Introduction to \LaTeX

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\textsc{Introduction}

\LaTeX{} is not a word processor!

Word, for instance, is a WYSIWYG - What you see is what you get.

\LaTeX{} is WYSIWYM - What you see is what you mean.

What you can do in \LaTeX{} is:

- Generate papers for journals and conferences
- Control and organize large documents
- Generate complex math formulas
- Manage bibliographies, references and indexes
- Support endless number of fonts and styles
Some examples: organize large documents

Document is actually a project, consist of few files.
## Some examples: tables

<table>
<thead>
<tr>
<th>Fruits</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pear</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Watermelon</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Some examples: complex math formulas

Automatic numbering:

\[ y = \int_{0}^{\infty} \frac{\beta x^2}{2\pi \arcsin\left(\frac{x}{\pi}\right)} \, dx \]  
\[ E = mc^2 \]  

Avoid numbering, ident and provide array of equations:

\[ \left| \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X_n e^{j2\pi kn\Delta fT} \right|^2 \leq \frac{1}{N} \sum_{n=0}^{N-1} \left| X_n e^{j2\pi kn\Delta fT} \right|^2 \]

\[ = \frac{1}{N} \sum_{n=0}^{N-1} |X_n|^2 \sum_{n=0}^{N-1} \left| e^{j2\pi kn\Delta fT} \right|^2 \]
Start writing in LaTeX

- Install MiKTeX
- Install Ghostscript
- Install either TeXnicCenter or LEd
- Start writing!
Start writing in \LaTeX

Setting the document:

\begin{document}
Hello world!
\end{document}

And the result is:

Hello world!
I have a comment to make ...

\texttt{L\LaTeX} code
\begin{verbatim}
documentclass{article}
\begin{document}
Hello world!
%But I have a comment to make!
\end{document}
\end{verbatim}

And the result is:

Result
Hello world!
Files, files, files

It is time to save the text into a file!

Simple LaTeX file extension is * .tex
Files, files, files

Common file types:
- \texttt{*.tex} - document description file (text).
- \texttt{*.bib} - bibliography information (text).
- \texttt{*.dvi} - document description file (binary), can be converted to ps/pdf or be preview using YAP.
- \texttt{*.ps} - description language of documents.
- \texttt{*.pdf} - evolution of \texttt{*.ps} files, commonly used.
- \texttt{*.bst} - BibTeX style description file (text).
- \texttt{*.sty} - document style description file (text).
Document with class!

The \documentclass[options]{class} sets some basic document properties.

class:

- **article** - for journals (no chapters, just sections)
- **report** - used for thesis (chapters allowed)
- **book, letter** and additional custom made...

options:

- **11p** - or any other value, set the font size
- **a4paper** - set the page size
- **onecolumn, twocolumn** - split (or not) the text into 2 columns
I have a package for you

\LaTeX allows adding additional packages.

Those packages enriches the \LaTeX fonts, symbols and possibilities.

For instance: \texttt{\usepackage{slashbox}} allows:

\begin{tabular}{|c|c|c|}
\hline
  \textbackslash & \textbackslash & \textbackslash \\
\hline
\hline
  X & Y & 0 & 1 \\
\hline
  0 & 1/3 & 1/3 \\
\hline
  1 & 0 & 1/3 \\
\hline
\end{tabular}

Where in regular \LaTeX, this table slash is not supported.
Some order

\LaTeX\ has a simple way to make the document be in order, there are:

- \texttt{\part{}} - everything but a \textit{letter} class
- \texttt{\chapter{}} - books and reports
- \texttt{\section{}} - everything but a \textit{letter} class
- \texttt{\subsection{}} - everything but a \textit{letter} class
- \texttt{\subsubsection{}} - everything but a \textit{letter} class
- \texttt{\paragraph{}} - everything but a \textit{letter} class
- \texttt{\subparagraph{}} - everything but a \textit{letter} class
Some order - example:

LaTeX code

\section{Introduction}
\subsection{Sub Introduction}
\section{Another Introduction}
\section*{Just Introduction}
\section*{Just Introduction}
\subsection{Sub Just Introduction}

Result

1 Introduction
1.1 Sub Introduction
2 Another Introduction
Just Introduction
2.1 Sub Just Introduction
Shopping list

\LaTeX\ code

\begin{itemize}
\item Item 1.
\begin{itemize}
\item List 2, Item 1
\end{itemize}
\item Item 2.
\end{itemize}

Result

- Item 1.
  - List 2, Item 1
- Item 2.
Shopping list, what else do we have in the basket?

On top of bullets, one can have:

**enumerate:**

1. enumerate

2. enumerate (too)

**description:**

1. description

2. description too

**list:**

same label: First item in the list

same label: Second item in the list
Setting up the table

\texttt{\LaTeX\ code}

\begin{tabular}{|l||c|c|}
\hline
this & is & a table \ \\ \hline
this is & the second & row \ \\ \hline
\end{tabular}

\texttt{Result}

\begin{tabular}{|l|c|c|}
\hline
this & is & a table \\
this is & the second & row \\
\hline
\end{tabular}
Font fashion

\texttt{\LaTeX} code
\begin{verbatim}
\tiny{tiny}
\large{large}
\Large{Large}
\end{verbatim}

Result
tiny large Large

Sizes, from tiny to huge:
\begin{verbatim}
\tiny, \scriptsize, \footnotesize, \small, \normalsize, \large, \Large, \LARGE, \huge, \Huge.
\end{verbatim}
Font fashion, the bold and the beautiful

\textit{Italic}
\textbf{Bold}
\underline{Underline}
\textsc{Small Capital}
\emph{Emphasize}

Result

\it{Italic}
\bf{Bold}
\underline{Underline}
\sc{Small Capital}
\emph{Emphasize}
Font fashion, the text collection

\texttt{LaTeX} code
\begin{verbatim}
\texttt{roman font} \\
\texttt{sans serif font} \\
\texttt{teletype font, it also called monospace font}
\end{verbatim}

Result
roman font
sans serif font
teletype font, it also called monospace font
Font fashion, the math collection

\begin{align*}
&\mathcal{X,Y} \sim \text{like in information theory} \\
&\mathfrak{L,F} \sim \text{like Laplace and Fourier transforms} \\
&\mathbb{R,C} \sim \text{like Real numbers and Complex numbers}
\end{align*}

Result

$\mathcal{X, Y}$ like in information theory
$\mathfrak{L, F}$ like Laplace and Fourier transforms
$\mathbb{R, C}$ like Real numbers and Complex numbers
Do the math

One of the most powerful parts of \LaTeX{} is the formula formatting and writing.

In addition to the \LaTeX{} basic math support, additional packages can provide more symbols and can make formulas look better.

Some of the popular packages are the amsmath and amssymb.
Math, the ABC

There are few main ways to write equations and formulas in \LaTeX:

- $y=x$ is used to insert formula or equation inside text
- \begin{equation} \end{equation} coupled with \begin{eqnarray} \end{eqnarray}
- \begin{eqnarray} \end{eqnarray} coupled with \begin{eqnarray} \end{eqnarray}
- \texttt{\textbackslash lefteqn} is rarely used for splitting formulas

While the \texttt{equation} can support only one line of equations, \texttt{eqnarray} supports multiple lines and helps align the equations.
Math, you need to give me an example

\textbf{LaTeX code}

This is a text with an equation $y=2x + 3.1S + 1.2f$ inside.
\begin{eqnarray}
y &=& (x+2)^2 \\ &=& (x+2)(x+2) \\ &=& x^2+2x+2x+4 \\ &=& x^2+4x+4
\end{eqnarray}

\textbf{Result}

This is a text with an equation $y = 2x + 3.1S + 1.2f$ inside.

\begin{align}
y &= (x + 2)^2 \\
    &= (x + 2)(x + 2) \\
    &= x^2 + 2x + 2x + 4 \\
    &= x^2 + 4x + 4
\end{align}
My two cents...

\textbf{\LaTeX{} code}

\begin{eqnarray}
y & = & (x+2)^{10} \\
& = & (x+2)(x+2)(x+2)(x+2)(x+2) \nonumber \\
& & (x+2)(x+2)(x+2)(x+2)(x+2) \\
& = & & \dots \nonumber \\
\end{eqnarray}

\textbf{Result}

\begin{align*}
y & = (x + 2)^{10} & \quad (1) \\
& = (x + 2)(x + 2)(x + 2)(x + 2)(x + 2) \\
& \quad (x + 2)(x + 2)(x + 2)(x + 2)(x + 2) & \quad (2) \\
& = \ldots
\end{align*}
Greek alphabet

The Greek alphabet is used in math mode. Capital Greek letters are spelled the same as lower case Greek letters but with capital letter in the start:

\begin{itemize}
\item $\alpha$, $\gamma$, $\Gamma$, $\epsilon$ and $\varepsilon$
\item $\lambda$, $\omega$, $\tau$ and $\sigma$
\item $\Sigma$, $\theta$, $\beta$ and $\Omega$
\item $\aleph$
\end{itemize}

\textbf{Result}

$\alpha$, $\gamma$, $\Gamma$, $\epsilon$ and $\varepsilon$
$\lambda$, $\omega$, $\tau$ and $\sigma$
$\Sigma$, $\theta$, $\beta$ and $\Omega$
$\aleph$
Adding argument superscript or subscript notation is very simple

\begin{eqnarray*}
& t_0 & \\
& f_{\text{cutoff}} & \\
& x^2 & \\
& e^{j (2\pi ft+\phi)} & \\
\end{eqnarray*}

Result

\begin{align*}
& t_0 \\
& f_{\text{cutoff}} \\
& x^2 \\
& e^{j(2\pi ft+\phi)}
\end{align*}
Getting on top of things

\begin{eqnarray*}
&\frac{1}{2}&\\
&\frac{x}{\frac{x+y}{2y+z}}&\\
&2x + 4 \overset{(a)}{=} 4&\\
&\binom{5}{2} = \frac{5!}{3!2!}&
\end{eqnarray*}

\textbf{Result}

\begin{align*}
\frac{1}{2} \\
\frac{x}{x+y} & \quad \frac{2x + 4 \overset{(a)}{=} 4}{\binom{5}{2} = \frac{5!}{3!2!}}
\end{align*}
The collection

Summation, multiplication and integration are very easy:

\begin{eqnarray}
\prod_{l=1}^{L} \sum_{n=0}^{N-1} \int_{0}^{\infty} \iiint \oint \int_{\frac{3\pi}{4}}^{\frac{7\pi}{4}} \nonumber
\end{eqnarray}

\begin{itemize}
\item \texttt{\prod}_{l=1}^{L}
\item \texttt{\sum}_{n=0}^{N-1}
\item \texttt{\int}_{0}^{\infty}
\item \texttt{\iiint}
\item \texttt{\oint}
\item \texttt{\int}_{\frac{3\pi}{4}}^{\frac{7\pi}{4}}
\end{itemize}

Result

\[
\prod_{l=1}^{L} \sum_{n=0}^{N-1} \int_{0}^{\infty} \iiint \oint \int_{\frac{3\pi}{4}}^{\frac{7\pi}{4}}
\]
Parenthesis

Writing () or [] may result sometimes with parenthesis size which doesn't fit the equation.

\[\begin{eqnarray*}
&\left(\frac{\sum_{n=1}^N b^n}{\sum_{n=1}^N b^{2n}}\right)&
&\left[\frac{\sum_{n=1}^N b^n}{\sum_{n=1}^N b^{2n}}\right]&
&\left\{\frac{\sum_{n=1}^N b^n}{\sum_{n=1}^N b^{2n}}\right\}&
\end{eqnarray*}\]

**Result**

\[
\left(\frac{\sum_{n=1}^N b^n}{\sum_{n=1}^N b^{2n}}\right)
\left[\frac{\sum_{n=1}^N b^n}{\sum_{n=1}^N b^{2n}}\right]
\left\{\frac{\sum_{n=1}^N b^n}{\sum_{n=1}^N b^{2n}}\right\}
\]
Parenthesis

Self generated parenthesis are in the case of commands like \( \binom{}{} \) or \( \begin{cases} \end{cases} \) and other...

\textbf{\LaTeX\ code}

\begin{eqnarray*}
g(x) = \\
\begin{cases}
  x^2 & \text{if } x \geq 1 \\
  1 & \text{if } x < 1
\end{cases}
\end{eqnarray*}

\textbf{Result}

\[ g(x) = \begin{cases} 
  x^2 & \text{if } x \geq 1 \\
  1 & \text{if } x < 1
\end{cases} \]
When you really need a reference

Labels are the method being used to add references in LaTeX documents. Adding a prefix, allows more than one element could have the same label.

\textbf{\LaTeX{} code}

\begin{eqnarray}
\label{Equation}
x[n]=\frac{1}{N}\sum_{k=0}^{N-1}X[k]e^{\frac{j2\pi nk}{N}}
\end{eqnarray}

See how to write a complicated equation in equation \eqref{Equation}.

\textbf{Result}

\[ x[n] = \frac{1}{N} \sum_{k=0}^{N-1} X[k] e^{\frac{j2\pi nk}{N}} \] (3)

See how to write a complicated equation in equation (3).
When you really need a reference

\begin{eqnarray}
\label{eq:Eq1} X[1] = 1 \end{eqnarray}
\begin{center}
\begin{tabular}{c|c}
  a & b \\
  \hline
  c & d \\
\end{tabular}
\end{center}

We use the same label in equation \eqref{eq:Eq1} and table \ref{tab:Eq1}.

\textbf{Result}

\begin{equation}
X[1] = 1
\end{equation}

\begin{tabular}{cc}
a & b \\
\hline
c & d
\end{tabular}

We use the same label in equation (4) and table 33.
A picture is worth a thousand words

\LaTeX{} supports various kind of pictures, the most common format is \texttt{*.EPS} (encapsulated postscript). The following programs supports \texttt{*.EPS} format:

- Inkscape
- Ghostscript
- Matlab
- Adobe Illustrator
- And more ...

The following formats are also supported: PDF, JPG and PNG, but not all of them can be compiled into DVI, meaning, no preview.
A picture is worth a thousand words

Don’t forget to add: \usepackage{graphicx}

\LaTeX code
\includegraphics[width=0.5\textwidth]{bulb.jpg}

Result
It’s time to thank someone

Additional strong part of the \LaTeX{} is the bibliography management. Major articles sources supports a format called \textit{BibTeX}. 

\textbf{Threshold Gate Approximations Based on Chow Parameters}

Winder, R.C.  
This paper appears in Computers, IEEE Transactions on  
Publication Date: April 1966  
Volume: C-18, Issue: 4  
On page(s): 372 - 375  
ISSN: 0018-9340  
Current Version Published: 2009-08-14

Abstract  
Seven methods are compared for deriving approximate realizing weights and threshold for a threshold function, given its Chow parameters. These include use of the parameters themselves, methods published by Bertaux and the author, and several new methods. The comparison is made over all seven-argument self-dual threshold function types, and establishes a certain “geometric rule” as best. One third of the types were exactly realized by the approximation, and the average number of misclassifications was very small.

Index Terms

- Controlled Indexing
- Not Available
It’s time to thank someone

BibTeX format

```bibtex
@ARTICLE{1362497,
title={Pre-scrambling method for PAPR reduction in OFDM communication systems},
author={Kwang Don Choe and Si Chul Kim and Park, S.K.},
journal={Consumer Electronics, IEEE Transactions on},
year={2004},
month={Nov.},
volume={50},
number={4},
pages={ 1044-1048},
doi={10.1109/TCE.2004.1362497},
ISSN={0098-3063}, }
```
It’s time to thank someone

Bibliography


It’s time to thank someone

Once a record is added to the bibliography *.BIB file. It can referred to with \cite{} command.
To refer the article in the previous slide the command would be \cite{1362497}.
The number can be changed to something more meaningful, like:

@ARTICLE{TheArticleIdontUnderstand,
title=....

And refer it by that name: \cite{TheArticleIdontUnderstand}.
Where to go from here?

There is a lot of additional material on \LaTeX{} all over the internet: Forums, web pages and wikis.

You can either google or bing with latex + problem: \textit{latex how to make my thesis to look cool}.

Or you can start here: latex wiki