Introduction to LaTeX

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Outline

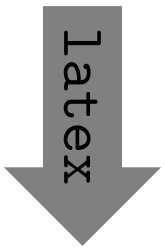
Why LaTeX?

- It makes beautiful documents
  - Especially mathematics
- It makes you focus only on the content
  - No need to worry about how the content is displayed.
- It is powerful — you can extend it
  - Packages for papers, presentations, spreadsheets, ...
- It is widely used in academic and scientific scopes.

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.

```
Int. Business' students are \emph{pretty} cool.
```



Int. Business' students are *pretty* cool.

More examples of commands and their output. . .

```
\begin{itemize}
\item Rice
\item Rabbit
\item Chicken
\end{itemize}
```

- Rice
- Rabbit
- Chicken

```
\begin{figure}
\includegraphics{gerbil}
\end{figure}
```

```
\begin{equation}
\alpha + \beta + 1
\end{equation}
```

$$\alpha + \beta + 1 \qquad (1)$$

Change your mind!

- Use commands to describe ‘what it is’, not ‘how it looks’.
- Focus on your content.
- Let LaTeX do its job.

Outline

Getting started

- A minimal LaTeX document:

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

- Commands start with a *backslash* \ .
- Every document starts with a `\documentclass` command.
- The *argument* in curly braces { } tells LaTeX what kind of document we are creating: an `article`.
- A percent sign % starts a *comment* — LaTeX will ignore the rest of the line.

Getting started with **Overleaf**

- Overleaf is a website for writing documents in LaTeX.
- It 'compiles' your LaTeX automatically to show you the results.

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

- Use this sample document to test all commands we'll learn.

Writing Text

- Type your text between `\begin{document}` and `\end{document}`.
- For the most part, you can just type your text normally.

```
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.

- Space in the source file is collapsed in the output.

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

The rain in Spain falls mainly on the plain.

Writing Text

- 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 LaTeX:

   percent sign
   hash (pound / sharp) sign
   ampersand
   dollar sign

- If you just type these, you'll get an error. If you want one to appear in the output, you have to *escape* it by preceding it with a backslash.

`\$\%\&\#!`	$%&#!

Writing Text

- Use `\emph` or `\alert` to highlight:

```
I should \emph{emphasise} that
this is an \alert{important} point.
```

I should *emphasise* that this is an important point.

- Or specify bold face or italics:

```
Text in \textbf{bold face}.
Text in \textit{italics}.
```

Text in **bold face**. Text in *italics*.

- Or specify a color:

```
It \textcolor{red}{stops}
and \textcolor{green}{starts}.
```

It stops and starts.

Writing Text

- If you write non-ASCII characters, you must scape accents:
  - `Castell\´{o}` → Castelló
  - `Val\`{e}ncia` → València
  - `Espa\~{n}a` → España
  - `Biling\"{u}ismo` → Bilingüismo
- Better: add this to the preamble of the document:

```
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
```

- This way you won't need to scape accents.

Handling Errors

- LaTeX can get confused when trying to compile a document.
  - If it does, it stops with an error, which you must fix.
- For example, if you misspell `\emph` as `\meph`, 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.

Exercise 1

Write this in LaTeX:

València's economy is service-oriented, as nearly 84% of the working population is employed in service sector occupations In 2009, València was designated *"the 29th fastest-improving European city"*.
Its influence in commerce, education, entertainment, media, fashion, science and the arts contributes to its status as one of the world's "Gamma"-rank global cities. The València metropolitan area had a GDP$ amounting to $52.7 billion, and $28,141 per capita.

Click to open this exercise in **Overleaf**

- Hint: watch out for characters with special meanings!

Writing Mathematics: Dollar Signs

- We use dollar signs $ to mark mathematics in text.

```
% not so good:
Let a and b be distinct positive
integers, and let c = a - b + 1.

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

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

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

- Always use dollar signs in pairs
  - one to begin the mathematics, and one to end it.
- LaTeX handles spacing automatically; it ignores your spaces.

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

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

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

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

Writing Mathematics: Notation

- Use caret ^ for superscripts and underscore _ for subscripts.

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

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

- Use curly braces { } to group superscripts and subscripts.

```
$F_n = F_n-1 + F_n-2$      % oops!

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

$F_n = F_n - 1 + F_n - 2$

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

- There are commands for Greek letters and common notation.

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

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

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

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

Writing Mathematics: Equations

- If it's big and scary, *display* it on its own line using `\begin{equation}` and `\end{equation}`.

```
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

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

where a, b and c are ...

- You should try this on-line LaTeX equation editor:
  - `https://www.codecogs.com/latex/eqneditor.php`

Exercise 2

Write this in LaTeX:

Let $X_1, X_2, \ldots, X_n$ be a sequence of independent and identically distributed random variables with $\mathrm{E}[X_i] = \mu$ and $\mathrm{Var}[X_i] = \sigma^2 < \infty$, and let

$$S_n = \frac{1}{n} \sum_{i}^{n} X_i \tag{1}$$

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 to open this exercise in **Overleaf**

- Hint: the command for ∞ is `\infty`. What about σ and μ?

Lists

- Use `itemize` environment for building unordered lists:

```
\begin{itemize}
\item Cats
\item Dogs
  \begin{itemize}
    \item Fox Terrier
    \item Damaltian
  \end{itemize}
\item Crocodiles
\end{itemize}
```

- Cats
- Dogs
  - Fox Terrier
  - Damaltian
- Crocodiles

- For numbered lists, use `enumerate` environment.

```
\begin{enumerate}
\item Buy ingredients
  \begin{enumerate}
    \item Go to the supermarket
    \item Pick up products
    \item Pay them
  \end{enumerate}
\item Make your paella
\item Enjoy!
\end{enumerate}
```

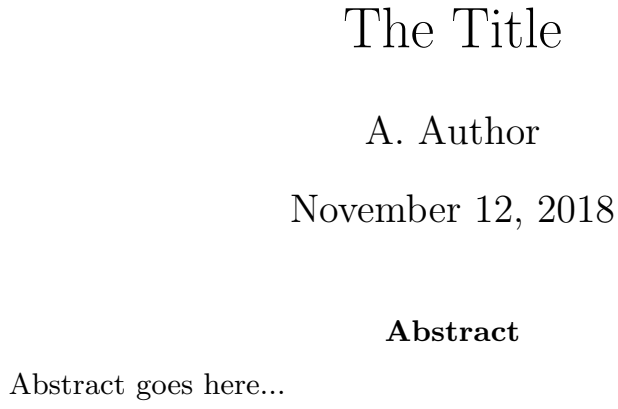
1. Buy ingredients
   1.1 Go to the supermarket
   1.2 Pick up products
   1.3 Pay them
2. Make your paella
3. Enjoy!

Outline

Title and Abstract

- Tell LaTeX 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}
```



Sections

- Just use `\section` and `\subsection` (and even `\subsubsection`).

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

\section{Introduction}
The problem of \ldots

\section{Method}
We investigate \ldots

\section{Data}
\subsection{Data Collection}
\subsubsection{Data Cleaning}

\section{Experiments}

\section{Conclusions}

\end{document}
```

1 Introduction

The problem of . . .

2 Method

We investigate . . .

3 Data

3.1 Data Collection

3.1.1 Data Cleaning

4 Experiments

5 Conclusions

- Tip: `\tableofcontents` can automatically generate the index.

Labels and Cross-References

- Use `\label` and `\ref` to reference Sections.
  - This way you can reference Equations, Tables or Figures too!

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

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

In Section \ref{sec:method}, ...

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

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

In Equation \ref{eq:euler}, ...

\end{document}
```

1 Introduction

In Section 2, ...

2 Method

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

In Equation 1, ...

Outline

Figures

- Add `\usepackage{graphicx}` to the preamble.
- Include an image using the `\includegraphics` command.
- `Figure` environment:
  - Allow LaTeX to decide where the figure will go (it can "float").
  - You can give the figure a caption.
  - And also add a label and reference it with `\ref`.

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

Figure \ref{fig:gerbil} shows ...

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

\end{document}
```

Figure 1: Aww ...

Figure 1 shows ...

Tables

- Use the `tabular` environment from the `tabularx` package.
- The argument specifies column alignment — **l**eft, **r**ight, **r**ight.

```
\begin{tabular}{lrr}
Item   & Qty & Unit \euro \\
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 \euro \\\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.
- Use double backslash `\` `\` to start a new row.

Tables

- We can envelop a `tabular` with a `table` environment.
  - This allows us to float, add a caption and/or reference it later.

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

\begin{table}
\centering
\begin{tabular}{l|cc}
Item   & Qty & Unit \\\hline
Widget & 1   & 199.99  \\
Gadget & 2   & 399.99  \\
Cable  & 3   & 19.99   \\
\end{tabular}
\caption{\label{tab:prizes} Quantities
and prizes  for each product.}
\end{table}

In Table \ref{tab:prizes}
we can see...

\end{document}
```

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

Table 1: Quantities and prizes for each product.

In Table ?? we can see...

Outline

Adding bibliography with bibTEX

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

```
@Article{Silvestre2012Explicit,
  title = {Explicit length modelling for
           statistical machine translation},
  author = {Joan Albert Silvestre-Cerda and Jesus Andres-Ferrer
            and Jorge Civera},
  journal = {Pattern Recognition},
  volume = {45},
  number = {9},
  pages = {3183 - 3192},
  year = {2012}
}

@phdthesis{Silvestre2016Different,
  title = {Different Contributions to Cost-Effective
            Transcription and Translation of Video Lectures},
  author = {Joan Albert Silvestre-Cerda},
  url = {http://hdl.handle.net/10251/62194},
  year = {2016},
  school = {Universitat Politecnica de Valencia}
}
```

- Most reference managers can export to bibTEXformat.

Adding bibliography with bibTeX

- Each entry in the `.bib` file has a *key* used to reference it.
- I.e., `Silvestre2012Explicit` is the key for this article:

```
@Article{Silvestre2012Explicit,
  author = {Joan Albert Silvestre-Cerda
            and Jesus Andres-Ferrer
            and Jorge Civera},
  ...
}
```

- It's a good idea to use a key based on the name, year and title.
- LaTeX can automatically generate the list of references.
- It can also automatically format your citations.

Adding bibliography with bibTEX

- Use the `natbib` package with `\citet` and `\citep`.
- Use `\bibliography` to insert the references list.
- Specify a `\bibliographystyle`.

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

\citet{Silvestre2016Different}
shows that ... Clearly,
Machine Translation is very cool
\citep{Silvestre2012Explicit}.

\bibliography{bib-example}
% 'bib-example' is the name of
% your bib file (bib-example.bib)

\bibliographystyle{abbrvnat}
% try changing to alpha or apalike

\end{document}
```

Silvestre-Cerda [2016] shows that ... Clearly, Machine Translation is very cool [Silvestre-Cerda et al., 2012].

References

J. A. Silvestre-Cerda. *Different Contributions to Cost-Effective Transcription and Translation of Video Lectures*. PhD thesis, Universitat Politecnica de Valencia, 2016. URL `http://hdl.handle.net/10251/62194`.

J. A. Silvestre-Cerda, J. Andres-Ferrer, and J. Civera. Explicit length modelling for statistical machine translation. *Pattern Recognition*, 45(9):3183 – 3192, 2012.

Mandatory exercise

1. Here is the text for a short article:[1]

   Click to open this exercise in **Overleaf**

2. Add LaTeX commands to the text to make it look like this one:

   Click to open the model document

Hints

- Use the `enumerate` and `itemize` environments for lists.
- To write a % percent sign, *escape* it with a backslash (`\%`).
- To write the equation
  - use `\frac{}{}` for the fraction,
  - `\left(` and `\right)` for the parentheses.

[1] Based on `http://www.cgd.ucar.edu/cms/agu/scientific_talk.html`

Outline

Installing LaTeX

- Overleaf is a cool on-line web LaTeX editor.
- To run LaTeX off-line on your own computer, you need to install 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.
  - We recomend LyX or Kile

Online Resources

- The LaTeX Wikibook
  - Excellent tutorials and reference material.
- TeX Stack Exchange
  - Ask questions and get excellent answers quickly.
- 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.