A brief guide on avoiding common faults writing your first thesis in LaTeX

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1 Introduction

Writing one's first longer seminar paper or thesis in LaTeX is a nontrivial task requiring an adequate amount of work and time. In the ideal case the reader will already have acquired the minimal skills required to write a document in LaTeX by writing a short seminar paper or in a lecture on scientific publication. If this is not the case, he or she will have to consult one of the many introductions to LaTeX available. On the website of the LaTeX project [1] one can find a long list of LaTeX resources for beginners and experts. As always, the best method is "learning by doing" under supervision of colleagues (or the thesis supervisor) already familiar with LaTeX. Of course there are many books on LaTeX. I personally use the book by Kopka and Daly [2].

The aim of these notes is to help the reader to avoid some of the most common faults occurring in beginner's seminar papers and theses.

2 Common faults and how to avoid them

2.1 Paragraphs in LaTeX

A frequently occurring typesetting mistake is misuse of the concept of paragraphs in LaTeX. In setting paragraphs LaTeX follows the basic rule: *A blank line in* LaTeX *code creates a new paragraph.* For example, the code

```
Previous paragraph.

A blank line creates a new paragraph.
```

compiles to:

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Previous paragraph.
A blank line creates a new paragraph.

A new line, however, has no meaning in LaTeX, *i.e.*

```
Previous sentence.
A new line has no influence in LaTeX.
```

compiles to:

Previous sentence. A new line has no influence in LaTeX.

Therefore, it is **most important** to avoid using blank lines to structure the LaTeX source code. Instead one can use the % symbol to structure code, *e.g.*

```
Previous sentence. We comment out the next line.
%
Now the text continues.
```

compiles to:

Previous sentence. We comment out the next line. Now the text continues.

On (very rare) occasions one may want to start a new paragraph without an indent. This can be achieved with the command `\noindent`.

```
Previous paragraph. We now begin a new paragraph
without indent.

\noindent
Start of the new paragraph.
```

compiles to

Previous paragraph. We now begin a new paragraph without indent.
Start of the new paragraph.

In most cases, beginning a new paragraph without an indent will spoil the readability and clarity of the text.

If one wants to title paragraphs, one should use LaTeX's `\paragraph`-environment. The example code

```
Previous text.
We want to begin a new paragraph with the title ``New paragraph.''
%
\paragraph{New paragraph:} This is the beginning of a new paragraph.
```

gives

Previous text. We want to begin a new paragraph with the title "New paragraph."

New paragraph: This is the beginning of a new paragraph.

2.2 Formulae in LaTeX

Though self-evident, I nevertheless remind the reader to check each formula of the thesis carefully. Common errors include:

- Formulae are *parts of sentences* and thus, if the sentence ends with a formula, it has to end with a full stop. The same holds for commas and all other punctuation marks. For example, this sentence ends with the function definition

$$f(x) := \sin x.$$

  Since it is the end of the sentence, the formula ends with a full stop.

- Sentences must not begin with formulae or mathematical symbols.

- Inconsistent nomenclature, *e.g.* using the symbols M and $\mathcal{M}$ for the same quantity (or even worse: using the same symbol for different objects) must be avoided.

- A common error in particle physics master theses is the inconsistent usage of

$$\int \frac{d^4k}{(2\pi)^4} \quad \text{and} \quad \int \frac{d^dk}{(2\pi)^d}.$$

- Formulae must not be wider than the textwidth. (The textwidth can be changed in the document preamble using the command `\textwidth`, *e.g.* `\textwidth160mm`.) Thus, too long formulae have to be wrapped. *E.g.* instead of

```
\[
\mathcal{L}_{SU(2)_L\times U(1)_Y} =
    - \frac{1}{2}\mathrm{Tr}(W_{\mu\nu}W^{\mu\nu})
    - \frac{1}{4} B_{\mu\nu} B^{\mu\nu}
    + \overline{\psi}i\gamma^\mu D_\mu\psi
    + (D_\mu \phi)^\dagger (D^\mu \phi)
    - \mu^2 \phi^\dagger \phi - \lambda (\phi^\dagger \phi)^2
    + \mathcal{L}_\text{Yukawa},
\]
```

  leading to

$$\mathcal{L}_{SU(2)_L\times U(1)_Y} = -\frac{1}{2}\mathrm{Tr}(W_{\mu\nu}W^{\mu\nu}) - \frac{1}{4} B_{\mu\nu} B^{\mu\nu} + \overline{\psi}i\gamma^\mu D_\mu\psi + (D_\mu \phi)^\dagger (D^\mu \phi) - \mu^2 \phi^\dagger \phi - \lambda (\phi^\dagger \phi)^2 + \mathcal{L}_\text{Yukawa},$$

  one should use constructions like

```
\[
\begin{split}
\mathcal{L}_{SU(2)_L\times U(1)_Y} =
```

```
    & - \frac{1}{2}\mathrm{Tr}(W_{\mu\nu}W^{\mu\nu})
      - \frac{1}{4} B_{\mu\nu} B^{\mu\nu} \\
    & + \overline{\psi}i\gamma^\mu D_\mu\psi \\
    & + (D_\mu \phi)^\dagger (D^\mu \phi)
      - \mu^2 \phi^\dagger \phi
      - \lambda (\phi^\dagger \phi)^2\\
    & + \mathcal{L}_\text{Yukawa}.
\end{split}
\]
```

leading to the much nicer

$$\begin{aligned}\mathcal{L}_{SU(2)_L\times U(1)_Y} = &-\frac{1}{2}\mathrm{Tr}(W_{\mu\nu}W^{\mu\nu}) - \frac{1}{4}B_{\mu\nu}B^{\mu\nu}\\ &+ \overline{\psi}i\gamma^\mu D_\mu\psi\\ &+ (D_\mu\phi)^\dagger(D^\mu\phi) - \mu^2\phi^\dagger\phi - \lambda(\phi^\dagger\phi)^2\\ &+ \mathcal{L}_\text{Yukawa}.\end{aligned}$$

Obviously, this greatly improves the readability of the formula.

- Associated formulae can be grouped as subequations, *e.g.*

```
\begin{subequations}\label{Maxwell-equ}
\begin{align}
& \vec{\nabla} \cdot \vec{E}(t,\vec{x})
    = 4\pi \rho(t,\vec{x}), \label{MW1}\\
& \vec{\nabla} \cdot \vec{B}(t,\vec{x}) = 0, \label{MW2}\\
& \vec{\nabla} \times \vec{B}(t,\vec{x}) -
    \frac{1}{c} \frac{\partial \vec{E}(t,\vec{x})}{\partial t}
    = \frac{4\pi}{c} \vec{j}(t,\vec{x}), \label{MW3}\\
& \vec{\nabla} \times \vec{E}(t,\vec{x})
    + \frac{1}{c} \frac{\partial \vec{B}(t,\vec{x})}{\partial t}
    = 0.\label{MW4}
\end{align}
\end{subequations}
```

compiles to

$$\vec{\nabla}\cdot\vec{E}(t,\vec{x}) = 4\pi\rho(t,\vec{x}), \tag{1a}$$

$$\vec{\nabla}\cdot\vec{B}(t,\vec{x}) = 0, \tag{1b}$$

$$\vec{\nabla}\times\vec{B}(t,\vec{x}) - \frac{1}{c}\frac{\partial\vec{E}(t,\vec{x})}{\partial t} = \frac{4\pi}{c}\vec{j}(t,\vec{x}), \tag{1c}$$

$$\vec{\nabla}\times\vec{E}(t,\vec{x}) + \frac{1}{c}\frac{\partial\vec{B}(t,\vec{x})}{\partial t} = 0. \tag{1d}$$

Having set the labels as in the above example, both the whole collection of equations and individual subequations can be referred to as

```
(\ref{Maxwell-equ}),
(\ref{MW1}),
(\ref{MW2}),
(\ref{MW3}),
(\ref{MW4}).
```

leading to

(1), (1a), (1b), (1c), (1d).

- One should always use brackets of the correct size. LaTeX automatically does that if the commands `\left` and `\right` are used. For example, instead of

```
\[
\exp ( -i\frac{\Delta m_j^2 L}{2E} ),
\]
```

resulting in

$$\exp(-i\frac{\Delta m_j^2 L}{2E})$$

one should use

```
\[
\exp \left( -i\frac{\Delta m_j^2 L}{2E} \right)
\]
```

yielding

$$\exp\left(-i\frac{\Delta m_j^2 L}{2E}\right)$$

with the correct bracket size.

- Names of mathematical functions consisting of more than one letter should be set in Roman type, *e.g.* one should use

```
\[
\mathrm{sin}\,x,\, \mathrm{cos}\,x,\, \mathrm{Tr}\,A, \ldots
\]
```

giving

$$\sin x,\, \cos x,\, \mathrm{Tr}\, A, \ldots$$

instead of

```
\[
sin\,x,\, cos\,x,\, Tr\,A, \ldots
\]
```

compiling to

$$\sin x,\ \cos x,\ Tr\, A, \ldots$$

Some functions have an own LaTeX command doing precisely this, like `\sin`, `\exp` *etc.*

- For the sake of readability, it is good to use `\exp\left(...\right)` instead of `e^{...}` for complicated exponents.

2.3 Some notes on punctuation

Quotation marks: The correct way of setting English quotation marks in LaTeX is ``...'', leading to "...".

Abbreviations: In LaTeX, the space between two sentences is larger than the space separating words. Since for LaTeX every dot corresponds to a full stop indicating the end of a sentence, this can lead to bad formatting. For instance, this issue has to be taken into account when using abbreviations ending with a dot. The LaTeX source code

```
Example 1: Further information on correct punctuation can
be found \textit{e.g.} in~\cite{RMPstyleguide}.\\
%
Example 2: Further information on correct punctuation can
be found \textit{e.g.}\ in~\cite{RMPstyleguide}.
```

compiles to

Example 1: Further information on punctuation can be found *e.g.* in [3].
Example 2: Further information on punctuation can be found *e.g.* in [3].

In example 1 LaTeX assumes that a new sentence begins after "*e.g.*" Thus the spacing between "*e.g.*" and the next word "in" is too large. This has to be corrected as in example 2, where the French spacing command `\` is used to indicate that a normal space follows.

Automatic line wrap in LaTeX: The automatic line wrap is an incredibly valuable feature of LaTeX. In some cases, however, caution is advised. Namely, at some points a line wrap can impede the readability of the text. This is usually the case, if table, equation, figure or reference numbers are contained in the text. Again, we provide two examples.

```
Example 1: Notes on common errors in formulae
can be found in subsection \ref{formulae}.\\
%
Example 2: Notes on common errors in formulae
can be found in subsection~\ref{formulae}.
```

The above code yields:

> Example 1: Notes on common errors in formulae can be found in subsection 2.2.
> Example 2: Notes on common errors in formulae can be found in subsection 2.2.

In example 2, the LaTeX-command ~ has been used to prohibit a line wrap between "subsection" and "2.2".

2.4 Citations

Concerning citations, the author is advised to stick to a convention. Looking at published papers in different journals gives an impression of common citation styles. In the case of a particle physics thesis, it is most convenient to cite papers using the styles LaTeX(EU) or LaTeX(US) provided by Inspire HEP [4].

3 Suggestions for convenient working with LaTeX

3.1 Preparation

The basic structure of the chapter (type of content, names of subsections, main messages to be presented, ...) should be already clear *before* beginning to write it in LaTeX. A draft of the chapter should, at least in form of keywords, exist in handwritten form on paper. This highly increases efficiency of writing.

3.2 Surrounding

Writing scientific texts in LaTeX is an important part of scientific work. The author should always work concentrated and avoid all types of distractions (music, radio, television, checking emails, ...) during writing.

Typesetting of a thesis is a serious work. On average, to my experience, writing up a high quality scientific text in LaTeX needs about one day per page.

3.3 Use of a master LaTeX file

In the case of longer texts with several chapters and appendices it is convenient to have one master file (including the document preamble) and to create individual files for each chapter. This can be done using the `\input` command. For example, a master LaTeX file could look as follows.

```
\documentclass[a4paper,12pt,titlepage,twoside]{report}

\begin{document}

\input{chapter1.tex}
```

```
\end{document}
```

The `\input` command includes the content of the file `chapter1.tex` into the master LaTeX file. Included files must not contain commands like `\begin{document}` *etc.* For example, `chapter1.tex` could look like:

```
\chapter{My first chapter}

Text.
```

Splitting a large LaTeX document into several files using `\input` has the following advantages:

- The master file remains clear and compact. Changes in the whole document are simple.
- Though the document is split into several files, LaTeX automatically does page numbering, table of contents *etc.* correctly.
- Reordering of chapters is much more convenient than in one large file.
- Spell checking (*e.g.* using Ispell [5] or Aspell [6]) can be done on individual chapters.

3.4 Use a spell checker

Good spell checkers for LaTeX documents are Ispell [5] (available for Unix-like operating systems) and Aspell [6] (available also for Microsoft Windows).

3.5 Use an editor which can do syntax highlighting for LaTeX

Standard editors having this property are for example Kile [7], TeXnicCenter [8], Emacs [9] and Vim [10].

4 General comments on the style of scientific papers

A very good resource on how to write scientific papers in a proper style is the "Reviews of Modern Physics Style Guide" [3]. I would also suggest the reader to look at some published scientific articles to get a feeling for the style of scientific papers, before he or she starts to write the thesis.

Let me finally comment that of course a thesis has to be proofread *carefully* before it is presented to the thesis supervisor for the first time.

References

[1] LaTeX- *A document preparation system*,
http://latex-project.org/

[2] H. Kopka and P.W. Daly, *Guide to* LaTeX, Fourth edition, Addison-Wesley, Boston Mass. U.S.A. (2004).

[3] *Reviews of Modern Physics Style Guide*,
Reviews of Modern Physics, American Physical Society
http://journals.aps.org/rmp/info/infoRMP.html

[4] Inspire HEP,
http://inspirehep.net/

[5] *International Ispell*,
http://ficus-www.cs.ucla.edu/geoff/ispell.html

[6] *GNU Aspell*,
http://aspell.net/

[7] *Kile - an Integrated LaTeX Environment*,
http://kile.sourceforge.net/

[8] *TeXnicCenter*,
http://www.texniccenter.org/

[9] *GNU Emacs*,
http://www.gnu.org/software/emacs/

[10] *Vi IMproved*,
http://www.vim.org/