Creating documents in LaTeX — a basic tutorial

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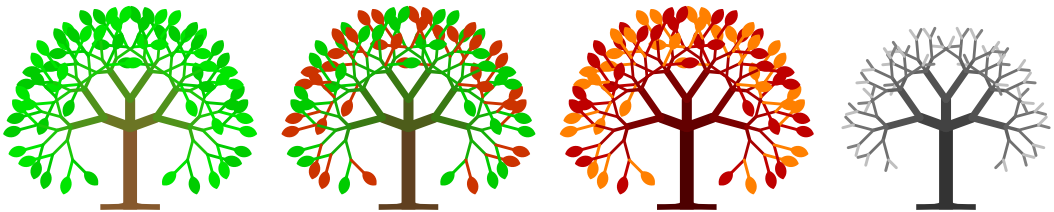
Contents

What is LaTeX

LaTeX — A document preparation system

- LaTeX is a *markup* language that allows you to write documents focusing on contents instead of formatting
- You don't have to worry about fonts or section/figures/tables/citation numbering
  - LaTeX will do it automatically for you
- All formatting will be taken care of by *packages*, or libraries you can load at the beginning of the document
- $\Rightarrow$ you can then focus on your text, which is the most important part of your document, leaving all the "makeup" to LaTeX

- LaTeX follows the WYMIWYG (*What you MEAN is what you get*) concept
  - instead of the WYSIWYG (*what you SEE is what you get*) concept used by most word processors
    - which, usually, are more like WYSIWYTYG (*what you see is what you THINK you get...*)



(trees generated using the `tikzsymbols` package)

Distributions

- In order to run LaTeX in your computer, you need a LaTeX *distribution*
  - There are several options; the two given below are the most widespread

Selected LaTeX distributions:

- TeXLive (linux) — `https://www.tug.org/texlive`

- MikTeX (windows) — `https://miktex.org`

- All popular Linux distributions (ubuntu, arch, opensuse, fedora, mandriva, etc.) have preset LaTeX platforms in their repositories
- MikTeX is also very easily installed on windows
- There are also, nowadays, online LaTeX platforms that you can use without download or install
  - but a very fast internet connection is recommended to avoid frustration and annoyance
- The distributions listed above are free and open source

Editors

- A LaTeX IDE (integrated development environment) is highly recommended, especially for newbies

Selected LaTeX IDEs:

- TeXStudio — `https://www.texstudio.org`

- TeXMaker — `http://www.xm1math.net/texmaker`

- TeXWorks — `http://www.tug.org/texworks`

- LyX — `https://www.lyx.org`

- Authorea (online) — `https://www.authorea.com`

- Overleaf (online) — `https://www.overleaf.com`

- To use any of them, you MUST first install a LaTeX distribution
  - except the online IDEs, of course
- All editors listed above are free; some are also open source

Preamble and body

- A typical LATEX document: a file with `.tex` extension
- it has two major parts: a *preamble* and a *body*

```
\documentclass[options]{class type}

% This is the document PREAMBLE
% here go configuration packages and commands

% all LaTeX commands start with a \ (backslash)
% everything following a % is a comment
% you can insert comments anywhere in the document
% if you want a % to appear in your text, escape it using \%

% the document class is always the first line of your document
% you can define some options that affect the formatting of the chosen class type
% some class types: article, book, report
% common options: 10pt|11pt|12pt (font size), oneside|twoside (use one or both sides
    ↪ of the paper)

\begin{document}

% This is the body of your document
% Your text, tables, figures, etc. (generically, your content) go here

\end{document}
```

Packages

- In the preamble are loaded packages (libraries) that affect and provide new commands
  - for instance, font packages, math packages, bibliography packages, etc.
- Packages are loaded with the command `\usepackage[options]{package name}`

A few useful examples:

- `\usepackage[a4paper, margin=20mm]{geometry}` loads the `geometry` package and sets the paper size to A4 and all margins to 20 mm
- `\usepackage[utf8]{inputenc}` allows you to use accented characters (á, ã, ã, ä, ç, etc)
  - the option used (`utf8`) is for files set up with the unicode encoding (other encodings are also possible)
  - newest versions of LaTeX are automatically set up for `utf8` encoding (i.e., there is no need to call this package anymore)
- `\usepackage{setspace}` gives access to interline spacing
  - after loading the package, set the spacing used in the document with one of the following commands:
    1. `\singlespacing` (default)
    2. `\onehalfspacing`
    3. `\doublespacing`
- `\usepackage{graphicx}` permits the inclusion of figures (jpg, png, eps, pdf, etc.) in the document

Non-english languages

- LaTeX automatically hyphenates your words
- Also, a few words (like chapter, section, page, etc.) and formatted date are sometimes used
  - but the default language is American English
- To change the language of the document, call the `babel` package in the preamble

```
% to hyphenate and translate keywords to brazilian portuguese (for instance)
\usepackage[brazil]{babel}
```

Multi-file documents

- Your document can be spread through multiple files
- The master document calls other files with the `\input` command:

```
\documentclass[12pt]{article}

% preamble

\input{style.tex} % all packages and configuration commands

\begin{document}

% body

\input{chapter1.tex}

\input{chapter2.tex}

\end{document}
```

Document title

- The title of your document comes from the following commands:

```
\title{My article}
\author{My name}
\date{time I wrote it} % if not given, results in the \today command's output

\maketitle % format and prints the title for you
% optionally, include titlepage among the \documentclass options for a title cover
```

- If you're using the `beamer` class (as I'm doing right now), you'll get something like this:


```
\title{A wonderful talk}
\author{presented by myself}

\maketitle
```

- `title`, `author` and `date` can be either in the preamble or in the body of the document
- `maketitle` must be issued from within the body of the document

Chapters, sections and subsections

- Creating headings in your document is straightforward:

```
\chapter{My chapter} % beware: the article class has no chapters!
\label{cha:mycha}

\section{A section}
\label{sec:mysec}

\subsection{A sub-section}
\label{sub:mysubsec}

\subsubsection{A sub-sub-section}
\label{ssub:mysubsubsec}
% And that's enough for most purposes!
% If you really need more, there are packages that allow you to add more sublevels
```

- We'll soon learn what is the purpose of the several `\label` commands
  - they are optional and, for now, see them simply as tags to identify each heading

Tables of contents

- You can add tables of contents and lists of tables and figures:

```
\tableofcontents

\listoffigures

\listoftables
```

- (Soon we'll see how to insert figures and tables to be shown in the lists above!)

Typesetting a LaTeX document

- Basic typesetting:
  - any amount of space between characters will be shortened to just one space character
    - use ~ to add space (and `\textasciitilde{}` if you want the ~ character)
- leave any amount of blank lines to start a new paragraph

This is a paragraph.
And this is another. This is still in the same paragraph.
One sentence, another sentence.
One sentence, another sentence.
One longer paragraph, in order to see how LaTeX breaks lines and keep going in the line below. And just some more text to make the paragraph even larger.
This is a
linebreak.
Finally, this is a

longer linebreak.

```
1  This is a paragraph.
2
3  And this is another.
4  This is still in the same paragraph.
5
6  One sentence, another sentence.
7
8  One sentence,         another sentence.
9
10 One longer paragraph, in order to see
   ↪ how \LaTeX{} breaks lines and keep
   ↪  going in the line below. And just
   ↪  some more text to make the
   ↪ paragraph even larger.
11
12 This is a \\ linebreak.
13
14 Finally, this is a \\[20mm] longer
   ↪ linebreak.
```

Basic formatting

A normal paragraph.

A centered paragraph.

Italics: *italicized text*.
Bold text: **boldface text**.
Font sizes:
text text text text text text text text text text
Notice the use of curly braces as delimiters for the scope of action of a command. If you want them to appear in the text, escape them: { e }

```
A normal paragraph.

\begin{center}
A centered paragraph.
\end{center}

Italics: \emph{italicized text}.

Bold text: \textbf{boldface text}.

Font sizes:

{\tiny text} {\scriptsize text} {\
    ↪ footnotesize text} {\small text}
    ↪ {\normalsize text} {\large text}
    ↪ {\Large text} {\LARGE text} {\huge
    ↪  text} {\Huge text}

Notice the use of curly braces as
    ↪ delimiters for the scope of action
    ↪  of a command. If you want them to
    ↪  appear in the text, escape them:
    ↪ \{ e \}
```

Environments

- Two useful environments:
  - (*environments* are constructions that format contents. They are invoked with a `\begin{env} \end{env}` clause)
- Bullet lists — `itemize` environment:

- Topic one
  - A subtopic
  - and another
- Topic two

```
\begin{itemize}
        \item Topic one
        \begin{itemize}
                \item A subtopic
                \item and another
        \end{itemize}
        \item Topic two
\end{itemize}
```

- Enumerated lists — `enumerate` environment:

1. Topic one
   1. A subtopic
   2. and another
2. Topic two

```
\begin{enumerate}
        \item Topic one
        \begin{enumerate}
                \item A subtopic
                \item and another
        \end{enumerate}
        \item Topic two
\end{enumerate}
```

- *Note:* you can mix the two kinds of list, if you want

Create and your own commands

- Let's say you need to write something several times throughout your document
  - for instance, you have to write "X-ray diffractometry" quite a lot
- It would be nice to create a shortcut:

```
1 \newcommand{\XRD}{X-ray diffractometry}
2
3 \XRD{} is a an experimental technique\
    ↪ ldots
4
5 As we can see from the \XRD{} results, \
    ↪ ldots
```

X-ray diffractometry is a an experimental technique...
As we can see from the X-ray diffractometry results, ...

- The "{}" after the call to the command is necessary, otherwise LaTeX would not insert a space after it
- Your commands can even have arguments:

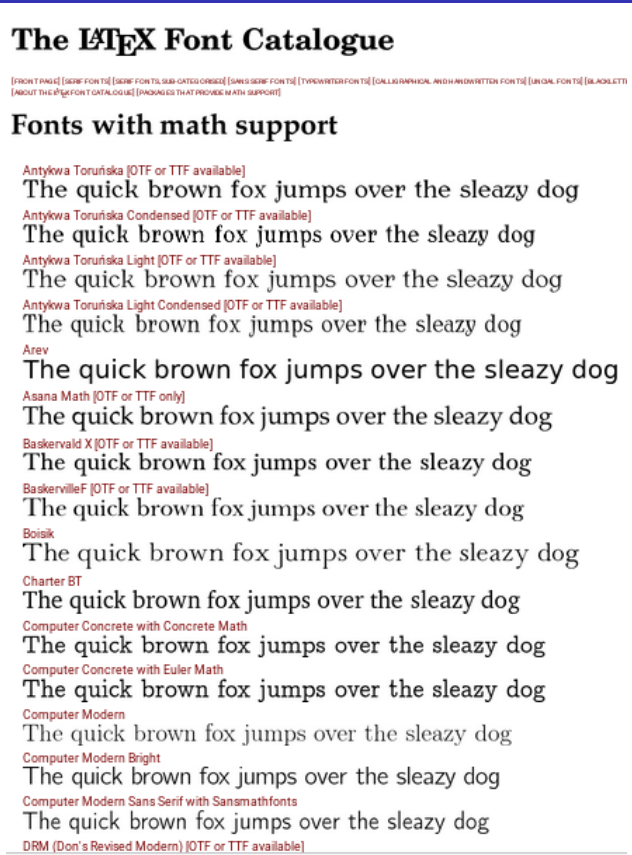
```
1 \newcommand{\sample}[2]{sample #1-#2}
2
3 From the composition of \sample{2}{5},
    ↪ we see that \ldots
4
5 As we can see, the mechanical properties
    ↪  of \sample{Ti2.5}{Al5} are not as
    ↪  high as\ldots
```

From the composition of sample 2-5, we see that ...
As we can see, the mechanical properties of sample Ti2.5-Al5 are not as high as...

- *Note:* The `\newcommand` command is much more powerful than that!
- There is also a `\renewcommand` command that can be used to redefine an existing one

Fonts

- There are lots of ways to change the fonts used in your document
- It is usually better to trust a package to do it for you!
- Consult the LaTeX Font Catalogue (`http://www.tug.dk/FontCatalogue`)



The LaTeX Font Catalogue

[FRONT PAGE] [SERIF FONTS] [SERIF FONTS, SUB-CATEGORISED] [SANS SERIF FONTS] [TYPEWRITER FONTS] [CALLIGRAPHICAL AND HANDWRITTEN FONTS] [UNICIAL FONTS] [BLACKLETTER]
[ABOUT THE LaTeX FONT CATALOGUE] [PACKAGES THAT PROVIDE MATH SUPPORT]

Fonts with math support

Antykwa Toruńska [OTF or TTF available]
The quick brown fox jumps over the sleazy dog
Antykwa Toruńska Condensed [OTF or TTF available]
The quick brown fox jumps over the sleazy dog
Antykwa Toruńska Light [OTF or TTF available]
The quick brown fox jumps over the sleazy dog
Antykwa Toruńska Light Condensed [OTF or TTF available]
The quick brown fox jumps over the sleazy dog
Arev
The quick brown fox jumps over the sleazy dog
Asana Math [OTF or TTF only]
The quick brown fox jumps over the sleazy dog
Baskervald X [OTF or TTF available]
The quick brown fox jumps over the sleazy dog
BaskervilleF [OTF or TTF available]
The quick brown fox jumps over the sleazy dog
Boisik
The quick brown fox jumps over the sleazy dog
Charter BT
The quick brown fox jumps over the sleazy dog
Computer Concrete with Concrete Math
The quick brown fox jumps over the sleazy dog
Computer Concrete with Euler Math
The quick brown fox jumps over the sleazy dog
Computer Modern
The quick brown fox jumps over the sleazy dog
Computer Modern Bright
The quick brown fox jumps over the sleazy dog
Computer Modern Sans Serif with Sansmathfonts
The quick brown fox jumps over the sleazy dog
DRM (Don's Revised Modern) [OTF or TTF available]

Figures

- Figures and tables are inserted in the text as *floats*
  - so called because they are not part of the text flux, but are instead positioned as if hovering over the page
  - do not forget to include `\usepackage{graphicx}` in the preamble if you plan to use figures!

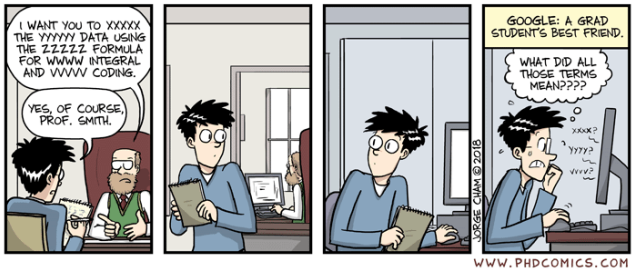


Figure 1: Taken from `http://phdcomics.com`

```
1 \begin{figure} % it's an environment!
2 \centering
3 \includegraphics[width=.9\textwidth]{
    ↪ comic1.png}
4 \caption{Taken from \url{http://
    ↪ phdcomics.com}}
5 \label{fig:comics}
6 \end{figure}
```

- *Note:* `\label` is just a name you give to the float.
  - you can use it to reference it in the text, as we'll see shortly
- you can also use `\begin{figure}[htbp]`, where `h` (here), `t` (top), `b` (bottom) and `p` (page) are indications to where LaTeX should place your float (it will only follow your suggestion if and when it is possible)
  - you can omit any of the `htbp` letters, or even change their order
- Notice the command `\url{webaddress}` to format a clickable link to a webpage. You need to put `\usepackage{url}` in the preamble to use this feature

Tabular material

- Table floats are set in a `table` environment
- The `tabular` environment is used to typeset a table

Table 1: List of equipments and suppliers

Equipment	Year	Vendor	PIC	Location
MO	2015	Zeiss	Joe	A5
MEV	2012	Hitachi	Moe	B3
XRD	2014	Panalytical	Larry	A2

```
\begin{table}
\caption{List of equipments and
   ↪ suppliers}
\label{tab:dados}
\centering
\begin{tabular}{lcccc}
\hline
Equipment & Year & Vendor & PIC &
   ↪ Location \\
\hline
MO & 2015 & Zeiss & Joe & A5\\
MEV & 2012 & Hitachi & Moe & B3\\
XRD & 2014 & Panalytical & Larry & A2\\
\hline
\end{tabular}
\end{table}
```

- Notice again the use of `\label` to tag the table float
- The `[htbp]` options are also available for tables

Inline and display math

- There are inline (using $ $) and displayed formulas (with the `equation` environment):

A sphere of radius R has a volume V given by

$$V = \int_0^{2\pi} \int_0^{\pi} \int_0^{R} \rho^2 \sin\theta d\rho d\theta d\phi = \frac{4}{3}\pi R^3 . \qquad (1)$$

It is not difficult to evaluate the integral, if you know what to do.

```
A sphere of radius $R$ has a volume $V$ given by
\begin{equation}
V = \int_{0}^{2\pi} \int_{0}^{\pi} \int_{0}^{R} \rho^2 \sin \theta d\rho d\theta d\phi
= \frac{4}{3} \pi R^3 \,.
\label{eq:vol}
\end{equation}
It is not difficult to evaluate the integral, if you know what to do.
```

The sum of the first n terms of an arithmetic progression is

$$S_n = \sum_{i=1}^{n} a_i = \frac{(a_1 + a_n)n}{2} , \qquad (2)$$

in which $a_i = a_{i-1} + (n-1)r$ (valid for $2 \le i \le n$, with a_1 and r given constants). Legend has it that Gauss discovered this formula while still a schoolboy…

```
The sum of the first $n$ terms of an arithmetic progression is
\begin{equation}
S_{n} = \sum_{i=1}^{n} a_{i} = \frac{(a_{1}+a_{n})n}{2} \,,
\end{equation}
in which $a_{i}=a_{i-1} + (n-1) r$ (valid for $2 \le i \le n$, with $a_{1}$ and $r$ given constants). Legend has it that Gauss discovered this formula while still a schoolboy\ldots
```

Some more options

- If you don't want to number a displayed equation, use `\[ \]`, instead of the `equation` environment

The sum of the first n terms of an arithmetic progression is given by

$$S_n = \sum_{i=1}^{n} a_i = \frac{(a_1 + a_n)n}{2},$$

in which $a_i = a_{i-1} + (n-1)r$ (valid for $2 \le i \le n$, with a_1 and r given constants). Legend has it that Gauss discovered this formula while still a schoolboy…

```
1 The sum of the first $n$ terms of an
    ↪ arithmetic progression is given by
2 \[
3 S_{n} = \sum_{i=1}^{n} a_{i} = \frac{(a
    ↪ _{1}+a_{n})n}{2} \,,
4 \]
5 in which $a_{i}=a_{i-1} + (n-1) r$ (
    ↪ valid for $2 \le i \le n$, with $a
    ↪ _{1}$ and $r$ given constants).
    ↪ Legend has it that Gauss
    ↪ discovered this formula while
    ↪ still a schoolboy\ldots
```

- The `amsmath` package (as always, in the preamble) gives you access to lots of new math-related stuff

The \label — \ref system

Figure 2: Taken from `http://phdcomics.com`.

```
\begin{figure}
\centering
\includegraphics[width=.6\textwidth]{
    ↪ comic-strip.jpg}
\caption{Taken from \url{http://
    ↪ phdcomics.com}.}
\label{fig:comic}
\end{figure}
```

The situation we see depicted in Figure 2 happens quite often in some cases...

```
The situation we see depicted in Figure
    ↪ \ref{fig:comic} happens quite
    ↪ often in some cases\ldots
```

$$e^{i\pi} = -1 \tag{3}$$

Equation (3) was first derived by Euler.

```
\begin{equation}
e^{i \pi}  = -1
\label{eq:euler}
\end{equation}

Equation (\ref{eq:euler}) was first
    ↪ derived by Euler.
```

- The `fig:`, `tab:` or `eq:` prefixes are not mandatory, but they are helpful to differentiate among the several kinds of stuff a label can point to (chapter, section, subsection, equation, list item, figure, table, etc., etc., etc.)
- The `\pageref{lab}` command gives you the page in which `\label{lab}` is found

Reference managers

- I strongly recommend you use a reference manager to keep track of your bibliography. Below are two excellent choices that work virtually in any operating system

Selected reference managers:

- JabRef — `http://www.jabref.org`

- Mendeley — `https://www.mendeley.com`

How to use BibTEX

- The most widespread citation tool for LATEX is BibTEX (`http://www.bibtex.org`)
- all your bibliographical references should be in (one or more) `bib` files

Put the following commands where you want your list of references to appear:

```
1 \bibliography{mybibfile}
2 \bibliographystyle{plain} % there are dozens of styles to chose from
```

- Then BibTEX does all the formatting work for you!

A BibTEX example

- For instance, let's say a file called `mybibfile.bib` constains the following entry (among others):

```
@article{ferreira2018,
        author = {Ferreira, P. P. and
            ↪ Santos, F. B. and Machado, A.
            ↪  J. S. and Petrilli, H. M.
            ↪ and Eleno, L. T. F.},
        journal = {Phys. Rev. B},
        pages = {045126},
        title = {Insights into the
            ↪ unconventional
            ↪ superconductivity in {HfV$\
            ↪ textcolor{2$Ga$}{4$} and {ScV
            ↪ $}2$Ga$_4$} from first-
            ↪ principles electronic-
            ↪ structure calculations},
        volume = {98},
        year = {2018}
}
```

- You can cite it in your work with the `\cite` command:

```
\documentclass[11pt]{article}

\begin{document}

Ferreira et al. \cite{ferreira2018} have
    ↪ shown that\ldots

\bibliography{mybibfile}
\bibliographystyle{plain}

\end{document}
```

Ferreira et al. [1] have shown that…

References

[1] P. P. Ferreira, F. B. Santos, A. J. S. Machado, H. M. Petrilli, and L. T. F. Eleno. Insights into the unconventional superconductivity in HfV_2Ga_4 and ScV_2Ga_4 from first-principles electronic-structure calculations. *Phys. Rev. B*, 98:045126, 2018.

ABNTEX2 — ABsurd Norms for LATEX

- Info only relevant to people working/studying in Brazil, mainly universities or research institutes

`https://www.abntex.net.br`

- ABNTEX2 will take care of all weird formatting required by ABNT (Brazilian Bureau of Standards)
- on their website (link above) you'll find templates and tutorials

Acknowledgements

Thank you for your attention!

LaTeX is fun.

Find more help on:

`https://stackoverflow.com` `https://ctan.org` `https://www.latex-project.org`

Acknowledgements:

`http://www5.usp.br` `http://site.eel.usp.br` `http://www.ppgem.eel.usp.br`

Questions, corrections, comments and suggestions: luizeleno@usp.br
`http://www.demar.eel.usp.br/docente/150`

This is version 1.1 of the tutorial. It can be freely distributed, but please point to the original project on github:

`https://github.com/luizeleno/LaTeX-tutorial-for-newbies`