

# L<sup>A</sup>T<sub>E</sub>X Workshop

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- Introduction
- Hello World!
- The Basics
- Figures, References, and Packages
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# L<sup>A</sup>T<sub>E</sub>X: How and Why?

- **Origins:**
  - Developed by **Leslie Lamport** in 1984
  - Built on top of Donald Knuth's **TeX** typesetting system (1978)
- **Purpose:**
  - Simplify the creation of complex documents
  - Provide superior control over document layout and formatting
- **Why:**
  - Many packages to do what you probably want to do
  - No need to worry about formatting: someone does the template, you just write

# L<sup>A</sup>T<sub>E</sub>X: How and Why? What about Word?

- **Superior Typesetting Quality:**
  - Professional and consistent formatting
  - Optimal handling of mathematical equations and symbols
- **Automated Document Management:**
  - Automatic numbering of sections, figures, tables, and references
  - Easy generation of tables of contents, bibliographies, and indexes
- **Version Control Compatibility:**
  - Plain text files integrate seamlessly with version control systems (e.g., Git)
- **Stability and Consistency:**
  - Consistent output across different platforms and devices
  - Minimal formatting issues when sharing documents
- **Focus on Content:**
  - Encourages separation of content and styling
  - Reduces distractions from formatting during the writing process

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# The Overleaf Minimum

```
\documentclass{article}
\usepackage{graphicx} % Required for inserting images

\title{Latex workshop}
\author{José Filipe}
\date{December 2024}

\begin{document}

\maketitle

\section{Introduction}

\end{document}
```

# The Bare Bones

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

```
    Hello world!
```

```
\end{document}
```



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# Paragraphs and linebreaks

- One “enter” does nothing
- Blank line to create new paragraph
- `\\` or `\linebreak` for break a line

# Paragraphs and linebreaks

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

Lorem ipsum odor amet, consectetur adipiscing elit.  
Donec proin hac nostra suspendisse nunc facilisis quisque.

Faucibus metus justo varius **\linebreak** pretium  
erat viverra auctor.

Habitasse quis purus iaculis **\** condimentum at  
inceptos magnis.

```
\end{document}
```

## Bold, italics, and underlines

- `\textbf{...}` bold text
- `\textit{...}` italic text
- `\underline{...}` underline text

## Bold, italics, and underlines

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

```
  Lorem \textbf{ipsum odor} amet,  
  consectetuer \textit{adipiscing} elit.
```

```
  Donec proin hac \underline{nostra} suspendisse  
  nunc \textbf{\textit{\underline{facilisis quisque}}}.  
\end{document}
```

# Generalising Commands

- As you probably noticed by now...
  - There is an escape character: `\`
  - Commands start with `\`
    - Almost every direct interface with  $\text{\LaTeX}$  starts with the `\`
    - To escape the escape character: `\\`
  - Followed by the command name
  - Optional arguments are enclosed in square brackets `[...]`
  - Arguments are enclosed in curly braces `{...}`
  - Multiple arguments are provided sequentially

# Generalising Commands

`\comandName`[opt. 1, opt. 2, ...]{arg. 1}{arg. 2}...

## Another $\text{\LaTeX}$ interface: Environments

- Define blocks of content with specific formatting or behaviour
- Start with `\begin{environment}` and end with `\end{environment}`
- The environment name must match in both `\begin{...}` and `\end{...}`
- Some environments accept optional arguments in square brackets [...]
- Common environments: `mintinlinelatexitemize`, `mintinlinelatexenumerate`, `mintinlinelatexfigure`, `mintinlinelatextable`, `mintinlinelatexequation`, etc.



# Lists

```

\documentclass[12pt]{article}

\begin{document}

    \begin{itemize}
        \item Lorem ipsum odor amet
        \item Justo sed duis purus
        \begin{itemize}
            \item Consectetuer adipiscing elit
            \item Donec proin hac nostra suspendisse
        \end{itemize}
        \item Nunc facilisis quisque
    \end{itemize}

\end{document}

```

# Lists

- Lorem ipsum odor amet
- Justo sed duis purus
  - Consectetuer adipiscing elit
  - Donec proin hac nostra suspendisse
- Nunc facilisis quisque

# Numbered Lists

```
\documentclass[12pt]{article}

\begin{document}

  \begin{enumerate}
    \item Lorem ipsum odor amet
    \item Justo sed duis purus
    \begin{enumerate}
      \item Consectetuer adipiscing elit
      \item Donec proin hac nostra suspendisse
    \end{enumerate}
    \item Nunc facilisis quisque
  \end{enumerate}

\end{document}
```

# Numbered Lists

1. Lorem ipsum odor amet
2. Justo sed duis purus
  - 2.1 Consectetuer adipiscing elit
  - 2.2 Donec proin hac nostra suspendisse
3. Nunc facilisis quisque

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# Figures

```
\documentclass[12pt]{article}

\begin{document}
  \begin{figure}
    \centering
    \includegraphics[width=0.5\columnwidth]{Figures/sps_logo}
    \caption{Logo IEEE SPS.}
  \end{figure}
\end{document}
```

# Figures

- Use a figure environment
- **\centering:**
  - Centers the content within the figure environment
  - Ensures the image is horizontally aligned in the middle of the page or column
- **\includegraphics:**
  - Inserts an image into the document
  - Commonly used options:
    - width: Specifies the width of the image (e.g., width=0.5\columnwidth)
    - height: Specifies the height of the image
    - scale: Scales the image by a factor
  - Takes path to image as argument (inside {...})
- **\caption:**
  - Adds a caption below the image

# Figures



Figure 1: Logo IEEE SPS.



# Figure Placement

- LaTeX handles figure placement automatically for optimal layout
- Common placement specifiers:
  - h – here
  - t – top
  - b – bottom
  - ! – override internal parameters
- Messing with Figure placement can disrupt the document flow!
- Letting  $\text{\LaTeX}$  decide ensures the professional appearance
- Just accept that  $\text{\LaTeX}$  knows better, this is not MS Word and that is a bonus!

# References

```
\documentclass[12pt]{article}

\begin{document}
  \begin{figure}
    \centering
    \includegraphics[width=0.5\columnwidth]{Figures/sps_logo}
    \caption{Logo IEEE SPS.}
    \label{fig:sps}
  \end{figure}
```

Figure~\ref{fig:sps} is the SPS logo!

```
\end{document}
```

# References

- `\label{...}` assigns a label to an element (e.g., figures, tables, sections)
  - We can call a figure by a name
  - No matter the order, it will always be the right figure!
  - It is a breeze to create lists of figure
  - Labels for figure usually start with `fig`:
- `\ref{...}` references the labelled element
- Using `~` ensures that "Figure" and its number stay on the same line

# References



Figure 2: Logo IEEE SPS.

Figure 2 is the SPS logo!

# Packages and Clever References

```
\documentclass[12pt]{article}
\usepackage{cleveref}

\begin{document}
  \begin{figure}
    \centering
    \includegraphics[width=0.5\columnwidth]{Figures/sps_logo}
    \caption{Logo IEEE SPS.}
    \label{fig:sps}
  \end{figure}

  \cref{fig:sps} is the SPS logo!
\end{document}
```

# Packages and Clever References



Figure 3: It is yet another IEEE SPS logo.

Both Figure 2 and fig. 3 are the SPS logo!

# Packages and Clever References

- `\usepackage{...}` loads extra functionalities, packages made by the communities (basically, libraries)
- We are importing the `cleveref` package
  - `\cref{...}` automatically includes the type of the referenced object (e.g., "Figure", "Table") without manual text
  - Using `\cref{fig:sps}` produces "Figure 1" automatically, maintaining proper spacing and formatting

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# The Equation Environment

- Use the `equation` environment to display numbered equations.
- Automatically centres the equation and assigns a number for referencing.
- Syntax:

```
\begin{equation}  
    % Your equation here  
\end{equation}
```

# The Equation Environment

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

Here is a simple equation:

```
\begin{equation}
```

$$E = mc^2$$

```
\end{equation}
```

```
\end{document}
```

# Mathematical Notation Basics

- Greek Letters: `\alpha` ( $\alpha$ ), `\beta` ( $\beta$ ), `\delta` ( $\delta$ ), `\Delta` ( $\Delta$ ), etc.
- Operations: `+` (+), `-` (-), `\times` ( $\times$ ), `\cdot` ( $\cdot$ )
- Fractions: `\frac{a}{b}` ( $\frac{a}{b}$ )
- Subscript: `a_{i}` ( $a_i$ )
- Superscript: `x^{2}` ( $x^2$ )
- Summations: `\sum_{i=1}^n x_i` ( $\sum_{i=1}^n x_i$ )
- Integrals: `\int_a^b f(x) dx` ( $\int_a^b f(x) dx$ )

# Mathematical Notation Basics – Challenge

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}} \quad (1)$$

# Referencing Equations

```
\documentclass[12pt]{article}
\usepackage{cleveref}
```

```
\begin{document}
```

The `\cref{eq:std}` shows the standard deviation:

```
\begin{equation}
\sigma = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}}
\label{eq:std}
\end{equation}
```

```
\end{document}
```

# Referencing Equations

The eq. (2) shows the standard deviation:

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}} \quad (2)$$

# Inline Equations

- Embed mathematical expressions within text using  $\$ \dots \$$
- For inline equations and symbols
- Supports standard  $\text{\LaTeX}$  math syntax

## Inline Equations

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

According to Newton's second law, the force applied to an object is given by  $F = ma$ , where:

```
\begin{itemize}
```

```
\item  $F$  is the force in Newtons ( $N$ )
```

```
\item  $m$  is the mass in kilograms ( $kg$ )
```

```
\item  $a$  is the acceleration in meters per  
second squared ( $m \cdot s^{-2}$ )
```

```
\end{itemize}
```

This equation is fundamental in physics.

```
\end{document}
```



## Inline Equations

According to Newton's second law, the force applied to an object is given by  $F = ma$ , where:

- $F$  is the force in Newtons ( $N$ )
- $m$  is the mass in kilograms ( $kg$ )
- $a$  is the acceleration in meters per second squared ( $m \cdot s^{-2}$ )

This equation is fundamental in physics.

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# Comparing Tables: booktabs vs. Regular Tables

Which table looks better?

Table 1: Regular style table.

Parameter	Value	Unit
Length	10	m
Width	5	m
Height	3	m

Table 2: Booktabs style table.

Parameter	Value	Unit
Length	10	m
Width	5	m
Height	3	m

# Why booktabs?

- Developed to improve the quality of tables in  $\text{\LaTeX}$  documents
- Aimed at enhancing readability and visual appeal of tables.
- **Best Practices:**
  - Avoid using vertical lines; rely on spacing and horizontal rules
  - Maintain consistency in table design throughout the document

# Basic Tables

```

\documentclass[12pt]{article}
\usepackage{cleveref}
\usepackage{booktabs}

\begin{document}
  \begin{table}
    \centering
    \caption{Basic table.}
    \label{tab:basic}
    \begin{tabular}{l|cr}
      \toprule
      \textbf{Parameter} & \textbf{Value} & \textbf{Unit} & \\
      \midrule
      Length            & 10           & m           & \\
      Width             & 5            & m           & \\
      \bottomrule
    \end{tabular}
  \end{table}
  \Cref{tab:basic} is a basic table.
\begin{end}

```

# Basic Tables

- `\begin{table} ... \end{table}`
  - Environment that holds the caption, label, and the actual table
- `\begin{tabular} ... \end{tabular}`
  - Defines the table's structure
  - Column alignment specified within curly braces:
    - l: Left-aligned
    - c: Center-aligned
    - r: Right-aligned
    - |: Vertical lines (use sparingly with booktabs)
- `&` separates columns
- `\\` ends rows

# Basic Tables

- `\toprule`: Thick line at the top
- `\midrule`: Thin line between header and data
- `\bottomrule`: Thick line at the bottom

# Basic Tables

Table 3: Basic table.

Parameter	Value	Unit
Length	10	m
Width	5	m

Table 3 is a basic table.



# Basic Tables – Challenge

Law	Differential form	Integral form
Gauss	$\nabla \cdot \vec{\mathbf{E}} = \frac{\rho}{\epsilon_0}$	$\int_S \vec{\mathbf{E}} \cdot \hat{n} \, dS = \frac{Q}{\epsilon_0}$
Gauss for Magnetism	$\nabla \cdot \vec{\mathbf{B}} = 0$	$\int_S \vec{\mathbf{B}} \cdot \hat{n} \, dS = 0$
Faraday	$\nabla \times \vec{\mathbf{E}} = -\frac{\partial \vec{\mathbf{B}}}{\partial t}$	$\oint \vec{\mathbf{E}} \cdot d\vec{r} = -\frac{d}{dt} \int_S \vec{\mathbf{B}} \cdot \hat{n} \, dS$
Ampère	$\nabla \times \vec{\mathbf{B}} = \mu_0 \vec{\mathbf{J}} + \mu_0 \epsilon_0 \frac{\partial \vec{\mathbf{E}}}{\partial t}$	$\oint \vec{\mathbf{B}} \cdot d\vec{r} = \mu_0 I + \mu_0 \epsilon_0 \int_S \vec{\mathbf{E}} \cdot \hat{n} \, dS$

# Advanced Tables

- As you probably can conclude, tables are not  $\text{\LaTeX}$  strong suit
- <https://www.tablesgenerator.com>

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# Text Structure

- Chapter (`\chapter{Chapter Name}`) - *(Only in certain document classes)*
- Section (`\section{Section Name}`)
- Subsection (`\subsection{Subsection Name}`)
- Subsubsection (`\subsubsection{Subsubsection Name}`)
- It is possible to associate a label to each of these, for referencing

# Text Structure

```
\documentclass{article}
```

```
\usepackage{cleveref}
```

```
\begin{document}
```

```
\section{Introduction}
```

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

This is the introduction section.

```
\section{Methodology}
```

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

Refer to `\cref{sec:intro}` for the introduction.

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

```
\label{sec:data}
```

Details about data collection for `\cref{sec:method}`.

```
\subsubsection{Survey Design}
```

```
\label{sec:survey}
```

Information on survey design.

```
\end{document}
```

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# IEEE Conference Template

- <https://www.overleaf.com/latex/templates/ieee-conference-template/grfzhhnscsfqn>
- Open as Template

# Organising a Project

- Erase all pdfs
- Change conference\_101719.tex to main.tex
- Erase everything between `\end{IEEEkeywords}` and `\end{document}`



# Organising a Project

- Create a new file called `body.tex`
- Paste the code in slide 53 inside the `document` environment into it
- Write `\input{body.tex}` bellow `\end{IEEEkeywords}`
  - “Pastes” the content of a tex file inside another
  - We can easily write the content in `body.tex` and change template, by using `\input{body}`

# Citations and Bibtex

- Create a new file called citations.bib
- Add the following two lines, below the `\input{body}` line

```
% This is the citations style  
\bibliographystyle{IEEEtran}  
% This is the file where the citations are stored  
\bibliography{citations}
```

# Citations and Bibtex

- Paste bibtex references inside citations.bib

```
@INPROCEEDINGS{Filipe2021,
  author={Filipe, Jose N. and Carreira, J. and Tavora, Luis M. N.
    and de Faria, Sergio M. M. and Navarro, Antonio and Assuncao, Pedro A. A.},
  booktitle={2021 Telecoms Conference (ConfTELE)},
  title={Tree-Based Ensemble Methods for Complexity Reduction of VVC Intra Coding},
  year={2021},
  volume={},
  number={},
  pages={1-6},
  doi={10.1109/ConfTELE50222.2021.9435476}
}
```

- Filipe2021 is the key we are going to use to cite this workshop
- It can be changed to whatever we want

# Citations and Bibtex

- Use `\cite{...}` to cite a work
- For instance, add the following to `body.tex`

This work~`\cite{Filipe2021}` is not about `\LaTeX`.

# Citations and Bibtex

- Order in bib file does not matter
- References are order according with the rules in the bibliography style (order of appearance, alphabetically, etc)
- Numbers are dynamically assigned by  $\text{\LaTeX}$  no need to worry about them at all!!!

# IPL Template

- <https://www.overleaf.com/latex/templates/polytechnic-university-of-leiria-thesis-template/tqgbrncfhwgt>
- Open as Template

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# What is Beamer?

- **Beamer** is a  $\text{\LaTeX}$  class for creating presentations
- It allows you to create slides with consistent styling and structure
- Utilizes frames to organize content into individual slides



# Basic Presentation

```
\documentclass{beamer}
```

```
\begin{document}
```

```
  \begin{frame}{Slide Title}  
    Your content goes here.  
  %\end{frame}
```

```
\end{document}
```

# Slightly Less Basic Presentation

```
\documentclass{beamer}
\usetheme{Madrid}

\title{Introduction to LaTeX Beamer}
\author{Jane Doe}
\institute{Engineering Department, XYZ University}
\date{\today}

\begin{document}

    \begin{frame}
        \titlepage
    % \end{frame}

    \begin{frame}{Slide Title}
        Your content goes here.
    % \end{frame}

\end{document}
```

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# Thank You