

# A $\text{\LaTeX}$ Tutorial

Johann von Tiesenhausen

Ingenuity Labs Research Institute  
Queen's University, Kingston, Canada

June 9<sup>th</sup>, 2022

# 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](#)

Why  $\text{\LaTeX}$  is cool

Some Important Person

May 13, 2022

# What is $\text{\LaTeX}$ ?



A  $\text{\LaTeX}$  Tutorial

3 of 29

Introduction

Documents

Lists

Tables

Math

Figures and  
references

Commands

- 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 [...] 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.”

- $\text{\LaTeX}$  is the corresponding software package
- TeX consists of the greek letters  $\tau$ ,  $\epsilon$ ,  $\chi$ , and is pronounced “lay-tech”

# A $\text{\LaTeX}$ document



A  $\text{\LaTeX}$  Tutorial

4 of 29

Introduction

Documents

Lists

Tables

Math

Figures and  
references

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

```
...
```

```
\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}
```

# Automatic Material Classification

Unal Artan \*

August 24, 2021

## 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  $\text{\LaTeX}$  package in preamble  
`\include{...}` insert  $\text{\LaTeX}$  code from another file in-place

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



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

# Enumerate

```
\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
$\theta_l$	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

```
\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!

# 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

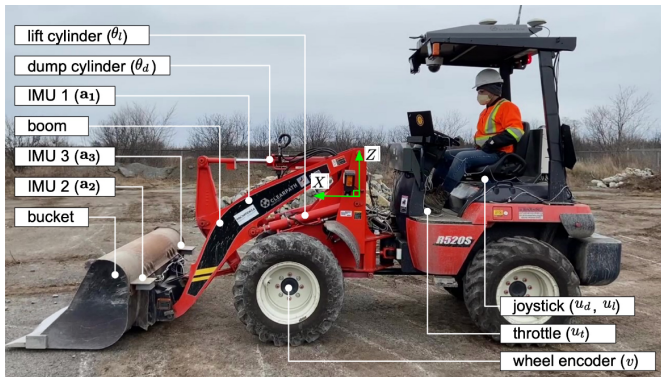


Figure 1: The Kubota R520s robotic 1-tonne-capacity wheel loader that was used for field experiments.



```
| ‘\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]”

# Inserting a bibliography

Often requires you to precompile 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}
```

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

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

Any questions?