Latex Fundamentals

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Latex

1. Write code (like HTML, not like Python)
2. Compile to get a pdf file
3. ???
4. Profit

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Document structure

example2.tex

```
\documentclass[10pt,a4paper]{article}
\usepackage[utf8]{inputenc}
\usepackage{amsmath}
\usepackage{amsfonts}
\usepackage{amssymb}

\author{Sebastiano Tronto}

\begin{document}

Here is a formula:

\begin{align*}
    e^x+1=0
\end{align*}

\end{document}
```

Preamble

Document body

Text

Math

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Preamble

- Include packages with \usepackage
- Define properties of the document (\documentclass, \author, ...)
- Define new commands and environments

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Text formatting

`\textbf{Hello}`
Hello

`\textit{Hello}` or `\emph{Hello}`
Hello

`\underline{Hello}`
<u>Hello</u>

`{\small Hello}`
Hello

`{\Large Hello}`
Hello

`{\huge Hello}`
Hello

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Text formatting

Some technicalities:

- Blocks are delimited by { and }
- `\textbf{...}` etc. are commands with one argument
- `\emph{...}` is context-aware (when in doubt use this)
- `\Large` etc. change the text until the end of the block
- Some people use `{\bf Hello}`, but it is deprecated

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Text formatting

```
{\tiny Hello}
{\scriptsize Hello}
{\footnotesize Hello}
{\normalsize Hello}
{\large Hello}
{\Large Hello}
{\LARGE Hello}
{\huge Hello}
{\Huge Hello}
```

{\tiny Hello}
{\scriptsize Hello}
{\footnotesize Hello}
{\normalsize Hello}
{\large Hello}
{\Large Hello}
{\LARGE Hello}
{\huge Hello}
{\Huge Hello}

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Math mode

```
One can write math inline, like \( \sum_i\frac{i}{2} \), or
in displaystyle:  \[ \sum_i\frac{i}{2} \]
```

One can write math inline, like $\sum_i \frac{i}{2}$ or in displaystyle:

$$\sum_i \frac{i}{2}$$

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Math mode

For formulas spanning multiple lines you can use:

```
\begin{align} (...)  \end {align}
```

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} \tag{1}$$

$$= 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \cdots \tag{2}$$

or `\begin{align*} (...)  \end{align*}` for no numbers.

Math mode

- Some people use `$2+2=4$` instead of `\(2+2=4\)`
- Some **evil** people use `$$2+2=4$$` instead of `\[2+2=4\]` (don't try this at home!)
- For `align` use `\nonumber` to remove one number and `&` to align.
- For example I always use `$2+2=4$` and the `align*` environment.

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Math mode

- Simple symbols: letters, numbers, $+, -, =, <, >$...
- Symbols that need a **command**:

`\alpha, \Phi`	`\times, \cdot`	`\sum`	`\leq, \geq`	`\infty`
α, Φ	$\times, \cdot$	$\sum$	$\leq, \geq$	∞

- Negate symbols with `\not`:

`x \not \in A`	$\rightarrow$	$x \notin A$
`x \not = y` or `x \neq y`	$\rightarrow$	$x \neq y$

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Math mode

- Some commands take one or more **arguments** (like `\frac`). Anything can be an argument:

$$\texttt{\textbackslash frac\{1\}\{\textbackslash sum\_\{n\}\}} \quad \rightarrow \quad \frac{1}{\sum_n \sqrt{n}}$$

- A few commands take **options**: `\sqrt[3]{x}` $\rightarrow \sqrt[3]{x}$

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Math mode

- Every symbol can have a **subscript** and a **superscript**

$$\texttt{x\_0\^{}\{23\}} \quad \rightarrow \quad x_0^{23}$$

- Anything can be a sub/superscript:

$$\texttt{\textbackslash int\_\{\textbackslash phi (y)\}\^{}\{2\^{}\{n\_1\}\}} \quad \rightarrow \quad \int_{\phi(y)}^{2^{n_1}}$$

Math mode

- Adjust parentheses size with `\left(` and `\right)`:

$$\left(\frac{x+6}{y-2}\right)$$

- Insert text with `\text` and spaces with `\,` and `\quad`:

this symbol $\sum_{n=0}^{\infty} \frac{x^n}{n!}$ is in math mode, *thisisnottext*

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Math mode

- Fancy letters with `\mathcal`, `\mathbb` and `\mathfrak`:

$$\mathcal{A} \qquad \mathbb{R} \qquad \mathfrak{p}$$

- For custom operators use `\operatorname{oper}`:

$$\operatorname{oper}(x)$$

- Pro-tip: write `\newcommand{\R}{\mathbb R}` and `\DeclareMathOperator{\lcm}{lcm}` in your preamble!

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Math mode

- Wikibooks page on Math mode:
  `https://en.wikibooks.org/wiki/LaTeX/Mathematics`
- Advanced stuff:
  `https://en.wikibooks.org/wiki/LaTeX/Advanced_Mathematics`
- List of Mathematical symbols:
  `https://www.caam.rice.edu/~heinken/latex/symbols.pdf`

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Environments

`\begin{something}` Inside an environment `\end{something}`

- We have seen `document` and `align`
- Text and symbols appear differently depending on the environment
- Certain commands are specific to an environment
- You can define new environments

Environments

Lists: `itemize` and `enumerate`

- First: $2 + 2 = 4$
- Second

```
\begin{itemize}
    \item First:  \[2+2=4\]
    \item Second
\end{itemize}
```

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Environments

Tables: `tabular` (text) and `array` (Math mode)

This	is	just
a	boring	table

```
\begin{tabular}{r|cc}
    This & is & just \\
    \hline
    a & boring & table
\end{tabular}
```

Matrices: `array` with parentheses or `pmatrix`

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Sections

- Use `\section{Section Name}` to start a new section
- Also: `\chapter` (book only), `\subsection`, `subsubsection`...
- `\section*{Name}` for no number
- Sections after `\appendix` are numbered differently

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Theorems

- In preamble: `\usepackage{amsthm}`
- Also in preamble `\newtheorem {envname}{Theorem}`
- Use `\newtheorem*` for no number

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Theorems

```
\newtheorem{theorem}{My Theorem}[section]
\newtheorem{pr}[theorem]{Proposition}

\theoremstyle{definition}
\newtheorem{defin}{New definition}[section]
\newtheorem{cor}{Corollary}[theorem]

\theoremstyle{remark}
\newtheorem*{warning}{Achtung}

⋮

\section{Second section}

\begin{theorem} Important Fact \end{theorem}
\begin{cor} Follows from Important Fact \end{cor}
\begin{defin} A new concept \end{defin}
\begin{warning} Don't make this mistake! \end{warning}
\begin{pr}[Gauss] Another fact \end{pr}
```

2 Second section

My Theorem 2.1. *Important Fact*

Corollary 2.1.1. Follows from Important Fact

New definition 2.1. A new concept

Achtung. Don't make this mistake!

Proposition 2.2 (Gauss)**.** *Another fact*

End of the lecture

For next time:

- Install Latex on your PC
- Start writing something in Latex (e.g. homework)
- Email me if you have any question

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