LaTeX Fundamentals

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Sponsored by GradQuant

10/27/2015

Outline

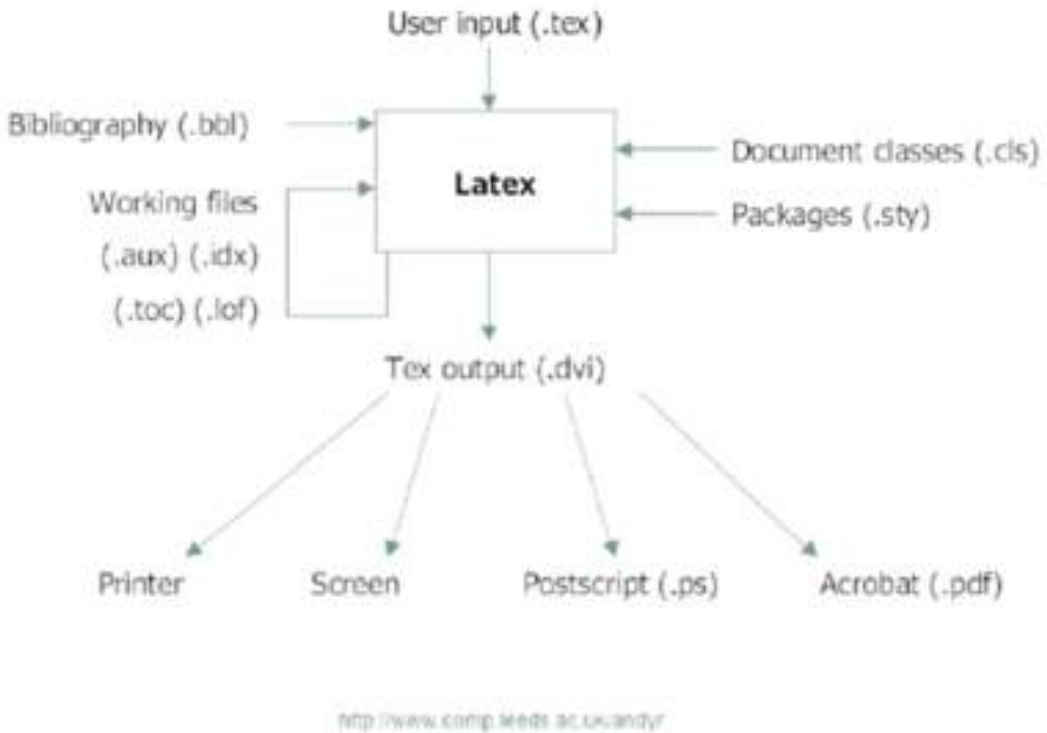
What is LaTeX

- LaTeXis pronouced "lay-tech" or "lah-tech", not "la-teks".
- LaTeXis document preparation for high quality typesetting.
- LaTeXis most often used to produce technical or scientific documents.

Why use LaTeX?

- Designed to accommodate academic use.
- Mathematic symbols and equations are easily integrated.
- Even complex tables, references, footnotes can be easily generated.
- Forces author to focus on logical structure of a document.

The Mechanisms of "TeXing"



In TeX:

Formula 1

$$\rho = \int 1 - \frac{2p^2 + 3p - 1}{6(p+1)(k-1)(n-k)} \left(\sum_{i=1}^{k} \frac{n-k}{n_i - 1} - 1 \right) xdx.$$

In MS Word:

Formula 2

$$\rho = \int -\frac{2p^2 + 3p - 1}{6(p+1)(k-1)(n-k)} \left(\sum_{i=1}^{k} \frac{n-k}{n_i - 1} - 1 \right) xdx$$

In TeX:

Formula 3

$$\begin{array}{ccccccccc}
 & & & & & & 0 & & \\
 & & & & & & \downarrow & & \\
0 & \longrightarrow & \mathcal{O}_C & \xrightarrow{\iota} & \mathcal{E} & \xrightarrow{\rho} & \mathcal{L} & \longrightarrow & 0 \\
 & & \| & & \downarrow{\scriptstyle \phi} & & \downarrow{\scriptstyle \psi} & & \\
0 & \longrightarrow & \mathcal{O}_C & \longrightarrow & \pi_*\mathcal{O}_D & \xrightarrow{\delta} & R^1f_*\mathcal{O}_V(-D) & \longrightarrow & 0 \\
 & & & & & & \downarrow{\scriptstyle \theta_i \otimes \gamma^{-1}} & & \\
 & & & & & & R^1f_*(\mathcal{O}_V(-iM)) \otimes \gamma^{-1} & & \\
 & & & & & & \downarrow & & \\
 & & & & & & 0 & &
\end{array}$$

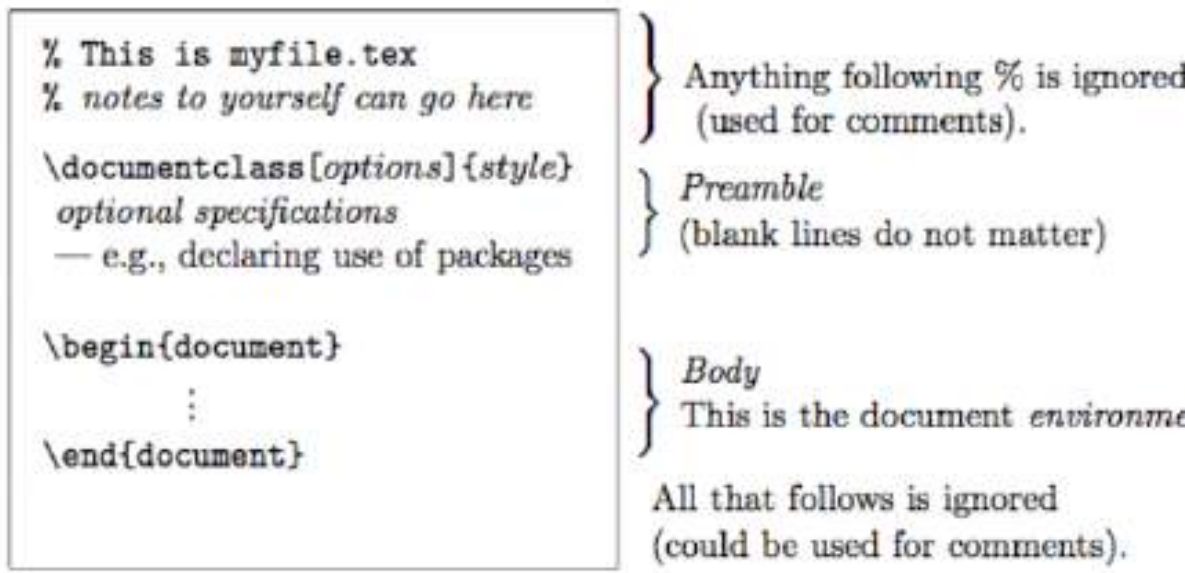
In MS Word:Oh, you gotta be kidding me...

Installing LaTeX

- Windows: Check out the proTeXt system; this allows you theinstall a full TEX system, including LATEX. `https://www.tug.org/protext/`
- MacOS: MacTeX.then you get everything you need.`https://tug.org/mactex/`
- Linux: Your system distribution or vendor has probablyprovided a TEX system including LaTeX.

Basic Document Structure

- In the preamble
  - documentclass
  - Packages
  - title/author
- In the body: contents
- In the back matter: bibliography



In the preamble

- Specify document class
  - we can use:
    \documentclass[12pt]{article}
  - document class: article, book,letter, report and slides.

- Specify package to be used
  - for example:
    \usepackage[margin=1in]{geometry} \usepackage{setspace}

- Note: Backslash at the beginning of command

In the preamble, cont.

- \title{First document}
- \author{Mary}
- \thanks{Funded by...}
- \date{October 2015}

To make title page and abstract

```
\begin{titlepage}
\maketitle
\end{titlepage}
\begin{abstract}
This is a simple paragraph
\end{abstract}
```

```
\documentclass[12pt]{article}
\usepackage{amsmath}
\usepackage{array}
\usepackage{setspace}
\doublespacing
\title{First Document}
\author{Mary}
\date{February 2014}
\begin{document}
\begin{titlepage}
\maketitle
\end{titlepage}
\begin{abstract}
This is a simple paragraph...
\end{abstract}
\newpage
...
\end{document}
```

In the body

To begin a new section:

define parindent and parskip in the preamble

\setlength{\parindent}{4em}

\setlength{\parskip}{0.5em}

```
\section{This is a section}
\subsection{This is a subsection}

This is the body of the subsection.
I can move to a new \underline{line} anytime, and I can put
in a \boxed{lot} of blanks with    no
\textbf{\textit{effect}}.\par

This is another



\subsection{Here is another subsection}
Welcome!...
```

Results:

1 This is a section

1.1 This is a subsection

This is the body of the subsection. I can move to a new line anytime, and I can put in a *lot* of blanks with no ***effect***.

This is another

1.2 Here is another subsection

Welcome!...

Font and Paragraph

Font and paragraph: Environment

```
\begin{center}
  The text is centered because I have entered the center environment.
  Text remains centered as long as we remain in this environment.
\end{center}
\begin{flushleft}
  Now we are out of the centering environment, and have begun the
  flushleft environment.
\end{flushleft}
\begin{flushright}
  This is another paragraph, but in the flushright environment.
  You will have occasion to use all four paragraph positions.
\end{flushright}

I am back to normal justification.  The added space you see between
the above paragraphs is due to entering those environments.
```

Result:

The text is centered because I have entered the center environment. Text remains centered as long as we remain in this environment.

Now we are out of the centering environment, and have begun the flushleft environment.

This is another paragraph, but in the flushright environment. You will have occasion to use all four paragraph positions.

I am back to normal justification. The added space you see between the above paragraphs is due to entering those environments.

Font Style

What you write		How it appears
`This is \textbf{boldface}.`	⇒	This is **boldface**.
`This is \textit{italic}.`	⇒	This is *italic*.
`This is \textrm{roman}.`	⇒	This is roman.
`This is \textsc{small caps}.`	⇒	This is SMALL CAPS.
`This is \textsf{sans serif}.`	⇒	This is sans serif.
`This is \textsl{slanted}.`	⇒	This is *slanted*.
`This is \texttt{typewriter}.`	⇒	This is typewriter.

Font Size

We can use

```
You can make the text {\large large} or {\Large larger} or
even {\LARGE larger still}.  You can also make it {\huge huge}.
You might want to make something {\small small} or
{\footnotesize smaller} or even {\scriptsize smaller still}.
You can make it really {\tiny tiny}.
```

Results:

You can make the text large or larger or even larger still. You can also make it huge. You might want to make something small or smaller or even smaller still. You can make it really tiny.

Level of Skipping

We can use

This is first line. \bigskip

This is second line. \medskip

This is third line. \smallskip

This is fourth line.

An ordinary line

Results:

This is first line.

This is second line.

This is third line.

This is fourth line.

An ordinary line

Footnote

Let's try:

```
This is first line.\bigskip

This is third line.  \smallskip

This is ordinary \footnote{footnotes working fine}
line
```

We can also make footnote to a table, see making table section...

List

There are three intrinsic list environments, distinguished by what appears at the beginning of each item: number, bullet, or your description.

- \begin{itemize}
- \begin{enumerate}
- \begin{description}

List-Description

We can use:

```
\begin{description}
  \item [Basic Body Structure] Basic Body Structure
  \item [Typesetting in \LaTex] Typesetting in \LaTex
  \item [Math Mode] Math Mode
\end {description}
```

Results:

Basic Body Structure Basic body structure

Typesetting in LaTeX Typesetting in LaTeX

Math Mode Math Mode

List-Itemize

We can use:

```
\begin{itemize}
    \item This is item 1
    \item This is item 2
        \begin{itemize}
            \item This is sub-item 1
            \item This is sub-item 2
        \end{itemize}
\end{itemize}
```

Results:

- This is item 1
- This is item 2
  - This is sub-item1
  - This is sub-item2

List-Enumerate

We can use:

```
\begin{enumerate}
    \item This is item 1
    \item This is item 2
        \begin{enumerate}
            \item This is sub-item 1
            \item This is sub-item 2
        \end{enumerate}
\end{enumerate}
```

Results:

1. This is item 1
2. This is item 2
   (a) This is sub-item1
   (b) This is sub-item2

A table is made with the tabular environment, which has the following syntax:

```
\begin{tabular}{column specs}
first row spec\\
.
.
.
last row spec\\
\end{tabular}
```

As indicated, each row ends with two backslashes. Each column specification can be left, center or right, abbreviated by just one character: l, c or r. In the body of the table, each column is separated by &.

Examples:

How it appears	What you write
left center right 1 2 3	\begin{tabular}{lcr} left & center & right \\ 1 & 2 & 3 \end{tabular}

Try:

```
\begin{tabular}{|l|c|r|} \hline
left & center & right \\\hline
1 & 2 & 3 \\\hline
\end{tabular}
```

Examples of making table with fixed length:

First call package in the preamble:

```
\usepackage{array}
```

Then, we can use:

```
 \begin{tabular}{ | m{5em} | m{1cm}| m{1cm} | }
\hline
cell1 dummy text dummy & cell2& cell3 \\
\hline
cell1 dummy text dummy & cell5 & cell6 \\
\hline
cell7 & cell8 & cell9 \\
\hline
\end{tabular}
```

Examples of combining rows and columns:

```
\usepackage{array}
```

Then, we can use:

```
 \begin{tabular}{ | m{5em} | m{1cm}| m{1cm} | } \hline
\multicolumn{3}{|c|}{Country List} \\[2ex]
\hline
cell1 dummy text dummy & cell2& cell3 \\
\hline
cell1 dummy text dummy & cell5 & cell6 \\
\hline
cell7 & cell8 & cell9 \\
\hline
\end{tabular}
```

Results:

Country List		
cell1 dummy text dummy	cell2	cell3
cell1 dummy text dummy	cell5	cell6
cell7	cell8	cell9

Examples of positioning, caption and footnote in a table:

```
\begin{table}[h!]
    \centering
    \begin{tabular}{ | m{5em} |m{1cm} | m{1cm} | }
        \hline
        \multicolumn{3}{|c|}{Country List \footnotemark[2]}\\ [3ex]
        \hline
        cell1 dummy text dummy & cell2 & cell3 \\
        \hline
        cell1 dummy text dummy  & cell5 & cell6 \\
        \hline
        cell7 & cell8& cell9 \\
        \hline
    \end{tabular}
    \caption{Table to test}
    \label{table:1}
    \end{table}
    \footnotetext[2]{Second footnote}
```

- **`cols`** : Defines the alignment and the borders of each column. It can have the following values:

`l`	left-justified column
`c`	centred column
`r`	right-justified column
`p{'width'}`	paragraph column with text vertically aligned at the top
`m{'width'}`	paragraph column with text vertically aligned in the middle (requires `array` package)
`b{'width'}`	paragraph column with text vertically aligned at the bottom (requires `array` package)
`|`	vertical line
`||`	double vertical line
`*{num}{form}`	the format form is repeated *num* times; for example `*{3}{|l}|` is equal to `|l|l|l|`

Inserting Figures

In the preamble, we need to \usepackage{graphicx}

```
%Importing figures
\newpage
\begin{figure}[t]
    \centering
    \includegraphics[scale=0.5]{../LaTeX}
    \caption{\LaTeX}
    \label{fig:1}
\end{figure}

Figure \ref{fig:1} shows a photograph of a gull.
```

LaTeXallows two writing modes for mathematical expressions: the inline mode and the display mode.

Inline:

The equation $E = mc^2$ was discovered in 1905.

Display:

The equation

$$E = mc^2$$

was discovered in 1905.

We can use:

The equation \$$E = mc^2$\$ was discovered in 1905.

The equation \$\$ $E = mc^2$\$\$ was discovered in 1905.

OR

\begin{equation}

$E = m^2$

\end{equation}

Some Mathematical Operations:

Operation	Symbol	Example: How it appears	Example: What you write
subscript	_	x_3	x_3
superscript	^	x^3	x^3
multiply	\times	$a \times b$	a\times b
divide	\div	$a \div b$	a\div b

The braces enclose an expression that can be used to define a more complex operand. For example, x_{a+b} is written as `$x_{a+b}$` and x^{a^2} is written as `$x^{a^2}$`. The order of subscripts and superscripts does not matter:

`x_{a+b}^{c+d}` $\Rightarrow x_{a+b}^{c+d}$

`x^{c+d}_{a+b}` $\Rightarrow x_{a+b}^{c+d}$

Set Notation:

What it is	How it appears	What you write
empty set	$\emptyset$	`\emptyset`
intersection	$\cap$	`\cap`
union	$\cup$	`\cup`
set minus	$\setminus$	`\setminus`
element in	$\in$	`\in`
subset (proper)	$\subset$	`\subset`
subset or equal	$\subseteq$	`\subseteq`
superset (proper)	$\supset$	`\supset`
superset or equal	$\supseteq$	`\supseteq`

Preceding any symbol by `\not` puts the line through the symbol, as in the following examples:

```
A\not\subseteq B   ⇒   A ⊈ B
x\not\in A\cup B   ⇒   x ∉ A ∪ B
A\setminus B\not\supset B   ⇒   A \ B ⊅ B
```

Greek Letters:

To produce $\alpha - \beta = \Delta - \delta$, we can write:
\alpha - \beta = \Delta -\delta

List of Greek Letters:

αA	\alpha A	νN	\nu N
βB	\beta B	$\xi \Xi$	\xi\Xi
$\gamma \Gamma$	\gamma \Gamma	oO	o O
$\delta \Delta$	\delta \Delta	$\pi \Pi$	\pi \Pi
$\epsilon \varepsilon E$	\epsilon \varepsilon E	$\rho \varrho P$	\rho\varrho P
ζZ	\zeta Z	$\sigma \Sigma$	\sigma \Sigma
ηH	\eta H	τT	\tau T
$\theta \vartheta \Theta$	\theta \vartheta \Theta	$\upsilon \Upsilon$	\upsilon \Upsilon
ιI	\iota I	$\phi \varphi \Phi$	\phi \varphi \Phi
κK	\kappa K	χX	\chi X
$\lambda \Lambda$	\lambda \Lambda	$\psi \Psi$	\psi \Psi
μM	\mu M	$\omega \Omega$	\omega \Omega

Mathematical Operation Symbols:

Operation	How it appears	What you write
sum	$\sum$	`\sum`
	$\sum_{i=1}^{n} x_i$	`\sum_{i=1}^n x_i`
integral	$\int$	`\int`
	$\int_a^b f(x)\,dx$	`\int_a^b f(x)\,dx`
parentheses	$()$	`\left( \right)`
	$\left(\frac{x}{1+y}\right)$	`\left(\frac{x}{1+y} \right)`
braces	$\{\}$	`\left\{ \right\}`
	$\left\{\sum_i x_i\right\}$	`\left\{\sum_i x_i \right\}`
brackets	$[]$	`\left[ \right]`
	$\left[\int_0^\infty f(x)\,dx\right]$	`\left[\int_0^\infty f(x)\,dx\right]`

Some examples:

Variable size style:

```
\[ \sqrt{\frac{\prod_{n=1}^N \left( \sum_{i\in I_n} x_i^n\right)}
                {\sqrt[3]{\sum_{i\in I_\infty} x_i}}
        }
\]
```

$$\sqrt{\frac{\prod_{n=1}^{N}\left(\sum_{i\in I_n} x_i^n\right)}{\sqrt[3]{\sum_{i\in I_\infty} x_i}}}$$

Display style:

```
\[ \sqrt{\frac{\displaystyle
          \prod_{n=1}^N \left( \sum_{i\in I_n} x_i^n\right)}
         {\sqrt[3]{\displaystyle\sum_{i\in I_\infty} x_i}}
       }
\]
```

$$\sqrt{\frac{\displaystyle \prod_{n=1}^{N} \left(\sum_{i\in I_n} x_i^n \right)}{\sqrt[3]{\displaystyle\sum_{i\in I_\infty} x_i}}}$$

Logical Term	How it appears	What you write
existential quantifier	$\exists$	`\exists`
universal quantifier	$\forall$	`\forall`
negation	$\neg$	`\neg`
disjunction	$\vee$	`\vee`
conjunction	$\wedge$	`\wedge`
implication	$\rightarrow$	`\rightarrow`
	$\Rightarrow$	`\Rightarrow`
equivalence	$\Leftrightarrow$	`\Leftrightarrow`
	$\equiv$	`\equiv`
such that	$\ni$	`\ni`

$$(x \in A \Rightarrow x \in B) \Leftrightarrow (A \subseteq B).$$

write `\[ (x\in A\Rightarrow x\in B) \Leftrightarrow (A\subseteq B). \]`

Other resources:

- `http://www.tablesgenerator.com/`

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- `https://www.sharelatex.com/learn/`

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- http://www.tablesgenerator.com/
- https://www.sharelatex.com/learn/
- https://en.wikibooks.org/wiki/LaTeX

The End.

Thank You!!