A Very Brief Introduction to LaTeX
MAT 3535

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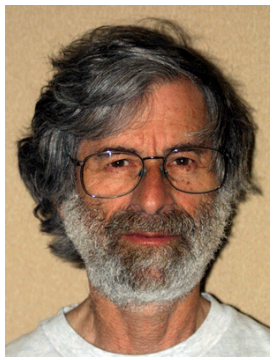
Topics

The Creators of TEX and LATEX

- TEX was created by Donald Knuth of Stanford U in the late 1970's.
- LATEX was begun by Leslie Lamport in the mid 1980's at *DEC*.
- Development continues with the LATEX3 Project.

Donald Knuth with the Spokeslion of the TEX Users Group

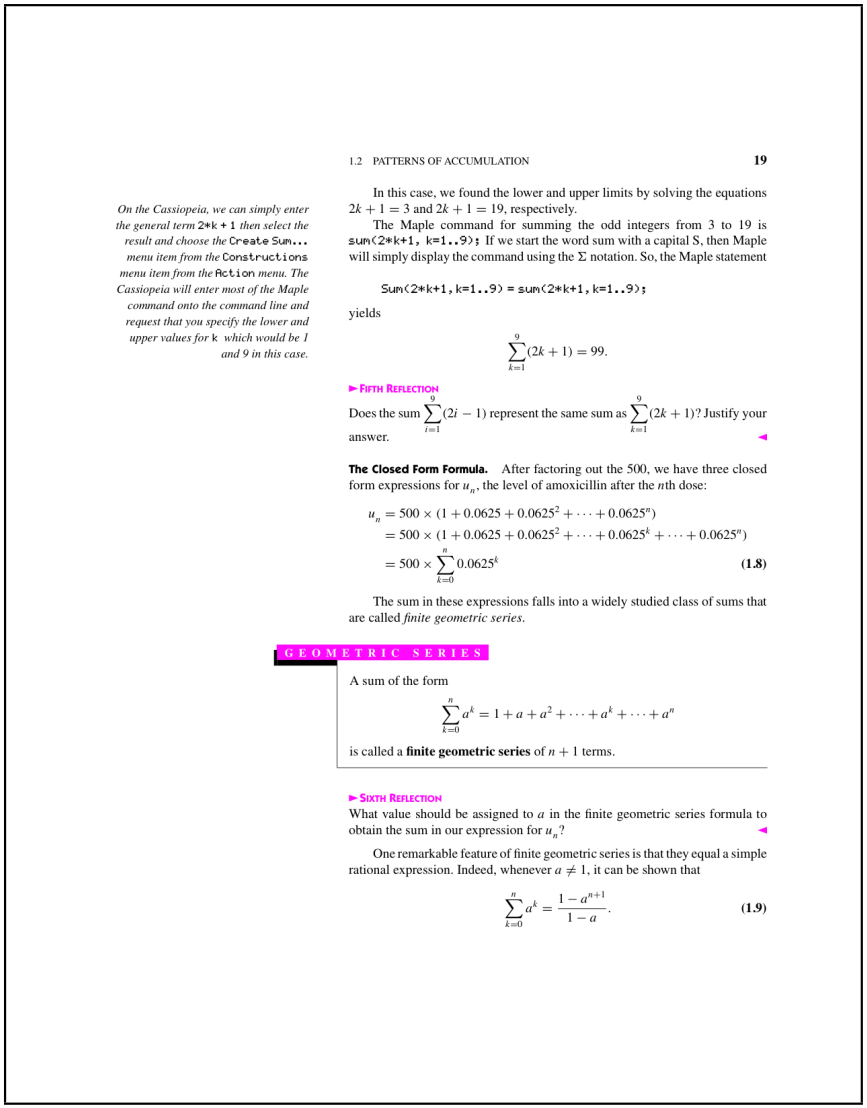


Leslie Lamport of *Microsoft Research*

Meet LaTeX

LaTeX is

- For logical, not *WYSIWYG*, composing
- A free, open-source system
- Easily extensible
- Typesets mathematics
- Automatic numbering of equations, chapters, sections, etc.
- Automatic table of contents, bibliography, index, etc.
- Automatic cross referencing
- Available for all platforms



1.2 PATTERNS OF ACCUMULATION 19

On the Cassiopeia, we can simply enter the general term `2*k+1` *then select the result and choose the* `Create Sum...` *menu item from the* `Constructions` *menu item from the* `Action` *menu. The Cassiopeia will enter most of the Maple command onto the command line and request that you specify the lower and upper values for* `k` *which would be 1 and 9 in this case.*

In this case, we found the lower and upper limits by solving the equations $2k + 1 = 3$ and $2k + 1 = 19$, respectively.

The Maple command for summing the odd integers from 3 to 19 is `sum(2*k+1, k=1..9);` If we start the word sum with a capital S, then Maple will simply display the command using the Σ notation. So, the Maple statement

```
Sum(2*k+1,k=1..9) = sum(2*k+1,k=1..9);
```

yields

$$\sum_{k=1}^{9}(2k+1) = 99.$$

► FIFTH REFLECTION

Does the sum $\sum_{i=1}^{9}(2i-1)$ represent the same sum as $\sum_{k=1}^{9}(2k+1)$? Justify your answer. ◄

The Closed Form Formula. After factoring out the 500, we have three closed form expressions for u_n, the level of amoxicillin after the nth dose:

$$\begin{aligned} u_n &= 500 \times (1 + 0.0625 + 0.0625^2 + \cdots + 0.0625^n) \\ &= 500 \times (1 + 0.0625 + 0.0625^2 + \cdots + 0.0625^k + \cdots + 0.0625^n) \\ &= 500 \times \sum_{k=0}^{n} 0.0625^k \end{aligned} \quad \textbf{(1.8)}$$

The sum in these expressions falls into a widely studied class of sums that are called *finite geometric series*.

GEOMETRIC SERIES

A sum of the form

$$\sum_{k=0}^{n} a^k = 1 + a + a^2 + \cdots + a^k + \cdots + a^n$$

is called a **finite geometric series** of $n + 1$ terms.

► SIXTH REFLECTION

What value should be assigned to a in the finite geometric series formula to obtain the sum in our expression for u_n? ◄

One remarkable feature of finite geometric series is that they equal a simple rational expression. Indeed, whenever $a \neq 1$, it can be shown that

$$\sum_{k=0}^{n} a^k = \frac{1 - a^{n+1}}{1 - a}. \quad \textbf{(1.9)}$$

Basic LaTeX Document

The basic LaTeX document has two parts:

Preamble *Declarations and definitions*
The *class*: article, book, report, etc.
LaTeX *packages* to load

Body *Document source*

Example (Simple LaTeX Document)

```
\documentclass{article}
\usepackage{times}
\begin{document}
\section{First Section}
Hello World.
\end{document}
```

1 First Section

Hello World.

Text in LaTeX

Plain text is typed directly; white-space and tabs are compressed and adjusted according to TeX's typography rules. Part, chapter, section, subsection commands are used for logical divisions. They are entered as in `\section{name of section}`. Other *environments* also use similar commands. The main command formats are:

1. `\`*command*`{`*text*`}`
2. `\begin{`*environment*`}` *text* `\end{`*environment*`}`

Example

```
\emph{emphasized text}
```

emphasized text

```
\begin{center}
  centered text
\end{center}
```

centered text

Text Style Examples

Example

- \texttt{Typewriter font}

  `Typewriter font`

- \textsf{San serif font}

  San serif font

- \textbf{Bold face text}

  Bold face text

- \textcolor{blue}{Text in color}

  Text in color

Simple List Examples

Example

Numbered list:

```
\begin{enumerate}
\item First item
\item Second item
\end{enumerate}
```

1. First item
2. Second item

Bulleted list:

```
\begin{itemize}
\item First item
\item Second item
\end{itemize}
```

- First item
- Second item

Lists can be nested independent of type.

Special Characters

There are a number of special characters in TEX.

Symbol	*TEX Usage*	*To print as text*
#	argument	\#
$	math mode	\$
&	tab stop	\&
%	comment	\%
{	open delimiter	\{
}	close delimiter	\}
~	nonbreaking space	\textasciitilde
_	subscript (math)	_
^	superscript (math)	\textasciicircum
\	escape character	\textbackslash

Math in LaTeX

There are two basic modes for mathematics: *inline* and *display*. Enter inline math, math in the line, by typing opening and closing '$' signs as in `$x^2$` to have x^2. Enter displayed math, expressions on their own line, by typing an opening '\[' and a closing '\]' as in `\[x^3.\]` to have

$$x^3.$$

Display math can be numbered automatically by using the *equation environment.* E.g., `\begin{equation} x^4.\end{equation}` gives

$$x^4. \tag{1}$$

Mathematics Definitions

Fraction Entered as `$\frac{num}{den}$`. $\frac{dy}{dx}$ is `$\frac{dy}{dx}$`

Root Entered as `$\sqrt{x}$` or `$\sqrt[n]{x}$`; e.g., $\sqrt{x}\sqrt[3]{x}$ is `$\sqrt{x}\sqrt[3]{x}$`

Superscript A caret gives superscripts. The expression $t^2\, e^{-t^2}$ is entered as `$t^2 e^{-t^2}$`

Subscript An underscore gives subscripts. The expression x_{n+1}^2 is given by `$x_{n+1}^2$`

Function Most standard functions have LaTeX definitions; e.g., $\sin(x)$ is entered as `$\sin(x)$`

Operator The standard operators are done similarly; e.g., $\lim f(x)$ is entered as `$\lim f(x)$`

See the LaTeX Reference sheet and LaTeX math and comparison sheet.

Mathematics Examples

Example

- `\[f^\prime(x) = \lim_{h\rightarrow 0} \frac{f(x+h)-f(x)}{h}\]`

$$f'(x) = \lim_{h\rightarrow 0} \frac{f(x+h)-f(x)}{h}$$

- `\[\Gamma(z) = \int_0^\infty x^{z-1} e^{-x} dx \]`

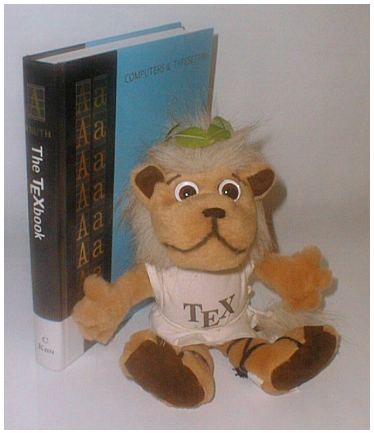
$$\Gamma(z) = \int_0^\infty x^{z-1} e^{-x} dx$$

- `\[f^{(n)}(z) = \frac{n!}{2\pi i} \oint_\gamma \frac{f(\zeta)}{(\zeta-z)^{n+1}} d\zeta\]`

$$f^{(n)}(z) = \frac{n!}{2\pi i} \oint_\gamma \frac{f(\zeta)}{(\zeta-z)^{n+1}} d\zeta$$

Including Graphics

Images are easy to add to a LaTeX document. There are many methods to insert a graphic file. One of the easiest ways (with pdfLaTeX) is to use the `graphicx` package and the command



`\includegraphics[width=`*value*`]{`*file name*`}`.

The TeXShop LaTeX template automatically sets this method up. The figure at the right is from:

```
\includegraphics[width=0.4\linewidth]{Lion.jpg}
```

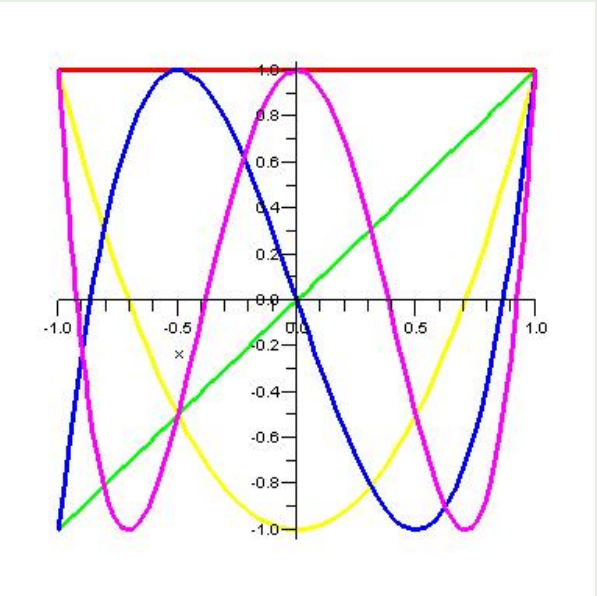
Maple Plot Example

Example (Chebyshev Polynomials)

The first 5 Chebyshev orthogonal polynomials are

$$T_0 = 1, T_1 = x, T_2 = 2x^2 - 1, T_3 = 4x^3 - 3x, T_4 = 8x^4 - 8x^2 + 1$$

The polynomials oscillate between -1 and 1 on the interval $[-1, 1]$.



Maple Plot Example Source

Example (Chebyshev Polynomials Example Source)

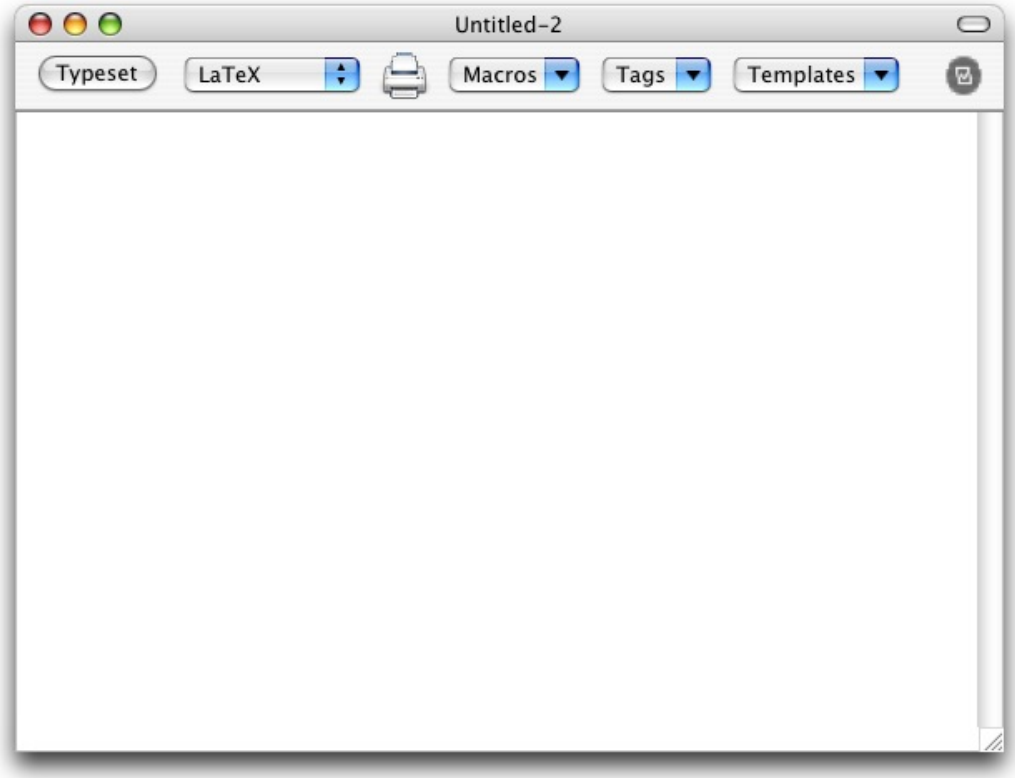
```
\begin{example}[Chebyshev Polynomials]

The first $5$ Chebyshev orthogonal polynomials are

\[ T_0 = 1, T_1 = x, T_2 = 2x^2-1, T_3 = 4x^3-3x, T_4 = 8x^4-8x^2+1 \]

These polynomials oscillate between $-1$ and $1$ on the interval
$[-1,1].$

\centerline{ \includegraphics[width=1.5in]{Chebyshev.jpg} }

\end{example}
```

LaTeX 2ε with Mac OS X in Math Sciences

We use Gerben Wierda's i-Installer to install and maintain teTeX, Thomas Esser's TeX distribution, for the basic system.[1] The front-end we use is Richard Koch's TeXShop.

To get started:
– Launch TeXShop.

A new window comes up.
– Choose *Latex Template* from the *Templates* pop-up menu. TeXShop will fill in a new document ready for you to start typing.



[1] Math Sciences also has a license for OzTeX

A First LaTeX Document

Choose a standard document class: article, amsart, report, or book

```
\documentclass{article}
```

A First LaTeX Document

Choose a standard document class: article, amsart, report, or book

```
\documentclass{article}
```

Add the title and your personal information

```
\title{Article in \LaTeX!}
\author{Yogi Berra}
```

A First LaTeX Document

Choose a standard document class: article, amsart, report, or book

```
\documentclass{article}
```

Add the title and your personal information

```
\title{Article in \LaTeX!}
\author{Yogi Berra}
```

Start the document

```
\begin{document}
```

A First LaTeX Document

Choose a standard document class: article, amsart, report, or book

```
\documentclass{article}
```

Add the title and your personal information

```
\title{Article in \LaTeX!}
\author{Yogi Berra}
```

Start the document

```
\begin{document}
```

And begin typing ...

```
\maketitle
The celebrated quadratic formula, shown in
Equation~\ref{quadform}, was known in verbal form
(for many cases) to the Babylonians.  The formula is
\begin{equation} \label{quadform}
x = \frac{-b \pm \sqrt{b^2 - 4 a c}}{2a}
\end{equation}
```

A First LaTeX Document (cont.)

End the document with

```
\end{document}
```

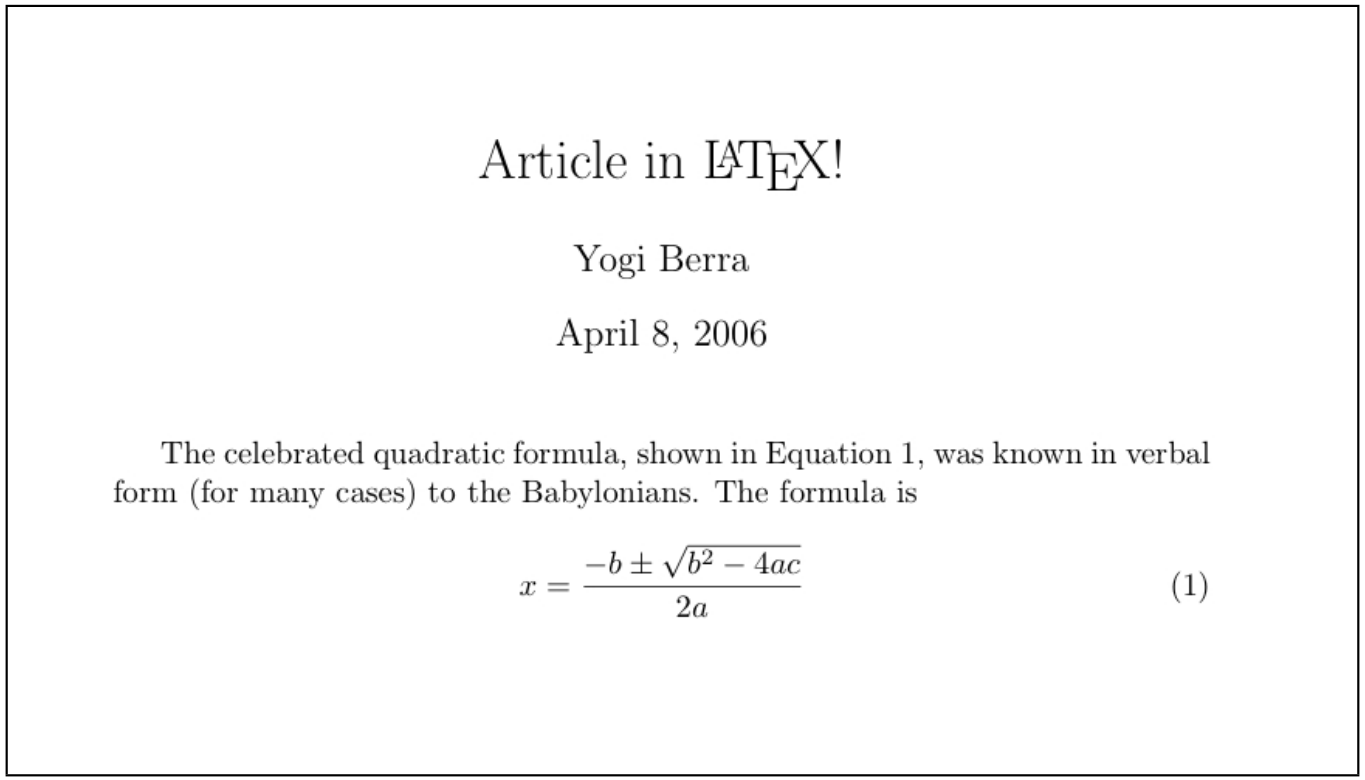
Click *Typeset* once.

A First LaTeX Document (cont.)

End the document with

```
\end{document}
```

Click *Typeset* once. Compare with the picture below. Click *Typeset* again. What changed?



Article in LaTeX!

Yogi Berra

April 8, 2006

The celebrated quadratic formula, shown in Equation 1, was known in verbal form (for many cases) to the Babylonians. The formula is

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

References

There is a huge collection of reference material, both books and online, available for LaTeX.

- Guide to LaTeX 2_ε – Helmut Kopka et al
- The LaTeX Companion – Frank Mittelbach et al
- Math Into LaTeX - George Grätzer

- The Not So Short Introduction to LaTeX 2_ε – Tobias Oetiker et al
- User's Guide for `amsmath`

- Google's list of LaTeX tutorials