Introduction to LaTeX

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What is LaTeX

From Wikipedia, the free encyclopedia

LaTeX (lah-tekh, lah-tek or lay-tek, a shortening of Lamport TeX) is a document preparation system. When writing, the writer uses plain text in markup tagging conventions to define the general structure of a document (such as article, book, and letter), to stylise text throughout a document (such as bold and italic), and to add citations and cross-references. A TeX distribution such as TeX Live or MikTeX is used to produce an output file (such as PDF or DVI) suitable for printing or digital distribution. Within the typesetting system, its name is stylised as LaTeX.

Installation of LaTeX

Windows

Download TeXLive on the follwing website
http://mirror.hust.edu.cn/CTAN/systems/texlive/Images/

Linux

For example, on Ubuntu (or Debian), Enter the command
sudo apt-get install texlive-full

MacOS

Download MacTeX on the following website
http://tug.org/mactex/mactex-download.html

Selection of IDEs

There are various IDEs recommended that support LaTeX, for example

Texmaker

http://www.xm1math.net/texmaker/

Sublime Text

http://www.sublimetext.com/

Tex Studio

http://www.texstudio.org/

They all have cross-platform support for Windows, Linux and MacOS.

Documentation on your computer

If you've installed a full version of TeXLive (as strongly recommended), the LaTeX documentation about all you want to is in front of you.

Open the command line and input the command
texdoc docname
For example, you can use the following types for the docname

tex	A documentation about TeX
article	A documentation about documentclass article
beamer	A documentation about documentclass beamer
pgf	A documentation about TikZ and PGF (used to draw graphs)

Just try to texdoc about all new things then you will be an expert in LaTeX.

The common syntax of LaTeX commands

Definition

Command is something that can be identified by Latex and represents a certian function in output file, or in relation with some specific character or format

All LaTeX commands have the following syntax

\command_name<special_args>[optional_args]{required_args}

special_args Seldom used in basic usage, for certain special usages in some packages

optional_args Used to define mode of the command, if not specified, LaTeX will use the default mode

required_args Must be filled

If you want to connect a letter after a command, a space must be appended after the command or LaTeX won't be able to compile it correctly. But two commands can be directly connected since there is a \ before each command.

The common syntax of LaTeX environments

Definition

Environment is an encapsulated part which has a certain format so that it will not be influenced by outer context

All LaTeX environments have the following syntax

```
\begin{environment_name}<special_args>[optional_args]
    ...
\end{environment_name}
```

special_args Similar to commands

optional_args Similar to commands

It is recommended to have a tab indent in each environment or your tex codes will be difficult to read by others or even yourself.

Environment in enviornment

Of course, the environments can be nested.

Example

```
\begin{environment_name}
    ...
    \begin{environment_name_2}
        ...
    \end{environment_name_2}
    ...
\end{environment_name}
```

All begins with documentclass

Definition

In a LaTeX file, the first line must be
\documentclass[options]{class}

For example, you can use the following types for the class

ariticle	Write a report or an science article
book	Write a book
beamer	Produce a lecture silde like this!

Actually some options can be added, such as

\documentclass[11pt,twoside,a4paper]{article}

Some details about the article class are on the next page. More features about other classes and options can be found in the LaTeX Document on your own.

The article class

The article class the most basic class in LaTeX, it provides you with some normalized structure and format for report writing. So usually you will use the following command as the first line of your tex document

\documentclass[options]{article}

Some of the options values are listed below (the default values are alerted)

- 10pt, 11pt, 12pt - the font size of the document
- a4paper, a5paper, letterpaper - the size of paper
- fleqn - make the math equations left aligned (default middle aligned)
- leqno - display the serial numbers of math equations on the left (default on the right)
- titlepage, notitlepage - whether to make the title an entire page
- onecolumn, twocolumn - the number of columns of the document
- twoside, oneside - influence the position of something on the page

The document environment

Definition

An document starts with the document environment. A typical (simplest) example is presented below.

Example

```
\documentclass[a4paper]{article}
\begin{document}
    ...
    Hello World!
    ...
\end{document}
```

All of your contents should be in the document environment. The document environment MUST be unique in the whole file.

Magic of packages

Definition

Some environments or commands cannot be used directly. In this case, packages should be included between documentclass and document environment.

Command

\usepackage[optional_args]{name}

There are some very useful packages that you can ALWAYS include:

- amsmath Define various maths environments
- amssymb Define various maths symbols
- geometry Adjust the margin, paper size, and etc.
- enumerate Generate a list like this!
- graphicx Insert image of all types

The usages of these and more packages will be introduced further.

Title, Author and Date

It's very useful to generate a title on the first page of a document, then these commands can be added between documentclass and document environment.

Command

```
\title{the title}
\author{the author}
\date{the date}
```

You can simply use \date{\today} to display today's date.

Then in the document environment, use the command \maketitle to generate a title.

Dividing into sections

Command

\section(*){name}
\subsection(*){name}
\subsubsection(*){name}

The default style of sections is like

1 Example Section Name

1.2 Example Subsection Name

1.2.3 Example Subsubsection Name

If a star(*) is added, the sequence number of the section, subsection or subsubsection won't be displayed.

Notice: Sections can be sorted into commands, not environments, so it doesn't have begin and end clauses. However, the whole contents between two sections is belonged to one section

Basic commands about lines and pages

Here are some basic commands about lines and pages in LaTeX, you will use them everywhere.

- \newline - begin a new line
- \\ - begin a new line
- \\[offset] - begin a new line with an offset
- \linebreak - begin a new line with the words discrete
- \newpage - begin a new page
- % - begin a line comment

Basic commands about fonts

First, lets start with some commands that transform font types

- \bf - **Sample Text**
- \it - *Sample Text*
- \rm - Sample Text
- \sc - Sample Text
- \sf - Sample Text
- \sl - *Sample Text*
- \tt - `Sample Text`

Note that the commands that transform font types influence the text in the whole scope ({...}) until another font type is specified. For example, how to use the first command \bf is shown below

```
{\bf Sample Text}
```

Sometimes we don't want to transform the font types, instead, we can only change the font type of some specified text, then the following commands are used (you can similarly use all font types on the previous page)

- \textbf - **Sample Text**
- \textit - *Sample Text*
- \textsc - Sample Text

However, in a math environment (will be introduced later), some other commands should be used

- \mathbf - **Sample Text**
- \mathit - *Sample Text*
- \mathsf - Sample Text

Note that the math environment doesn't include all of the font types on the previous page. More information about font types can be found here.

Font size can also be easily modified

- \tiny - Sample Text
- \scriptsize - Sample Text
- \footnotesize - Sample Text
- \small - Sample Text
- \normalsize - Sample Text
- \large - Sample Text
- \Large - Sample Text
- \LARGE - Sample Text
- \huge - Sample Text
- \Huge - Sample Text

Changing the color is similar to changing font types.

If you want to transform to a color (like \bf), you can use \color{name}
Similarly, you can use \textcolor{name} like \textbf
The background color of the whole page can be set using
\pagecolor{name}

There are some defined color name in the xcolor package, such as black, pink, blue, red, green, brown, yellow, white and etc. You can find more information in the documentation of xcolor (texdoc xcolor)

The equation environment

Definition

An equation enviornment contains a set of maths equations

```
\begin{euqation(*)}
   ...
\end{euqation(*)}
```

Example

$$curl\ F = \left(\frac{\partial F_z}{\partial y} - \frac{\partial F_y}{\partial z}\right)\hat{n}_x + \left(\frac{\partial F_x}{\partial z} - \frac{\partial F_z}{\partial x}\right)\hat{n}_y + \left(\frac{\partial F_y}{\partial x} - \frac{\partial F_x}{\partial y}\right)\hat{n}_z \quad (1)$$

If a star(*) is added, the sequence number of the equation won't be displayed.

The LaTeX script of the equation above is quite long, but not so difficult as you think so, while how I display the script to you is far more confusing, and you may check it in the tex file of the lecture sildes

```
curl\ F=\left(\frac{\partial F_z}{\partial y}
        -\frac{\partial F_y}{\partial z}\right)\hat{n_x}
    +\left(\frac{\partial F_x}{\partial z}
        -\frac{\partial F_z}{\partial x}\right)\hat{n_y}
    +\left(\frac{\partial F_y}{\partial x}
        -\frac{\partial F_x}{\partial y}\right)\hat{n_z}
```

In the script, only a space after \ will be printed as a space, \partial prints the symbol ∂, \frac{...}{...} makes a fraction, \left(and \right) makes brackets (of course they can be nested and must be in couple, but you can use two kinds of brackets on the both side, i.e., \left[and \right\rbrace, in which you must use \rbrace or \} to print a right brace }

How about equations with multiple lines?
The aligned enviornment can be used.

Example

$$\begin{cases} x+y=1 \\ x-y=1 \end{cases} \Longrightarrow \begin{cases} x=1 \\ y=0 \end{cases} \tag{2}$$

```
\left\lbrace\begin{aligned}
    x+y&=1\\x-y&=1
\end{aligned}\right.\Longrightarrow
\left\lbrace\begin{aligned}
    x&=1\\y&=0
\end{aligned}\right.
```

We can use a dot(.) when we want to insert nothing in one of the brackets.

The align/aligned enviornment

Definition

An align enviornment is used outside a maths enviornment like equation

```
\begin{align(*)}
   ...
\end{align(*)}
```

Definition

An aligned enviornment is used inside a maths enviornment like equation

```
\begin{euqation(*)}
   \begin{aligned}
      ...
   \end{aligned}
\end{euqation(*)}
```

Other properties of them are very similar.

The align/aligned enviornment is an basic align and multiline enviornment.

Example

$$a + b \Leftrightarrow b + a \tag{3}$$
$$(a + b) + c \Leftrightarrow a + (b + c) \tag{4}$$

```
\begin{align}
    a+b & \Leftrightarrow b+a \\
    (a+b)+c & \Leftrightarrow a+(b+c)
\end{align}
```

In order to make a new line, you can easily use \\ where you'd like (but not in certain maths enviornments such as equation). & is used to align the equations, you can use multiple &s and the &s on every line will be aligned respectively.

Something more about equation environment

What if the space between equation and the main body paragraph is considered larger than expectation? Is there any way to modify the line spaceing?
In default style of equation is like

Example

your body paragraph is supposed to be typed here

$$a \times b = c \tag{5}$$

your body paragraph is supposed to be typed here

But if we add \setlength\abovedisplayskip or belowdisplayskip(pt) before the equation environment, we have

Example

your body paragraph is supposed to be typed here

$$a \times b = c \tag{6}$$

your body paragraph is supposed to be typed here

```
{\setlength\abovedisplayskip{0pt}
\setlength\belowdisplayskip{0pt}
\begin{equation}
a \times b =c
\end{equation}}
```

The margin between the body paragraphs and the equation will be lessened as is in the example.

Typing subscript or superscript out side an equation environment

Sometimes you may encounter such circumstance as typing subscript or superscript in your paragraph without entering an equation environment.

Example

The concentration of $[H_3O^+]$

$[H_3O^+]$ is typed in the following way,
[H$_{3} $O $^{+} $]
in which we type every subscript with
$_{anyting you wanna enter as subscript}$
every subscript with
$^{anyting you wanna enter as subscript}$
if we only want to type one character as the subscript or superscript {} can be omitted.

Draw a simple tabular

Example

Title 1	Title 2	Title 3
1	2	3

The example above goes like this:

```
\begin{tabular}{|l|c|r|} %l represents aligning left;
                         c represents centering;
                         r represents aligning right
                         | means the vertical frame of a column
\hline    % hline means to draw a horizontal line for all columns
Title 1&Title 2&Title 3 %& is used to divide contents of different columns
\hline
1 & 2 &3
\hline
\end{tabular}
```

Draw tabular of various structure

Example

multicolumn		*
row	*	*
	*	*

```
\begin{tabular}{|c|c|c|}
\hline
\multicolumn{2}{|c|}{multicolumn} & * \\
\hline
\multirow{2}{1.5cm}{row} & * & *\\
\cline{2-3}
\multirow{2}{1.5cm}{} & * & *\\
\hline
\end{tabular}
```

\multirow{the number of boxes this multicloumn will occupy}{the width of the box(..cm)}{contents}
\multicolumn{the number of boxes this multicloumn will occupy}{|l/c/r|}{contents}
\cline{the column number of the beginning of the line – the column number of the end of the line}

Table environment

Definition

A table enviornment is used to arrange the place of a tabular

```
\begin{table(*)}[htbp]
    \begin{tabular(*)}
  ...
    \end{tabular(*)}
\end{table(*)}
```

[h] means inserting the tabular to the current place.
[t] means inserting the tabular to the top of the page.
[b] means inserting the tabular to the bottom of the page.
[p] means inserting the tabular to another new page.
Besides, we can also insert command between \begin{table(*)}[htbp] and \begin{tabular(*)}, such as \centering, \small and etc, to arrange some special format of the tabular.

Insert a graph

Enumerate and Item

Contributors

This LaTeX beamer slide is contributed to

- Liu Yihao (https://github.com/tc-imba)
- Zhou Yanjun (https://github.com/AuroraZK)
- Zhang Yifei (https://github.com/zhangyifei-chelsea)

For LaTeX lectures of the JI Technology Department.
For all students in JI as a reference in report/homework writing.

This is a long-term maintained project on GitHub, if you have any suggestions, make an issue on it, PRs are welcomed as well.