A LaTeX Tutorial

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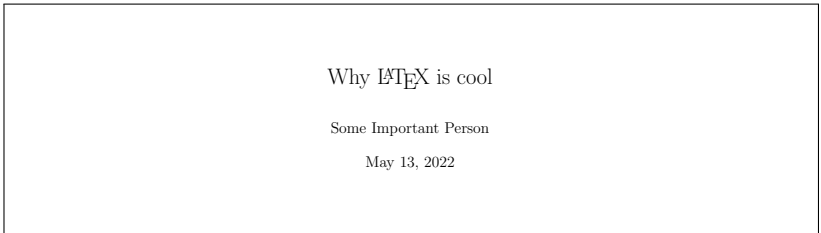
Goals of this presentation

- **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

What is LaTeX?

- 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."
- LaTeXis the corresponding software package
- TeX consists of the greek letters τ, ϵ, χ, and is pronounced "lay-tech"

A LaTeX document


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

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

Dimensions and layout

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 11`pt` font, 1`em` = 11`pt`)
`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

Packages:

enumitem	custom enumerations/nesting

Commands:

itemize	bullet points
enumerate	numbered lists
description	description lists (used here)

Itemize

```
\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

Tables

Packages:

array	tables with fixed-width cells
tabularx	tables with fixed page width
multirow	merge rows/columns

Commands:

tabular	table environment

Tables

```
\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

Math

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	`x_y`	x_y
superscript	`x^y`	x^y
grouping	`x^{y+z}`	x^{y+z}
fraction	`\frac{x}{y}`	$\frac{x}{y}$
square root	`\sqrt{x+y}`	$\sqrt{x+y}$
greek letters	`\alpha \beta \gamma`	$\alpha\ \beta\ \gamma$
spacing	`\; \: \, \!`	contextual

Equations

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

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

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

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

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

Matrices

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

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

Exactly!

Figures and references

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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

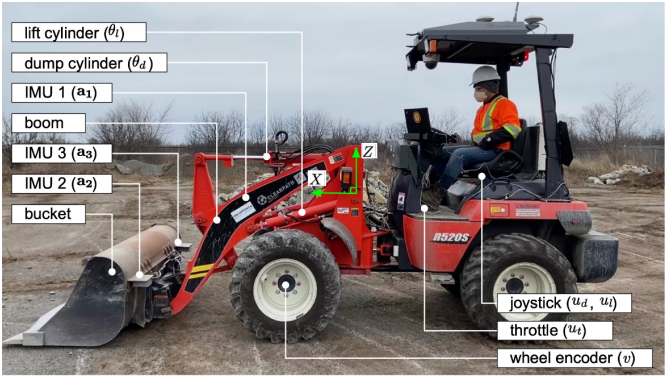

Figure 1: The Kubota R520s robotic 1-tonne-capacity wheel loader that was used for field experiments.

Label references

```
``\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.

Bibliography references

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.

Hyperlinks

URL links:

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

Paper

Internal links:

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

This part

That part

Custom commands

```
\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][]{\; ^{#1} \!\!\! \sqrt{#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

```
\newenvironment{LARGEcenter}
  {\begin{center}\LARGE}
  {\end{center}}

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

Any questions?