Introduction to \LaTeX
\LaTeX is a scientific document preparation system

Steven G. Wicker

Winston Salem, NC
wickersg@wfu.edu

June 1, 2010

How to Get \LaTeX

- You will want the latest version of MixTeX
- Go to http://miktex.org/
- Download the complete MiKTeX system (not the basic one)
- You can think of \LaTeX as a compiler. You do not compose your documents in MixTex.
- You must use a text editor. MixTex comes with TeXWorks. It gives a side by side view of your code and your document.
- I use WinEDT. The Math Dept. maintains some licences for WinEDT 5.5, but not the newest version.
- Once the code is written in an editor, then it must be compiled by MixTex.

Commands to get started

\documentclass[twocolumn, 12pt]{article}
\begin{document}
\title{your title}
\author{author's name(s)}
\date {2 June 2009}
\maketitle
THE BODY OF YOUR PAPER
\end{document}

Other classes: letter, book, report, wfuthesis. Note "begin" and "end"'s

A Few General Notes

- A line can be a long or as short as you wish it to be. \LaTeX controls the line breaks.
- To start a new paragraph, skip one or more lines
- Spaces within lines are meaningless to \LaTeX. One is equivalent to 50. You must use commands to control spacing.
- \, \: \; are ways to add in spaces (and \! negativespace).
- \\ is used to end lines
- Special Characters: # $ % & { } ^ ~ \"
Some Uses for Special Characters

- Easy way to enter math mode is to use a $; the formula goes between a set of $\$.
- \(^\) is use for superscripts. Example: \(x^4\) produced by \(x^4\). 
- \(_\) gives a subscript. Example: \(x_0\) produced by \(x_0\).
- \& is used to separate columns in some environments.
- To produce a displayed formula it goes between a set of $$.
- If you need to produce the characters you can use commands \$ or the \verb command or verbatim environment.
- The verbatim environment is a useful way to include pieces of code in your document.

A Few Tips

- When you have compiling error (and you will), the actual error may not be on the line indicated by the compiler. Look at lines above the error.
- Copying code is a good way to get stared; however, using pieces of code from others can cause problems. People often define their own commands.
- Also, not all commands work in each environment the same way.
- Make sure all your "begins" have a matching "end". And that all \ or { have cooresponding \ and}.

WinEDT

TeXworks

Theorems and Such

**Definition**

A triangle that has a right angle is called a **right triangle**.

**Theorem**

*In a right triangle, the square of hypotenuse equals the sum of squares of two other sides.*

**Proof.**

We leave the proof as an exercise to our astute reader. We also suggest that the reader generalize the proof to non-Euclidean geometries.
Packages

- Sometimes you will need to call additional packages into \LaTeX
- Packages are called before \begin{document}
- \usepackage[colorlinks=true, linkcolor=black, urlcolor=black, citecolor=black]{hyperref} for hyperlinks
- \usepackage{amsfonts, amssymb, latexsym} additional math fonts
- \usepackage{graphicx} for inserting images
- Beware—May vary by the documentclass you are using!

Alternative Way to Insert a Graphic

\begin{figure}[h]
\hspace{1.5in} \includegraphics[height=55mm,width=40mm]{FEpic1.jpg}
\end{figure}

The optional [h] indicates the figure is to go HERE!

Inline vs Displayed Equation

Here is an example of a simple equation inline: $\int^2_0 4x^3 - 7x^2$. Note that equations may look different whether they are inline or displayed. Here is the same equation displayed:

$$\int^2_0 4x^3 - 7x^2$$

Code: $$\int^2_0 4x^3 - 7x^2$$
A More Complex Displayed Equation

This sample uses the array environment, with $\$\$ to create the display. Not labeled/numbered (Raynor):

\[
\begin{cases}
-\Delta v = \chi_{\overline{B}} & \forall x \in \Omega \\
v = 0 & \forall x \in \partial\Omega.
\end{cases}
\]

Code:

\[
\left\{
\begin{array}{rlll}
-\Delta v & = \chi_{\overline{B}} & & \forall x \in \Omega \\
v & = 0 & & \forall x \in \partial\Omega.
\end{array}
\right.
\]

Equation Environment with a Label

Here is the previous example using the equation environment to get a label. It produces one label for both equations, which is convenient much of the time (Raynor):

\[
\begin{cases}
-\Delta v = \chi_{\overline{B}} & \forall x \in \Omega \\
v = 0 & \forall x \in \partial\Omega.
\end{cases}
\tag{1}
\]

Code:

\[
\begin{equation}
\left\{
\begin{array}{rlll}
-\Delta v & = \chi_{\overline{B}} & & \forall x \in \Omega \\
v & = 0 & & \forall x \in \partial\Omega.
\end{array}
\right.
\end{equation}
\]

Equation Array - Labeled

The eqnarray environment environment, like many equation display environments, has two versions. "eqnarray" creates a multiline displayed equation with labels (Raynor).

\[
\vec{\tilde{e}}_4 = \vec{e}_4 - \frac{\langle \vec{e}_1, \vec{e}_3 \rangle}{\|\vec{e}_1\|^2} \vec{e}_2 \\
= \begin{bmatrix} \tilde{\beta} \\ 0 \end{bmatrix}.
\]

Code:

\[
\begin{eqnarray}
\vec{\tilde{e}}_4 & = & \vec{e}_4 - \frac{\langle \vec{e}_1, \vec{e}_3 \rangle}{\|\vec{e}_1\|^2} \vec{e}_2 \\
& = & \begin{bmatrix} \tilde{\beta} \\ 0 \end{bmatrix}.
\end{eqnarray}
\]

eqnarray* - No Labels

"eqnarray*" creates a multiline displayed equation with no labels (Raynor):

\[
\vec{\tilde{e}}_4 = \vec{e}_4 - \frac{\langle \vec{e}_1, \vec{e}_3 \rangle}{\|\vec{e}_1\|^2} \vec{e}_2 \\
= \begin{bmatrix} \tilde{\beta} \\ 0 \end{bmatrix}.
\]

Code:

\[
\begin{eqnarray*}
\vec{\tilde{e}}_4 & = & \vec{e}_4 - \frac{\langle \vec{e}_1, \vec{e}_3 \rangle}{\|\vec{e}_1\|^2} \vec{e}_2 \\
& = & \begin{bmatrix} \tilde{\beta} \\ 0 \end{bmatrix}.
\end{eqnarray*}
\]

SG Wicker
Why use Array Type Environments?

\[2x^2 + 3(x-1)(x-2) = 2x^2 + 3(x^2 - 3x + 2)\]
\[= 2x^2 + 3x^2 - 9x + 6\]
\[= 5x^2 - 9x + 6\]

With the = do not line up nicely and you have no option to number/label your equation.

Using the Equation Array

\[\begin{eqnarray*}2x^2 + 3(x-1)(x-2) &= &2x^2 + 3(x^2-3x+2) \\ &= & 2x^2 + 3x^2 - 9x + 6 \\ &= & 5x^2 - 9x + 6\end{eqnarray*}\]

Referring to Labels

- There maybe times that you wish to refer back to a particular equation, theorem, definition, etc.
- Example: In a previous slide, example equation 1 was taken from Dr. Raynor.
- Code: To label the equation, place, for example, \label{raynor1} anywhere in the equation.
- To reference the equation, use \ref{raynor1}. Note, this reference only gives you the number.

Case Definitions

Used when a definition have two or more cases. Use the case statement.

\[f(x) = \begin{cases} 1 & -1 \leq x < 0 \\ \frac{1}{2} & x = 0 \\ 1 - x^2 & \text{otherwise} \end{cases}\]

The code for the above example:

\begin{cases}
1 & -1 \leq x < 0 \\
\frac{1}{2} & x = 0 \\
1 - x^2 & \text{otherwise}
\end{cases}
Align Environment - Unstarred and Starred

The advantage of the align environment is that you can force multiple parts of each line to align correctly vertically, making pretty multipart sets of equations (Raynor):

\[
\begin{align}
\frac{\partial u_i}{\partial t} + \sum_{j=1}^n u_j \frac{\partial u_i}{\partial x_j} &= \nu \Delta u_i - \frac{\partial p}{\partial x_i} + f_i(x,t) & x \in \mathbb{R}^n, t \geq 0 (4) \\
\nabla \cdot \vec{u} &= 0 & x \in \mathbb{R}^n, t \geq 0 (5) \\
\vec{u}(x,0) &= \vec{u}_0(x) & x \in \mathbb{R}^n. (6)
\end{align}
\]

A Matrix Using the Array Environment

\[
J\mathcal{H}(\omega)|_{D_\omega} = \begin{pmatrix}
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
0 & 0 & a(\omega) & 0
\end{pmatrix},
\]

Code:

\[
\begin{bmatrix}
0 & \cdots & 0 \\
\vdots & \ddots & \vdots \\
0 & \cdots & 0
\end{bmatrix}
\]

Another matrix example

\[
\begin{bmatrix}
0 & \cdots & 0 \\
\vdots & \ddots & \vdots \\
0 & \cdots & 0
\end{bmatrix}
\]

Code:

\[
\begin{bmatrix}
0 & \cdots & 0 \\
\vdots & \ddots & \vdots \\
0 & \cdots & 0
\end{bmatrix}
\]
URL's

- A regular URL:
  \url{http://www.math.wfu.edu/} (You may need this for list of references.)
- A URL with text other than the web address:
  \textcolor{DarkOrchid}{\url{http://www.math.wfu.edu/}}\textcolor{red}{\href{http://www.math.wfu.edu}{WFU MATH}} (Maybe used in presentations.)

\usepackage{hyperref} (might not be needed)
\textcolor{DarkOrchid}{\url{http://www.math.wfu.edu/}}
\textcolor{red}{\href{http://www.math.wfu.edu}{WFU MATH}}

For Later Reference

http://www.wfu.edu/~wickersg/latex/index.html

- WFU Thesis Style
- Beamer References
- Poster Example
- Books:
  * LaTeX: A Document Preparation System by Leslie Lamport
  * \LaTeX{} for Everyone by Jane Hahn
  * Math Into LaTeX by George Grtzer