Learning LaTeX

Ryan Rubenzahl
rrubenza@caltech.edu

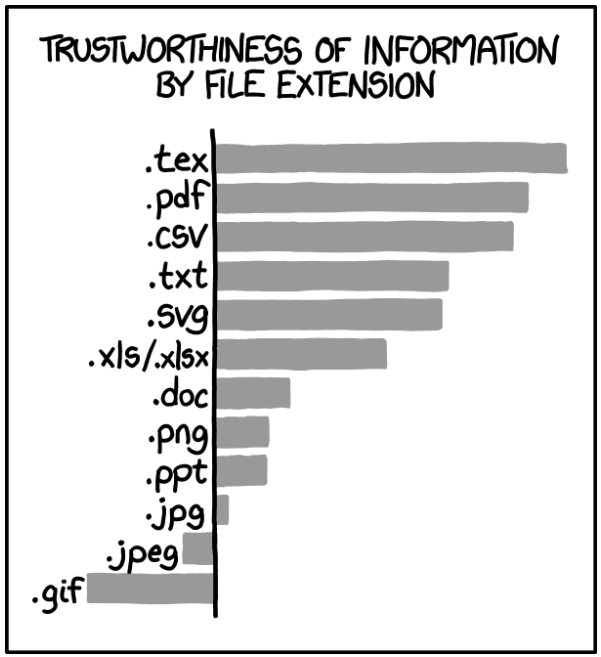
Intro to Astronomy 2019

July 28, 2019

Outline

What is LaTeX? Why should I use it?

- LaTeX (Lay-TECH or Lah-TECH) is a typesetting software that is designed for producing scientific and mathematical documents of high typographical quality
- LaTeX worries about formatting, you worry about content



Outline

How can I get LaTeX?

- So LaTeXwill make my papers look beautiful and make me more trustworthy. How can I harness this power?
- Either install a local TeX distribution, or use an online editor
- TeX distributions:
  - TeX Live (GNU/Linux, Mac OS, Windows)
  - MacTeX (Mac OS)
  - MiKTeX (Windows)
- May not include an *editor*, e.g. MacTeX comes with TeXShop, a LaTeX editor/previewer
  - Can always use your own favorite text editor (e.g. Vim), and compile from the command line via

```
pdflatex mydocument.tex
```

- **Online editor:** Overleaf (Google docs for LaTeX)

Outline

Learning LaTeX / Getting Started

- The tutorials on Overleaf are fantastic for getting started
- The TeX wiki is another great resource/guide
- Many great templates to try out on Overleaf
  - For professional journal templates, check out: REVTeX (aps, aip, prl, etc.)
- For a full-length starter guide, check out *The Not So Short Introduction to LaTeX* [1]

Outline

Help/Troubleshooting Resources

- Unless you are literally a god, compiling your LaTeX document will probably not be error-free every time
  - e.g. `Underfull \hbox (badness 10000)`
- Google is your friend, but your best friend is
  - TeX stack exchange
- Forgot the command for that one symbol? Check out Detexify
  - Lets you draw the symbol, and tells you the code for it
  - If you have a Mac, you can download Detexify as an app!

Outline

Basic Commands

- All command begin with a backslash '\' and take one of two formats:
  - Command name consists only of letters, terminated by a space/number/'non-letter'
    - e.g. `\LaTeX`, `\hfill`, `\newline`
  - Command name consists of a backslash and exactly one non-letter
    - e.g. `\,`, `\;`, `\{`, `\}`
- A command is written as follows:

```
\command[optional parameter]{parameter}
```

- One may also define their own command:

```
\newcommand{name}[num]{definition}
```

  - `num` = number of parameters, which are referred to in `definition` by #1, #2, etc. Command is called with `\name` just like any other.

Making a Document: Setup

- Preamble: section of code between `\documentclass` and `\begin{document}`
- Document Classes: Defined by `\documentclass[options]{class}`
  - *class* specifies the type of document, e.g. article, beamer, report, book, etc.
  - *options* specify the behavior of the document, e.g. font-size, paper-size, one/two column, etc.
- The preamble is also where one can import packages

  `\usepackage[options]{package}`
  - E.g. amsmath, amssymbol, hyperref, TikZ, physics, cancel, minted
- The actual document is then started with a `\begin{document}` and ended with `\end{document}`

Making a Document: Example

Example: The Preamble

```
\documentclass[11pt, letterpaper]{article}
\usepackage[top=2.2cm, bottom=2cm, left=1cm,
↪  right=2cm]{geometry}

\usepackage{fancyhdr}

\usepackage{physics}
\usepackage{amssymb, amsmath}
\usepackage{cancel}

\begin{document}
...
\end{document}
```

Sections

- To define the start of a section, simply use the appropriate command:

  ```
  \section{...}, \subsection{...}, \subsubsection{...}
  \paragraph{...}, \subparagraph{...}
  ```

- The section will be in effect until a new section command is encountered or the document ends
  - Only with `report` or `book` class: `\chapter{...}`
- Some sections do not take an argument, e.g.

  ```
  \abstract, \appendix, \tableofcontents
  ```

- Sections can be cross-referenced with the use of labelling

Example: Cross-referencing

```
\section{Introduction\label{sec:intro}}
Here is the intro, Section \ref{sec:intro}
```

Environments

- A LaTeX environment is a way of grouping part of a document according to some formatting rules
  - Environments may be nested so long as order is maintained
- Declared with `\begin{environment}` and ended with `\end{environment}`
  - The main `\begin{document}` itself is an example of an environment
- Some common environments:
  - `itemize` for simple (bulleted) lists, `enumerate` for enumerated lists
  - `tabular`, `figure`, `minipage`, `center`, `quote`

Writing Mathematical Equations

- For mathematical typesetting, use $\mathcal{AMS}$-LaTeX

```
\usepackage{amsmath, amssymb, amsfonts, amsbsy}
```

- See list of Greek letters and mathematical symbols
- Several different "math-mode" environments:

Inline math-mode (source)

```
For $x \ll 1$ we can...
```

Inline math-mode (output)

For $x \ll 1$ we can...

Equation math-mode (source)

```
The equation of motion
\begin{equation}
m \ddot{x} + kx = 0
\end{equation}
describes a harmonic...
```

Equation math-mode (output)

The equation of motion

$$m\ddot{x} + kx = 0 \qquad (1)$$

describes a harmonic oscillator.

Writing Mathematical Equations

- More math environments:

Unnumbered Eq. (source)

```
The Pythagorean Theorem,
\[ a^2 + b^2 = c^2 \]
```

Unnumbered Eq. (output)

The Pythagorean Theorem,

$$a^2 + b^2 = c^2$$

Multiline Eq. (source)

```
The net force is
\begin{align*}
F_{net} &= \sum_i F_i \\
        &= F - F_f \\
        &= m a
\end{align*}
```

Multiline Eq. (output)

The net force is

$$\begin{aligned} F_{net} &= \sum_i F_i \\ &= F - F_f \\ &= ma \end{aligned}$$

Figures

Example: Figure

```
\begin{figure}
\centering
\includegraphics[width=0.2\textwidth]{./Figures/cat.png}
\caption{An image of a cat.}
\label{img:cat image}
\end{figure}
```

Example: Figure

Figure: An image of a cat.

Tables

Example: Table

```
\begin{table}
\centering
\begin{tabular}{|c| ccc |}
\hline
x & 1 & 2 & 3 \\
y & 4 & 5 & 6 \\
\hline
\end{tabular}
\caption{Our data.}
\label{tab:table}
\end{table}
```

Example: Table

x	1	2	3
y	4	5	6

Table: Our data.

Managing References I

- LaTeX has two main, and very powerful, ways to manage a bibliography
- `thebibliography` environment

Example: thebibliography [1]

```
Partl~\cite{pa} has
proposed that \ldots
\begin{thebibliography}{99}
\bibitem{pa} H.~Partl:
\emph{German \TeX},
TUGboat Volume~9, Issue~1 (1988)
\end{thebibliography}
```

Example: thebibliography

Partl [1] has proposed that ...

H. Partl: *German TeX*, TUGboat Volume 9, Issue 1 (1988)

- Remove `label` option to have entries enumerated automatically

Managing References II

- LaTeX has two main, and very powerful, ways to manage a bibliography
- BibTeX
- Reference entries are stored in separate .bib file
- Reference section is created with one line in main .tex file:

```
\bibliography{references.bib}
```

- .bib file has entries stored in specific formats, which LaTeX understands and formats for you!
- Overleaf has a fantastic set of tutorials on how to setup a bibliography both of these ways

Extra: Whitespace

- Whitespace before a line is ignored
- Whitespace after a command is ignored
  - Easy fix: add an empty parameter `{}`, e.g. `\LaTeX{}`
- Whitespace (larger than a single space) between words is ignored
- A single line break is treated as normal whitespace
- ≥ 1 empty line between two lines defines the end/start of a paragraph
- Create your own whitespace using

```
\hspace{5pt}, \vspace{-3pt}, \, \; \quad \qquad,
↪  \hfill, \vfill
```

- For line (page) breaking, use `\newline` or `\\` (`\newpage`)
  - `\clearpage` will fill the remaining room of a page with whitespace

Extra: Text/Comments

- Words can be `monospace`, *emphasized*, **bolded**, *italicized*, and colored!

```
\texttt{text}, \textbf{text}, \textit{text}
\emph{text}, {\color{color}text}
```

- Change size of font on the fly using one of

```
\tiny, \scriptsize, \footnotesize, \small,
\normalsize, \large, \Large, \LARGE, \huge, \Huge
```

- The default font is Computer Modern (CMU, sans serif in `beamer`)
  - One may change the font throughout the document by adding, for example, `\usepackage{Palatino}` to the Preamble
- Make footnotes with the `\footnote{footnote text}` command[1]
- Comments may be written using the percent sign %

[1] The footnote text shows up like this.

Extra: Common Mistakes

- Quote marks: begin your quote with ``, end with ''
- Certain symbols like underscores will not work outside of math mode
  - If you need it, you can usually escape it with backslash: `\_`
- Be careful with exponentiation: `$10^{-23}$`
- Format parenthesis in equations properly: use `\left ( \right )`
- Put text inside a math environment with `\text {}`
- LaTeX is not always the most intuitive - there is a learning curve!
  - You will spend 15 minutes at one point fighting with the float-placement algorithm
  - Most issues are easily google-able, or are on TeX stack exchange

References I

[1] Tobias Oetiker.
The Not So Short Introduction to LaTeX.
https://tobi.oetiker.ch/lshort/lshort.pdf, 2015.