SM-2302 Software for Mathematicians

LaTeX2: Structured documents

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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 LaTeXdocuments.

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.

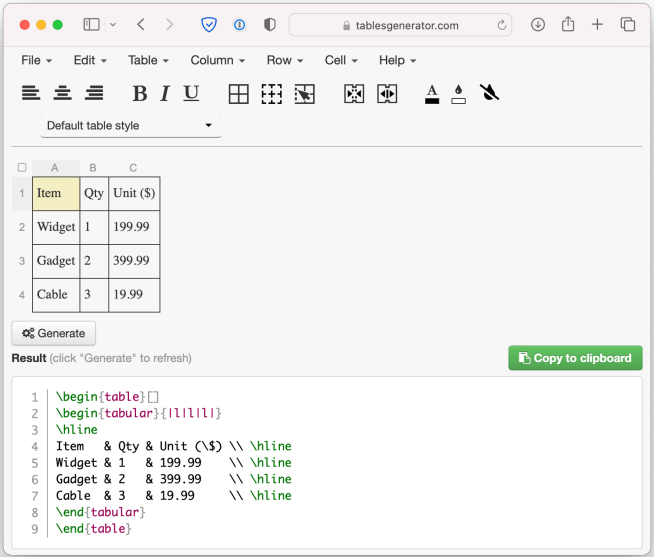
```
\begin{table}[htbp]
\begin{tabular}{|l|l|l|}
\hline
Item   & Qty & Unit (\) \\ \hline
Widget & 1   & 199.99    \\ \hline
Gadget & 2   & 399.99    \\ \hline
Cable  & 3   & 19.99     \\ \hline
\end{tabular}
\caption{My table}
\label{tab:mytab}
\end{table}
```

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

Table: My table

- The argument specifies column alignment–**l**eft, **c**entre, **r**ight.
- `\hline` and `|` specifies horizontal and vertical lines resp.
- Use `&` to separate columns and `\\` to start new line.

Tablesgenerator.com



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?

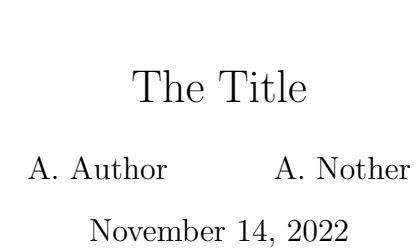
Title, author, date

- Tell 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}
```



Abstract

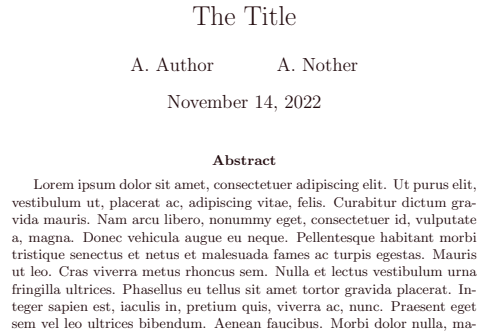
- Typically, a paper begins with the abstract.
- Use the `abstract` environment for this.

```
\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}
```



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**.

The bibtex format

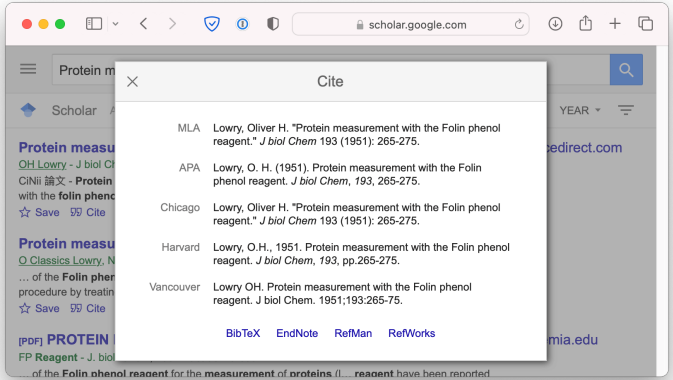
- LaTeX works off a 'bibtex' database format:

```
@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.



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,stype=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}

% Textual citation, all authors
\citet*{lowry1951protein}

% Parenthetical citation
\citep{lowry1951protein}

% Prints only the author name
\citeauthor{lowry1951protein}

% Prints only the year
\citeyear{lowry1951protein}
```

Lowry et al. (1951)

Lowry, Rosebrough, Farr, and Randall (1951)

(Lowry et al., 1951)

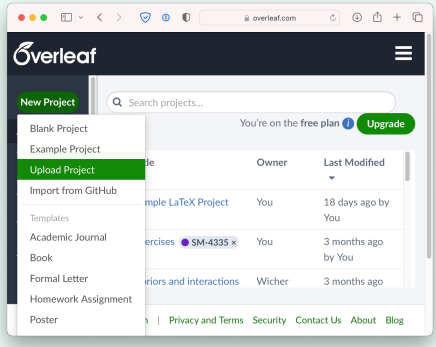
Lowry et al.

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.



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

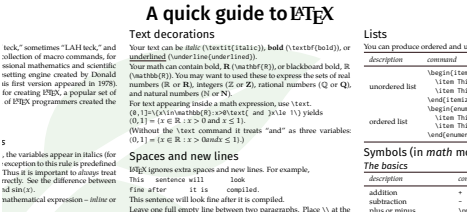
See `https://www.overleaf.com/latex/examples` and `http://texample.net` for examples of (most of) these packages.

Installing LaTeX

- To run LaTeX on your own computer, you'll want to use a LaTeX *distribution*. A distribution includes a `latex` program and (typically) several thousand packages.
  - On Windows: MikTeX or TeXLive
  - On Linux: TeXLive
  - On Mac: MacTeX
- You'll also want a text editor with LaTeX 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 used 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.
$\{0,1\}=\{x\in\mathbb{R}:x>0\text{ and }x\le 1\}$ yields
$\{0,1\} = \{x \in \mathbb{R} : x > 0 \text{ and } x \le 1\}$.
(Without the \text command it treats "and" as three variables:
$\{0,1\} = \{x \in \mathbb{R} : x > 0 \mathit{and} x \le 1\}$.)

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 u

description	*command*
unordered list	\begin{item \item Thi \item Thi \end{itemiz
ordered list	\begin{enum \item Thi \item Thi \end{enumer

Symbols (in *math* m

The basics

description	*co*
addition	+
subtraction	-

- 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
```