A LaTeX Example

A Practical Introduction to LaTeX

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1 Introduction

LaTeX is a program designed to typeset documents. Unlike programs such as Microsoft Word and LibreOffice Writer, LaTeX does not show you what the output looks like to begin with, but instead, you type what you *mean* and LaTeX then figures out how to best display this. Most new-comers to LaTeX find this quite daunting and sometimes annoying, but once familiar with the way LaTeX, it becomes incredibly powerful.

1.1 Philosophy

The main philosphy behind LaTeX is 'what you mean is what you get' which is in contract to applications such as Microsoft Word and LibreOffice Writer which work on 'what you see is what you get'.

To illustrate the difference, suppose we want to emphasize a particular word in the middle of a sentence. In Word, one would highlight the word and then italicized and someone new to LaTeX would be tempted to write

This is a sentence with just *one* word emphasized.

```
This is a sentence with just \textit{one} word emphasized.
```

but italics doesn't always equate with emphasis. In printed text, italics are fine for emphasis, but when it comes to a presentation, bold text and some colour is more appropriate for emphasis. For this reason, we really ought to be using the `\emph` command which is dedicated to emphasize text. As an example that illustrates the difference, consider an emphasized word within an emphasized sentence:

"*Here's an* emphasized *word within a phrase.*"

```
``\emph{Here's an \emph{emphasized} word within a phrase.}''
```

1.2 Mathematics

One of the greatest strengths of LaTeX is its ability to handle mathematics very nicely. Maths can be inputted in two main ways: inline, or in dedicated environments.

Inline maths is surrounded by `\(...\)`, though you'll often see `$...$`. For the most part, they are exactly equivalent; however, the former is preferred as it is proper LaTeX and will mess up less often (for example, if you accidentally start an inline equation within an inline math environment). As the name implies, the math is displaying within the text: $E = mc^2$. It is useful for short equation or to refer to particular symbols.

On the other hand, there are also display maths environments which present the full equation on its own line:

$$i\hbar\frac{\partial \Psi(\boldsymbol{x},t)}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi(\boldsymbol{x},t) + V(\boldsymbol{x},t)\Psi(\boldsymbol{x},t). \tag{1}$$

The display environment come in two main varieties: `{equation}` and `{align}`. The former is used to display a single line, while the second is useful to display multiple equations:

$$\nabla \cdot \boldsymbol{E} = \frac{\rho}{\varepsilon_0} \tag{2a}$$

$$\nabla \cdot \boldsymbol{B} = 0 \tag{2b}$$

$$\nabla \times \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t} \tag{2c}$$

$$\nabla \times \boldsymbol{B} = \mu_0 \boldsymbol{J} + \mu_0 \varepsilon_0 \frac{\partial \boldsymbol{E}}{\partial t} \tag{2d}$$

The alignment within the `{align}` environment is controlled with the `&` symbol.

1.3 Cross-Referencing

LaTeX takes care of all the referencing with `\label{...}` to place a label, and `\ref{...}` to refer back to a label. With the cleveref package, it takes care of explaining what you're referring to (whether it be a section, equation, figure, etc.):

eq. (1)
eqs. (2a) to (2d)
section 1 and eq. (2)

```
\cref{eq:schrodinger_equation}

% Spaces are counted, the `%` at the end of
% the lines tells LaTeX it ignore them.
\cref{%
  eq:gauss_law,%
  eq:gauss_law_magnetism,%
  eq:maxwell-faraday_equation,%
  eq:ampere_law%
}

\cref{sec:introduction,eq:maxwell_equations}
```

When a reference is invalid (either because of a typo, or because the associated label doesn't exist), references show up as '??'.

1.4 Bibliography

LaTeX's referencing capabailities do not end referencing labels within the document (c.f. section 1.3) but can also be used to manage bibliographies, indices and glossaries (though usually with the help of additional programs).

One very common use is to manage citations and bibliographies. A fairly common package for this is BibTeX which works with biber. As with a lot of other things in LaTeX, the commands automatically takes care of inserting the proper reference to some article:

The paper by Smith and Doe [1].

```
The paper by \citeauthor{Smith2013} \cite{Smith2013}.
```

1.5 Glossary

Glossary entries can be recorded with the `\gls{...}`, and at the end of the document `\printglossaries` displays the glossary and cross-links each term to the pages on which they are used. This can be useful to keep track of jargon or certain keywords.

Another useful feature of the glossaries package is its ability to handle acronyms so that they are defined the first time used, and subsequently the acronym is used only.

The Standard Model (SM) of particle physics ... in the SM.

```
The \gls{SM} of particle physics \dots{} in the \gls{SM}.
```

1.6 Sharing & Contributing

If you found this little document helpful, please feel free to share it others; it's completely free! I also welcome suggestions for or modifications to this document.

Glossary

LaTeX A program to typeset document widely used in academia. 1, 2

biber An alternative backend to BibTeX providing a number of ameliorations. 3

BibTeX A file-format and backend to store and process bibliographical entries. The backend is superseded by biber. 3

sm Standard Model. 3

References

[1] J. Smith and J. Doe, 'On the generation of pseudo-random references', Journal of Applied Referencing 6, 216–220 (2013) 10.1000/1.