### NOTE:

`\printindex` won't produce any text until you have run the external indexing application.

Here's an example document:



#### Listing 18

↑ Input

```
% arara: pdflatex: { synctex: on }
% arara: makeindex
% arara: pdflatex: { synctex: on }
\documentclass[12pt,oneside]{scrbook}

\usepackage{makeidx}

\makeindex
```

## 6 Generating Indexes and Glossaries

```
\title{Sample Document}
```

```
\author{Me}
```

```
\begin{document}
```

```
\maketitle
```

```
\chapter{Sample}
```

Stuff about eigenvectors\index{eigenvector} and  
eigenvalues\index{eigenvalue}.

```
\chapter{Another Sample}
```

Some more stuff about eigenvectors\index{eigenvector} and  
eigenvalues\index{eigenvalue}. Something about  
eigen-decomposition\index{eigen-decomposition}.

```
\backmatter
```

```
\printindex
```

```
\end{document}
```

If you are using `arara` to build your document (see [Section 1.1.2](#)), remember to include the `% arara:` comments, as shown in the above listing. If you are using `latexmk` to build your document, remember to include the `.idx` custom dependency to your RC file, as described in [Section 1.1.1](#).

If you aren't using an automated method to build your document, you will need to run `PDFLATEX`, then run `makeindex`, and then run `PDFLATEX` again (see [Section 1.1](#)).

If you prefer to use `xindy` instead of `makeindex`, you need to run `texindy` (a `xindy` wrapper customised for `LATEX` documents). If you are using `arara`, change the line:

```
% arara: makeindex
```

to (change the language as required):

```
% arara: texindy: { language: english }
```

(Make sure you have added the `texindy` rule as described in [Section 1.1.2](#).) If you are using `latexmk` to build your document, you will need to change the custom dependency for `.idx` files, as described in [Section 1.1.1](#).

**Overriding the Default Sort**

By default the index entry will be sorted according to the word being indexed. However, you can override this by writing the argument of `\index` in the form:

$$\langle sort \rangle @ \langle word \rangle$$

Definition

where  $\langle sort \rangle$  is how to sort the term and  $\langle word \rangle$  is how the term should appear in the index.

The `makeindex` application doesn't understand  $\LaTeX$  commands. It simply sorts the term as is. So, for example, if you do

```
\index{\AE olian}
```

Input

then `makeindex` will sort it according to the characters `\`, A, E, `_` (space), o, l, i, a, n. Since `makeindex` sorts symbols (such as `\`) before letters, it will put `\AE_ollian` before, say, `adze`, since `\` comes before “a”.

To get around this, you need to specify the sort key:

```
\index{AEolian@AE olian}
```

Input

Now `makeindex` will put “Æolian” after “adze”. Here's another example that indexes a function or method:

```
\index{sqrt()@{\texttt{sqrt()}}}
```

Input

You will also need to do something similar if you are entering the character directly via the inputenc package:

```
\index{elite@      }
```

Input

Note, however, that you don't need to do this if you are using xindy. You just need to make sure you match the input encoding. For example:

```
% arara: pdflatex: { synctex: on }
% arara: texindy: { language: english, codepage: latin1}
% arara: pdflatex: { synctex: on }
\documentclass[12pt,oneside]{scrbook}

\usepackage[latin1]{inputenc}
\usepackage{makeidx}
```

↑ Input

↓ Input

Later in the document:

```
\index{      }
```

Input

### Setting the Location Format

Each index entry has an associated *location list* that directs the reader to the pages in the document associated with that entry. For example, if you look up `\index` in this book's [index](#), the entry's location list will include this page. If the location list is long, it's helpful to highlight a particular location to direct the reader to the principle definition or discussion related to that term. This is usually done by formatting the relevant location in a different font, for example bold or italic.

You can specify the format for the location by writing the argument of `\index` in the form:

`<word>|<format>`

Definition

where `<format>` is the name of a text-block command *without* the leading backslash. For example:

`\index{eigenvector|textbf}`

Input

You can combine `@` and `|`. For example:

`\index{sqrt()@<texttt{sqrt()}>|textbf}`

Input

### NOTE:



Make sure the format you use is the name of a command that takes an argument. While it won't cause an error to use, say, `bfseries` instead of `textbf`, it will cause the unexpected side-effect of rendering the rest of your index in that font, instead of just that particular location.

You can also use `\format` to cross-reference another entry. If you have an entry that's just a synonym for another entry, you can use:

```
\word|see{\name}
```

Definition

where `\name` is the other entry. If you want to direct the reader to a similar topic, you can use:

```
\word|seealso{\topic}
```

Definition

where `\topic` is the other entry.

For example:

```
\index{eigenvector|seealso{eigenvalue}}
```

Input

### Sub Levels

An entry in the index may have sub-items. With `makeindex` you can have a maximum of three levels. With `xindy` you can have an arbitrary number of levels. However, it's a good idea to consider the advice in the Oxford Style Manual [12]: "In all but the most complex indexes, subentries within subentries (*sub-subentries*) should be avoided." In other words, just because it's possible to do something doesn't mean you should do it.

To indicate a subentry, the argument of `\index` should be in the form:

`<main entry>!<subentry>`

Definition

For example:

```
\index{reptile!caiman}
```

Input

If you really must have a sub-subentry:

```
\index{reptile!crocodilian!caiman}
```

Input

You can combine `@`, `|` and `!`. For example:

```
\index{methods!sqrt()@ \texttt{sqrt()}}|textbf}
```

Input

[Listing 17](#) can now be modified as follows (download the document for the complete code):

## Listing 19

[↑ Input](#)

```
% In the preamble:
% arara: pdflatex: { synctex: on }
% arara: biber
% arara: makeindex
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass[oneside,12pt]{scrbook}
```

```
\usepackage{makeidx}
\makeindex
```

```
% Later in the document:
```

Some sample code is shown in Listing~\ref{lst:sample}.

This uses the function `\linline"sqrt()"`

```
\index{sqrt()@ \texttt{sqrt()}}%
\index{functions!sqrt()@ \texttt{sqrt()}}%
\index{square root|see{\texttt{sqrt()}}}.
```

```
\begin{Definition}[Tautology]
```

## 6 Generating Indexes and Glossaries

A `\emph{tautology}\index{tautology|textbf}` is a proposition that is always true for any value of its variables.

`\end{Definition}`

`\begin{Definition}[Contradiction]`

A `\emph{contradiction}\index{contradiction|textbf}` is a proposition that is always false for any value of its variables.

`\end{Definition}`

% At the end of the document:

`\printbibliography`

`\printindex`

`\end{document}`

[↓ Input](#)

The index for the above document looks like:

contradiction, 2

↑ Output

functions

`sqrt()`, 2

`sqrt()`, 2

square root,

    see `sqrt()`

tautology, 2

↓ Output

### Troubleshooting

- My index hasn't appeared.
  1. Make sure you have the command `\printindex` at the place where you want the index to appear (this command is defined in the `makeidx` package).
  2. Make sure you have the command `\makeindex` in the preamble.

3. If you are building the document using arara make sure you included all the `% arara:` directives as shown in Listing 19. If you are using latexmk, make sure you have included the `.idx` dependency, as described in Section 1.1.1. If you're not using an automated tool, make sure you run (PDF)TEX, then `makeindex` and then (PDF)TEX again (see Section 1.1).
  4. Check `makeindex`'s log file (which has the extension `.ilg` by default) for error messages.
- I want to index the character `"`, `@`, `!` or `|` but it's not working.  
If you want any of these symbols in your index, you will need to prefix the character with the double-quote symbol `"`. For example to index the `@` symbol:

```
\index{"@}
```

Input

- I have multiple entries of the same item. For example:

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identity matrix, 10, 22–30

identity matrix, 4

Check to make sure the sort argument to each of the corresponding `\index` commands is the same. Pay particular attention to spaces as `makeindex` will treat the following entries differently:

```
\index{identity_matrix}  
\index{identity__matrix}
```

↑ Input

↓ Input

TeX however treats multiple spaces the same as a single space, so the text will appear the same in the index.

- TeX says that the command `\printindex` is undefined.  
You have forgotten to load the `makeidx` package.

### 6.1.2 Creating Glossaries, Lists of Symbols or Acronyms (glossaries package)

There are a number of packages available to assist producing a list of acronyms (such as the acronym package) or a glossary (such as the nomencl package). You can see a list of available packages in the [OnLine T<sub>E</sub>X Catalogue's Topic Index](#) [3]. Here, I've chosen to describe the glossaries package. Firstly, it encompasses the functionality of both acronym and nomencl as glossaries allows you to define multiple lists of acronyms, lists of symbols or glossaries. Secondly, I wrote the glossaries package, so it's the one with which I am most familiar.

The glossaries package is very flexible, but the downside to that is that it has too many features to cover briefly. I'm therefore only going to introduce the basics here. If you want more detail you'll have to read the user manual [16]. I will use the term “glossary” to mean a list of terms or a list of notation or a list of symbols or a list of acronyms.

#### NOTE:

If you want to use both glossaries and hyperref, you must load hyperref *before* glossaries. This is an exception to the usual advice of loading hyperref last.



### Defining Glossary Entries

Firstly, in order to make the glossary (or glossaries, if you have more than one) appear, you must use the command

`\makeglossaries`

Definition

in the preamble. This is analogous to the `\makeindex` command described in [Section 6.1.1](#).

Next you need to define the terms you want to appear in the glossary. This is done using the command:

`\newglossaryentry{<label>}{<key-val list>}`

Definition

The first argument `<label>` is a unique label so that you can refer to this entry in your document text. The entry will only appear in the glossary if you have referenced it in the document using one of the commands listed later. The second argument is a comma-separated list of `<key>=<value>` options. Common keys are:

- `name`

The name of the entry (as it will appear in the glossary).

## 6 *Generating Indexes and Glossaries*

- **description**

A brief description of this entry (to appear in the glossary).

- **text**

How this entry will appear in the document text where the singular form is required. If this key is omitted the value of `name` will be used.

- **first**

How this entry will appear in the document text the first time it is used, where the first use requires the singular form. If this key is omitted the value of `text` is used.

- **plural**

How this entry will appear in the document text where the plural form is required. If this key is omitted, the value is obtained by appending the letter “s” to the value of the `text` key.

- **firstplural**

How this entry will appear in the document text the first time it is used, where the first use requires the plural form. If this field

is omitted, the value is obtained by appending the letter “s” to the value of the first key.

- symbol

This key is provided to allow the user to specify an associated symbol, but most glossary styles ignore this value.

- sort

This value indicates how to sort this entry (analogous to using the @ character in the argument of `\index`, as described in [Section 6.1.1](#)). If this key is omitted the value of name is used.

- type

This is the glossary type to which this entry belongs (see [Section 6.1.2](#)). If omitted the main (default) glossary is assumed.

### **EXAMPLES:**

The following defines the term “set” and assigns a brief description. The term is given the label set. This is the minimum amount of information you must give:

```
\newglossaryentry{set}% the label
{%
  name={set},% the term
  description={a collection of objects}% a brief description
}
```

[↑ Input](#)[↓ Input](#)

The following entry also has an associated symbol:

```
\newglossaryentry{U}% the label
{%
  name={universal set},% the term
  description={the set of all things},% a brief description
  symbol={\ensuremath{\mathcal{U}}}% the associate symbol
}
```

[↑ Input](#)[↓ Input](#)

The plural of the word “matrix” is “matrices” not “matrixs”, so the term needs the plural form set explicitly:

```
\newglossaryentry{matrix}% the label
{name={matrix},% the term
 description={a rectangular table of elements},% brief description
 plural={matrices}% the plural
}
```

↑ Input

↓ Input

The glossaries package also provides the shortcut command:

```
\newacronym[⟨key-val list⟩]{⟨label⟩}{⟨abbrv⟩}{⟨long⟩}
```

Definition

The default behaviour of this command is equivalent to:

```
\newglossaryentry{⟨label⟩}{name={⟨abbrv⟩},description={⟨long⟩},
text={⟨abbrv⟩},first={⟨long⟩}
(⟨abbrv⟩)},plural={⟨abbrv⟩s},firstplural={⟨long⟩s
(⟨abbrv⟩s)},⟨key-val list⟩}
```

↑ Input

↓ Input

### EXAMPLE:

```
\newacronym{svm}{SVM}{support vector machine}
```

↑ Input

is equivalent to

```
\newglossaryentry{svm}% the label
{%
  name={SVM},%
  description={support vector machine},%
  first={support vector machine (SVM)},%
  firstplural={support vector machines (SVMs)},%
  text={SVM},%
  plural={SVMs}%
}
```

↑ Input

↓ Input

There are some package options that modify the behaviour of `\newacronym`. For example, the package option `description` changes `\newacronym` so that you need to explicitly set the description in the optional argument. For example:

```
\usepackage[description]{glossaries}
```

↑ Input

```
\newacronym[description={a statistical pattern recognition  
technique}]{svm}{SVM}{support vector machine}
```

↓ Input

Another package option is `footnote` which will modify the behaviour of `\newacronym` so that the long form is displayed as a footnote on first use. For a full list of available options, see the glossaries documentation [16].

## Displaying Terms in the Document

Any glossary term that has been defined using `\newglossaryentry` or `\newacronym`, as described above, can be displayed in the document using one of the commands described in this section. (There are other less commonly used commands available as well, see the glossaries documentation [16] for details of them.)

Each term has an associated *first use flag*. This is a boolean (true/false) switch that determines whether or not the entry has been used. This is how the glossaries package determines whether to display the value of the first key or to display the value of the text key. You can reset this flag using:

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`\glsreset{<label>}`

Definition

Conversely, you can unset it using:

`\glsunset{<label>}`

Definition

To display a term that has previously been defined using either `\newglossaryentry` or `\newacronym` you can use one of the following commands:

`\gls[<options>]{<label>}[<insert>]`

Definition

`\glspl[<options>]{<label>}[<insert>]`

Definition

`\Gls[<options>]{<label>}[<insert>]`

Definition

`\Glspl[<options>]{<label>}[<insert>]`

Definition

These commands all have the same syntax: `<label>` is the label that uniquely identifies the term (as supplied in `\newglossaryentry` or `\newacronym`),

`<insert>` is additional text to insert after the term (but inside the hyperlink, if used with the `hyperref` package), and `<options>` is a `<key>=<value>` list of options. Available options are:

- `format`

This specifies how to format the associated location for this entry. It is analogous to the `|` special character used in `\index` (see [Section 6.1.1](#)). As with `\index`, the format must not include the initial backslash. For example, `format=textbf` indicates that the location should be displayed in bold. (If you are using the `hyperref` package, you should use the `hyper<xx>` formats instead, such as `hyperbf`, see the glossaries documentation [16] for further detail.)

- `counter`

This specifies which counter to use for the associated location in the glossary. This is usually the page number, but can be changed to, say, the section in which the term is used.

- `hyper`

This is a boolean key which can be used to enable/disable the hyperlink to the relevant entry in the glossary. Note that setting `hyper=true` will only have an effect if hyperlinks are supported

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(through loading the `hyperref` package before loading the `glossaries` package). The above commands all have starred versions that are a shortcut for `hyper=false`. For example `\gls*{svm}` is equivalent to `\gls[hyper=false]{svm}`.

The above commands `\gls` and `\Gls` will display the value of the first or text key, depending on whether or not the entry has already been used. Similarly, `\glspl` and `\Glspl` will display the value of the firstplural or plural key, depending on whether or not the entry has already been used. The upper case forms, `\Gls` and `\Glspl`, will capitalise the first letter.

### EXAMPLE:

Suppose I have defined the following entry:

```
\newglossaryentry{matrix}% the label
{name={matrix},% the term
description={a rectangular table of elements},% brief description
plural={matrices}% the plural
}
```

↑ Input

↓ Input

Then (later in the document)

`\Glspl{matrix}` are usually denoted by a bold capital letter, such as `\mathbf{A}`. The `\gls{matrix}[‘s] $(i,j)$th` element is usually denoted `$a_{ij}`. `\Gls{matrix} $\mathbf{I}$` is the identity `\gls{matrix}`.

↑ Input

↓ Input

will display:

Matrices are usually denoted by a bold capital letter, such as **A**. The matrix's  $(i, j)$ th element is usually denoted  $a_{ij}$ . Matrix **I** is the identity matrix.

↑ Output

↓ Output

If you have used the symbol key when you defined a term, you can access its value with:

`\glsymbol[⟨options⟩]{⟨label⟩}[⟨insert⟩]`

Definition

This has the same syntax as commands like `\gls` but it doesn't affect or query the first use flag.

Terms that have been defined using `\newacronym` can also be referenced using the commands:

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`\acrshort[⟨options⟩]{⟨label⟩}[⟨insert⟩]`  
`\Acrshort[⟨options⟩]{⟨label⟩}[⟨insert⟩]`

Definition

`\acrlong[⟨options⟩]{⟨label⟩}[⟨insert⟩]`  
`\Acrlong[⟨options⟩]{⟨label⟩}[⟨insert⟩]`

Definition

`\acrfull[⟨options⟩]{⟨label⟩}[⟨insert⟩]`  
`\Acrfull[⟨options⟩]{⟨label⟩}[⟨insert⟩]`

Definition

*These commands don't affect the first use flag.* The first two (`\acrshort` and `\Acrshort`) will display the abbreviation only, the middle two (`\acrlong` and `\Acrlong`) will display the long form only, and the last two (`\acrfull` and `\Acrfull`) display both the long and short form. These commands have the same syntax as `\gls` and `\Gls`.

If you find these commands a little long-winded to type, you can use the package option `shortcuts`, which will provide shorter synonyms, such as `\acs`, `\acl` and `\acf`. This option also defines `\ac` which is equivalent to `\gls`. See the glossaries user guide [16] for further details.

### ANOTHER EXAMPLE:

Suppose I have defined an acronym as follows:

```
\newacronym{svm}{SVM}{support vector machine}
```

Input

Then (later in the document):

```
First use: \gls{svm}\@. Next use: \gls{svm}\@. Short:  
\acrshort{svm}\@. Long: \acrlong{svm}. Full: \acrfull{svm}\@.
```

↑ Input

↓ Input

produces:

```
First use: support vector machine (SVM). Next use: SVM. Short: SVM.  
Long: support vector machine. Full: support vector machine (SVM).
```

↑ Output

↓ Output

(Recall \@ from [Volume 1](#) [[15](#), §2.13].)

### NOTE:

Avoid using commands like `\gls` in section headings or captions. Instead, use commands like:



```
\glsentrytext{<label>}
```

Definition

## 6 Generating Indexes and Glossaries

(displays the value of the `text` key without a hyperlink) or

`\glsentryfirst{⟨label⟩}`

Definition

(displays the value of the `first` key without a hyperlink). These commands don't affect the first use flag. For related commands, see the glossaries user guide [16].



Take care if you want to use the uppercase variants, such as `\Gls` or `\Acrlong`. If the first letter is an accent (either entered using accents commands such as `\'e` or entered directly such as `é` with the `inputenc` package) then you must group that letter when you define the term.

### EXAMPLE:

```
\newglossaryentry{elite}% label
{%
  name={{é}lite},%
  description={select group or class}%
}
```

↑ Input

↓ Input

### Defining New Glossaries

If you want the list of acronyms to be separate from the main glossary, you need to use the package option `acronym`. This will change the effect of `\newacronym` so that it adds the term to the list of acronyms instead of to the main glossary.

You can also define your own custom glossaries using

```
\newglossary[⟨log-ext⟩]{⟨name⟩}{⟨in-ext⟩}{⟨out-ext⟩}{⟨title⟩}  
[⟨counter⟩]
```

Definition

where `⟨name⟩` is a label that uniquely defines this new glossary and `⟨title⟩` is the title to be used when the glossary is displayed in the document via `\printglossary` or `\printglossaries`, see [Section 6.1.2](#). The other mandatory arguments, `⟨in-ext⟩` and `⟨out-ext⟩`, specify the file extensions to give to the input and output files for this new glossary. The first optional argument `⟨log-ext⟩` is the extension for the log file. This information is provided for the benefit of the `makeglossaries` application. The final optional argument `⟨counter⟩` is the name of the counter used by default in the location lists for this new glossary. If omitted, the page counter is used (unless overridden by the `counter` package option).

**NOTE:**

All glossaries must be defined before `\makeglossaries` to ensure that the relevant output files are opened.

**EXAMPLE:**

The following defines a new glossary called “notation”:

```
\newglossary[nlg]{notation}{not}{ntn}{Notation}
```

Input

When it gets displayed (using `\printglossary` or `\printglossaries`) the title will default to “Notation”. I now need to use the `type` key if I want to define an entry to go in this new glossary:

```
\newglossaryentry{not:set}% label
{%
  type=notation,% glossary type
  name={ $S$ },%
  description={A set},%
  sort={S}%
}
```

↑ Input

↓ Input

Later in the document I can use this entry:

A `\gls{not:set}` is a collection of objects.

Input

### Displaying Glossaries

Now that you know how to define entries and how to use them in the document text, let's now look at the more complicated task of displaying the glossaries. To display all the defined glossaries use:

`\printglossaries`

Definition

To only display a particular glossary use:

`\printglossary[<options>]`

Definition

where *<options>* is a comma-separated list of *<key>=<value>* options. Available keys:

- type

The glossary to print. If omitted, the main (default) glossary is assumed.

- `style`

The glossary style to use. There are a lot of predefined styles to choose from, such as `list`, `long` or `tree`. See the glossaries user manual [16] for further details.

- `title`

Overrides the default title for this glossary.

- `toctitle`

Overrides the default title for the table of contents.

- `numberedsection`

Put this glossary in a numbered section (instead of an unnumbered section).

- `nonumberlist`

Suppress the location lists for this glossary.

### NOTE:

By default, the glossaries aren't added to the table of contents. If you want them added to the table of contents use the package option `toc`.



```
\usepackage[toc]{glossaries}
```

Input

Only those entries that have been used in the document (via commands like `\gls`) are displayed in the glossary. If you want to add an entry without displaying it in the document, use

```
\glsadd[⟨options⟩]{⟨label⟩}
```

Definition

where `⟨label⟩` is the unique label identifying the entry. The optional argument `⟨options⟩` is the same as for commands like `\gls` except there is no `hyper` key.

Alternatively, you can add all defined entries using:

```
\glsaddall[⟨options⟩]
```

Definition

where `⟨options⟩` is the same as for `\glsadd` except that there is also a `types` key where the value should be a comma-separated list of all the glossaries to iterate over. For example, to add all entries defined in the “acronym” glossary and the “notation” glossary, but not the “main” glossary:

```
\glsaddall[types={acronym,notation}]
```

Input

### NOTE:



As with `\printindex` the glossaries won't be displayed until the relevant files have been created either by `makeindex` or by `xindy`. Unlike in [Section 6.1.1](#), if you want to use `xindy` to create your glossary files, you can't use the `texindy` wrapper but must either use `xindy` directly or use the `makeglossaries` wrapper, described below. If you want to use `xindy` with the `glossaries` package, you must use the `xindy` package option:

```
\usepackage[xindy]{glossaries}
```

Input

If omitted, `makeindex` will be assumed.

If you have Perl installed, you can use the `makeglossaries` application that comes with the `glossaries` package. If you have been using `latexmk` or `xindy`, then you already have Perl installed. If you don't want to install Perl for some reason, there's a Java alternative to `makeglossaries` called `makeglossariesgui` that's available from [CTAN \[2\]](#). However, if you don't install Perl, you are restricting your options as you won't be able to use `xindy`<sup>6.1</sup>.

If you are using `arara` (see [Section 1.1.2](#)), then all you need to do is add another `% arara:` directive in your source code:

---

<sup>6.1</sup>or a lot of other useful Perl scripts, such as `epstopdf`

```
% arara: makeglossaries
```

Input

If you are using `latexmk`, then make sure you have added the custom dependencies for `.gls` as described in [Section 1.1.1](#). If you are not using any automated tool to build your document, you will have to invoke `makeglossaries` between (PDF)TEX runs (see [Section 1.1](#)).

Adding to [Listing 19](#):

#### Listing 20

↑ Input

```
% In the preamble:
% arara: pdflatex: { synctex: on }
% arara: biber
% arara: makeglossaries
% arara: makeindex
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass[oneside,12pt]{scrbook}

\usepackage[toc,acronym]{glossaries}

\newglossary[nlg]{notation}{not}{ntn}{Notation}
```

## 6 Generating Indexes and Glossaries

`\makeglossaries`

```
\newglossaryentry{matrix}% the label
{name={matrix},% the term
description={a rectangular table of elements},% brief description
plural={matrices}% the plural
}
```

```
\newacronym{svm}{SVM}{support vector machine}
```

```
\newglossaryentry{not:set}% label
{%
type=notation,% glossary type
name={ $\mathcal{S}$ },%
description={A set},%
sort={S}%
}
```

% Later in the document:

`\Glspl{matrix}` are usually denoted by a bold capital letter, such as  `$\mathbf{A}$` . The `\gls{matrix}[’s] $(i,j)$th` element is

## 6 Generating Indexes and Glossaries

usually denoted `$a_{ij}$`. `\Gls{matrix}` `$\mathbf{I}$` is the identity `\gls{matrix}`.

First use: `\gls{svm}\@`. Next use: `\gls{svm}\@`. Short: `\acrshort{svm}\@`. Long: `\acrlong{svm}`. Full: `\acrfull{svm}\@`.

A `\gls{not:set}` is a collection of objects.

% At the end of the document:

`\backmatter`

`\printglossaries`

 [Input](#)

### Troubleshooting

If you run into difficulties with the glossaries package, first consult the [glossaries FAQ](#). You can also check my [bug tracker](#) if you think you've stumbled on a bug. If you are using TeXnicCenter instead of TeXworks, there are instructions on how to get TeXnicCenter to run makeglossaries in an article I wrote on the L<sup>A</sup>T<sub>E</sub>X Community's Know How section [\[13\]](#).

If you're completely confused about how to generate the glossary files, you might want to consider using `datagidx` instead, described [next](#).

### 6.2 Using $\text{\LaTeX}$ to Sort and Collate Indexes or Glossaries (`datagidx` package)

[Section 6.1](#) described how to create an index or glossaries using an external indexing application. Some users stumble when it comes to invoking the indexing application. There is an alternative where  $\text{\TeX}$  does the sorting and collating. This by-passes the need to use `makeindex`, `xindy` or `makeglossaries`, but it's less efficient and takes longer to build your document. This section describes how to do this using the `datagidx` package. This package comes with my `datatool` bundle (at least version 2.13). The documentation for `datagidx` is included in the `datatool` user manual [\[17\]](#).

The `datatool` package allows you to define databases that you can access in your document. The `datagidx` package has a special interface to this facility that allows you to define databases for the purposes of indexing. These databases and their definitions must be defined in the preamble. In this section, the term “indexing” will be used to refer to either indexes or glossaries, as the same mechanism is used for both tasks.

A new indexing database is defined using:

```
\newidx{⟨label⟩}{⟨title⟩}
```

Definition

where  $\langle label \rangle$  is a label that uniquely identifies this database and  $\langle title \rangle$  is the title to be used when the index (or glossary) is displayed. For example:

```
\newidx{index}{Index}
```

Input

creates a new database labelled `index`. When the index is displayed, it will have the section heading “Index”.

As in [Section 6.1](#), each term in the index (or glossary) database has an associated location list. This list is initially null. The locations are added to terms used in the document on *the second* L<sup>A</sup>T<sub>E</sub>X run. When you display the index, only those entries with a non-null location list or a cross-reference will be shown. The default location is the page number on which the entry was referenced. The `datagidx` package knows about the following page numbering styles: `arabic`, `roman`, `Roman`, `alph` and `Alph`. If your document has another type of numbering style, or if you want to use a different counter for the location, consult the `datagidx` section of the `datatool` manual [17].

Once you have defined the indexing database, you can now define terms associated with that database using

```
\newterm[⟨options⟩]{⟨name⟩}
```

Definition

## 6 Generating Indexes and Glossaries

where  $\langle name \rangle$  is the term and  $\langle options \rangle$  is a list of  $\langle key \rangle = \langle value \rangle$  options. The following keys are available:

- database

Identifies the database in which to store this term. For example:

```
\newterm[database=index]{eigenvalue}
```

Definition

It can be somewhat cumbersome having to type the database for each new term. Instead you can define the default database using:

```
\DTLgidxSetDefaultDB{\label{}}
```

Definition

For example:

```
\newgidx{index}{Index}  
\DTLgidxSetDefaultDB{index}
```

↑ Input

```
\newterm{eigenvalue}  
\newterm{eigenvector}
```

 [Input](#)

- **label**

A label uniquely identifying this term. If omitted the label is extracted from  $\langle name \rangle$ .

- **sort**

The sort key. If omitted this is extracted from  $\langle name \rangle$ .

- **parent**

The parent entry, if this is a sub-term. (The value should be the label identifying the parent, which must already be defined.)

- **text**

How the entry should appear in the document text. If omitted,  $\langle name \rangle$  is used. If present,  $\langle name \rangle$  indicates how the term should appear in the index/glossary.

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- **description**

An optional associated description.

- **plural**

The plural form of this term. If omitted this value is obtained by appending “s” to  $\langle name \rangle$  (or the value of `text` if supplied).

- **symbol**

An optional associated symbol.

- **short**

An associated short form, if required. (Defaults to  $\langle name \rangle$  if omitted.)

- **long**

An associated long form, if required. (Defaults to  $\langle name \rangle$  if omitted.)

- **shortplural**

The plural of the associated short form. If omitted, the value is obtained by appending “s” to the short form.

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- `longplural`

The plural of the associated long form. If omitted, the value is obtained by appending “s” to the long form.

- `see`

A cross-reference to a synonym. The value should be the label of another entry. This entry will not have a location list, just the reference to the other term.

- `seealso`

A cross-reference to a closely related term. Both this term and the cross-referenced term should have a location list.

It's also possible to add your own custom keys. See the `datagidx` section of the `datatool` user guide [17] for further details.

As with `\newglossaryentry`, discussed in [Section 6.1.2](#), if the term starts with an accented letter (or a ligature) the letter must be grouped.

**EXAMPLE:**

```
\newterm[label=elite,sort=elite]{{é}lite}
```

[↑ Input](#)

```
\newterm
[%
  plural={{æ}sophagi},
  label={oesophagus},
  sort={oesophagus},
  description={tube connecting throat and stomach}
]
{{æ}sophagus}
```

[↓ Input](#)

There is a shortcut command for defining acronyms:

```
\newacro[⟨options⟩]{{⟨short⟩}}{⟨long⟩}
```

[Definition](#)

where *⟨short⟩* is the abbreviation and *⟨long⟩* is the long form. The optional argument *⟨options⟩* is the same as for `\newterm`. This is equivalent to:

```
\newterm
[%
```

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```
description={\capitalisewords{<long>}},%
short={\acronymfont{<short>}},%
long={<long>},%
text={\DTLgidxAcrStyle{<long>}{\acronymfont{<short>}}},%
plural={\DTLgidxAcrStyle{<long>s}{\acronymfont{<short>s}}},%
sort={<short>},%
<options>%
]%
{\MakeTextUppercase{<short>}}
```

where

`\DTLgidxAcrStyle{<long>}{<short>}`

Definition

formats the full version of the acronym. This defaults to: <long> (<short>), and

`\acronymfont{<text>}`

Definition

is the font used to format acronyms. By default this just displays its argument, but can be redefined if you want the acronyms formatted in a particular style or font (such as small-caps). The other commands used above are:

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`\MakeTextUppercase{⟨text⟩}`

Definition

This is defined by the `textcase` package and converts `⟨text⟩` to uppercase.

`\capitalisewords{⟨text⟩}`

Definition

This is defined by the `mfirstuc` package and capitalises the first letter of each word in `⟨text⟩`.

### EXAMPLE:

`\newacro{svm}{support vector machine}`

Input

Once you have defined the terms in the preamble, you can later use them in the document:

`\gls{[⟨format⟩]⟨label⟩}`

Definition

`\glspl{[⟨format⟩]⟨label⟩}`

Definition

`\Gls{[⟨format⟩]⟨label⟩}`

Definition

`\Glspl{[⟨format⟩]⟨label⟩}`

Definition

These are similar to those described in [Section 6.1.2](#), but they have a different syntax. Here `⟨format⟩` is the name of a text-block commands (such as `\textbf`) *without* the initial backslash that should be used to format the location for this reference. This is analogous to the `|` special character described in [Section 6.1.1](#).

There are also commands associated with acronyms:

`\acr{[⟨format⟩]⟨label⟩}`

Definition

`\acrpl{[⟨format⟩]⟨label⟩}`

Definition

`\Acr{[⟨format⟩]⟨label⟩}`

Definition

`\Acrpl{[⟨format⟩]⟨label⟩}`

Definition

Unlike the glossaries package, described in [Section 6.1.2](#), there is a difference between datagid's `\gls` and `\acr`. Here `\gls` will always display the value



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of the text field, whereas `\acr` will display the full form on first use (the text field) and the abbreviation on subsequent use (the short field).

You can also add terms to the index without creating any link text:

`\glsadd{<label>}`

Definition

This adds the term uniquely identified by `<label>`.

`\glsaddall{<database name>}`

Definition

This adds all the terms defined in the database uniquely identified by `<database name>`.

### NOTE:



Unlike most commands, the optional part of the above commands occurs *inside* the mandatory argument.

### EXAMPLES:

Given the elite and oesophagus examples defined on page 193, I can reference those entries in the text as follows:

`\Gls{elite}` and `\glspl{oesophagus}`.

Input

This produces:

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Élite and œsophagi.

Output

Elsewhere, I might have the main topic about œsophagi:

The `\gls{[textbf]oesophagus}` connects the throat and the stomach.

↑ Input

↓ Input

This produces:

The œsophagus connects the throat and the stomach.

Output

and the associated location will be typeset in bold.

Here's an example using the svm example defined on page 196:

First use: `\acr{svm}\@`. Subsequent use: `\acr{svm}\@`. Full form: `\gls{svm}`.

↑ Input

↓ Input

This produces:

First use: support vector machine (SVM). Subsequent use: SVM. Full form: support vector machine (SVM).

↑ **Output**

↓ **Output**

You can unset and reset acronyms using

`\glsunset{<label>}`

Definition

and

`\glsreset{<label>}`

Definition

To display the index or glossary or list of acronyms use:

`\printterms[<options>]`

Definition

where `<options>` is a comma-separated `<key>=<value>` list. Common options are:

- database

The label uniquely identifying the database containing the relevant terms.

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- `postdesc`

This may have the value `dot` (put a full stop after the description, if there is a description) or `none` (don't put a full stop after the description).

- `columns`

This value must be an integer greater than or equal to 1, indicating the number of columns for the page layout.

- `style`

The style to use. There are a number of predefined styles, such as `index` or `gloss`. See the user guide [17] for further details.

- `namecase`

Indicates whether any case change should be applied to the entry's name. Available values are: `nochange` (no change), `uc` (convert to uppercase), `lc` (convert to lower case), `firstuc` (convert the first letter to uppercase) and `capitalise` (capitalise each initial letter using `\capitalisewords`).

For a full list of options see the `datagidx` section of the `datatool` user guide [17].

[Listing 20](#) can now be rewritten as follows:

## Listing 21

 Input

```

% arara: pdflatex: { synctex: on }
% arara: biber
% arara: pdflatex: { synctex: on }
% arara: pdflatex: { synctex: on }
\documentclass[oneside,12pt]{scrbook}

\usepackage{datagidx}

\newgidx{index}{Index}
\newgidx{glossary}{Glossary}
\newgidx{acronym}{Acronyms}
\newgidx{notation}{Notation}

\DTLgidxSetDefaultDB{glossary}

\newterm
[%
  description={a rectangular table of elements},% brief description
  plural={matrices}% the plural
]%
{matrix}% the name

```

```
\DTLgidxSetDefaultDB{acronym}
```

```
\newacro{svm}{support vector machine}
```

```
\DTLgidxSetDefaultDB{notation}
```

```
\newterm
```

```
[%
```

```
  label={not:set},% label
```

```
  description={A set},%
```

```
  sort={S}%
```

```
]%
```

```
{\ensuremath{\mathcal{S}}}
```

```
\DTLgidxSetDefaultDB{index}
```

```
\newterm
```

```
[%
```

```
  label={function},%
```

```
  text={function}%
```

```
]%
```

## 6 Generating Indexes and Glossaries

```
{functions}
```

```
\newterm
```

```
[%
```

```
    see={sqrt},%
```

```
]%
```

```
{square root}
```

```
\newterm
```

```
[%
```

```
    label={fn.sqrt},
```

```
    parent={function}
```

```
]%
```

```
{\texttt{sqrt()}}
```

```
\newterm
```

```
[%
```

```
    label={sqrt},
```

```
]%
```

```
{sqrt()}
```

```
\newterm{tautology}
```

## 6 Generating Indexes and Glossaries

`\newterm{contradiction}`

% later in the document:

`\Glspl{matrix}` are usually denoted by a bold capital letter, such as `$_{\mathbf{A}}$`. The `\gls{matrix}`'s `$(i,j)$`th element is usually denoted `$_{a_{ij}}$`. `\Gls{matrix}` `$_{\mathbf{I}}$` is the identity `\gls{matrix}`.

First use: `\acr{svm}\@`. Next use: `\acr{svm}\@`. Full: `\gls{svm}\@`.

A `\gls{not:set}` is a collection of objects.

...

Some sample code is shown in Listing~\ref{lst:sample}. This uses the function `\gls{fn.sqrt}`.`\glsadd{sqrt}`

...

`\begin{Definition}[Tautology]`

## 6 Generating Indexes and Glossaries

A `\emph{\gls{[textbf]tautology}}` is a proposition that is always true for any value of its variables.

`\end{Definition}`

`\begin{Definition}[Contradiction]`

A `\emph{\gls{[textbf]contradiction}}` is a proposition that is always false for any value of its variables.

`\end{Definition}`

% At the end of the document:

`\backmatter`

`\printterms[database=glossary]`

`\printterms[database=acronym]`

`\printterms[database=notation]`

`\printbibliography`

`\printterms[database=index]`

[↓ Input](#)

Note that there is now no need to call either `makeindex` or `makeglossaries`. The only external application being called is `biber` for the bibliography.

## A. GENERAL ADVICE

If you encounter any L<sup>A</sup>T<sub>E</sub>X problems, check Appendix B (Common Errors) and Appendix C (Need More Help?) in *L<sup>A</sup>T<sub>E</sub>X for Complete Novices* [15].

### A.1 Too Many Unprocessed Floats

A common problem PhD student's encounter when writing a thesis is the “too many unprocessed floats” error. This is usually caused by having too many figures and tables in the results chapter and not enough surrounding text. If this happens, there are a number of things you can try doing:

[FAQ: Too many unprocessed floats]

1. Make sure you haven't been too restrictive in where you want your floats to go. If you use a placement specifier, give LaTeX as many options as possible. For example:

```
\begin{figure}[htbp]
```

Input

which indicates that the figure can be placed “here” (h), at the top of a page (t), at the bottom of the page (b) or on a page solely

consisting of floats (p). If you just use the h placement specifier then you are stating: “I want it *here* and *nowhere else!*” If T<sub>E</sub>X can’t put it *exactly here*, then you have given no alternative place to put it, and it won’t get placed anywhere, unless a `\clearpage` command is issued, at which point all remaining unprocessed floats will be dumped at that point. If you are determined that an image must be placed *exactly here* then it should not be placed in a floating environment.

2. Try increasing the amount of text in the chapter. Remember that you should never simply print all the figures and tables in a results chapter without discussing them to some extent.
3. If all else fails, try using the `\clearpage` command. This forces all unprocessed floats to be processed immediately, and start a new page. This may result in the page ending prematurely, if you wish to avoid this, you can use the `afterpage` package, and use the command:

```
\afterpage{\clearpage}
```

Input

For other problems, check the FAQ [19].

## A.2 General Thesis Writing Advice

This section is not specific to  $\text{\LaTeX}$ . Some of the points have already been mentioned in asides or footnotes. Remember that each college or university or even school within a university may have different requirements, and requirements will also vary according to country, so some of this advice may not apply to you. I am writing from the point of view of an English scientist, and am basing it on my own experience and on the comments of English science-based PhD examiners and supervisors. I cannot guarantee that your own department or university will agree with them. *If in doubt, check with your supervisor.*

1. Find out the thesis style requirements from your supervisor or your department's website. Many universities still require [double-spaced](#), single-sided documents with [wide margins](#). Double-spacing is by and large looked down on in the world of typesetting, but this requirement for a PhD thesis has nothing to do with aesthetics or readability. In England the purpose of the PhD viva is to defend your work<sup>A.1</sup>. Before your viva, paper copies of your thesis are sent to your examiners. The double spacing and wide margins provide the examiners room to write the comments and criticisms

---

<sup>A.1</sup>I gather this is not the case in some other countries, where the viva is more informal, and the decision to pass or fail you has already been made before your viva.

they wish to raise during the viva, as well as any typographical corrections. Whilst they could write these comments on a separate piece of paper, cross-referencing the page in the thesis, it is more efficient for the comments to actually be on the relevant page of the thesis. That way, as they go through the manuscript during your viva, they can easily see the comments, questions or criticisms they wish to raise alongside the corresponding text. If you present them with a single-spaced document with narrow margins, you are effectively telling them that you don't want them to criticise your work!

2. Don't try to pad your thesis with irrelevant information. This includes adding items in your bibliography that are not referenced in the text, adding figures or tables that are not explained in the text, and supplying all the source code you have written. The outcome of your viva will not depend on the physical size of your thesis, but on the clarity of your writing and on the quality of your work.
3. Clearly delineate your thesis through the use of chapters and sections, outlining your original aims and objectives, an overview of the subject matter including references to other people's work in the area, the methods you employed to extend or innovate the field, your results and conclusions.

## A General Advice

4. Make sure your references include some recent journal or conference papers to illustrate that you are aware of new developments in your field. Remember that due to the nature of publishing, most books are dated by the time they reach the book shelves. Journal and conference papers are likely to be more up-to-date<sup>A.2</sup>.
5. Always explain acronyms, technical terms and symbols. It is a good idea to include a glossary of terms, list of notation or list of acronyms to avoid confusion (see [Chapter 6](#) (Generating Indexes and Glossaries)).
6. If you have equations, make sure you explain the variables used, and how you go from one equation to the next. Depending on your field, you might also consider clarifying the mathematics by providing graphical representations of the equations<sup>A.3</sup>.
7. If you include any graphs, bar charts, pie charts or any other form

---

<sup>A.2</sup>Having said that, I know someone who submitted an article to a journal, and it took three and a half years before the reviewers came back with comments. In the end, the author withdrew the manuscript because by that time the topic was out of date.

<sup>A.3</sup>When I was a PhD student, I was once rendered speechless when asked to provide a graphical illustration of an equation involving a quadruple summation that had no graphical meaning from my point of view. Perhaps this was a drawback of being a mathematician doing a PhD in an electronics department.

## A General Advice

of data plot, make sure it is clearly labelled and no distortion is introduced (such as using three-dimensional bar charts or pie charts<sup>A.4</sup>.)

8. If you have used a computer application to generate numerical results, make sure you have some understanding of the underlying process and what the results mean. This doesn't necessarily mean that you need to understand complex computer code, or complex algorithms, but what you shouldn't do is say something along the lines of, "well, I clicked on this button, and it said  $m = 0.678$ ." What is the purpose of the button? What does  $m$  represent? What does the result  $m = 0.678$  signify? What value were you expecting or hoping to get? Numbers on their own are meaningless. If I ran into a room shouting "I've got 42!" What does that mean? Forty-two what? Forty-two brilliant reviews? (Great!) Forty-two percent in an exam? (Not good.) Forty-two spots on my face? (Very bad!)
9. Don't waste time worrying about the best way to word your thesis in your first draft. Write first, then edit it later or you will never get started.

---

<sup>A.4</sup>The sole purpose of 3D pie charts or bar charts appears to be to look pretty and impress people who have no understanding of mathematics.

## A General Advice

10. If your supervisor offers to critique chapters of your thesis, don't say no! Such offers are not made out of politeness, but a desire to ensure that you pass. Don't be embarrassed and worry that it's not good enough, that's the whole point in your supervisor helping you improve it<sup>A.5</sup>.
11. Write in a clear concise manner. A thesis is a technical document, not a novel, so don't be tempted to write something along the lines of: "I awaited with bated breath, my whole body quivering with excitement at the eager anticipation that my algorithm would prove superior to all others, and, oh joy, my experiments proved me right."
12. Don't decorate your thesis with irrelevant clip art. It is unprofessional and highly inappropriate in the sciences.
13. Make regular backups of your work. Be prepared for any of the following: accidentally deleting your thesis, accidentally overwriting your thesis with another file, software failure, hardware failure, viruses, fire and theft. Consider using at least a two-tier system where you keep one backup in a safe place where you live and ask a close relative or friend to take care of another backup.

---

<sup>A.5</sup>but don't expect your supervisor to actually write your thesis!

## *A General Advice*

Items [9](#) and [10](#) above were supplied by Dr Gavin Cawley<sup>A.6</sup> who has been both a PhD supervisor and examiner.

---

<sup>A.6</sup>School of Computing Sciences, University of East Anglia

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## ACRONYMS

**CTAN** The Comprehensive T<sub>E</sub>X Archive Network. <http://mirror.ctan.org/>.

**UK FAQ** UK List of T<sub>E</sub>X Frequently Asked Questions. <http://www.tex.ac.uk/faq>.

# SUMMARY OF COMMANDS AND ENVIRONMENTS

*Commands or environments defined in the  $\text{\LaTeX}$  kernel are always available.*

## Symbols

!

makeindex sublevel special character [§6.1]

␣

A visual indication of a space in the code. When you type up the code, replace all instances of this symbol with a space via the space bar on your keyboard. [§1.0]

"

makeindex escape special character [§6.1]

#⟨digit⟩

**Defined in:**  $\text{\LaTeX}$  Kernel.

Replacement text for argument ⟨digit⟩. (See [Volume 1](#) [15, §8].) [§4.5]

\$

**Defined in:**  $\text{\LaTeX}$  Kernel.

## Symbols

A N  
B O  
C P  
D Q  
E R  
F S  
G T  
H U  
I V  
J W  
K X  
L Y  
M Z

Switches in and out of in-line math mode. (See [Volume 1](#) [15, §9.1].) [§4.5]

%

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Comment character used to ignore everything up to and including the newline character in the source code. Sometimes comments are used to provide information to applications that build your document, such as arara. [§2.0]

% arara:

Instruction to arara indicating how to build the document. This is ignored if you are not using arara. [§1.1]

,

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Closing quote or apostrophe ' symbol in text mode or prime symbol ' in math mode. (See [Volume 1](#) [15, §4.3].) [§4.7]

''

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Closing double quote " symbol in text mode or double prime " in math mode. (See [Volume 1](#) [15, §4.3].) [§4.7]

--

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

En-dash – symbol. (Normally used for number ranges. See [Volume 1](#) [15, §4.3].) [§5.1]

@

Used in the argument of `\index` to separate the sort key from the term being indexed. [§6.1]

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

[	Acute accent over $\langle c \rangle$ . Example: $\backslash' \{o\}$ produces ó. (See <a href="#">Volume 1</a> [15, §4.3].) [§6.1]
<b>Defined in:</b> L <sup>A</sup> T <sub>E</sub> X Kernel.	
Open delimiter of an optional argument. (See <a href="#">Volume 1</a> [15, §2.8.2].) [§1.0]	
\	$\backslash +$
<b>Defined in:</b> L <sup>A</sup> T <sub>E</sub> X Kernel.	<b>Defined in:</b> <a href="#">tabbing</a> environment.
Escape character indicating a command. (See <a href="#">Volume 1</a> [15, §2.6].) [§6.1]	Shifts the left border by one tab stop to the right. [§4.6]
$\" \{ \langle c \rangle \}$	$\ -$
<b>Defined in:</b> L <sup>A</sup> T <sub>E</sub> X Kernel.	<b>Defined in:</b> L <sup>A</sup> T <sub>E</sub> X Kernel.
Umlaut over $\langle c \rangle$ . Example: $\" \{o\}$ produces ö. (See <a href="#">Volume 1</a> [15, §4.3].) [§5.1]	1) Outside <a href="#">tabbing</a> environment inserts a discretionary hyphen [§4.6]; 2) Inside <a href="#">tabbing</a> environment shifts the left border by one tab stop [§4.6].
$\' \{ \langle c \rangle \}$	$\ ;$
<b>Defined in:</b> L <sup>A</sup> T <sub>E</sub> X Kernel.	<b>Defined in:</b> <a href="#">algorithm2e</a> package.
	When used in the body of one of the environments defined by

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

algorithm2e, such as [algorithm](#), marks the end of the line. Outside those environments, this is a math spacing command. [[§4.8](#)]

`\<`

**Defined in:** [tabbing](#) environment.

Jumps to the next tab stop. [[§4.6](#)]

`\=`

**Defined in:**  $\text{\LaTeX}$  Kernel.

1) Outside [tabbing](#) environment puts a macron accent over the following character [[§4.6](#)]; 2) Inside [tabbing](#) environment sets a tab-stop. [[§4.6](#)].

`\>`

**Defined in:** [tabbing](#) environment.

Jumps to the previous tab stop. [[§4.6](#)]

`\@`

**Defined in:**  $\text{\LaTeX}$  Kernel.

Used when a sentence ends with a capital letter. This command should be placed after the letter and before the punctuation mark. (See [Volume 1](#) [[15](#), [§2.13](#)].) [[§6.1](#)]

`\\`

**Defined in:**  $\text{\LaTeX}$  Kernel.

Starts a new row in [tabbing](#) or tabular-style environments. (See [Volume 1](#) [[15](#), [§4.6.1](#)].) [[§2.0](#)]

`]`

**Defined in:**  $\text{\LaTeX}$  Kernel.

Closing delimiter of an optional argument. (See [Volume 1](#) [[15](#), [§2.8.2](#)].) [[§1.0](#)]

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

`^{\maths}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Displays its argument as a superscript. (See [Volume 1 \[15, §9.4.3\].](#)) [[§4.8](#)]

`_{\maths}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Displays its argument as a subscript. (See [Volume 1 \[15, §9.4.3\].](#)) [[§4.8](#)]

“

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Open double quote “ symbol. (See [Volume 1 \[15, §4.3\].](#)) [[§4.7](#)]

{

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Marks the beginning of a group. (See [Volume 1 \[15, §2.7\].](#)) [[§1.0](#)]

|

When used in `\index`, this symbol indicates that the rest of the argument list is to be used as the encapsulating command for the page number. [[§6.1](#)]

}

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Marks the end of a group. (See [Volume 1 \[15, §2.7\].](#)) [[§1.0](#)]

~

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Unbreakable space. (See [Volume 1 \[15, §4.3\].](#)) [[§4.7](#)]

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

## A

`\a{accent symbol}{character}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Used in the [tabbing](#) environment to create accented characters. [[§4.6](#)]

`\begin{abstract}`

**Defined in:** Most article- or report-style classes, such as `scrartcl` or `scrreprt`. Not usually defined in book-style classes, such as `scrbook`, but is defined in `memoir`.

Displays its contents as an abstract. [[§2.0](#)]

`\ac[options]{label}[insert]`

**Defined in:** glossaries package.

A synonym for `\gls`. This command is only available if the package option `shortcuts` is used. [[§6.1](#)]

`\acf[options]{label}[insert]`

**Defined in:** glossaries package.

A synonym for `\acrfull`. This command is only available if the package option `shortcuts` is used. [[§6.1](#)]

`\acl[options]{label}[insert]`

**Defined in:** glossaries package.

A synonym for `\aclong`. This command is only available if the package option `shortcuts` is used. [[§6.1](#)]

`\Acr[{format}]label}`

**Defined in:** datagidx package.

As `\acr` but the first letter is converted to uppercase. [[§6.2](#)]

`\acr[{format}]label}`

**Defined in:** datagidx package.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

Displays an acronym. On first use the full form is displayed. On subsequent use only the short form is displayed. [§6.2]

`\Acrfull[⟨options⟩]{⟨label⟩}`  
[⟨insert⟩]

**Defined in:** glossaries package.

Displays the long and short form of the given acronym, the first letter converted to uppercase. [§6.1]

`\acrfull[⟨options⟩]{⟨label⟩}`  
[⟨insert⟩]

**Defined in:** glossaries package.

Displays the long and short form of the given acronym. [§6.1]

`\Acrlong[⟨options⟩]{⟨label⟩}`  
[⟨insert⟩]

**Defined in:** glossaries package.

Displays the long form of the given acronym, the first letter converted to uppercase. [§6.1]

`\acrlong[⟨options⟩]{⟨label⟩}`  
[⟨insert⟩]

**Defined in:** glossaries package.

Displays the long form of the given acronym. [§6.1]

`\acronymfont{⟨text⟩}`

**Defined in:** glossaries and datagidx packages.

Font used to display acronyms. [§6.2]

`\Acrpl{[⟨format⟩]⟨label⟩}`

**Defined in:** datagidx package.

As `\acrpl` but the first letter is converted to uppercase. [§6.2]

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

`\acrpl{[<format>]}<label>}`

**Defined in:** datagidx package.

Displays the plural of an acronym. On first use the full form is displayed. On subsequent use only the short form is displayed. [§6.2]

`\Acrshort[<options>]{<label>}`  
`[<insert>]`

**Defined in:** glossaries package.

Displays the short form of the given acronym, the first letter converted to uppercase. [§6.1]

`\acrshort[<options>]{<label>}`  
`[<insert>]`

**Defined in:** glossaries package.

Displays the short form of the given acronym. [§6.1]

`\acs[<options>]{<label>}[<insert>]`

**Defined in:** glossaries package.

A synonym for `\acrshort`. This command is only available if the package option `shortcuts` is used. [§6.1]

`\addbibresource[<options>]`  
`{<resource>}`

**Defined in:** biblatex package.

Adds a resource, such as a .bib file [§5.3]

`\addtokomafont{<element name>}{<commands>}`

**Defined in:** scrartcl, screpr and scrbook classes.

Sets the font characteristics for the given KOMA-Script element. (See [Volume 1](#) [15, §5.3].) [§4.1]

`\AE`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

Æ ligature. [§6.1]

`\afterpage{<code>}`

**Defined in:** afterpage package.

Indicates code that should be implemented at the next page break. [§1.1]

`\begin{algorithm}[<placement>]`

**Defined in:** algorithm2e package.

A floating environment for typesetting algorithms. [§4.8]

`\begin{algorithm2e}`  
`[<placement>]`

**Defined in:** algorithm2e package.

Replacement for [algorithm](#) when used with the algo2e package option. [§4.8]

`\ang{<angle>}`

**Defined in:** siunitx package.

Typesets  $\langle angle \rangle$  where  $\langle angle \rangle$  is a single number or three semi-colon separated values. [§4.9]

`\author{<name>}`

**Defined in:** Most classes that have the concept of a title page.

Specifies the document author (or authors). This command doesn't display any text so may be used in the preamble, but if it's not in the preamble it must be placed before [\maketitle](#). [§2.0]

## B

`\backmatter`

**Defined in:** Most book-style classes, such as scrbook.

Suppresses chapter and section numbering, but still adds unstarred sectional units to the table of

## Symbols

A	N
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M	Z

contents. (See also `\frontmatter` and `\mainmatter`.) [§2.0]

`\begin{<env-name>}[<env-option>]{<env-arg-1>}...{<env-arg-n>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Starts an environment. (Must have a matching `\end`. See [Volume 1](#) [15, §2.15].) [§2.0]

`\bfseries`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Switches to the bold weight in the current font family. (See [Volume 1](#) [15, §4.5.1].) [§4.1]

`\bibitem[<tag>]{<key>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Indicates the start of a new reference in the bibliography. May

only be used inside the contents of the `thebibliography` environment. (See [Volume 1](#) [15, §5.6].) [§5.1]

`\bibliography{<bib list>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inputs the .bbl file (if it exists) and identifies the name(s) of the bibliography database files where the citations are defined. [§5.2]

`\bibliographystyle{<style-name>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Specifies the bibliography style to be used by bibtex. [§5.2]

## C

`\capitalisewords{<text>}`

**Defined in:** mfirstuc package.

Converts the initial letter of each word in `<text>` to uppercase. [§6.2]

## Symbols

A	N
B	O
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D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

`\caption[<short caption>]{<caption text>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inserts the caption for a float such as a figure or table. (See [Volume 1](#) [15, §7].) [§4.8]

`\centering`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Switches the paragraph alignment to centred. (See [Volume 1](#) [15, §2.12].) [§4.1]

`\cfoot[<scrplain>]{<scrheadings>}`

**Defined in:** scrpage2 package.

Indicates what to put in the centre footer area for the scrplain and scrheadings page styles. [§4.2]

`\chapter[<short title>]{<title>}`

**Defined in:** Book-style classes (such as scrbook or scrreprt) that have the concept of chapters.

Inserts a chapter heading. [§2.0]

`\thead[<scrplain>]{<scrheadings>}`

**Defined in:** scrpage2 package.

Indicates what to put in the centre heading area for the scrplain and scrheadings page styles. [§4.2]

`\Cite[<prenote>][<postnote>]{<key>}`

**Defined in:** biblatex package.

Like `\cite` but for use at the start of a sentence. [§5.3]

`\cite[<text>]{<key list>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

Inserts the citation markers of each reference identified in the key list. A second run is required to ensure the reference is correct. When used with biblatex, this command has two optional arguments. [§5.2]

`\citep[⟨pre⟩][⟨post⟩]{⟨key⟩}`

**Defined in:** natbib package.

Paranthetical citation. [§5.2]

`\citet[⟨pre⟩][⟨post⟩]{⟨key⟩}`

**Defined in:** natbib package.

Textual citation. [§5.2]

`\clearpage`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inserts a page break and processes any unprocessed floats [§3.0]

## D

`\date{⟨text⟩}`

**Defined in:** Most classes that have the concept of a title page.

Specifies the document date. This command doesn't display any text so may be used in the preamble, but if it's not in the preamble it must be placed before `\maketitle`. If omitted, most classes assume the current date. [§2.0]

`\documentclass[⟨option-list⟩]{⟨class-name⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Loads the document class file, which sets up the type of document you wish to write. (See [Volume 1](#) [15, §4].) [§2.0]

`\DontPrintSemicolon`

**Defined in:** algorithm2e package.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
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L	Y
M	Z

Switches off the end of line

semi-colon. (See also

[\PrintSemicolon.](#)) [[§4.8](#)]

[\doublespacing](#)

**Defined in:** setspace package.

Switches to double line-spacing.

[[§4.3](#)]

[\DTLgidxAcrStyle{⟨long⟩}](#)

[{⟨short⟩}](#)

**Defined in:** datagidx package.

Formats the long and short form of an acronym. [[§6.2](#)]

[\DTLgidxSetDefaultDB{⟨database label⟩}](#)

**Defined in:** datagidx package.

Sets the default indexing database. [[§6.2](#)]

E

[\Else{⟨block⟩}](#)

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate an else-block [[§4.8](#)]

[\ElseIf{⟨block⟩}](#)

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate an elseif-block [[§4.8](#)]

[\emph{⟨text⟩}](#)

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Toggles the upright and italic/slanted rendering of *⟨text⟩*. (See [Volume 1](#) [[15](#), [§4.5.1](#)].) [[§4.7](#)]

[\end{⟨env-name⟩}](#)

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

**Symbols**

<a href="#">A</a>	<a href="#">N</a>
<a href="#">B</a>	<a href="#">O</a>
<a href="#">C</a>	<a href="#">P</a>
<a href="#">D</a>	<a href="#">Q</a>
<a href="#">E</a>	<a href="#">R</a>
<a href="#">F</a>	<a href="#">S</a>
<a href="#">G</a>	<a href="#">T</a>
<a href="#">H</a>	<a href="#">U</a>
<a href="#">I</a>	<a href="#">V</a>
<a href="#">J</a>	<a href="#">W</a>
<a href="#">K</a>	<a href="#">X</a>
<a href="#">L</a>	<a href="#">Y</a>
<a href="#">M</a>	<a href="#">Z</a>

Ends an environment. (Must have a matching `\begin`. See [Volume 1](#) [15, §2.15].) [§2.0]

`\ensuremath{⟨maths⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Ensures that its argument is displayed in maths mode. (If it's already in maths mode, it just displays its argument, but if it's not already in maths mode, it will typeset its argument in in-line maths mode.) This command is usually only used in definitions, such as in `\newglossaryentry`, where it may be used in either text or math mode. [§6.1]

`\epsilon`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Greek lower case epsilon  $\epsilon$ . (See [Volume 1](#) [15, §9.4.2].) [§4.8]

`\equiv`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Relational  $\equiv$  symbol. (See [Volume 1](#) [15, §9.4.7].) [§4.7]

`\excludeonly⟨⟨file list⟩⟩`

**Defined in:** `excludeonly` Package.

Lists which of the files that are not to be included using `\include`. Only those files not in the list will be included. (The opposite effect of `\includeonly`.) [§3.0]

## F

`\begin{figure}[⟨placement⟩]`

**Defined in:** Most classes that define sectioning commands.

## Symbols

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B	O
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F	S
G	T
H	U
I	V
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K	X
L	Y
M	Z

Floats the contents to the nearest location according to the preferred placement options, if possible. Within the environment, `\caption` may be used one or more times, as required. (See [Volume 1](#) [15, §7.1].) [§4.8]

`\For{⟨condition⟩}{⟨body⟩}`

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate a for-loop [§4.8]

`\frac{⟨numerator⟩}{⟨denominator⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Displays a fraction. (See [Volume 1](#) [15, §9.4.5].) [§4.8]

`\frontmatter`

**Defined in:** Most book-style classes, such as scrbook.

Switches to lower case Roman numeral page numbering. Also suppresses chapter and section numbering, but still adds unstarred sectional units to the table of contents. (See also `\mainmatter` and `\backmatter`.) [§2.0]

## G

`\Gls[⟨options⟩]{⟨label⟩}[⟨insert⟩]`

**Defined in:** glossaries package.

Displays a glossary term according to its first use flag. The first letter of the term is converted to uppercase. [§6.1]

`\Gls{[⟨format⟩](label)}`

**Defined in:** datagidx package.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

Displays a glossary or index term with the first letter converted to uppercase. [§6.2]

`\gls{[format]}(label)`

**Defined in:** datagidx package.

Displays a glossary or index term. [§6.2]

`\gls[options]{(label)}[insert]`

**Defined in:** glossaries package.

Displays a glossary term according to its first use flag. [§6.1]

`\glsadd{(label)}`

**Defined in:** datagidx package.

Adds the given entry to the glossary or index without displaying any text. [§6.2]

`\glsadd[options]{(label)}`

**Defined in:** glossaries package.

Adds the given entry to the glossary without displaying any text. [§6.1]

`\glsaddall{(database name)}`

**Defined in:** datagidx package.

Adds all the defined entries in the named database without displaying any text. [§6.2]

`\glsaddall[options]`

**Defined in:** glossaries package.

Adds all the defined entries without displaying any text. [§6.1]

`\glsentryfirst{(label)}`

**Defined in:** glossaries package.

Displays the value of the first key for a glossary entry. [§6.1]

`\glsentrytext{(label)}`

**Defined in:** glossaries package.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

Displays the value of the text key for a glossary entry. [§6.1]

`\Glspl[<options>]{<label>}`  
`[<insert>]`

**Defined in:** glossaries package.

Displays the plural form of a glossary term according to its first use flag. The first letter of the plural text is converted to uppercase. [§6.1]

`\Glspl[[<format>]]{<label>}`

**Defined in:** datagidx package.

Displays the plural form of a glossary or index term with the first letter converted to uppercase. [§6.2]

`\glspl[[<format>]]{<label>}`

**Defined in:** datagidx package.

Displays the plural form of a glossary or index term. [§6.2]

`\glspl[<options>]{<label>}`  
`[<insert>]`

**Defined in:** glossaries package.

Displays the plural form of a glossary term according to its first use flag. [§6.1]

`\glsreset{<label>}`

**Defined in:** glossaries and datagidx packages.

Resets a glossary term's first use flag. [§6.1]

`\glsymbol[<options>]{<label>}`  
`[<insert>]`

**Defined in:** glossaries package.

Displays the symbol element of a glossary entry. [§6.1]

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

`\glsunset{<label>}`

**Defined in:** glossaries and datagridx packages.

Unsets a glossary term's first use flag. [§6.1]

`\gram`

**Defined in:** siunitx package.

Indicates a gram in commands like `\si`. [§4.9]

## H

`\headfont`

**Defined in:** scrpage2 package.

Determines the font used by the header and footer with the `scrplain` and `scrheadings` page styles. [§4.2]

`\headmark`

**Defined in:** scrpage2 package.

Used in commands like `\ihead` to insert the current running header. [§4.2]

`\hfill`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inserts a horizontal space that will expand to fit the available width. [§4.4]

`\hspace{<length>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inserts a horizontal gap of the given width. [§4.4]

## I

`\If{<condition>}{<block>}`

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate an if-statement [§4.8]

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

`\ifoot[<scrplain>]`  
`{<scrheadings>}`

**Defined in:** scrpage2 package.

Indicates what to put in the inner footer area for the *scrplain* and *scrheadings* page styles. [§4.2]

`\ihead[<scrplain>]`  
`{<scrheadings>}`

**Defined in:** scrpage2 package.

Indicates what to put in the inner heading area for the *scrplain* and *scrheadings* page styles. [§4.2]

`\include{<file name>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Issues a `\clearpage`, creates an associated auxiliary file, inputs *<file name>* and issues another `\clearpage`. (See also `\input`.) [§3.0]

`\includeonly<<file list>>`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel  
(Preamble Only).

Lists which of the files that are included using `\include` should be read in. Any files not in the list won't be included. [§3.0]

`\index{<text>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Adds indexing information to an external index file. The command `\makeindex` must be used in the preamble to enable this command. The external index file must be post-processed with an indexing application, such as `makeindex`. [§6.1]

`\input{<file name>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

Reads in the contents of  $\langle file\ name \rangle$ . (See also `\include`.) [§3.0]

`\itshape`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Switches to the italic form of the current font family, if it exists. (See **Volume 1** [15, §4.5.1].) [§4.2]

## K

`\kill`

**Defined in:** `tabbing` environment.

Sets the tab stops defined in the line but won't typeset the actual line. [§4.6]

`\kilo`

**Defined in:** `siunitx` package.

Indicates a kilo multiplier in commands like `\si`. [§4.9]

`\KwData{\langle text \rangle}`

**Defined in:** `algorithm2e` package.

For use in algorithm-like environments to indicate the algorithm input data [§4.8]

`\KwIn{\langle text \rangle}`

**Defined in:** `algorithm2e` package.

For use in algorithm-like environments to indicate the algorithm input [§4.8]

`\KwOut{\langle text \rangle}`

**Defined in:** `algorithm2e` package.

For use in algorithm-like environments to indicate the algorithm output [§4.8]

`\KwResult{\langle text \rangle}`

**Defined in:** `algorithm2e` package.

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

## Summary of Commands and Environments

For use in algorithm-like environments to indicate the algorithm output [§4.8]

`\KwRet{⟨value⟩}`

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate a value returned [§4.8]

`\KwTo`

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate “to” keyword [§4.8]

### L

`\label{⟨string⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Assigns a unique textual label linked to the most recently

incremented cross-referencing counter in the current scope. (See [Volume 1](#) [15, §5.5].) [§2.0]

`\large`

**Defined in:** Most document classes.

Switches to large sized text. (See [Volume 1](#) [15, §4.5.2].) [§4.1]

`\leftarrow`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Left arrow  $\leftarrow$ . (See [Volume 1](#) [15, §9.4.7].) [§4.8]

`\listoffigures`

**Defined in:** Most classes that have the concept of document structure.

Inserts the list of figures. A second (possibly third) run is

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M	Z

required to ensure the page numbering is correct. [§2.0]

`\listoftables`

**Defined in:** Most classes that have the concept of document structure.

Inserts the list of tables. A second (possibly third) run is required to ensure the page numbering is correct. [§2.0]

`\lstinline`

[*<opts>*]*<char>**<code>**<char>*

**Defined in:** listings package.

Typesets *<code>* as an inline code snippet. [§4.5]

`\lstinputlisting{<options>}`  
*<filename>*

**Defined in:** listings package.

Reads in *<filename>* and typesets the contents as displayed code. [§4.5]

`\begin{lstlisting}[<options>]`

**Defined in:** listings package.

Typesets the contents of the environment as displayed code. [§4.5]

`\lstlistoflistings`

**Defined in:** listings package.

Prints a list of listings for those listings with the caption set. [§4.5]

`\lstset{<options>}`

**Defined in:** listings package.

Sets options used by the listings package. [§4.5]

`\lvert`

**Defined in:** amsmath (Math Mode).

## Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

## Summary of Commands and Environments

Left vertical bar | delimiter. (See [Volume 1](#) [15, §9.4.9].) [§4.8]

### M

`\mainmatter`

**Defined in:** Most book-style classes, such as `scrbook`.

Switches to Arabic page numbering and enables chapter and section numbering. (See also [\frontmatter](#) and [\backmatter](#).) [§2.0]

`\makeglossaries`

**Defined in:** `glossaries` package.

Activates [\printglossaries](#) (and [\printglossary](#)). [§6.1]

`\makeindex`

**Defined in:**  $\text{\LaTeX}$  Kernel (Preamble Only).

Enables [\index](#). [§6.1]

`\MakeTextUppercase{\text}`

**Defined in:** `textcase` package.

Converts  $\langle\text{text}\rangle$  to uppercase. [§6.2]

`\maketitle`

**Defined in:** Most classes that have the concept of a title page.

Generates the title page (or title block). This command is usually placed at the beginning of the document environment. [§2.0]

`\MakeUppercase{\text}`

**Defined in:**  $\text{\LaTeX}$  Kernel.

Converts its argument to upper case. [§5.1]

### Symbols

A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z

`\mathbf{⟨maths⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Renders  $\langle maths \rangle$  in the predefined maths bold font. (Doesn't work with numbers and nonalphabetical symbols. See [Volume 1](#) [15, §9.4.1].) [§4.8]

`\mathcal{⟨maths⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Typesets its argument in the maths calligraphic font. Example: `$\mathcal{S}$` produces  $\mathcal{S}$ . (See [Volume 1](#) [15, §9.4.1].) [§6.1]

`\metre`

**Defined in:** siunitx package.

Indicates the metre unit for use in commands like `\si`. [§4.9]

## N

`\newacro[⟨options⟩]{⟨short⟩}{⟨long⟩}`

**Defined in:** datagidx package.

Defines a new acronym. [§6.2]

`\newacronym[⟨key-val list⟩]{⟨label⟩}{⟨abbrv⟩}{⟨long⟩}`

**Defined in:** glossaries package.

Shortcut that uses

`\newglossaryentry` to define an acronym. [§6.1]

`\newcommand{⟨cmd⟩}[⟨n-args⟩][⟨default⟩]{⟨text⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Defines a new command. (See [Volume 1](#) [15, §8].) [§4.2]

`\newgidx{⟨label⟩}{⟨title⟩}`

**Defined in:** datagidx package.

## Symbols

A	N
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## Summary of Commands and Environments

Defines a new index (or glossary) database. [§6.2]

```
\newglossary[/log-ext]{<name>}  
{<in-ext>}{<out-ext>}{<title>}  
[<counter>]
```

**Defined in:** glossaries package.

Defines a new glossary. [§6.1]

```
\newglossaryentry{<label>}{<key-val  
list>}
```

**Defined in:** glossaries package.

Defines a new glossary entry or term. [§6.1]

```
\newline
```

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Forces a line break. [§4.7]

```
\newterm[<options>]{<name>}
```

**Defined in:** datagidx package.

Defines a new index or glossary term. [§6.2]

```
\newtheorem{<name>}[<counter>]  
{<title>}[<outer  
counter>]
```

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Defines a new theorem-like environment. The optional arguments are mutually exclusive. Some packages, such as ntheorem and amsthm, redefine this command to have a starred variant that defines unnumbered theorem-like environments. [§4.7]

```
\newtheoremstyle{<name>}  
{<space above>}{<space  
below>}{<body  
font>}{<indent>}{<head  
font>}{<post head  
punctuation>}{<post head
```

## Symbols

A	N
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H	U
I	V
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M	Z

`space}\{head spec}`

**Defined in:** amsthm package.

Defines a new theorem style called `<name>`. [§4.7]

`\normalfont`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Switches to the default font style. (See **Volume 1** [15, §4.5.1].) [§4.2]

`\num{<number>}`

**Defined in:** siunitx package.

Typesets `<number>` with appropriate spacing. [§4.9]

## O

`\ofoot[<scrplain>]  
{<scrheadings>}`

**Defined in:** scrpage2 package.

Indicates what to put in the outer footer area for the `scrplain` and `scrheadings` page styles. [§4.2]

`\ohead[<scrplain>]  
{<scrheadings>}`

**Defined in:** scrpage2 package.

Indicates what to put in the outer heading area for the `scrplain` and `scrheadings` page styles. [§4.2]

`\onehalfspacing`

**Defined in:** setspace package.

Switches to one-half line-spacing. [§4.3]

## P

`\pagemark`

**Defined in:** scrpage2 package.

Used in commands like `\ihead` to insert the current page number. [§4.2]

## Symbols

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C	P
D	Q
E	R
F	S
G	T
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J	W
K	X
L	Y
M	Z

`\pagenumbering{<style>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Sets the style of the page numbers. [§2.0]

`\pagestyle{<style>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Sets the style of the headers and footers. [§4.2]

`\par`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Insert a paragraph break. [§1.0]

`\Parencite[<prenote>]`

`[<postnote>]{<key>}`

**Defined in:** biblatex package.

Like `\parencite` but for use at the start of a sentence. [§5.3]

`\parencite[<prenote>]`

`[<postnote>]{<key>}`

**Defined in:** biblatex package.

Like `\cite` but the citation is enclosed in parentheses. [§5.3]

`\parindent`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

A length register that stores the indentation at the start of paragraphs. (See [Volume 1](#) [15, §2.17].) [§4.7]

`\per`

**Defined in:** siunitx package.

Indicates a divider in commands like `\si`. [§4.9]

`\pnumfont`

**Defined in:** scrpage2 package.

## Symbols

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I	V
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M	Z

Determines the font used by `\pagemark` with the `scrplain` and `scrheadings` page styles. [§4.2]

`\printbibliography[⟨options⟩]`

**Defined in:** `biblatex` package.

Prints the bibliography. [§5.3]

`\printglossaries`

**Defined in:** `glossaries` package.

Prints all of the defined glossaries. [§6.1]

`\printglossary[⟨key-val option list⟩]`

**Defined in:** `glossaries` package.

Prints the glossary identified in the optional argument or the default glossary if none identified. [§6.1]

`\printindex`

**Defined in:** `makeidx` package.

Prints the index. Must be used with `\makeindex` and `\index`. (The external index file must first be processed by an indexing application.) [§6.1]

`\PrintSemicolon`

**Defined in:** `algorithm2e` package.

Switches on the end of line semi-colon. (See also `\DontPrintSemicolon`.) [§4.8]

`\printterms[⟨options⟩]`

**Defined in:** `datagidx` package.

Displays the index or glossary or list of acronyms. [§6.2]

`\begin{Proof}[⟨title⟩]`

**Defined in:** `ntheorem` package with standard package option.

Typesets its contents as a proof. [§4.7]

## Symbols

A	N
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`\begin{proof}[(title)]`

**Defined in:** amsthm package.

Typesets its contents as a proof.  
[§4.7]

`\publishers{<text>}`

**Defined in:** scrartcl, screprt, scrbook classes.

Specifies the publisher (set after all the other titling information).  
[§2.0]

## Q

`\qedhere`

**Defined in:** amsthm package.

Overrides default location of QED marker in [proof](#) environment. [§4.7]

`\qedsymbol`

**Defined in:** amsthm package.

QED symbol used at the end of the [proof](#) environment. [§4.7]

## R

`\raggedright`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Ragged-right paragraph justification. (See [Volume 1](#) [15, §2.12].) [§4.1]

`\raggedsection`

**Defined in:** KOMA-Script classes, such as scrbook and screprt.

Governs the justification of headings. Defaults to [\raggedright](#) [§4.1]

`\ref{<string>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

References the value of the counter linked to the given label.

## Symbols

A	N
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## Summary of Commands and Environments

A second (possibly third) run of  $\LaTeX$  is required to ensure the cross-references are up-to-date. (See [Volume 1](#) [15, §5.5].) [§4.5]

`\renewcommand{<cmd>}[<n-args>][<default>]{<text>}`

**Defined in:**  $\LaTeX$  Kernel.

Redefines an existing command. (See [Volume 1](#) [15, §8.2].) [§4.1]

`\Return{<value>}`

**Defined in:** `algorithm2e` package.

For use in algorithm-like environments to indicate a value returned [§4.8]

`\rmfamily`

**Defined in:**  $\LaTeX$  Kernel.

Switches to the predefined serif font. (See [Volume 1](#) [15, §4.5.1].) [§4.1]

`\rvert`

**Defined in:** `amsmath` (Math Mode).

Right vertical bar | delimiter. (See [Volume 1](#) [15, §9.4.9].) [§4.8]

S

`\scshape`

**Defined in:**  $\LaTeX$  Kernel.

Switches to the small-caps form of the current font family, if it exists. (See [Volume 1](#) [15, §4.5.1].) [§4.7]

`\second`

**Defined in:** `siunitx` package.

Indicates the second unit for use in commands like `\si`. [§4.9]

`\SI{<number>}{<unit>}`

**Defined in:** `siunitx` package.

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## Summary of Commands and Environments

Typesets a number and unit, combining the functionality of `\num` and `\si`. [§4.9]

`\si{⟨unit⟩}`

**Defined in:** siunitx package.

Typesets the given unit. [§4.9]

`\sim`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Relational  $\sim$  symbol. [§4.7]

`\singlespacing`

**Defined in:** setspace package.

Switches to single line-spacing. [§4.3]

`\sqrt[⟨order⟩]{⟨operand⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Displays a root. (See [Volume 1](#) [15, §9.4.6].) [§4.5]

`\square⟨unit⟩`

**Defined in:** siunitx package.

Indicates a squared unit in commands like `\si`. [§4.9]

`\squared`

**Defined in:** siunitx package.

Indicates a squared term in commands like `\si` after a unit command such as `\metre`. [§4.9]

`\sum`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Summation  $\sum$  symbol. (See [Volume 1](#) [15, §9.4.7].) [§4.8]

## Symbols

A	N
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M	Z

## T

`\begin{tabbing}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Allows you to define tab stops from the left margin. [§4.6]

`\begin{table}[placement]`

**Defined in:** Most classes that define sectioning commands.

Floats the contents to the nearest location according to the preferred placement options, if possible. Within the environment, `\caption` may be used one or more times, as required. (See [Volume 1](#) [15, §7.2].) [§4.8]

`\tableofcontents`

**Defined in:** Most classes that have the concept of document structure.

Inserts the table of contents. A second (possibly third) run is required to ensure the page numbering is correct. [§2.0]

`\textbf{⟨text⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Renders `⟨text⟩` with a bold weight in the current font family, if it exists. (See [Volume 1](#) [15, §4.5.1].) [§1.0]

`\Textcite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}`

**Defined in:** biblatex package.

Like `\textcite` but for use at the start of a sentence. [§5.3]

`\textcite[⟨prenote⟩][⟨postnote⟩]{⟨key⟩}`

**Defined in:** biblatex package.

## Symbols

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## Summary of Commands and Environments

Like `\cite` but designed for use in the flow of text. [§5.3]

`\texttt{⟨text⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Renders `⟨text⟩` in the predefined monospaced font. (See [Volume 1](#) [15, §4.5.1].) [§6.1]

`\begin{thebibliography}{⟨widest entry label⟩}`

**Defined in:** Most classes that define sectioning commands.

Bibliographic list. (See [Volume 1](#) [15, §5.6].) [§5.0]

`\theorembodyfont{⟨declarations⟩}`

**Defined in:** ntheorem package.

Changes the current theorem body fonts to `⟨declarations⟩`. [§4.7]

`\theoremheaderfont{⟨declarations⟩}`

**Defined in:** ntheorem package.

Changes the current theorem header fonts to `⟨declarations⟩`. [§4.7]

`\theoremnumbering{⟨style⟩}`

**Defined in:** ntheorem package.

Changes the current theorem numbering style to `⟨style⟩`. [§4.7]

`\theoremstyle{⟨style name⟩}`

**Defined in:** ntheorem and amsthm packages.

Changes the current theorem style to `⟨style name⟩`. [§4.7]

`\title{⟨text⟩}`

**Defined in:** Most classes that have the concept of a title page.

## Symbols

A	N
B	O
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Specifies the document title. This command doesn't display any text so may be used in the preamble, but if it's not in the preamble it must be placed before `\maketitle`. [§2.0]

`\titlehead{<text>}`

**Defined in:** scrartcl, scrreprt, scrbook classes.

Specifies the title header (typeset at the top of the title page). [§2.0]

`\begin{titlepage}`

**Defined in:** Most classes that have the concept of a title page.

The contents of this environment are displayed on a single-column page with no header or footer and the page counter is set to 1. [§4.4]

`\ttfamily`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Switches to the predefined monospaced font. (See **Volume 1** [15, §4.5.1].) [§4.5]

U

`\uElseIf{<condition>}{<block>}`

**Defined in:** algorithm2e package.

Like `\ElseIf` but doesn't put "end" after `<block>` [§4.8]

`\uIf{<condition>}{<block>}`

**Defined in:** algorithm2e package.

Like `\If` but doesn't put "end" after `<block>` [§4.8]

`\usepackage[<option-list>]{<package-list>}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

## Symbols

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## Summary of Commands and Environments

Loads the listed package(s). (See [Volume 1](#) [15, §4.2].) [§2.0]

### V

`\vec{⟨c⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Typesets its argument as a vector. (See [Volume 1](#) [15, §9.4.11].) [§4.8]

`\vee`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Operator  $\vee$  symbol. (See [Volume 1](#) [15, §9.4.7].) [§4.7]

`\begin{verbatim}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Typesets the contents of the environment as is. (Can't be used

in the argument of a command.) [§4.5]

`\vfill`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inserts a vertical space that will expand to fit the available height. [§4.4]

`\vspace{⟨length⟩}`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel.

Inserts a vertical gap of the given height. [§4.4]

### W

`\wedge`

**Defined in:** L<sup>A</sup>T<sub>E</sub>X Kernel (Math Mode).

Operator  $\wedge$  symbol. (See [Volume 1](#) [15, §9.4.7].) [§4.7]

## Symbols

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## Summary of Commands and Environments

`\While{⟨condition⟩}{⟨body⟩}`

**Defined in:** algorithm2e package.

For use in algorithm-like environments to indicate a while-loop [§4.8]

### Symbols

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## HISTORY

### 16<sup>th</sup> March, 2013 (Version 1.3)

- Added recap on building the document.
- Added sections on `latexmk` and `arara`.
- Changed examples to use KOMA.
- Added sections on `jabref`, `natbib` and `biblatex`.
- Added information about the `listings`, `siunitx`, `amsthm`, `ntheorem` and `algorithm2e` packages.
- Added section on `datagidx` to the chapter on indexes and glossaries.
- Added summary section.
- Some sections have been reordered.

## *History*

- Removed section on modifying textual tags such as `\contentsname` (now in Volume 1).

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