Introduction to \LaTeX
Part I

Clyde Clements

October 17, 2002
What is $\TeX$?

- $\TeX$ is a typesetting system
- It is “intended for the creation of beautiful books—and especially for books that contain a lot of mathematics”.
- Created by Donald E. Knuth (Ph.D. in Mathematics, California Institute of Technology)
- First version appeared in 1978
  Second version appeared in 1982
  Third (and final!) version appeared in 1990
What is \TeX? 

- \TeX{} is a typsetting system
- It is “intended for the creation of beautiful books—and especially for books that contain a lot of mathematics”.
- Created by Donald E. Knuth (Ph.D. in Mathematics, California Institute of Technology)
- First version appeared in 1978
  Second version appeared in 1982
  Third (and final!) version appeared in 1990

Features
- High-quality output
- Powerful, extensible through macro definitions
- Stable
What is \TeX?  

- \TeX{} is a typesetting system  
- It is “intended for the creation of beautiful books—and especially for books that contain a lot of mathematics”.  
- Created by Donald E. Knuth (Ph.D. in Mathematics, California Institute of Technology)  
- First version appeared in 1978  
  Second version appeared in 1982  
  Third (and final!) version appeared in 1990  

Features  

- High-quality output  
- Powerful, extensible through macro definitions  
- Stable  

Primary drawback  

- Difficult to learn
What is \LaTeX?  

- \LaTeX is a set of macros for \TeX
- Created by Leslie Lamport (Ph.D. in Mathematics, Brandeis University)
- First widely available version, numbered 2.09, appeared in 1985
  Second (and current) version, numbered 2.0, appeared in 1994
  Future version will appear in 200x
- Offers structured, or logical, document design. Compare

  This is how to emphasize text.          This is how to \{\it emphasize\} text.
What is \LaTeX?

- \LaTeX is a set of macros for \TeX
- Created by Leslie Lamport (Ph.D. in Mathematics, Brandeis University)
- First widely available version, numbered 2.09, appeared in 1985
  Second (and current) version, numbered 2e, appeared in 1994
  Future version will appear in 200x
- Offers structured, or logical, document design. Compare
  This is how to \textit{emphasize} text. \hspace{1cm} This is how to \texttt{\textbackslash it emphasize} text.
  with
  This is how to \textbf{emphasize} text. \hspace{1cm} This is how to \texttt{\textbf{emphasize}} text.
- Encourages writers to think about content rather than form
How to Use \LaTeX: A Quick Tour

- Create a plain text file.
  File name should end with .tex, e.g. sample.tex

- Process the file with \LaTeX.
  At the command prompt, type:
  
  ```latex
  latex sample.tex
  ```

  \LaTeX creates sample.dvi.
  dvi stands for 'device independent'; this file can be used to create output on a range of printing devices.

- To view document, type:
  
  ```
  xdvi sample.dvi
  ```

- To print document, type:
  
  ```
  dvips -P chase-mailroom sample.dvi
  ```
Creating an Input File: Some Preliminaries

- Ten special characters:
  # $ % & { } _ ^ ~ \n
- Most commands start with \n
- Arguments to commands are usually enclosed in \{\}, e.g. \emph{emphasize}\n
- Braces are also used for grouping, e.g. {\it emphasize}\n
- Optional arguments are usually enclosed in [ ]\n
- Comments are started with %\n
- Spaces mark the ends of words and sentences. Blank lines mark the ends of paragraphs. Number of spaces or blank lines is insignificant.
Structure of a \LaTeX Document

Every document must contain:
\documentclass[options]{class}
\begin{document}
\end{document}

Section between \documentclass and \begin{document} is called the \textit{preamble}.
Structure of a LaTeX Document

Every document must contain:

\documentclass[options]{class}
  ...
\begin{document}
  ...
\end{document}

Section between \documentclass and \begin{document} is called the preamble.

Standard document classes: article, report, letter,
Structure of a \LaTeX{} Document

Every document must contain:

\documentclass[options]\{class\}
\begin{document}
\end{document}

Section between \documentclass and \begin{document} is called the \textit{preamble}.

Standard document classes: article, report, letter, and for those of you who are very productive, book.
Structure of a \LaTeX Document

Every document must contain:

\documentclass[options]{class}
  ...
\begin{document}
  ...
\end{document}

Section between \documentclass and \begin{document} is called the \textit{preamble}.


Options:

10pt|11pt|12pt Sets the type size of the document. Default: 10pt

letterpaper|legalpaper Formats the document for the appropriate paper size. Default: letterpaper

onecolumn|twocolumn Specifies one-column or two-column pages. Default: onecolumn
Example

\documentclass{article}
\begin{document}
This is my first document. Spaces mark the ends of words and sentences. Blank lines mark the ends of paragraphs.

Here is a new paragraph. The number of spaces or blank lines is insignificant.
\end{document}

This is my first document. Spaces mark the ends of words and sentences. Blank lines mark the ends of paragraphs.
Here is a new paragraph. The number of spaces or blank lines is insignificant.
Why Use \LaTeX?  

- Stresses logical design vs. visual design
Why Use \LaTeX?  

- Stresses logical design vs. visual design

“A visual system makes it easier to create visual effects rather than a coherent structure; logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing.”  Jon Warbrick
Why Use \LaTeX? 

- Stresses logical design vs. visual design
  
  “A visual system makes it easier to create visual effects rather than a coherent structure; logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing.” Jon Warbrick

- Provides excellent mathematical typesetting
Why Use \LaTeX? 

- Stresses logical design vs. visual design
  
  “A visual system makes it easier to create visual effects rather than a coherent structure; logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing.”  Jon Warbrick

- Provides excellent mathematical typesetting

- Cross-references, bibliographies, table of contents, etc. are handled easily
Why Use \LaTeX? 

- Stresses logical design vs. visual design
  “A visual system makes it easier to create visual effects rather than a coherent structure; logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing.” Jon Warbrick

- Provides excellent mathematical typesetting

- Cross-references, bibliographies, table of contents, etc. are handled easily

- Available FREE of charge on many platforms
Why Use \LaTeX?  

- Stresses logical design vs. visual design  
  “A visual system makes it easier to create visual effects rather than a coherent structure; logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing.”  
  Jon Warbrick  

- Provides excellent mathematical typesetting  

- Cross-references, bibliographies, table of contents, etc. are handled easily  

- Available FREE of charge on many platforms  

- \LaTeX documents are plain text (or ASCII) files; therefore, highly portable*
Why Use \LaTeX? 

- Stresses logical design vs. visual design
  
  "A visual system makes it easier to create visual effects rather than a coherent structure; logical design encourages you to concentrate on your writing and makes it harder to use formatting as a substitute for good writing."  Jon Warbrick

- Provides excellent mathematical typesetting

- Cross-references, bibliographies, table of contents, etc. are handled easily

- Available FREE of charge on many platforms

- \LaTeX \ documents are plain text (or ASCII) files; therefore, highly portable*

- NOT a Microsoft product; i.e. \LaTeX \ actually works :-)

* \LaTeX \ is a TeX program that provides a markup language for typesetting computer documents.
Sectioning Commands; Producing a Title

- \part \chapter \section \subsection 
  \subsubsection \paragraph

Example of use: \section{Name of Section}

- article class does not have a \chapter command

- \appendix. This command takes no argument and produces no text, but changes how subsequent sections are numbered. For example, “Chapter 1” is replaced with “Appendix A”.

- Producing a title: \title \author \date

Example of use: \title{This is my title}
\maketitle produces the actual title.
Example

\documentclass[12pt]{report}
\title{A Report on Ordinary Differential Equations}
\author{Otus D. Evans}
\date{May 5, 1995}
\begin{document}
\maketitle

\chapter{Initial-Value Problems for Ordinary Differential Equations}

\section{Theory of Initial-Value Problems}
Differential equations are used to model problems in science and engineering that involve the change of some variable with respect to another. Most of these problems require the solution to an initial-value problem, that is, the solution to a differential equation that satisfies a given initial condition.
\end{document}
A Report on Ordinary Differential Equations

Otus D. Evans

May 5, 1995
Chapter 1

Initial-Value Problems for Ordinary Differential Equations

1.1 Theory of Initial-Value Problems

Differential equations are used to model problems in science and engineering that involve the change of some variable with respect to another. Most of these problems require the solution to an initial-value problem; that is, the solution to a differential equation that satisfies a given initial condition.
Changing the Type Style

The type style can be changed by using one of the following commands.

**Upright shape**  
\textup{Upright shape}  
{\upshape Upright shape}

**Italic shape**  
\textit{Italic shape}  
{\itshape Italic shape}

**Slanted shape**  
\textsl{Slanted shape}  
{\slshape Slanted shape}

**Small caps shape**  
\textsc{Small caps shape}  
{\scshape Small caps shape}

**Medium series**  
\textmd{Medium series}  
{\mdseries Medium series}

**Boldface series**  
\textbf{Boldface series}  
{\bfseries Boldface series}

**Roman family**  
\textrm{Roman family}  
{\rmfamily Roman family}

**Sans serif family**  
\textsf{Sans serif family}  
{\sffamily Sans serif family}

**Typewriter family**  
\texttt{Typewriter family}  
{\ttfamily Typewriter family}
The above commands can be combined in the logical way.

A mathematician is a machine for converting \texttt{coffee} into \texttt{Theorems}.

\begin{verbatim}
A mathematician is a machine for converting \textsl{\textsf{coffee}} into \texttt{Theorems}.
\end{verbatim}
Interlude
Interlude

Anyone who cannot cope with mathematics is not fully human. At best he is a tolerable subhuman who has learned to wear shoes, bathe and not make messes in the house.

— Lazarus Long, in *Time Enough for Love*
Changing the Type Size

\LaTeX{} provides the following commands for changing the type size.

\begin{verbatim}
\text \{\tiny text\}
\text \{\scriptsize text\}
\text \{\footnotesize text\}
\text \{\small text\}
\text \{\normalsize text\}
\text \{\large text\}
\text \{\Large text\}
\text \{\LARGE text\}
\text \{\huge text\}
\text \{\Huge text\}
\end{verbatim}
Typesetting Mathematics: Part I

In-text Formula

Three ways to create an in-text formula:

\begin{math} ... \end{math}
\( ... \)
$ ... $
Typesetting Mathematics: Part I

In-text Formula

Three ways to create an in-text formula:

\begin{math} ... \end{math}
\( ... \)
$ ... $

Does $x - y$ always equal $-y + x$? Does $x - y$ always equal $( - y + x )$?

Note that $x$ is not the same as $x$. Note that $x$ is not the same as $x$.
Displayed Formula

Two ways to create a displayed formula:

\begin{displaymath} ... \end{displaymath}
\[
\[
\]
Displayed Formula

Two ways to create a displayed formula:

\begin{displaymath} ... \end{displaymath}
\[ ... \]

Let’s consider the two functions

\[ f(x) = x - (x - 2)(x - 4)(x - 6)(x - 8) \]
and

\[ g(x) = x + (x - 1)(x - 3)(x - 5)(x - 7) \]

where $x > 0$.
Subscripts, Mathematical Symbols, and More

Subscripts and superscripts are produced with _ and ^

Let $x_i = i \cdot h^{2^i}$. Let $x_i = i \cdot h^{2^i}$.

Note that $x_n + 1$ is not the same as $x_{n+1}$. Note that $x_{n+1}$ is not the same as $x_{\{n+1\}}$. 

$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$

$\lim_{n \to \infty} \frac{1}{n} \sum_{i=1}^{n} \frac{1}{i}$

$\int_{a}^{b} f(x) \, dx$
Subscripts, Mathematical Symbols, and More

Subscripts and superscripts are produced with _ and ^

Let \( x_i = i \cdot h^{2^i} \).

Note that \( x_{n+1} \) is not the same as \( x_{n+1} \).

\( \LaTeX \) defines a number of other mathematical structures and symbols.

Making Greek letters is as easy as \( \pi \).

Making Greek letters is as easy as \( \pi \).

Thus, we have

\[
\int_{a}^{b} f(x) \, dx = \lim_{\| P \| \rightarrow 0} \sum_{i=1}^{n} f(x_i^*) \Delta x_i
\]

where \( \sum_{i=1}^{n} f(x_i^*) \Delta x_i \) is . . .

Note a displayed summation vs. an inline summation.

Spacing in Math Mode

\( \backslash! \) negative thin space \( \backslash; \) thick space
\( \backslash, \) thin space \( \backslash\text{ } \) interword space
\( \backslash: \) medium space
Subscripts, Mathematical Symbols, and More

Subscripts and superscripts are produced with _ and ^

Let $x_i = i \cdot h^{2^i}$. Let $x_i = i \cdot h^{2^i}$.

Note that $x_{n+1}$ is not the same as $x_{n+1}$. Note that $x_{n+1}$ is not the same as $x_{n+1}$.

\[ \int_a^b f(x) \, dx = \lim_{\| P \| \to 0} \sum_{i=1}^{n} f(x_i^*) \Delta x_i \]

where $\sum_{i=1}^{n} f(x_i^*) \Delta x_i$ is . . .

Note a displayed summation vs. an inline summation.

Spacing in Math Mode

\! negative thin space \; thick space
\, thin space \quad interword space
\: medium space
\[ \int \int z \, dx \, dy \]
Changing Type Style in Math Mode

\mathit \mathrm \mathbf \mathsf \mathtt \mathcal

So we have $a + b$. So we have $(\mathbf{a} + b)$.
Numbered Displayed Formula

This is produced with the equation environment:

\begin{equation} \frac{\partial u}{\partial t} = \lambda^2 \frac{\partial^2 u}{\partial x^2} \end{equation}
Cross-References

Cross-references allow you to refer to a section, equation, figure, etc. by assigning it a key.

\label{key} Assigns a number to key.
\ref{key} Prints the number assigned to key.
\pageref{key} Prints the page number of the place in the text where the corresponding \label appears.
Cross-References

Cross-references allow you to refer to a section, equation, figure, etc. by assigning it a key.

\label{key} Assigns a number to key.
\ref{key} Prints the number assigned to key.
\pageref{key} Prints the page number of the place in the text where the corresponding \label appears.

Example

\section{Introduction}
\label{sec:intro}

The binomial theorem states that if $n$ is a positive integer, then
\begin{equation}
(1 + x)^{n} = \sum_{k=0}^{n} \binom{n}{k} x^{k}
\label{eq:binom_theorem}
\end{equation}
This is Section~\ref{sec:intro}.
The binomial theorem is given in equation~\eqref{eq:binom_theorem} on page~\pageref{eq:binom_theorem}.
1 Introduction

The binomial theorem states that if \( n \) is a positive integer, then

\[
(1 + x)^n = \sum_{k=0}^{n} \binom{n}{k} x^k
\]

This is Section 1. The binomial theorem is given in equation (1) on page 1.
NOTE: You need to run LaTeX twice to resolve cross-references.
On the first run of LaTeX:

This is TeX, Version 3.14159 (Web2C 7.2)
(ex2.tex
LaTeX2e <1998/06/01>
Babel <v3.6j> and hyphenation patterns for american, french, german, ngerman, spanish, nohyphenation, loaded.
(/opt/TeX/share/texmf/tex/latex/base/article.cls
Document Class: article 1998/05/05 v1.3y Standard LaTeX document class
(/opt/TeX/share/texmf/tex/latex/base/size12.clo))
No file ex2.aux.

LaTeX Warning: Reference ‘sec:intro’ on page 1 undefined on input line 18.

LaTeX Warning: Reference ‘eq:binom_theorem’ on page 1 undefined on input line 20.

LaTeX Warning: Reference ‘eq:binom_theorem’ on page 1 undefined on input line 21.

[1] (ex2.aux)

LaTeX Warning: There were undefined references.

LaTeX Warning: Label(s) may have changed. Rerun to get cross-references right.

)

Output written on ex2.dvi (1 page, 948 bytes).
Transcript written on ex2.log.
On the second run of \LaTeX:

This is TeX, Version 3.14159 (Web2C 7.2)
(ex2.tex
LaTeX2e <1998/06/01>
Babel <v3.6j> and hyphenation patterns for american, french, german, ngerman, s
panish, nohyphenation, loaded.
(/opt/TeX/share/texmf/tex/latex/base/article.cls
Document Class: article 1998/05/05 v1.3y Standard \LaTeX document class
(/opt/TeX/share/texmf/tex/latex/base/size12.clo)) (ex2.aux) [1]
(ex2.aux) )
Output written on ex2.dvi (1 page, 876 bytes).
Transcript written on ex2.log.
Defining Your Own Commands

\newcommand \newcommand{\dal}{Dalhousie University}

I am a student at \dal in Halifax, Nova Scotia.

Could also use \dal{}.

\renewcommand \renewcommand{\emph}[1]{\textbf{#1}}

This word is emphasized.

This \emph{word} is emphasized.
Homework!

\LaTeX\ provides two example input files: small2e.tex and sample2e.tex. On mscs, these files can be found in the following directory:

/opt/TeX/share/texmf/tex/latex/base/

Copy the files to your home directory and give them a try!
Next Time

- Mathematical Typesetting: Part II
- Creating Bibliographies with \texttt{BIBTEx}
- Importing Graphics into Documents
- Use of \texttt{dalthesis} Document Class