An Introduction to LaTeX

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January 17, 2011

Don't Books Look Different From What MS Word Produces?

Here are some major differences between how books look and how an MS Word document looks

- A larger left margin on the left page and a larger right margin on the right page
- Paragraphs are spaced so that if a paragraph would look better on a new page, then it is put on the next page
- Spacing between words is adjusted so that the text appears justified
- There is a larger space at the end of a sentence, than between words in that sentence
- Ligatures: These are actually two letters joined together as one, e.g. fi, fl, ff etc.

Ever Wondered How Your Books Are Typeset?

This is how the process is executed

- An author types his book and gives it to the publishing company
- The publishing company hires book-designers to decide the layout of the document
- The book-designer puts formatting information as marginal notes on the manuscript (?)
- The manuscript then goes to the typesetter, who, based on the notes of the book-designer typesets the book

Now imagine if you were able to get professional quality typesetting without going through this lengthy process, for something not as big as a book, say, a lab project report. . . That is where LaTeX comes into the picture.

What is LaTeX?

TeX

- Created by Donald E. Knuth.
- Started writing it in 1977.
- Objective was to explore the potential of digital publishing and to reverse the deteriorating typographical quality at that time.

LaTeX

- Enables users to typeset and print their work at the highest typographical quality.
- Uses predefined, professional layouts.
- Originally written by Leslie Lamport, now maintained by Frank Mittelbach

Major Advantages of LaTeX

- LaTeX defines the document structure and not the layout
- The layout is in a separate file or in another place in the file
- This is similar to CSS and HTML
- Allows for easy portability
- If the formatting needs to be changed, it can be easily managed by changing the style file. The rest of the document does not have to be changed

Major Advantages of LaTeX

- Professionally designed layouts are available, so the documents look as if they are "printed"
- Mathematical formulae can be typeset in a convenient way
- Users need only a few commands to define document structure. They do not have to bother with the messy job of document layout
- Footnotes, references, table of contents, bibliography, links and cross-reference can be generated easily
- Add-on packages are available for tasks not directly supported by LaTeX
- Authors are encouraged to write well-structured texts
- TeX is highly portable and free, and this means that it works on almost all platforms

Disadvantages of LaTeX?

- LaTeX does not work well for people who have sold their souls . . .
- Although parameters can be adjusted within a predefined document style, the design of a new style is complex and difficult and takes a lot of time[1].
- It is extremely difficult to write unstructured and disorganized documents.
- Your dog may never understand the concept of Logical Markup.

[1] This may be corrected in LaTeX3

A comparison of LaTeX with MS Word

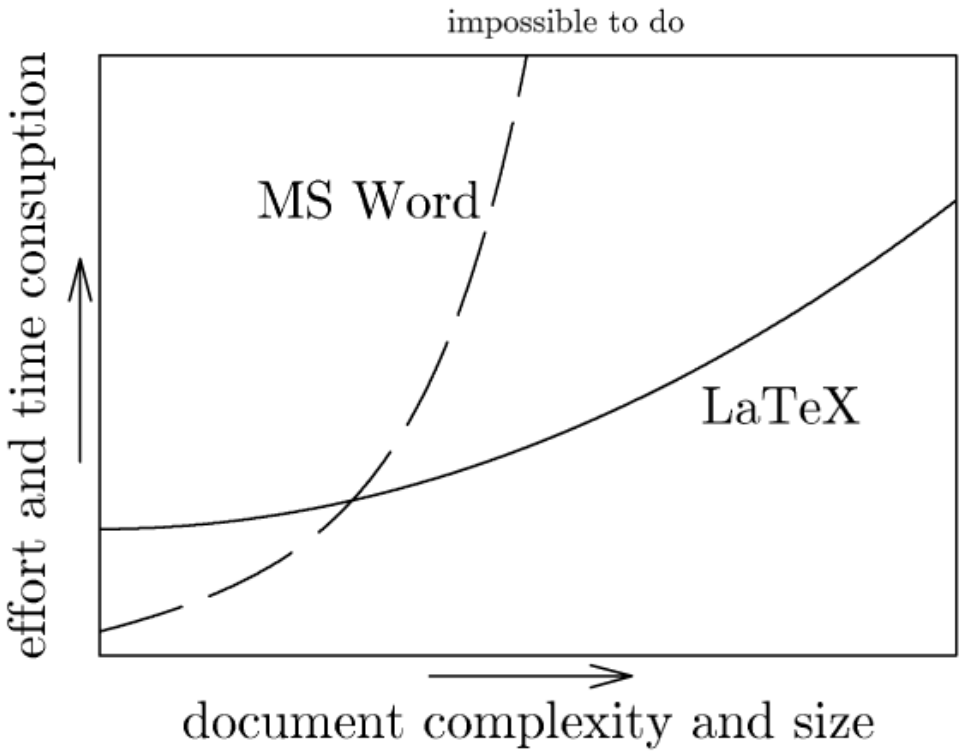


Figure: A comparison of LaTeX with MS Word

The LaTeX Document Classes

A LaTeX document begins with a

`\documentclass[options]{document class}`

LaTeX broadly supports the following document classes:

- `article`
- `proc`
- `minimal`
- `report`
- `book`
- `slides`
- `memoir`
- `letter`

"Hello World!" Equivalent in LaTeX

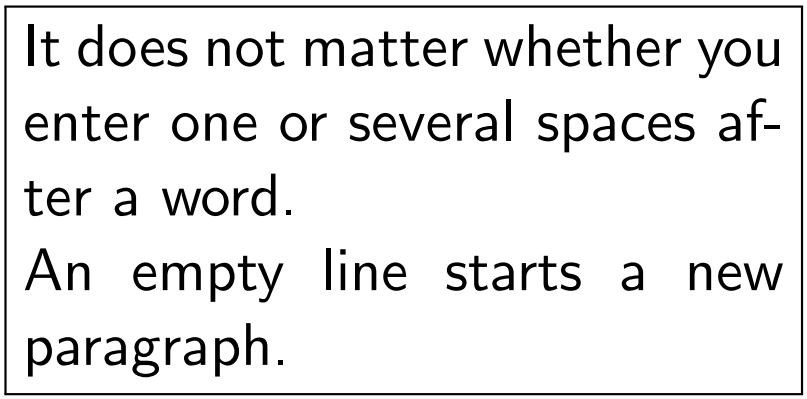
Hello World!
My first LaTeX document!

```
1 \documentclass{article}
2 \begin{document}
3 Hello World!
4
5 My first \LaTeX{}
      document!
6 \end{document}
```

Spaces I

- Any tab, newline or space is considered a whitespace
- Whitespaces at the start of a line are generally ignored
- Several consecutive whitespace characters are treated as a single whitespace
- An empty line marks end of paragraph
- Several empty lines are considered as a single empty line

Spaces II




```
1 It does not matter
      whether you
2 enter one or several
                      spaces
3 after a word.
4
5 An empty line starts a
      new
6 paragraph.
```

Special Characters

- These are reserved characters that either have special meaning under LaTeX or are not available in all the fonts
- Entering these directly in the document can make LaTeXdo all sorts of weird things
- The special characters are

  `# $ % ^ & _ { } ~ \`
- They can be typed in the document by appending a backslash before the character, i.e.

  `\# \$ \% \^ \& \_ \{ \} \~ \textbackslash`

Commands

- These begin with a backslash
- Name consists of letters only, or of letters followed by exactly one non-letter
- Terminated by a space or a non letter
- They may support parameters which must be given in braces `{}` and optional parameters which must be given in square brackets `[]`. For example:

```
\command[option1, option2,...]{argument1}
{argument2}...
```

Environments

- Similar to commands
- Generally used when effect is desired over a larger part of the document (or the whole of the document)
- Syntax is of the form

```
\begin{environment}
...
\end{environment}
```

Comments I

- When the % symbol is encountered, everything till the end of the line is ignored
- This is similar to the // comments in C++
- Can be used to insert text in the source file which does not occur in the final output file
- There also exists a *comment* environment in the *verbatim* package

Comments II

This is an example of a comment

```
1 This is an %rather
      stupid
2 %but instructive
3 example of a comment
```

This is another example of a comment

```
1 This is another \begin{
      comment}rather
      stupid
2 but instructive\end{
      comment}
3 example of a comment
```

Packages

- These are bundles of commands, environments and layouts
- These can add functionality not present in LaTeX by default
- A package can be included in your document by adding a `\usepackage{package name}` just after `\documentclass{}` (i.e. in the preamble)

Typesetting Text I

This text is bold
This text is slanted
This text is emphasized

```
\textbf{This text is bold}

\textsl{This text is slanted}

\emph{This text is emphasized}
```

Typesetting Text II

We quote in LaTeX like “this” and not like ”this”
Hyphenate commander-in-chief
Please read pages 21–32
Is your answer a yes—or a no?

```
1 We quote in \LaTeX{}
      like ``this'' and
      not like "this"\\
2 Hyphenate commander-in-
      chief\\
3 Please read pages
      21--32\\
4 Is your answer a yes---
      or a no?
```

Typesetting Text III

My website is http://www.ee.iitb.ac.in/student/~skandhurkat

My website is http://www.ee.iitb.ac.in/student/\~{}skandhurkat\\

My website is http://www.ee.iitb.ac.in/student/$\sim$skandhurkat\\

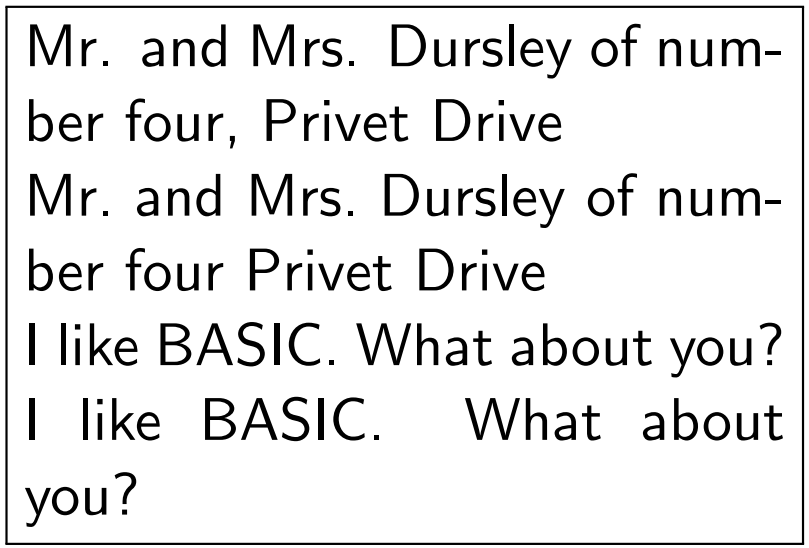
My website is \url{http://www.ee.iitb.ac.in/student/~skandhurkat}

Typesetting Text IV

$30^\circ C$ is $86^\circ F$
Ellipses are put in not like this... but like this...
Not shelfful, but shelfful
Hôtel, Naïve, élève, ¡Señorita!.
Phone number: +91 22 2572 2545
Phone number: +91 22 2572 2545

```
$30^\circ{}C$ is $86^\circ{}F$\\
Ellipses are put in not like this... but like this\ldots\\
\fontfamily{times-ttf}\selectfont Not shelfful, but shelf\mbox{}ful \normalfont\\
H\^otel, Na\"ive, \'el\`eve, !`Se\~norita!.\\
Phone number: +91 22 2572 2545\\
Phone number: \mbox{+91 22 2572 2545}
```

Typesetting Text V




```
1 Mr. and Mrs. Dursley of
      number four,
    Privet Drive\\
2 Mr.\ and Mrs.\ Dursley
    of number four
    Privet Drive\\
3 I like BASIC. What
    about you?\\
4 I like BASIC\@. What
    about you?
```

Typesetting Text VI

The following sectioning commands are used in LaTeX:

- `\part{}`
- `\chapter{}`
- `\section{}`
- `\subsection{}`
- `\subsubsection{}`
- `\paragraph{}`
- `\subparagraph{}`

`\appendix` changes the chapter numbers to letters.
`\tableofcontents` creates the table of contents.
The above sectioning commands are available in the starred versions. They are not numbered. For example:

```
\chapter*{Preface}
```

Typesetting Text VII

`\maketitle` creates the title page
The contents of the title are defined in the preamble as

```
\title{An Introduction to \LaTeX{}}
\author{Skand Hurkat}
```

and optionally

```
\date{Whatever date you want. Default is \today{}}
```

Typesetting Text VIII

Apart from the sectioning commands mentioned previously, LaTeX 2_ε introduced same additional commands for the `book` class. These alter chapter headings and page numbering. They are

- `\frontmatter`
  - Should be the first thing after `\begin{document}`
  - Switches page numbering to Roman and chapters and sections are non-enumerated
  - These chapters/sections shall appear in the table of contents
- `\mainmatter`
  - Should be placed just before the first chapter of the book
  - Page numbering to Arabic and chapters/sections are numbered

Typesetting Text IX

- `\appendix`
  - Should be placed just before additional material in the book
  - Chapter numbering to alphabets
- `\backmatter`
  - Should be placed before bibliography and index
  - No visual effect

Typesetting Text X

This is an example of a reference to section **??** on page **??** Footnotes are often used in LaTeX

```
1 This is an\label{sec:
      this_section}
      example of a
      reference to
      section~\ref{sec:
      this_section} on
      page~\pageref{sec:
      this_section}\\
2 Footnotes\footnote{This
       is a footnote} are
       often used in \
      LaTeX{}
```

Typesetting Text XI

- An item
- Another item

```
\begin{itemize}
\item An item
\item Another item
\end{itemize}
```

1. An item
2. Another item

```
\begin{enumerate}
\item An item
\item Another item
\end{enumerate}
```

Typesetting Text XII

- An item
- 1. Nested item
  2. Another nested item

```
\begin{itemize}
\item An item
\item {\begin{enumerate}
    }
\item Nested item
\item Another nested
    item
\end{enumerate}}
\end{itemize}
```

Typesetting Math I

For typesetting advanced math formulae, we need to use the $\mathcal{AMS}$-LaTeX package. This can be included with a simple `\usepackage{amsmath}` in the preamble.
$\mathcal{AMS}$-LaTeX is produced by the *American Mathematical Society* and is used extensively for mathematical typesetting.

Typesetting Math II

Single equations are typeset within a paragraph by enclosing them between $ $ or between \(\)

Add a squared to b squared to get c squared. Or equivalently $a^2 + b^2 = c^2$
Add a squared to b squared to get c squared. Or equivalently $a^2 + b^2 = c^2$

```
1 Add a squared to b
      squared to get c
      squared. Or
      equivalently $a^2+b
      ^2=c^2$\\
2 Add a squared to b
      squared to get c
      squared. Or
      equivalently \(a^2+
      b^2=c^2\)
```

Typesetting Math III

An equation can be typeset on its own line by enclosing it within `\[ \]` or within the `equation*` environment. Equations can be numbered by enclosing them in the `equation` environment.

Einstein's theory of relativity states that energy equals mass times speed of light squared. Putting this in a mathematical form:

$$E = mc^2$$

```
1 Einstein's theory of
      relativity states
      that energy equals
      mass times speed of
       light squared.
      Putting this in a
      mathematical form:
      \[E = m c^2\]
```

Typesetting Math IV

Einstein's theory of relativity states that energy equals mass times speed of light squared. Putting this in a mathematical form:

$$E = mc^2$$

```
Einstein's theory of
    relativity states
    that energy equals
    mass times speed of
     light squared.
    Putting this in a
    mathematical form:
\begin{equation*}
E = m c^2
\end{equation*}
```

Typesetting Math V

Einstein's theory of relativity states that energy equals mass times speed of light squared. Putting this in a mathematical form:

$$E = mc^2 \tag{1}$$

(1) is considered to be ...

```
1 Einstein's theory of
      relativity states
      that energy equals
      mass times speed of
       light squared.
      Putting this in a
      mathematical form:
2 \begin{equation} \label
      {eq:emcsquare}
3 E = m c^2
4 \end{equation}
5 \eqref{eq:emcsquare} is
       considered to be \
      ldots
```

Typesetting Math VI

Lowercase Greek letters are typeset as `\alpha, \beta, \gamma...` while uppercase letters are typeset as `\Gamma, \Delta...`

This is how Greek letters are typeset:

$$\alpha, \beta, \gamma \ldots$$

$$\Gamma, \Delta \ldots$$

```
1 This is how Greek
      letters are typeset
      :
2 \[\alpha, \beta, \gamma
       \ldots\]
3 \[\Gamma, \Delta \ldots
      \]
```

Typesetting Math VII

$$sgn(x) = \begin{cases} 1 & \text{if } x>0 \\ 0 \text{ if } x = 0 \\ -1 \text{if } x<0 \end{cases} \quad (2)$$

```
\begin{equation}
sgn(x) =
\begin{cases}
1 \hfill \text{if }x \
    textgreater 0\\
0 \hfill \text{if }x
    =0\\
-1 \hfill \text{if }x \
    textless 0
\end{cases}
\end{equation}
```

Typesetting Math VIII

$$\lim_{x \rightarrow 0} \frac{sin(x)}{x} = 0 \quad \text{(incorrect)}$$

```
\begin{equation}
\lim_{x \rightarrow 0}
    \frac{sin(x)}{x} =
    0 \tag{incorrect}
\end{equation}
```

$$\begin{aligned} a &= b + c && (3) \\ &= d + e && (4) \end{aligned}$$

```
\begin{eqnarray}
a & = & b+c \\
& = & d + e
\end{eqnarray}
```

Typesetting Math IX

$$\int_{-\infty}^{\infty} \left| \frac{sin(x)}{x} \right| dx = \infty \quad (5)$$

```
\begin{equation}
\int_{-\infty}^\infty \
    left|\frac{sin(x)}{
    x}\right| dx = \
    infty
\end{equation}
```

Typesetting Math X

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & \cdots \\ a_{21} & a_{22} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix} \quad (6)$$

```
\begin{equation}
\mathbf{A} = \left[
\begin{matrix}
a_{11} & a_{12} & \
    cdots\\
a_{21} & a_{22} & \
    cdots\\
\vdots & \vdots & \
    ddots
\end{matrix}
\right]
\end{equation}
```

Typesetting Math XI

Theorem (Fermat)

No three positive integers a, b and c can satisfy the equation $a^n + b^n = c^n$ for any integer value of n greater than two.

Proof.

The proof cannot fit on this slide. □

```
\newtheorem{thm}{Theorem}
\begin{thm}[Fermat] No three positive integers $a$, $b$ and $c$ can satisfy the equation $a^n + b^n = c^n$ for any integer value of $n$ greater than two.\end{thm}
\begin{proof}
The proof cannot fit on this slide.
\end{proof}
```

Typesetting Math XII

Paradox (Liar's)

This is a lie.

Proof.

Paradoxes have no proofs. □

Remark

Best not to get into a paradoxical situation.

```
\newtheorem{paradox}{Paradox}
\theoremstyle{remark}\newtheorem*{rmk}{Remark}
\begin{paradox}[Liar's]
This is a lie.
\end{paradox}
\begin{proof}
Paradoxes have no proofs.\qedhere
\end{proof}
\begin{rmk}
Best not to get into a paradoxical situation.
\end{rmk}
```

Floats

- Floats are a term for items that cannot be broken over a page
- By default, LaTeX provides the "table" and "figure" floats
- They are not a part of the normal flow of text but separate entities
- May be positioned in a part of the page to themselves
- They always have a caption and are numbered that they may be referred from another part of the text

Figures

Figures are typeset as

```
\begin{figure}[placement specifier]
... figure contents ...
\end{figure}
```

The following placement specifiers are supported:

- `h`
- `t`
- `p`
- `b`
- `!`
- `H`

Tables

Tables are typeset as

Country	**Pageviews**
India	67
United States	6
France	3
⋮	⋮

Table: Pageviews by country

```
\begin{table}
\begin{center}
\begin{tabular}{|l|r|}
\hline
\textbf{Country} & \
    textbf{Pageviews}\\
\hline
India & 67 \\
United States & 6\\
France & 3\\
\vdots & \vdots\\
\hline
\end{tabular}
\caption{Pageviews by
    country}
\end{center}
\end{table}
```

List of Floats

Just as `\tableofcontents` inserts the table of contents, a list of floats too may be obtained.
The commands `\listoffigures` and `\listoftables` insert the list of figures and list of tables respectively.

How to Proceed Further

This was a (very) short introduction to LaTeX and should give enough material to start writing documents in LaTeX
Because LaTeX is so vast and has been developed extensively, one can master LaTeX only with a lot of practice.
I would recommend that you try typesetting some simple documents in LaTeX. Try to make your lab reports in LaTeX.
Otherwise, head to `www.gutenberg.org` and try to typeset a classic in LaTeX.
Here are some useful resources on the net:

- `http://en.wikibooks.org/wiki/LaTeX`
- `http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf`
- `http://www.google.co.in/search?&q=LaTeX`