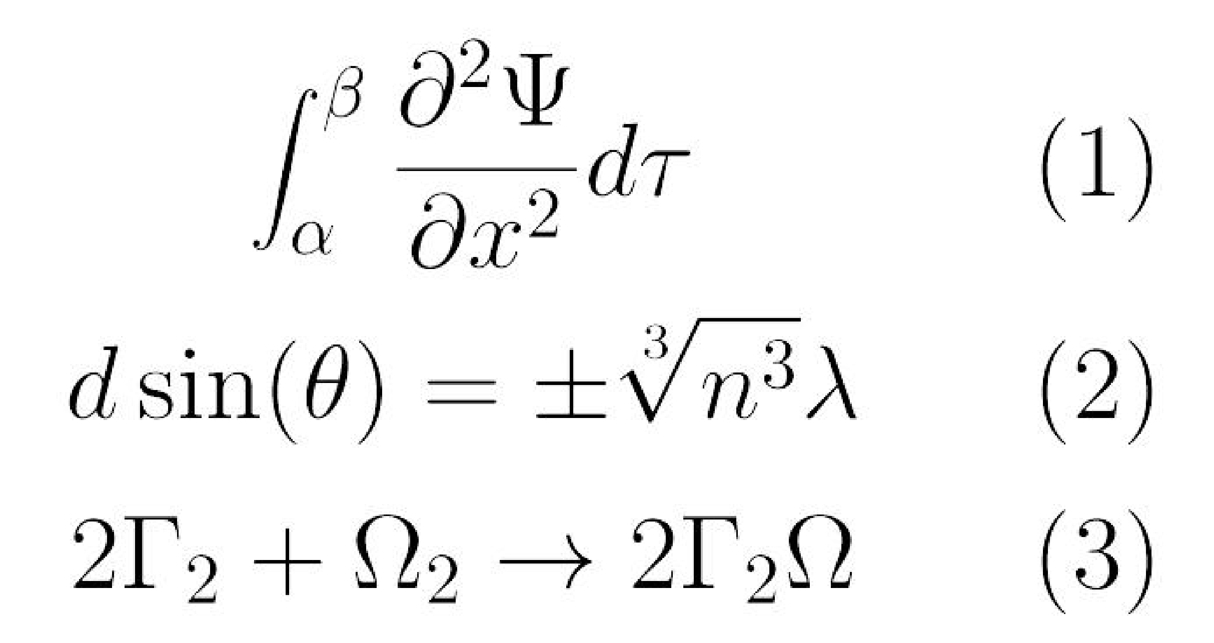
LaTeX Week 3

Math (some review from last week)
Formatting (references and more)

Math (review from last time)

- Last time, we looked at math constructions symbols
  - ^{asdf} _{fdsa} \sqrt[n]{asdf} \int{foo}
  - $...$, \begin{equation} ... \end{equation}
  - \frac{asdf}{fdsa}
- Produced the following:



$$\int_\alpha^\beta \frac{\partial^2\Psi}{\partial x^2} d\tau \tag{1}$$

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

$$2\Gamma_2 + \Omega_2 \rightarrow 2\Gamma_2\Omega \tag{3}$$

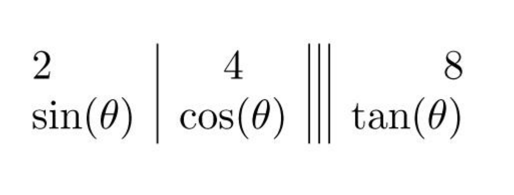
Math (Matrices & Tables)

- We had to go quickly last time, so let's try again.
- Matrices are useful in many equations (esp. quantum)
- Matrices in LaTeX are multi-column arrays
  - Arrays are a computer science construct for holding many of one type of thing
  - In math mode, they are created with:
    - \begin{array}{*formatting_options*} ... \end{array}
    - Here, the formatting options are l, c and r for left, center, and right-justification
    - Number of arguments = number of columns
  - Enter elements with &, skip lines with \\
  - Examples on next slide

Matrices

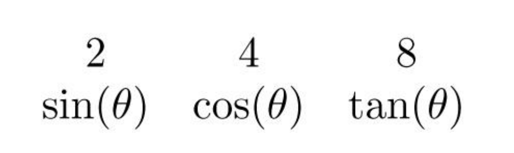
All of these have inner code:

2 & 4 & 8 \\
\sin(\theta) & \cos(\theta) & \tan(\theta)



$$\begin{array}{l|c|||r} 2 & 4 & 8 \\ \sin(\theta) & \cos(\theta) & \tan(\theta) \end{array}$$

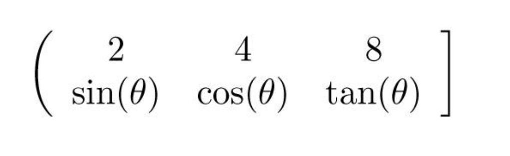
{l | c ||| r}



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

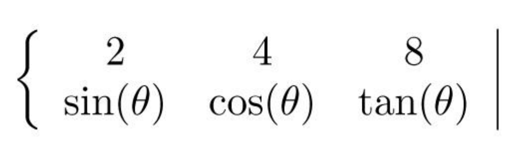
{ccc}

Can also add symbols on either end of the matrix:



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

\left(\begin{array}...\end{array}**\right]**



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

\left\{\begin{array}...\end{array}**\right|**
note: the "{" character is encoded by "\{"

Matrices Wrap up

- Matrices as "array" environments are part of LaTeX.
  - Other packages like **amsmath** do similar things a little bit more "easily", but you have to remember the names of the different types of matrices
- Again, math mode is required for matrices / arrays.

Tables

- Tables in LaTeX are almost identical to matrices
- 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 options are identical to matrices
- Element separation and line separation are identical to matrices

Tables

- In tables, we have multi-column entries that are especially useful for things like titles
  - \multicolumn{num_col}{just}{text}
  - num_col is number of columns to use
  - just is the text justification (l, c, r)
- We can make horizontal lines in the table
  - \hline (must be on new line, auto-inserts new line)
- Can include math in an entry
  - ... & $math_here$ & ... \\

Exercises

- Last section on Week 2's Assignment, Sample 1's Section 3
- www.ph.utexas.edu/~sps/LaTeX

Formatting

- You now pretty much the basics of LaTeX - let's start making our documents interesting as well as beautiful:
  - References to equations, figures
  - Aligning multiple equations
  - Bibliographic info, citing sources in-text
  - Formatting images
  - Lists
  - subsection, subsubsection environments
  - (Un)Numbering sections
  - Customizing your LaTeX experience

Labels

- Labels allow you to name an environment in a code-like way so you can refer to it elsewhere
- Typically, this is great for figures and equations
- Within the other environment, use:
  - \label{label_name}
    - A nice convention is to distinguish figures and equations like \label{eq:snells_law} versus \label{snells_law}
    - Helps you remember what's what when referencing
- Refer to labels with \ref{label_name}
  - Like textbook, will read: as seen in equation 100...

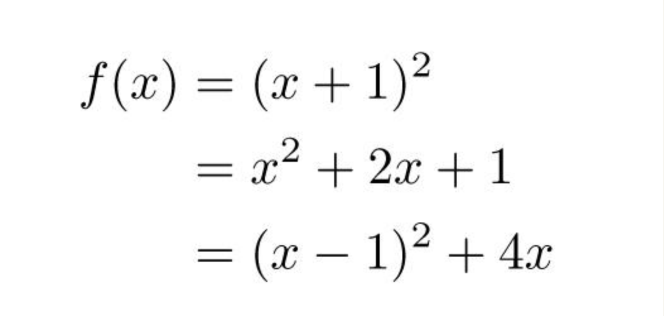
Sidebar: Equation Numbering

- Equations numbered sequentially by occurrence in code
- Will just do 1, 2, ..., 100 by default
- Can number equations within sections or subsections too:
  - \numberwithin{equation}{level}
    - level is section or subsection or subsubsection
- Can also have LaTeX not number it by using \[...\] or $$
  - Other option is \begin{equation*} ... \end{equation*}
    - Won't number unless you use \tag{...} within the environment, giving a specific number to use (VERY BAD - why?)
    - Needs the **amsmath** package

Sidebar: The **align** environment

- Another handy thing for equations is the **align** environment (needs **amsmath**)
- Lets you include multiple equations at once:

```
\begin{align}
    f(x)&=(x+1)^2 \\
    &=x^2+2x+1 \\
    &=(x-1)^2 + 4x
\end{align}
```



$$\begin{aligned} f(x) &= (x+1)^2 \\ &= x^2 + 2x + 1 \\ &= (x-1)^2 + 4x \end{aligned}$$

- Aligns all lines by location of & within line
- See next page

The **align** environment

- Numbers each line by default
  - Can use \begin{**align***}...\end{**align***} to number none of the equations (\tag for explicit numbers}
  - For **align**, use "\notag" before the \\ to not number
  - Label before linebreak on lines you want to reference

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 a reference takes you to that spot in the document
  - 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) red.

The **hyperref** package

- In addition to the now-better references, we also can reference websites:
  - **\url{site}** yields the site in mono-spaced font
  - **\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:

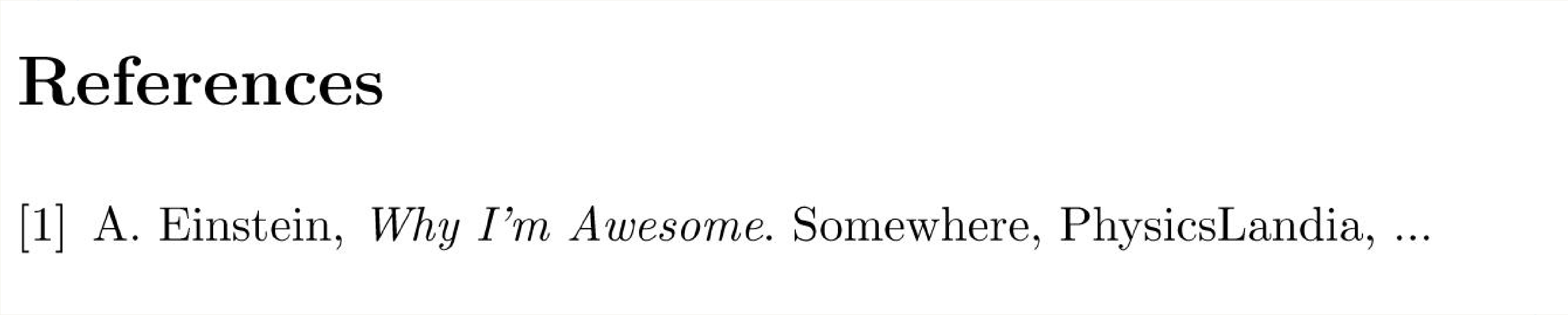
```
\begin{thebibliography}{9}
\bibitem{einstein}
   A.~Einstein,
   \emph{Why I'm Awesome}.
   Somewhere, PhysicsLandia,
...
\end{thebibliography}
```

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.

Citations

- Code on the previous page yields the following:



References

[1] A. Einstein, *Why I'm Awesome.* Somewhere, PhysicsLandia, ...

- The **\emph** command gives itallic text. **\textbf** is 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 **itemize** environment for that.

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

- The **description** environment takes optional arguments in the **item**s 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

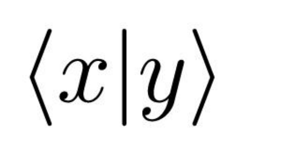
- Paragraphs have label on same line, and won't be included in a ...

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)

Custom Formatting (and more)

- 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.

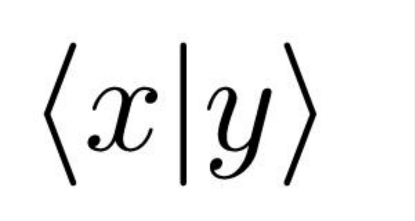
Bra-Ket example

- So, to get the <x|y> that we saw before, I could write:

```
\newcommand{\braket}[2]{\ensuremath{\left\langle{#1}|{#2}\right\rangle}}
```

in the preamble.

- **\ensuremath** makes sure we're in math mode, and if not, does so for this command
- **\langle** and **\rangle** are the angle braces.
- In code, I would write **\braket**{x}{y} to get



$$\left\langle x \middle| y \right\rangle$$

- I could write similar codes for just the bra or the ket

Title-Abstract Example

- 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
  - Will have abstract appear in one column
  - Will have abstract take up full page width
  - Just painful
- Here's where the **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.

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 @_@