

# A Brief Introduction to L<sup>A</sup>T<sub>E</sub>X

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## The Idea of L<sup>A</sup>T<sub>E</sub>X

One of the greatest motivating forces for Donald Knuth when he began developing the original TeX system was to create something that allowed simple construction of mathematical formulae, while looking professional when printed. The fact that he succeeded was most probably why TeX (and later on, LaTeX) became so popular within the scientific community. Typesetting mathematics is one of LaTeX's greatest strengths. It is also a large topic due to the existence of so much mathematical notation.

If your document requires only a few simple mathematical formulas, plain LaTeX has most of the tools that you will ever need. If you are writing a scientific document that contains numerous complex formulas, the “**amsmath**” package introduces several new commands that are more powerful and flexible than the ones provided by basic LaTeX. The “**mathtools**” package fixes some amsmath quirks and adds some useful settings, symbols, and environments to amsmath.

### Before We Begin:

1. All L<sup>A</sup>T<sub>E</sub>X commands starts with a backslash (\).
2. Main arguments are defined inside braces {} and the optional arguments can be set inside brackets []. Optional arguments are defined before the main arguments.
3. In a TeX document, comments starts with

a, % sign and are ignored during typesetting. Thus, they don't appear on the original text itself.

## 1 Creating a Basic L<sup>A</sup>T<sub>E</sub>X Document

- The first line of any L<sup>A</sup>T<sub>E</sub>X document, defines what the **documentclass** of that document would be. It tells the TeX Engine, how to typeset the document.

Some common document classes are, *article*, *book*, *letter*, *report*, *scrartcl*, *scrreprt*, *scrbook*, *prosper*, *beamer* or, some other custom defined documentclass. Some optional arguments can also be defined when declaring a documentclass (some of L<sup>A</sup>T<sub>E</sub>X commands also takes optional arguments). Some of the useful optional arguments when defining the documentclass are — font size (ex. 11 pt), paper size (ex. a4), encoding (ex. utf8), twocolumn etc.

### Usage:

```
\documentclass [opt, opt]{class}
```

- Now comes the **title** section.

Usage:

```
\title {text}
\author {names}
\date {text}
```

*Note that,* you have to insert the `\maketitle` command, after the document begin declaration line, for the **title** section to appear in the document. If you don't want the date to appear then leave the argument as empty.

- After that, we define what packages do we want to use when writing the document. This provides us with extra features additional to what  $\text{\LaTeX}$  initially offers and enables you with more control over the document creation process.

Usage:

```
\usepackage[opt,opt]{package name}
```

All the available  $\text{\LaTeX}$  packages and their documentation can be found here at <https://ctan.org/pkg/>.

You can find topic specific packages and additional help at <https://ctan.org/topics/cloud>

- The main document or, the document body starts by declaring the beginning of the document and finishes by declaring the end of the document.

Usage:

```
\begin{document}
  \maketitle
  .... Actual Document Body ....
\end{document}
```

**Document Structure:**  $\text{\LaTeX}$  allows you to break up documents into the following hierarchy: **part**, **chapter**, **section**, **subsection**, **subsubsection**, **paragraph**, **subparagraph** (part being highest in the hierarchy, and subparagraph being the lowest).

## 2 Basic Formatting of a $\text{\LaTeX}$ Document

### 2.1 Text Formatting

1. `\textbf{text}` - **Bold**, Not Bold.  
*% Note that,* the Formatting will only applied to the text inside the braces.
2. `\textit{text}` - *Italic*
3. `\underline{text}` - Underline
4. `\large text` - large
5. `\Large text` - Large

### 2.2 Paragraph Formatting

1. By default new paragraphs are indented. To avoid indentation use `\noindent` command at the start of the line.
2. `\\` - Begin new line without creating a new paragraph.
3. `\pagebreak` - Start a New page.

4. `\begin{center}`  
Centered Text  
`\end{center}`

⇓

Centered Text

5. `\begin{flushleft}`  
Left Justified  
`\end{flushleft}`

⇓

Left Justified

6. `\begin{flushright}`  
Right Justified  
`\end{flushright}`

⇓

Right Justified

## 2.3 Special Characters, Symbols & Delimiters

1. `\textbackslash` - \
2. `\ldots` - ...
3. `\cdot` - · (Denotes dot multiplication)
4. `\textbar` - |
5. `\textbullet` - •
6. `\textless` - <
7. `\textgreater` - >

Other special characters (i.e. #, \$, %, ^, &, {, }, etc) are written after a backslash (\) when needed in the document.

To see how to write all the symbols withing a L<sup>A</sup>T<sub>E</sub>X document see <https://www.dickimaw-books.com/latex/novices/html/symbols.html> and, [https://en.wikibooks.org/wiki/LaTeX/Special\\_Characters](https://en.wikibooks.org/wiki/LaTeX/Special_Characters).

## Miscellaneous

1. `\linespread{x}` - Changes the line spacing by the multiplier of x.
2. `\tableofcontents` - Inserts a Table of Contents where written.
3. Use `\pagestyle{empty}` command for empty header, footer and no page numbers.
4. Use a \*, as in `\section*{title}`, to not number a particular item—these items will also not appear in the table of contents.
5. `\hspace{l}` - Horizontal space of length l (ex. l=10pt).
6. `\vspace{l}` - Vertical space of length l.
7. `\rule{w}{h}` - Line of width w and height h. ■

## 3 Referencing

In L<sup>A</sup>T<sub>E</sub>X floating environments can be referred to from elsewhere in the document. But, what is a Floating Environment?

**Floating Environment:** Floats are containers for things in a document that cannot be broken over a page. L<sup>A</sup>T<sub>E</sub>X by default recognizes “table” and “figure” floats, but you can define new ones of your own. Floats are there to deal with the problem of the object that won’t fit on the present page and to help when you really don’t want the object here just now.

Floats are not part of the normal stream of text, but separate entities, positioned in a part of the page to themselves (top, middle, bottom, left, right, or wherever the designer specifies). They always have a caption describing them and they are always numbered

so they can be referred to from elsewhere in the text.

One can reference to Floats after they appeared or even before the item appeared in the text!

Usage:

A marker for cross-reference using the command, `\label{marker}`, often of the form `\label{sec:item}` is set before the ending statement of a “Float” and when needed we can just use `\ref{marker}` to refer to it.

## 4 Lists

### 4.1 Bulleted List

Usage:

```
\begin{itemize}
  \item Bulleted Item 01
  \item Bulleted Item 02
\end{itemize}
```

⇓

- Bulleted Item 01
- Bulleted Item 02

### 4.2 Numbered List

Usage:

```
\begin{enumerate}
  \item Numbered Item 01
  \item Numbered Item 02
\end{enumerate}
```

⇓

1. Numbered Item 01
2. Numbered Item 02

### 4.3 Description List

Usage:

```
\begin{description}
  \item [Name] Maidul Hasan
  \item [ID] 1703016
  \item [Department] Department of Me-
    chanical Engineering
\end{description}
```

⇓

**Name** Maidul Hasan

**ID** 1703016

**Department** Department of Mechanical  
Engineering

## 5 Tabular Environment and Tables

To typeset material in rows and columns, tabular is needed, while the table environment is a container for floating material similar to figure, into which a tabular environment may be included.

### 5.1 Tabular Environment

Usage:

```
\begin{center}
```

% |: to put vertical lines

% l: left justified text (other available options are ‘r’: right justified & ‘c’: centered)

% p{x}: Used to define the width (x) of a certain column. This process is also known as “**Text Wrapping**”

```
\begin{tabular}{|l|p{4.7cm}|}
  \hline
  Name & Maidul Hasan \\
```

```

% & denotes the end of a column and start of another
\hline
ID & 1703016 \\
\hline
Department & Department of Mechanical Engineering
\hline
\end{tabular}
\end{center}

```

```

\hline
\end{tabular}
\end{center}

% Label of the table for future referencing
\label{student01:info}
\end{table}

```

↓

↓

Name	Maidul Hasan
ID	1703016
Department	Department of Mechanical Engineering

This is the tabular environment of Table 1.

Table 1: Student Information

Name	Maidul Hasan
ID	1703016
Department	Department of Mechanical Engineering

## 5.2 Tables

Usage:

```

\begin{table}[htbp]

% h: right here
% t: top of the page
% b: bottom of the page
% p: next page

% Table Caption
\caption {Student Information}

\begin{center}
\begin{tabular}{|l|p{4.7cm}|}
\hline
Name & Maidul Hasan \\
\hline
ID & 1703016 \\
\hline
Department & Department of Mechanical Engineering

```

## 6 Graphical Elements

Usage:

```

\begin{center}
\begin{figure}[htbp]
\caption{Lion Head Logo}
% the package “graphicx” is needed to
use the command \includegraphics
\includegraphics [width=3in, height=3in]
{lion_head_logo.jpg}
\label{fig:lionlogo}
\end{figure}
\end{center}

```

↓

Figure 1: Lion Head Logo



## 7 Bibliography and Citation

L<sup>A</sup>T<sub>E</sub>X provides a very good way for citation. This feature is specially useful when writing a research paper or any type of academic document.

For citation L<sup>A</sup>T<sub>E</sub>X provides a special file format (.bib) where you can store all of your references in an elaborate and orderly fashion. For convenience you can store all of your references in one bib file and later you may use this bib file for referencing in other T<sub>E</sub>X documents.

### 7.1 BIB<sub>T</sub>E<sub>X</sub>

**Note:** When using BIB<sub>T</sub>E<sub>X</sub> you need to run latex, bibtex and latex twice more to resolve dependencies.

#### Usage:

A .bib file may contain hundreds of citation references. But each entry follows a specific

format which is shown below.

```
@entrytype{key,
..... Fields .....
}
```

#### 7.1.1 BIB<sub>T</sub>E<sub>X</sub> Entry Types

Some of the most common entry types in a bib<sub>T</sub>E<sub>X</sub> file are,

**@article** Journal or magazine article.

**@book** Book with publisher.

**@booklet** Book without publisher.

**@inbook** A part of a book and/or range of pages.

**@incollection** A part of book with its own title.

**@conference** Article in conference proceedings.

**@techreport** Tech report, usually numbered in series.

**@phdthesis** PhD. Thesis.

**@unpublished** Unpublished.

**@misc** If nothing else fits.

#### 7.1.2 BIB<sub>T</sub>E<sub>X</sub> Fields

Fields provides additional and essential informations about the entry-type.

*Note that,* not all the fields needs to be filled. A specific entry-type may require one field while another one may not require that field.

Available BIB<sub>T</sub>E<sub>X</sub> fields are listed below.

**author** Names of authors, of format,  
author = "X and Y and Z"

**booktitle** Title of book when part of it is cited.

**edition** Edition of a book.

**chapter** Chapter or Section number.

**pages** Page range (2, 6, 9–12).

**series** Name of series of books.

**journal** Journal name.

**number** Number of journal or magazine.

**volume** Volume of a journal or book.

**month** Month published. Use 3 letter abbreviation.

**year** year of publication.

**institution** Sponsoring institution of tech. report.

**title** Title of work.

**type** Type of tech report, ex. “Research Note”.

**organization** Organization that sponsors a conference.

**school** Name of school (for thesis).

**editor** Editors names.

**publisher** Publisher’s name.

**address** Address of the publisher. Not necessary for major publishers.

**note** Any additional information.

## 7.2 Citation

Usage:

`\cite{key}`

The  $\text{\LaTeX}$  document should have the following two lines **just before** `\end{document}` (As, the ‘References’ section will appear where these two lines are putted, and we want the ‘References’ section to appear at the end of the document), where ‘bibfile.bib’ is the name of the  $\text{\LaTeX}$  file.

`\bibliographystyle{bibtex style}`  
`\bibliography{bibfile}`

Available bibtex styles are, *plain*, *abbrv*, *alpha*, *abstract*, *apa*, *unsrt*.

*Ex:* For in depth introduction to  $\text{\LaTeX}$  you may read the official  $\text{\LaTeX}$  documentation [1]. Also there are several cheat sheets available online. This one [3] gives a brief introduction to  $\text{\LaTeX}$  and also works as a good cheat sheet for references. For a short but on point cheat sheet you may try this one [2].

## 8 Equations

### 8.1 Math Environment

Usage:

% Inline equation of format, \$ equation \$

`\textit{Inline Equation:}` \$  $\int a^x dx = \frac{a^x}{\ln(a)} + C$

% Newline equation of format, \[equation\]

`\textit{Newline Equation:}`  $\int_{\psi_1}^{\psi_2} \frac{-1}{\beta} \int_{x_0}^x \text{curl}_z \tau_\eta dx + C$

⇓

*Inline Equation:*  $\int a^x dx = \frac{a^x}{\ln(a)} + C$   
*Newline Equation:*

$$\psi_l = \frac{-1}{\beta} \int_0^x \text{curl}_z \tau_\eta dx + C$$

## 8.2 Float Equations

Usage:

Equation `\ref{eq:1}` and `\ref{eq:2}` represents Maxwells' equation.

`\begin{equation}`

`\overrightarrow{A} = \frac{\mu}{4\pi} \frac{\overrightarrow{J}}{\int_V (\overrightarrow{J} \cdot d\mathbf{V})}`

`\label{eq:1}`

`\end{equation}`

`\begin{equation}`

`\nabla \cdot \overrightarrow{D} = \rho`

`\label{eq:2}`

`\end{equation}`

⇓

Equation 1 and 2 represents Maxwells' equation.

$$\vec{A} = \frac{\mu}{4\pi} \int_V \frac{\vec{J}(\vec{x}') dV'}{r} \quad (1)$$

$$\nabla \cdot \vec{D} = \rho \quad (2)$$

## 9 Conclusion

This concludes our brief introduction to L<sup>A</sup>T<sub>E</sub>X. But it's just the tip of the iceberg. There's so much more to learn. So, I have listed some links below that may come handy.

- L<sup>A</sup>T<sub>E</sub>X Packages - <https://ctan.org/pkg>
- L<sup>A</sup>T<sub>E</sub>X Topic Based Packages & Cheat Sheets - <https://ctan.org/topics/cloud>
- L<sup>A</sup>T<sub>E</sub>X Wikibooks - <https://en.wikibooks.org/wiki/LaTeX>
- Kile(a L<sup>A</sup>T<sub>E</sub>X IDE for Linux)'s Main Features - [https://docs.kde.org/trunk5/en/extragear-office/kile/intro\\_mainfeat.html#intro\\_docwizard](https://docs.kde.org/trunk5/en/extragear-office/kile/intro_mainfeat.html#intro_docwizard)
- IPython's Rich Display System - <https://nbviewer.jupyter.org/github/ipython/ipython/blob/2.x/examples/Notebook/Display%20System.ipynb#LaTeX>
- Getting to Grips with L<sup>A</sup>T<sub>E</sub>X, Andrew Roberts - <https://www.andy-roberts.net/writing/latex>
- L<sup>A</sup>T<sub>E</sub>X Special Characters & Symbols - <https://www.dickimaw-books.com/latex/novices/html/symbols.html>
- L<sup>A</sup>T<sub>E</sub>X Special Characters & Symbols - [https://kapeli.com/cheat\\_sheets/LaTeX\\_Math\\_Symbols.docset/Contents/Resources/Documents/index](https://kapeli.com/cheat_sheets/LaTeX_Math_Symbols.docset/Contents/Resources/Documents/index)
- Learn How to Write Markdown & L<sup>A</sup>T<sub>E</sub>X in The Jupyter Notebook, Khelifi Ahmed Aziz - <https://towardsdatascience.com/write-markdown-latex-in-the-jupyter-notebook->



Have fun.  
Best Wishes & Regards, Maidul Hasan

**Note:** This "document" is by no means meant to be a tutorial to teach the basics of  $\text{\LaTeX}$ . This was prepared to serve as a reference once you've learned the basics. My personal suggestion would be that, you learn  $\text{\LaTeX}$  from the official documentation or wiki-book or any other course/source that suits you the most.

## References

- [1] Latex documentation. <https://www.latex-project.org/help/documentation/>.
- [2] Winston Chang. Latex cheat sheet. <https://wch.github.io/latexsheet/>, 2014.
- [3] Richard G. Freedman and Philip Thomas. A super brief, yet super awesome, latex cheat sheet. Jun 2013.