



An Interactive Introduction to \LaTeX

TLC Workshop

<https://haziqj.ml/learn-latex>

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Overview

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- Sections

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What's next?

Why L^AT_EX?



AV Wa
No kerning



AV Wa
Kerning applied

- It makes beautiful documents.
- Open source and active community. Lots of packages available.
- Extensible document types (articles, presentation slides, books, theses, exam papers, etc.).

Reminder

Sign up for Overleaf if you haven't done so!

How does it work?

- You write your document in plain text with commands that describe its structure and meaning.
- The \LaTeX program then processes your text and commands to produce a beautifully formatted document.

The rain in Spain falls \emph{mainly} on the plain.



The rain in Spain falls *mainly* on the plain.

This workshop is inspired by the \LaTeX course by JD Miller. MIT license.

More examples of commands and output...

```
\begin{itemize}
  \item Tea
  \item Milk
  \item Biscuits
\end{itemize}
```

- Tea
- Milk
- Biscuits

```
\begin{figure}
\includegraphics{gerbil}
\end{figure}
```



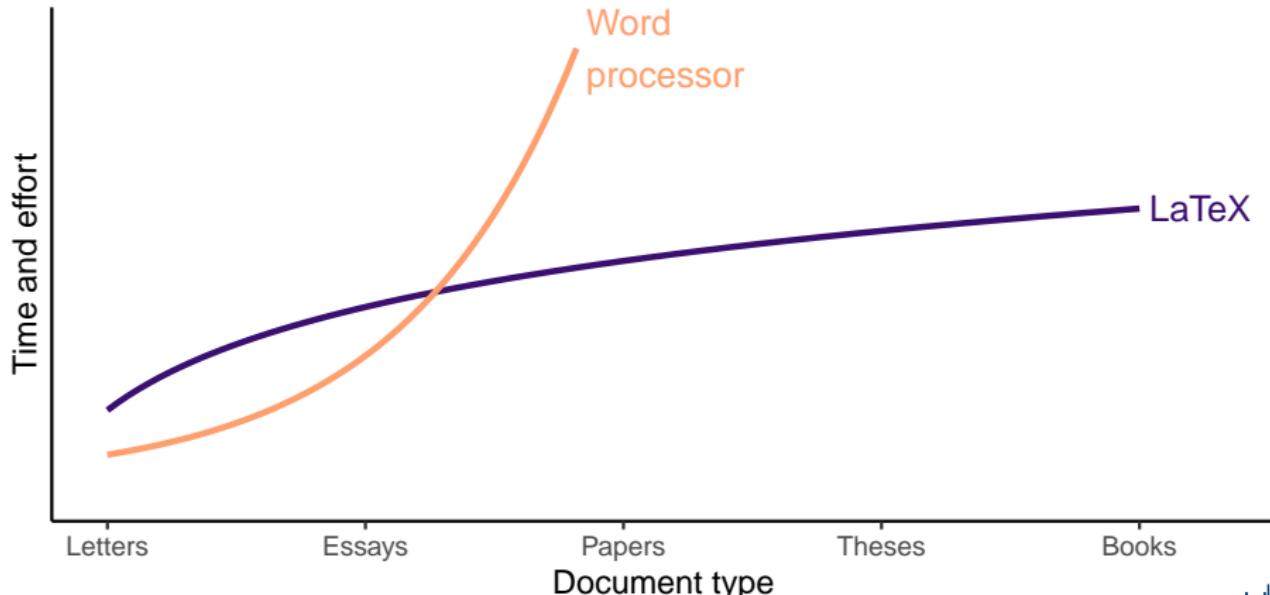
```
\begin{equation}
y = \alpha + \beta x
\end{equation}
```

$$y = \alpha + \beta x \quad (1)$$

*Image license: CC0

Attitude adjustment

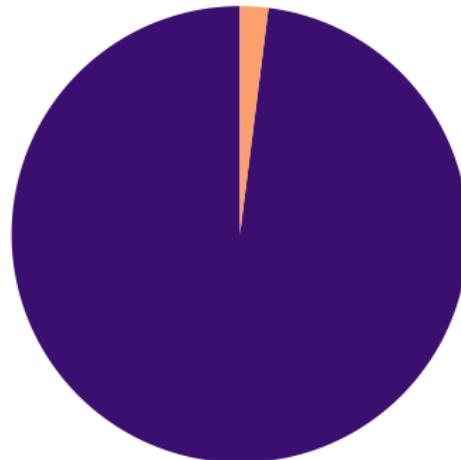
- Use commands to describe ‘what it is’ and not ‘how it looks’.
- Focus on your content.
- Let \LaTeX do its job.



Float placements

L^AT_EX takes care of figure placements (“floats”) automatically.

Moving a picture in MS Word



- You mess up the whole document
- It actually does what you want



College Student
@CollegeStudent

using microsoft word

moves an image 1 mm to the left

all text and images shift. 4 new pages appear. in the distance, sirens.

10:12 AM · Sep 24, 2017 · Twitter Web Client

52.3K Retweets 1,694 Quote Tweets 171.8K Likes



Citations

Sometimes, however, what others tell us is important as *corroboration* of what we have already found out (or think we have found out) for ourselves. The Scottish philosopher Thomas Reid makes this point in connection with mathematical research in the belief that, if it applies to the science ‘in which, of all sciences, authority is acknowledged to have least weight’ [2], it will be even more significant in other areas of thought and practice... Russell, as we shall see in a later chapter, considered this aspect of our reliance upon testimony essential to the understanding of what it is to be a physical thing and he criticized logical positivism for its failure to appreciate the implications of this point [4]. In the Analysis of Matter he says explicitly, ‘I mean here by “objective” not anything metaphysical but merely “agreeing with the testimony of others”’ [3].

Excerpt from *Testimony: A Philosophical Study* by C. A. J. Coady (1992)

Bibliography

- [1] C. A. J. Coady. *Testimony: A philosophical study*. Clarendon Press, 1992.
- [2] T. Reid, D. Brookes, and K. Haakonssen. "Thomas Reid: Essays on the Intellectual Powers of Man." In: *Thomas Reid-Essays on the Intellectual Powers of Man*. Edinburgh University Press, 2002.
- [3] B. Russell. "Analysis of Matter (1927)." In: *Consciousness in the Physical World: Perspectives on Russellian Monism* (2015), p. 29.
- [4] B. Russell. *Logic and knowledge: Essays 1901-1950*. Spokesman Books, 2007.

Mathematics

Theorem 1 (Central Limit Theorem)

Let X_1, \dots, X_n be an independent random sample from a distribution whose mean is μ and variance is σ^2 . Then $\bar{X}_n := \frac{1}{n} \sum_{i=1}^n X_i$ converges in distribution to a random variable whose density function is

$$f(x) = \frac{1}{\sqrt{2\pi}} \exp \left[-\frac{1}{2} \left(\frac{x - \mu}{\sigma/\sqrt{n}} \right)^2 \right] \quad (2)$$

The proof of Theorem 1 uses *characteristic functions*, whereby the standardised version of (2) is obtained in the limit as $n \rightarrow \infty$.

Chemical equations

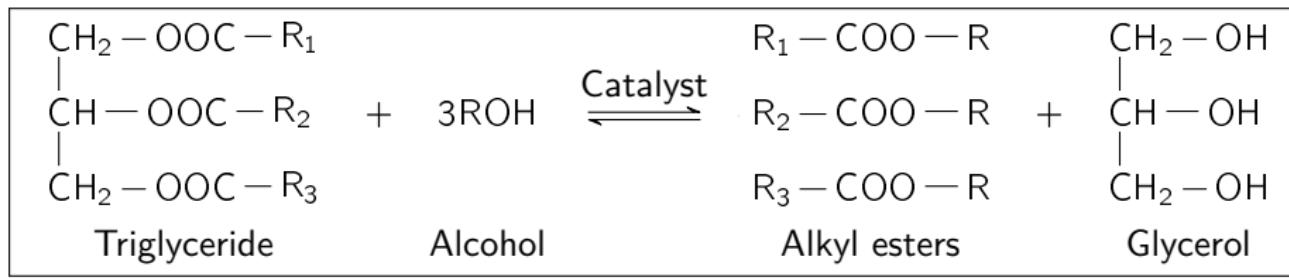
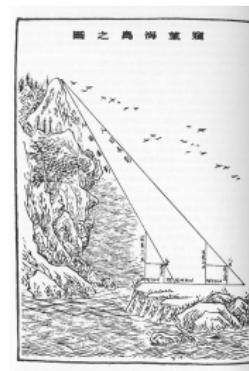


Figure 1: Transesterification of triglyceride with alcohol.

Figure 1 obtained from <https://tex.stackexchange.com/a/472486>

Multilingual support



الْكِتَابُ الْمُخْتَصِرُ فِي حِسَابِ الْجَبْرِ وَالْمُقَابَلَةِ
(The Compendious Book on
Calculation by Completion and
Balancing), also known as
الْجَبْرِ (Al-Jabr), written by
مُحَمَّدْ بْنُ مُوسَى (Muhammad ibn Mūsā
al-Khwārizmī) around 820 CE.

海岛算经 (Hǎidǎo suàn jīng—The Sea Island Mathematical Manual) was written by 刘徽 (Liú Huī) ca. 200 CE. The Chinese were aware of a good approximation of $\pi \approx 355/113 = 3.1415929204$ very early on (祖冲之 Zǔ Chōng Zhī, 500 CE).

For teaching

- Setting of question papers (assignments, tests, exams, etc.)
- Syllabus documents
- Presentations

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Getting started

A minimal L^AT_EX document

```
\documentclass{article}  
\begin{document}  
Hello, World! % your content goes here...  
\end{document}
```

- Commands start with a backslash `\`.
- Every document starts with a `\documentclass` command.
- The *argument* in curly braces `{ }` tells L^AT_EX what kind of document we are creating (in this case, an article).
- A percent sign `%` starts a *comment*—L^AT_EX will ignore the rest of the line.

Getting started



<https://www.overleaf.com/>

- Overleaf is a website for writing documents in \LaTeX .
- It ‘compiles’ your \LaTeX document online to show you the results.
- As we go through the following slides, try out the examples by typing them into the example document on Overleaf!

Exercise 0 (Hello world)

Click [Hello World](#) to open the “Hello world” document in **Overleaf** (you’ll need to sign in first). Let’s get started!

Typesetting text

- Type your text between `\begin{document}` and `\end{document}`.
- For the most part, you can just type your text normally.

Words are separated by one or more spaces.

Paragraphs are separated by one or more blank lines.

Words are separated by one or more spaces.

Paragraphs are separated by one or more blank lines.

- Blank space in the source file is collapsed in the output.

The rain in Spain
falls mainly on the plain.

The rain in Spain falls mainly on the plain.

Typesetting text (Caveats)

- Quotation marks a bit tricky: Use a backtick `\`` on the left and an apostrophe `'` on the right.

Single quotes: ``text'`.

Single quotes: `'text'`.

Double quotes: ```text''`.

Double quotes: `"text"`.

- Some common characters have special meanings in \LaTeX :
 - `%` is used to comment text
 - `#` is used for macros definitions
 - `&` is used for alignment
 - `$` is used for maths
- If you just type these, you'll get an error. If you want one to appear in the output, you have to *escape* it by preceding it with a backslash `\`.

`\$ \% \& \#`

`\$ \% \& \#`

Handling errors

- \LaTeX can get confused when it is trying to compile your document. If it does, it stops with an error, which you must fix before it will produce any output.
- For example, if you misspell `\emph` as `\meph`, \LaTeX will stop with an undefined control sequence error, because `\meph` is not one of the commands it knows.

Advice on errors

1. Don't panic! Errors happen. The error messages can give a clue as to what's wrong.
2. Fix them as soon as they arise—if what you just typed caused an error, you can start your debugging there.
3. If there are multiple errors, start with the first one—the cause may even be above it.

Exercise

Exercise (Typesetting Text)

Typeset the following paragraph¹ in LATEX:

In March 2006, Congress raised that ceiling an additional \$0.79 trillion to \$8.97 trillion, which is approximately 68% of GDP. As of October 4, 2008, the “Emergency Economic Stabilization Act of 2008” raised the current debt ceiling to \$11.3 trillion.

Click [Exercise 1](#) to open this exercise in Overleaf.

Watch out for

- characters with special meanings % # & \$
- typesetting quotation marks correctly.

¹http://en.wikipedia.org/wiki/Economy_of_the_United_States

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What's next?

Inline equations

- Dollar signs \$ are used to mark mathematics in text.

% not so good:

Let a and b be distinct positive integers, and let $c = a - b + 1$.

% much better:

Let $\$a\$$ and $\$b\$$ be distinct positive integers, and let $\$c = a - b + 1\$$.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

- Always use dollar signs in pairs—one to **begin** and one to **end**.
- \LaTeX handles spacing automatically; it ignores your spaces.

Let $\$y=mx+c\$$ be \ldots

Let $y = mx + c$ be ...

Let $\$y = m x + c\$$ be \ldots

Let $y = mx + c$ be ...

More notation

- Use caret/hat $\hat{}$ for superscripts and underscore $\underline{}$ for subscripts.

```
$y = c_2 x^2 + c_1 x + c_0$
```

$$y = c_2 x^2 + c_1 x + c_0$$

- Use curly braces $\{ \} \}$ to group supers/sub scripts.

```
% oops!
```

```
$F_n = F_{n-1} + F_{n-2}$
```

$$F_n = F_{n-1} + F_{n-2}$$

```
% ok!
```

```
$F_n = F_{\{n-1\}} + F_{\{n-2\}}$
```

$$F_n = F_{n-1} + F_{n-2}$$

- There are commands for Greek letters and common notation.

```
$\mu = A e^{Q/RT}$
```

$$\mu = A e^{Q/RT}$$

```
$\Omega = \sum_{k=1}^n \omega_k$
```

$$\Omega = \sum_{k=1}^n \omega_k$$

Detexify

The screenshot shows a web browser window for detexify.kirelabs.org. The page title is "Detexify LaTeX handwritten symbol recognition". The main content area features a large input field containing a handwritten symbol, which is identified as a Greek letter beta (β). A red "X" icon is displayed in the top right corner of the input field, indicating an error or a failed attempt to recognize the symbol.

Handwritten symbol:

Identified symbol: β

Score: 0.10291823112281329

LaTeX command: \beta

Mode: mathmode

Identified symbol: β

Score: 0.11024688463388

LaTeX command: \ss

Mode: textmode

Identified symbol: β

Score: 0.1218880372150471

LaTeX command: \usepackage{ marvosym }

Mode: textmode

Score: 0.13370433935413875

Displayed equations

- If the mathematics is big and scary, *display* it on its own line using `\begin{equation}` and `\end{equation}`

The roots of a quadratic equation are given by

```
\begin{equation}
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
```

```
\end{equation}
```

where \$a\$, \$b\$ and \$c\$ are \ldots

The roots of a quadratic equation are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (3)$$

where a , b and c are ...

Caution

\LaTeX mostly ignores your spaces in mathematics, but it can't handle blank lines in equations—don't put blank lines in your mathematics.

Interlude: Environments

- equation is an *environment* (a context).
- The `\begin` and `\end` commands are used to create many different environments. E.g., `itemize` and `enumerate` for lists:

```
\begin{itemize} % for bullet points
```

```
\item Biscuits
\item Tea
\end{itemize}
```

- Biscuits
- Tea

```
\begin{enumerate} % for numbers
```

```
\item Biscuits
\item Tea
\end{enumerate}
```

1. Biscuits
2. Tea

Interlude: Packages

- All of the commands and environments we've used so far are built into \LaTeX .
- *Packages* are libraries of extra commands and environments. There are thousands of freely available packages.
- We have to load each package we want to use with a `\usepackage` command in the *preamble*.
- Example: `amsmath` from the American Mathematical Society.

```
\documentclass{article}
\usepackage{amsmath} % preamble
\begin{document}
% now we can use commands from amsmath here...
\end{document}
```

An example with amsmath

- Align a sequence of equations at the equals sign

$$\begin{aligned}(x + 1)^3 &= (x + 1)(x + 1)(x + 1) \\&= (x + 1)(x^2 + 2x + 1) \\&= x^3 + 3x^2 + 3x + 1\end{aligned}$$

with the `align*` environment.

```
\begin{align*}
(x+1)^3 &= (x+1)(x+1)(x+1) \\
&\quad \&= (x+1)(x^2 + 2x + 1) \\
&\quad \&= x^3 + 3x^2 + 3x + 1
\end{align*}
```

- An ampersand `&` separates the left column (before the `=`) from the right column (after the `=`).
- A double backslash `\\"` starts a new line.

Exercise

Exercise 2 (Maths)

Typeset the following paragraph in \LaTeX :

Let X_1, X_2, \dots, X_n be a sequence of independent and identically distributed random variables with $E[X_i] = \mu$ and $\text{Var}[X_i] = \sigma^2 < \infty$, and let

$$S_n = \frac{1}{n} \sum_{i=1}^n X_i$$

denote their mean. Then as n approaches infinity, the random variables $\sqrt{n}(S_n - \mu)$ converge in distribution to a normal $N(0, \sigma^2)$.

Click [Exercise 2](#) to open this exercise in **Overleaf**.

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What's next?

Figures

- Requires the `graphicx` package, which provides the `\includegraphics` command.
- Supported graphics formats include JPEG, PNG and PDF.

```
\includegraphics[width=0.5\textwidth]{gerbil}
```



```
\includegraphics[width=0.3\textwidth,  
angle=270]{gerbil}
```



Interlude: Optional arguments

- We use square brackets `[]` for *optional* arguments, instead of braces `{ }`.
- `\includegraphics` accepts optional arguments that allow you to transform the image when it is included. For example, `width=0.3\textwidth` makes the image take up 30% of the width of the surrounding text (`\textwidth`).
- `\documentclass` accepts optional arguments, too. E.g. `\documentclass[12pt,twocolumn]{article}` makes the text bigger (12pt) and puts it into two columns.

Floats

- Allow L^AT_EX to decide where the figure will go (it can “float”).
- You can also give the figure a caption, which can be referenced with `\ref`.
- For more on floats, visit this link.

```
\begin{figure}[htbp]
\centering
\includegraphics[% width=0.5\textwidth]{gerbil}
\caption{\label{fig:gerbil}Aww\ldots.}
\end{figure}
```

Figure `\ref{fig:gerbil}` shows a gerbil.



Figure 2: Aww...

Figure 2 shows a gerbil.

Interlude: Tables

- Use the `tabular` environment wrapped in the `table` environment that floats it. You can also `\caption` and `\label` to `\ref` it later.

```
\begin{table}[htbp]
\begin{tabular}{|l|l|l|l|}
\hline
Item & Qty & Unit (\$) & \\
Widget & 1 & 199.99 & \\
Gadget & 2 & 399.99 & \\
Cable & 3 & 19.99 & \\
\end{tabular}
\caption{My table}
\label{tab:mytab}
\end{table}
```

Item	Qty	Unit (\$)
Widget	1	199.99
Gadget	2	399.99
Cable	3	19.99

Table 1: My table

- The argument specifies column alignment—`left`, `centre`, `right`.
- `\hline` and `|` specifies horizontal and vertical lines resp.
- Use `&` to separate columns and `\backslash` to start new line.

Tablesgenerator.com

The screenshot shows the Tablesgenerator.com web application. At the top, there is a toolbar with various icons for file operations, editing, and styling. Below the toolbar, a dropdown menu shows "Default table style". The main area contains a table with four rows and three columns labeled A, B, and C. The first row is a header with "Item", "Qty", and "Unit (\$)". The subsequent rows contain data: "Widget" with Qty 1 and Unit \$199.99, "Gadget" with Qty 2 and Unit \$399.99, and "Cable" with Qty 3 and Unit \$19.99. Below the table is a "Generate" button. To the right, there is a "Result" section with a message "Result (click "Generate" to refresh)" and a "Copy to clipboard" button. At the bottom, a code editor displays the generated LaTeX code:

```
1 | \begin{table}[]
2 | \begin{tabular}{|l|l|l|l|}
3 | \hline
4 | Item & Qty & Unit (\$) \\ \hline
5 | Widget & 1 & 199.99 \\ \hline
6 | Gadget & 2 & 399.99 \\ \hline
7 | Cable & 3 & 19.99 \\ \hline
8 | \end{tabular}
9 | \end{table}
```

Exercise

Exercise 3 (Figures)

Let's practice adding a picture using `\begin{figure}... \end{figure}` and `\includegraphics`. Download the following image by clicking on it.



Click [Exercise 3](#) to open this exercise in **Overleaf**.

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What's next?

Title, author, date

- Tell \LaTeX the `\title` and `\author` names in the preamble. Note that author names are separated by `\and`.
- The `\date` command can be used to manually specify the date, or use `\date{\today}` for today's date.
- Then use `\maketitle` (inserted just after `\begin{document}`) to actually create the title.

```
\documentclass{article}

\title{The Title}
\author{A. Author \and A. Nother}
\date{\today}

\begin{document}
\maketitle
\end{document}
```

The Title

A. Author

A. Nother

November 14, 2022

Abstract

- Typically, a paper begins with the abstract.
- Use the `abstract` environment for this.

```
\documentclass{article}
\usepackage{lipsum} % load this
\title{The Title}
\author{A. Author \and A. Nother}
\date{\today}

\begin{document}
\maketitle

\begin{abstract}
\lipsum[1] % placeholder text
\end{abstract}

\end{document}
```

The Title

A. Author A. Nother

November 14, 2022

Abstract

 Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Sections

- To section the document, use `\section` and `\subsection`.

```
\documentclass{article}  
\begin{document}  
  
\section{Introduction}  
The problem of \ldots  
  
\subsection{Sample Preparation}  
  
\subsection{Data Collection}  
  
\section{Results}  
  
\section{Conclusion}  
  
\end{document}
```

1 Introduction

The problem of ...

1.1 Sample Preparation

1.2 Data Collection

2 Results

3 Conclusion

Cross-referencing

- As with equations, figures and tables, it is possible to cross-reference the sections. Just use `\label` and `\ref`.

```
\documentclass{article}
\begin{document}

\section{Introduction}
Results are presented in section
\ref{sec:results}.
In section \ref{sec:conc}, we conclude.

\section{Results}
\label{sec:results}

\section{Conclusion}
\label{sec:conc}

\end{document}
```

1 Introduction

Results are presented in section 2. In section 3, we conclude.

2 Results

3 Conclusion

Exercise

Exercise 4 (Structure)

The document you will load contains all the text, but its structure is missing. Go ahead and fix this:

- Add title, author and date.
- Add the abstract.
- Add sections.
- Cross reference the sections.

Click [Exercise 4](#) to open this exercise in **Overleaf**.

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The bibtex format

Citation styles

What's next?

The bibtex format

- `LATEX` works off a 'bibtex' database format:

```
@article{lowry1951protein,  
    title={Protein measurement with the Folin phenol reagent},  
    author={Lowry, OH and Rosebrough, NJ and Farr, AL and  
           Randall, RJ},  
    journal={Journal of Biological Chemistry},  
    volume={193},  
    pages={265--275},  
    year={1951}  
}
```

- Each bibtex entry has a *key* that you can use to reference it in the document. E.g., `lowry1951protein` is the key for the article above.
- It's a good idea to use a key based on the name, year and title.

A bib file

- Collect all your references into a bib file, say `refs.bib`. This file should be in the folder together with your `tex` file.
- Most reference managers (e.g. Mendeley or Zotero) can export to `bibtex` format.
- You can also use Google Scholar and do this manually.

The screenshot shows a web browser window with the URL `scholar.google.com` in the address bar. A search query has been entered. A modal dialog box titled "Cite" is displayed, listing citations in various styles:

Citation Style	Text Content
MLA	Lowry, Oliver H. "Protein measurement with the Folin phenol reagent." <i>J biol Chem</i> 193 (1951): 265-275.
APA	Lowry, O. H. (1951). Protein measurement with the Folin phenol reagent. <i>J biol Chem</i> , 193, 265-275.
Chicago	Lowry, Oliver H. "Protein measurement with the Folin phenol reagent." <i>J biol Chem</i> 193 (1951): 265-275.
Harvard	Lowry, O.H., 1951. Protein measurement with the Folin phenol reagent. <i>J biol Chem</i> , 193, pp.265-275.
Vancouver	Lowry OH. Protein measurement with the Folin phenol reagent. <i>J biol Chem</i> . 1951;193:265-75.

Below the modal, there are links for `BibTeX`, `EndNote`, `RefMan`, and `RefWorks`.

BibLATEX

- Use the `biblatex` package with the `natbib` option.
- The bibliography file must be called using `\addbibresource`.
- At the end, print the bibliography using `\printbibliography`

```
\documentclass{article}  
\usepackage[natbib]{biblatex}  
\addbibresource{refs.bib}  
% if 'refs' is the name of  
% the bib file
```

```
\begin{document}  
The most cited paper ever is  
\cite{lowry1951protein}.
```

```
\printbibliography  
\end{document}
```

The most cited paper ever is [1].

References

- [1] OH Lowry et al. "Protein measurement with the Folin phenol reagent".
In: *Journal of Biological Chemistry* 193 (1951), pp. 265–275.

Citation styles

- Use the optional argument `style` to change the citation style.

```
...
```

```
\usepackage[natbib, style=apa]{  
    biblatex}
```

```
...
```

The most cited paper ever is Lowry et al., 1951.

References

Lowry, O., Rosebrough, N., Farr, A., & Randall, R. (1951). Protein measurement with the folin phenol reagent. *Journal of Biological Chemistry*, 193, 265–275.

- A number of citation styles exist:
 - numeric: (default) Numeric citation scheme
 - apa: American Psychological Association
 - ieee: Institute of Electrical and Electronics Engineers
 - chicago: Chicago style
 - mla: Modern Language Association

Some natbib commands

- The `natbib` option allows several alternative citation commands, especially using some kind of author-year style such as the APA style.

% Textual citation

```
\citet{lowry1951protein}
```

Lowry et al. (1951)

% Textual citation, all authors

```
\citet*{lowry1951protein}
```

Lowry, Rosebrough, Farr, and Randall (1951)

% Parenthetical citation

```
\citep{lowry1951protein}
```

(Lowry et al., 1951)

% Prints only the author name

```
\citeauthor{lowry1951protein}
```

Lowry et al.

1951

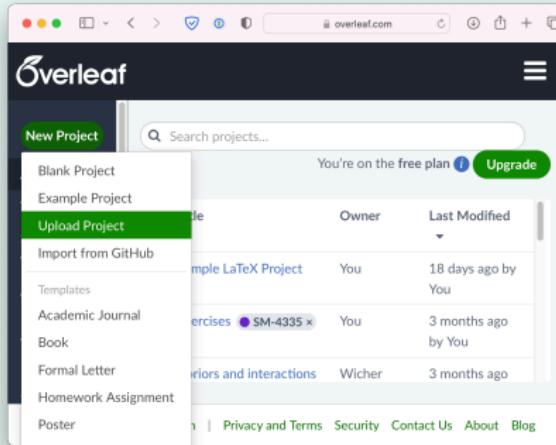
% Prints only the year

```
\citeyear{lowry1951protein}
```

Exercise

Exercise 5 (Bibliography)

We will add citations to the previous document. To get started, download the zip file which contains all the files you need by clicking [Exercise 5](#). **Do not unzip the zip file.** Instead, upload it to Overleaf.



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What's next?

Wrap-up



You have now learned how to...

- Typeset text in `LATEX`
- Use lots of different commands
- Typeset some beautiful mathematics
- Use several different environments (figures, tables, lists).
- Load packages
- Structure an article
- Cross-reference parts of the article
- Insert bibliography automatically

Ready for more?

- Other document classes
 1. Typesetting exams: [link](#)
 2. Making presentations using beamer: [link](#)
 3. Write your own book: [link](#)
 4. Drawing with tikz: [link](#)
- Unofficial UBD beamer theme: [link](#)
- Maybe next time: Reproducible documents using RMarkdown.