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 a word which can be identified by Latex and represents a certain 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

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

Geometry package

The settings of the layout of the pages is in geometry package.

Command

```
\usepackage{geometry}
\geometry{options}
```

Some of the options are listed below:

- paper - same as the paper settings in documentclass
- layout - use another type of paper's layout
- left/right - the blank length on the left/right
- top/bottom - the blank length on the top/bottom

Example

```
\geometry{paper=a4paper,layout=a5paper}
\geometry{left=2.5cm,right=2.5cm,top=2.5cm,bottom=2.5cm}
```

Use UTF-8 encoding in LaTeX

UTF-8 encoding is widely used in modern computer applications, so it's useful to include the inputenc package and use UTF-8 encoding.

Command

```
\usepackage[utf-8]{inputenc}
```

Example

café

However, different operating systems and compiling engines have different support on UTF-8 encoding, some UTF-8 codes that work on your computer may not work on others, so it is recommended to use commands (will be introduced later) instead of directly copy and paste the UTF-8 codes from the Internet.

(This part is not important)
If you want to use a language other than English, another package babel in needed.

Command

\usepackage[languages]{babel}

- languages - a list of languages, the last one to be the default language

Example

```
\usepackage[greek,english]{babel}
\textgreek{abcdefgABCDEFG}
```

Then LaTeX will print αβςδεφγAB῍ΔΕΦΓ
Of course, you can use some commands these greek letters, such as \alpha, \beta and etc, which is more convenient when you only need to print few of them, and it doesn't need any package listed above.

Special symbols

Some special symbols can't be directly used since they are reserved by LaTeX

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

Many LaTeX starters are confused with how to correctly print quotes, hyphens and dots.
` prints a left single quote, ' prints a right single quote.
`` prints a left double quote, '' prints a right double quote.
one hyphen (-) print like -
two hyphens (--) print like –
three hyphens (---) print like —
\dots prints the dots with a correct format (...) instead of directly use three dots (...)

Accent on letters

Sometimes you may need an accent form of a letter, here is an example of letter o

\`{o}	ò	\'{o}	ó	\^{o}	ô	\"{o}	ö	\~{o}	õ
\={o}	ō	\.{o}	ȯ	\u{o}	ŏ	\v{o}	ǒ	\H{o}	ő
\t{oo}	o͡o	\r{o}	o̊	\c{o}	o̧	\d{o}	ọ	\b{o}	o̲

Something interesting

You may be curious about how to print words like LaTeX, actually it's defined as a command.

- \TeX - TeX
- \LaTeX - LaTeX
- \LaTeXe - LaTeX 2$_\varepsilon$

Spaces may be confusing

There are defined command of spaces in different width and usages.

- ␣ - the basic space in LaTeX (printed in yellow since it's transparent). Note that any number of spaces or tabs is equal to one space, and the space after a command is ignored. If you want to add an extra space, use \␣ which makes a 1/3 em space (1 em is approximately the width of an M in the current font)
- ~ - If two words can't be separated on two lines, you can tell LaTeX about it using a tie (~), such as Prof.~Hamade (Prof. Hamade).
- \, - makes a 1/6 em space, commonly used before units (notice the space before em on this page)
- \; - makes a 2/7 em space
- \quad - makes a 1 em space
- \qquad - makes a 2 em space
- - makes actually the space of text, but text will be invisible.

Separate contents into 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 - $\mathbf{Sample\ Text}$
- \mathit - $\mathit{Sample\ Text}$
- \mathsf - $\mathsf{Sample\ Text}$

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

Build a colorful document

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.

black	gray	olive	teal	blue
green	orange	violet	brown	lightgray
pink	white	cyan	lime	purple
yellow	darkgray	magenta	red	

You can find more information in the documentation of xcolor (texdoc xcolor)

Enumerate and Item

When you need to enumerate some items as a list, you may use the enumerate package.

Command

```
\usepackage{enumerate}
\begin{enumerate}[style]
    \item ...
    \item ...
    \item ...
\end{enumerate}
```

This will generate a normal list with the serial numbers in the specified style, which could be the following (as example)

- 1 - 1, 2, 3, 4, ...
- (i) - (i), (ii), (iii), (iv), ...
- [1.] - [1.], [2.], [3.], [4.], ...

If you want to generate an unordered list, use itemize instead of enumerate.

Command

```
\usepackage{enumerate}
\begin{itemize}
    \item[style] ...
    \item[style] ...
    \item[style] ...
\end{itemize}
```

In this case, the position of style is different from that in enumerate, and the symbol displayed in the beginning of each item will be exactly same as the style. If style is not added, a default style will be used.

Ulem package

If you want to add some lines on the text, use the ulem package.

Command

```
\usepackage{ulem}
\uline{Sample Text}
```

There are different kinds of lines supported:

- \uline - Sample Text
- \uuline - Sample Text
- \uwave - Sample Text
- \sout - ~~Sample Text~~
- \xout - Sample Text
- \dashuline - Sample Text
- \dotuline - Sample Text

Text align

If you want to align a paragraph of text, use these three environments for left/center/right align.

Command

```
\begin{flushleft/center/flushright}
    ...
\end{flushleft/center/flushright}
```

However, if only a single line needs to be aligned, use these three commands.

Command

```
\leftline
\centerline
\rightline
```

The equation environment

An equation environment contains a set of maths equations

Command

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

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. Note that the environment name in the \begin and \end statements must be the same(both or neither have a * here).

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 environment can be used.

Example

```
\begin{equation}
    \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.
\end{equation}
```

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

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

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 spacing?
In default style of equation is like

Example

```
your body paragraph is supposed to be typed here
\begin{equation}a \times b = c \end{equation}
your body paragraph is supposed to be typed here
```

your body paragraph is supposed to be typed here

$$a \times b = c \tag{3}$$

your body paragraph is supposed to be typed here

But if we add
\setlength\abovedisplayskip{length} or
\setlength\belowdisplayskip{length}, we have

Example

```
your body paragraph is supposed to be typed here
{\setlength\abovedisplayskip{0em}
\setlength\belowdisplayskip{0em}
\begin{equation}a \times b = c \end{equation}}
your body paragraph is supposed to be typed here
```

your body paragraph is supposed to be typed here

$$a \times b = c \tag{4}$$

your body paragraph is supposed to be typed here

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

The align/aligned environment

An align environment is used outside a maths environment like equation

Command

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

An aligned environment is used inside a maths environment like equation, it is known as an inline environment.

Command

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

The align/aligned environment is a basic align and multiline environment.

Example

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

$$a + b \Leftrightarrow b + a \tag{5}$$

$$(a + b) + c \Leftrightarrow a + (b + c) \tag{6}$$

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

A simple method of entering math environment

Usually, we can use \$\$...\$\$ to display a maths equation instead of \begin{equation*}...\end{equation*}, which almost have same effect.

However, there is another style of math environment, inline style, which will display the maths equation on the same line of the text before it. It is used like \$...\$

Example

This is a simple equation

$$x^2 + y^2 = 1$$

This is a simple inline equation $x^2 + y^2 = 1$
The concentration of $[H_3O^+]$

```
This is a simple equation $$x^2+y^2=1$$
This is a simple inline equation $x^2+y^2=1$ \\
The concentration of [H$_3$O$^+$]
```

The difference between inline and normal

Actually, the display style of inline and normal equations have some differences.

Example

Expression	inline	normal
`\left(\frac{1}{\frac{1}{2}}\right)^{\frac{1}{2}}`	$\left(\frac{1}{\frac{1}{2}}\right)^{\frac{1}{2}}$	$\left(\frac{1}{\frac{1}{2}}\right)^{\frac{1}{2}}$
`\lim_{n\to\infty}a_n=+\infty`	$\lim_{n\to\infty} a_n = +\infty$	$\lim_{n\to\infty} a_n = +\infty$
`\sum_{k=1}^{10}k=55`	$\sum_{k=1}^{10} k = 55$	$\sum_{k=1}^{10} k = 55$

However, most of the differences can be fixed by some other commands

Example

Expression	inline	normal
`\left(\dfrac{1}{\frac{1}{2}}\right)^{\frac{1}{2}}`	$\left(\frac{1}{\frac{1}{2}}\right)^{\frac{1}{2}}$	$\left(\frac{1}{\frac{1}{2}}\right)^{\frac{1}{2}}$
`\lim\limits_{n\to\infty}a_n=+\infty`	$\lim\limits_{n\to\infty} a_n = +\infty$	$\lim\limits_{n\to\infty} a_n = +\infty$
`\sum\limits_{k=1}^{10}k=55`	$\sum\limits_{k=1}^{10} k = 55$	$\sum\limits_{k=1}^{10} k = 55$

Here the command \limits can be used in much more situations to fix the position of the bounds. The command \dfrac is used to print a fraction in normal size.

Basic Maths Commands

Here some basic commands commonly used in LaTeX are introduced. You may need amsmath and amssymb packages.

- x^abc, x_abc, x^abc_abc - x^abc, x_abc, x^abc_abc
- x^{abc}, x_{abc}, x^{abc}_{abc} - x^{abc}, x_{abc}, x^{abc}_{abc}
- \sqrt{a}, \sqrt[b]{a} - $\sqrt{a}$, $\sqrt[b]{a}$
- \overline{a+b}, \underline{a+b} - $\overline{a+b}$, $\underline{a+b}$
- \overbrace{1+2+\cdots+n}^n - $\overbrace{1+2+\cdots+n}^{n}$
- \underbrace{1+2+\cdots+n}_n - $\underbrace{1+2+\cdots+n}_{n}$
- \overrightarrow{a+b}, \vec{a+b} - $\overrightarrow{a+b}$, $\vec{a+b}$
- \dots, \cdot, \cdots, \vdots, \ddots - $\dots$, $\cdot$, $\cdots$, $\vdots$, $\ddots$

- \sum_{k=1}^{10}a_k - $\sum_{k=1}^{10} a_k$
- \prod_{k=1}^{10}a_k - $\prod_{k=1}^{10} a_k$
- \int_a^bx^2dx, \oint ,\iint\limits_A^{\quad B} -

$$\int_a^b x^2 dx \qquad \oint \qquad \iint\limits_A^B$$

- \lim_{n\to\infty}\sup a_n - $\lim_{n\to\infty} \sup a_n$
- \cos, \sin, \tan, \arccos, \arcsin, \arctan, \log, \ln - cos, sin, tan, arccos, arcsin, arctan, log, ln
- \rightarrow, \leftarrow, \leftrightarrow, \Rightarrow, \longleftarrow, \Longleftrightarrow - $\rightarrow$, $\leftarrow$, $\leftrightarrow$, $\Rightarrow$, $\longleftarrow$, $\Longleftrightarrow$

Matrix environment

Matrix is commonly used in Maths. There are various kinds of matrix environments defined in amsmath package, they are matrix, pmatrix, bmatrix, Bmatrix, vmatrix, Vmatrix.

Command

```
\begin{[p/b/B/v/V]matrix}
    ... & ... & ... \\
    ⋮ & ⋱ & ⋮ \\
    ... & ... & ... \\
\end{[p/b/B/v/V]matrix}
```

Here is some examples of the style of these matrix.

Example

matrix

$$\begin{matrix} a & b \\ c & d \end{matrix}$$

bmatrix

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

vmatrix

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix}$$

pmatrix

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

Bmatrix

$$\begin{Bmatrix} a & b \\ c & d \end{Bmatrix}$$

Vmatrix

$$\begin{Vmatrix} a & b \\ c & d \end{Vmatrix}$$

The gather/gathered environment

The gather/gathered environment is used to print multiline equations, similar to the align/aligned environment but all of the lines align in center. Each line of the equation will be ordered.

Command

```
\begin{gather(*)}
    ...
\end{gather(*)}
\begin{equation(*)}
    \begin{gathered}
        ...
    \end{gathered}
\end{equation(*)}
```

Example

```
\begin{gather}
    a+b=1 \\
    aaa+c=2222
\end{gather}
```

$$a + b = 1 \tag{7}$$

$$aaa + c = 2222 \tag{8}$$

The flalign and multline environment

There another two maths environment called flalign and multline, useful in some special situations.

Example

```
\begin{flalign}
    a+b&=1&=b+a\\
    b&=2&=c
\end{flalign}
```

$$a + b = 1 = b + a \quad (9)$$

$$b = 2 = c \quad (10)$$

You may notice that the left column is aligned left and the right column is aligned right, different from the align environment.

Example

```
\begin{multline}
    a+b+c=1\\b+c=2\\c=3
\end{multline}
```

$$a + b + c = 1$$

$$b + c = 2$$

$$c = 3 \quad (11)$$

Here, the first column aligns left, the last aligns right and others align center. Note that it is only one equation in order.

Measuring units in LaTeX

- pt - The smallest unit in LaTeX, 1/72.27 inch
- bp - 1/72 inch
- in - inch
- cm - centimeter
- mm - millimeter
- em - the width of letter M of the current font (commonly used in width measuring)
- ex - the height of letter x of the current font (commonly used in height measuring)
- \linewidth - the width of current line in the container
- \pagewidth - the width of the page
- \pageheight - the height of the page
- \textwidth - the normal width of text on the page
- \textheight - the normal height of text on the page

Include graphs

It's very useful to include graphs in LaTeX, especially in report and paper writing. Here is a common template of including a single floating graph.

Command

```
\usepackage{graphicx}
\begin{figure}[position]
    \centering
    \includegraphics[options]{file}
    \caption{caption}
    \label{label}
\end{figure}
```

- position - we usually use htbp here
- options - the width, height and other options about the graph
- caption - the caption displayed above/under the graph
- label - used for references in a document (will be introduced later)

Usually you need to optimize the size and some other properties of the graph, most of them can be set in options. (Only some useful options are listed here)

- height - use any LaTeX measuring unit.
- width - use any LaTeX measuring unit.
- scale - scale the graph to this proportion
- angle - rotate the graph in anti-clockwise by this angle

Example

```
\usepackage{graphicx}
\begin{figure}[htbp]
    \centering
    \includegraphics[width=0.8
\linewidth,angle=180]{sample.jpg}
    \caption{3 greatest people in
JI}
    \label{fig-sample}
\end{figure}
```

Figure: 3 greatest people in JI

Include multiple graphs

Sometimes you need to include a series of graphs, then the subfigure package can be used.

Example

```
\usepackage{graphicx}
\usepackage{subfigure}
\begin{figure}[htbp]
    \centering
    \subfigure[God Gan]{
    \includegraphics[width=0.4
\linewidth]{sample-1.jpg}
        \label{fig-sample-1}

    ...(with Master Fu, Professor and
God Hang)
\end{figure}
```

(a) God Gan

(b) Master Fu

(c) Professor

(d) God Hang

Draw tables

Table is another common element in LaTeX, for example, there is a simple table like this:

Example

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

Title 1	Title 2	Title 3
1	2	3

Command

```
\begin{tabular}{format}
    ...
\end{tabular}
```

format can be set as follow

- | - represents a vertical separate symbol
- l - align left in this column
- c - align center in this column
- r - align right in this column

Example

|l|c|r|

Title 1	Title 2	Title 3
1	2	3

||c|cc||

Title 1	Title 2	Title 3
1	2	3

How to arrange cells in tabular environment is very similar to the align environment. However, we usually need horizontal lines in tables.

Command

```
\hline = \cline{1-max_col}
\cline{start-end}
```

Example

```
\begin{tabular}{c|l|c|r}
    \hline\hline
    & Title 1 & Title 2 & Title
3 \\
    \cline{2-4}
    Table 1 & 2 & 3 \\
    \cline{2-4}
    & 4 & 5 & 6 \\
    \hline\hline
\end{tabular}
```

	Title 1	Title 2	Title 3
Table	1	2	3
	4	5	6

Here we draw a table with a multirow, but it only works with multirows of odd row number. A more convenient method of drawing multirows will be introduced.

Multicolumn and Multirow

Command

\multicolumn{ncols}{format}{text}

- ncols - the number of columns to be merged
- format - the format of the merged column, excluding the left | (eg. c|)
- text - the text in the merged column

\usepackage{multirow}
\multirow{nrows}{width}[fixup]{text}

- nrows - the number of rows to be merged
- width - the width of the merged rows (use * for auto)
- fixup - the vertical position of the text (optional, default in the center)
- text - the text in the merged row

Example

```
\begin{tabular}{|c|c|c|c|}
    \hline
    \multirow{4}{*}{Table} & Title 1 & Title 2 & Title 3 & Title 4 \\
    \cline{2-5}
    & \multicolumn{2}{c|}{Text 1} &
\multicolumn{2}{c|}{\multirow{3}{*}{Text 3}} \\
    \cline{2-3}
    & \multicolumn{2}{c|}{Text 2} & \multicolumn{2}{c|}{} \\
    \cline{2-3}
    & Text 4 & Text 5 & \multicolumn{2}{c|}{} \\
    \hline
\end{tabular}
```

<table>
<tr><td rowspan="4">Table</td><td>Title 1</td><td>Title 2</td><td>Title 3</td><td>Title 4</td></tr>
<tr><td colspan="2">Text 1</td><td colspan="2" rowspan="3">Text 3</td></tr>
<tr><td colspan="2">Text 2</td></tr>
<tr><td>Text 4</td><td>Text 5</td></tr>
</table>

Table environment

A table environment is used to arrange the place of a tabular, similar to the figure environment

Command

```
\begin{table(*)}[position]
    \centering
    \begin{tabular}{format}
        ...
    \end{tabular}
    \caption{caption}
    \label{label}
\end{table(*)}
```

The position, caption, label are same as those in figure environment.

About htbp

The htbp order is an official order of displaying graphs and tables.

- h - insert to the current place
- t - insert to the top of the page
- b - insert to the bottom of the page
- p - insert to a new page, which is common in dealing with big graphs and tables.

LaTeX compiler will try these methods from left to right as you defined. Usually, we use htbp so that it will try to put the graph or table in the current place. If fails, then it will try the top, the bottom, and the next page until success.

The array environment

When you use tabular in maths environment, the text format in the tabular won't be italic. However, there is a replacement of tabular, which is array environment.

Command

```
\begin{array}{format}
    ...
\end{array}
```

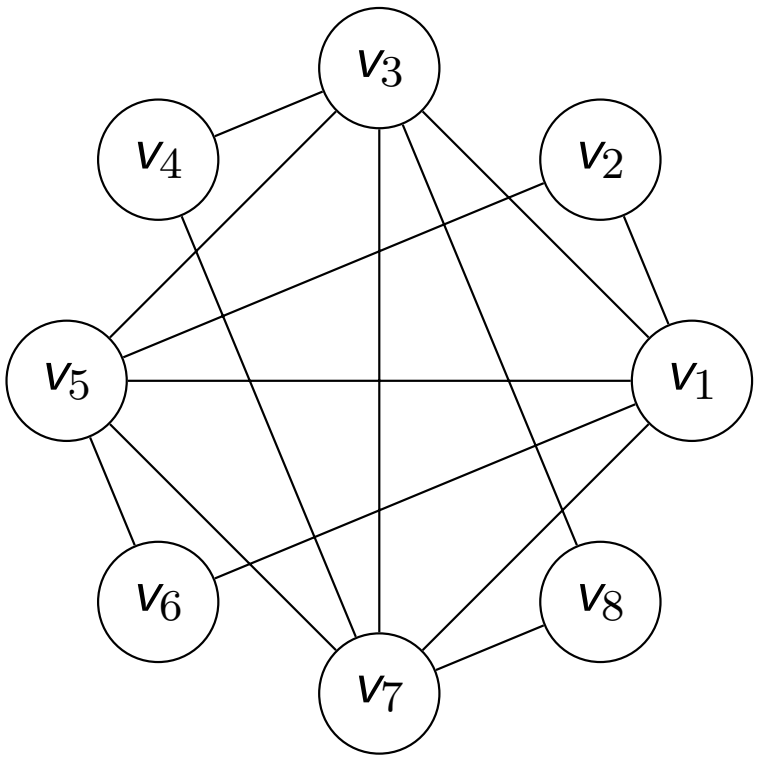
The properties and usages of these two environment are exactly the same.

Note that there is also a package called array, which is an enhancement of both tabular and array, you may use texdoc array to learn about it.

Draw graphs with TikZ and PGF

In your VE203, if you write your homework in LaTeX (with a 10% bonus), you will need this package to draw graphs. There is a document of more than one thousand pages about it (texdoc tikz or texdoc pgf)

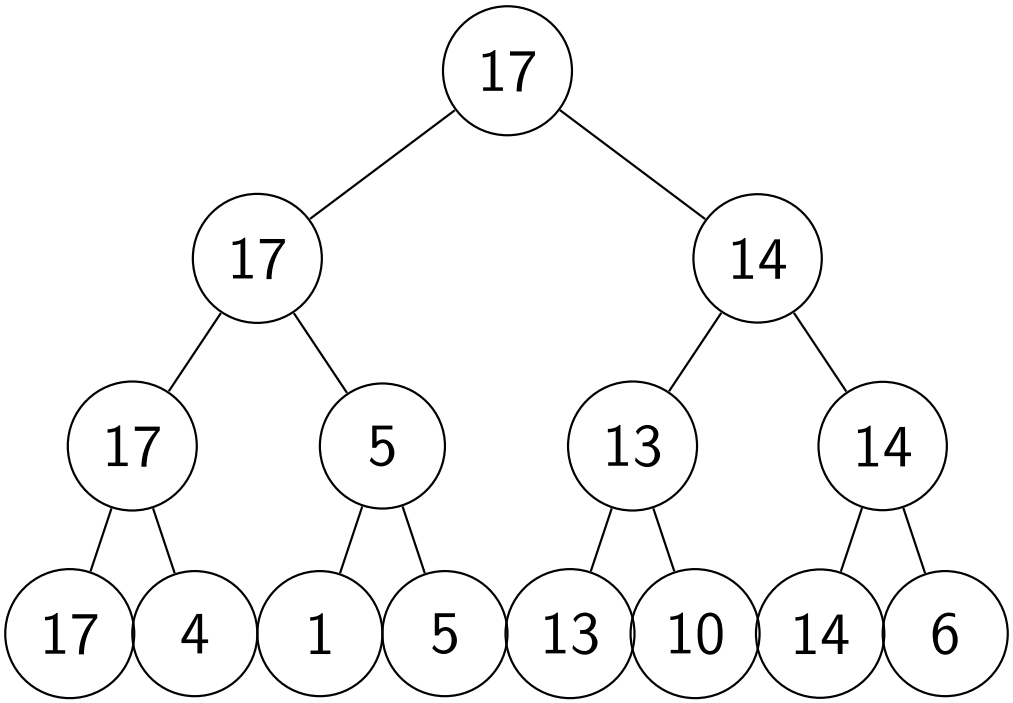
Example



\usepackage{tikz}

```
\begin{tikzpicture}[scale=2, bend angle=22.5]
\tikzstyle{every node}=[draw,shape=circle];
\foreach \i in {1,...,8}
{
\path (45*\i-45:1cm) node (v\i) {$v_\i$};
}
\draw
(v1) -- (v2) (v3) -- (v4) (v5) -- (v6) (v7) --
      (v8)
(v1) -- (v3) (v3) -- (v5) (v5) -- (v7) (v7) --
      (v1)
(v2) -- (v5) (v4) -- (v7) (v6) -- (v1) (v8) --
      (v3)
(v1) -- (v5) (v3) -- (v7);
\end{tikzpicture}
```

Example



‘

```
\begin{tikzpicture}[scale=0.8]
\tikzstyle{every node}=[draw,shape=
      circle,minimum size=0.8cm];
\node {17}[sibling distance=4cm]
child { node {17}[sibling distance=2cm]
    child {
        node {17}[sibling distance=1cm]
        child { node {17} }
        child { node {4} }
    }
    child {
        node {5}[sibling distance=1cm]
        child { node {1} }
        child { node {5} }
    }
}
child { node {14}[sibling distance=2cm]
    child {
        node {13}[sibling distance=1cm]
        child { node {13} }
        child { node {10} }
    }
    child {
        node {14}[sibling distance=1cm]
        child { node {14} }
        child { node {6} }
    }
};
\end{tikzpicture}
```

Newcommand

Sometimes you are building a huge project (like this lecture), and you may use certain type of syntax for many many times. Now it's time to define your own command with \newcommand in the beginning of the document (where the \usepackage commands appear).

Command

\newcommand{\yourcommand}[arg_num]{code}

- arg_num - number of arguments in your command
- code - the code of your command, use #1, #2, ..., #n to represent the arguments

Example

\newcommand{\samplecommand}[1]{\alert{\textbackslash #1}}

It is defined to simply display the commands in red in this lecture.

Renewcommand

Another times you need to redefine the commands, then \renewcommand can be used. It's very similar to \newcommand, the only difference is that you must use \newcommand when the command doesn't exists, while using \renewcommand when the command has been defined (by you or LaTeX packages) before.

Command

```
\renewcommand{\definedcommand}[arg_num]{code}
```

Example

```
\renewcommand{\thesection}{\Roman{section}}
\renewcommand{\thesubsection}{\Alph{subsection}}
```

By default, the number before the section titles of \section is 1, 2, 3, etc, this command will change them to a capital form of roman numbers, I, II, III, etc. And subsection numbers become A, B, C, etc.

New/Renewenvironment

Environments can also be defined.

Command

\newenvironment{name}[arg_num]{begdef}{enddef}
\renewenvironment{name}[arg_num]{begdef}{enddef}

- name - the name of your environment
- arg_num - number of arguments in your environment
- begdef - the code to substitute the begin clause of your environment
- enddef - the code to substitute the end clause of your environment

Example

```
\newenvironment{command}{\begin{block}{Command}}{\end{block}}
```

Include and Input

When you are building a huge project, if you write all of the code in a single file, the compiling of the whole project will be very slow, and the length of the file will also confuse you. Then you can use \include and \input to avoid this.

Command

\include{file} - Include the file on a new page, the files are compiled separately.
\input{file} - Directly replace the command with the whole file, doesn't start a new page, but the compiling won't speed up.

If you are including a .tex file, then the extension name can be omitted. Another command \includeonly{list} can be added to the beginning of the document, so that only the include files in list are compiled and others are ignored, this is very useful in debugging huge projects.

Reference

You may remember the \label command used in equations, graphs and tables, they are used for reference in other parts of the document.

Command

\ref{label}

Example

Figure 2(a) - Figure \ref{fig-sample-1}
Figure 1 - Figure \ref{fig-sample}

Once the position of these figures are changed, or some more figures are added between them, the number of them will change, but there label won't. So LaTeX will automatically generate the correct number for them and you don't need to modify them again and again.

Hyperlink

Hyperlinks are supported in LaTeX, use the hyperref package.

Command

```
\usepackage{hyperref}
\hypersetup{options}
\url{url}
\href{url}{text}
```

Some common options are listed below:

- colorlinks - boolean (default false)
- urlcolor - color for linked URLs (default magenta)
- linkcolor - color for normal internal links (default red)

Minipage and Multicol

minipage is a very useful environment for dividing pages into a grid.

Example

```
\begin{minipage}{0.32\linewdith}
    ...
\end{minipage}
\hfill (Fill the space horizontally)
\begin{minipage}{0.32\linewdith}
    ...
\end{minipage}
\hfill
\begin{minipage}{0.32\linewdith}
    ...
\end{minipage}
\vfill (Fill the space vertically)
```

```
\begin{minipage}{0.32\linewdith}
    ...
\end{minipage}
\hfill
\begin{minipage}{0.32\linewdith}
    ...
\end{minipage}
\hfill
\begin{minipage}{0.32\linewdith}
    ...
\end{minipage}
```

The code above generate six minipages in a grid of 3 column $\times$ 2 row. Don't try to add up the width of minipages in a line for more than about 0.98\linewidth, or the last minipage will be on a new line. The example on the previous page is printed with a multicols environment, different from \multicolumn command in a table.

Command

```
\usepackage{multicol}
\begin{multicols}{col_num}
    ...
\end{multicols}
```

This will generate a paragraph with col_num columns as shown in the example.

Listings

Sometimes you are asked to attach your code about your report or homework. Using listings package will avoid dealing with various special symbols and rearranging all of your code. (texdoc listings for more information)

Example

```
\usepackage{listings}
\lstset{language=[LaTeX]TeX, numbers=left, tabsize=4,
keywordstyle=\color{blue}\bfseries, identifierstyle=\bf, breaklines=true,
basicstyle=\tiny,rulecolor=\color{brown},
numberstyle=\color[RGB]{20,20,20}}
\lstinputlisting{tikz/binary_tree.tex} - Input a whole source code file
\begin{lstlisting}
Put your code here.
\end{lstlisting}
```

输入中文

虽然密院并不需要输入中文，但为了证明我会在 LaTeX 中输入中文，很有必要在最后一页介绍一下。

这里我使用一种较为简便的方法：ctex+XeLaTeX，首先，使用 ctex 宏包（\usepackage{ctex}），然后切换到 XeLaTeX 编译环境。在 ctex 中，已经定义了几个常用的字体，如宋体（\songti），仿宋（\fangsong），楷书（\kaishu）等。

例

```
\usepackage[scheme=plain]{ctex}
\songti
这个功能你们应该是用不到的。
```

在选项中加入[scheme=plain]后可以防止文档的标题，章节等英文字段被汉化。

Symbol tables from lshort

The following tables demonstrate all the symbols normally accessible from *math mode*. Note that some tables show symbols only accessible after loading the amssymb package in the preamble of your document[1]. If the $\mathcal{AMS}$ package and fonts are not installed on your system, have a look at CTAN:pkg/amslatex. An even more comprehensive list of symbols can be found at CTAN:info/symbols/comprehensive.

Table: Math Mode Accents.

$\hat{a}$	`\hat{a}`	$\check{a}$	`\check{a}`	$\tilde{a}$	`\tilde{a}`
$\grave{a}$	`\grave{a}`	$\dot{a}$	`\dot{a}`	$\ddot{a}$	`\ddot{a}`
$\bar{a}$	`\bar{a}`	$\vec{a}$	`\vec{a}`	$\widehat{AAA}$	`\widehat{AAA}`
$\acute{a}$	`\acute{a}`	$\breve{a}$	`\breve{a}`	$\widetilde{AAA}$	`\widetilde{AAA}`
$\mathring{a}$	`\mathring{a}`				

[1] The tables were derived from `symbols.tex` by David Carlisle and subsequently changed extensively as suggested by Josef Tkadlec.

Table: Greek Letters.

There is no uppercase of some of the letters like \Alpha, \Beta and so on, because they look the same as normal roman letters: A, B...

α	\alpha	θ	\theta	o	o	υ	\upsilon
β	\beta	ϑ	\vartheta	π	\pi	ϕ	\phi
γ	\gamma	ι	\iota	ϖ	\varpi	φ	\varphi
δ	\delta	κ	\kappa	ρ	\rho	χ	\chi
ϵ	\epsilon	λ	\lambda	ϱ	\varrho	ψ	\psi
ε	\varepsilon	μ	\mu	σ	\sigma	ω	\omega
ζ	\zeta	ν	\nu	ς	\varsigma		
η	\eta	ξ	\xi	τ	\tau		
Γ	\Gamma	Λ	\Lambda	Σ	\Sigma	Ψ	\Psi
Δ	\Delta	Ξ	\Xi	Υ	\Upsilon	Ω	\Omega
Θ	\Theta	Π	\Pi	Φ	\Phi		

Table: Binary Relations.

You can negate the following symbols by prefixing them with a \not command.

$<$	<	$>$	>	$=$	=
$\leq$	\leq or \le	$\geq$	\geq or \ge	$\equiv$	\equiv
$\ll$	\ll	$\gg$	\gg	$\doteq$	\doteq
$\prec$	\prec	$\succ$	\succ	$\sim$	\sim
$\preceq$	\preceq	$\succeq$	\succeq	$\simeq$	\simeq
$\subset$	\subset	$\supset$	\supset	$\approx$	\approx
$\subseteq$	\subseteq	$\supseteq$	\supseteq	$\cong$	\cong
$\sqsubset$	\sqsubset [a]	$\sqsupset$	\sqsupset [a]	$\bowtie$	\Join [a]
$\sqsubseteq$	\sqsubseteq	$\sqsupseteq$	\sqsupseteq	$\bowtie$	\bowtie
$\in$	\in	$\ni$	\ni , \owns	$\propto$	\propto
$\vdash$	\vdash	$\dashv$	\dashv	$\models$	\models
$\mid$	\mid	$\parallel$	\parallel	$\perp$	\perp
$\smile$	\smile	$\frown$	\frown	$\asymp$	\asymp
:	:	$\notin$	\notin	$\neq$	\neq or \ne

[a] Use the latexsym package to access this symbol

Table: Binary Operators.

$+$	`+`	$-$	`-`		
$\pm$	`\pm`	$\mp$	`\mp`	$\triangleleft$	`\triangleleft`
$\cdot$	`\cdot`	$\div$	`\div`	$\triangleright$	`\triangleright`
$\times$	`\times`	$\setminus$	`\setminus`	$\star$	`\star`
$\cup$	`\cup`	$\cap$	`\cap`	$*$	`\ast`
$\sqcup$	`\sqcup`	$\sqcap$	`\sqcap`	$\circ$	`\circ`
$\vee$	`\vee` , `\lor`	$\wedge$	`\wedge` , `\land`	$\bullet$	`\bullet`
$\oplus$	`\oplus`	$\ominus$	`\ominus`	$\diamond$	`\diamond`
$\odot$	`\odot`	$\oslash$	`\oslash`	$\uplus$	`\uplus`
$\otimes$	`\otimes`	$\bigcirc$	`\bigcirc`	$\amalg$	`\amalg`
$\bigtriangleup$	`\bigtriangleup`	$\bigtriangledown$	`\bigtriangledown`	$\dagger$	`\dagger`
$\lhd$ [a]	`\lhd` [a]	$\rhd$ [a]	`\rhd` [a]	$\ddagger$	`\ddagger`
$\unlhd$ [a]	`\unlhd` [a]	$\unrhd$ [a]	`\unrhd` [a]	$\wr$	`\wr`

Table: BIG Operators.

$\sum$	\sum	$\bigcup$	\bigcup	$\bigvee$	\bigvee
$\prod$	\prod	$\bigcap$	\bigcap	$\bigwedge$	\bigwedge
$\coprod$	\coprod	$\bigsqcup$	\bigsqcup	$\biguplus$	\biguplus
$\int$	\int	$\oint$	\oint	$\bigodot$	\bigodot
$\bigoplus$	\bigoplus	$\bigotimes$	\bigotimes		

Table: Arrows as Accents.

$\overrightarrow{AB}$	\overrightarrow{AB}	$\underrightarrow{AB}$	\underrightarrow{AB}
$\overleftarrow{AB}$	\overleftarrow{AB}	$\underleftarrow{AB}$	\underleftarrow{AB}
$\overleftrightarrow{AB}$	\overleftrightarrow{AB}	$\underleftrightarrow{AB}$	\underleftrightarrow{AB}

Table: Arrows.

$\leftarrow$	\leftarrow or \gets	$\longleftarrow$	\longleftarrow
$\rightarrow$	\rightarrow or \to	$\longrightarrow$	\longrightarrow
$\leftrightarrow$	\leftrightarrow	$\longleftrightarrow$	\longleftrightarrow
$\Leftarrow$	\Leftarrow	$\Longleftarrow$	\Longleftarrow
$\Rightarrow$	\Rightarrow	$\Longrightarrow$	\Longrightarrow
$\Leftrightarrow$	\Leftrightarrow	$\Longleftrightarrow$	\Longleftrightarrow
$\mapsto$	\mapsto	$\longmapsto$	\longmapsto
$\hookleftarrow$	\hookleftarrow	$\hookrightarrow$	\hookrightarrow
$\leftharpoonup$	\leftharpoonup	$\rightharpoonup$	\rightharpoonup
$\leftharpoondown$	\leftharpoondown	$\rightharpoondown$	\rightharpoondown
$\rightleftharpoons$	\rightleftharpoons	$\Longleftrightarrow$	\iff (bigger spaces)
$\uparrow$	\uparrow	$\downarrow$	\downarrow
$\updownarrow$	\updownarrow	$\Uparrow$	\Uparrow
$\Downarrow$	\Downarrow	$\Updownarrow$	\Updownarrow
$\nearrow$	\nearrow	$\searrow$	\searrow
$\swarrow$	\swarrow	$\nwarrow$	\nwarrow
$\rightsquigarrow$	\leadsto [a]		

[a] Use the latexsym package to access this symbol

Table: Delimiters.

(	(	)	)	↑	\uparrow
[	[or \lbrack	]	] or \rbrack	↓	\downarrow
{	\{ or \lbrace	}	\} or \rbrace	↕	\updownarrow
⟨	\langle	⟩	\rangle	⇑	\Uparrow
|	| or \vert	‖	\\| or \Vert	⇓	\Downarrow
/	/	\	\backslash	⇕	\Updownarrow
⌊	\lfloor	⌋	\rfloor		
⌉	\rceil	⌈	\lceil		

Table: Large Delimiters.

⎧	\lgroup	⎫	\rgroup	⎰	\lmoustache
⎪	\arrowvert	⎪	\Arrowvert	⎪	\bracevert
⎩	\rmoustache				

Table: Miscellaneous Symbols.

$\dots$	\dots	$\cdots$	\cdots	$\vdots$	\vdots	$\ddots$	\ddots
$\hbar$	\hbar	$\imath$	\imath	$\jmath$	\jmath	ℓ	\ell
$\Re$	\Re	$\Im$	\Im	$\aleph$	\aleph	$\wp$	\wp
$\forall$	\forall	$\exists$	\exists	$\mho$ [a]	\mho [a]	∂	\partial
$'$	'	$\prime$	\prime	$\emptyset$	\emptyset	∞	\infty
∇	\nabla	$\triangle$	\triangle	$\Box$ [a]	\Box [a]	$\Diamond$ [a]	\Diamond [a]
$\bot$	\bot	$\top$	\top	$\angle$	\angle	$\surd$	\surd
$\diamondsuit$	\diamondsuit	$\heartsuit$	\heartsuit	$\clubsuit$	\clubsuit	$\spadesuit$	\spadesuit
$\neg$	\neg or \lnot	$\flat$	\flat	$\natural$	\natural	$\sharp$	\sharp

[a] Use the latexsym package to access this symbol

Table: Non-Mathematical Symbols.

These symbols can also be used in text mode.

†	\dag	§	\S	©	\copyright	®	\textregistered
‡	\ddag	¶	\P	£	\pounds	%	\%

Table: $\mathcal{AMS}$ Delimiters.

⌜	\ulcorner	⌝	\urcorner	⌞	\llcorner	⌟	\lrcorner
|	\lvert	|	\rvert	‖	\lVert	‖	\rVert

Table: $\mathcal{AMS}$ Greek and Hebrew.

F	\digamma	$\varkappa$	\varkappa	ℶ	\beth	ℷ	\gimel	ℸ	\daleth

Table: Math Alphabets.

Example	Command	Required package
ABCDEabcde1234	`\mathrm{ABCDE abcde 1234}`	
ABCDEabcde1234	`\mathit{ABCDE abcde 1234}`	
ABCDEabcde1234	`\mathnormal{ABCDE abcde 1234}`	
$\mathcal{ABCDE}\dashv\lfloor\rfloor\lceil\rceil\infty\in\ni\triangle$	`\mathcal{ABCDE abcde 1234}`	
$\mathscr{ABCDE}$	`\mathscr{ABCDE abcde 1234}`	mathrsfs
$\mathfrak{ABCDEabcde1234}$	`\mathfrak{ABCDE abcde 1234}`	amsfonts or amssymb
$\mathbb{ABCDE}\beth\nvDash\nVdash\ngtr$	`\mathbb{ABCDE abcde 1234}`	amsfonts or amssymb

Table: $\mathcal{AMS}$ Binary Operators.

$\dotplus$	\dotplus	$\centerdot$	\centerdot		
$\ltimes$	\ltimes	$\rtimes$	\rtimes	$\divideontimes$	\divideontimes
$\Cup$	\doublecup	$\Cap$	\doublecap	$\smallsetminus$	\smallsetminus
$\veebar$	\veebar	$\barwedge$	\barwedge	$\doublebarwedge$	\doublebarwedge
$\boxplus$	\boxplus	$\boxminus$	\boxminus	$\circleddash$	\circleddash
$\boxtimes$	\boxtimes	$\boxdot$	\boxdot	$\circledcirc$	\circledcirc
$\intercal$	\intercal	$\circledast$	\circledast	$\rightthreetimes$	\rightthreetimes
$\curlyvee$	\curlyvee	$\curlywedge$	\curlywedge	$\leftthreetimes$	\leftthreetimes

Table: $\mathcal{AMS}$ Binary Relations.

$\lessdot$	\lessdot	$\gtrdot$	\gtrdot	$\doteqdot$	\doteqdot
$\leqslant$	\leqslant	$\geqslant$	\geqslant	$\risingdotseq$	\risingdotseq
$\eqslantless$	\eqslantless	$\eqslantgtr$	\eqslantgtr	$\fallingdotseq$	\fallingdotseq
$\leqq$	\leqq	$\geqq$	\geqq	$\eqcirc$	\eqcirc
$\lll$	\lll or \llless	$\ggg$	\ggg	$\circeq$	\circeq
$\lesssim$	\lesssim	$\gtrsim$	\gtrsim	$\triangleq$	\triangleq
$\lessapprox$	\lessapprox	$\gtrapprox$	\gtrapprox	$\bumpeq$	\bumpeq
$\lessgtr$	\lessgtr	$\gtrless$	\gtrless	$\Bumpeq$	\Bumpeq
$\lesseqgtr$	\lesseqgtr	$\gtreqless$	\gtreqless	$\thicksim$	\thicksim
$\lesseqqgtr$	\lesseqqgtr	$\gtreqqless$	\gtreqqless	$\thickapprox$	\thickapprox

Table: $\mathcal{AMS}$ Binary Relations. (... continue)

$\preccurlyeq$	\preccurlyeq	$\succcurlyeq$	\succcurlyeq	$\approxeq$	\approxeq
$\curlyeqprec$	\curlyeqprec	$\curlyeqsucc$	\curlyeqsucc	$\backsim$	\backsim
$\precsim$	\precsim	$\succsim$	\succsim	$\backsimeq$	\backsimeq
$\precapprox$	\precapprox	$\succapprox$	\succapprox	$\vDash$	\vDash
$\subseteqq$	\subseteqq	$\supseteqq$	\supseteqq	$\Vdash$	\Vdash
$\shortparallel$	\shortparallel	$\Supset$	\Supset	$\Vvdash$	\Vvdash
$\blacktriangleleft$	\blacktriangleleft	$\sqsupset$	\sqsupset	$\backepsilon$	\backepsilon
$\vartriangleright$	\vartriangleright	$\because$	\because	$\varpropto$	\varpropto
$\blacktriangleright$	\blacktriangleright	$\Subset$	\Subset	$\between$	\between
$\trianglerighteq$	\trianglerighteq	$\smallfrown$	\smallfrown	$\pitchfork$	\pitchfork
$\vartriangleleft$	\vartriangleleft	$\shortmid$	\shortmid	$\smallsmile$	\smallsmile
$\trianglelefteq$	\trianglelefteq	$\therefore$	\therefore	$\sqsubset$	\sqsubset

Table: $\mathcal{AMS}$ Arrows.

$\dashleftarrow$	\dashleftarrow	$\dashrightarrow$	\dashrightarrow
$\leftleftarrows$	\leftleftarrows	$\rightrightarrows$	\rightrightarrows
$\leftrightarrows$	\leftrightarrows	$\rightleftarrows$	\rightleftarrows
$\Lleftarrow$	\Lleftarrow	$\Rrightarrow$	\Rrightarrow
$\twoheadleftarrow$	\twoheadleftarrow	$\twoheadrightarrow$	\twoheadrightarrow
$\leftarrowtail$	\leftarrowtail	$\rightarrowtail$	\rightarrowtail
$\leftrightharpoons$	\leftrightharpoons	$\rightleftharpoons$	\rightleftharpoons
$\Lsh$	\Lsh	$\Rsh$	\Rsh
$\looparrowleft$	\looparrowleft	$\looparrowright$	\looparrowright
$\curvearrowleft$	\curvearrowleft	$\curvearrowright$	\curvearrowright
$\circlearrowleft$	\circlearrowleft	$\circlearrowright$	\circlearrowright
$\multimap$	\multimap	$\upuparrows$	\upuparrows
$\downdownarrows$	\downdownarrows	$\upharpoonleft$	\upharpoonleft
$\upharpoonright$	\upharpoonright	$\downharpoonright$	\downharpoonright
$\rightsquigarrow$	\rightsquigarrow	$\leftrightsquigarrow$	\leftrightsquigarrow

Table: $\mathcal{AMS}$ Negated Binary Relations and Arrows.

$\nless$	\nless	$\ngtr$	\ngtr	$\varsubsetneqq$	\varsubsetneqq
$\lneq$	\lneq	$\gneq$	\gneq	$\varsupsetneqq$	\varsupsetneqq
$\nleq$	\nleq	$\ngeq$	\ngeq	$\nsubseteqq$	\nsubseteqq
$\nleqslant$	\nleqslant	$\ngeqslant$	\ngeqslant	$\nsupseteqq$	\nsupseteqq
$\lneqq$	\lneqq	$\gneqq$	\gneqq	$\nmid$	\nmid
$\lvertneqq$	\lvertneqq	$\gvertneqq$	\gvertneqq	$\nparallel$	\nparallel
$\nleqq$	\nleqq	$\ngeqq$	\ngeqq	$\nshortmid$	\nshortmid
$\lnsim$	\lnsim	$\gnsim$	\gnsim	$\nshortparallel$	\nshortparallel
$\lnapprox$	\lnapprox	$\gnapprox$	\gnapprox	$\nsim$	\nsim
$\nprec$	\nprec	$\nsucc$	\nsucc	$\ncong$	\ncong
$\npreceq$	\npreceq	$\nsucceq$	\nsucceq	$\nvdash$	\nvdash
$\precneqq$	\precneqq	$\succneqq$	\succneqq	$\nvDash$	\nvDash
$\precnsim$	\precnsim	$\succnsim$	\succnsim	$\nVdash$	\nVdash
$\precnapprox$	\precnapprox	$\succnapprox$	\succnapprox	$\nVDash$	\nVDash
$\subsetneq$	\subsetneq	$\supsetneq$	\supsetneq	$\ntriangleleft$	\ntriangleleft
$\varsubsetneq$	\varsubsetneq	$\varsupsetneq$	\varsupsetneq	$\ntriangleright$	\ntriangleright
$\nsubseteq$	\nsubseteq	$\nsupseteq$	\nsupseteq	$\ntrianglelefteq$	\ntrianglelefteq
$\subsetneqq$	\subsetneqq	$\supsetneqq$	\supsetneqq	$\ntrianglerighteq$	\ntrianglerighteq
$\nleftarrow$	\nleftarrow	$\nrightarrow$	\nrightarrow	$\nleftrightarrow$	\nleftrightarrow
$\nLeftarrow$	\nLeftarrow	$\nRightarrow$	\nRightarrow	$\nLeftrightarrow$	\nLeftrightarrow

Table: $\mathcal{AMS}$ Miscellaneous.

$\hbar$	\hbar	$\hbar$	\hslash	$\Bbbk$	\Bbbk
$\square$	\square	$\blacksquare$	\blacksquare	Ⓢ	\circledS
$\vartriangle$	\vartriangle	$\blacktriangle$	\blacktriangle	$\complement$	\complement
$\triangledown$	\triangledown	$\blacktriangledown$	\blacktriangledown	$\Game$	\Game
$\lozenge$	\lozenge	$\blacklozenge$	\blacklozenge	$\bigstar$	\bigstar
$\angle$	\angle	$\measuredangle$	\measuredangle		
$\diagup$	\diagup	$\diagdown$	\diagdown	$\backprime$	\backprime
$\nexists$	\nexists	$\Finv$	\Finv	$\varnothing$	\varnothing
$\eth$	\eth	$\sphericalangle$	\sphericalangle	$\mho$	\mho

Package List

These are the packages you are most likely to use in daily LaTeX writing.

- geometry
- amsmath
- amssymb
- amsfonts
- multicol
- multirow
- tabu
- graphicx
- subfigure
- hyperref
- ulem
- ctex
- enumerate
- latexsym
- tikz
- listings

Bibliography

- LaTeX 入门, 刘海洋, 电子工业出版社, 2013.6, ISBN 978-7-121-20208-7
- The Not So Short Introduction to LaTeX 2_ε, Tobias Oetiker, Hubert Partl, Irene Hyna and Elisabeth Schlegl, Version 5.05, July 18, 2015 (http://www.ctan.org/tex-archive/info/lshort/english/)
- Introduction to LaTeX, David Reid (https://wenku.baidu.com/view/f08fbdf24693daef5ef73d23.htm

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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.