

# Basic L<sup>A</sup>T<sub>E</sub>X Usage

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# Introduction

- $\text{\LaTeX}$  (pronounced “Lah-tech” or “Lay-tech”) is a *document preparation system*. It is a collection of programs that together have the functionality of a word processor such as Open Office, Microsoft Word, or Word Perfect—and much, much more!
- $\text{\LaTeX}$  is based on Donald E. Knuth’s  $\text{\TeX}$  typesetting language.  $\text{\LaTeX}$  was first developed in 1985 by Leslie Lamport, and is still being updated and improved. With  $\text{\LaTeX}$ , you only need to worry about the *structure* and *content* of your document, and not the actual layout or appearance. It is universal among mathematicians, physicists, computer scientists, and (to a lesser extent) other flavors of scientists.
- $\text{\LaTeX}$  is powerful! it can be used to produce everything from simple notes to complicated presentations. This presentation was written in  $\text{\LaTeX}$ .

## How do you write a $\text{\LaTeX}$ file?

$\text{\LaTeX}$ files are plain text, which means they can be read on any computer platform.  $\text{\LaTeX}$ files are somewhat like HTML files, so if you know how to write HTML you have a head start!

- Extra space between words is irrelevant. Both lines below would produce the same output:

```
The quick red fox jumped
```

```
The      quick      red      fox      jumped
```

- New paragraphs are indicated by one or more blank lines.
- Additional structure and formatting are specified by commands (identified by a backslash) such as :

```
\title{Harry Potter and the Chamber of Secrets}
```

```
\author{J.K. Rowling}
```

```
\chapter{The worst birthday}
```

## Math Mode

- Inline math mode—math in the middle of a sentence—is indicated with a pair of dollar signs:

therefore `$x^2 + 1 = y$`, and...

becomes “therefore  $x^2 + 1 = y$  and...”

- Displayed math mode—an equation set on its own line and centered—is indicated with two dollar signs or `\[ \]` (backslash-square bracket). For example, the text:

our main equation is

```
\[
a^2 + b^2 = c^2
\]
```

Will produce the output  
our main equation is

$$a^2 + b^2 = c^2$$

- You can make accented characters like so: `\'e` for `é`, `\"a` for `ä`, etc.
- You get curly quotation marks with backticks (the key to the left of the 1 key), and apostrophes: `'x` is “backtick x apostrophe”. For the double quotation marks just used, use two backticks or apostrophes. A good editor will take care of this for you.
- You can create **bold**, underline, *italic*, using the commands

```
\textbf{bold}
\underline{underlined}
\emph{itallic}
```

- There are many other useful symbols built into  $\text{\LaTeX}$ . For example:

```
\heartsuit, \spadesuit, \clubsuit,
\diamondsuit, \aleph$.
```

Produces ♡, ♠, ♣, ♠, ℵ.

- Many more wonderful symbols!

# The structure of a $\text{\LaTeX}$ document

- A  $\text{\LaTeX}$ document always begins with `\documentclass{something}`. The “something” is usually “article”. This presentation was written using the “beamer”.
- Usually following the `documentclass` are some other commands that get things set up before we start writing. Those things together are the *preamble* of the document. You start writing your masterpiece with `\begin{document}` and end it with `\end{document}`.
- The preamble often includes the `\usepackage` command, which can alter the look of the document and define new commands. Probably the two most common packages are `amsmath`, which sets up a lot of convenient math commands, and `amsfonts`, which loads some of the fonts used by the `amsmath` package.

```
\documentclass{article}
\usepackage{amsmath, amsfonts}
\usepackage[margin=1in]{geometry}

\begin{document}

% the percent sign makes LaTeX ignore
% everything on that line

\section{The first section}

Type some cool stuff here. And here.

Now start a \emph{new} paragraph.

\end{document}
```

# Building and viewing a $\text{\LaTeX}$ document

- We usually give latex documents the extension `.tex`, so your document will be in a file called `somefile.tex`. Once you have written this file, you will want to view it somehow. In order to have nice output you must compile your document.
- There are several common ways to do this.
  - ▶ `latex somefile.tex` will produce a dvi file which you can view with `xdvi`.
  - ▶ `pdflatex somefile.tex` will produce a pdf file which you can view with `xpdf`, `acroread`, or `evince`.
- Usually, you want to convert dvi files to postscript or pdf files. This is done using the commands
  - ▶ `dvips somefile.dvi` converts the dvi into a postscript (ps) file.
  - ▶ `ps2pdf somefile.ps` converts the postscript into a pdf.

## Common math commands

You can use the following commands in math mode. If they aren't enclosed by dollar signs (or double dollar signs),  $\LaTeX$  will complain when you typeset your document.

exponents:  $x^{2n}$

subscripts:  $y_{m+1}$

fractions:  $\frac{\text{numerator}}{\text{denominator}}$

trig functions:  $\sin$   $\cos$   $\tan$   $\exp$   $\ln$   $\log$

integrals:  $\int_a^b$

series:  $\sum_a^b$

square roots:  $\sqrt{\text{stuff}}$

nth roots:  $\sqrt[n]{\text{stuff}}$

centered/lowered dots:  $\cdots$ ,  $\ldots$

matrices:  $\begin{pmatrix}$

$a_1$  &  $a_2$  \\

$a_3$  &  $a_4$  \\

$\end{pmatrix}$

## Additional math commands

Greek letters: `\alpha`, `\beta`, `\gamma`, etc  
uppercase Greek letters: `\Gamma`, `\Delta`, etc  
binomial coefficient: `\binom{n}{k}`  
greater/lesser than or equal to: `\ge` `\le`  
not equal to: `\ne`  
infinity: `\infty`  
limits: `\lim_{n \to 5} x^n`  
curly brackets: `\{` and `\}`

$\LaTeX$  can be picky about order of evaluation, which is specified using curly brackets `\{}`. For example, the  $\LaTeX$  code renders as

`\sum_{i=1}^n \ne \sum_{i=1}`

$$\sum_{i=1}^n \neq \sum_i = 1$$

Now let's try some examples. Use the file you made above and typeset the page

Since  $x^4 = \sqrt{y+1}$ , we know that

$$(-1)^n (2n)! \sum_{k=0}^n \frac{(2x)^{2k}}{(n-k)!}.$$

This in turn means that

$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}.$$

Find  $\tan(\alpha\beta \cdots \omega)$  then multiply by 6.

## The *Beamer* package

- In order to create a slide show in latex, which uses all the beautiful latex formatting abilities, we will use the beamer package. There are several important commands for making slides
- The commands `\begin{frame}` and `\end{frame}` control the start and end of each slide.
- The `\pause` command is useful in dividing slides.

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- To create lists, use the command `\begin{itemize}` and `\end{itemize}` (bullet list) or `\begin{enumerate}` and `\end{enumerate}` (numbered list) along with the command `\item`. To use arbitrary item labels use `\begin{description}` and `\item[label]`.

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- Other useful commands include `\begin{center}` and `\end{center}` and `\textcolor`.

```
\documentclass{beamer}
\usepackage{amsmath, amsfonts}
\usetheme{Boadilla}
\setbeamertemplate{footline}[frame number]
```

```
\begin{document}
```

```
\begin{frame}
```

```
  The first frame.
```

```
\end{frame}
```

```
\begin{frame}
```

```
  \frametitle{The second frame.}
```

```
  \begin{itemize}
```

```
    \item Item 1
```

```
    \pause
```

```
    \item Item 2
```

```
  \end{itemize}
```

```
\end{frame}
```

```
\end{document}
```

# Beamer Themes

- There are many different themes for beamer, which are easily changed by editing the `\usetheme{Broadilla}`
- Here are a few themes to try

AnnArbor	Madrid
default	Malmoe
PaloAlto	Pittsburg
Luebebeck	Warsaw
- You can find a complete list of and description all the standard themes at <http://mike.depalatis.net/beamerthemes/>.

## Including pictures

- In the program you used to create the picture, save it in the correct format. If you plan to use latex to build your document, save as a *.eps* file. If you plan to use pdflatex, save as a *.pdf* file, although pdflatex can also read *.jpg* and *.png* files if you specify the extension.
- Once you have the *.eps/.pdf* file, put it in the same directory as your *.tex* file. In the preamble of your document, put `\usepackage{graphicx}` (yes, that's an 'x') and where you want your picture to go, put `\includegraphics{filename}`, like so:

My beautiful picture:

```
\includegraphics[scale=.75]{filename}
```

Isn't it nice?

- The “scale” stuff allows you to shrink and enlarge the picture to look right on the page.

## Tables and arrays

- In order to make a table in latex we use variants on the commands

```
\begin{pmatrix}
```

```
\end{pmatrix}
```

Recall that the symbol  $\&$  was used to separate columns and  $\\$  was used to separate rows.

- The general variants are *pmatrix*, *bmatrix*, *vmatrix*, *Bmatrix*, and *Vmatrix*, which are all variants of *array* with different borders. The use of *array* is more complicated . . .
- When using *array*, you have to specify the number of rows and columns in advance, and include any column separators.
- Row separators can be included with the command `\hline`

For example, the command produces

```
\begin{array}{c|c}
```

```
i & 2^i \\
```

```
\hline
```

```
0 & 1 \\
```

```
1 & 2 \\
```

```
2 & 4 \\
```

```
3 & 8 \\
```

```
4 & 16 \\
```

```
5 & 32 \\
```

```
\end{array}
```

$i$	$2^i$
0	1
1	2
2	4
3	8
4	16
5	32

## Advanced Topics

- Bib $\TeX$ - Automatic formatting of your bibliography.
  - ▶ Many journals and libraries will even give you the bibtex.
  - ▶ Use `\citebibentry` to reference it.

```
@article{Horn,  
AUTHOR={Jakob Horn},  
TITLE={\ "Uber die konvergenz der hypergeometrischen  
{R}eihen zweier und dreier Ver\ "anderlichen},  
JOURNAL={Math. Ann.},  
YEAR={1889},  
NUMBER={34},  
PAGES={554--600},  
}
```

- Hyperlinks! Just like in html you can make links in your pdf documents by using the *hyperref* package. Simply add `\usepackage{hyperref}` to your preamble.
  - ▶ `\label` and `\ref`.
  - ▶ `\url{http://latex-is-great.com}`.
  - ▶ `\href{http://alink.org}{link-text}`.

## Further resources

- Your classmates.
- The library has/will have soon  $\LaTeX$ books on 2-hour reserve!
- “The Not-So-Short Introduction to  $\LaTeX$ ”; google for “lshort.pdf” and you’ll find it. It’s a very nice introduction and includes lots of material I didn’t cover today.
- To get  $\LaTeX$  on a Windows machine at home: download a  $\LaTeX$  distribution from [miktex.org](http://miktex.org) (in theory).
- To get  $\LaTeX$  on a Mac you’ll need [MacTeX](#) and an editor. I’m told many people like [TeXShop](#) but there are others available too.

Thank You.