LaTeX Workshop for UT Austin Geophysical Society

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Outline

What is LaTeX?

LaTeX is a markup language written for the TeX typesetting program.

Features of LaTeX

- Open source
- Allows public to produce high-quality documents individually
- Provides identical output on all computers (both now and in the future)
- Widely used in academia
  - Ex. Mathematics, computer science, economics, engineering, physics, and statistics.

Figure 1: CTAN lion drawing by Duane Bibby.

Why would I want to use LaTeX?

Q. Why would I want to learn how to use LaTeX when I can just use Word?

Answer(s)

- Open source
- Output is in PDF (through pdfTeX)
  - Can view on any computer and never have to worry about presentation not showing up right.
- Ability to typeset mathematical equations quickly and cleanly
- Professional standard in academia

Aren't these really just cosmetic reasons?

Yes, but to some degree you will be judged by the quality of the way your present your work. Also, ease of dissemination of information is very important in research.

Bottom line

Latex

$$th_x(t) = \frac{\sum_{j=0}^{u_x} s_x(t-j)h_x(t-j)}{t_0}, \quad (2)$$

where $s_x(t)$ is the time period from time slot $t-1$ to time slot t of VM x, and $h_x(t) = 1$ if VM x is scheduled from time slot $t-1$ to time slot t and $h_x(t) = 0$ otherwise. If VM x is scheduled at time t, $th_x(t)$ increases. Otherwise, $th_x(t)$ decreases by $\frac{th_x(t-1)}{t_0}$. Intuitively, if $th_x(t)$ increases, the utility value decreases and VM x will have fewer chances to be scheduled in subsequent time slots.

As you can see from two figures, they are quite different in writing equations in the document. This is the reason I recommend latex all the time. I even took one course required latex as the default editing tool. Otherwise, a part of my scores was deducted because of not using it. Once you make a format fitting to you, you do not need to worry about making a format again. Cool!

Word

$$th_x(t) = \frac{\sum_{j=0}^{u_x} s_x(t-j)h_x(t-j)}{t_0}, \quad (2)$$

where $s_x(t)$ is the time period from time slot $t-1$ to time slot t of VM x, and $h_x(t)=1$ if VM x is scheduled from time slot $t-1$ to time slot t and $h_x(t)=0$ otherwise. If VM x is scheduled at time t, $th_x(t)$ increases. Otherwise, $th_x(t)$ decreases by $\frac{th_x(t-1)}{t_0}$. Intuitively, if $th_x(t)$ increases, the utility value decreases and VM x will have fewer chances to be scheduled in subsequent time slots.

Figure 2: Credit: http://home.gwu.edu/ jinho10/Home.html

. . . which would you rather read?

Outline

Setup and Installation

To get a LaTeX distribution on your computer

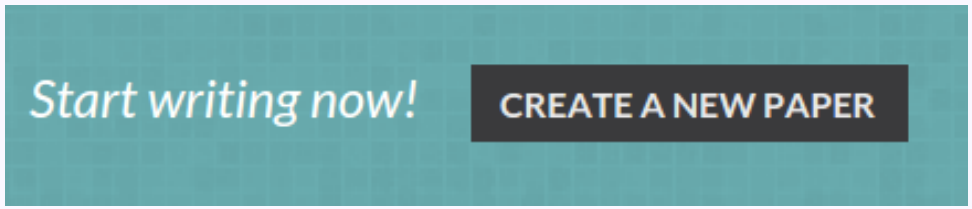
- Download and install the distribution for your operating system.
  - Probably the latest version of TeX Live.
- Download and install a front end (or be hardcore and just use vim/emacs. :P)
  - Windows: MiKTeX
  - Mac: TeXShop
  - Linux: TeXworks
- Install any packages you want in the proper directory
- Start creating!

Outline

Open The (Web) Editor: Overleaf

For today's workshop we're going to be using a web front end: Overleaf

1. Navigate to www.overleaf.com
2. Click the "Create A New Paper" button



3. Once the template is loaded, click the "Source" button in the upper left corner
4. We're going to start from scratch, so select all and delete

Creating a (simple) document

```
\documentclass{article}

\begin{document}

Hello, World!

\end{document}
```

Creating a (simple) document

```
\documentclass{article}

\begin{document}

Hello, World!\\

The quick brown fox jumps over the lazy dog.

\end{document}
```

Creating a document

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

\usepackage{graphicx} % For images
\usepackage{float}    % For tables and other floats
\usepackage{amsmath}  % For math
\usepackage{amssymb}  % For more math
\usepackage{fullpage} % Set margins & place page numbers
\usepackage{mathrsfs} % For nice math calligraphy fonts
\usepackage{verbatim} % Allows commenting out
\begin{document}

Hello, World!\\
$\sin x \cdot \tan x \times \alpha \beta$\\
$\gamma \sum \prod \sqrt{y}$

\end{document}
```

Creating a paper

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

\title{The Title of a Paper of Great Importance}
\author{First Author}

\begin{document}
\maketitle

\begin{abstract}
Here is a collection of words that form a run on sentence
to test an idea that was formed in a brain made of cells
made of molecules made of atoms made of patrons and
leptons and nope screw string theory.
\end{abstract}
\clearpage
Stuff and things go here
\end{document}
```

Inserting Figures

```
\documentclass[letterpaper,12pt]{article}
...
\usepackage{graphicx}
%\graphicspath{{Images/}} %Overleaf has frog.jpg in the
  %local dir but in general set
  %to your dir with figures
...
\begin{document}
...
\begin{figure}
\includegraphics[width=\textwidth]{frog.jpg}
\end{figure}
...
\end{document}
```

Inserting Figures

Better Figures

```
\documentclass[letterpaper,12pt]{article}
...
\usepackage{graphicx}
%\graphicspath{{Images/}}
...
\begin{document}
...
\begin{figure}[!htbp]  %here, top, bottom, page.
\centering
\includegraphics[width=\textwidth]{frog.jpg}
\caption{This is a frog!}
\label{Fig:frog}
\end{figure}
...
\end{document}
```

Better Figures

Figure 3: This is a frog!

Rescaling Figures

```
\documentclass[letterpaper,12pt]{article}
...
\usepackage{graphicx}
%\graphicspath{{Images/}}
...
\begin{document}
...
\begin{figure}[h!tbp]
\centering
\includegraphics[scale=0.40]{frog.jpg}
\caption{This is a frog!}
\label{Fig:frog}
\end{figure}
...
\end{document}
```

Rescaling Figures

Figure 4: This is a frog!

Rescaling Figures

```
\documentclass[letterpaper,12pt]{article}
...
\usepackage{graphicx}
%\graphicspath{{Images/}}
...
\begin{document}
...
\begin{figure}[h!tbp]
\centering
\includegraphics[width=0.80\textwidth]{frog.jpg}
\caption{This is a frog!}
\label{Fig:frog}
\end{figure}
...
\end{document}
```

Rescaling Figures

Figure 5: This is a frog!

Outline

Typesetting in Math Mode

Typesetting in Math Mode is what really gives LaTeX its power. It is intuitive, quick, clean, and produces wonderful results! To initiate Math Mode enclose whatever you want to typeset between two "$".

Some examples

- `$\Sigma$` = Σ
- `$\int f(x) \,dx$` = $\int f(x)\,dx$
- `$e^x_{\text{text}}$` = e^x_{text}
- `$\frac{\sin x}{\prod_{i=0}^n}$` = $\frac{\sin x}{\prod_{i=0}^{n}}$

and so...

$$\Rightarrow \int_{\rho}^{R} \frac{\sqrt[3]{r}\,\ln r}{r^2+1}\,dr + \int_{L_2} f(z)\,dz = e^{i\pi/3} \int_{\rho}^{R} \frac{\sqrt[3]{r}\,\ln r + i\pi\sqrt[3]{r}}{r^2+1}\,dr$$

Math Mode: Display Style

The displaymath environment will pop your equation out of the text and display it prominently in the center of the page.

In Line vs. Displayed

- It is seen that this requires $C = -k^2$, where $k^2 > 0$, reducing to $\rho \frac{\partial}{\partial \rho}\left[\rho \frac{\partial R(\rho)}{\partial \rho}\right] - \left(n^2 - \rho^2 k^2\right) R(\rho) = 0.$
- It is seen that this requires $C = -k^2$, where $k^2 > 0$, reducing to

$$\rho \frac{\partial}{\partial \rho}\left[\rho \frac{\partial R(\rho)}{\partial \rho}\right] - \left(n^2 - \rho^2 k^2\right) R(\rho) = 0.$$

Math Mode: Display Style

The displaymath environment is entered by enclosing whatever you want to typeset between opening "\[" and closing "\]".

In Line vs. Displayed

- \$\int \limits_{-\infty}^{\infty} \psi^* \psi \,dx \$ = $\int \limits_{-\infty}^{\infty} \psi^* \psi \, dx$
- \[\int \limits_{-\infty}^{\infty} \psi^* \psi \,dx \] =

$$\int \limits_{-\infty}^{\infty} \psi^* \psi \, dx$$

Outline

Fun with Packages!

There are a ton of really useful packages, and just fun packages that you can use to make your documents stand out and entertaining.

One useful and N fun packages

- My “custom” style file (what I use for TEXing my homework).
- Coffee stains
- The Simpsons

Outline

What Can I Do With LaTeX?

"Fancy" looking equations

The Lagrangian for the ABC "toy" theory containing three elementary particles of spin 0, masses $m_{A,B,C}$, and one primitive vertex with the vertex factor $-ig$.

$$\begin{aligned}\mathscr{L} = &\left[\frac{1}{2}\left(\partial_\mu \phi_A\right)\left(\partial^\mu \phi_A\right) - \frac{1}{2}\left(\frac{m_A c}{\hbar}\right)^2 \phi_A^2\right] \\ &+ \left[\frac{1}{2}\left(\partial_\mu \phi_B\right)\left(\partial^\mu \phi_B\right) - \frac{1}{2}\left(\frac{m_B c}{\hbar}\right)^2 \phi_B^2\right] \\ &+ \left[\frac{1}{2}\left(\partial_\mu \phi_C\right)\left(\partial^\mu \phi_C\right) - \frac{1}{2}\left(\frac{m_C c}{\hbar}\right)^2 \phi_C^2\right] - g\phi_A\phi_B\phi_C\end{aligned}$$

What Can I Do With LaTeX?

Homework...with fancy looking equations

1. The physical (real) electric field in a monochromatic wave is given by

$$\begin{aligned}\boldsymbol{\mathscr{E}}(\boldsymbol{r},t) &= \mathrm{Re}\left\{\boldsymbol{E}_0\, e^{(i\boldsymbol{k}\cdot\boldsymbol{r}-\omega t)}\right\} \\ &= \sum_{i=1,2} \boldsymbol{\epsilon}_i \mathrm{Re}\left\{E_{0_i}\, e^{(i\boldsymbol{k}\cdot\boldsymbol{r}-\omega t)}\right\} \\ &= \sum_{i=1,2} \boldsymbol{\epsilon}_i\, \mathscr{E}_i(\boldsymbol{r},t)\,,\end{aligned}$$

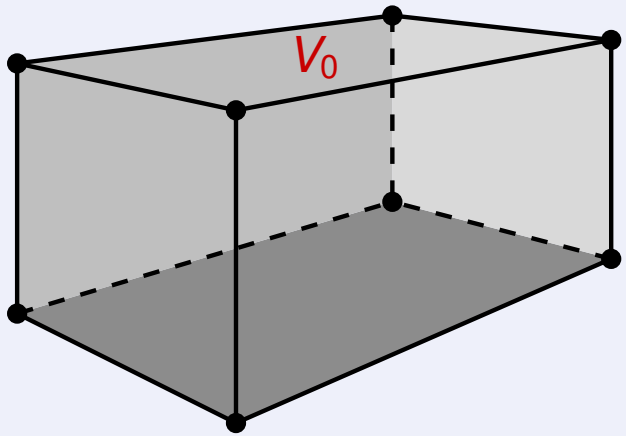
in terms of linear polarization vector $\boldsymbol{\epsilon}_{1,2}$, satisfying $\boldsymbol{\epsilon}_i \cdot \boldsymbol{\epsilon}_j = \delta_{ij}$, $\boldsymbol{\epsilon}_i \times \boldsymbol{\epsilon}_j = \hat{\boldsymbol{k}}$. Show that the physical electric field, $\boldsymbol{\mathscr{E}}(\boldsymbol{r},t)$, is constrained by

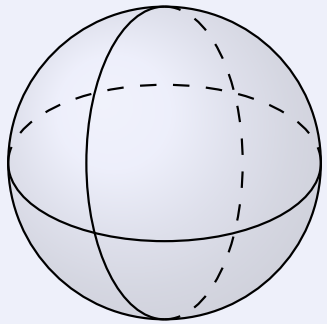
$$\sum_{i,j=1}^{2} \mathscr{E}_i(\boldsymbol{r},t)\, \underline{\underline{A}}_{ij}\, \mathscr{E}_j(\boldsymbol{r},t) = 1.$$

This is a double sum over polarizations. Find the 2×2 matrix $\underline{\underline{A}}$ and show that the tip of the electric field vector traces out an ellipse as a function of time at each point $\boldsymbol{r}$ in space.

What Can I Do With LaTeX?

Draw All The Things (with TikZ)





What Can I Do With LaTeX?

More Like "What Can't You Do!?"

- Typeset professional documents
  - Ex. Thesis, CV, Reports
- Create presentations in pdf
  - Ex. This presentation! (You can even embed video using the media9 package. 0_0)
- Circuit diagrams (circuitikz package)
- Feynman diagrams (feynmp package)
- Business cards
- Conference posters (beamerposter package)
- . . . basically everything!

Backup Slides

Backup

How Can I Learn More About LaTeX?

- Comprehensive TeX Archive Network (CTAN)
- There are lots of great online resources. A great place to start is Overleaf.
  - Free student accounts
  - Free LaTeX tutorial very similar to one given tonight
- Questions or confused? Check the TeX Stack Exchange
- Ask people who have used LaTeX. They're usually happy to share their tricks of the trade.

Installing packages

- Most distributions will come with a package manager. It let's you search and install packages by query.
- If you don't know where to install a package so it can be universally accessed by your operating system, just save it in the same directory as your TEX file.
- If you're working on a Windows machine you'll probably need to run "texhash" from the command prompt before your computer will recognize the new package.

Figure

```
%%%%%%%%%%%%%%%%%%    FIGURE    %%%%%%%%%%%%%%%%%%
\begin{figure}[h!tbp]
\centering
\includegraphics[scale=1.00]{}
%\caption{}
%\label{fig:}
\end{figure}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Figure: Example

```
%%%%%%%%%%%%%%%%%%   FIGURE   %%%%%%%%%%%%%%%%%%
\begin{figure}[h!tbp]
\centering
\includegraphics[scale=0.40]{frog.pdf}
\caption{Here is a very interesting picture of a frog.
\label{fig:frog}
\end{figure}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Noting Figure~\ref{fig:frog}, it is seen that\ldots
```

Figure: Example

Figure 6: Here is a very interesting picture of a frog.

Noting Figure 6, it is seen that. . .

Table

```
%%%%%%%%%%%%%%%%%%   TABLE   %%%%%%%%%%%%%%%%%%
\begin{table}[!hbtp]
\caption{Caption}
\centering
\scalebox{1.00}{
\begin{tabular}[!hbtp]{ | c | c | c | }
\hline\hline

\hline\hline
\end{tabular}}
\label{table:TABLE}
\end{table}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Equation

```
%%%%%%%%%%%    EQUATION    %%%%%%%%%%%
\begin{equation}

\label{eq:1}
\end{equation}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Equation: Example

```
%%%%%%%%%%%   EQUATION   %%%%%%%%%%%
\begin{equation}
\alpha + \beta = \gamma
\label{eq:alpha}
\end{equation}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Here is Equation~\ref{eq:alpha}.
```

Equation: Example

$$\alpha + \beta = \gamma \tag{1}$$

Here is Equation 1.

Matrix

```
%%%%%%%%%%%  MATRIX   %%%%%%%%%%%
\begin{pmatrix}
X & X\\
\end{pmatrix}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Matrix: Example

```
%%%%%%%%%%%%  MATRIX    %%%%%%%%%%%%
\[
\begin{pmatrix}
1 & 0\\
0 & 1
\end{pmatrix}
\]
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Matrix: Example

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

Split line equation

```
\[
\begin{split}
Y &= mx + b \\
&= mx +b
\end{split}
\]
```

Split line equation: Example

$$\begin{aligned} Y &= mx + b \\ &= \alpha + \epsilon \end{aligned}$$

Parentheses: Non-enclosing

```
\[ ( \frac{\alpha}{\beta} ) \]
\[ [ \frac{\alpha}{\beta} ] \]
\[ \{ \frac{\alpha}{\beta} \} \]
```

$$\left(\frac{\alpha}{\beta} \right)$$

$$\left[\frac{\alpha}{\beta} \right]$$

$$\left\{ \frac{\alpha}{\beta} \right\}$$

. . . This doesn't look very nice.

Parentheses: Enclosing

```
\[ \left( \frac{\alpha}{\beta} \right) \]
\[ \left[ \frac{\alpha}{\beta} \right] \]
\[ \left\{ \frac{\alpha}{\beta} \right\} \]
```

$$\left(\frac{\alpha}{\beta} \right)$$

$$\left[\frac{\alpha}{\beta} \right]$$

$$\left\{ \frac{\alpha}{\beta} \right\}$$

. . . This does!

How can I use the $, #, _ , \ symbols in documents?

You need to put the \ immediately before them:

$$\backslash\$ = \$$$

$$\backslash\# = \#$$

$$\backslash\_ = \_$$

$$\backslash\text{textbackslash} = \backslash$$

How is LaTeX pronounced?

The original author, Leslie Lamport, says in his book *LaTeX: A document Preparation System*

One of the hardest things about LaTeX is deciding how to pronounce it. This is also one of the few things I'm not going to tell you about LaTeX, since pronunciation is best determined by usage, not fiat. TeX is usually pronounced "*teck*", making "*lah*-teck", and "*lay*-teck" the logical choices; but language is not always logical, so "lay-tecks" is also possible.

Can I create a SVG in LaTeX?

Not directly.
However, if you're running Linux you can use this script to convert your LaTeX markup output to SVG in about 1 second:

LaTeX2SVG