2011 CSGSA Refresher Series
Latex
One Code to Write Them All

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By the end of this talk...

- You should understand the basics of how LaTeX works
- how to start using it
- and why you should.

Outline

LaTeX – What? When? Who?

- a universal document generation system
- created by Leslie Lamport in 1984, based on earlier *Tex*
- markup language, like HTML, with CSS, on steroids
- typeset papers, thesis', books, presentations
- highly customizable, can be programmed and it needs to be compiled
- *very* powerful support for math, citations, figures, tables and keeping track of them all

LaTeX – Why? (or "what's wrong with Word?")

- Have you ever *used* Word?
- Focus on content - LaTeX handles making it look good
- Easy to create standards using style packages
- Not a wordprocessor
- Open, regular format that is human readable compiles to postscript or pdf
  - many LaTeX-aware tools spellchecking, conversion to HTML, spellcheck,...
- linguafranca of math notation - email, google docs, ...
- Because we're programmers, we love compiling things

The Bare Necessities - Starting Template

```
\documentclass[10pt]{article}
\usepackage{graphicx}
\usepackage{times}
\title{A Proof that P=NP}
\author{Z. Brainiac}
\date{\today{}}
\begin{document}
\maketitle
% Place your text here
I can't wait to compile this!
\end{document}
```

Installing LaTeX

Windows - MikTex.org or TexLive

Mac - MacTex or install TeXShop GUI environment

linux - you figure it out... (just kidding, TexLive)

school - department machines and servers all should have it installed already

Compiling - There Can Only Be One

Two main approaches:

Postscript - eps output - images: eps only

`latex mydoc.tex`	→	mydoc.dvi
	→	errors – “badness 10000”
		underfull, overfull boxes
		line numbers not helpful
`dvips -o mydoc.ps mydoc.dvi`	→	mydoc.ps
`ps2pdf mydoc.ps`	→	mydoc.pdf

PDF - pdf output - images:pdf,gif,png,jpg

`pdflatex mydoc.tex`	→	mydoc.pdf
	→	errors – “badness 10000”

Don't Underestimate the Power of the LaTeX

Getting LaTeX up and running is often surprisingly difficult at first. Give yourself time.

Grad Courses - install it this weekend and compile a small doc, play with the notation. *Instant respect* from profs and grad TA markers.

Conference - *Before* you start writing, go to the website and get the .sty template for the conference

Thesis - same as above. Also, exeriment including chapters as seperate files.

The LaTeX Philosophy: Say it direct and simple

You describe the content, LaTeX handles the formatting:

sections	\chapter{Introduction} \section{Notation}
references	\ref{name of figure}
citations	\cite{turing45} \citet{turing45}
table of contents	\tableofcontents
footnotes	\footnote{Text of footnote}
math	\sum \prod \pi \epsilon
text	\large{big word} \emph{italic text} {\bf bold text} ...
tables	\begin{table}[c|c|c]\hline col1 & col2 & col3 \end{table}

Simple Creation of Headings

A Proof that P=NP

Z. Brainiac

September 13, 2007

Abstract

We will outline a proof that $P = NP$ by substituting the usual walk tojl bookjs mont ahat

1 Background

1.1 Early Work

1.1.1 Failures

2 Proof Outline

Definitions

```
\title{A Proof that P=NP}
\author{Z. Brainiac}
\date{\today{}}
\begin{document}
\maketitle
\abstract{We will outline a
proof ... }
\section{Background}
\subsection{Early Work}
   \subsubsection{Failures}
\section{Proof Outline}
   \subsection*{Definitions}
```

Lists

- Bulletted Lists
  - something
  - something else
  - and another thing

1. Enumerated List
   (a) first thing
   (b) penultimate thing
   - first sub-thing
   - second sub-thing

   (c) last thing

```
\begin{itemize}
  \item Bulletted Lists
  \begin{itemize}
    \item something
    \item something else
    \item and another thing
  \end{itemize}
\end{itemize}
\begin{enumerate}
  \item Enumerated List
  \begin{enumerate}
    \item first thing
    \item penultimate thing
     \begin{itemize}
        \item first sub-thing
        \item second sub-thing
      \end{itemize}
    \item last thing
```

Descriptions

first Lorum ipsum fredo

second In ultrices porta lacus. Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien.

third In at felis. In fermentum libero eget elit. In aliquet magna vel diam. Suspendisse fringilla.

```
\begin{description}
  \item[first] Lorum ipsum fredo
  \item[second] In ultrices porta ...
  \item[third] In at felis. ...
\end{description}
```

Type faces

	Text Mode	Math Mode
Emphasized	\emph{ ...}or {\em ...}	
Typewriter	\texttt{ ...} or {\tt ...}	\mathtt{ ...}
Bold	\textbf{ ...} or {\bf ...}	\mathbf{ ...}
Roman	\textrm{ ...} or {\rm ...}	\mathrm{ ...}
Italicized	\textit{ ...}	\mathit{ ...}
SMALL CAPS	\textsc{ ...}	
Sans Serif	\textsf{ ...}	
$\mathcal{CALLIGRAPHIC}$		\mathcal{...}
$\mathfrak{FRAKTUR}$		\mathcal{...}
$\mathbb{BLACKBOARD}$		\mathbb{...}

Type sizes

- Tiny - {\tiny ...}
- Script - {\scriptsize ...}
- Footnote - {\footnotesize ...}
- Small - {\small ...}
- normal - {\normalsize ...}
- large - {\large ...}
- Large - {\Large ...}
- LARGE - {\LARGE ...}
- huge - {\huge ...}
- Huge - {\Huge ...}

References are Easy

To refer to a table, figure, section or equation in your document you need two elements, a label and a reference:

put `\label{labelName}` after the entity

```
\section{Definitions}          or    \begin{equation}
\label{sec:defn}                     \label{eq:bellman}
```

use \ref{labelName} in your text

"The set S_π, see section \ref{sec:defn} ..."

becomes

The set S_π, see section 2.1 ...

Figure Environment

Environments define a block of content with different properties

1 The Ice Age

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Mauris est nunc, pharetra nec, aliquam bibendum, adipiscing a, neque.

In ultrices porta lacus. Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien. In at felis. In fermentum libero eget elit. In aliquet magna vel diam. Suspendisse fringilla.

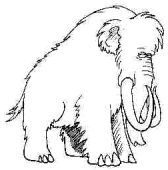

Figure 1: A Mammoth

The mammoth, see Figure 1, is aliquam et enim. Duis eget pede sit amet libero vulputate vestibulum. Duis ultricies felis vel ipsum. Aliquam ligula. Nulla tortor. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Mauris luctus felis vel urna.

```
\begin{figure}[h]
  \begin{center}
  \includegraphics[height=.75in]
                  {mammoth.png}
  \caption{A Mammoth}
  \label{fig:mammoth}
  \end{center}
\end{figure}
```

The mammoth, see Figure \ref{fig:mammoth} is ...

Table Environment

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Mauris est nunc, pharetra nec, aliquam bibendum, adipiscing a, neque.

In ultrices porta lacus. Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien. In at felis. In fermentum libero eget elit. In aliquet magna vel diam. Suspendisse fringilla.

Name	ID	Score
Peter	3297	3.0
John	2719	3.3
Sarah	9172	3.7

Table 1: Score Tables for Today

The scores, see Table 1, is aliquam et enim. Duis eget pede sit amet libero vulputate vestibulum. Duis ultricies felis vel ipsum. Aliquam ligula. Nulla tortor. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Mauris luctus felis vel urna. Donec sem. Nunc fermentum, augue id nonummy feugiat, sapien lacus varius lacus, a semper mauris nunc vitae elit.

```
\begin{table}[h]
  \begin{center}
  \begin{tabular}{|l|cr|}
    \hline
    {\bf Name} & ID & Score \\
    \hline
    Peter    & 3297 & 3.0\\
    John     & 2719 & 3.3\\
    Sarah    & 9172 & 3.7\\
    \hline
  \end{tabular}
  \end{center}
  \caption{Score Tables for Today}
  \label{tab:numbers}
\end{table}
```

The mammoth, see Figure \ref{fig:mammoth}, is ...

Theorems

In ultrices porta lacus. Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien. In at felis. In fermentum libero eget elit. In aliquet magna vel diam. Suspendisse fringilla.

Rule 1 *Bayes rule states that sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien.*

In theorem 1 we see that pede sit amet libero vulputate vestibulum. Duis ultricies felis vel ipsum. Aliquam ligula. Nulla tortor. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Mauris luctus felis vel urna. Donec sem. Nunc fermentum, augue id nonummy feugiat, sapien lacus varius lacus, a semper mauris nunc vitae elit.

Rule 2 *Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien.*

```
\newtheorem{thm}{Rule}
...
\begin{thm}
  \label{th:bayes}
  Bayes rule states ...
\end{thm}

In theorem \ref{th:bayes}
we see...
```

Two ways to invoke math mode

inline - We write

```
$\mathcal{T}:S \times \phi \mapsto \Re$
```

to get $\mathcal{T} : S \times \phi \mapsto \Re$

equation - An equation environment shows up on a different line

```
\begin{equation}
  \sum_{i=0}^N V_\pi(x)
\end{equation}
```

$$\sum_{i=0}^{N} V_{\pi}(x) \tag{1}$$

To drop all equation numbers:

```
\begin{equation*}...\end{equation*}
```

Other Equation Layouts

Add `\usepackage{amsmath}` to top of your document for more equation fun:

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Mauris est nunc, pharetra nec, aliquam bibendum, adipiscing a, neque.

In ultrices porta lacus. Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien. In at felis. In fermentum libero eget elit. In aliquet magna vel diam. Suspendisse fringilla.

$$\begin{aligned} p(A) &= \sum_B p(A|B) \sum_C p(B|C)p(C) && (1)\\ &= \sum_B p(A|B) f_1(B) \\ &= f_2(A) && (2) \end{aligned}$$

Duis eget pede sit amet libero vulputate vestibulum. Duis ultricies felis vel ipsum. Aliquam ligula. Nulla tortor. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Mauris luctus felis vel urna. Donec sem. Nunc fermentum, augue id nonummy feugiat, sapien lacus varius lacus, a semper mauris nunc vitae elit.

```
\begin{align}
   p(A)     &= \sum_B p(A|B)
                \sum_C p(B|C) p(C)\\
   \notag   &= \sum_B p(A|B) f_1(B)\\
            &= f_2(A)
\end{align}
```

$$\begin{aligned} p(A) &= \sum_B p(A|B) \sum_C p(B|C)p(C) && (2)\\ &= \sum_B p(A|B) f_1(B) \\ &= f_2(A) && (3) \end{aligned}$$

Math in its bones

The best thing about LaTeX is how it deals with math:

super-scripts	a^2	a^2
	e^{f(x^2+x+z)}	$e^{f(x^2+x+z)}$
sub-scripts	V_\pi(x)	$V_\pi(x)$
both	\int^a_b	$\int_b^a$
	\sum_{i=0}^N	$\sum_{i=0}^N$
	\prod_{s=1}^\infty	$\prod_{s=1}^\infty$
fractions	\frac{1}{x}	$\frac{1}{x}$
large brackets	\left[... \right]	$\left[\frac{\frac{a+b}{N}}{\sum_X x+y+z} \right]^{\frac{1}{x}}$
	\biggl{ \biggr} (\Biggl)	

Math in its bones

The best thing about LaTeX is how it deals with math:

$\Gamma\tau\epsilon\epsilon\kappa$	\pi \phi \alpha \delta \aleph	$\pi\phi\alpha\delta\aleph$
spacing	\:	single space
	~	single non-breaking space
	\quad \qquad	space double-space
	\vspace{.5in} \hspace{8pt}	vertical/horizontal
misc	\sim	$\sim$
	\backslash	$\backslash$

If you can't remember the symbol try detexify:
http://detexify.kirelabs.org/classify.html

Style Sheets

`.sty` or `.cls` files describing layout and formatting

conferences - most CS conferences provide a Word template and a late style sheet

thesis - Brian D'Alwis' style sheet package
`http://www.cs.ubc.ca/ bsd/ubcdiss/`
(FoGS will love you.)

Bibliographies – BibTeX

Create a .bib file, say references.bib

```
@article{pearl:1993za,
Author = {Judea Pearl},
Journal = {Statistical Science},
Pages = {266-269},
Title = {Graphical models, causality and intervention.
Volume = {8},
Year = {1993}} }
```

- Many websites provide .bib file (citeseer, ACM, ...)
- Tools : BibDesk (Mac), CiteULike.com

Bibliographies – BibTeX

Add bibliography: Before `\end{document}` add:

```
\bibliographystyle{plain}
\bibliography{references}
\end{document}
```

use natbib: `\usepackage[square]{natbib}`

Add citation: In your text simply write

- `\citet{pearl:1993za}` to get "Pearl [1993] showed..."
- `\citep{pearl:1993za}` to get "It was shown in [Pearl,1993]..."

Bibliographies – BibTeX

Compile: You need to add another step:

- `pslatex yourdoc.tex`
- `bibtex yourdoc`
- `pslatex yourdoc.tex`
- `pslatex yourdoc.tex` (yes, you have to do it twice)

In ultrices porta lacus. Sed urna felis, consequat ut, interdum sit amet, aliquet tincidunt, sapien. In at felis. In fermentum libero eget elit. In aliquet magna vel diam. Suspendisse fringilla.

Pearl showed [1] that pede sit amet libero vulputate vestibulum. Duis ultricies felis vel ipsum. Aliquam ligula. Nulla tortor. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Mauris luctus felis vel urna. Donec sem. Nunc fermentum, augue id nonummy feugiat, sapien lacus varius lacus, a semper mauris nunc vitae elit.

References

[1] Judea Pearl. Graphical models, causality and intervention. *Statistical Science*, 8:266–269, 1993.

Making LaTeX presentations is easy

LaTeX can do presentations as well

Beamer: This presentation, many styles, simple `frame` environment for each slide

Prosper: Very popular, few years old, lots of standard slide styles (example)

Seminar: 15 years old, not updated, basis for new ones. Don't use it.

Customization

LaTeX allows you to define your own commands and evironments

- `\newcommand{\comment}[1]{}`
  You type: `\comment{Text you don't want seen}`
- `\newcommand{\ms}[2]{\sum_{i=#1}^{#2}X_i}`
  You type: `\ms{0}{N}`
  You get: $\sum_{i=0}^{N} X_i$
- `\newenvironment[#args]{begin}{end}`

Packages...gotta collect them all!

\uspackage{usefulpackage}

times, palatino, and charter: different fonts to use

algorithm2e : for laying out pseudocode

hyperref and url: for inserting hypertext references

multirow: for spanning multiple rows in tables, `\multicol` built in

pdflatex: why bother with an intermediate? Also has the advantage that hyphenated words are searchable un-hyphenated.

listings: for flexible typesetting of code fragments

savetrees: for squeezing more goodness out of that 6-page limit

geometry: for simple ways to set pagelayouts

fancyhdr: for setting headers and footers

Other tools

convert: convert image formats

ispell: interactive spell check, understands LaTeX

make: if you're really keen

xfig + psfrag: a match made in heaven, leave text tags in image, save as eps, `\psfrag{tag}{$x^n$}` replaces the tags in the image

fig2dev: convert for xfig images

gnuplot: do you gnuplot?

lgrind: (on cascade) convert program code files to LaTeX formatting, include with one simple tag

Even More tools

longtable:	tables can extend over multiple pages
acronym:	tag acronyms in text `\ac{mdp}` and acronym shows up, listing of all acronyms, first occurence fully spelled out
varioref:	dynamic page references “on the following page”
xspace:	solve extra space problem in newcommands
appendix:	better appendix headers
floatpag:	control page numbering in figures

Making Figures

- Illustrator + export to pdf
- xFig + save as EPS + convert ps2pdf or psfrag
- (mac) OmniGraffle + LaTeXit (soooo cool)
- powerpoint....don't....do it.

Distributions

There are lots of LaTeX editors out there and different ways to install it

editors: Vim and Emacs have LaTeX modes to colour code it and check spelling, what more do you need?

MaxOSX: TeXShop is a good WYSIWYG editor with a nice previewer.

Eclipse: TeXclipse plugin lets you manage latex projects in eclipse, section outline, code compeltion, compile in IDE.

Useful links

- Hypertext Help with LaTeX
  `http://tex.loria.fr/general/latex2e.html`
- LaTeX on the department wiki `bugs.cs.ubc.ca/cgi-bin/twiki/view/Grads/WritingTools`
- Local installation
  `/cs/local/generic/lib/pkg/teTeX-2.0.2/`
- Local LaTeX info
  `http://www.cs.ubc.ca/~edmonds/ubc/lg/local-guide.html`
- CS department ubc-thesis style
  `/cs/local/generic/share/texmf/tex/latex/contrib/ubc/cs/ubc-thesis`
- BibTeX template
  `http://www.cs.ubc.ca/~bsd/tex/templates.bib`

Summary

LaTeX ...

- uses an open, declarative markup
- allows a standard layout that conforms to a style sheet
- lets you focus on content, not style and layout
- lets you write any mathematical expression easily
- provides easy support for chapters, tables of contents, bib...
- lets you use your favourite text editor
- makes you crazy, geeky cool...use LaTeX!

Any questions?