



SM-2302 Software for Mathematicians

L^AT_EX2: Structured Documents & More

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Structured Documents

- 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.
- You can try out the new commands in Overleaf:

Click here to open the example document in **Overleaf**

For best results, please use Google Chrome or a recent FireFox.

- Let's get started!

Title and Abstract

- Tell L^AT_EX the `\title` and `\author` names in the preamble.
- Then use `\maketitle` in the document to actually create the title.
- Use the `abstract` environment to make an abstract.

```
\documentclass{article}
```

```
\title{The Title}
```

```
\author{A. Author}
```

```
\date{\today}
```

```
\begin{document}
```

```
\maketitle
```

```
\begin{abstract}
```

```
Abstract goes here...
```

```
\end{abstract}
```

```
\end{document}
```

The Title

A. Author

October 1, 2022

Abstract

Abstract goes here...

Sections

- Just use `\section` and `\subsection`.
- Can you guess what `\section*` and `\subsection*` do?

```
\documentclass{article}
```

```
\begin{document}
```

```
\section{Introduction}
```

The problem of `\ldots`

```
\section{Method}
```

We investigate `\ldots`

```
\subsection{Sample Preparation}
```

```
\subsection{Data Collection}
```

```
\section{Results}
```

1 Introduction

The problem of ...

2 Method

We investigate ...

2.1 Sample Preparation

2.2 Data Collection

3 Results

4 Conclusion

Labels and Cross-References

- Use `\label` and `\ref` for automatic numbering.
- The `amsmath` package provides `\eqref` for referencing equations.

```
\documentclass{article}
\usepackage{amsmath} % for \eqref
\begin{document}
```

```
\section{Introduction}
\label{sec:intro}
```

In Section `\ref{sec:method}`, we `\ldots`

```
\section{Method}
\label{sec:method}
```

```
\begin{equation}
\label{eq:euler}
e^{i\pi} + 1 = 0
\end{equation}
```

By `\eqref{eq:euler}`, we have `\ldots`

1 Introduction

In Section 2, we ...

2 Method

By (1), we have ...

$$e^{i\pi} + 1 = 0 \tag{1}$$

Structured Documents Exercise

Typeset this short paper in \LaTeX : ¹

[Click to open the paper](#)

Make your paper look like this one. Use `\ref` and `\eqref` to avoid explicitly writing section and equation numbers into the text.

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

- Once you've tried, [click here to see my solution](#).

¹From <http://pdos.csail.mit.edu/scigen/>, a random paper generator.

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Graphics

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

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

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



Image license: CC0

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. Example:
`\documentclass[12pt,twocolumn]{article}`

makes the text bigger (12pt) and puts it into two columns.

- Where do you find out about these? See the slides at the end of this presentation for links to more information.

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`.

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

```
Figure \ref{fig:gerbil} shows \ldots
```

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

\end{document}
```



Figure 1: Aww...

Figure 1 shows ...

Tables

- Tables in L^AT_EX take some getting used to.
- Use the `tabular` environment from the `tabularx` package.
- The argument specifies column alignment — `left`, `right`, `right`.

```
\begin{tabular}{lrr}
```

```
Item & Qty & Unit \ $ \ \
```

```
Widget & 1 & 199.99 \ \
```

```
Gadget & 2 & 399.99 \ \
```

```
Cable & 3 & 19.99 \ \
```

```
\end{tabular}
```

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

- It also specifies vertical lines; use `\hline` for horizontal lines.

```
\begin{tabular}{|l|r|r|} \hline
```

```
Item & Qty & Unit \ $ \ \ \hline
```

```
Widget & 1 & 199.99 \ \
```

```
Gadget & 2 & 399.99 \ \
```

```
Cable & 3 & 19.99 \ \ \hline
```

```
\end{tabular}
```

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

- Use an ampersand `&` to separate columns and a double backslash `\ \` to start a new row (like in the `align*` environment that we saw in part 1).

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- Put your references in a .bib file in 'bibtex' database format:

```
@Article{Jacobson1999Towards,  
  author = {Van Jacobson},  
  title = {Towards the Analysis of Massive Multiplayer Online  
          Role-Playing Games},  
  journal = {Journal of Ubiquitous Information},  
  Month = jun,  
  Year = 1999,  
  Volume = 6,  
  Pages = {75--83}}
```

```
@InProceedings{Brooks1997Methodology,  
  author = {Fredrick P. Brooks and John Kubiawicz and  
          Christos Papadimitriou},  
  title = {A Methodology for the Study of the  
          Location-Identity Split},  
  booktitle = {Proceedings of OOPSLA},  
  Month = jun,  
  Year = 1997}
```


- Each entry in the `.bib` file has a *key* that you can use to reference it in the document. For example, `Jacobson1999Towards` is the key for this article:

```
@Article{Jacobson1999Towards,  
  author = {Van Jacobson},  
  ...  
}
```

- It's a good idea to use a key based on the name, year and title.
- L^AT_EX can automatically format your in-text citations and generate a list of references; it knows most standard styles, and you can design your own.

bibT_EX 3

- Use the natbib package² with `\citet` and `\citep`.
- Reference `\bibliography` at the end, and specify a `\bibliographystyle`.

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

\citet{Brooks1997Methodology}
show that \ldots. Clearly,
all odd numbers are prime
\citep{Jacobson1999Towards}.

\bibliography{bib-example}
% if `bib-example' is the name of
% your bib file

\bibliographystyle{plainnat}
% try changing to abbrunat

\end{document}
```

Brooks et al. [1997] show that Clearly, all odd numbers are prime [Jacobson, 1999].

References

Fredrick P. Brooks, John Kubiawicz, and Christos Papadimitriou. A methodology for the study of the location-identity split. In *Proceedings of OOPSL* June 1997.

Van Jacobson. Towards the analysis of massive multiplayer online role-playing games. *Journal of Ubiquitous Information*, 6:75–83, June 1999.

Exercise: Putting it All Together

Add an image and a bibliography to the paper from the previous exercise.

1. Download these example files to your computer.

[Click to download example image](#)

[Click to download example bib file](#)

2. Upload them to Overleaf (use the project menu).

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More Neat Things

- Add the `\tableofcontents` command to generate a table of contents from the `\section` commands.
- Change the `\documentclass` to
`\documentclass{scrartcl}`
or
`\documentclass[12pt]{IEEEtran}`
- Define your own command for a complicated equation:

```
\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.

Online Resources

- The Overleaf Learn Wiki — hosts these slides, more tutorials and reference material
- The L^AT_EX Wikibook — excellent tutorials and reference material.
- T_EX Stack Exchange — ask questions and get excellent answers incredibly quickly
- L^AT_EX Community — a large online forum
- Comprehensive T_EX Archive Network (CTAN) — over four thousand packages plus documentation
- Google will usually get you to one of the above.

Thanks, and happy T_EXing!