Various tools are available to help maintain BibTeX databases (see [109, §13.4] for details). These include tools to sort databases, search them, syntax check and pretty print them (the program bibclean [17] even checks ISBN and ISSN fields to see whether the checksum is correct), and extract from them the entries cited in a set of aux files (so as to create a bib file containing only the entries used in a particular document). Many of the utilities are available from BibNet. Some of these tasks are easy to do oneself using AWK, which is an interpreted programming language available on most Unix systems [4]. For example, the command line

\begin{verbatim}
awk 'BEGIN{ RS="" } /Riemann/ m
\end{verbatim}

searches the file my.bib in the current directory and prints all the entries that contain the word Riemann (assuming that records are separated by a blank line). Note that this AWK call prints complete bib entries, not just the lines on which the word occurs, as a grep search would.

13.4. Indexing and MakeIndex

An index to a book (or thesis, or report) has three main purposes.

1. To provide easy access to all the significant information.

2. To reveal relationships.

3. To reveal omissions.

A good index is therefore much more than a table of contents. But it is much less than a list of every important word, since it records useful information, not just key words. While a printed book is necessarily expressed in a linear order, the index is not constrained by ordering and can therefore reveal links between different parts of the book and bring together topics described in the text with varying terminology. A good index saves time for the reader as a result of what it does not contain: if a topic is not present in the index the reader can be sure that it is not covered in a significant way in the text.

An index should contain surprises—pointers to passages that the reader might overlook when scanning the book and its table of contents. It should anticipate the various ways in which a reader might search for a topic, by including it under multiple entries, where appropriate. For example, block. LU factorization might be listed under block, factorization, LU, and, in a book not about matrices, under matrix. Since decomposition is a commonly used synonym for factorization, an entry “decomposition, see factorization” would also be appropriate in this example.
13.4. Indexing and MakeIndex

One source of index entries is section and subsection headings, since these provide the framework of the text. Entries should be nouns or nouns preceded by adjectives. Any conventions used in the index must be explained in a note at the beginning. For example, you might use “" after a page number to denote reference to a table, and “" for a figure.

If many names are to be indexed, it is worth creating separate name and subject indexes, as in this book. One reason for indexing names is to enable the reader to find where a particular paper in the bibliography is referenced, assuming, of course, that the author's name is mentioned at the point of reference.

A common mistake is to produce an index entry with too many page locators. If there are more than about five page locators, subentries should be introduced to help the reader pinpoint the information required. For example, the index entry

\begin{verbatim}
    norm, 119-121, 123, 135, 159, 180
\end{verbatim}

is much better broken down into, for example,

\begin{verbatim}
    norm
      absolute, 119, 121
dual, 120
elliptic, 180
Hölder inequality, 123
spectral radius, relation with 135
unitarily invariant, 159
\end{verbatim}

In the following example the subentries serve little purpose because they all have the same page number:

\begin{verbatim}
    LU factorization
      definition, 515
      existence, 515
      uniqueness, 515
\end{verbatim}

This example should be collapsed into the single entry "LU factorization, 515", which is just as useful for a reader searching for information about the LU factorization.

Choose as main headings the word that the reader is most likely to look under. Thus

\begin{verbatim}
    equations, displaying, 54
equations, 54
\end{verbatim}

is better than

\begin{verbatim}
    displaying equations, 54
displaying equations, 54
\end{verbatim}
This example is formatted as if there are no other subentries of “equations”. In the examples below, the subentry is assumed to be one of several and so appears on a separate line.

In subentries, use connectives to clarify the meaning of the entries. The entry

slides
   number, 138

could refer to a discussion on how to number the slides or on how many to produce. Adding the word “of” avoids the ambiguity:

slides
   number of, 138

It can be useful to add the word “of” even in unambiguous cases to make the entry read smoothly from subentry to heading:

words
   order of, 60

In traditional typesetting, indexing was a task to be done once a book was at the page-proof stage, and was often performed under severe time pressure. Nowadays, authors typesetting their own books by computer can index earlier in the production process, making use of indexing software.

MakeIndex is a C program, written by Pehong Chen [56], [109, Chap. 12] with advice from Leslie Lamport, that makes an index for a \textsc{\LaTeX} document. The user has to place \texttt{index} commands in the \textsc{\LaTeX} source that define the name and location of the items to be indexed. If a \texttt{makeindex} command is placed in the preamble (before \texttt{\begin{document}}) then \textsc{\LaTeX} writes the index entries, together with the page numbers on which they occur, to an \texttt{idx} file. This is read by the MakeIndex program, which processes and sorts the information, producing an \texttt{ind} file that generates the index when included in the \textsc{\LaTeX} document (see Figure 13.1). MakeIndex provides various options in the \texttt{index} command to support standard indexing requirements, such as subentries, page ranges and cross-references to other entries. Here is how the beginning of one sentence from page 187 was typed:

\texttt{\item It is easy to prepare\transparencies\index{slides!preparing in \TeX}\with \TeX\ if the paper}

The exclamation mark in the \texttt{index} command denotes the beginning of a subentry. Multiple indexes (such as name and subject indexes) can be produced with the aid of the index package by David M. Jones, available from \url{ftp://theory.lcs.mit.edu/pub/tex/index/}

Here are some tips on indexing in \textsc{\LaTeX}.
13.4. Indexing and MakeIndex

1. Insert the index entry immediately following the word to be indexed, on the same line and with no spaces before the \texttt{indexing} command (as in the example above). This ensures that the correct page reference is produced and avoids unwanted spaces appearing in the output.

2. If the scope of the item being indexed is more than one sentence, so that the scope may be broken over a page, index the item as a page range. For example, this list of items is contained within commands:

   \texttt{\index{LaTeX\LaTeX!indexing in|}}
   \texttt{\index{indexing!in latex in \LaTeX|}}
   \texttt{\index{LaTeX\LaTeX!indexing in|}}

   The \texttt{\}} and \texttt{\}} strings serve to delimit the range of the index command.

3. See entries can be produced by commands of the form

   \texttt{\index{dots|see{ellipsis}}}

   To produce also \texttt{see also} entries in an analogous way you can use the following definition, adapted from that for \texttt{\index{makeidx}}.

   \texttt{\newcommand{\seealso}[2]{\textbf{\textit{\texttt{\textbf{\textit{see also}} #1}}}}}

   Place all \texttt{see} and \texttt{see also} index entries together, to make it easier to edit them and check for consistency. I suggest placing them after the last item in the book to be indexed (ideally, just before the bibliography); this ensures that \texttt{see also} appears after the page references for an entry.

4. Do not leave the task of indexing to the very last stage. For, in inserting the \texttt{\index} entries, you are likely to introduce errors (of spacing, at least) and so a further round of proofreading will be needed after the indexing stage.

   AWK tools for indexing are described in [4, §§3] and [22]; these tools do not support subentries. A simple and elegant way to construct key word in context (KWIC) indexes using AWK is also described in [4]. A KWIC index lists each word in the context of the line in which it is found; the list is sorted by word and arranged so that the key words line up. One of the main uses of KWIC indexes is to index titles of papers.

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From "Handbook of Writing for the Mathematical Sciences" by Nicholas J. Higham
For an interesting example of an index, see Halmos’s *I Want to Be a Mathematician* [127]. Priestley [230] says “If index writing has not bloomed into an art form in *I Want to Be a Mathematician*, it has at least taken a quantum leap forward. From ‘academic titles, call me mister’ to ‘Zygmund, A., at faculty meetings’ this one is actually worth reading.”

**13.5. Further Sources of Information**

The best (and the most humorous) introduction to **TEX** is *Learning **TEX*** [118] by Griffiths and D. J. Higham. A much longer and more detailed book that is very handy for reference is *A Guide to **TEX** 2e* [166] by Kopka and Daly. Lamport’s ***TEX**: A Document Preparation System* [172] is the “official” guide to **TEX**. For those still using the obsolete **TEX** 2.09, Carlisle and Higham [53] explain the advantages to be gained by upgrading to **TEX** 2e.

For technical details of **TEX**, **B**i**TEX** and **M**ake**INDEX**, and descriptions of the many available packages, see *The **TEX** Companion* [109] by Goossens, Mittelbach and Samarin. *The **TEX** Graphics Companion* [110] by Goossens, Rahtz and Mittelbach is the most comprehensive and up-to-date reference on producing graphics with **TEX** and PostScript. If you are a really serious **TEX** or **T**eX user you will want to study Knuth’s *The **T**eXbook* [161], the “bible” of **TEX**, or another advanced reference such as Salomon’s *The Advanced **T**eXbook* [244].

**B**i**TEX** is described in all the **TEX** textbooks mentioned above, but most comprehensively in *The **TEX** Companion* [109].

An article by Knuth [158]24 offers many insights into mathematical typesetting and type design, and describes early versions of **TEX** and METAFONT (METAFONT [160] is Knuth’s system for designing typefaces).

The Comprehensive **TeX** Archive Network (CTAN) is a network of ftp servers that hold up-to-date copies of all the public domain versions of **TeX**, **TEX**, and related macros and programs. The three main sites are at

```
ftp.dante.de,   http://www.dante.de/
ftp.tex.ac.uk, http://www.tex.ac.uk/tex-archive
```

which are located in Germany, England and Massachusetts, USA, respectively. There are many mirror sites around the world, details of which may be obtained from the **TeX** Users Group (TUG) Web pages. The organization of **TeX** files is the same on each site and starts at */tex-archive*. To search a CTAN site during an anonymous ftp session type the command.

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24The beginning of the abstract is quoted on page 86.
13.5. Further Sources of Information

The best (and the most humorous) introduction to \TeX{} is *Learning \TeX{}* [118] by Griffiths and D. J. Higham. A much longer and more detailed book that is very handy for reference is *A Guide to \TeX{} & \LaTeX{}* [166] by Kopka and Daly. Lamport’s *\LaTeX: A Document Preparation System* [172] is the “official” guide to \LaTeX{}. For those still using the obsolete \TeX{} 2.09, Carlisle and Higham [53] explain the advantages to be gained by upgrading to \LaTeX{} 2ε.

For technical details of \TeX{}, \LaTeX{} and \MakeIndex{}, and descriptions of the many available packages, see *The \TeX{} Companion* [109] by Goossens, Mittelbach and Samarin. The \TeX{} Graphics Companion [110] by Goossens, Rahtz and Mittelbach is the most comprehensive and up-to-date reference on producing graphics with \LaTeX{} and PostScript. If you are a really serious \TeX{} or \LaTeX{} user you will want to study Knuth’s *The \TeX{} Book* [161], the “bible” of \TeX{}, or another advanced reference such as Salomon’s *The Advanced \TeX{} Book* [244].

\LaTeX{} is described in all the \TeX{} textbooks mentioned above, but most comprehensively in *The \TeX{} Companion* [109].

An article by Knuth [158] offers many insights into mathematical typesetting and type design, and describes early versions of \TeX{} and METAFONT (METAFONT [160] is Knuth’s system for designing typefaces).

The Comprehensive \TeX{} Archive Network (CTAN) is a network of ftp servers that hold up-to-date copies of all the public domain versions of \TeX{}, \LaTeX{}, and related macros and programs. The three main sites are at

\begin{itemize}
  \item ftp.dante.de, \url{http://www.dante.de/}
  \item ftp.tex.ac.uk, \url{http://www.tex.ac.uk/tex-archive}
  \item tug2.cs.umb.edu, \url{http://tug2.cs.umb.edu/ctan/}
\end{itemize}

which are located in Germany, England and Massachusetts, USA, respectively. There are many mirror sites around the world, details of which may be obtained from the \TeX{} Users Group (TUG) Web pages. The organization of \TeX{} files is the same on each site and starts at \verb|/tex-archive|. To search a CTAN site during an anonymous ftp session type the command

\begin{itemize}
  \item \verb|find /tex|, where \verb|/tex| is a Unix regular expression (a filename optionally containing wildcards) on which to search.
\end{itemize}

The TUG runs courses and conferences on \TeX{} and produces a journal called *TUGboat*. It also produces a newsletter for members called *\TeX{} and \LaTeX{} News*. Contact details for TUG are given in Appendix D.

The UK \TeX{} Users Group, based in the UK, also organizes meetings and produces a newsletter (called *Baskerville*). It cooperates with TUG and supports the UK \TeX{} archive (the UK node of CTAN). More information is available on the Web at \url{http://www.tex.ac.uk/UKTUG/} or via email to unix-enquiries@ac.ukex.tex

Excellent advice on preparing an index is given in *The Chicago Manual of Style* [58] and in Buxton’s *The Art of Indexing* [35]. The collection *Indexers on Indexing* [130] contains articles on many different aspects of indexing that originally appeared in *The Indexer*, the journal of the Society of Indexers (UK). This society is involved in awarding indexing prizes; the 1975 Wheatley Medal was awarded for the index (by Margaret D. Anderson) to the first edition of [45]. Other good references are *Words into Type* [240] and *Copy-Editing* [45].

\footnote{The beginning of the abstract is quoted on page 86.}