LaTeX Week 4

Math (recap from last session)
Formatting (references and more)
Past Equation Formatting

• We have covered math environments
  o $...$,$ \begin{equation} ... \end{equation}$
• And math expressions
  o $^\text{asdf}_{\text{fdsa}} \sqrt[n]{\text{asdf}} \int\text{foo}$

\[
\int_{\alpha}^{\beta} \frac{\partial^2 \Psi}{\partial x^2} d\tau
\]  (1)

\[
d \sin(\theta) = \pm \sqrt{n^3} \lambda
\]  (2)

\[
2\Gamma_2 + \Omega_2 \rightarrow 2\Gamma_2\Omega
\]  (3)
• Matrices in LaTeX are multi-column arrays
  o In math mode, they are created with:
    ▪ \begin{array}{formatting_options} ... \end{array}
    ▪ The formatting options are l, c and r for left, center, and right-justification, one each for a column
  o Elements separated by &, end lines with \\

$$\begin{array}{ccc}
2 & 4 & 8 \\
\sin(\theta) & \cos(\theta) & \tan(\theta)
\end{array}$$

\left(\begin{array}{ccc}
2 & 4 & 8 \\
\sin(\theta) & \cos(\theta) & \tan(\theta)
\end{array}\right)

• Amsmath package has some extra features
• http://en.wikibooks.org/wiki/LaTeX/Mathematics
Past Tables

• Tables use the "tabular" environment instead of the "array" environment, and are created outside math mode
• For most "cool" table features, you need the `tabularx` package.
• Formatting and element separation identical to matrices
Past Formatting

- Labels provide reference points throughout a document
  - \label{label_name}
- References of form
  - \ref{label_name}
- Number equations within sections or subsections
  - \numberwithin{equation}{level}
    - Where level is section, subsection, or subsubsection
- Align equations using the \begin{align} … \end{align}
  - Aligns with the positions of the ‘&’ in equations
Past Labels

• You may notice that the first time you compile LaTeX after adding labels, you'll get some "??" where you referred to a label
• LaTeX uses auxiliary files for references of all kinds, so you may need to compile twice - once to build files, once to use them
• Labels are normally plain text...
The `hyperref` package

- ... but we can make them hyperlinks!
  - Clicking on the reference takes you to the label position
  - This comes for free with the `hyperref` package
- `hyperref` settings
  - Defaults are kinda bad - puts a rectangle around each hyperlink
  - Can use `\hypersetup{options}` in the preamble to fix things.
  - Example: `\hypersetup{colorlinks=true, urlcolor=blue, linkcolor=blue, citecolor=red}`
    - This makes equations blue, urls blue, and citations (we'll come back to that), and all without lines around them
The \texttt{hyperref} package

• In addition to the now-better references, we also can reference websites:
  o \texttt{url\{site\}} yields the site in mono-spaced font
  o \texttt{href\{site\}\{text\}} yields the text "text" but links to the url "site".

• Very customizable:
  http://en.wikibooks.org/wiki/LaTeX/Hyperlinks

• Can also use citations...
Citations

- Easily add a References section, refer to sources easily.
- LaTeX has a `thebibliography` environment built-in.
- Place this at the very end (not necessary, but conventional), before `\end{document}`
- Example:
  ```latex
  \begin{thebibliography}{9}
  \bibitem{einstein}
  A.~Einstein, \textit{Why I'm Awesome}. Somewhere, PhysicsLandia, \dots
  \end{thebibliography}
  ```

The number of digits in the number provided here, k, yields the maximum number of bibliography entries, $10^k - 1$. So, 1 or 9 or 5 all yield a max of 9 entries. 56, 23, 99 all yield a max of 99 entries.

The ~ is a non-breaking space. That means that A. and Einstein will never be split onto separate lines.

The \dots produces ellipsis (…).
Citations

• Code on the previous page yields the following:

References


• The `\textbf` command gives bold-faced. Other options exist (see our resource page).
• Can cite sources in a similar manner to equations, but with `\cite{item_name}`.
• In text, shows up as "...[ref_number]..."
• Can use the `natbib` package for other in-text options.
• http://en.wikibooks.org/wiki/LaTeX/Bibliography_Management
Formatting Images

- Images can have captions (text underneath). Inside the `figure` environment, use `\caption{text}` to have text appear. It will say "Figure n. text"
- To size the image, can use option `scale=?` where ? is .50 for 50% of original size, 1.5 is 3/2 the original size, etc.
- Can have subfigures (i.e., figures 5a and 5b, each with an optional caption and with an overall figure 5 caption) - use the `subcaption` package then the following:

\begin{figure}
  \begin{subfigure}[b]{size}
    \includegraphics{..}
    \caption{..}
    \label{..}
  \end{subfigure} .... \caption{...} ... \label{....} ...
\end{figure}

A handy note for "size" is `\textwidth`, so you can scale by that. For example, `\begin{subfigure}[b]{.5\textwidth}` will allocate space for the image to be half the width of the text.
Lists

• Sometimes, you might want bulleted lists or itemized lists, and LaTeX can do that (may need the `enumerate` package).

• The `enumerate` environment is numbered, but can take on any form (1,2,3 or a,b,c, or (A),(B),(C) or (I.),(II.),(III.)):

  \begin{enumerate}[style]
  \item{cut a hole in a box...}
  \end{enumerate}

Where style could be "1", "a", "(A)", or "(I.)" to get the examples above.
Lists

• Bulleted lists are very similar.
• Can use the \textbf{itemize} environment for that.

\begin{itemize}
  \item Bulleted lists are very similar.
  \item Can use the \textbf{itemize} environment for that.
\end{itemize}

• The \textbf{description} environment takes optional arguments in the \textbf{items} for the printed label for the item
• Can nest any of the list types (list of lists)
Subsubsections

• Depending on the size of your document, you may want to break things up a little or a lot.
• A simple one-page document might have 1 section, or 2 if multicolumn.
• A 10 page paper might have some big sections, where you want to talk about error analysis in your results section.
• A 1000 page textbook may have all kinds of sections with esoteric little baby sections
• LaTeX supports this with sections, subsections, and subsubsections. You can get more than this with code available online.
Numbering Sections

- At least for simple things, this is pretty straightforward:
- In the preamble, you can write:
  \setcounter{secnumdepth}{n}
where n is the maximum depth with which to number sections.
  
  n=0 won't number any sections (nice sometimes)
  n=1 will label sections, but not subsections
  n=2 will label sections and subsections, but not subsubsections.
  n=4 adds paragraphs, n=5 adds subparagraphs

- Paragraphs have label on same line, and won't be included in a ...
Table of Contents

• ... Table of Contents!
• You'll see a lot of LaTeX documents online have one.
• You probably won't need one most of the time
• Just add \tableofcontents wherever you want it and it'll do it for you (may have to compile twice)
• Will go down to subsubsections in terms of inclusion
• If you use the hyperref package, the items in the ToC will be hyperlinked in the document (in addition to having the sections be present for viewing in Adobe)
LaTeX is a programming language, and as such, you can make new commands.

If I were writing up solutions to my quantum mechanics class, I might want to use Dirac notation (looks like this):

\[ \langle x | y \rangle \]

The first part \( <x| \) is the bra, the \( |y> \) is called the ket (bra-ket notation).

Maybe I want a function to make the bra, one to make the ket and one to make the combination (so I don't have two bars in the middle):
Bra-Ket example

• I can use the `\def\function_name{value}` command in the preamble to define a simple replacement (essentially like an acronym where if I put `\function_name` in my code, value will appear

• If I want parameters / arguments, I can use: `\newcommand{\cmnd_name}[num_vars]{...#n...}` in the preamble.

• Again, `\cmnd_name` is the new function name, but I tell it how many variables I can want (1 for the individual bras and kets, 2 for the braket), then use them to create a full "macro" to substitute, using `#n` to get the value of the n-th variable.
Bra-Ket example

• So, to get the $\langle x|y \rangle$ that we saw before, I could write:
  \newcommand{\braket}[2]{
    \ensuremath{\left \langle #1 \middle| #2 \right \rangle}
  }
  in the preamble.
• \ensuremath makes sure we're in math mode, and if not, does so for this command
• \left, \middle and \right indicate the item(s) that will determine the height of the following symbol
• \langle and \rangle are the angle braces.
• In code, I would write \texttt{\braket{x}{y}} to get

\[ \langle x|y \rangle \]

• I could write similar codes for just the bra or the ket
• If you want a two-column document with a centered abstract spanning both columns, you pretty much can't do this in a twocolumn document the way you want
  o Will have abstract appear in one column
  o Will have abstract take up full page width
  o Just painful
• Here's where the \texttt{multicols} package comes in. \begin{multicols}{num\_cols}
...
\end{multicols}
• Now, can make the document onecolumn so the abstract will look good, but then have text be twocolumn where ever you want.
• Unfortunately, multicol doesn't deal with floats well.
• If you need floats, \texttt{usepackage\{abstract\}} …
If you only need a two-column document with a one-column abstract, and you want floats (i.e. figures), try the following:

\documentclass[twocolumn]{article}
\usepackage{abstract}
\begin{document}
\title{Using even more packages in \LaTeX}
\author{Donald Knuth \dots in spirit}

\twocolumn[
\maketitle
\begin{onecolabstract}
The abstract package provides single column abstracts in two-column documents.\end{onecolabstract}]

Note: The \twocolumn environment is designed to end the current page and start a new page with two columns, headed by the enclosed text as a one column header, spanning the page. To prevent it from starting a new page, we stick our \maketitle inside!
Page Formatting

- Like the abstract bit, some useful little tricks for pages
- `\newpage` forces the new page then continues
- `\clearpage` will stop, print all floating things (remember the issue with pictures?), then continue.
  - This is a nice compromise for breaking up text and images if you're lazy
  - If you're not lazy, you'll re-scale things until LaTeX does it without having to `\clearpage` - but this is for people crazy enough to teach a LaTeX seminar @___@