Introduction to LaTeX

LaTeXis a scientific document preparation system

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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 \! negative space).
- \\ 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 superscrips. Example: x^4 produced by `$x^4$`
- _ gives a subscript. Example: x_0 produced by `$x_0$`
- & is used to sperate 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. □

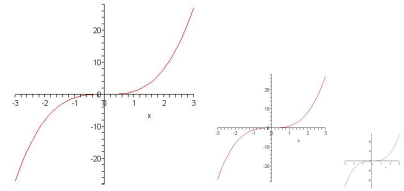
`\begin{definition}` or `theorem` or `proof`

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!

Graphics

Here we include three images, one each of PDF, PNG, and JPG types.



Sample code:

```
\includegraphics[width=0.1\textwidth]{picture.jpg}
```

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: $\int_0^2 4x^3 - 7x^2$. Note that equations may look different whether they are inline or displayed. Here is the same equation displayed:

$$\int_0^2 4x^3 - 7x^2$$

Code: `$$ \int^2_04x^3-7x^2 $$`

A More Complex Displayed Equation

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

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

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):

$$\left\{\begin{array}{rlll} -\Delta v & = \chi_{\overline B} & & \forall x \in \Omega\\ v & =0& & \forall x \in \partial\Omega. \end{array}\right. \tag{1}$$

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.
```

Equation Array - Labeled

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

$$\begin{aligned} \tilde{\vec{e}}_4 &= \vec{e}_4 - \frac{\langle \vec{e}_1, \vec{e}_3 \rangle}{\|\vec{e}_1\|^2} \vec{e}_2 && (2)\\ &= \begin{bmatrix} \tilde{\beta} \\ 0 \end{bmatrix}, && (3) \end{aligned}$$

```
\begin{eqnarray} % note use of vectors
\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},
```

eqnarray* - No Labels

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

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

```
\begin{eqnarray*}
\vec{\tilde{e}}_4 & = & \vec{e}_4- \frac{\langle \vec{e}_1, \vec{e}
& = & \begin{bmatrix}
\tilde{\beta} \\
0
\end{bmatrix}.
\end{eqnarray*}
```

Why use Array Type Environments?

$$2x^2 + 3(x-1)(x-2) = 2x^2 + 3(x^2-3x+2)$$
$$= 2x^2 + 3x^2 - 9x + 6$$
$$= 5x^2 - 9x + 6$$

```
$$2x^2 + 3(x-1)(x-2) = 2x^2 + 3(x^2-3x+2) $$
$$ = 2x^2 + 3x^2 - 9x + 6  $$
$$ = 5x^2 - 9x + 6 $$
```

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

Using the Equation Array

$$\begin{aligned} 2x^2 + 3(x-1)(x-2) &= 2x^2 + 3(x^2-3x+2) \\ &= 2x^2 + 3x^2 - 9x + 6 \\ &= 5x^2 - 9x + 6 \end{aligned}$$

```
\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*}
```

Refereing 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.

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

The code for the above example:

```
f(x) =
\begin{cases}
1           & -1 \le x < 0 \\
\frac{1}{2} & x = 0 \\   Note the fraction
1 - x^2     & \mbox{otherwise}  note mbox
\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):

$$\frac{\partial u_i}{\partial t} + \sum_{j=1}^{n} u_j \frac{\partial u_1}{\partial x_j} = \nu \Delta u_i - \frac{\partial p}{\partial x_i} + f_i(x,t) \quad x \in \mathbb{R}^n, t \geq 0 \quad (4)$$

$$\nabla \cdot \vec{u} = 0 \quad x \in \mathbb{R}^n, t \geq 0 \quad (5)$$

$$\vec{u}(x,0) = \vec{u}_0(x) \quad x \in \mathbb{R}^n, \quad (6)$$

```
\begin{align} % or align* for the unlabeled version
\frac{\partial u_i}{\partial t} + \sum_{j=1}^n u_j \frac{\partial u_1}{\par
\nabla \cdot \vec{u} & = 0 & & x \in \mathbb{R}^n, t \geq 0 \\
\vec{u}(x,0) & = \vec{u}_0 (x) & & x \in \mathbb{R}^n,
\end{align}
```


A Matrix Using the Array Environment

$$J\mathcal{H}(\omega)|_{D_\omega} = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & a(\omega) & 0 \end{pmatrix}, \quad (7)$$

```
\begin{equation}% equation* for no label
J\mathcal{H}(\omega)|_{D_\omega}= \left(
\begin{array}{cccc}
0 & 1 & 0 & 0\\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
0 & 0 & a(\omega)& 0
\end{array} \right)\label{jhomega},
\end{equation}
```


A matrix expression

Using one of the many matrix command options

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \times \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$$

Code:

```
$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} =
\begin{bmatrix} A & B \\ C & D \end{bmatrix} \times
\begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$$
```


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:
  http://www.math.wfu.edu/ (You may need this for list of references.)
- A URL with text other than the web address:
  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
    ISBN-13: 978-0201529838
  * LaTEX for Everyone by Jane Hahn
    ISBN-13: 978-0136059080
  * Math Into LaTeX by George Grtzer
    ISBN-13: 978-0817641313