Dept of Civil & Environmental Engineering

A Quick LaTeX Primer

LaTeX: What is it?

- LaTeX is essentially a markup language
  - You provide LaTeX with a text-based document that is part text, part code (kind of like a simple HTML)
  - LaTeX does all of the formatting, referencing, pagination, table of contents, etc. for your document through a compiler
  - Thousands of LaTeX packages allow you to customize the final appearance of your document

LaTeX: the simplest document

```
% A LaTeX document - note '%' is a comment mark
% header-----------------------------------------------------------------------
\documentclass[12pt](article) %12 pt font: other options include books & letters
\usepackage{amsmath}          %for equations

% body-------------------------------------------------------------------------
\begin{document}
\section{Introduction}
This is the simplest document, here is my favorite equation:

\begin{equation}
e^{i\pi}-1=0
\end{equation}

All other equations just aren't as cool...
\end{document}
```

pdfLaTeX

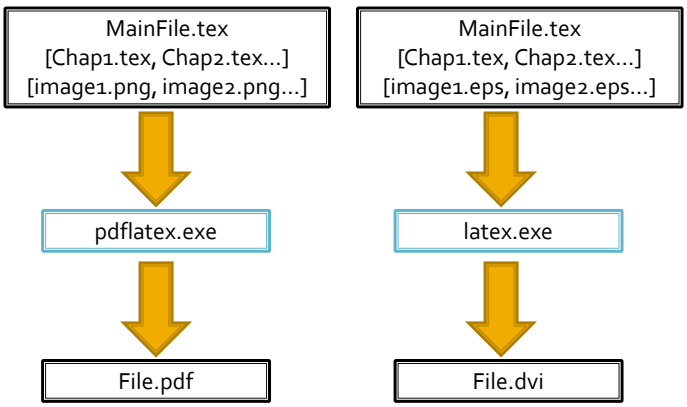
1 Introduction

This is the simplest document, here is my favorite equation:

$$e^{i\pi} - 1 = 0 \quad (1)$$

All other equations just aren't as cool...

How it works (simple)



[]-optional files

Regular Text

- Most cases, just type (like in notepad)
- For formatting:
  - Bold:
    `\bf This is bold. \rm This is not.` (or \textbf{})
  - Italics:
    `\textit{This is italics.} This is not.` (or \it..\rm)

This is Bold. This is not.
This is italicized. This is not.

- Special issues:
  - Quotes: ``This is a quote'', "not this"
  - Reserved characters:
    - # $ & % → `_ \# \$ \& \% \_`

Useful Environments

Itemize

```
\begin{itemize}
  \item ted \\
  \item mary \\
  \item frank
\end{itemize}
```

- ted
- mary
- frank

Enumerate

```
\begin{enumerate}
  \item ted \\
  \item mary \\
  \item frank
\end{enumerate}
```

1. ted
2. mary
3. frank

Verbatim

```
\begin{verbatim}
  //this is really good for code
  //it preserves all spacing and ignores special chars
  for (i=0;i<R;i++){
    x=(double)(i)*1.2;
  }
\end{verbatim}
```

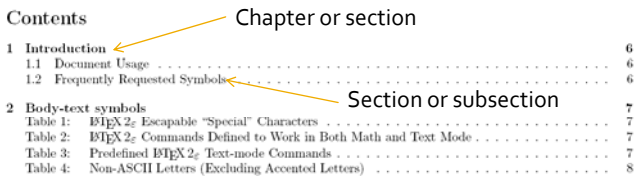
```
//this is really good for code
//it preserves all spacing and ignores special chars
for (i=0;i<R;i++){
  x=(double)(i)*1.2;
}
```

Sections and Paragraphs

- Chapter/Section Headers are added easily:
  - `\section{Introduction}`
  - `\section{Methods}`
  - `\subsection{The Finite Element Method}`
- Depending upon your style package, these may be formatted differently
- It is good habit to label your sections if you are referencing them elsewhere:
  - `\section{Introduction}\label{sec:Intro}`
- Referenced as follows:
  - `As stated in section \ref{sec:Intro}, I have figured out the meaning of life. Good for me.`
- Paragraphs are just text preceded by a blank line. Indendation is default, can be suppressed using `\noindent [text…]`

Table of contents/figures

- Once you have your paper outlined into sections, subsections and chapters, the table of contents is easy
- just add `\tableofcontents` where you want it



- Tables of figures & tables are a bit rougher, but there are packages for this

Equations

- Equations are probably the most impressive part of LaTeX
- Always use the following header!
  - `\usepackage{amsmath}`
- Inline equations (in text):
  - `where $C_i=\psi$ and $m=1$.` where $C_i = \psi$ and $m = 1$.
- Indented equations:
  - `\begin{equation}\label{eqn:C_defn}`
  - `C_i=\psi \left(\gamma^c\right)`
  - `\end{equation}`

$$C_i = \psi\left(\gamma^c\right)$$

- Equation Numbering is default, can be suppressed with \nonumber before equation.
- Equations are referenced using, e.g., `\cite{eqn:C_defn}` in text

Equations

- Standard functions (sin, exp…) are given their own formats, which should be used:
  - `$\sin(\theta)$` $\sin(\theta)$
  - `$sin(\theta)$` $sin(\theta)$
- To add this text property to other special functions (e.g., erf()), you need to add a declaration to the header:
  - `\DeclareMathOperator{\erfc}{erfc}`

Equations

- `C_i` subscript C_i
- `C^i` superscript C^i
- Curly braces are only used to group terms, and do not show up in equations
  - `H_{specified}` not `H_specified` $H_{specified}$ $H_specified$
- For parentheses, use \left(and right) (or left[or \left\{ …)
  - -these will adjust their size for the contents of the parenthesis

Equations: Characters

α	\alpha	θ	\theta	o	o	τ	\tau
β	\beta	ϑ	\vartheta	π	\pi	υ	\upsilon
γ	\gamma	γ	\gamma	ϖ	\varpi	ϕ	\phi
δ	\delta	κ	\kappa	ρ	\rho	φ	\varphi
ϵ	\epsilon	λ	\lambda	ϱ	\varrho	χ	\chi
ε	\varepsilon	μ	\mu	σ	\sigma	ψ	\psi
ζ	\zeta	ν	\nu	ς	\varsigma	ω	\omega
η	\eta	ξ	\xi				
Γ	\Gamma	Λ	\Lambda	Σ	\Sigma	Ψ	\Psi
Δ	\Delta	Ξ	\Xi	Υ	\Upsilon	Ω	\Omega
Θ	\Theta	Π	\Pi	Φ	\Phi		

Symbols	Latex Command	
	Normal Mode	Math Mode
$\tilde{o}$	\~{o}	\tilde{o}
$\acute{o}$	\'{o}	\acute{o}
$\hat{o}$	\^{o}	\hat{o}
$\ddot{o}$	\"{o}	\ddot{o}
$\grave{o}$	\`{o}	\grave{o}
$\bar{o}$	\={o}	\bar{o}
$\dot{o}$	\.{o}	\dot{o}
$\breve{o}$	\u{o}	\breve{o}
$\check{o}$	\v{o}	\check{o}
$\H{o}$	\H{o}	
$\t{oo}$	\t{oo}	
$\c{o}$	\c{o}	
$\d{o}$	\d{o}	
$\underline{\vec{o}}$		\vec{o}
$\underline{o}$	\b{o}	

Equations: Fractions

- There are multiple fraction types available
  - `$\frac{A}{B}$ (size determined by LaTeX)`
  - `$\tfrac{A}{B}$ (small fraction)`
  - `$\dfrac{A}{B}$ (big fraction)`

$\frac{A}{B}$ $\tfrac{A}{B}$

- Fractions can be nested
  - `$\frac{A}{\frac{B}{C}+1}$`

$$\frac{A}{\frac{B}{C}+1}$$

Implicitly dfrac

Implicitly tfrac

Equations: Shorthand

- If you find yourself typing the same equation (or part of an equation) out, you can declare a macro operator in the header:

```
\newcommand{\fp}[2]{\frac{\partial #1}{\partial #2}}
```

- - a new command, \fp, with two arguments inserted in the fraction expression as #1 and #2

`$\fp{C}{t}$` → $\frac{\partial C}{\partial t}$

- This is much easier than writing:

```
$frac{\partial C}{\partial t}$
```

- I usually have a library of these that I just append to the header

Including Images

- Image files (if using pdftex) are best saved as .png files, using screen capture software. .jpgs or bmps may also be used.
- Store the picture in the same folder as the .tex file
- The following header must be present:

```
\usepackage[pdftex]{graphicx}
```

- Insert a statement like the one below:

```
\begin{figure}[htb]
\begin{center}
\includegraphics*[width=4.5in]{image1.png}
\caption{This is the caption for the picture.}
}\label{fig:CoordinateSystems}
\end{center}
\end{figure}
```

- Figures may be referenced just like sections (i.e., `\ref{fig:fig1}`)

Including Tables

```
\begin{table}[!ht]
\centering
\renewcommand{\tabcolsep}{0.35pc} % reduce column spacing
\renewcommand{\arraystretch}{1.1} % enlarge line spacing
\begin{tabular}{|r||cr|cr|cr|c|}
    \hline
   & ACM  & error   & UFD  & error   & CDFD & error & HIGHFD \\
ID & mg/L & [\%]~   & mg/L & [\%]~   & mg/L & [\%]~ & mg/L \\
\hline
1 & 97.179 & -0.48 & 96.865 & -0.80 & 97.119 & -0.54 & 97.645 \\
2 & 91.621 & -1.08 & 91.432 & -1.28 & 91.864 & -0.81 & 92.617 \\
3 & 87.029 & -1.00 & 86.189 & -1.96 & 87.044 & -0.98 & 87.909 \\
4 & 82.115 & -0.66 & 80.033 & -3.18 & 81.753 & -1.10 & 82.659 \\
5 & 81.495 & -0.03 & 78.397 & -3.83 & 80.700 & -1.01 & 81.522 \\
\hline
6 & 99.919 & -0.00 & 99.834 & -0.09 & 99.890 & -0.03 & 99.923 \\
7 & 99.135 & 0.03 & 98.736 & -0.28 & 98.943 & -0.17 & 99.108 \\
8 & 97.225 & 0.46 & 95.870 & -0.94 & 96.383 & -0.41 & 96.781 \\
9 & 94.565 & 2.51 & 89.931 & -2.51 & 91.634 & -0.67 & 92.248 \\
10 & 93.018 & 22.25 & 74.517 & -2.07 & 81.646 & 7.30 & 76.091 \\
\hline
11 & 97.180 & -0.50 & 97.274 & -0.40 & 97.235 & -0.44 & 97.666 \\
12 & 91.650 & -0.92 & 91.977 & -0.57 & 91.719 & -0.85 & 92.502 \\
13 & 86.951 & -0.24 & 86.574 & -0.67 & 86.259 & -1.03 & 87.161 \\
14 & 83.331 & 3.86 & 79.289 & -1.18 & 79.396 & -1.05 & 80.235 \\
 \hline
\end{tabular}
\caption{Steady-state concentrations of the ACM, UFD, CDFD and HIGHFD simulations, and their
relative deviation from the HIGHFD simulation results for the high dispersivity case
($\alpha_l$=1,$\alpha_t$=0.3).} \label{tab:Test1SteadyState}
\end{table}
```

Table preferential placement

Alignment codes

Each column should have same # of separators (&)

ID	ACM mg/L	error [%]	UFD mg/L	error [%]	CDFD mg/L	error [%]	HIGHFD mg/L
1	97.179	-0.48	96.865	-0.80	97.119	-0.54	97.645
2	91.621	-1.08	91.432	-1.28	91.864	-0.81	92.617
3	87.029	-1.00	86.189	-1.96	87.044	-0.98	87.909
4	82.115	-0.66	80.033	-3.18	81.753	-1.10	82.659

Style Files

- Different publishers often provide "style files" so your article gets reformatted in the style of the publication
  - (this is a great way to impress your advisor)
- Style files must exist in the main TeX directory or in the same folder as the tex file
- Declaration in the header:
  - `\documentclass[wrr]{agu2001}` AGU
  - `\documentclass[reviewcopy]{elsart}` Elsevier
  - `\documentclass[12pt]{article}` Default

WATER RESOURCES RESEARCH, VOL. ???, XXXX, DOI:10.1029/,

Water Flows Downhill I. An Asymptotic Analysis

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Abstract. I have determined in all of my brilliance that water flows downhill. Not only does it flow downhill, but under the right circumstances, it can also flow uphill or even sideways, given the chance. Basically, water flows anywhere unless there is some reason for it not to, like a vacuum cleaner is in the way or some space alien has decided to evaporate it into water vapor. In that case, it does like to flow somewhere else, fast.

1. Introduction

Water flows downhill. Everyone knows it, even dumb kindergarten kids who know nothing else. They see cartoons with rivers in them and stuff and then they think that they know everything there it to know about water. But they don't know anything about capillary forces or the Navier-Stokes equations, so I'm pretty sure they are just pretending that they are smart to impress their overindulgent parents. Silly kindergartners. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows downhill. Water flows

multiple homogeneous hydrological response units (HRUs) which share similar land use/land type, vegetation coverage, and soil properties. Upon each HRU, a 1-dimensional water balance model is applied for a given timestep, then water is routed between HRUs using a routing scheme. Varying levels of numerical rigor have been applied in the treatment of the solution of coupled ordinary differential equations that define the water and energy balance. Here, a general formulation of the problem is posed that enables multiple numerical schemes to be tested. This formulation will act as the basis for the object-oriented software code RAVEN. Note that this approach may be extended to the energy balance, but this is not done here.

Bibliographies

- The .bib file

Shortcuts can be used to replace journal names

Different reference types get different structures.
The first Item is how it is cited in text using

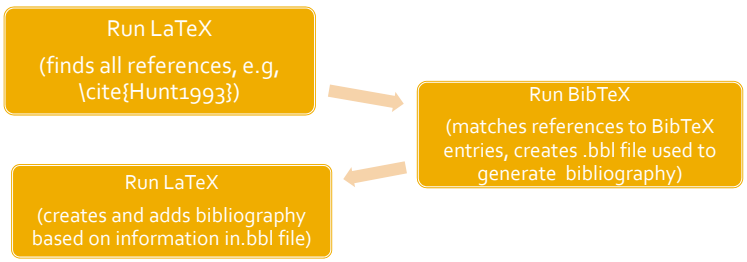
`\cite{Bear1972}`

```
@STRING{WRR=     {Water Resources Research}}
@STRING{AWR=     {Advances in Water Resources}}
@STRING{JH=      {Journal of Hydrology}}
@STRING{GW=      {Ground Water}}

@phdthesis{BatyckyPhD,
    author=      {Robert Batycky},
    title=       {A Three-dimensional Two-phase Field Scale Streamline Simulator},
    school=      {Stanford University},
    year=        {1997}
}
@book{Bear1972,
    author=      {Jacob Bear},
    title =      {Dynamics of Fluids in Porous Media},
    publisher =  {Elsevier},
    address =    {New York},
    pages=       {},
    year =       {1972}
}
@ARTICLE{BroadbridgeEtAl2000,
  AUTHOR =       {P. Broadbridge and J. M. Hill and J. M. Goard},
  TITLE =        {Symmetry Reductions of Equations for Solute Transport in Soil},
  JOURNAL =      {Nonlinear Dynamics },
  YEAR =         {2000},
  volume =       {22},
  number =       {1},
  pages =        {15-27}
}
```

Bibliographies

- To create a bibliography, the BibTeX software must be used both before and after running pdfLaTeX



Citations

- Regular references:
  - `\cite{Craig2005}` inserts (Craig, 2005) or [12], etc. into text
- Reference type in bibliography and text depends upon bibliography style (e.g., chicago.sty):
  - `\usepackage{chicago}`
- A special package, natbib.sty, can be used for different reference types
  - `\citet{Craig2005}` produces Craig (2005)
  - `\citep{Craig2005}` produces (Craig, 2005)

Separating your document into multiple files

- WinEdt Allows you to create a "project" with a main file and a bunch of lesser files
- All you have to do to add each file is to add the following line in the "master" tex file
  - `\include{Calibration}`
  - (for file Calibration.tex in same directory)
- The file is treated as if it is just inserted in this spot

That's It!

- There is a whole lot more out there
  - Index
  - Special packages for colored tables, rotated text, text wrapping, line art, korean, special fonts, etc. etc.
  - Drawing graphs in LaTeX
  - Writing code in LaTeX

Resources

- http://en.wikibooks.org/wiki/LaTeX
  - An excellent resource for beginning & advanced users
- www.winedt.com
  - A Great LaTeX editor – cheap and effective
- www.miktex.com
  - All the downloads you need to get things working
- www.ctan.org/tex-archive/support/excel2latex/
  - A handy converter from excel tables to LaTeX tables
- http://ctan.tug.org/tex-archive/info/lshort/english/lshort.pdf
  - A very nice intro document