Automatic labels

Abstract

This is an example of a abstract. An abstract is a short description of the contents of the document. As a general rule, abstracts should be no more than a few sentences for papers and a few paragraphs for books. This document describes how to use LaTeX's self numbering and labeling features.

Contents

1 Introduction

This document is designed to illustrate LaTeX's ability to number and reference sections, subsections, theorems, equations, and so on. We will also illustrate appendices, bibliographies, indices, and footnotes.[1] Footnotes are created using `\footnote{text}` and, if appearing at the end of a sentence, should appear after the period.

1.1 Compile more than once

Auxiliary files that store information about labels and page numbers are created the first time the LaTeX source is compiled. The next time LaTeX is compiled, those files are referenced to create the table of contents, section numbers, and theorem numbers. Because of this, LaTeX must be compiled two or three times

[1] Yes, even footnotes! Oh, lucky day!

in order to properly display the labels. The output shown by the compiler may warn you if it appears that LaTeX should be run again.

Sections are created with `\section[TOC name]{Section Name}`, where the optional `[TOC name]` string changes the name of the section in the table of contents. There is also a similar `\subsection` command. To print a section without a number (which will also not show up in the table of contents), use `\section*{Section Name}`. The table of contents is created with the `\tableofcontents` command.

1.2 Bibliographies using BibTeX

Bibliographies can created with BibTeX. To do this, follow these instructions (which have been auto-magically numbered using the `enumerate` environment):

1. create a new file called `file.bib`.
2. In that new file, create or copy and paste bibliography entries in the BibTeX format. Examples of the format can be found in the sample .bib file on our web site.

   BibTeX formatted citations can be copy and pasted from paper indexing services such as MathSciNet or Google Scholar.
3. Cite authors or works using `\cite{name1, name2}`. For example, some of Euler's works include [Euler, 1741, Euler, 1759]. Later, Euler published [Euler, 1775]. To include in the bibliography without citing, use `\nocite`.
4. Place these two lines in the LaTeX file (usually towards the end of the file) before the `\end{document}` command:

   ```
   \bibliography{file}
   \bibliographystyle{alpha}
   ```

   Other choices for the bibliography styles are: `abbrv`, `acm`, `alpha`, `apalike`, `ieeetr`, `plain`, and `siam`.
5. Compile the LaTeX file, compile the bibliography with BibTeX by either
   (a) entering `bibtex file` at the command line (the `.bib` extension is not included after `file`), or
   (b) finding the bibtex command in a drop down menu (look for a command such as `pdflatex+bibtex`),

   and then compile the LaTeX file two more times (unless this has been done automatically by the software).

1.3 Creating an index

To create an index, place these two lines before the `\begin{document}` command:

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

Mark words for inclusion in an index using the `\index{word}` command. The page reference will appear on the same page that the `\index{word}` command is located. There are variations on the `\index` command which can be used to change how the entries appear in the index; such options are found on page 87 of the text.

Similar to BibTeX, the index must be compiled with its own command. To compile an index, compile the LaTeX file, enter `makeindex file` at the command line or use a drop down menu command, then compile the LaTeX file two more times if necessary.

2 Referencing other parts of the text

To mark a location in the text for future reference, insert `\label{name}`. The names for each of the labels in the document must be unique. To reference this label, use the command `\ref{name}` to reference the section (or subsection) and use the `\pageref{name}` to reference the page. For example, we showed how to include bibliographies in Section 1.2 on page 2.

2.1 Referencing in math mode

Cross-referencing is enhanced by the standard `amssymb`, `amsmath`, and `amsthm` packages. To create a numbered displayed equation in mathematics mode, use `\begin{equation}..\end{equation}` instead of the usual `\[..\]`. The `\label{name}` command must appear between the `\begin{equation}` and the `\end{equation}` commands. When later referring to an equation, the command `\eqref{name}` produces parentheses around the equation number.

For example, the following identity can be proved using polar coordinates:

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}. \tag{1}$$

The integral in (1) is known as the Gaussian integral.

Differently named `\label` commands can be placed in each line in either the `align` or `multline` environments. To suppress a line number when using these environments, place the `\nonumber` command somewhere on that line. Instead of a line number, a word or symbol can be placed in parenthesis on the side of an `align` or `multline` command using `\tag{word}`.[2]

[2]Use this sparingly!

For an example of this, we have

$$\begin{aligned}\left(\int_{-\infty}^{\infty} e^{-x^2}\,dx\right)^2 &= \iint_{\mathbb{R}^2} e^{-(x^2+y^2)}\,d(x,y) && (\star)\\ &= \int_0^{2\pi}\int_0^{\infty} e^{-r^2} r\,dr\,d\theta && (2)\\ &= 2\pi\int_{-\infty}^{0} \frac{1}{2}e^u\,du && (u=-r^2)\\ &= \pi,\end{aligned}$$

where we integrated over the plane $\mathbb{R}^2$ in $(\star)$ and switched into polar coordinates in (2).

Whenever you have a equation number in the document, you are telling the reader "remember where this line is!", and so it is polite to suppress equation numbers unless those equations are actually referenced in the document.

2.2 Theorems and proofs

Theorems, lemmas, exercises, and the like can be created using these steps.

1. Place `\newtheorem{name1}{Name2}` before the `\begin{document}`. The first name, `name1`, is the environment name and will only used internally in the LaTeX document. The section name, `name2`, is what will be shown to the reader along with a number.

2. Create a theorem-like statement using the syntax

   `\begin{name1}[optional] ..text.. \end{name1}`.

For example, we display Theorem 1 next.

Theorem 1 (Euler)**.** *If t is a real number, then $e^{it} = \cos t + i \sin t$.*

Those wanting more control over the appearance of the theorem environment are referred to page 72 in the text.

The proof of this theorem can be written between `\begin{proof}` and `\end{proof}` statements. This will automatically generate an end of proof symbol. The placement of the end of proof symbol can be manipulated using `\qedhere`.[3] Here is an example of the proof environment, which serves as a proof of Euler's Theorem, our Theorem 1.

[3] See page 72 of the text.

Proof. Using the power series for e^{it},

$$\begin{aligned} e^{it} &= 1 + \frac{(it)^1}{1!} + \frac{(it)^2}{2!} + \frac{(it)^3}{3!} + \frac{(it)^4}{4!} + \cdots \\ &= 1 + i\frac{t^1}{1!} - \frac{t^2}{2!} - i\frac{t^3}{3!} + \frac{t^4}{4!} + \cdots \\ &= \left(1 - \frac{t^2}{2!} + \frac{t^4}{4!} - \cdots\right) + i\left(t - \frac{t^3}{3!} + \frac{t^5}{5!} - \cdots\right), \end{aligned}$$

which, using the power series for $\cos t$ and $\sin t$, is equal to $\cos t + i \sin t$. □

A Appendix

All appendix material must appear between a `\appendix` command but before the `\end{document}` command. After that, include any appendix sections with the usual `\section{Section Name}` command.

References

[Euler, 1741] Euler, L. (1741). Solutio problematis ad geometriam situs pertinentis. *Commentarii academiae scientiarum Petropolitanae*, 8:128–140.

[Euler, 1759] Euler, L. (1759). Sur la force des colonnes. *Mem. Acad., Berlin*, 13:1759.

[Euler, 1775] Euler, L. (1775). Meditationes circa singulare serierum genus. *Novi Comm. Acad. Sci. Petropol*, 20(1775):140–186.

[Mendes and Lindbloom-Airey, 2019] Mendes, A. and Lindbloom-Airey, S. (2019). Position sequences and a q-analogue for the modular hook length formula. *Electron. J. Combin.*, 26(4):Paper 4.18, 17.

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