

# A $\text{\LaTeX}$ Tutorial

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# Goals of this presentation

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

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Why  $\text{\LaTeX}$  is cool

Some Important Person

May 13, 2022

# What is L<sup>A</sup>T<sub>E</sub>X?

- From [Encyclopædia 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<sup>A</sup>T<sub>E</sub>X is the corresponding software package
- TeX consists of the greek letters  $\tau$ ,  $\epsilon$ ,  $\chi$ , and is pronounced “lay-tech”

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

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

% remaining preamble goes here

\begin{document}

% content goes here

\end{document}
```

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# Creating a title

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

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

\begin{document}

\maketitle
...
```

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# Adding sections

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```
...
\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

<b>1 Wavelet Analysis</b>	<b>1</b>
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 L<sup>A</sup>T<sub>E</sub>X package in preamble  
\input{...} input L<sup>A</sup>T<sub>E</sub>X code from another file in-place  
\include{...} insert L<sup>A</sup>T<sub>E</sub>X code from another file on separate pages

comments	% ...
<b>bold</b>	\textbf{...}
<i>italic</i>	\textit{...} or \emph{...}
<u>underline</u>	\underline{...}
inline equations	\$...\$
block equations	\$\$...\$\$ or \[...\]
“quotes”	`...' or ``'''
...and many more!	\ldots

# Dimensions and layout

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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
\vspace{...}	add vertical space
\hspace{...}	add horizontal space

# Typesetting notes

- 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

# Lists

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Packages:

`enumitem` custom enumerations/nesting

Commands:

`itemize` bullet points

`enumerate` numbered lists

`description` description lists (used here)

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```
\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

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# Enumerate

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```
\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

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# Tables

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## Packages:

array tables with fixed-width cells

tabularx tables with fixed page width

multirow merge rows/columns

## Commands:

tabular table environment

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# Tabular

```
\begin{tabular}{ | r | l | l | l | }
```

---

```
Signal & Description & Range \\
```

---

```
$\theta_l$ & lift & [0, 604] mm \\
```

---

```
$\theta_d$ & dump & [0, 396] mm \\
```

---

```
\end{tabular}
```

Signal	Description	Range
$\theta_l$	lift cylinder	[0, 604] mm
$\theta_d$	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

# Equations

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

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

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# Custom operators and text

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In the preamble:

```
| \DeclareMathOperator{\CWT}{CWT}
```

used in (1) gives:

```
| \beta(s) = \int^{\infty}_{-\infty} \CWT(s, \tau) \; \mathrm{d}\tau
```

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

# Multiline equations

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

$$a_{1,X} = a_{1,x} \cos \alpha - a_{1,z} \sin \alpha \quad (2)$$
$$= 42$$

# Matrices

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

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

# Matrices

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

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

Exactly!

# Algorithms I

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```
\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}
```

---

**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  $DTW[1..n][0] \leftarrow \text{infinity}$   $DTW[0][1..m] \leftarrow \text{infinity}$  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      $DTW[i][j] \leftarrow cost + \min(DTW[i - 1, j],$ 
        $DTW[i, j - 1],$ 
        $DTW[i - 1, j - 1])$ 
6   end
7 end
8 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

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# Creating a figure I

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```
\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}
```

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# Creating a figure II

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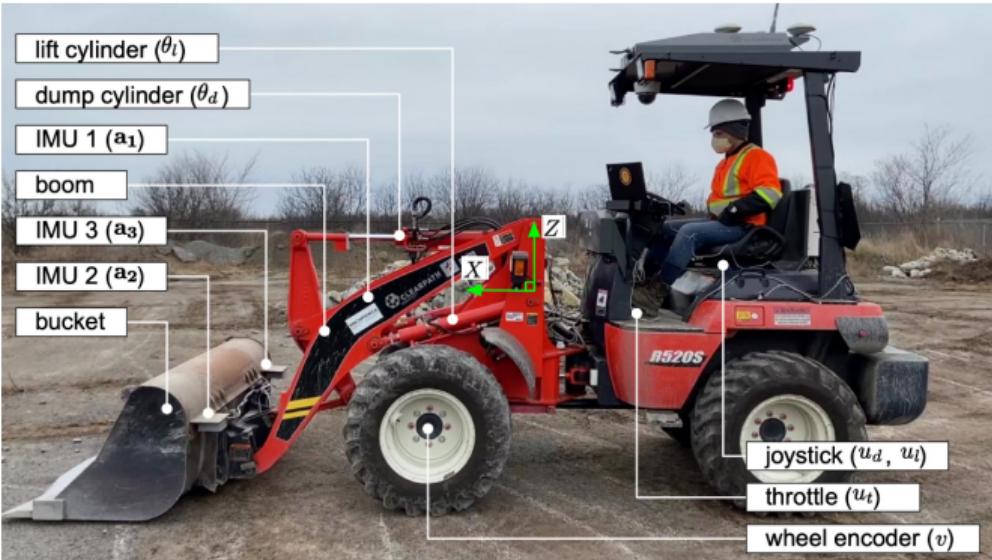


Figure 1: The Kubota R520s robotic 1-tonne-capacity wheel loader that was used for field experiments.

# Label references

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```
| ``\dots the Kubota Loader in Figure~\ref{fig:loader}''
```

“...the Kubota Loader in Figure 1”

```
| ``used in \eqref{eq:CWTint} gives ''
```

“used in (1) gives”

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

# Bibliography references

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## 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:

```
“\dots due to breakthrough research \cite{artan2021}”
```

“...due to breakthrough research [1]”

# Inserting a bibliography

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```
| \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.

# Hyperlinks

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URL links:

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

Paper

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Internal links:

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

This part

That part

# Custom commands

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```
| \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][]{\sqrt[\dimexpr#1+1]{#2}}
```

```
| [ \proot[3]{x+y} + \proot{x} ]
```

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

# Custom environments I

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

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

# Custom environments II

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

Any questions?