

A Brief introduction into the world of T_EX/L^AT_EX

Ryan D. Siskind
Department of Mathematics
North Carolina State University

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1 Introduction

1.1 What is T_EX/L^AT_EX?

“T_EX is intended for the creation of beautiful books - and especially for books that contain a lot of mathematics.”

- Donald E. Knuth

L^AT_EX built on T_EX's foundation, but with easier commands and a larger set of diagnostic messages.

1. Divides document into *logical units*: abstract, sections, subsections, theorems, bibliography, etc.
2. Automatically numbers elements (units, figures, tables, equations, etc.)
3. Controls the placement and formatting of each element.
4. Creates and updates bibliographies and indices as you go.

2 Getting Started

- Get a T_EX/L^AT_EX Typesetting compiler
 - www.ams.org
 - * PC: TeX Live, proTeXt, TeXnic Center, WinEdt, etc.
 - * Mac: TeXShop, iTeXMac, XeTeX, etc.
 - * Unix: teTeX, LyX, etc.

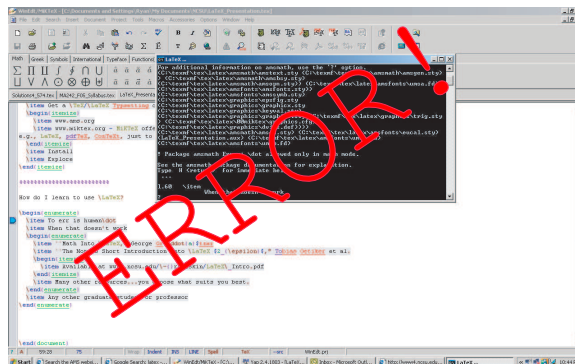
- <http://www.miktex.org> - MiKTeX offers a complete set of utilities, macro packages and fonts (e.g., LaTeX, pdfTeX, ConTeXt, just to name a few) *SPECIFICALLY FOR PC!*
- <http://www.tug.org/mactex/> - MacTeX-2007 will completely install a typesetting utility called TeXShop.

- Install
- Explore

3 LaTeX-ing 101

3.1 How do I learn to use T_EX/L_AT_EX?

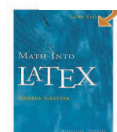
1. To err is human...



3.2 Read a Book

2. When that doesn't work

(a) "Math Into L_AT_EX," George Grätzer



(b) "The Not So Short Introduction Into L_AT_EX_{2_ε}," Tobias Oetiker et al.

- Available at <http://tobi.oetiker.ch/>



(c) Many other resources...you choose what suits you best (Check out Amazon.com for a comprehensive list of available books)

3. *MOST* other graduate students or professors

4 The Basics

4.1 Commands

Common characters and words found in L^AT_EX documents:

1. `{ }` - denotes a group made of everything that is contained between the braces.
2. `\` - denotes the beginning of a command.
 - Want to put a square root symbol around the group $h^2 - a^2$?
`\sqrt{h^2-a^2}` compiles as $\sqrt{h^2 - a^2}$.
3. `\begin{ }` and `\end{ }` - denotes where an element of the document begins and ends. These elements are also referred to as environments
4. Any number of spaces and a single return carriage counts as one space. Two return carriages starts a new paragraph.
5. `\\` - forced new line.

4.2 .tex Files

- Header

```
\documentclass[10pt]{article}
% Preamble
\begin{document}
% Body
Hello World!
\end{document}
```

4.3 What is a Document Class?

Controls specific parts of a document “behind the scenes.”

1. Numbering

2. Margins
3. Overall visual design

Many exist, few are standard: *article, amsart, report, etc.*

Benefit: Instead of manually changing the format of a paper to fit the requirements of a specific Journal, L^AT_EX takes care of everything!

There is a standard format for thesis preparation at NCSU. Available at

<http://www4.ncsu.edu/jwb/tex/ncsu-thesis.sty>

4.4 Packages and More Preamble

Between document class and the beginning of the document:

1. Load packages; `\usepackage{PackageName}`
2. Page dimensions;
3. Define elements; `\newtheorem{ax}{Axiom}`
4. Define commands; `\newcommand{\ds}{\displaystyle}`
5. Title, author, address, etc.

5 Time to Write

5.1 Formatting and Fonts

All of the following can be accessed with AMSFonts package...

1. Typeface styles
 - (a) **Boldface** `\textbf{text}`
 - (b) *Italics* `\textit{text}` or `\emph{text}`
 - (c) *Slanted* `\textsl{text}`
 - (d) SMALL CAPS `\textsc{text}`
2. Math fonts
 - (a) Alphabets: $\gamma, \Gamma, \delta, \Delta, \pi, \Pi, \sigma, \Sigma, \theta, \Theta, \omega, \Omega, \dots$
 - (b) Symbols: $\oint, \nabla, [a], \neq, \dagger, \Leftrightarrow, \dots$
 - (c) Punctuation: $\tilde{h}, \bar{e}, \vec{l}, \acute{l}, \ddot{o}, \dots$
3. List Environments (controlled by T_EX)

(a) Numbered/Lettered lists: *enumerate*

(b) Bulleted lists: *itemize*

- There is only one rule for list environments - `\item` MUST follow `\begin{list_environment}`.

```
\begin{enumerate}
  \item Numbered lists: \emph{enumerate}
  \item Bulleted lists: \emph{itemize}
\begin{itemize}
  \item There is only one rule for list
        environments- \verb+\item+
        MUST follow
        \verb+\begin{list_environment}+.
\end{itemize}
\end{enumerate}
```

5.2 Do the math

We all know how to type essays, but how do we make the math look so good? The *amsmath* package: `\usepackage{amsmath}` needs to be in the preamble.

1. Inline math mode (`$ stuff $` or `\(stuff \)`)

Evaluate `\lim_{x\rightarrow 0} \frac{f(x)}{g(x)}`
using L'hospital's Rule.

looks like

Evaluate $\lim_{x \rightarrow 0} \frac{f(x)}{g(x)}$ using L'hospital's Rule.

More examples of inline math

- `\sum_{n=0}^{\infty} \frac{x^n}{n!};`

$$- \sum_{n=0}^{\infty} \frac{x^n}{n!};$$

- `\(\prod_{i=0, i \neq j}^n \frac{x-x_j}{x_i-x_j}.\)`

$$- \prod_{i=0, i \neq j}^n \frac{x-x_j}{x_i-x_j}.$$

2. Display mode ($\$$ stuff $\$$ or $\backslash[$ stuff $\backslash]$)

Evaluate $\lim_{x \rightarrow 0} \frac{f(x)}{g(x)}$ using L'hospital's Rule.

looks like:

Evaluate

$$\lim_{x \rightarrow 0} \frac{f(x)}{g(x)}$$

using L'hospital's Rule.

- $\sum_{n=0}^{\infty} \frac{x^n}{n!};$

–

$$\sum_{n=0}^{\infty} \frac{x^n}{n!};$$

- $\prod_{i=0, i \neq j}^n \frac{x - x_j}{x_i - x_j}$

–

$$\prod_{i=0, i \neq j}^n \frac{x - x_j}{x_i - x_j}$$

Since “Display Mode” math is used for equations, it is sometimes necessary to label the equations for future reference.

- Use the equation environment

```
\begin{equation}
\ln(p(r)) = c - n \left[ \frac{r}{nl} \beta + \ln \frac{\beta}{\sinh \beta} \right]
\end{equation}
```

$$\ln(p(r)) = c - n \left[\frac{r}{nl} \beta + \ln \frac{\beta}{\sinh \beta} \right] \quad (1)$$

6 Alignment

Alignment environments makes everything look nice; these environments are controlled by the document class. Some environments assign numbers to each line, others do not (you can also control the numbering).

6.1 Math Alignment

The *align* environment: `\begin{align}`

- Lines up multiple lines of equation(s) anywhere you choose (i.e. at = or at the beginning of each line) by using & as your alignment indicator.

- ```
\begin{align}
&\frac{\partial u}{\partial t} =
 \alpha\frac{\partial^2 u}{\partial x^2}
 +x(x-2)\sin{(3\pi t)}\backslash\backslash
&u(t,0)=u(t,2)=0\backslash\backslash
&u(0,x)=\sin{(\pi x/2)}
\end{align}
```

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} + x(x-2) \sin(3\pi t) \quad (2)$$

$$u(t,0) = u(t,2) = 0 \quad (3)$$

$$u(0,x) = \sin(\pi x/2) \quad (4)$$

We can pick specific lines to not be numbered with the command `\notag` (also not the different placement of the alignment tabs);

- ```
\begin{align}
&\frac{\partial u}{\partial t} &=
  \alpha\frac{\partial^2 u}{\partial x^2}
  +x(x-2)\sin{(3\pi t)}\backslash\backslash
&u(t,0) &=u(t,2)=0 \quad \backslashnotag\backslash\backslash
&u(0,x) &= \sin{(\pi x/2)} \quad \backslashnotag
\end{align}
```

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} + x(x-2) \sin(3\pi t) \quad (5)$$

$$u(t,0) = u(t,2) = 0$$

$$u(0,x) = \sin(\pi x/2)$$

If you want to suppress the line numbering altogether, simply add an asterisk in the environment declaration: `\begin{align*}`;

$$\begin{aligned}\frac{\partial u}{\partial t} &= \alpha \frac{\partial^2 u}{\partial x^2} + x(x-2) \sin(3\pi t) \\ u(t, 0) &= u(t, 2) = 0 \\ u(0, x) &= \sin(\pi x/2)\end{aligned}$$

We can also lump multiple equations together with different alignment properties (not discussed here) using the equation-array environment `\begin{eqnarray}`

- Numbered

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} + x(x-2) \sin(3\pi t) \tag{6}$$

$$u(t, 0) = u(t, 2) = 0 \tag{7}$$

$$u(0, x) = \sin(\pi x/2) \tag{8}$$

- or Unnumbered (using an asterisk)

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} + x(x-2) \sin(3\pi t)$$

$$u(t, 0) = u(t, 2) = 0$$

$$u(0, x) = \sin(\pi x/2)$$

6.2 Non-math alignment

- The *tabbing* environment: `\begin{tabbing}`
 - Useful when inserting tabbed code into a paper.
 - Each *tab* is inserted using `\>` and is aligned in the previous line using `\=`.

```
\begin{tabbing}
\% \=COMPOSITETRAPEZOID.M\\
\> err=zeros(300,1);\\
\> for \= j=1:300,\\
\>     \> H=j; \% \# of subintervals\\
\>     \> x=linspace(-1,1,H+1);\\
\>     \> for \=i=1:H\\
\>         \>     \> err(j)=\=err(j)+(2/H)*(abs(x(i))*exp(x(i))\\
\>         \>         \>         \>+abs(x(i+1))*exp(x(i+1)))/2;\\
\>     \> end\\
\>     \> err(j)=abs(err(j)-(2-2/exp(1)));\\
\> end
\end{tabbing}
```



Figure 1: See no evil, hear no evil, speak no evil

```
% COMPOSITETRAPEZOID.M
err=zeros(300,1);
for j=1:300,
    H=j; % # of subintervals
    x=linspace(-1,1,H+1);
    for i=1:H
        err(j)=err(j)+(2/H)*(abs(x(i))*exp(x(i))
            +abs(x(i+1))*exp(x(i+1)))/2;
    end
    err(j)=abs(err(j)-(2-2/exp(1)));
end
```

7 Tables and Figures

To keep track of tables and figures for future reference, \LaTeX allows you to use a table and figure environment (much like the equation environment).

```
\begin{figure}
\includegraphics[height=1.5in]{./figures/sameway_right}
\caption{See no evil, hear no evil, speak no evil}
\label{Fig:Monkeys}
\end{figure}
```

The `\label{}` command labels each figure/table/equation so the reference command `\ref{}` can be used.

7.1 Tables

Inside the *table* environment, we can create the following tables:

- ```
\begin{tabular}{r|rr}
& a & b\\\hline
a & a & b\\
b & b & b\\
\end{tabular}
```

- $$\begin{array}{c|cc} & a & b \\ \hline a & a & b \\ b & b & b \end{array}$$
- ```
\begin{tabular}{|c|c|c|}\hline
Nodes & $x_i$ & $\alpha_i$\\\hline
& $-1$ & $1/3$\\\cline{2-3}
3 & $0$ & $4/3$\\\cline{2-3}
& $1$ & $\{1\}/\{3\}$\\\hline
\end{tabular}
```

- | Nodes | x_i | α_i |
|-------|-------|------------|
| 3 | -1 | 1/3 |
| | 0 | 4/3 |
| | 1 | 1/3 |

7.2 Arrays

$$\begin{pmatrix} \alpha & \beta & \gamma \\ \delta & \epsilon & \zeta \\ \eta & \theta & \iota \end{pmatrix}$$

1. We can use the tabular command (with a lot of '\$'s);

```
\left(
\begin{tabular}{ccc}
\alpha$ & $\beta$ & $\gamma$ \\
\delta$ & $\epsilon$ & $\zeta$ \\
\eta$ & $\theta$ & $\iota$
\end{tabular}
\right)$
```

or...

2. The array function (assumes math-mode throughout)

```
\left(
\begin{array}{ccc}
\alpha & \beta & \gamma \\
\delta & \epsilon & \zeta \\
\eta & \theta & \iota
\end{array}
\right)$
```



Figure 2: woof

$$\begin{pmatrix} \alpha & \beta & \gamma \\ \delta & \epsilon & \zeta \\ \eta & \theta & \iota \end{pmatrix} \quad \begin{pmatrix} \alpha & \beta & \gamma \\ \delta & \epsilon & \zeta \\ \eta & \theta & \iota \end{pmatrix}$$

7.3 Figures

\LaTeX only (nicely) accepts one type of figure to import into your document. It is an “Encapsulated Post Script” or .eps file.

- Get a graphics program that supports .eps file conversion.
 - Adobe Illustrator
- To get any .eps file included in your file:
 - You must have the *graphicx* package loaded
 - Use the following syntax

```
\begin{figure}  
  \includegraphics{filename.eps}  
  \caption{Figure Description}  
\end{figure}
```

7.4 Multiple Figures

Two pictures with individual captions can be presented in the same figure and still be reference by the same figure number.

```
\begin{figure}  
  \subfigure[Man]{\includegraphics[height = 1.5in]{./figures/man}}  
  \subfigure[Dog]{\includegraphics[height =
```



(a) Man



(b) Dog

Figure 3: Man vs. Dog

```
1.5in][./figures/mickey}}  
\caption{Man vs. Dog}  
\end{figure}
```

8 Future Presentations

1. More details on user-controlled items;
2. User defined commands and macros;
3. Beamer (the slide program which this presentation was created using).

Thank you!
rdsiskin@ncsu.edu