A Mathematical Introduction to LaTeX

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A Brief History of LaTeX

TeX is almost certainly older than you.

- "TeX" developed by Don Knuth in 1978
- Pronounced "tech", from Greek τεχνη
- Markup language, like HTML
- LaTeX was derived from TeX by Leslie Lamport in 1985
- Idea: Focus on content while LaTeX takes care of the presentation for you

Get the software

LaTeX is free, platform-independent software.

- `pdflatex` package for OS X/UNIX-based platforms
- LyX for WYSIWYG: `http://www.lyx.org`
- Online: `http://scribtex.com`

My first document

Hello, world!

Code for my first document

LaTeX code:

```
\documentclass{article}
\begin{document}
Hello, world!
\end{document}
```

Contrast with a similar HTML document:

```
<html>
   <body>
      Hello, world!
   </body>
</html>
```

Document Layout

1. Document type
   - `article`
   - `beamer` (slides)
   - `report`
2. Preamble (header)
   - Include packages
   - Set spacing
   - Declare macros, commands
3. Body (content)

Sample templates

See `http://hashman.ca/tex` for

- `article.tex`,
- `report.tex`, and
- `slides.tex`

sample templates.

This gives you some sample preamble information and templates for your use.

\begin{document}

Squeeze Theorem.

Let (x_n), (y_n) and (z_n) be sequences in $\mathbb{R}$. Suppose $(x_n) \to L$, $(z_n) \to L$, and for all $n \geq n_0$, we have $x_n \leq y_n \leq z_n$; then $(y_n) \to L$.

Proof. Let $\varepsilon > 0$. Since $(x_n) \to L$, there is some integer n_1 such that $\forall\ n \geq n_1$, we have $|x_n - L| < \varepsilon$.

Similarly, for the same ε, since (z_n) converges, $\exists\ n_2 \in \mathbb{N}$ such that $\forall\ n \geq n_2$, we have $|z_n - L| < \varepsilon$.

Then take $N = \max(n_0, n_1, n_2)$, and let $n \geq N$. For all $n \geq N$, we must have

$$L - \varepsilon < x_n \leq y_n \leq z_n < L + \varepsilon$$

which implies $|y_n - L| < \varepsilon$. So (y_n) converges to L. □

Squeeze Theorem Code, I

```
{\bf Squeeze Theorem.}

Let $(x_n)$, $(y_n)$ and $(z_n)$ be
sequences in $\mathbb{R}$.

Suppose $(x_n) \to L$, $(z_n) \to L$,
and for all $n \ge n_0$, we have $x_n
\le y_n \le z_n$; then $(y_n) \to
L$.
```

Squeeze Theorem Code, II

```
\begin{proof}
Let $\epsilon > 0$. Since $(x_n)\to L$,
there is some integer $n_1$ such that
$\forall n \ge n_1$, we have
$|x_n - L| < \epsilon$.\\[2mm]

Similarly, for the same $\epsilon$, since
$(z_n)$ converges, $\exists n_2 \in
\mathbb{N}$ such that $\forall n \ge
n_2$, we have $|z_n - L| < \epsilon$.\\[2mm]
```

Squeeze Theorem Code, III

```
Then take $N = \max(n_0, n_1, n_2)$,
and let $n \ge N$. For all $n \ge N$,
we must have

\[ L - \epsilon < x_n
              \le y_n
              \le z_n < L + \epsilon \]

which implies $|y_n - L| < \epsilon$.
So $(y_n)$ converges to $L$.
\end{proof}
```

Terminology

- **Control characters:** `$ % # & ^_ { }`, etc.
- **Command:** sequence beginning with ‘`\`’, e.g. `\bf` or `\mathbb{R}`
- **Environment:** section delimited by commands, with special properties, e.g. `\begin{proof}` and `\end{proof}`
- **Math mode:** delimited by $’s

Common math mode commands

Display	LaTeX code
x^{i+1}	`x^{i+1}`
$\frac{1}{2}$	`\frac{1}{2}`
$\sqrt{b^2-4ac}$	`\sqrt{b^2-4ac}`
$\ln{e}$	`\ln{e}`
$\lim_{n\to\infty} (x_n)$	`\lim_{n\to\infty} (x_n)`
$\cos{(2{\pi}n)}$	`\cos{(2{\pi}n)}`
$\sum_{i=1}^n s_i b_i$	`\sum_{i=1}^n s_i b_i`

Common math mode commands, continued

Display	**LaTeX code**
$10 \equiv 3 \pmod{7}$	`10 \equiv 3 \pmod{7}`
$\int_a^b f(x)\,dx$	`\int_a^b f(x)\,dx`
$\mathcal{P}$	`\mathcal{P}`
$\tau \ \varepsilon \ \chi$	`\tau \epsilon \chi`
$A \cap B \ne \varnothing$	`A \cap B \ne \varnothing`
$\beta = \{v_1, \ldots, v_n\}$	`\beta = \{v_1, \ldots, v_n\}`
$f \colon S \to \mathbb{R}$	`f \colon S \to \mathbb{R}`

Tricks for LaTeX veterans!

DON'T

- ...use arrays for matrices. Use a `matrix` environment.
- ...forget about the '`*`' commands.
- ...let people tell you you're using LaTeX "wrong."
- ...be afraid to write macros to make your code shorter.

DO

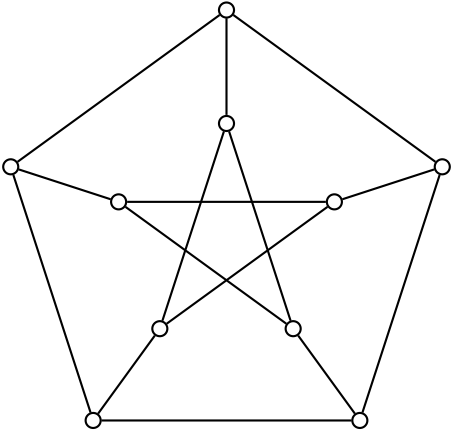
- ...use a good text editor.
- ...be willing to learn all the time. The learning curve is steep but your speed improves quickly.
- ...use Google (or your search engine of choice). It is your friend.
- ...use LaTeX for your assignments. More legible work means TAs are more forgiving on marking!

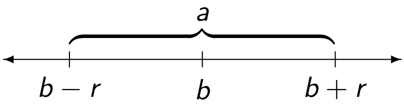
Macros and Other User-Defined Objects

- $\mathbb{R}$: `\mathbb{R}` vs. `\R`
- $\operatorname{dim}(V)$: `\operatorname{dim}` vs. `\dim`
- $\overline{\int}_P(e^x)$: `\overline{\int}` vs. `\uint`
- $\subseteq$: `\subseteq` vs. `\ss`
- Centering math in `enumerate` environment without moving the numbers
- Question counters
- Using the provided document structuring commands to easily generate a table of contents, title page, etc.

My take on this can be found in the `macros.sty` file on my website.

TiKZ and Other Graphics Packages





fin.

More resources:

- My website:
  `http://hashman.ca/tex`
- Wikibooks' LaTeX guide:
  `http://en.wikibooks.org/wiki/LaTeX`
- David Wilkins' Primer:
  `http://www.maths.tcd.ie/~dwilkins/LaTeXPrimer/`
- Random math grad students, particularly when fretting over their theses