

SM-2302 Software for Mathematicians

L^AT_EX2: Structured documents

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<https://github.com/sm2302-aug23>

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Introduction

- In Part 1, we learned about commands and environments for typesetting text and mathematics.
- Now, we'll learn about commands and environments for structuring documents.
- Firstly, we'll go through how to place floats, such as figures and tables, in \LaTeX documents.

Let's get started!

Figures

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

```
\includegraphics{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 \LaTeX 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: Aww...

Figure 1 shows a gerbil.

Interlude: Tables

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

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

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

The screenshot shows the Tablesgenerator.com web application. At the top is a navigation bar with menus for File, Edit, Table, Column, Row, Cell, and Help. Below this is a toolbar with icons for table styles, text formatting (bold, italic, underline), table manipulation (insert, delete, merge, split), and other functions. A dropdown menu shows 'Default table style'. The main workspace contains a table with 4 rows and 3 columns. The first row is the header, and the subsequent rows contain data. Below the table is a 'Generate' button. Underneath, the 'Result' section shows the LaTeX code for the table, with a 'Copy to clipboard' button. The LaTeX code is as follows:

```
1 \begin{table}□
2 \begin{tabular}{|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}
```

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

Generate

Result (click "Generate" to refresh)

Copy to clipboard

Exercise

Exercise 1 (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**.

Figures

Structure

Title, author, date

Abstract

Sections

Bibliography

What's next?

Title, author, date

- Tell L^AT_EX 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, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur 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 2 (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**.

Figures

Structure

Bibliography

- The bibtex format

- Citation styles

What's next?

The bibtex format

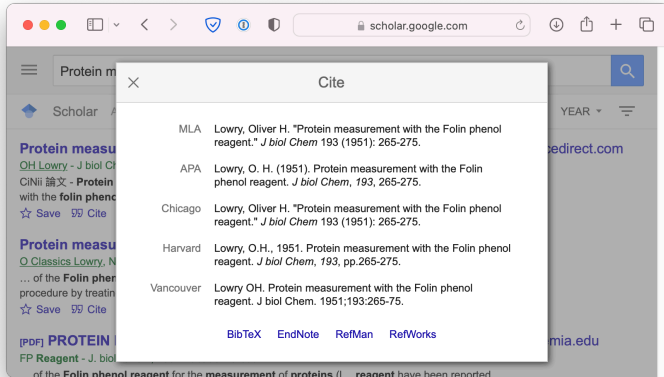
- L^AT_EX works off a 'bibtex' database format:

```
@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.



- 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, useful when using an 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.

% Prints only the year

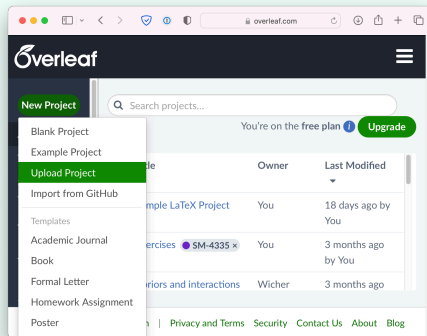
`\citeyear{lowry1951protein}`

1951

Exercise

Exercise 3 (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.



Figures

Structure

Bibliography

What's next?

- More neat packages

- Installing \LaTeX

- More resources

More neat things

- Add the `\tableofcontents` command to generate a table of contents at the beginning of a document.
- Change the `\documentclass` to `\documentclass{IEEEtran}` or `\documentclass{apa7}`.
- Define your own commands for complicated equations.

```
\newcommand{\rperf}{\rho_{\text{perf}}}  
$$  
\rperf = {\bf c}'{\bf X} + \varepsilon  
$$
```

$$\rho_{\text{perf}} = \mathbf{c}'\mathbf{X} + \varepsilon$$

More neat packages

- beamer: for presentations (like this one!)
- todonotes: comments and TODO management
- tikz: make amazing graphics
- pgfplots: create graphs in \LaTeX
- listings: source code printer for \LaTeX
- spreadtab: create spreadsheets in \LaTeX
- gchords, guitar: guitar chords and tabulature
- cwpuzzle: crossword puzzles

See <https://www.overleaf.com/latex/examples> and <http://texample.net> for examples of (most of) these packages.

Installing L^AT_EX

- To run L^AT_EX on your own computer, you'll want to use a L^AT_EX *distribution*. A distribution includes a latex program and (typically) several thousand packages.
 - On Windows: MikT_EX or T_EXLive
 - On Linux: T_EXLive
 - On Mac: MacT_EX
- You'll also want a text editor with L^AT_EX support. See http://en.wikipedia.org/wiki/Comparison_of_TeX_editors for a list of (many) options.
- You'll also have to know more about how latex and its related tools work—see the resources on the next slide.

More resources

- Overleaf is a great resource for learning \LaTeX :

A quick guide to \LaTeX

Text decorations

Your text can be *italic* (`\textit{italic}`), **bold** (`\textbf{bold}`), or underlined (`\underline{underlined}`).

Your math can contain bold, \mathbf{R} (`\mathbf{R}`), or blackboard bold, \mathbb{R} (`\mathbb{R}`). You may want to use these to express the sets of real numbers (\mathbb{R} or \mathbf{R}), integers (\mathbb{Z} or \mathbf{Z}), rational numbers (\mathbb{Q} or \mathbf{Q}), and natural numbers (\mathbb{N} or \mathbf{N}).

For text appearing inside a math expression, use `\text`.
(`0,1`) \rightarrow ($x \in \mathbb{R} : x > 0$ and $x \leq 1$) yields
(`0,1`) = { $x \in \mathbb{R} : x > 0$ and $x \leq 1$ }.

(Without the `\text` command it treats "and" as three variables:
(`0,1`) = { $x \in \mathbb{R} : x > 0$ and $x \leq 1$ }.)

Spaces and new lines

\LaTeX ignores extra spaces and new lines. For example,
This sentence will look fine after it is compiled.
This sentence will look fine after it is compiled.
Leave one full empty line between two paragraphs. Place `\` at the

Lists

You can produce ordered and unordered lists.

unordered list

ordered list

Symbols (in *math mode*)

The basics

description	code
addition	<code>+</code>
subtraction	<code>-</code>
times or minus	<code>\times</code>

- Others
 - The \LaTeX Wikibook—excellent tutorials and reference material.
 - \TeX Stack Exchange—ask questions and get excellent answers incredibly quickly
- Unofficial UBD beamer theme: [link](#)
- Need to convert to docx? Consider pandoc.

`pandoc mydoc.tex -o mydoc.docx`