# Typesetting Beautiful Mathematics with LaTeX

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# Outline

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# LaTeX is a Document Typesetter

- A typesetter produces well-designed books or articles intended to be read.
- LaTeX takes raw text (a text file) and typesets it (the output file).

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| | |
|---|---|
| **Platform** | Windows, Unix/Linux, Mac, ... |
| **Quality** | Camera-ready output |
| **Extendable** | Customizable for any project |
| **Flexible** | Produces output as PostScript, pdf, html, ... |
| **Free** | The most stable open source software |

# Microsoft Word Versus LaTeX

## WYSIWYG Versus WYSIWYW

**Kerning** In Word: Table In LaTeX: Table

# Microsoft Word Versus LaTeX

## WYSIWYG Versus WYSIWYW

**Kerning** In Word: Table In LaTeX: Table

**Ligatures** In Word: fire flower

In LaTeX: fire flower

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**Kerning** In Word: Table In LaTeX: Table

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**Small caps** In Word: AAa AB BC CD

In LaTeX: AAa AB BC CD

**Hyphenation** Automatic at line breaks between syllables

- Graphics taken from the essay "The Beauty of LaTeX" by Dario Taraborelli, `http://nitens.org/taraborelli/latex`

# Outline

# From Mark-Up to Output

## From Plain Text to Professional Text!

```
\documentclass[11pt]{article}

\title{Laden and Unladen Swallows}
\author{M.\ Python, B.S.}

\begin{document}
\maketitle

\section{Introduction}

In this paper, we examine the puzzle of the
laden versus the unladen swallow.  It is known
that the unladen swallow will travel faster
than the laden swallow, unless the laden swallow
is carrying more than five coconuts.  Both Henri
Poincar\'e and Paul Erd\H{o}s agree \ldots
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# From Mark-Up to Output

## From Plain Text to Professional Text!



Laden and Unladen Swallows

M. Python, B.S.

February 16, 2010

## 1 Introduction

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   If okay, continue; otherwise go to step 1
5. Print, publish, post

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# The Brief LaTeX History

- 1978, Donald Knuth created TeX and METAFONT
- 1985, Leslie Lamport created macro add-ons
- 1989, TeX and METAFONT frozen
- 1990, AMS released $\mathcal{AMS}$-TeX, and later, $\mathcal{AMS}$-LaTeX
- Current version is LaTeX $2_\varepsilon$

# The LaTeX Philosophy

- Content and presentation are separate
- Author should focus on content
- Layout and presentation determined by the software
- Good typesetting makes the content easy to read and is itself invisible

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# Classes

## The Overall Design Format.

- Article
- Book
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- Article
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- Memoir, exam, amsbook, cv, etc.

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- Font styles
  - *Italics: Knights of the Round Table*
  - *Slanted: Knights of the Round Table*
  - Small Caps: Knights of the Round Table
  - **Bold: Knights of the Round Table**

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What is LaTeX?
- Typesetting, Not Processing
- How Does It Work?
- History and Philosophy

What's So Great About LaTeX?
- Classes, Styles, Fonts
- Labeling and References
- Mathematics Typesetting
- Extending LaTeX
- Graphics
- Citations

So Why Should I Use LaTeX?
- Top 8 Reasons To Use LaTeX
- Obtaining LaTeX

# Labeling and References

## Easy to Use and Automatically Generated.

### 1 The Physics of Swallows

We give the introductory physics of small birds in this section. In Section 2 we focus on laden swallows.

### 2 The Laden Swallow

As promised in Section 1, we give results concerning laden swallows. The basic result is

$$V_l = \frac{V_s}{gc}. \tag{1}$$

In equation 1, $c$ represents the number of coconuts.

# Labeling and References

## Easy to Use and Automatically Generated.

```
\section{The Physics of Swallows}\label{physics}

We give the introductory physics of small birds
in this section.  In Section \ref{laden} we
focus on laden swallows.

\section{The Laden Swallow}\label{laden}

As promised in Section \ref{physics}, we give
results concerning laden swallows.  The basic
result is
\begin{equation}\label{ladeneq}
   V_l = \frac{V_s}{gc}. \end{equation}
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- Let's look at a more intense example...

# Mathematics

**Example 1.** *Evaluate* $\iint_S \mathbf{F} \cdot \mathbf{n}\, d\sigma$ *if* $\mathbf{F} = (x^3 + \sin z)\mathbf{i} + (x^2 y + \cos z)\mathbf{j} + e^{x^2+y^2}\mathbf{k}$ *and* $S$ *is the surface of the region bounded by* $z = 4 - x^2$, $y + z = 5$, *and* $z = y = 0$.

*Solution.* By the Divergence Theorem, we have

$$\begin{aligned}
\iiint_R (3x^2 + x^2 + 0)\, dx\, dy\, dz &= \iiint_R 4x^2\, dx\, dy\, dz \\
&= \int_{-2}^{2} \int_{0}^{4-x^2} \int_{0}^{5-z} 4x^2\, dy\, dz\, dx \\
&= \int_{-2}^{2} \int_{0}^{4-x^2} 4x^2(5 - z)\, dz\, dx \\
&= \int_{-2}^{2} (20x^2 z - 2x^2 z^2)\Big|_{0}^{4-x^2} dx \\
&= \int_{-2}^{2} (48x^2 - 4x^4 - 2x^6)\, dx = \tfrac{4608}{35}. \qquad \square
\end{aligned}$$

# Mathematics

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\begin{ex}
 Evaluate
 $\iint_S \vect{F}\cdot\vect{n}\ d\sigma$ if
 $\vect{F}=\vijk{(x^3+\sin z)}{+(x^2y+\cos z)}
              {+e^{x^2+y^2}}$
 and $S$ is the surface of the region bounded
 by $z=4-x^2$, $y+z=5$, and $z=y=0$.
\end{ex}
```

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\begin{proof}[Solution.]
By the Divergence Theorem, we have
 \begin{align*}
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 &= \int_{-2}^2\int_0^{4-x^2} 4x^2(5-z)\ dz\ dx\\
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                  \Bigr|_0^{4-x^2} dx\\
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  = \tfrac{4608}{35}. \qedhere
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\end{proof}
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- Environments: `\usepackage{multicol}`

# Packages and Commands

Command macros may be defined by the user – Ultimate customization!

- Defines an “example” environment:
  ```
  \theoremstyle{plain}
  \newtheorem{ex}{Example}
  ```
- Define a “vector” formatting:
  ```
  \newcommand{\vect}[1]{\mathbf{#1}}
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  \newcommand{\vect}[1]{\vec{#1}}
  ```
- Define the i-j-k vector form:
  ```
  \newcommand{\vijk}[3]
  {#1\vect{i} #2\vect{j} #3\vect{k}}
  ```

# Symbols

- All Greek letters
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- Called by name, i.e., `$\pi$` produces $\pi$, `$\forall$` produces $\forall$, `$\pm$` produces $\pm$

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$$\cong \sim \approx \triangle \mathbb{R} \Sigma \Pi \pi \propto \neq \leq \equiv \lambda \delta$$

$$\heartsuit \overline{AB} \rho \psi \Psi \Omega \forall \exists \cup \cap \wedge \clubsuit \oint \partial$$

$$\sigma \varsigma \Longrightarrow \mathbb{Z} \oplus \div \| \pm \perp \supseteq \nabla \longmapsto$$

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# Graphics and Pictures

- Use any program you like to create your graphics, and save it as
  - `.eps` if PostScript is the output
  - `.pdf`, `.jpg`, `.png` if pdf is the output
- Put `\usepackage{graphicx}` in your `.tex` file
- `\includegraphics[`*options*`]{name_of_file}`

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- `\includegraphics[`*options*`]{name_of_file}`
- Using the `figure` environment "floats" the graphic and provides a `\caption` command
- Tables have a similar environment

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# Bibliographies

## Automatic reference lists

- BibTeX is a textfile of reference data
  saved as `myfile.bib`
- Bibliographies automatically generated by using
  `\bibliographystyle{`*style name*`}`
  `\bibliography{myfile}`
- Citation and reference list style is customizable:
  APA, Chicago, AMS, Law, etc.

# Sample BibTeX Entry

```
@ARTICLE{python,
  author={Monty Python},
  title={Laden and unladen swallows},
  journal={Grail Monthly},
  volume=20,
  number=3,
  month={June},
  year=1975}

The author M.\ Python \cite{python} stipulates
that coconuts are the only factor in the velocity
of laden swallows \ldots
```

# Bibliographic Sample, Plain



## 1 Plain Style

The author M. Python [1] stipulates that coconuts are the only factor in the velocity of laden swallows ...

## References

[1] Monty Python. Laden and unladen swallows. *Grail Monthly*, 20(3), June 1975.

# Bibliographic Sample, APA



## 1 APA Style

The author M. Python (Python, 1975) stipulates that coconuts are the only factor in the velocity of laden swallows ...

## References

Python, M. (1975, June). Laden and unladen swallows. *Grail Monthly*, *20*(3).

# Indexing

```
We give results concerning laden swallows.
\index{swallow!laden} The basic result is
\begin{equation}\label{ladeneq}
   V_l = \frac{V_s}{gc}.
\end{equation}
In equation \ref{ladeneq}, $c$ represents the
number of coconuts.\index{coconuts!number of}
```

The `\index` command automatically puts the entries *coconuts, number of* and *swallow, laden* in the index in alphabetical order with the corresponding page numbers. The `\makeindex` command gathers the entries, and `\printindex` typesets the index.

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# Top 8 Reasons To Use LaTeX

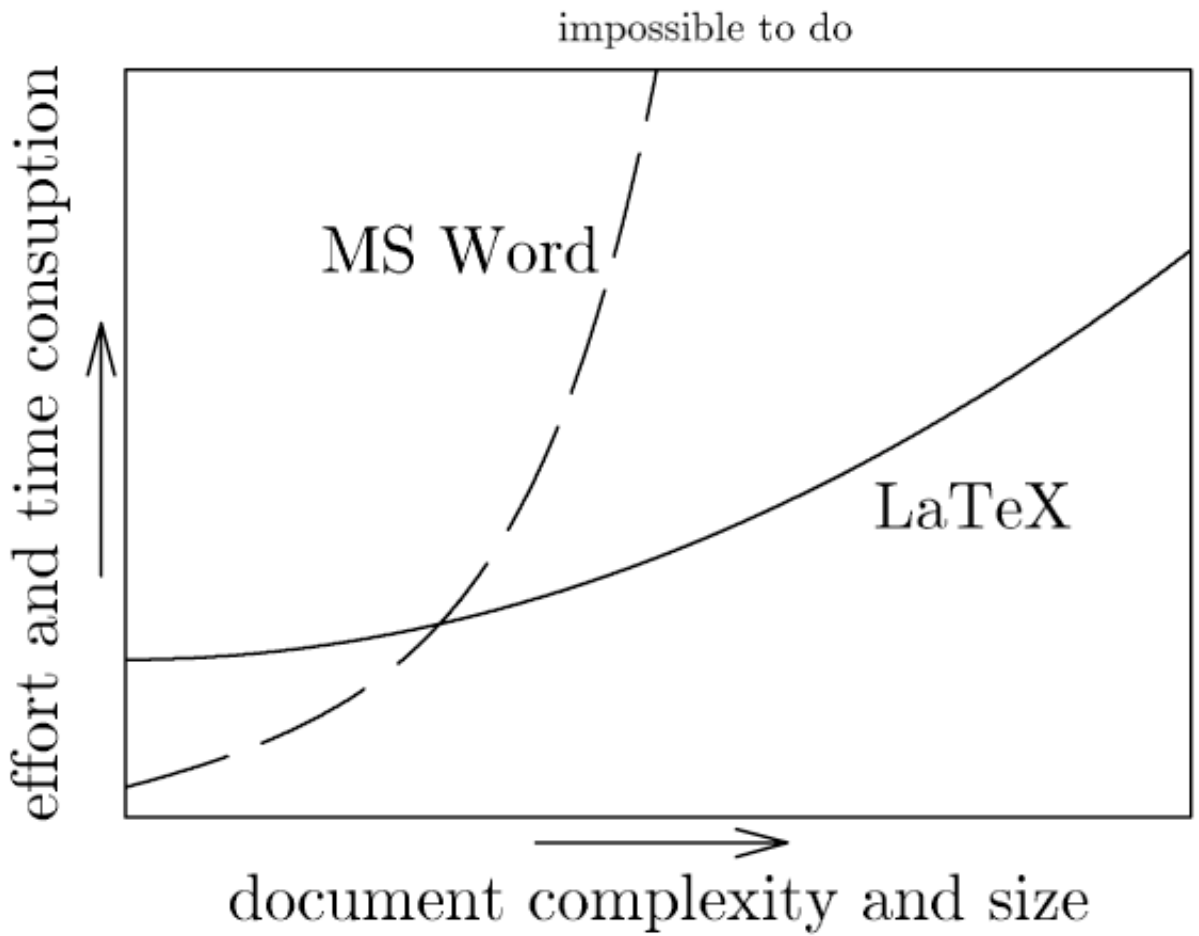


Image by Marko Pinteric, `www.pinteric.com/miktex.html`.

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8. Free!

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# Where Can I Get LaTeX?

**Windows** The MikTeX 2.8 distribution with the TeXnicCenter 2.0 editor or the TeXworks 0.2.3 editor, `www.miktex.org` (111 MB)

**Mac** The MacTeX 2010 distribution with the TeXShop 2.37 editor or the TeXworks 0.2.3 editor, `www.tug.org/mactex` (1.6 GB)

**Linux** MikTeX 2.8 with Kile 2.0.3 for KDE, `kile.sourceforge.net` (Kile: 12.4 MB)

# For Further Information


- Leslie Lamport.
  *LaTeX, a Document Typesetting System.*
  Addison-Wesley, 1994.
- Tobias Oetiker, et al.
  *The Not So Short Introduction to LaTeX 2ε (Or LaTeX 2ε in 141 Minutes)*, Version 4.26.
  http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf
- Frank Mittelbach, et al
  *The LaTeX Companion*, 2nd edition.
  Addison-Wesley, 2004.
- http://www.ctan.org and http://www.tug.org
  The Comprehensive TeX Archive Network
  The TeX Users Group

# Thank you!



This presentation, with active hyperlinks, will be posted at

`http://web.me.com/drcgarner`

(Click on “Presentations” at the top)