

Introduction to L^AT_EX

Part 1: The Basics

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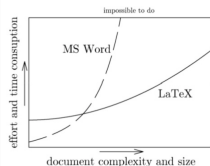
Next in Line...



Why $\text{\LaTeX}$?

Why $\text{\LaTeX}$?

- It makes beautiful documents
 - Especially mathematics (scientific features)
- It was created by scientists, for scientists
 - A large and active community
- It is powerful – you can extend it
 - Packages for papers, presentations, spreadsheets, ...
- Open source and portability
- Separation of content and style



How does it work?

How does it work?

- You write your document in *plain text* with **commands** that describe its structure and meaning
- The latex program processes your text and commands to produce a beautifully formatted document → TeX distribution (TeX Live, MikTeX,...) used to produce output file

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



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



L^AT_EX software

L^AT_EX software

- L^AT_EX free software distributed under the L^AT_EX Project Public License
- LaTeX2e is the current version of L^AT_EX and there are number of community-supported TeX distributions available
- BibTeX – reference management software typically used with L^AT_EX for formatting lists of references

Overleaf

- no installation
- version control
- real-time collaboration
- hundreds of L^AT_EX templates

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Next in Line...



Basic document

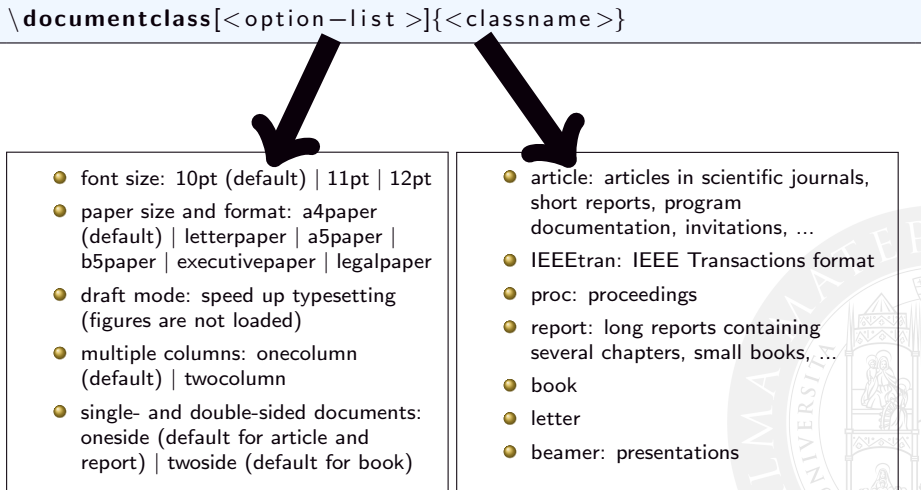


```
\documentclass[ist >]{<classname>}
\begin{document}
.
.
.
.
.
.
.
.
.
.
\end{document}
```

- Commands start with a backslash \
- Every document starts with a \documentclass command

Main documentclass options and classes

```
\documentclass[<option-list>]{<classname>}
```



- font size: 10pt (default) | 11pt | 12pt
- paper size and format: a4paper (default) | letterpaper | a5paper | b5paper | executivepaper | legalpaper
- draft mode: speed up typesetting (figures are not loaded)
- multiple columns: onecolumn (default) | twocolumn
- single- and double-sided documents: oneside (default for article and report) | twoside (default for book)

- article: articles in scientific journals, short reports, program documentation, invitations, ...
- IEEEtran: IEEE Transactions format
- proc: proceedings
- report: long reports containing several chapters, small books, ...
- book
- letter
- beamer: presentations

Main documentclass options and classes

```
\documentclass[<option-list>]{<classname>}
```



- font size: 10pt (default) | 11pt | 12pt
- paper size and format: a4paper (default) | letterpaper | a5paper | b5paper | executivepaper | legalpaper

- article: articles in scientific journals, short reports, program documentation, invitations, ...
- IEEEtran: IEEE Transactions format

Main useful document classes

- article
- report & book
- presentation

report) | twoside (default for book)

- beamer: presentations

Preamble of a document

usepackage command for loading extra commands

```
\documentclass[<option-list>]{<classname>}
```

user defined commands

```
\usepackage{<package-name>}
```

document's meta-data

```
%new commands definition
```

```
\newcommand{\BP}{\textsf{BurdPers}}
```

```
%meta-data commands examples
```

```
\title{Introduction to \LaTeX}
```

```
\author{Roberta Calegari}
```

```
\begin{document}
```

```
.  
.
```

```
\end{document}
```

- A percent sign % starts a comment ($\LaTeX$ ignore the rest of the line)

Packages Usage

- Packages are libraries of extra commands and environments
- thousands of freely available packages
- load each of the packages you want to use with a `\usepackage` command in the preamble

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

Handling Errors

- $\text{\LaTeX}$ 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`, $\text{\LaTeX}$ 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
- 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.

Next in Line...



Text, Quotes & Special Chars I

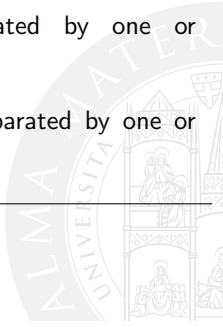
- Type your text between `\begin{document}` and `\end{document}`
- Space in the source file is collapsed in the output

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.



Text, Quotes & Special Chars II

- Quotation marks are 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 L^AT_EX:

% percent sign

& ampersand

hash (pound / sharp) sign

\$ dollar sign

- Appear in the output → escape it by preceding it with a backslash

\\$ \% & \#

\$%&#

Font: Size

Font sizes are identified by special names, the actual size is not absolute but relative to the font size declared in the `\documentclass` statement

- tiny, scriptsize, footnotesize, small, normalsize, large, Large, LARGE, huge, Huge

In this example the `{\huge huge font size}` is set and the `{\footnotesize Foot note size also}`. There's a fairly large set of font sizes.

In this example the **huge font size** is set and the Foot note size also. There's a fairly large set of font sizes.

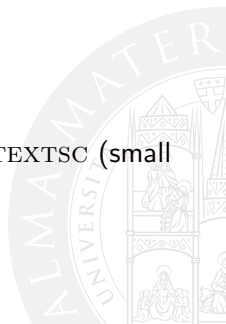
Font: Family & Style

By default, in standard $\text{\LaTeX}$ classes the serif typeface (a.k.a. roman) font is used. The other font typefaces (sans serif and typewriter, a.k.a. monospace) can be used by entering some specific commands

- `sffamily` – `textsf` (sans serif)
- `rmfamily` – `textrm` (serif)
- `ttfamily` -- `texttt` (typewriter – monospace)

Most common font styles

- *textit* (italic), **textbf** (bold), underline (underlined), `TEXTSC` (small caps), *emph* (emphasise)



First Example: Hello World!

- Try different fonts and quotes in this simple example.

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

▶ [Click here to open the example document in Overleaf](#)

- Example of different font sizes and types

▶ [Overleaf font sizes and types examples](#)



Exercise 1

- Typeset this text¹

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 here to open the example document in Overleaf

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

Next in Line...



Environment: unordered list

- Environments are delimited by an opening tag `\begin` and a closing tag `\end`
- Everything inside those tags will be formatted in a special manner depending on the type of the environment
- Using lists pretty straightforward and do not require you to add any additional packages
- `\itemize` environment for unordered lists

```
\begin{itemize}
  \item One
  \item Two
  \item[*] Three
\end{itemize}
```

- One
- Two
- * Three

Environment: ordered list

- `\enumerate` environment for ordered lists

```
\begin{enumerate}
  \item One
  \item Two
  \item Three
\end{enumerate}
```

```
\begin{enumerate}
  \item One
    \begin{enumerate}
      \item Two
      \item Three
      \item Four
    \end{enumerate}
  \item Five
  \item Six
\end{enumerate}
```

① One

② Two

③ Three

① One

① Two

② Three

③ Four

② Five

③ Six



Environment: description

- `\description` environment for description lists

```
\begin{description}  
  \item[DescOne] One  
  \item[DescTwo] Two  
  \item[DescThree] Three  
\end{description}
```

DescOne One
DescTwo Two
DescThree Three

Typesetting Mathematics: Dollar Signs

- dollar signs `$` special $\rightarrow$ to mark mathematics in text
- use dollar signs in pairs: one to begin the mathematics, and one to end it
- spaces ignored

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

Let `$y=mx+b$` be `\ldots`
Let `$y = m x + b$` be `\ldots`

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

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

Typesetting Mathematics: Notation

- Use caret `^` for superscripts and `_` for subscripts
- Use curly braces `{ }` to group superscripts and subscripts
- commands for Greek letters and common notation

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

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

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

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

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

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

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

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

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

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

Typesetting Mathematics: equation environment

- If it's big and scary, display it on its own line using `\begin{equation}` and `\end{equation}`
- $\text{\LaTeX}$ mostly ignores your spaces in mathematics, but it can't handle blank lines in equations —don't put blank lines in your mathematics

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

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (1)$$

where a , b and c are ...

Mathematic packages: examples with amsmath I

- defines commands for common mathematical operators
- use `equation*` for unnumbered equations

```
\begin{equation*}
\Omega=\sum_{k=1}^n \omega_k
\end{equation*}
```

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

```
\begin{equation*} % bad!
\min_{x,y} (1-x)^2
+ 100(y-x^2)^2
\end{equation*}
\begin{equation*} % good!
\min_{x,y} \{(1-x)^2
+ 100(y-x^2)^2\}
\end{equation*}
```

$$\min_{x,y} (1-x)^2 + 100(y-x^2)^2$$

$$\min_{x,y} \{(1-x)^2 + 100(y-x^2)^2\}$$

Mathematic packages: examples with amsmath II

- you can use `\operatorname` for others

```
\begin{equation*}
\beta_i = \frac{
\operatorname{Cov}(R_i, R_m)}{
\operatorname{Var}(R_m)}
\end{equation*}
```

$$\beta_i = \frac{\operatorname{Cov}(R_i, R_m)}{\operatorname{Var}(R_m)}$$

Mathematic packages: examples with amsmath III

- Align a sequence of equations at the equals sign with the `align*` environment
- An ampersand `&` separates the left column (before the `=`) from the right column (after the `=`)
- A double backslash `\\` starts a new line

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

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

Exercise 2

- Typeset this text

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 $N(0, \sigma^2)$.

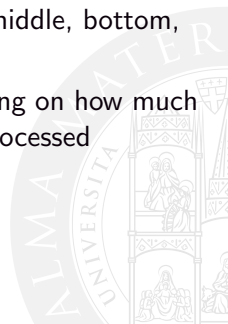
► [Click here to open the exercise in Overleaf](#)

Next in Line...



Floats

- containers for things in a document that cannot be broken over a page, e.g. table and figure
- not part of the normal stream of text, but separate entities, positioned in a part of the page to themselves (top, middle, bottom, left, right, or wherever the designer specifies)
- $\text{\LaTeX}$ automatically floats Tables and Figures, depending on how much space is left on the page at the point that they are processed



Figure

- Requires the graphicx package: `\includegraphics` command
- Supported graphics formats include JPEG, PNG and PDF (usually).
- use square brackets `[ ]` for optional arguments, instead of braces `{ }`
- optional arguments to transform the image when it is included: for example, `width=0.3\textwidth`

```
\includegraphics [
  width=0.15\textwidth ]
{img/sample.jpeg}
```



```
\includegraphics [
  width=0.15\textwidth ,
  angle=270]{img/sample.jpeg}
```



Table

- tabular environment from the `tabularx` package.
- the argument specifies column alignment — `left`, `right`
- use `\hline` for horizontal lines
- `&` to separate columns and a double backslash `\\` to start a new row

```
\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

```
\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

Next in Line...



Title and Abstract

- `\title` and `\author` names in the preamble
- 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}
```

► [Click here to open the example document in Overleaf](#)

Section and Subsection

- use `\section` and `\subsection`
- use `\section*` and `\subsection*` for no numbering

```
...
\section{Introduction}
The problem of \ldots

\section{Method}
We investigate \ldots

\subsection{Sample Preparation}

\subsection{Data Collection}

\section{Results}

\section{Conclusion}
```

1 Introduction

The problem of ...

2 Method

We investigate ...

2.1 Sample Preparation

2.2 Data Collection

3 Results

4 Conclusion



Next in Line...



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

\end{document}
```

1 Introduction

In Section 2, we ...

2 Method

By (1), we have ...

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

(1)

Exercise 2

- Typeset this short paper²

► Click here to open the paper in pdf

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

²From <http://pdos.csail.mit.edu/scigen/>, a random paper generator.

Next in Line...



Packages

- Use packages in $\text{\LaTeX}$ to add more functions
- Packages add new functions to $\text{\LaTeX}$
- All packages must be included in the preamble
- Packages add features such as support for pictures, links and bibliography
- You can browse list of TEX and $\text{\LaTeX}$ packages and class files on CTAN subpage <http://www.ctan.org/pkg/>



More Neat Packages

- **beamer**: for presentations (like this one!)
- **todonotes**: comments and TODO management
- **tikz**: make amazing graphics
- **pgfplots**: create graphs in $\text{\LaTeX}$
- **listings**: source code printer for $\text{\LaTeX}$
- **spreadtab**: create spreadsheets in $\text{\LaTeX}$
- **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.



Next in Line...



Bibtex database I

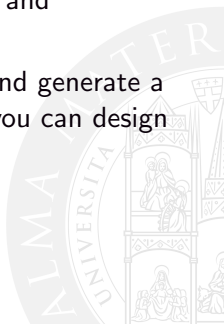
- Most reference managers can export to bibtex format
- Put your references in a .bib file in 'bibtex' database format

```
@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}
```

Bibtex database II

- 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 the first article
- It's a good idea to use a key based on the name, year and title/journal/topic
- $\text{\LaTeX}$ can automatically format your in-text citations and generate a list of references; it knows most standard styles, and you can design your own



Bibliography style

- Use the natbib package with `\citet` and `\citep`
- `\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' name of your bib file
\bibliographystyle{plainnat}
%try changing to abbrvnat

\end{document}
```

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

References

Frederick P. Brooks, John Kubiatowicz, and Christos Papadimitriou. A methodology for the study of the location-identity split. In *Proceedings of OOPSLA*, June 1997.

Van Jacobson. Towards the analysis of massive multiplayer online role-playing games. *Journal of Ubiquitous Information*, 6:75–81, June 1999.

Exercise 3

- Add an image and a bibliography to the paper from the previous exercise
- Download these example files to your computer
- Upload them to Overleaf (use the project menu)

► [Click here to download a bib example](#)



Exercise 4: Recap

- Here is the text for a short article³
- Download these example files to your computer and write it down in L^AT_EX

▶ [Click here to download the example](http://www.cgd.ucar.edu/cms/agu/scientific_talk.html)

³Based on http://www.cgd.ucar.edu/cms/agu/scientific_talk.html

Next in Line...



Online resources

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



Introduction to L^AT_EX

Part 1: The Basics

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*Joint International Doctoral (Ph.D) degree in Law, Science and
Technology*

December 15, 2020, Bologna, Italy

