Introduction to LaTeX for Sophomore Seminar

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(with slight modifications by Charlie Peck)

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1 What is LaTeX?

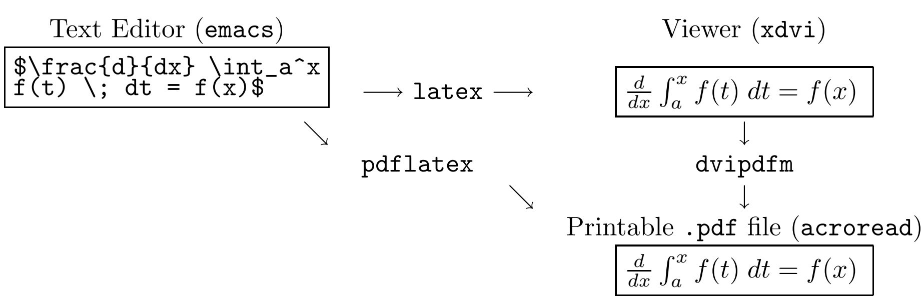
LaTeX is a typesetting program designed especially for writing mathematical text. You've already seen several examples of mathematical writing which was typset using either LaTeX or its cousin, TeX: Most handouts you get from me, Mic, or Tim are written in LaTeX, and these days many mathematical books – including *Chapter Zero* – are typset using some form of TeX. Writing mathematics in LaTeX takes some getting used to, but the results are sufficiently pretty that I think you'll agree it's time well-spent.

LaTeX is equally suited to writing documents for computer science; articles, reports, papers, dissertations, and the like. The learning

2 Creating and Compiling a LaTeX document

The first thing to keep in mind is that unlike a typical word processor, what you see as you create your LaTeX file is not what the final product will look like. Instead, you will use a *text editor* to type text intermixed with various codes telling LaTeX what to do. Then you'll run your text through a *compiler*, and view the result with a *viewer*. Depending on how you do it, you might need to run a second program to get a printable `.pdf` file.

Schematically, this process looks like:



On the ACL machines this can be acheived with:

```
codd$ latex paper.tex           # DVI output, viewed with xdvi
codd$ pdflatex paper.tex        # PDF output, viewed with acroread
```

3 A simple LaTeX document

By way of example, on a following page is a simple LaTeX file input file and its output. Here are some things to notice about it.

3.1 Preamble

The first few lines of the document, prior to the `\begin{document}`, give LaTeX some preliminary information about the document, tell LaTeX where to look for some of the commands that will be used in the document. The preamble also defines a few commands to be used later. Don't worry much about the preamble for now.

3.2 Beginnings and Endings

The main part of the document begins with `\begin{document}` and ends with `\end{document}`. In between, there are several smaller sections of the document that are set off with `\begin{something}` and `\end{something}`.

3.3 Mathematics

The heart of LaTeX is its ability to typeset mathematics. Anything mathematical is set off with either a single dollar sign `$` at the beginning and the end, or with a double dollar sign `$$` at the beginning and the end. Mathematical symbols are represented by commands such as `\cup` or `\in`.

3.4 Graphics

If you want to get fancy, you can include files created elsewhere into a LaTeX document. The easiest way to do this is to save your picture as an Encapsulated Postscript (`.eps`) file. Maple, in particular, can export any graph it creates to an `.eps` file. The lines in the preamble following `%Figures` define a command, `\myfig`, for including figures. The `\myfig` command is used at the end of the document.

Caution: `.eps` figures typically can't be seen when you view the file with `xdvi`, only when you look at the `.pdf` file.

4 A More Complicated LaTeX document

Following the simple LaTeX file and its output, you'll find a more complicated LaTeXfile and the output it produces. Some things to notice about the more complicated document:

4.1 "Hidden" preamble

The preamble to the second document is actually pretty short, but that's because the most complicated parts have been placed into another file, `macros.tex`.

4.2 Sectioning

This document is broken down into numbered sections. The sections are given names inside the LaTeX file with the `\label` command, so they can be referred to by number with the `\ref` command. LaTeX will keep track of the section number for you, even if you insert a new section, causing everything to be re-numbered. Similarly, theorems are numbered and can be referred to by number.

4.3 Tables

LaTeX can make tables. Within a table, separate entries with `&` and end a line with `\\`.

```
\documentclass[10pt]{article}
\usepackage{amsmath,amsthm}
\usepackage{epsfig}

\newcommand{\myfig}[2]{\begin{figure}[htbp]\begin{center}
      {\scalebox{.4}{\includegraphics{#1.eps}}}
      \caption{#2}\label{fig:#1}
    \end{center}\end{figure}}

\newtheorem*{theorem}{Theorem}

\begin{document}

\begin{theorem}[2.4.2]
    Let $A$, $B$, and $C$ be sets.  Then
    $$A \cup (B \cap C) = (A \cup B) \cap (A \cup C).$$
\end{theorem}

\begin{proof}
    To show that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ we
    must show two things:

    \begin{align*}
(\subseteq) & \qquad A \cup (B \cap C) \subseteq (A \cup B)
\cap (A \cup C), \\
(\supseteq) & \qquad (A \cup B) \cap (A \cup C) \subseteq A
\cup (B \cap C).
    \end{align*}

    \begin{itemize}
\item[$(\subseteq)$]
To prove the first inclusion, let $x \in A \cup (B \cap C)$.
This means that $x \in A$ or $x \in (B \cap C)$.  If $x \in
A$, then $x$ is in the union of $A$ with any other set.  So $x
\in A \cup B$, and $x \in A \cup C$.  Likewise, if $x \in (B
\cap C)$, then $x \in B$ and $x \in C$.  We can deduce from
this that $x \in A \cup B$ and that $x \in A \cup C$.  In
either case, $x$ is seen to be in $(A \cup B) \cap (A \cup
C)$.  This concludes the proof that $A \cup (B \cap C)
\subseteq (A \cup B) \cap (A \cup C)$.


\item[$(\supseteq)$]
Conversely, to prove the second inclusion, suppose that $x \in
(A \cup B) \cap (A \cup C)$.  That is, $x \in (A \cup B)$ and
$x \in (A \cup C)$.  We know in general, of course, that
either $x \in A$ or $x \not\in A$.  If $x \in A$, then
certainly $x \in A \cup (B \cap C).$ So suppose that $x
\not\in A$.  In this case, $x$ must be in $B$ because $x \in A
\cup B$.  Also we see that $x \in C$ since $x \in A \cup C$.
We then conclude that $x \in B \cap C$.  Hence here, too, $x
\in A \cup (B \cap C)$.  We have now shown that $(A \cup B)
\cap (A \cup C) \subseteq A \cup (B \cap C)$.
    \end{itemize}

    Therefore, $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.
\end{proof}

\myfig{venn}{Venn Diagram for
$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$}

\end{document}
```