

A \LaTeX Tutorial

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Goals of this presentation



- **Not** comprehensive
- Starting reference to show that \LaTeX isn't *that* scary
- Provide some tips & tricks
- Tons of useful \LaTeX tutorials by [Overleaf](#)

Why \LaTeX is cool

Some Important Person

May 13, 2022

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What is L^AT_EX?



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- From [Encycolpedia Britannica](#):

“TeX, a page-description computer programming language developed during 1977–86 by Donald Knuth, a Stanford University professor, to improve the quality of mathematical notation in his books.

Text formatting systems, unlike WYSIWYG (“What You See Is What You Get”) word processors, embed plain text formatting commands in a document, which are then interpreted by the language processor to produce a formatted document for display or printing. TeX marks italic text, for example, as *this is italicized*, which is then displayed as this is italicized.”

- L^AT_EX is the corresponding software package
- TeX consists of the greek letters τ , ϵ , χ , and is pronounced “lay-tech”

A \LaTeX document



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Commands

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

```
% remaining preamble goes here
```

```
\begin{document}
```

```
% content goes here
```

```
\end{document}
```

Creating a title

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

\title{Automatic Material Classification}
\author{Unal Artan \thanks{Thank you to Natalie \& Johann}}
\date{August 24, 2021}

\begin{document}

\maketitle

...
```

Adding sections

```
...  
\tableofcontents  
  
\section{Wavelet Analysis}  
  
Researchers began studying wavelets in the 30s, because of their inherent  
cuteness in comparison to waves.  
  
\subsection{Digression}  
  
Would that this were a whiteboard instead \ldots  
  
\end{document}
```

NOTE: Requires two compilations to output the table of contents.

Automatic Material Classification

Unal Artan *

August 24, 2021

Contents

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1.1	Digression	1

1 Wavelet Analysis

Researchers began studying wavelets in the 30s, because of their inherent cuteness in comparison to waves.

1.1 Digression

Would that this were a whiteboard instead . . .

*Thank you to Natalie & Johann

Commonly used syntax

`\usepackage{...}` import a \LaTeX package in preamble
`\input{...}` input \LaTeX code from another file in-place
`\include{...}` insert \LaTeX code from another file on separate pages

comments

`% ...`

bold

`\textbf{...}`

italic

`\textit{...}` or `\emph{...}`

underline

`\underline{...}`

inline equations

`$...$`

block equations

`$$...$$` or `\[...\]`

“quotes”

``...'` or ``...'``

...and many more!

`\ldots`

Dimension	Description
pt	point, smallest unit of measure
in	inch (72.27 pt)
cm	centimeter
mm	millimeter
em	relative to current point size (e.g., for 11pt font, 1em = 11pt)
en	half the width of em
Command	Description
<code>\vspace{...}</code>	add vertical space
<code>\hspace{...}</code>	add horizontal space

- Extra spaces between words are ignored
- An empty line starts a new **paragraph**
- Two backslashes (`\\`) **forces** a line break, but does not start a new paragraph (i.e., no indent)
- Periods with trailing whitespace are treated as **end of sentence**, which can be escaped by a trailing backslash (e.g., i.e.\)
- Tilde (`~`) inserts **non-breaking whitespace**
- Adding an asterisk (`*`) after some environment names will hide their numbering (e.g., `section*`, `figure*`, `equation*`)
- Curly braces (`{...}`) may be used as blocks for formatting

Packages:

`enumitem` custom enumerations/nesting

Commands:

`itemize` bullet points

`enumerate` numbered lists

`description` description lists (used here)

```
\begin{itemize}
  \item Lima
  \item Navy
  \item Kidney
  \begin{itemize}
    \item[yes] Bean
    \item[no] Stone
  \end{itemize}
\end{itemize}
```

- Lima
- Navy
- Kidney
 - yes Bean
 - no Stone

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

1. One
2. Two
3. Three
 - 3.a Three Eh
 - 3.b Three Bee

Packages:

`array` tables with fixed-width cells

`tabularx` tables with fixed page width

`multirow` merge rows/columns

Commands:

`tabular` table environment

```
\begin{tabular}{| r | l | l | }  
  \hline  
  Signal & Description & Range \\  
  \hline  
  $\theta_l$ & lift & [0, 604] mm \\  
  \hline  
  $\theta_d$ & dump & [0, 396] mm \\  
  \hline  
\end{tabular}
```

Signal	Description	Range
θ_l	lift cylinder	[0, 604] mm
θ_d	dump cylinder	[0, 396] mm

Packages:

- `amsmath` core math functionality
- `amssymb` extended mathematical symbols set
- `cases` piecewise notation
- `algorithm2e` algorithm environment

Commands:

- `equation` equation environment
- `split` multiline equation environment
- `align` multiple aligned equations environment
- `(pbv)matrix` matrices (similar syntax to tables)

Common equation syntax

Description	Code	Output
subscript	<code>x_y</code>	x_y
superscript	<code>x^y</code>	x^y
grouping	<code>x^{y+z}</code>	x^{y+z}
fraction	<code>\frac{x}{y}</code>	$\frac{x}{y}$
square root	<code>\sqrt{x+y}</code>	$\sqrt{x+y}$
greek letters	<code>\alpha \beta \gamma</code>	$\alpha \beta \gamma$
spacing	<code>\; \: \, \!</code>	contextual

```
\begin{equation}  
  \beta(s) = \int_{-\infty}^{\infty} CWT(s, \tau) \, d\tau  
  \label{eq:CWTint}  
\end{equation}
```

$$\beta(s) = \int_{-\infty}^{\infty} CWT(s, \tau) \, d\tau \quad (1)$$

Multiline equations

```
\begin{equation}
\begin{split}
a_{1, X} &= a_{1,x} \cos{\alpha} - a_{1,z} \sin{\alpha} \\
&= 42
\end{split}
\end{equation}
```

$$\begin{aligned} a_{1,X} &= a_{1,x} \cos \alpha - a_{1,z} \sin \alpha \\ &= 42 \end{aligned} \tag{2}$$

Matrices

```
\[
  \begin{bmatrix}
    0 & -1 & 0 & 0 \\
    1 & 0 & 0 & 0 \\
    0 & 0 & 1 & 0 \\
    0 & 0 & 0 & 1
  \end{bmatrix}
\]
```

$$\begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

```
\[  
  \begin{bmatrix}  
    0 & -1 & 0 & 0 \\  
    1 & 0 & 0 & 0 \\  
    0 & 0 & 1 & 0 \\  
    0 & 0 & 0 & 1  
  \end{bmatrix}  
\]
```

$$\begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Exactly!

Algorithms I



```
\begin{algorithm}[H]
  \caption{Dynamic Time Warping}
  \KwIn{Time series  $X[1..n]$  and  $Y[1..m]$ }
  \KwOut{Cost matrix  $DTW[0..n][0..m]$ }
   $DTW[0][0]$  \gets 0 \tcp*{warping path root}
  ...

  \For{$i$ \gets 1 \textbf{to} $n$}
  {
    ...
  }

  \KwRet{ $DTW[1..n][1..m]$ }
  \label{alg:DTW}
\end{algorithm}
```

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Algorithm 1: Dynamic Time Warping

Input: Time series $X[1..n]$ and $Y[1..m]$

Output: Cost matrix $DTW[0..n][0..m]$

```
1  $DTW[0][0] \leftarrow 0$  // warping path root
2  $DTW[1..n][0] \leftarrow infinity$   $DTW[0][1..m] \leftarrow infinity$  for  $i \leftarrow 1$  to  $n$  do
3   for  $j \leftarrow 1$  to  $m$  do
4      $cost \leftarrow |X[i] - Y[j]|$  // Euclidian distance
5      $DTW[i][j] \leftarrow cost + \min(DTW[i-1, j],$ 
6        $DTW[i, j-1],$ 
7        $DTW[i-1, j-1])$ 
8   end
9 end
10 return  $DTW[1..n][1..m]$ 
```

Figures and references

Packages:

`graphicx` including graphics
`biblatex` bibliography management
`hyperref` hyperlinks

Commands:

`includegraphics` include graphics ...
`addbibresource` add bibliography (.bib) file
`printbibliography` insert bibliography
`cite` in-text citation
`href` create hyperlink

Creating a figure I

```
\begin{figure}[t]
  \centering
  \includegraphics[height=0.65\textheight]{%
    figures/loader_diagram.png}%
}
\caption{The Kubota R520s robotic 1–tonne–capacity wheel loader that was
  used for field experiments.}
\label{fig:loader}
\end{figure}
```

Creating a figure II



Figure 1: The Kubota R520s robotic 1-tonne-capacity wheel loader that was used for field experiments.

```
| ‘\ldots the Kubota Loader in Figure~\ref{fig:loader}’
```

“...the Kubota Loader in Figure 1”

```
| ‘see Equation~\ref{eq:CWTint}’
```

“see Equation 1”

Note: “fig:” and “eg:” are not necessary, but they help when writing. “ch:” and “sec:” are often used for chapters and sections.

BibTeX entry (.bib files):

```
@inproceedings{artan2021,  
  author    = {Artan, Unal and Fernando, Heshan and Marshall, Joshua A.},  
  booktitle = {2021 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)},  
  title     = {Automatic Material Classification via Proprioceptive Sensing and Wavelet Analysis During  
              Excavation},  
  year      = {2021},  
  pages     = {612–617},  
  doi       = {10.1109/AIM46487.2021.9517696}  
}
```

Corresponding in-text citation:

```
“‘\ldots due to breakthrough research \cite{artan2021}’”
```

“...due to breakthrough research [1]”

NOTE: Often requires you to compile your document, run bibtex, then compile it again with resolved references ...

```
\bibliographystyle{ieeetr}  
\bibliography{references.bib}
```

- [1] U. Artan, H. Fernando, and J. A. Marshall, “Automatic material classification via proprioceptive sensing and wavelet analysis during excavation,” in *2021 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, pp. 612–617, 2021.

URL links:

```
\href{https://ieeexplore.ieee.org/document/9517696}{Paper}
```

[Paper](https://ieeexplore.ieee.org/document/9517696)

Internal links:

```
\hypertarget{link:thisPart}{This part}  
\hyperlink{link:thisPart}{That part}
```

This part

That part

```
| \newcommand{cmd}[args][default]{def}
```

cmd	name of the command
args	number of parameters
default	default value for optional first parameter #1
def	command body

```
| \newcommand{\proot}[2][\; \hat{\#1} \; \!\!\!\; \sqrt{\#2}]{  
| \[ \proot[3]{x + y} + \proot{x} \]
```

$$\sqrt[3]{x+y} + \sqrt{x}$$

`| \newenvironment{name}[args][default]{begdef}{enddef}`

<code>name</code>	name of the environment
<code>args</code>	number of parameters
<code>default</code>	default value for optional first parameter #1
<code>begdef</code>	<code>\begin</code> command body
<code>enddef</code>	<code>\end</code> command body

Custom environments II

```
\newenvironment{LARGEcenter}  
  {\begin{center}\LARGE}  
  {\end{center}}  
  
\begin{LARGEcenter}  
  Thank you for your time!  
\end{LARGEcenter}
```

Any questions?