Introduction to Making Documents with LaTeX

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Introduction

What LaTeX is

- A cross-platform typesetting environment
- Best way to produce aesthetically pleasing, logically coherent documents, especially when dealing with mathematical equations
- Free and customizable

What LaTeX isn't

- WYSIWYG (What You See is What You Get)
  - MS Word, LibreOffice
- Bloated memory hog

How it Works

1. The TEX typesetting engine reads a plain text file, usually written using LATEX (a set of TEX macros)

```
\documentclass{article}
\begin{document}
Hello world
\end{document}
```

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1. The TEX typesetting engine reads a plain text file, usually written using LATEX (a set of TEX macros)
2. Produces a readable, formatted document image (.dvi)

```
craig@sonicboom ~/Documents/presentations/latex_intro $ latex hello.tex
This is pdfTeX, Version 3.1415926-2.4-1.40.13 (TeX Live 2012/Debian)
 restricted \write18 enabled.
entering extended mode
(./hello.tex
LaTeX2e <2011/06/27>
Babel <v3.8m> and hyphenation patterns for english, dumylang, nohyphenation, lo
aded.
(/usr/share/texlive/texmf-dist/tex/latex/base/article.cls
Document Class: article 2007/10/19 v1.4h Standard LaTeX document class
(/usr/share/texlive/texmf-dist/tex/latex/base/size10.clo)) (./hello.aux)
[1] (./hello.aux) )
Output written on hello.dvi (1 page, 232 bytes).
Transcript written on hello.log.
craig@sonicboom ~/Documents/presentations/latex_intro $ ls
hello.aux  hello.dvi  hello.log  hello.pdf  hello.tex  jupiter.pdf  jupiter.tex
```

How it Works

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Hello world

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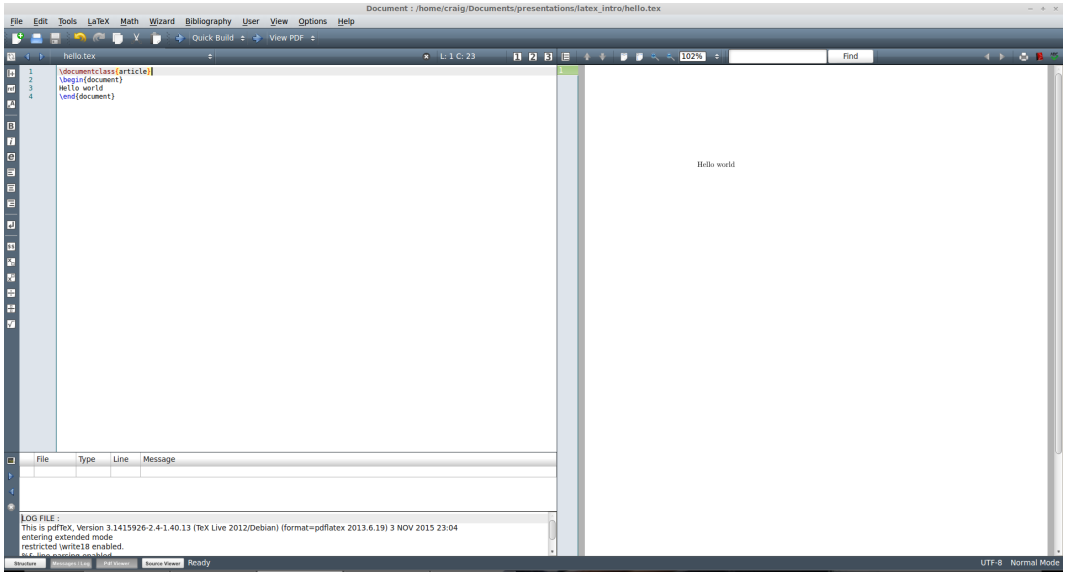
Separates design from content $\rightarrow$ enhanced logical structure

What you Need

1. Text editor or IDE
   - Texmaker, Vim/Emacs/gedit with plugins, Notepad++, Sublime
   - Look for built-in output viewer, code completion



What you Need

1. Text editor or IDE
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   - Look for built-in output viewer, code completion
2. Sane LaTeX installation
   - Windows - MikTeX
   - Mac - MacTeX
   - Linux - texlive

Special Characters, commands, and comments

- Special characters
  - tells LaTeX to do something, won't print like you intend
  - # $ % ^ & _ { } ~ \
- LaTeXcommands
  - Start with a \, i.e. \backslash, \alpha→ α
- Comment lines with %

Input file structure and layout

- Preamble
  - Contains document type and all formatting directions and information not directly related to content
  - Authors, date, institutions, title, external packages

```
\documentclass[11pt]{article}
\input{header}
\usepackage{verbatim}
\usepackage{amsmath}
\usepackage[top=1in, bottom=1in, left=1in, right=1in]{geometry}
\def\mn{{\mu \nu}}
```

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\def\mn{{\mu \nu}}
```

- \begin{document} . . . \end{document}

Packages and external files

- Packages add customization and fine tuning
- Commonly used:
  - amsmath – must have for mathematical formulae
  - geometry – adjust page margins
  - graphicx – including images
  - nag – ensures up to date syntax
  - cleverref – manages references in a clever way
  - hyperref – functional document and hyperlinks
- See: http://www.howtotex.com/packages/9-essential-latex-packages-everyone-should-use/

Typesetting

- Paragraphs and sentences
  - paragraphs broken by empty line
  - extra spaces after period ignored
  - line break without new paragraph \\ or \newline
  - * prohibits page break after new line
  - \newpage starts a new page
  - be careful after equations

```
The time-dependent Schr\"{o}dinger equation,
\begin{align*}
i\hbar\frac{\partial \Psi}{\partial t} = \hat{H} \Psi ,
\end{align*}

is important.          You should know it.
```

The time-dependent Schrödinger equation,

$$i\hbar\frac{\partial \Psi}{\partial t} = \hat{H}\Psi,$$

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Typesetting

- Organize content in outline form using Sections, subsections, chapters, and subchapters

```
\section{This is a numbered section}
\subsection*{this is an unnumbered subsection}
\subsubsection{this is a numbered sub-sub-section}
\section{A second section}
\subsection{with a numbered sub-section}
\subsubsection{and a numbered sub-sub-section}
```

1 This is a numbered section

this is an unnumbered subsection

1.0.1 this is a numbered sub-sub-section

2 A second section

2.1 with a numbered sub-section

2.1.1 and a numbered sub-sub-section

Typesetting

- Make lists with “itemize” and “enumerate” environments

```
\begin{itemize}
\item This is an itemized list
\begin{itemize}
\item with a nested list
\end{itemize}
\item second item
\end{itemize}
```

- This is an itemized list
  - with a nested list
- second item

Typesetting

- Make lists with “itemize” and “enumerate” environments

```
\begin{enumerate}
\item This is an enumerated list
\begin{enumerate}
\item with a nested list
\end{enumerate}
\item second item
\end{enumerate}
```

1. This is an enumerated list
   (a) with a nested list
2. second item

Some useful commands and characters

- bold, italic, underline
  - `\textbf{bold}`→**bold**
  - `\textit{italic}`→*italic*, `\emph{italic}`→*italic*
  - `\underline{underline}`→underline
- other stuff
  - superscript `$^{...}$` A^{n}
  - subscript `$_{...}$` A_{n}
  - degree `$^\circ$C`→$^{\circ}$C
  - quotation uses two grave accents (`) and two vertical quotation marks ('), "A"
  - Greek `$\alpha_{\textrm{n}}^i$` α_{n}^{i}

Some useful environments

- **verbatim** – direct quote, not interpreted
  - Good for displaying code
  - \usepackage{verbatim} and \usepackage{fancyvrb}
    - \begin{verbatim}...\end{verbatim}
    - \verb@...@
    - \VerbatimInput{hello.cc}

```
/* Hello World */
#include <iostream>
using namespace std;
int main() {
  cout<<"Hello World!"<<endl;
  return 0;
}
```

Some useful environments

- **tabular** – the way to make tables
  - `\begin{tabular}[position]{table spec}...\end{tabular}`
    - 'position' specifies vertical position relative to surrounding text (t,b, or c)
    - 'table spec' specifies number of columns and text justification (l,r, or c)
    - & moves to the next column, \\ starts a new line, `\hline` inserts a horizontal line

```
\begin{tabular}{|r|l|}
\hline
7C0 & hexadecimal \\
3700 & octal \\ \cline{2-2}
11111000000 & binary \\
\hline \hline
1984 & decimal \\
\hline
\end{tabular}
```

7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

Mathematical Formulae

Producing consistent, aesthetically pleasing mathematical formulae is the main strength of TEX

- Use `amsmath` package, included with all installations
  - `\usepackage{amsmath}`
- Produced by the American Mathematical Society
- Types of equations

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- Types of equations
  - inline – This, $0.25 + \frac{3}{4} = 1$, is an inline equation

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- Types of equations
  - displayed and numbered
    This is a displayed and numbered equation,

$$0.25 + \frac{3}{4} = 1 \tag{1}$$

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Producing consistent, aesthetically pleasing mathematical formulae is the main strength of TEX

- Use `amsmath` package, included with all installations
  - `\usepackage{amsmath}`
- Produced by the American Mathematical Society
- Types of equations
  - displayed and unnumbered
    This is a displayed and unnumbered equation,

$$0.25 + \frac{3}{4} = 1$$

Mathematical Formulae

Inline equations obtained from math mode with `$...$`

- Fractions are displayed differently, text is italicised
- reserve for less important formulae

```
Add $a$ squared and $b$ squared
to get $c$ squared. Or, using
a more mathematical approach:
$a^2 + b^2 = c^2$
```

Add a squared and b squared to get c squared. Or, using a more mathematical approach:
$a^2 + b^2 = c^2$

Mathematical Formulae

Display equations with `\begin{align}...\end{align}`

```
Einstein says
\begin{align}
E = mc^2 \label{clever}
\end{align}
He didn't say
\begin{align}
1 + 1 = 3 \tag{dumb}
\end{align}
```

Einstein says

$$E = mc^2 \tag{2}$$

He didn't say

$$1 + 1 = 3 \tag{3}$$

Equation numbers are tracked by a counter, can be manually set `\setcounter{equation}{0}`

$$E = mc^2 \tag{1}$$

Mathematical Formulae

Display unnumbered equations with `\begin{align*}...\end{align*}`

```
Einstein says
\begin{align*}
E = mc^2 \label{clever}
\end{align*}
He didn't say
\begin{align*}
1 + 1 = 3 \tag{dumb}
\end{align*}
```

Einstein says

$$E = mc^2$$

He didn't say

$$1 + 1 = 3$$

Multi-line equations

Use `align` environment for multi-line equations, align with &. Use `\nonumber` to omit equation number on specific line

```
\begin{align}
        i\hbar\frac{\partial \Psi}{\partial t}
                = & \hat{H} \Psi \nonumber \\
        =& E \Psi
\end{align}
```

$$\begin{aligned} i\hbar\frac{\partial \Psi}{\partial t} &= \hat{H}\Psi \\ &= E\Psi \end{aligned} \tag{2}$$

Some useful commands

Greek

- `\alpha, \beta, gamma` α, β, γ
- `\varepsilon, \epsilon` ε, ϵ

Sum, integral, product

```
\begin{align*}
        \sum_{i=1}^n \qquad
        \int_0^{\frac{\pi}{2}} \qquad
        \prod_\epsilon
\end{align*}
```

$$\sum_{i=1}^{n} \qquad \int_0^{\frac{\pi}{2}} \qquad \prod_{\epsilon}$$

- `\hat{H}` $\hat{H}$
- `\times` A$\times$B, `\cdot` A$\cdot$B
- `\partial` ∂

Greek, super and sub script, sum (substack), integral, product operators, dots, frac, predefined functions, partial

Arrays and matrices

uses array environment for arrays, amsmath uses matrix environments

Graphics

use graphicx package (options), no real standard find what works, figure env. center, caption, includegraphics, remove extensions to avoid conflict b/w latex pdflatex

Bibliographies

Use BibTeX, keep main bib file w/ consistent naming convention, bibliography command at end, bibliographystyle at beginning

Cross referencing and citation

Cleveref package, cite, ref, naming labels

Custom commands

newcommand-name, num of args, definition, hashtag w/ number for arguments, bra, ket, braket, 2x2 matrix
newenvironment, renewenvironment to override existing commands

Chemistry specific packages

https://www.ctan.org/topic/chemistry, chemfig-rings, rxn, achemso

Putting it all together

Keep a universal header, bib, and main document template. Copy and edit as needed. Example file with header, equations, cross reference, citations, and sections

Resources

lshort, ctan, http://www.xm1math.net/texmaker/