Introduction to LaTeX on Athena

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TeX, LaTeX, etc

- TeX: Typesetting language developed by Donald Knuth to typeset his own books
  - Nobody uses raw TeX anymore
- LaTeX: Set of macros/extensions to TeX, written by Leslie Lamport
  - Many modern derivatives, e.g. TeXLive

On Mac and Windows

- Windows
  - MiKTeX
    http://miktex.org/

- Mac:
  - TeXShop
    http://pages.uoregon.edu/koch/texshop/

Typesetting vs. Word Processing

- Typesetting: printed layout of document, fonts, characters, etc
  - Ideal for academic papers, particularly laying out equations
- Word Processing: content of document, editing, spell-checking, etc.
  - Ideal for quick document creation and simple layouts

LaTeX lifecycle

- LaTeX source files are plain text, with commands and markup inserted in them
  - Files typically have `.tex` extension
- Compiled
  - into "device independent" files for previewing `.dvi` extension
    - and then into PostScript
  - into PDF files

Hello, World

```
\documentclass{article}
```

Preamble

```
\begin{document}
``Hello, world!''
This is my first LaTeX document.
\end{document}
```

Body

Compiling

```
joeuser@athena:~$ pdflatex hello_world.tex
This is pdfTeX, Version 3.1415926-1.40.10 (TeX Live 2009/Debian)
entering extended mode
(./hello_world.tex
LaTeX2e <2009/09/24>
Babel <v3.8l> and hyphenation patterns for english, usenglishmax, dumylang,
noh […] loaded.
(/usr/share/texmf-texlive/tex/latex/base/article.cls
Document Class: article 2007/10/19 v1.4h Standard LaTeX document class
(/usr/share/texmf-texlive/tex/latex/base/size10.clo)) (./hello_world.aux)
[1{/var/lib/texmf/fonts/map/pdftex/updmap/pdftex.map}] (./hello_world.aux) )
</usr/share/texmf-texlive/fonts/type1/public/amsfonts/cm/cmr10.pfb>
Output written on hello_world.pdf (1 page, 16436 bytes).
Transcript written on hello_world.log.
joeuser@athena:~$
```

Hello, World

- Output PDF file

> “Hello, world!” This is my first LaTeX document.

- Wait, why didn't it keep the line after between "Hello, world!" ?

LaTeX Formatting

- Line breaks and extra spaces are ignored
- Auto page breaks, line breaks, and hyphenation
- Justifies text
- No blank line between paragraphs
- Indents paragraphs
- Large margins, suitable for binding
- 10 point, single-space font

Paragraph Breaks

- LaTeX will insert line breaks where appropriate.
- Leave a blank line to signify a new paragraph

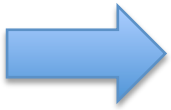
```
When in the Course of human events, it becomes
necessary for one people to dissolve the political
bands which have connected them with another…

We hold these truths to be self-evident…
```

Spacing

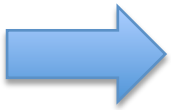
- All extra spaces are ignored
- Latex automatically inserts 2 spaces at the end of a sentence.

```
Any   extra
spaces      are
condensed.
```



Any extra spaces are condensed.

```
A sentence ends
with 2 spaces. Even
if I leave only
one!    Or too
many.
```



A sentence ends with 2 spaces. Even if I leave only one! Or too many.

Overriding Default Spacing

```
… Smith et al. proved…
… Smith et al.\ proved…
```

… Smith et al. proved…

… Smith et al. proved …

```
…like Vitamin B.  Also…
…like Vitamin B\@.  Also…
```

…like Vitamin B. Also…

…like Vitamin B. Also…

- `\@` means "the punctuation that follows this ends a sentence"
- `\` □ means "the punctuation that preceded this does not end the sentence"

Linebreaks and Pagebreaks

- LaTeX automatically breaks lines at the edge of a page
- When possible, it breaks lines at a space between words
  - Or it will hyphenate (more later)
- LaTeX will break pages between paragraphs when possible
  - Or in the middle of a paragraph

Overriding Line Breaks

- Use \\ at the end of a line to signify that you want a forced line break

```
Line 1
Line 2
```

Line 1 Line 2

```
Line 1\\
Line 2
```

Line 1
Line 2

Non-breaking Spaces

- Sometimes you have spaces that shouldn't become line breaks (e.g. names)

```
…the great Albert Einstein
once said…
```

… the great Albert
Einstein once said…

```
…the great Albert~Einstein
once said
```

… the great
Albert Einstein once said…

Overriding Hyphenation

- LaTeX will hyphenate long words rather than moving them to the next line, to keep the margins neat

- Use \mbox{} to prevent it.

```
The song \mbox{Supercalifragilisticexpialidocious} is from the
film Mary Poppins.
```

Overriding Pagebreaks

- `\newpage`
  on a line by itself will force a page break
- The `\\` command has a variant (`\\*`) that says "Break the line here, but the line break can't be used as a page break

```
This is on page 6.\\*
This is also on page 6.
```

  – (You'll see the asterisk used elsewhere for this behavior).

Getting the most of LaTeX

- LaTeX is a typesetting language; its goal is to make your manuscript look nice
- If you find yourself overriding line breaks, spacing and hyphenation a lot, there's probably a better way to get the formatting you want
  - Never use a series of non-breaking spaces to lay out text horizontally

Quotation Marks

- LaTeX uses different opening and closing quotation marks
  - Word calls these "smart quotes" - (‘ and ’)
- Opening quotation mark is a *backtick* or *grave accent*: `
- Closing mark is an *apostrophe* or *single quote*: '
- Emacs and some other programs will automatically convert " to the correct markup

Quoting and spaces

- Consider nested quotes:

```
```Moo!` said the cow.''
```

“‘Moo!’ said the cow.”

- `\,` tells LaTeX to leave some space

```
``\,`Moo!` said the cow.''
```

“ ‘Moo!’ said the cow.”
```

Metacharacters

- The following characters mean something special to LaTeX

  `#  $  %  &  _  {  }  ~  ^  \`

- To type most metacharacters (except the ones highlighted above), use a backslash:
  - Correct: `You owe me \$50.`
  - Incorrect: `You owe me $50.`

Tilde, caret (circumflex) and backslash

- ~
  - Math symbol "similar": `$\sim$`
  - Accent: `Do you like pi\~{n}a coladas?`
- ^
  - Math: `$\hat{o}$`
  - Accent: `In Paris, I stayed in an h\^{o}tel`
- \
  - `$\backslash$`

Dashes

- *hyphen*: e.g. x-ray
- *en-dash (ndash)*: ranges (pp. 1–40)
- *em-dash (mdash)*: Used to offset parts of sentences — like this — when it's necessary to call attention to them
- Use 1, 2, or 3 dashes in a row to get your desired output

```
The modern x-ray tube --- a hot cathode
tube --- is described on pages 1--40.
```

LaTeX Commands

- \command[options]{arguments}
  - Just like on the command line
    $ command -option argument
  - separate multiple options with commas
- Many commands don't take options
- A few don't take arguments, but instead change the way the document looks after they appear
  - called "declarations"

Hello, World

```
\documentclass{article}
```

Preamble

```
\begin{document}
``Hello, world!''
This is my first LaTeX document.
\end{document}
```

Body

`\documentclass`

- Sets the type of document
  - article, report, book, letter, slides
    - formatting rules change based on document type
  - as well as other customizations
    - default font size, page size
- Required in every document
- Used along with packages to control how your document comes out

`\begin` and `\end`

- Open and close an *environment*
  - In this case, the environment is "document"
- Many more environments such as bullet lists, numbered lists, double spacing, single-spacing, etc.

Changing the font size

- Default is 10 point.
  - Can choose between 10, 11, or 12 point
  - For the *default* font. Can do larger or smaller for specific parts of text.

- `\documentclass[12pt]{article}`

Common documentclass options

- twocolumn - 2 columns per page
- titlepage - generate a separate titlepage
- leqno - print numbers for equations on the left side
- fleqn - Aligns formula on the left side of the page
- landscape - landscape mode
- twoside - controls where the margin is for binding
- draft - mark where output exceeds margins

Packages

- \usepackage[options]{packagename}
- Some packages define new commands, others make changes to your document just by virtue of using them
- Common ones
  - fullpage
  - setspace

Other Packages

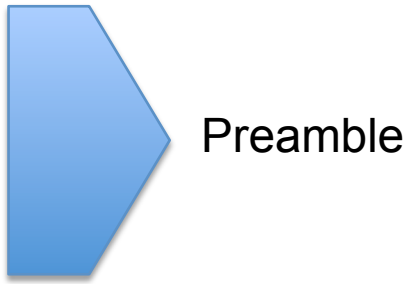
- Thousands of packages available
- Only a small subset are included with most distributions
- Some popular packages by third parties
  - e.g. amsmath by American Mathematical Society
- If you use a non-standard, non-popular package, make sure you either include the .sty file or note where it can be obtained

Line Spacing

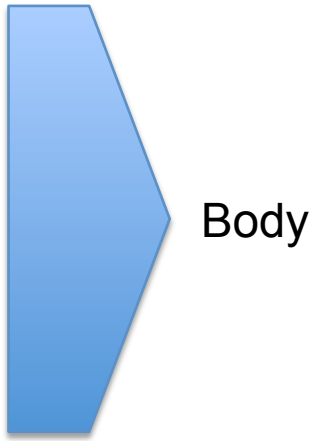
- Single-spacing is the default for most document classes
  - Use setspace package to change
  - Defines some declarations and environments
  - `singlespace`
  - `doublespace`
  - `onehalfspace`
  - `spacing{n}`
- Note: You may see references to the "doublespace" package. Non-standard, but used at MIT for years.

Spacing, cont.

```
\usepackage{setspace}
\doublespacing
```




```
\begin{singlespace}
This is single spaced
\end{singlespace}
```



Fun with Margins

- LaTeX produces large margins (1.875 in)
- For typical one-inch margins
  - `\usepackage{fullpage}`

- For more complicated stuff
  - `\addtolength{\oddsidemargin}{-.875in}`
  - `\addtolength{\evensidemargin}{-.875in}`
  - `\addtolength{\textwidth}{1.75in}`

Specifying a font

- Fonts are defined by:
  - Family: roman, sans serif, `teletype`
    - Rough equivalents: Times, Helvetica (Arial), Courier
  - Series ("weight"): medium or **boldface**
  - Shape: "upright" (normal), *italic*, "slant" ("oblique"), SMALL CAPS
  - Size: Size in points (more later)

Shapes

Declarations

- \upshape
- \itshape
- \slshape
- \scshape

- Cannot be used in math mode

Commands

- \textup
- \textit
- \textsl
- \textsc

- Can be used in math mode

Series

Declarations

- \mdseries
- \bfseries

Commands

- \textmd
- \textbf

Family

Declarations

- \rmfamily
- \sffamily
- \ttfamily

Commands

- \textrm
- \textsf
- \texttt

Bold, Italics, Underline

- This is `\textbf{bold}`.
  - `{\bfseries so is this}`
- This is `\textit{italics}`.
- Underline: Don't.
  - Underlining is rarely used as emphasis in typeset books.
  - If you really want to, `\underline{text}`
    - won't break across lines cleanly, and other issues

But wait, there's more

- Consider separating the logical structure from the type style
  - Do you want this text in italics for visual reasons? Or because it's a scientific name?
- Define commands for commonly used things
- Then decide later how to format them

New Commands

- Defined in preamble
  - `\newcommand{\url}[1]{\texttt{#1}}`
  - `\newcommand{\genus}[1]{\textit{#1}}`

- Used in body
  - `\url{http://web.mit.edu}`
  - `\genus{Homo sapiens}`

New Commands, cont.

- `\newcommand{\area}{$\pi r^{2}$}`
- Except… what happens when you do:

  `$c = \area$`
- \ensuremath - ensure argument is processed in math mode

  `\newcommand{\area}{\ensuremath{\pi r^{2}}`

Size Matters

- \tiny
- \scriptsize
- \footnotesize
- \small
- \normalsize
- \large
- \Large
- \LARGE
- \huge
- \Huge

Titles

- Preamble

```
\title{The Feline Life Cycle}
\author{E. Schr\"{o}dinger}
\date{1935}
```

  - If not provided, today's date will be used

- Body

```
\maketitle
```

  – If you want it on a page by itself, you need to add `\newpage` after `\maketitle`

Sections

```
\section{Superhero Origins}

\subsection{Radioactive Arachnids}

\subsection{Gamma-Ray Exposure}

\subsubsection{Adverse Reactions}

\paragraph{Short Temper}

\paragraph{Skin Discoloration}

\subparagraph{Not Easy Being Green}
```

Sections

- Two higher-level sections
  - `\part` - often omitted
  - `\chapter` - normal top level, except in article class
- Append a `*` to the command to skip numbering and table of contents entries for a specific section

```
\subsection*{Notes}
```

Table of Contents

- \tableofcontents
  - inserts a table of contents
  - using the names of sections, subsections, etc.

- Requires processing the document twice, once to generate it and once to include it.

Footnotes

```
All months\footnote{Except February} have at
least 30 days.
```

All months[1] have at least 30 days.

1. Except February

Page Numbering and Style

- Page numbering can be reset with `\pagenumbering{style}`
  - style = arabic, roman
- `\thispagestyle{style}`
  - style = empty (no page numbers)
  - style = plain (page number as footer)
  - other options

Centering and Filling

```
\begin{center}
This is centered.
\end{center}
```

This is centered.

```
Some text \hfill Some more text
```

Some text Some more text

- See also \dotfill and \hrulefill

Quotations

- The `quote` and `quotation` environments.
- Both do block quotes
- quote is for short quotes
  - paragraphs in the quote are not indented
- quotation is for multi-paragraph quotes
  - paragraphs in the quote are indented

Quotations

```
… the famous Sherman-esque statement,
\begin{quote}
If drafted, I will not run; if nominated, I will not
accept; if elected, I will not serve.
\end{quote}
is actually a combination of two statements he made both
before and after the Civil War.
```

… the famous Sherman-esque statement:

> If drafted, I will not run; if nominated, I will not accept; if elected,
> I will not serve.

is actually a combination of two statements he made both before and after the Civil War.

Lists

- For bullets, use `itemize` instead of `enumerate`
- Use normal paragraph breaks below item for multi-paragraph items

```
\begin{enumerate}
\item Collect
  underpants.
\item ???
\item Profit!
\end{enumerate}
```

1. Collect underpants.
2. ???
3. Profit!

Definition Lists (Description Lists)

```
\begin{description}
\item [MIT] The best school in the world.
\item [Harvard] A relatively unknown liberal arts
college.
\item [Caltech] A cheap imitation of MIT, plus it's
on the wrong coast.
\end{description}
```

MIT The best school in the world.

Harvard A relatively unknown liberal arts college.

Caltech A cheap imitation of MIT, plus it's on the wrong coast.

Tables

- `\begin{tabular}{`*`columns`*`}`
  `\end{tabular}`
  - & separates columns
  - where *columns* is a series of letters representing each column and the justification within it (e.g. r = right justified), or a pipe (|) representing vertical lines
- Use `\hline` to draw a horizontal line after each row
  - `\cline{i-j}` to draw a horizontal line across cols i-j

Table Example

```
\begin{tabular}{||l|lr||}
\hline
Tuition & term & \$30,000 \\
\hline
Ramen & each & \$0.01 \\
\cline{2-3}
& box & \$10.00 \\
\hline
Drinking from the Fire Hose & & priceless \\
\hline
\end{tabular}
```

Table Example Result

Tuition	term	$30,000
Ramen	each	$0.50
	box	$10.00
Drinking from the fire hose		priceless

Accents and special characters

Accents

- `\'{e}` é
- `\`{a}` à
- `\^{o}` ô
- `\"{o}` ö
- `\~{n}` ñ
- `\c{c}` ç

Special characters

- `\oe` œ
- `\ae` æ
- `\aa` å
- `\o` ø
- `\l` ł
- `\ss` ß
- `?'` ¿
- `!'` ¡

Miscellaneous Symbols

- `\S` §
- `\P` ¶
- `\copyright` ©
- `\pounds` £
- `\ldots` …
- `\LaTeX` LaTeX

Modes

- Paragraph mode
  - The default mode: a sequence of words to be split across lines, paragraphs, and pages
- LR (left to right) mode
  - Render as a string of words from left to right, even if you run out of space on the page
  - Used by \mbox
- Math mode
  - letters are considered to be variables and spaces are ignored, Greek symbols allowed

Math Mode

- Math symbols can be part of text ("in-text equations")
  - math environment
- Or displayed in a block
  - displaymath environment
- Or numbered for reference later
  - equation environment
- Environment

math environment

- Enclose in $ or inside \(\)

```
Let $a$ and $b$ be two prime
integers, where $b > a$.
```

Let a and b be two prime integers, where $b > a$.

```
The rate is \( y + 2x \) in most
cases.
```

The rate is $y + 2x$ in most cases.

displaymath environment

- Enclose in $$ or inside \[\]

```
The Pythagorean theorem is most
commonly expressed as the equation $
$a^{2} + b^{2} = c^{2}$$ which is
called the Pythagorean equation.
```

The Pythagorean theorem is most commonly expressed as the equation

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

which is called the Pythagorean equation.

equation environment

- Like displaymath, but numbers equations, for reference later

```
The relationship is \begin{equation}a+b
  \end{equation} which makes no sense.
```

The relationship is

$$a + b \tag{1}$$

which makes no sense

More Math

- Superscripts and subscripts
  - `x^{2}`
  - `a_{i}`
- Fractions
  - `$22/7$ is not quite $\pi$.`
  - `By the $\frac{V^{2}}{R}$ of Grayskull!`
- Roots
  - `\sqrt{4}`
  - `\sqrt[3]{9}`

Even More Math

- Most Greek letters are referred to by name, with a capital letter indicating the uppercase version
- Common operators:

```
\sum_{i=1}^{n}
\int_{0}^{1}
\lim_{n \rightarrow \infty} x = 0
```

Matrices and Arrays

- array environment
  - specify column alignment, like tabular

```
\( \begin{array}{lcr}
a+b & xy & 27 \\
c+d & u+v & 4201
\end{array} \)
```

$$\begin{array}{lcr} a+b & xy & 27 \\ c+d & u+v & 4201 \end{array}$$

Delimiters

- { } [ ] ( ) | (and many more)
- Tell LaTeX whether it's a left or right delimiter

```
\( \left[ \begin{array}{lcr}
a+b & xy & 27 \\
c+d & u+v & 4201
\end{array} \right] \)
```

$$\left[\begin{array}{lcr} a+b & xy & 27 \\ c+d & u+v & 4201 \end{array} \right]$$

Comments

- Preceeded by %
- Will appear in .tex file, but not in final document
- Useful for leaving notes for others (if working on a manuscript together)

```
\begin{equation}
% This formula should be fixed before publishing
a+b=c
\end{equation}
```

Compiler Errors

- Compiler will give you line number, and often tell you what it thinks you did wrong
- Compiler prompt is a question mark
  - Can do some rudimentary debugging and on-the-fly fixes
- enter "x" to quit and fix errors

Common Errors

- Typos in commands or environment names
- Mis-matching or unmatched braces
- Missing \end
- Missing required arguments
- Using metacharacters incorrectly
- Using math-mode notation in text

Generating PostScript

- `pdflatex filename.tex` will generate PDF output
  - in most cases, this is all you need
- `latex filename.tex` will generate a "device independent" (DVI) file
  - preview with xdvi filename.dvi
- `dvips filename.dvi` will generate PostScript output.

Compiler Warnings

- “underfull hbox” – “There was not enough text on this line” – OK if you want blank lines
- “underfull vbox”– couldn’t find a good place to break the page, so it produced a page with not enough text on it
- Also “overfull”

Compiler Errors

- “undefined control sequence”
  - doesn’t understand the command, usually a typo in the command name
- \begin{foo} ended by \end{bar}
  - mismatched begin and end, you probably forgot the \end
- There’s no line here to end
  - You tried to leave a blank line with \\. Use \vspace instead.

More Errors

- Missing $ inserted
- Missing { inserted
  - LaTeX thinks it should insert the symbol. Either allow it to do that, or fix it
- Missing number, treated as zero
  - you typed “0” instead of “0pt” or “0in”
- Misplaced alignment tab character &
  - You attempted to use an ampersand without escaping it

The ? prompt

- The compiler has stopped and needs help
- Common Commands
  - “h” to see more info about what happened and how latex can fix it
  - “x” to quit, and go edit your file
  - Return/Enter to accept LaTeX’s suggestion
  - I to insert a character

More Info

- LaTeX: A Document Preparation System
  - ISBN: 0201529831
  - $35 on Amazon ($8 used)
  - Barker and Hayden stacks
- SIPB "Inessential LaTeX" http://stuff.mit.edu/sipb/ilatex
- /usr/share/texmf-texlive/tex/latex/base/sample2e.tex

- http://web.mit.edu/ist/helpdesk/minicourses/