

5 Textual tools

Every text-handling system needs to support a repertoire of tools for doing things with text. \LaTeX implements many dozens, of which a small selection of the most frequently used is given here:

- footnotes and end-notes;
- marginal notes;
- cross-references, both normal ones and bibliographic citations;
- indexes and glossaries;
- typesetting in multiple columns.

5.1 Footnotes and end-notes

The command `\footnote{Like this}`, followed by the text of the footnote in curly braces, will produce an auto-numbered footnote with a raised small number where you put the command, and the numbered text automatically printed at the foot of the page.¹ The number is reset to 1 at the start of each chapter (but there are packages to override that and make them run continuously throughout the document, or even restart at 1 on each page or section).

¹ Like this.

L^AT_EX automatically creates room for the footnote, and automatically reformats it if you change your document in such a way that the point of attachment and the footnote would move to the next (or preceding) page.

Verbatim inside footnotes

Because L^AT_EX reads the whole footnote before doing anything with it, you can't use the `\verb` (inline verbatim) command inside footnotes on its own: either use the `\VerbatimFootnotes` command from the `fancyvrb` package, or precede `\footnote` with `\protect`, or use (abuse?) the `\url` command instead (which you should be using for Web and email addresses in any case).

Footnotes in titling commands (`\title`, `\author`, etc) are generally regarded as Bad Style, and you should avoid them; if you can't, they produce the symbols *, †, ‡, §, ¶, ||, **, ††, and ‡‡ for the values 1–9 (and an error message for the tenth such footnote). In accordance with standard publishing practice, footnotes inside a `minipage` environment produce lettered notes instead of numbered ones, and they get printed at the bottom of the minipage, *not* the bottom of the physical page (but this too can be changed).

There is a package (`endnote`) to hold over your footnotes and make them print at the end of the chapter instead or at the end of the whole document, and there is a package (`fnpara`) to print many short footnotes in a single footnoted paragraph so they take up less space. It is also possible to have several separate series of footnotes active simultaneously, which is useful in critical editions or commentaries in the Humanities: for example, a numbered series for the original author's original footnotes; a lettered series for footnotes by subsequent commentators or authorities in later editions; and a roman-numeral series for your own footnotes. It is also possible to format footnotes within footnotes.

If your footnotes are few and far between, you may want to use the sequence of footnote symbols above instead of numbers. You can do this by redefining the output of the footnote counter to be the `\fnsymbol` command (with the `footnote` as its argument):

```
\renewcommand{\thefootnote}{\fnsymbol{footnote}}
```

There are also ways to refer more than once to the same footnote, and to defer the positioning of the footnote if it occurs in a float like a Table or Figure, where it might otherwise need to move to a different page, but these techniques are out of scope here.

5.2 Marginal notes

You can add marginal notes to your text instead of footnotes. You need to make sure that you have a wide-enough margin, of course: use the `geometry` package (see section 3.1.2 on page 57) to allocate enough space, otherwise the notes will be too cramped. or as well as

There are several packages to help with formatting marginal notes, but you can also define one yourself. Add this new command to your Preamble:

```
\newcommand{\marginal}[1]{%  
  \leavevmode\marginpar{\tiny\raggedright#1\par}}
```

Then you can use `\marginal{Some text}` where you need it. Be careful, however, because marginal notes are aligned with the line where the command starts, so a very long one followed too closely by another will cause \LaTeX to try and adjust the position so they don't overlap.

We're jumping ahead a bit here, as we haven't covered how to define your own commands yet. I won't even try to explain it here, although the astute reader can probably deduce it by inspection. See Chapter 7 starting on page 161 for more information about making up your own commands.

5.3 References and citations

This is one of the most powerful features of \LaTeX . As we mentioned when discussing Figures and Tables, you can label any point in a document with a name you make up, so that you can refer to it by that name from anywhere else in the document (or even from

another document) and \LaTeX will always work out the right cross-reference number for you, no matter how much you edit the text or move it around.

As we will see later, a similar method is also used to cite documents for a bibliography or list of references, and there are packages to sort and format these in the correct style for different journals or publishers.²

5.3.1 Cross-references

You label the place in your document you want to refer to by adding the command `\label` followed by a short name you make up, in curly braces:³ exactly as we did for labelling Figures and Tables in section 4.2.2 on page 81.

```
\section{New Research}
\label{newstuff}
```

You can then refer to this place from anywhere in the same document with the command `\ref` followed by the name you used, eg

```
In section~\ref{newstuff} there is a list of recent
projects.
```

 In section 13.5 there is a list of recent projects.

- Note the use of the unbreakable space (~) between the `\ref` and the word before it. This prints a space but prevents the line ever breaking at that point, should it fall close to the end of a line when being typeset.
- The `\S` command can be used if you want the section sign § instead of the word 'section' (there is also a `\P` command that produces the paragraph sign or pilcrow ¶).

Labels MUST be unique (that is, each value MUST occur only *once* as a label within a single document), but you can have as many references

² Be aware that in some disciplines where cross-references are not much used, the word 'references' may be used to mean 'bibliographic references'.

³ This section is labelled `normalxref`, for example.

to them as you like. If you are familiar with `HTML`, this is the same concept as the internal linking mechanism using `#` labels (or IDs in XHTML or HTML5).

Labels in normal text: If the label is in normal text, as above, the reference will give the current chapter/section/subsection number (depending on the current document class).⁴

Labels in Tables or Figures: If the label is inside a Table or Figure, the reference provides the Table number or Figure number prefixed by the chapter number (remember that in Tables and Figures the `\label` command MUST come *after* the `\caption` command).

The `\ref` command does not produce the word 'Figure' or 'Table' for you: you have to type it yourself, or use the `varioref` package which automates it.

Labels in lists: A label in an item in an enumerated list will provide the item number. In other lists its value is null or undefined.

Labels elsewhere: If there is no apparent countable structure at the point in the document where you put the label (in a bulleted list, for example), the reference will be null or undefined.

The command `\pageref` followed by any of your label values will provide the page number where the label occurred, instead of the reference number, regardless of the document structure. This makes it possible to refer to something by page number as well as by its `\ref` number, which is useful in very long documents like this one (`varioref` automates this too).

Unresolved references are printed as two question marks, and they also cause a warning message at the end of the log file. There's never any harm in having `\labels` you don't refer to, but using `\ref` when you don't have a matching `\label` is an error, as is defining two labels with the same value.

5.3.2 Bibliographic references

The mechanism used for references to reading lists and bibliographies is very similar to that used for normal cross-references. Instead

⁴ Thus I can refer here to the label at the start of this section as `\ref {normalxref}` and get the value 'Section 5.3.1 on page 110'.

L^AT_EX records the label values each time the document is processed, so the updated values will get used the *next* time the document is processed. You therefore need to process the document one extra time before final printing or viewing, if you have changed or added references, to make sure the values are correctly resolved. Most L^AT_EX editors handle this automatically by typesetting the document twice when needed.

of using `\ref` you use `\cite` or one of the variants explained in section 5.3.2.3; and instead of `\label`, you attach a label value to each of the reference entries for the books, articles, reports, etc that you want to cite. You keep these reference entries in a ***bibliographic reference database*** that uses the B^IB^TE_X data format (see section 5.3.2.2 on page 114).

This does away with the time needed to maintain and format references each time you cite them, and dramatically improves accuracy. It means you only ever have to enter the bibliographic details of your references once, and you can then cite them in any document you write, and the ones you cite will get formatted automatically to the style you specify (eg Harvard, Oxford, IEEE, Vancouver, MLA, APA, etc).

5.3.2.1 Choosing between B^IB^TE_X and *biblatex*

L^AT_EX has two systems for doing citations and references, B^IB^TE_X (old) and *biblatex* (new): both of them use the same file format, also called B^IB^TE_X. Both support the numeric and abbreviated alphabetic style formats built into L^AT_EX plus a very wide range of others.

B^IB^TE_X: the older B^IB^TE_X has been in use for several decades and is still specified in many older document classes, especially journal article and book publishing formats. While it will continue to work, it has several drawbacks:

1. it doesn't handle non-ASCII characters easily;
2. nor does the sort-and-extract program it uses (also called *bibtex*);

Bibliographic reference databases

Although it is possible to type the details of each reference manually, it's much easier to use a program designed for the purpose. There are several available (see [Wikipedia's list](#)), including [Zotero](#) and [Mendeley](#). Both are open-source, but *Mendeley* was recently bought out by Elsevier; although it was still free of charge at the time of writing there have been concerns about Elsevier's use of your data. Their features vary but *Zotero's* primary benefit is that it can grab bibliographic metadata from web pages, so that you don't have to type it in. Both can extract the metadata from the PDFs of articles you download from journal sites. And both can export the data in BIB_TE_X format, which is essential.

Once your data is in BIB_TE_X format, you can manage your collection of references with any of the many free BIB_TE_X-based database programs such as [JabRef](#) (see [Figure 5.1 on the next page](#)).

[Endnote](#) and [Reference Manager](#) are commercial products which do not use the BIB_TE_X data format, but which can export RIS format which *Zotero*, *JabRef*, and *Mendeley* can all import.

You add your entries to whichever system you choose, usually by downloading references from an online database like *Web of Science*, *JSTOR*, *PubMed* etc, or by using *Zotero* to gather the entry from a web page (you can also type references in by hand). *JabRef* lets you click an icon or menu entry and the L^AT_EX citation command will be inserted into your document editor at the cursor location.

3. the style format files (`.bst` files) are written in its own rather strange and unique language, making it extremely difficult to modify them or write new ones;
4. many of the style format files are old and out of date;
5. the range of data fields in references is limited and also out of date.

biblatex the newer `biblatex` system is now a well-established L^AT_EX package to replace almost all of BIB_TE_X. The main advantages are:

1. it works with UTF-8 characters, so non-ASCII, non-Latin, and other writing systems are handled natively, especially when using $X_{\text{L}}\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$.
2. there is a new sort-and-extract program (*biber*) to replace *bibtex*, which also handles UTF-8 natively.
3. the style format files are written entirely in $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ syntax, and under active development, so updating or writing layout formats it is much easier than with $\text{BIB}\text{T}_{\text{E}}\text{X}$.
4. it extends the number and type of data fields that you can use in references.
5. it supports the popular author–year citation format natively, without the need for additional packages.

The only current drawback is that not all of the citation and reference formats supported in $\text{BIB}\text{T}_{\text{E}}\text{X}$ are yet available in *biblatex*, but the range is still wide, and modifications are usually easy to make.

The *biblatex* package with the *biber* program is therefore recommended, especially with $X_{\text{L}}\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$. However, as mentioned, there are a few classes and packages which have not yet been rewritten and may still require $\text{BIB}\text{T}_{\text{E}}\text{X}$ style formats, and there are some less common style formats which are not available for *biblatex*. However, the flexibility of the *biblatex* data model means altering or extending style formats to create your own is much easier than it is for $\text{BIB}\text{T}_{\text{E}}\text{X}$, although this is not a task for the beginner.

Cheatsheet

Clea F Rees has written an excellent cheatsheet with virtually everything on it that you need for quick reference to using *biblatex*. This is downloadable as the package *biblatex-cheatsheet* from CTAN.

5.3.2.2 The $\text{BIB}\text{T}_{\text{E}}\text{X}$ file format

The format for $\text{BIB}\text{T}_{\text{E}}\text{X}$ files is used for both $\text{BIB}\text{T}_{\text{E}}\text{X}$ and *biblatex*, using either *biber* or *bibtex*. The file format is specified in the [original \$\text{BIB}\text{T}_{\text{E}}\text{X}\$ documentation](#) (look on your system for the file `btxdoc.pdf`). The

`biblatex` package and its updated style formats provide many more fields and document types.

Each `BIBTEX` entry starts with an `@` sign followed by the name of the type of document, followed by the whole entry in a single set of curly braces. The first value is the unique key (label) that you make up, followed by a comma:

```
@book{fg,  
...  
}
```

Then comes each field (in any order), using the format:

```
fieldname = {value},
```

There **MUST** be a comma after each line of an entry *except the last line*:

```
@book{fg,  
  title           = {{An Innkeeper's Diary}},  
  author          = {John Fothergill},  
  edition         = {3rd},  
  publisher       = {Penguin},  
  year            = 1929,  
  address         = {London}  
}
```

Some `TEX`-sensitive editors have a `BIBTEX` mode which understands these entries and provides menus or templates for writing them. The rules are:

- There **MUST** be a comma after each line of an entry *except the last line*;
- There **MUST NOT** be a comma after the last field in the entry (*only* — eg after `{London}` in the example);
- Some styles recapitalise the title when they format: to prevent this, enclose the title in double curly braces as in the example;
- Also use extra curly braces to enclose multi-word surnames, otherwise only the last will be used in the sort, and the others will be assumed to be forenames, for example the British explorer can be sorted under T with `author = {Ranulph {Twisleton Wykeham Fiennes}};`

- Multiple authors go in the one `author` field, separated by the word `and` (see example below);
- Values which are purely numeric (eg years) may omit the curly braces;
- Fields can occur in any order but the format must otherwise be strictly observed;
- Fields which are not used do not have to be included (so if your editor automatically inserts them as blank or prefixed by `OPT` [optional], you can safely delete them as unused lines).

There is a required minimum set of fields for each of a dozen or so types of document: book, article (in a journal), article (in a collection), chapter (in a book), thesis, report, conference paper (in a Proceedings), etc, exactly as with all other reference management systems. These are all (entry types and entry fields) listed in detail in the `biblatex` documentation (Lehman, Kime, Boruvka & Wright, 2015, sections. 2.1 & 2.2, 8).

Here's another example, this time for a book on how to write mathematics — note the multiple authors separated by `and`.

```
@book{mathwrite,  
  author =      {Donald E Knuth and Tracey Larrabee and Paul M Roberts},  
  title =       {{Mathematical Writing}},  
  publisher =   {Mathematical Association of America},  
  address =     {Washington, DC},  
  series =      {MAA Notes 14},  
  isbn =        {0-88385-063-X},  
  year =        {1989}}
```

Every reference in your reference database MUST have a unique key value (label or ID): you can make this up, just like you do with normal cross-references, but some bibliographic software automatically assigns a value, usually based on an abbreviation of the author and year. These keys are for *your* convenience in referencing: in normal circumstances your readers will not see them. You can see these labels in the right-hand-most column and at the bottom of the screenshot in Figure 5.1, and in the examples above. You use this label in your documents when you cite your references (see section 5.3.2.3 on page 117).

There are many built-in options to the `biblatex` package for adjusting the citation and reference formats, only a few of which are covered

here. Read the package documentation for details: it is possible to construct your own style simply by adjusting the settings, with no programming required (unlike the older $\text{BIB}\text{T}\text{E}\text{X}$ styles, which are written in a programming language used nowhere else).

Many users keep their $\text{BIB}\text{T}\text{E}\text{X}$ files in the same directory as their document[s], but it is also possible to tell $\text{L}\text{A}\text{T}\text{E}\text{X}$ and $\text{BIB}\text{T}\text{E}\text{X}$ that they are in a different directory. This is a directory specified by the $\$BIBINPUTS$ shell or environment variable. On Unix & GNU/Linux systems (including Apple Macintosh OS X), and in TEX Live for Windows, this is your TEX installation's `texmf/bibtex/bib` directory — the same one that old-style $\text{BIB}\text{T}\text{E}\text{X}$ `.bst` style files are kept in — but you should use your *personal TEX directory* and create a subdirectory of the same name in there for your own `.bib` files. $\text{M}\text{I}\text{K}\text{T}\text{E}\text{X}$ also uses the same $\$BIBINPUTS$ variable, but it is not set on installation: you need to set it using the Windows Systems Settings (see for example www.computerhope.com/issues/ch000549.htm).

5.3.2.3 Citation commands

The basic command is `\cite`, followed by the label of the entry in curly braces. You can cite several entries in one command: separate the labels with commas.

```
\cite{fg}
\cite{bull,davy,heller}
```

For documents with many citations, use the Cite button or menu item in your bibliographic reference manager, which will insert the relevant command for you (you can see it activated for the *TeXStudio* editor in [Figure 5.1 on the preceding page](#)).

How the citation appears is governed by two things:

1. the reference format (style) you specify in the options to the `biblatex` package (see [section 5.3.2.4 on page 120](#)) or in a `\bibliographystyle` command if you are using $\text{BIB}\text{T}\text{E}\text{X}$ (see [section 5.3.2.5 on page 120](#)) instead of `biblatex`;
2. the type of citation command you use: `\cite`, `\textcite`, `\parencite`, `\autocite`, `\footcite`, etc, as shown below.

There are three built-in formats in `biblatex`:

authoryear: There are two basic types of author–year citation:

year in parentheses: used in phrases or sentences where the name of the author is part of the sentence, and the year is there to identify what is being cited; in `biblatex` this command is `\textcite{fg}`

... as has clearly been shown by Fothergill (1929).

This is sometimes called ‘author-as-noun’ citation.

whole citation in parentheses: used where the phrase or sentence is already complete, and the citation is being added in support: in `biblatex` this command is `\parencite{fg}`

... as we have already clearly shown (Fothergill, 1929).

Note that author–year format is not built into `LATEX` but can be done with the use of the `natbib` package and others.

numeric: This format is popular in some scientific disciplines and `\cite` produces just a number in square brackets [42]. The references at the end of the document may be numbered in order of reference or sorted by author.

alphabetic: This format is also popular in some scientific disciplines and `\cite` produces a three- or four-letter abbreviation of the author’s name and two digits of the year, all in square brackets [Fot29]. The references at the end of the document are listed with the the abbreviated key value as their label. This format is also called ‘abbreviated’.

To direct your reader to a specific page or chapter, you can add a prefix and/or a suffix as optional arguments in square brackets before the label.

```
...as shown by \textcite[p 12]{mathwrite}.
```

A prefix gets printed at the start of the citation and the suffix gets printed at the end, but all still within the parentheses, if any. As they are both optional arguments, and as suffixes are far more common than prefixes, when only one optional argument is given, it is assumed to be the suffix.. The example here therefore produces:

... as shown by Knuth et al. (1989, p. 12).

Table 5.1: Built-in citation style commands and formats (`biblatex`)

Style	Command	Result
authoryear	<code>\parencite{fg}</code>	(Fothergill, 1929)
authoryear	<code>\textcite{fg}</code>	Fothergill (1929)
authoryear	<code>\footcite{fg}</code>	¹
numeric	<code>\cite{fg}</code>	[42]
alphabetic	<code>\cite{fg}</code>	[Fot29]
authoryear	<code>\cite{fg}</code>	Fothergill 1929

¹ Fothergill 1929.

If you are using `bibtex` instead of `biblatex`, you can only specify a suffix.

Footnoted citations are common in History and related disciplines, to the extent that scholars in these fields actually call their references ‘footnotes’, which is confusing to others.⁵ The command `\footcite` does these (see Table 5.1 on page 119) but it is only relevant for author-year styles (in numeric style it just produces the number, which would be misleading).

There are many variant forms of the citation commands, either for specific styles like Harvard, IEEE, APA, MLA, etc; or for grammatical modifications like capitalising name prefixes, omitting the comma between name and year, or adding multiple notes; or for extracting specific fields from an entry (eg `\titlecite`). If you have requirements not met by the formats described here, you can find them in the documentation for the `biblatex` package.

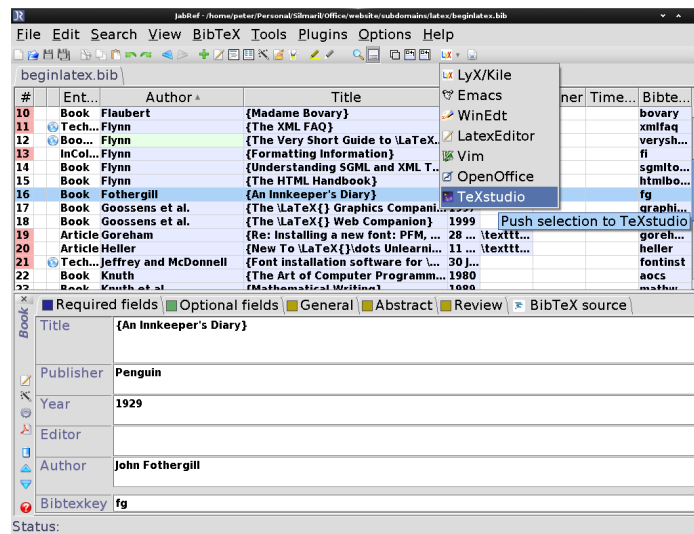
Modern Language Association (MLA) citation is a special case, as it omits the year and instead REQUIRES the location of the citation within the document (eg the chapter, section, page, or line). It may include the title, if there would otherwise be ambiguity. The `biblatex` format for MLA citation handles the context-dependent formatting with the command `\autocite`; for `BIBTEX` there is an old version of MLA implemented in the `mla` and `hum2` packages.

If you are using `BIBTEX` instead of `biblatex`, the commands you can use are not standardised except for `\cite`. Instead, they depend on which style format you use; for example the popular `natbib` package, which

⁵ It’s not clear how they refer to conventional footnotes, or if they even use them.

implements author-year citation for the natural sciences, uses `\citet` and `\citep` instead of `\textcite` and `\parencite`.

Figure 5.1: JabRef displaying a file of references, ready to insert a citation of Fothergill's book into a L^AT_EX document being edited with T_EXStudio



Your reference management software will have a display something like Figure 5.1 on page 119 (details vary between systems, but they all do roughly the same job in roughly the same way), showing all your references with the data in the usual fields (title, author, date, etc).

Your B^IB^T_EX file, which contains all your bibliographic data, can be saved or exported as a `.bib` file from most reference management software (*JabRef* uses this format natively), It looks like the examples in section 5.3.2.2 on page 114. Your `.bib` file works with both *biblatex* and *biber*, but *biblatex* provides more field types and document types so that your references can be formatted more accurately.

If your bibliographic management software doesn't save B^IB^T_EX format direct, save your data in RIS format, then import the `.ris` file into *JabRef* and save it as a `.bib` file from there.

5.3.2.4 Setting up *biblatex* with *biber*

You set up your document with the following packages:

1. the `babel` package with appropriate languages, *even if you are only using one language*. The default language is American English, so there are commands to map this to other language variants (the example below shows this for British English);
2. the `csquotes` package, which automates the use of quotation marks around titles or not, depending on the type of reference;
3. the `biblatex` package itself, specifying the *biber* program and the style of references you want, either `numeric`, `alphabetic`, or `authoryear`; or a publisher's style (in this example I am using `APA` format); and any options for handling links like DOIs, URIs, and ISBNs;
4. the language mapping command, if needed (see the documentation for the style you have chosen to find out if you need this);
5. finally, the name of your `BIBTEX` file[s] (see the panel 'Bibliographic reference databases' on p.113) with one or more `\addbibresource` commands.

```
\usepackage[frenchb,german,british]{babel}
\usepackage{csquotes}
\usepackage[backend=biber,doi=true,isbn=true,
  url=true,style=apa]{biblatex}
\DeclareLanguageMapping{british}{british-apa}
\addbibresource{myrefs.bib}
```

At the end of your document you need to add the `\printbibliography` command (or elsewhere at the point in your document where you want the full list of references you have cited to be printed). See section 5.3.2.6 on page 122 for details of how `XYTEX` produces the references.

5.3.2.5 Using `BIBTEX`

The principles underlying `BIBTEX` are identical to `biblatex`: you create and maintain your `BIBTEX` file of references in exactly the same way, and you use the `\cite` in the same way. But there is no basic package to load with options: instead, you specify the name of the style you want,

Versions of *biber* and *biblatex*

One critically important point to note is that *biblatex* and *biber* are step-versioned; that is, each version of the *biblatex* package only works with a specific version of the *biber* program. There is a table of these dependencies in the *biblatex* documentation PDF. If you manually update *biblatex* for some reason (perhaps to make use of a new feature), you **MUST** also update your copy of *biber* to the correct version, and *vice versa*, otherwise you will not be able to produce a bibliography.

The $\text{BIB}\TeX$ method is nowadays deprecated, partly because it does not handle UTF-8 character-encoding correctly, and partly because its unusual internal programming language makes it hard to extend.

using a `\bibliographystyle` command in your Preamble, plus any additional packages needed to help with the formatting. You then use the `\bibliography` command to give the name of your $\text{BIB}\TeX$ file (*without* the `.bib` extension) *at the point you want the references to be printed*.

```
\bibliographystyle{apsr}  
\usepackage{natbib,har2nat}  
...  
\bibliography{myrefs}
```

In this example the American Political Science Review (APSR) variant of the Harvard reference style has been selected (common in the political and economic sciences), which normally means numerical citation, but the author wants the Natural Sciences (author-year) form of citation, which is provided by the *natbib* package, which in turn requires the *har2nat* package to handle Harvard-style formatting. As explained above, the *natbib* package provides `\citet` for textual citation like Fothergill (1929), and `\citep` for parenthetical citation like (Fothergill, 1929).

There is an option on all the `cite` commands and variants to let you specify a suffix to the citation, so `\citep[Foreword, p.13]{fg}` produces (Fothergill, 1929, p. 13, Foreword).

See section 5.3.2.6 on page 122 for details of how PDF \LaTeX produces the references.

5.3.2.6 Producing the references

Because of the `record-extract-format` process (the same as used for cross-references), you will get a warning message about ‘unresolved references’ the first time you process your document after adding a new citation for a previously uncited work and running *biber* or *bibtex*. The *bibtex* program produces a bold ?? where the unresolved reference will be; *biber* produces the entry label in bold instead. This will disappear once \LaTeX has been run again, which is why most editors have a Build function to do the job for you.

Your \LaTeX editor’s `Typeset` or `Build` button or menu entry should therefore handle the business of running *biber* or *bibtex* for you. If not, here’s how to do it manually in a Command window:

For X \LaTeX with *biber*: Run X \LaTeX , then run *biber* to extract and sort the details from the `BIB \TeX` file, and then run X \LaTeX again:

```
xelatex myreport
biber myreport
xelatex myreport
```

For PDF \LaTeX with *bibtex*: Run PDF \LaTeX , then run *bibtex* to extract and sort the details from the `BIB \TeX` file, and then run PDF \LaTeX again twice (to resolve the references):

```
pdflatex myreport
bibtex myreport
pdflatex myreport
pdflatex myreport
```

In practice, authors tend to retypeset their documents from time to time during writing anyway, so they can keep an eye on the typographic progress of the document. Just clicking the `Typeset` or `Build` button after adding a new `\cite` command, and subsequent runs of \LaTeX

will incrementally incorporate all references without you having to worry about it.

If you work from the command line, the *latexmk* script automates this, running *bibtex* or *biber* and re-running L^AT_EX again when needed.

5.4 Indexes and glossaries

Indexes and glossaries are tools for directing or helping the reader. Any book or report sized document should have an index, although they are uncommon in theses. Glossaries are usually only needed where there is a substantial number of technical terms needing formal definition and cross-referencing.

5.4.1 Indexes

L^AT_EX has an automated indexing facility which uses the standard *makeindex* program for sorting and collation. To use indexing, use the package `makeidx` and include the `\makeindex` command in your Preamble to initialise the index:

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

When you want to index something, use the command `\index` followed by the entry in curly braces, as you want it to appear in the index, in one of the following formats:

Plain entry: Typing `\index{beer}` will create an entry for 'beer' with the current page number;

Subindex entry: For an entry with a subentry use an exclamation mark to separate them: `\index{beer!lite}`. You can create another level as well, so you can have subsubentries like `\index{beer!lite!American}`;

Cross-references: 'See' entries are done with the vertical bar (one of the rare times it does *not* get interpreted as a math character): `\index{Microbrew|see{beer}}`;

Font changes: To change the style of an entry, use the @-sign followed by a font change command:

```
\index{beer!Rogue!Chocolate Stout@\textit{Chocolate Stout}}
```

This example indexes *Chocolate Stout* as a third-level entry and italicises it at the same time. Any of the standard `\text` font-change commands work here: see Table 6.7 on page 150 for details.

You can also change the font of the index number on its own, as for first-usage references, by using the vertical bar in a similar way to the ‘see’ entries above, but substituting a font-change command name alone (*without* a backslash or curly braces) such as `textbf` for bold-face text (see the index):

```
\index{beer!Rogue!Chocolate Stout|textbf}
```

Out of sequence: The same method can be used as for font changes, but using the alternate index word instead of the font command name, so `\index{Oregon Brewing Company@Rogue}` will add an entry for ‘Rogue’ in the ‘O’ section of the index, as if it was spelled ‘Oregon Brewing Company’.

When the document has been processed through \LaTeX it will have created a `.idx` file, which you run through the `makeindex` program by clicking the `Index` button or menu entry in your editor, or by typing the `$makeindex` command followed by your document name without the `.tex` filetype.

The program will look for the `.idx` file with the same name as your document, and output a `.ind` file with the sorted index in it. This is what gets used by the command `\printindex` which you put at the end of your document, where you want the index printed. The default index format is two columns with a space between letters of the alphabet. The Unix manual page⁶ for the `makeindex` program has details of how to add letter headings to each alphabet group.

⁶ On Unix & GNU/Linux systems (including Apple Macintosh OSX, just type the command `$man makeindex`; the page is also available in many reference sites on the web.

5.4.2 Glossaries

Glossaries can be done in a similar manner to indexes, using the command `\makeglossary` in the Preamble and the command `\glossary` in the same way as `\index`. There are some subtle differences in the way glossaries are handled: both the books by Lamport (1994) and by Mittelbach, Goossens, Braams, Carlisle and Rowley (2004) duck the issue, but there is some documentation on `glotex` on CTAN. There is also a `gloss` package based on BIBTEX which uses `\gloss` in the same way as `\cite`.

However, by far the best way is to use the `glossaries` package (not `glossary`, which is obsolete, and not `gloss`). This is a relatively complex package, as glossaries are a relatively complex tool, but there is extensive help in the documentation. It requires the `makeglossaries` script from CTAN (there is also a `makeglossariesgui` Java GUI).

Basically, you need to create a set of definitions, one per item to be glossed, using the `\newglossaryentry` command:

```
\newglossaryentry{esis}{name={ESIS},description={The
\textbf{Element Structure Information Set} of a
marked-up document, originally defined for SGML
(replaced for XML using W3C Schemas by the
Post-Schema-Validation InfoSet, PSVI). See
\url{http://xml.coverpages.org/WG8-n931a.html}}}
```

This specifies *a*) the label you will use (`esis`); *b*) the name of the item as it will be printed (`ESIS`); and *c*) the textual description to go in the glossary. Probably the best place to put these is in a separate file like `mygloss.tex`, which you can get L^AT_EX to read with an `\input{mygloss.tex}` command in your Preamble.

You can then use the `\gls` command in your text to produce the printable name of any entry, using the label to refer to it, eg `\gls{esis}`. It is possible to use or define variant commands to handle references at the start of a sentence (where you need a capital letter if the name is not an acronym), and grammatical alteration like unusual plurals or forms ending in ‘—ing’.

At the end of your document, where you want the glossary printed, you use the command `\printglossaries`. The glossary need to be processed separately from the main document, using the `makeglossaries`

script, exactly the same way as you do for *biber*, *bibtex*, and *makeindex*. The Build function of your editor should do this for you, or use a Makefile or a utility like *latexmk*. As with all these tools, there are many more facilities built into them: read the documentation.

The [acronym](#) package can also be used to create a kind of glossary containing a list of acronyms and their expansions, as well as driving the use of expansion on first mention. However, the [glossaries](#) package now contains built-in support for acronyms.

5.5 Multiple columns

Use the `multicol` package: the environment is called `multicols` (note the plural form) and it takes the number of columns as a second argument in curly braces:

```
\usepackage{multicol}
...
\begin{multicols}{3}
...
\end{multicols}
```

TeX has built-in support for two-column typesetting via the `twocolumn` option in the standard Document Class Declarations, but it is relatively inflexible in that you cannot change from full-width to double-column and back again on the same page, and the final page does not balance the column heights. However, it does feature special `figure*` and `table*` environments which type-

set full-width figures and tables across a double-column setting.

The more extensive solution is the `multicol` package, which will set up to 10 columns, and allows the number of columns to be changed or reset to one in mid-page, so that full-width graphics can still be used. It also balances the height of the final page so that all columns are the same height — if possible: it's not

always achievable — and you can control the width of the gutter by setting the `\columnsep` length to a new dimension.

Multi-column work needs some skill in typographic layout, though: the narrowness of the columns makes typesetting less likely to fit smoothly because it's hard to hyphenate and justify well when there is little space to manoeuvre in.