

# Technical Typesetting

## An Overview of $\text{\LaTeX}$

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# Introduction

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Two main approaches to typesetting (and one blended approach):

- “What you see is what you get” (WYSIWYG)
  - Word, Pages
- Markup
  - $\text{\LaTeX}$ , Markdown, HTML
- “What you see is what you mean” (WYSIWYM)
  - LyX

# What is $\text{\LaTeX}$ ?

“ $\text{\LaTeX}$ . . . is a document preparation system for high-quality typesetting. It is most often used for medium-to-large technical or scientific documents but it can be used for almost any form of publishing.”

— The  $\text{\LaTeX}$  Project

- $\text{\LaTeX}$  is pronounced «Lah-tech» or «Lay-tech»

- Separation of presentation and content philosophy
- Focus on writing without worrying about formatting
  - Typesetting system will take care of the formatting
- Excellent mathematical typesetting
- No copying & pasting or saving figures
  - Improves reproducibility

# Effort vs. Complexity

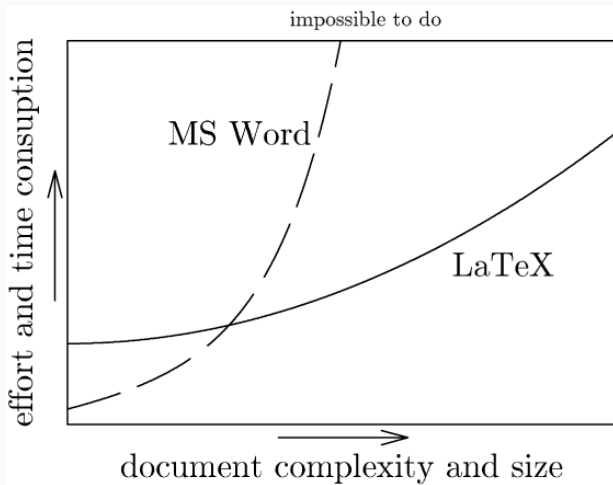


Figure 1: Image from <http://www.pinteric.com/miktex.html>



# Section 1

This is a sample *list*:

- Item 1
- Item 2
- Item 3

Figure 2: A document created in Word

```
\documentclass{article}  
\begin{document}  
\section*{Section 1}  
This is a sample \textit{list}:  
\begin{itemize}  
\item Item 1  
\item Item 2  
\item Item 3  
\end{itemize}  
% this is a sample comment  
\end{document}
```

## Section 1

This is a sample *list*:

- Item 1
- Item 2
- Item 3

Figure 3:  $\text{\LaTeX}$  syntax and output

# The $\text{\LaTeX}$ System

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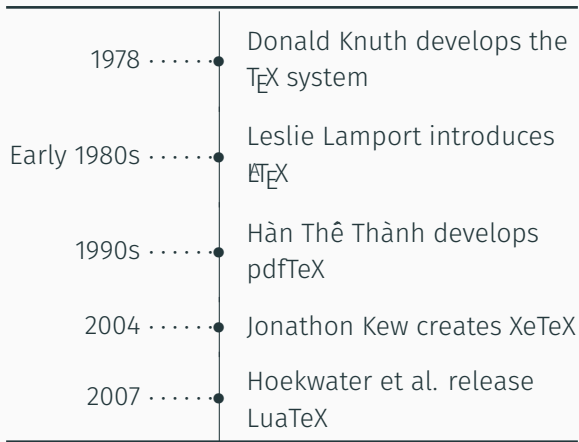


Table 1: A  $\text{T}_{\text{E}}\text{X}$  Timeline [1]

# Installation



## Linux

Check your Linux distributions software source for a TeX distribution including LaTeX. You can also install [TeX Live](#) directly.



## Mac OS

The [MacTeX](#) distribution contains everything you need, including a complete TeX system with LaTeX itself and editors to write documents.



## Windows

Check out the [MiKTeX](#) or [proTeXt](#) or [TeX Live](#) distributions; they contain a complete TeX system with LaTeX itself and editors to write documents.



## Online

LaTeX online services like [Papeeria](#), [Overleaf](#), and [ShareLaTeX](#) offer the ability to edit, view and download LaTeX files and resulting PDFs.

Figure 4: Installation guide from <https://www.latex-project.org/get/>

# Choose Your $\text{\LaTeX}$ Editor

- $\text{\TeX}$  can be written in any standard text editor
  - Run `tex`, `pdftex`, `latex`, or `pdflatex` on the `.tex` file
- However, there are many specially-designed  $\text{\TeX}$  editors
  - Point-and-click compilation
- My personal favorite is TeXstudio
- For an exhaustive list of editors, check out this Wikipedia page



Figure 5: The TeXstudio logo

# Compilation

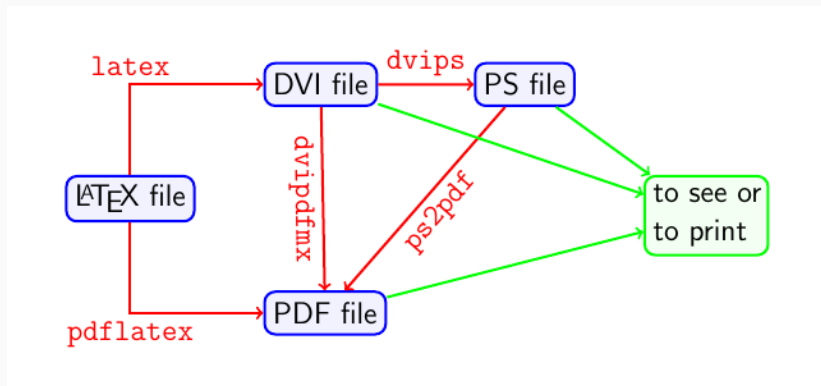


Figure 6: Source: [https://www.sharelatex.com/learn/Choosing\\_a\\_LaTeX\\_Compiler](https://www.sharelatex.com/learn/Choosing_a_LaTeX_Compiler)

# Compilation

- **DVI:** Device independent file format; not intended to be human-readable; consist of binary data describing the visual layout of a document; typically intended as input to a second program
- **PS:** PostScript file format; describes text and graphics on page based on vector graphics
- **PDF:** Portable Document Format; based on PostScript; documents independent of application software, hardware, and operating systems
- **However, most good editors include icons that can keep you away from the terminal/command prompt if you so choose**



# Document Classes

- The first step in creating any  $\text{\LaTeX}$  document is to declare a document class, or simply the type of document you wish to generate
- Some useful document classes are included in the table below

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Document Class	Description
article	flexible; technical reports, journal articles, documentation, etc.
proc	conference proceedings
report	longer reports and theses
book	books
letter	formal letters
beamer	slides

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**Table 2:** Adapted from: [https://en.wikibooks.org/wiki/LaTeX/Document\\_Structure#Document\\_classes](https://en.wikibooks.org/wiki/LaTeX/Document_Structure#Document_classes)

- The  $\text{\LaTeX}$  system is built on commands
- Commands serve as “blueprints” to the compiler – providing instructions about formatting, special characters, etc.
- Commands begin with `\`
- Mathematical commands must be written in math mode

# Example Commands

Command	Result
<code>\textbf{Bold Text}</code>	<b>Bold Text</b>
<code>{\it Italic Text}</code>	<i>Italic Text</i>
<code>\section{Bayes' Theorem}</code>	Creates section "Bayes' Theorem"
<code>\&amp;</code>	&
<code>\textbackslash</code>	\

# New Commands

- $\text{\TeX}$  is shipped with numerous commands
- However, sometimes it is useful to define your own command

```
\newcommand{\ec}{\textsc{Evil Corp}}
```

If writing an article on `\textit{Mr. Robot}`, it may be worthwhile to make an `\ec` command.

If writing an article on *Mr. Robot*, it may be worthwhile to make an EVIL CORP command.

## New Commands With Arguments

```
\newcommand{\betadist}[3]{\frac{\Gamma(#2 + #3)}{\Gamma(#2)\Gamma(#3)}#1^{\#2-1}(1-#1)^{\#3-1}}
```

```
$$\betadist{x}{\alpha}{\beta}$$
```

```
$$\betadist{t}{\gamma}{\mu}$$
```

$$\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}x^{\alpha-1}(1-x)^{\beta-1}$$
$$\frac{\Gamma(\gamma+\mu)}{\Gamma(\gamma)\Gamma(\mu)}t^{\gamma-1}(1-t)^{\mu-1}$$

- Environments are similar to commands in that they provide formatting instructions
- However, they are typically applied to larger blocks of text

## Example Environments

```
\begin{center}  
  This text is \textit{centered}.  
\end{center}
```

This text is *centered*.

## Example Environments

```
\begin{tabular}{c c}  
\toprule  
Fruit & Count \\  
\midrule  
Apple & 2 \\  
Banana & 7 \\  
Orange & 4  
\end{tabular}
```

Fruit	Count
Apple	2
Banana	7
Orange	4



## Example Environments

- T<sub>E</sub>X shorthand for inline math:  $\dots$

A function  $f$  is said to be continuous at  $c$  if it is both defined at  $c$  and  $\lim_{x \rightarrow c} f(x) = f(c)$ .

A function  $f$  is said to be continuous at  $c$  if it is both defined at  $c$  and  $\lim_{x \rightarrow c} f(x) = f(c)$ .

## Example Environments

- $\LaTeX$  shorthand for displayed math: `\[...\]`

```
\[f(x \mid \mu, \sigma^2) = \frac{1}{\sqrt{2 \sigma^2 \pi}}  
\exp \Big\{-\frac{(x-\mu)^2}{2 \sigma^2}\Big\}\]
```

$$f(x \mid \mu, \sigma^2) = \frac{1}{\sqrt{2\sigma^2\pi}} \exp\left\{-\frac{(x-\mu)^2}{2\sigma^2}\right\}$$

## Example Environments

```
\usepackage{amsmath}
\begin{align*}
f(x) &= (x-5)(x+3) \\
&= x^2 - 2x - 15
\end{align*}
```

$$\begin{aligned} f(x) &= (x - 5)(x + 3) \\ &= x^2 - 2x - 15 \end{aligned}$$

- It is sometimes useful/necessary to create custom environments
- Syntactically similar to new commands

# New Environments

```
\newenvironment{examplebox}
{\begin{tabular}{|l|}
\hline \\
\textbf{Example}}
{\\\\hline
\end{tabular}}
```

```
\begin{examplebox}
If  $X \sim \text{Poi}(\lambda_1)$  and  $Y \sim \text{Poi}(\lambda_2)$ ,
then  $X+Y \sim \text{Poi}(\lambda_1 + \lambda_2)$ .
\end{examplebox}
```

**Example** If  $X \sim \text{Poi}(\lambda_1)$  &  $Y \sim \text{Poi}(\lambda_2)$ ,  $X + Y \sim \text{Poi}(\lambda_1 + \lambda_2)$ .

- BibTeX
  - Bundled with  $\text{\LaTeX}$
- BibLaTeX
  - Recently succeeded BibTeX
- Natbib
  - The natbib package allows for different citation formats

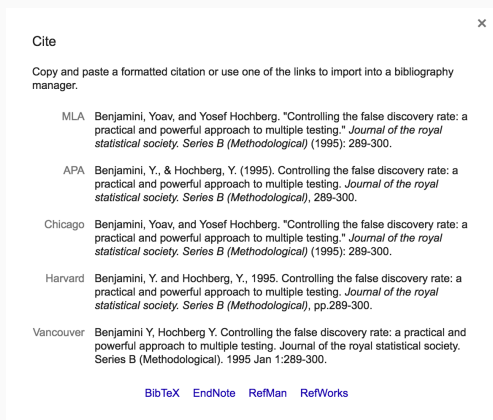
- Store references in an external file with the `.bib` extension
- Each entry should begin with a declaration of the reference type (i.e., `@type`), followed by a citation key and a host data specific to the reference
- Depending on the reference type, certain attributes are required while others are optional
- BibTeX does not have a nice way to cite web pages — it is often recommended to use the `@misc` reference type
  - BibLaTeX has an `@online` entry type

# The .bib file

```
@article{benjamini1995controlling,  
  title={Controlling the false discovery rate: a practical and  
  powerful approach to multiple testing},  
  author={Benjamini, Yoav and Hochberg, Yosef},  
  journal={Journal of the royal statistical society. Series B (Methodological)},  
  pages={289--300},  
  year={1995},  
  publisher={Blackwell Publishers}  
}
```



- Google Scholar makes creating the .bib file easy
- Find article → Click cite → Click BibTeX



The screenshot shows a 'Cite' dialog box with a close button (X) in the top right corner. Below the title, there is a instruction: 'Copy and paste a formatted citation or use one of the links to import into a bibliography manager.' The main content area lists five citation styles: MLA, APA, Chicago, Harvard, and Vancouver. Each style is followed by the same citation text for the article: 'Benjamini, Yoav, and Yosef Hochberg. "Controlling the false discovery rate: a practical and powerful approach to multiple testing." *Journal of the royal statistical society. Series B (Methodological)* (1995): 289-300.' At the bottom of the dialog, there are five blue links: BibTeX, EndNote, RefMan, and RefWorks.

Cite ×

Copy and paste a formatted citation or use one of the links to import into a bibliography manager.

MLA Benjamini, Yoav, and Yosef Hochberg. "Controlling the false discovery rate: a practical and powerful approach to multiple testing." *Journal of the royal statistical society. Series B (Methodological)* (1995): 289-300.

APA Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the royal statistical society. Series B (Methodological)*, 289-300.

Chicago Benjamini, Yoav, and Yosef Hochberg. "Controlling the false discovery rate: a practical and powerful approach to multiple testing." *Journal of the royal statistical society. Series B (Methodological)* (1995): 289-300.

Harvard Benjamini, Y. and Hochberg, Y., 1995. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the royal statistical society. Series B (Methodological)*, pp.289-300.

Vancouver Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the royal statistical society. Series B (Methodological)*. 1995 Jan 1:289-300.

[BibTeX](#) [EndNote](#) [RefMan](#) [RefWorks](#)

Figure 7: Google Scholar screenshot

- Before the `\end{document}` command, include `\bibliographystyle{style}` and `\bibliography{bibfile}`
- To cite in-text, insert `\cite{citation_key}` or `\cite{citation_key_01,citation_key_02,...}`

## Generating the Bibliography

- Multiple passes are required to link references in the `.bib` file to the `.tex` document
  1. `pdflatex latex_source_code.tex`
  2. `bibtex latex_source_code.aux`
  3. `pdflatex latex_source_code.tex`
  4. `pdflatex latex_source_code.tex`

# $\text{\LaTeX}$ in Reproducible Research

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# R Markdown & Jupyter Notebook

- R Markdown
  - R Markdown is a format for writing reproducible reports with R
  - Ability to embed R code and output into various document types
  - Check out this cheatsheet:  
<https://www.rstudio.com/wp-content/uploads/2015/02/rmarkdown-cheatsheet.pdf>
- Jupyter Notebook
  - Web application that allows users to create and share live code, results, and commentary
  - Supports over 40 programming languages including Python and R
- Both support the use of Markdown, in which it is possible to embed  $\text{\LaTeX}$
- Less clean alternative → `listings` package

# Pandoc: Your best friend

- Universal document converter
- Convert one markup format into another
- “Swiss-army knife”
- The conversion “tree” is too large to fit on this slide!  
(<http://pandoc.org/>)
- See <http://pandoc.org/installing.html> for installation details

# LaTeX in the Cloud

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- Online L<sup>A</sup>T<sub>E</sub>X editors are available
- Great for collaboration
- No need to worry about compiling issues
- Great for beginners → do not need a T<sub>E</sub>X distribution
- My personal favorites are Overleaf and ShareLaTeX





J. Allen.

The TeX family tree: LaTeX, pdfTeX, XeTeX, LuaTeX and ConTeXt, 2012.