Using LaTeX

About these notes These notes give some starting tips on using LaTeX to typeset mathematical documents. To learn the system at all fully you'll need a proper LaTeX manual, but you can get started with this, and begin to see something of how the system works. To see what's happening you'll need to see this document both in its pretty (typeset) form and in its raw or (input) form. If you're reading this on paper, the input form follows the typeset form.

What is LaTeX? LaTeX is a powerful but (conceptually) simple program for processing mathematical and ordinary text. Based on TeX (an even more powerful typesetting markup language), LaTeX has become more or less the mathematician's international gold standard for preparing professionally typeset mathematical documents. LaTeX is quite different from—indeed, essentially opposite to—WSYWIG (what you see is what you get) word processors such as . . . gasp . . . Microsoft Word. LaTeX is closer in spirit to HTML (HyperText Markup Language; used for creating Web pages) in that both include explicit "markup" commands, which tell the computer to treat words or characters in special ways. In LaTeX jargon, for example, the command `{\it dog}` causes the word *dog* to be set in italics. The similar command `{\bf dog}` causes **dog** to be set in boldface type.

How LaTeX works To use LaTeX, one first creates (using any old word processor or text editor, even Microsoft Word) an "input file," called something like `latexprimer.tex`. This file is fed to LaTeX, which creates a new file, called something like `latexprimer.dvi`. This new file is something like a JPEG or a GIF file; it's hard or impossible for a human to read in raw form, but with appropriate software it can be viewed or printed to produce a beautifully typeset result. Exactly *how* the `*.tex` file is fed to LaTeX and how the result is viewed or printed depends on the software you have available; that subject won't be treated here.

The best way to start to see how LaTeX works is to look carefully at an input file (like the one that produces this document). You'll see that nearly all LaTeX commands start with a backslash (\). Many commands start with something of the `\begin{commandname}` and end with `\end{commandname}`. The basic structure of LaTeX was designed by a mathematician (Donald Knuth); perhaps for that reason an input file always contains lots of curly braces.

Making numbered lists A numbered list is just that—a collection of items sorted and labeled by number. Here is an example:

1. This is the first item to be enumerated. Notice how indentation is handled; the format is called a "hanging indent."

   Here is a second paragraph of stuff within the first numbered item.

2. Here is the second item to be enumerated.

3. Here is the third item to be enumerated.

Now the enumerated list is done; the margins revert to their defaults.

To see how exactly how LaTeX produced this list you'll need to look carefully at the input form of this document.

Font styles and sizes There's seldom any good reason to mess around with the basic LaTeX font (called Computer Modern), but there are often good reasons to use the *italic* style and **boldface** style. Other styles, such as the sans serif style and the *slant* style, are possible, but seldom of much use. The input form of this document shows how these styles are created.

Type sizes are easily changed (though there's seldom much reason to do so). Here are some words that illustrate some of the sizes possible:

small, large, Large.

The input file shows how to produce these effects. (In practice, they're seldom really needed.)

Math mode LaTeX handles mathematical symbols and expressions like a dream, but it needs to be told *exactly* what you want. As a rule you turn math mode on and off by using either single or double dollar signs. To produce $a+b=c$, for instance, you type `$a+b=c$`. To produce $\int_a^b f(x)dx$, you type `$\int_a^b f(x) dx$` . To produce $\frac{a}{b}=c$, you type `$\frac{a}{b}=c$` . To produce $\frac{a}{b+d}=c$, you type `$\frac{a}{b+d}=c$`. Notice the careful use of wiggly brackets to group things, and how subscripts and superscripts are formed.

The examples above illustrate the **in-line math** style; everything appears on the same line as the ordinary type, and spacing can get crowded. The other possibility is called **displayed equation** style; here's an example:

$$f'(c) = \lim_{n\to\infty} \frac{1-r^{n+1}}{1-r} = \frac{1}{r}.$$

Note that the equation is centered on its own line, doesn't interfere with surrounding text, and is easier to read when expressions are complicated. On the other hand, displayed equations take more vertical space, and can be annoying to read if they come along too often.

LaTeX nicely handles Greek mathematical symbols, such as π, ϵ, δ, θ, ξ, α, and β. See the input file for how this is done.

```
% This is the file  latexprimer.tex .   Any line in the input file
% that begins with a % (percent sign) is treated as a comment, and ignored
% by LaTeX.   Note that blank lines and empty spaces are ignored
% by LaTeX, so it's fine to leave spaces wherever doing so is convenient.

\documentclass{article}
\usepackage{amsmath}
\setlength{\parskip}{5pt}
\setlength{\parindent}{24pt}
\setlength{\oddsidemargin}{0in}
\setlength{\textwidth}{6.5in}
\setlength{\textheight}{9in}
\pagestyle{plain}

% All lines above this point are considered part of the ``preamble''.  They
% tell LaTeX various things about the document to come, but aren't actually
% part of the document as such, which begins after the following line.
% Note that most commands begin with backslashes, and that lengths can
% be measured in inches or in ``points'' (one point is 1/72 of an inch).
% Other units of measurement (cm, mm, etc.) are also allowed.
% The \pagestyle command says that pages are numbered in the ``usual'' way.

\begin{document}

\centerline{\Large Using \LaTeX\ }

% The line above tells LaTeX to center the stuff within braces.  The
% first word in braces ( \Large ) tells LaTex to use Large characters.
% The word \LaTeX\ is handled in a special way; that's why it appears
% with backslashes.

\vskip .25 in

% The line above LaTeX to skip .25 inches vertically.
% The following command creates a paragraph header (set in boldface)
% out of the given text.

\paragraph*{About these notes}
These notes give some vague suggestion on how to use \LaTeX\ to
typeset  mathematical documents.   To learn the system at all fully
you'll need a proper \LaTeX\ manual, but you can get started with this,
and begin to see something of how the system works.  To see what's
happening  you'll need to see this document both in its pretty (typeset)
form and in its raw or (input) form.   If you're reading this on paper,
the input form follows the typeset form.

\paragraph*{What is \LaTeX?}
\LaTeX\ is a  powerful but (conceptually) simple program for processing
mathematical and ordinary text.   Based on \TeX\ (an even more powerful
typesetting markup language), \LaTeX\ has become more or less the
mathematician's
international gold standard for preparing professionally typeset mathematical
documents.   \LaTeX\ is quite different from---indeed, essentially opposite
to---WSYWIG (what you see is what you get) word processors such as \dots
```

```
gasp \dots Microsoft Word.   \LaTeX\ is closer in spirit to HTML (HyperText
Markup Language; used for creating Web pages) in that both include explicit
‘‘markup’’ commands, which tell the computer to treat words or characters in
special ways.   In \LaTeX\ jargon, for example, the command \verb+{\it dog}+
causes the word {\it dog} to be set in italics.    The similar command
\verb+{\bf dog}+ causes {\bf dog} to be set in boldface type.

% The \verb command is slightly atypical.  Don’t worry about it too much
% at this point.   In effect, it causes things to be printed ‘‘verbatim,’’
% whatever that means.

\paragraph*{How \LaTeX\ works}
To use \LaTeX, one first creates (using any old word processor or text editor,
even Microsoft Word) an ‘‘input file,’’ called something like
\verb+latexprimer.tex+.This file is fed to \LaTeX, which creates a new file,
called something like \verb+latexprimer.dvi+.  This new file is
something like a
JPEG or a GIF file; it’s hard or impossible for a human to read in
raw form, but
with appropriate software it can be viewed or printed to produce a beautifully
typeset result.  Exactly {\em how} the \verb+*.tex+ file is fed to
\LaTeX\ and how
the result is viewed or printed depends on the software you have
available; that
subject won’t be treated here.

The best way to start to see how \LaTeX\ works is to look carefully at an input
file (like the one that produces this document).   You’ll see that nearly all
\LaTeX\ commands start with a backslash (\verb+\+).  Many commands start with
something of the \verb+\begin{commandname}+ and end with
\verb+\end{commandname}+.
The basic structure of \LaTeX\ was designed by a mathematician (Donald Knuth);
perhaps for that reason an input file always contains lots of curly braces.

\paragraph*{Making numbered lists}
A numbered list is just that---a collection of items sorted and labeled by
number.   Here is an example:
\begin{enumerate}
% The command above tells LaTeX that an enumerated list is coming.
% Each ‘‘item’’ in the list starts with an \item  command.

\item
This is the first item to be enumerated.   Notice how indentation
is handled; the format is called a ‘‘hanging indent.’’

\item
Here is the second item to be enumerated.

\item
Here is the third item to be enumerated.
\end{enumerate}
% The command above tells LaTeX that an enumerated list has ended.
Now the enumerated list is done; the margins revert to their defaults.
```

```
To see how exactly how \LaTeX\ produced this list you'll need to
look carefully at the input form of this document.

\paragraph*{Font styles and sizes}   There's seldom any good reason
to mess around with the basic \LaTeX\ font (called Computer Modern), but
there are often good reasons to use the {\it italic} style and
{\bf boldface} style.    Other styles, such as the {\sf sans serif} style
and the {\sl slant} style, are possible, but seldom of much use.
The input form of this document shows how these styles are created.

% Note the commands above that produce italic, bold, and other shapes.
% In each case, curly brackets ({ and }) define the ``scope'' of the command.

Type sizes are easily changed (though there's seldom much reason
to do so).   Here are some words that illustrate some of the sizes
possible:
\begin{quote}
{\small small}, {\large large}, {\Large Large}.
\end{quote}
The input file shows how to produce these effects.  (In practice, they're
seldom really needed.)

\paragraph*{Math mode}
\LaTeX\ handles mathematical symbols and expressions like a dream,
but it needs to be told {\em exactly} what you want.   As a rule
you turn math mode on and off by using either single or double
dollar signs.   To produce $a+b=c$, for instance, you type
\verb@$a+b=c$@.   To produce $\int_a^b f(x) dx$, you type
\verb@$\int_a^b f(x) dx$@ .
To produce $\frac{a}{b}=c$, you type \verb@$\frac{a}{b}=c$@. To produce
$\frac{a}{b+d}=c$, you type \verb@$\frac{a}{b+d}=c$@.  Notice
the careful use of wiggly brackets to group things, and how
subscripts and superscripts are formed.

% As earlier, you should basically ignore the \verb commands above.  The
% important commands are those that start and end with the dollar sign ($).

The examples above illustrate the {\bf in-line math} style; everything
appears on the same line as the ordinary type, and spacing can get
crowded.   The other possibility is called {\bf displayed equation} style;
here's an example:
$$
f'(c)  = \lim_{n \to \infty} \frac{1-r^{n+1}}{1-r} = \frac{1}{r} .
$$
% Look carefully at how the \frac command works; the numerator is in the first
% set of braces and the denominator in the second.
Note that the equation is centered on its own line, doesn't interfere
with surrounding text, and is easier to read when expressions
are complicated.    On the other hand, displayed equations take
more vertical space, and can be annoying to read if they come along too
often.

\LaTeX\ nicely handles Greek mathematical symbols, such as  $\pi$, $\epsilon$,
$\delta$, $\theta$, $\xi$, $\alpha$, and $\beta$.   See the input file
```

```
for how this is done.

\end{document}
% Every document ends with an \end{document} command.
```