Hello World

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March 3, 2019

Contents

TODO:

- style for code, for little chunks of code, for large chunks of code and their output.

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Chapter 1

Introduction

Introduce what LaTeX is.

At the beginning of most documents there will be information about the document itself, such as the title and date, and also information about the authors, such as name, address, email etc. All of this type of information within LaTeX is collectively referred to as *top matter*.

1.1 Definition

Following conventions will be used in this report:

package

command

option

1.2 Packages

While writing your document, you will probably find that there are some areas where basic LaTeX cannot solve your problem. If you want to include graphics, colored text or source code from a file into your document, you need to enhance the capabilities of LaTeX. Such enhancements are called packages. Some packages come with the LaTeX base distribution. Others are provided separately. Modern TeX distributions come with a large number of packages pre-installed.

1.3 Box

The key lies in LaTeX is box, which is the smallest unit processed by LaTeX. Everything is thought as a box, and then aligned into page.

1.3.1 Introduction

A *box* is the TeXterm for an invisible container that can hold a visible element, nothing, or other boxes. *Glue* is the TeXterm for an invisible connector that determines the separation between boxes. A visible element can be a letter, image, geometric shape, etc. TeXbuilds pages by gluing boxes together. In a typical document, letter boxes are glues to other letter boxes to form words, which are then elastically glued to other words to form sentences. Sentences are broken into lines and placed in paragraph boxes. Elastic glue is squeezed or stretched to fully justify lines within paragraph boxes. Paragraph boxes are glued to diagram boxes, and so on.

While it is true that boxes can hold other boxes, not all commands that can generate boxes be used within all other commands that can generate boxes. There are often workarounds for these limitations.

The size of a box is typically to the size and position of its contents, but it doesn't have to be. Many box commands accept custom widths and/or heights, and there are other commands that effect the shape and position of boxes. Boxes are placed relative to other boxes, while visible elements are placed relative to the boxes which contains them.

Alice was beginning to get very tired of sitting by her sister on the bank, and of having nothing to do: once or twice she had peeped into the book her sister was reading, but it had no pictures or conversations in it, "and what is the use of a book," thought Alice "without pictures or conversation?"

This box is narrow.

This box, wide.

This box is shifted.

This box has zero size.

1.3.2 Boxes

character boxes

TEXcharacter boxes have three dimensional propreties:

- **height** is the length between the baseline and the top of the box.
- **depth** is the length between the baseline and the bottom of the box.
- **width** is the width of the box.

parbox, minipage, and pbox

A \parbox is a box of specific width formatted in paragraph mode. In paragraph mode, text is broken into lines and lines are broken into pages. \parbox[pos][height][contentpos]{width}{text}

   width defines the width of the paragraph box. Text will be broken into lines so that it fits within this width.

   pos selects which baseline to join. It can be **t**op, **b**ottom, or **c**enter.

   contentpos positions the contents of the box within the box. It can be one of **c**enter, **t**op, **b**ottom or **s**pread. Note that *contentpos* has no effect if the box is not larger than the text it contains.

   \pbox[pos][height]{width}{text}

Chapter 2

Basic

2.1 Document classes

article
> For articles in scientific journals, presentation, short reports, program documentation, invitations, etc

report
> For longer reports containing several chapters, small books, thesis, etc

book
> For real books

slides
> For slides, this class uses big sans serif letters

letter
> For letter

beamer
> For presentations.

2.1.1 Document Class Options

11pt
> Font size, default 10pt.

a4paper
> Paper size, default letterpaper. Available options: a5paper, b5paper, executivepaper and legalpaper.

fleqn
> Typesets displayed formula left-aligned instead of centered(default).

leqno
> Places the numbering of formulas on the left hand side instead of the right(default).

titlepage, notitlepage
> The article class does not start a new page by default, while report and book do.

twocolumn
> Two columns, default one.

twoside,oneside
> The article and report classes are single sides and the book class is double sided by default.

landscape
> landscape mode. default portrait.

openright,openany
> Begin a chapter either only on right hand pages or on the next page available. This does not apply to *article* class, as it doesn't know about chapters. The report class by default starts chapters on the next page available and the book class starts them on right hand pages.

draft,final
> draft mode, which will speed up typesetting, because figures are not loaded, just indicated by a frame. In draft mode, LaTeX indicates hyphenation and justification problems with a small square in the right-hand margin of the problem line so they can be located quickly.

2.1.2 Papersize

letterpaper 11×8.5 in

legalpaper 14×8.5 in

executivepaper 10.5×7.25 in

a4paper 20.7×21 in

a5paper 21×14.8 in

b5paper 25×17.6 in

2.2 Sections

LaTeX provides 7 levels of depth for defining sections.

part
> level -1, not in letters.

chapter
> level 0, only books and reports.

section
> level 1, not in letters.

subsection
> level 2, not in letters.

subsubsection
> level 3, not in letters.

paragraph
> level 4, not in letters.

subparagraph
> level 5, not in letters.

2.2.1 Options

For some section with very long title, LaTeX arrows you to give an optional extra version in the Table of Contents and any running heads. For example, `\section[Short Name]{Very long title}`, with this command, **Short Name** will appears in Table of Contents, instead of the Very long title.

Each sections command also has a "starred" version which does not produce numbers. Because the *-form sectioning commands don't enter Table of Contents automatically, LaTeX offers two commands to insert such info directly into a contents file:

`\addtocontents{file}{text}` or `\addcontentsline{file}{type}{text}`

file the extension of the contents file, usually toc, lof or lot.

type For *lof* or *lot*, *figure* or *table* is specified.

text Actually info written to Table of Contents.

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Table 2.1: Special Characters

˜	\textasciitilde or \˜{}
&	\&
#	\#
_	_
$	\$
\	\textbackslash
%	\%
^	\textasciicircum or \^{}
{	\{
}	\}
<, >	\textless, \textgreater

\oe, \OE	œ, Œ
\ae, \AE	æ, Æ
\aa, \AA	å, Å
\o, \O	ø, Ø
\l, \L	ł, Ł
\ss	ß
?`	¿
!`	¡
\dag	†
\ddag	‡
\S	§
\P	¶
\copyright	©
{\it \$}	$
{\it \&}	&
\i	ı
\j	ȷ

2.2.2 Table of Contents

One can modify the style of Table of Contents.

2.3 Special Characters and Phrases

LaTeX

    \LaTeX{}

˜   Non breakable space

... \ldots

2.3.1 Special Symbols

2.3.2 Space

option to \\ like this \\[10pt]

change the vertical distance between lines.
Horizontal space \hspace{1cm}
    Vertical space:
This is \smallskip This is \medskip This is \bigskip End

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accent	command	example
acute	\'{a}	á
grave	\`{a}	à
umlaut	\"{a}	ä
	\={a}	ā
	\^{a}	â
	\"{a}	ä
	\~{a}	ã
	\.{a}	ȧ
	\u{a}	ă
	\v{a}	ǎ
	\H{a}	a̋
	\t{aa}	a͡a
	\c{a}	ą
	\d{a}	ạ
	\b{a}	a̲

2.3.3 Dashes

- hyphen 'double-quote'

-- dash denoting a range, e.g. 155–159

--- punctuation dash—here it is.

2.3.4 Accents

There are a variety of control sequences for producing accents. These accents **cannot** be used within mathematical formulae, some different control sequencys are used to produce accents within mathematics.

2.4 Alignment

Command \begin{center} ... \end{center} and
\begin{flushright} ... \end{flushright} and
\begin{flushleft} ... \end{flushleft}
to align in center, right and left

2.5 Font

The default font used by Palin TeX is **cmr10**, Knuth only put 128 glyphs in the fonts, and the char encoding is somewhat different from ASCII. So to play chars not in cmr10, you have to specify the texttype, for example: {\tt\string\TeX}

2.5.1 *italic correction*

{\it italicized\/} or {\sl slanting type\/} correction.

The control command \/ produces the so-called *italic correction*, which is recommended when changing font back from an *italic* or *slanted* into a roman or **boldface** font, in order to produce extra space to compensate for the way in which some *italic* and *slanted* letters lean into the following blank space. However, this italic correction should not be used before a comma or a full stop.

2.5.2 Families

By default, LaTeX use serif typeface(roman) font. Other font typefaces (sans serif, typewriter, a.k.a monospace) can be used with some specific commands. serif(roman) family
sans serif family
typewriter(monospace) family
switch to ttfamily

switch to sffamily
switch back to default one.

To change the default fonts, use the commands:
\renewcommand{\familydefault}{\sfdefault}

2.5.3 Style

medium;
bold;
upright;
slanted style, which makes the text look a bit like italics but not quite;
SMALL CAPS.
underline
The corresponding switch commands are:

```
\mdseries
\bfseries
\upshape
\itshape  or  \it
\slshape  or  \sl
\scshape  or  \sc
```

If you look closely, you will notice that italic text is not only slanted but that different letters are actually used (e.g. a and *a*). However, this is only true for serif text, not for sans-serif text. Text that is only slanted without using different characters is called "slanted" instead of "italic".

2.5.4 Size

Huge
huge
LARGE
Large
large
small
footnotesize
scriptsize
tiny
normalsize (default)
All the sizes of other commands depends on the size of normal text.

2.6 Color

To color text in LaTeX, use *xcolor* package. There are two syntax to add color to text:

```
\colorbox{color}{text}   % background color
\textcolor{color}{text}  % text color
{\color{color} some text}
\textcolor{color!20!}{text}      % use 20% of choosed color
```

red, green, blue. blue

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2.6.1   pagecolor

Use command `\pagecolor{colorg}` to set the background color of page.

For unknown reason, if I change the bg color with `\pagecolor{color}`, the 'Go to TOC' button will fail in the following pages (including the current one).

2.6.2 Basic colors names available in LaTeX

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

2.7 Footer and Header

Use command `\pagestyle{style}` or `\thispagestyle{style}` to set page style, the possible styles are:

plain
> default style. The header is empty and the footer contains page numbers in the center.

empty
> Both header and footer are cleared.

headings
> Puts running headings on each page. The document style specifies what goes in the headings.

myheadings
> You specify what is to go in the heading with the `\markboth` or the `\markright` commands. The footer is empty in this page style. The header contains the page number on right side (on even pages) or on left side (on odd pages) along with other user-supplied information; there is an exception for the first page of each chapter, where the footer contains centred page number while the header is blank.

For double-sided documents (books), use different command `\fancyhead` and `fancyfoot` with several options.

```
\pagestyle{fancy}
\fancyhf{}
% show chapter name in the left of even pages and right of odd pages
\fancyhead[LE,RO] {\leftmark}
% show section name in the right of even pages and left of odd pages
\fancyhead[RE,LO] {\rightmark}
% show page number in foot center of even and odd pages
\fancyfoot[CE,CO] {\thepage}
```

This is a footnote [1] [2]

The following commands can be used in the headers and footers:

\thepage
> Number of current page

\thechapter
> Number of current chapter

\thesection
> Number of current section

\chaptername
> chapter name

\leftmark
> Names and number of current top-level structure(e.g. *Chapter for reports, Sectoin for articles*) in uppercase letters.

\rightmark
> Names and number of current next to top-level structure in uppercase letters.

---

[1] first footnote
[2] second footnote

2.7.1 Pagenumber

`\pagenumbering{...}`

arabic

roman lowercase

Roman Uppercase

alph lowercase English letters

Alph Uppercase

2.8 Length

2.8.1 Unit

sp scaled point, 65535 sp = 1 pt

pt point, 1/72.27 in, or 0.0138 in or 0.3515 mm

bp big point, 1 in = 72 bp

dd didot point, 1157 dd = 1238 pt

mm a millimeter

pc pica, 1 pc = 12 pt = 4.218 mm

cc cicero, 1 cc = 12 dd = 4.513 mm

cm a centimeter

in a inch = 25.4 mm

ex roughtly the height of an 'x' (lowercase) in the current **font**

em roughtly the width of an 'M' (Uppercase) in the current **font**

mu math unit = 1/18 em, where **em** is taken from the math symbols family.

Hou much a point is depends on whom you ask. TEX thinks a point is the 72.27th part of an inch, which is 2.54 cm. On the other hand, PostScript and Adobe think a point is the 72th part of an inch (which is a big point in TEX).

2.8.2 general length

`\hskip` *length*	horitontal blank space of *length*
`\vskip` *length*	vertical blank space of *length*

Note: If the word following the horizontal skip happens to be 'plus 'then you will probably get an error message:

```
! Missing number, treated as zero.
```

To avoid it, typing '`\hskip 20 mm \relax`'

2.8.3 Structured length

\baselineskip Vertical distance between lines in a paragraph.

\columnsep column separation

\columnwidth the width of a column

\evensidemargin

\oddsidemargin

\linewidth

\lineskip

\paperwidth

\paperheight

\parskip Vertical space between paragraphs

\tabcolsep

\textheight Height of the text area in the page

\textwidth

\topmargin

2.8.4 table

Length between columns : `\setlength{\tabcolsep}`

2.9 Space

First note that, as a general rule, you should never put a blank space after a left parenthesis or before a right parenthesis. If you were to put a blank space in these places, then you run the risk that TeX might start a new line immediately after the left parenthesis or before the right parenthesis, leavin the parenthesis marooned at the beginning or end of a line.

TeX has its own rules for deciding the lengths of blank spaces. For instance, TeX will put an extra amount of space after a full stop if it considers that the full stop marks the end of a sentence.

The rule adopted by TeX is to regard a period (full stop) as the end of a sentence if it is preceded by a lowercase letter. If the period is preceded by an uppercase letter then TeX assumes that it is not a full stop but follows the initials of somebody's name.

This works very well in most cases. However TeX occasionally gets things wrong. This happens with a number of common abbreviations (as in 'Mr. Smith' or in 'etc.'), and, in particular, in the names of journals given in abbreviated form (e.g., 'Proc. Amer. Math. Soc.'). The way to overcome this problem is to put a backslash before the blank space in question. Thus we should type:

```
Mr.\ Smith
etc.\ and
Proc.\ Amer.\ Math.\ Soc.
```

TeX determines itself how to break up a paragraph into lines, and will occasionally hyphenate long words where this is desirable. However it is sometimes necessary to tell TeX not to break at a particular blank space. The special character used for this purpose is ~. It represents a blank space at which TeXis not allowed to break between lines. It is often desirable to use ~in names where the forenames are represented by initials. Thus to obtain 'W. R. Hamilton' it is best to type W.~R.~Hamilton.

2.10   Commands

2.10.1   newcommand

\def can define commands that take delimiters other than braces, while \newcommand can't.
\def\foo<#1>{something #1}
\foo<happy>

2.11   List

Three are three kinds of list in LaTeX:

itemize

- First item

- Another item

enumerate

1. One

2. Two

description

Foo Foo

Bar Bar

description

Use \fill so that the explanaion begins in newline.

2.11.1   Bullet

One can change the bullet of a list easily without loading any package.

Unordered lists

– dash

∗ asterisk

α Any math character

a Char

Ordered lists

roman:

(i) enumerate

(ii) Option (A1) specify label 'A'.

Roman:

(I) One

(II) Two

arabic:

(1) One

(2) Two

   alph:

(a) a

(b) b

   Alph:

(A) a

(B) b

2.12 Table

`\toprule, \midrule, \bottomrule` used as seperation line.

2.12.1 tabbing

tabbing env. can also produce table format:

TEX	: A typesetting program
Emacs	: A text editor
	a programming env.
	a mail reader
	and a lot more besides
AbiWord	: A word processor

The alighment of text can be: l,c,r or plength

Planet	Features
Mercury	Lunar like crust
	Crustal faulting
	Small magnetic fiels
	Guess what's this

2.12.2 Multi-columns or rows

`multicolumn{num}{pos}{item}`

Planet	Distance from sum (km)	
	Maximum	Minimum
Mercury	69400000	46800000
Pluto	734600000	4461000000

Similarly, we can apply \multirow[pos]{num}{*}{item} when include *multirow* package.

	Distance from sum (kilometer)	
Planet	Maximum	Minimum
Mercury	69400000	46800000
Pluto	734600000	4461000000

Height (cm)	Ideal weight (kg)
155	53.5–64
160	56–67
190	78–92.5

rowcolor

When use \rowcolor in \multirow or \multicolumn environment, if it is not put at the start of a new line, it will raise a **Misplace noalign** . You can either ignore it or you can use \ cellcolor from the same package.

2.12.3   alignment

Using package *tabularx* , one can manipulate the alignment of the cells.

flush left fixed width: `\newcolumntype{L}[1]{>{\raggedright\arraybackslash}p{#1}}`
center fixed width: `\newcolumntype{C}[1]{>{\centering\arraybackslash}p{#1}}`
flush right fixed width: `\newcolumntype{R}[1]{>{\raggedleft\arraybackslash}p{#1}}`

1cm width	2cm width	3cm width
left	center	right

2.12.4   centering a wide table

To center a very wide table, you can take the following ways:

- `\makebox[\textwidth][c]{<table>}`

- use adjustbox (from package *adjustbox*)

```
\begin{adjustbox}{center}
    \begin{tabular}{ccc}
table content
    \end{tabular}
\end{adjustbox}
```

- `\centerline{<table>}`

2.12.5   Line height

\renewcommand{\arraystretch}{2} to increase the row height to 2 times of original one. Don't forget to change it back to original value with \renewcommand{\arraystretch}{1}.

To change only height of one row, you can use \rule{0pt}{height} in the start of a row.

This trick also change the height of a row by adding extra space to it: \\[distance]. For example: command. \\ add one line of space, [\−1em]: minus 1em from previous spacing.

2.12.6   Line break in a table cell

makecell

Using the \thead and \makecell command from package *makecell*

A Head	**A Second Head**	**A Third Head**
Some text	Some really long text	Another long text

tabularx

Use the *tabularx* environment instead of *tabular* from package *tabularx*

Section:	This is my long paragraph

2.12.7 Wide table

use package *adjustbox* to fit the width of your table to pages.

Name	lab 1	lab 2	lab 3	lab 4	lab 5	lab 6	lab 7	lab 8	lab 9	lab 10	lab 11	lab 12	lab 13

2.13 Figure

2.13.1 wrapfig

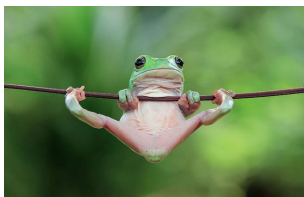Surrounding figures with text using package *wrapfig*. Note that text can't follow the wrapfig env. directly.

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Figure 2.1: A frog

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.
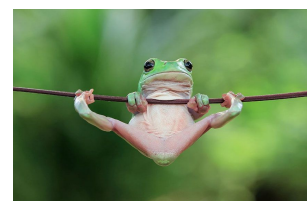
Figure 2.2: A frog

2.13.2 minipage

To use *minipage* environment, note that add a % behind every `\end{minipage}` statement.

```
\begin{figure}
    \begin{minipage}{0.5\textwidth}
    \end{minipage}%
    \begin{minipage}{0.5\textwidth}
    \end{minipage}
\end{figure}
```

2.14 Equation

2.15 Code

2.15.1 Verbatim

The default tool to display code in LaTeX is **verbatim**, which generates an output in monospaced font.

```
Tex enclodes inside \texttt{verbatim} envi. is printed directl and all
\LaTeX{} commands are ignored.
```

A starred version of verbatim envi. will produce slightly different output where white spaces are emphasized with a special symbol.

```
Tex␣enclodes␣inside␣\texttt{verbatim}␣envi.␣is␣printed␣directl␣and␣all
\LaTeX{}␣commands␣are␣ignored.
```

Verbatim-like text can also be used in paragraph by means of the `\verb` command. Any charactre, except letters and *, can be used as delimiter. For instance `Delimiter` use + as delimiter.

2.15.2 Highlighting code

To produce highlight code, we need *listings*

```
    import numpy as np

    def f(x1, x2):
        if x1 > x2:
            print "Hello␣World"

    a=4, b=5
    f(b, a)
```

2.15.3 Importing code from a file

To import code from files, using command `\lstinputlisting`.

```
\lstinputlisting[language=Python]{hello_wrold.py}
\lstinputlisting[language=Python, caption = Python]{hello_wrold.py}
\lstinputlisting[language=Python, firstline=2, lastline=12]{hello_wrold.py}
```

2.15.4 Code Style

listings is highly customisable.

```
\definecolor{codegreen}{rgb}{0,0.6,0}
\definecolor{codegray}{rgb}{0.5,0.5,0.5}
\definecolor{codepurple}{rgb}{0.58,0,0.82}
\definecolor{backcolour}{rgb}{0.95,0.95,0.92}

\lstdefinestyle{mystyle}{
    backgroundcolor=\color{backcolour},
    commentstyle=\color{codegreen},
    keywordstyle=\color{magenta},
    numberstyle=\tiny\color{codegray},
    stringstyle=\color{codepurple},
    basicstyle=\footnotesize,
    breakatwhitespace=false,
    breaklines=true,
    captionpos=b,
    keepspaces=true,
    numbers=left,
    numbersep=5pt,
    showspaces=false,
    showstringspaces=false,
    showtabs=false,
    tabsize=2
}

\lstset{style=mystyle}
```

2.15.5   listings

lstinline

To wrap lstinline , one need to avoid to read the argument with the wrapper macro. Currently, I can't find any method to add background to inline code using \ lstinline . We have no way to wrap \ lstinline in other environments, like \colorbox to make background color for it. Even the following fails compilation:
\newcommand{\command}{\lstinline[language=TeX, basicstyle=\color{RawSienna}]}
\colorbox{gray}{\command#\color#}
    \newcommand\codeinline{\lstinline[style=inlinecode]}
\codeinline+&$%+

2.16   Box

Use \makebox to fit wide table or figures.
a very long sentences that will fill up the cell, but it will still be centerized.   this it the right cell that will exceed the right margin

2.17   Miscellaneous

\rule{length}{width}

2.18   Reference

reference command : \cite, \ref, \pageref and \label Put \label in argument of \section for cross-referencing: \section{\label{}}

2.19   Bibliography

to cite a bibliography, use the \cite command. Please refer to [1] or [1, option].

2.19.1   BIBTeX

Another way to cite bibliography is using BIBTeX.
BIBTeX style:

plain Entries sorted alphabetically with numeric labels.

unsrt Entries printed in order of citation.

alpha Use author's name and the year of publication as labels.

abbrv compact style, first name, month, and journal names are abbrevitated

acm it hse author name in small caps, and numbers as labels.

apalike require *apalike* package. Entries formatted alphabetically, last name first, each entry having a hanging indentation and no label.

To run BIBTeX with LaTeX, (I) one needs to run LaTeX firstly to generate a list of \cite references in its auxiliary file .aux. (II) Then run BIBTeX to read the auxiliary file, looking up the references in the database, and write results into .bbl file (formatted according to the format specified in the .bst style file). (III) Run LaTeX again to read the .bbl reference file. (IV) Finally run LaTeX a third time, resolving all reference.

Bibliography

[1] wikipedia.com.

Chapter 3

Math

3.1 Font

Fonts in mathematical mode.

\mathit italic (default)

\mathrm roman

$$A BCDEFGHIJKLMNOPQRSTUVWXYZ$$

\rm

$$\mathrm{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$

\mathbf bold

\mathsf sans serif

$$A BCDEFGHIJKLMNOPQRSTUVWXYZ$$

\sf

$$\mathsf{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$

\mathtt typewritter

\mathcal calligraphic (upper case only)

$$\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$

\cal

$$\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$

The recommended way to obtain ordinary text in displayed mathematical formulae is to use **\hbox**.

$$M^{\perp} = \{f \in V' : f(m) = 0 \text{ for all } m \in M\}.$$

Note the space before and after 'for all' in the input.

3.1.1 Space

```
\begin{equation*}
    \begin{aligned}
        f(x) =& x^2\! + 3x\! + 2 \\
        f(x) =& x^2 + 3x + 2 \\
        f(x) =& x^2\, + 3x\, + 2 \\
        f(x) =& x^2\: + 3x\: + 2 \\
        f(x) =& x^2\; + 3x\; + 2 \\
        f(x) =& x^2\ + 3x\ + 2 \\
        f(x) =& x^2\quad + 3x\quad + 2 \\
        f(x) =& x^2\qquad + 3x\qquad + 2 \\
    \end{aligned}
\end{equation}
```

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$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$
$$f(x) = x^2 + 3x + 2$$

3.2 Symbols

3.2.1 Greek Letters

\epsilon	ϵ	\varepsilon	ε
\theta	θ	\vartheta	ϑ
\pi	π	\varpi	ϖ
\rho	ρ	\varrho	ϱ
\sigma	σ	\varsigma	ς
\phi	ϕ	\varphi	φ
\zeta	ζ	\iota	ι
\kappa	κ	\xi	ξ
o	o	\upsilon	υ
\chi	χ	\psi	ψ

3.2.2 Uppercase Greek Letters

\Gamma	Γ	\Xi	Ξ	\Phi	Φ
\Delta	Δ	\Pi	Π	\Psi	Ψ
\Theta	Θ	\Sigma	Σ	\Omega	Ω
\Lambda	Λ	\Upsilon	Υ		

3.2.3 Miscellaneous Symbols

\aleph	$\aleph$	\prime	$\prime$	\forall	$\forall$
\hbar	$\hbar$	\emptyset	$\emptyset$	\exists	$\exists$
\imath	$\imath$	\nabla	∇	\neg	$\neg$
\jmath	$\jmath$	\surd	$\surd$	\flat	$\flat$
\ell	ℓ	\top	$\top$	\natural	$\natural$
\wp	$\wp$	\bot	$\bot$	\sharp	$\sharp$
\Re	$\Re$	|	$\|$	\clubsuit	$\clubsuit$
\Im	$\Im$	\angle	$\angle$	\diamondsuit	$\diamondsuit$
\partial	∂	\triangle	$\triangle$	\heartsuit	$\heartsuit$
\infty	∞	\backslash	$\backslash$	\spadesuit	$\spadesuit$

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

3.2.4 "Large" Operators

3.2.5 Binary Operators

\pm	$\pm$	\cap	$\cap$	\vee	$\vee$
\mp	$\mp$	\cup	$\cup$	\wedge	$\wedge$
\setminus	$\setminus$	\uplus	$\uplus$	\oplus	$\oplus$
\cdot	$\cdot$	\sqcap	$\sqcap$	\ominus	$\ominus$
\times	$\times$	\sqcup	$\sqcup$	\ominus	$\ominus$
\ast	$\ast$	\triangleleft	$\triangleleft$	\oslash	$\oslash$
\star	$\star$	\triangleright	$\triangleright$	\odot	$\odot$
\diamond	$\diamond$	\wr	$\wr$	\dagger	$\dagger$
\circ	$\circ$	\bigcirc	$\bigcirc$	\ddagger	$\ddagger$
\bullet	$\bullet$	\bigtriangleup	$\bigtriangleup$	\amalg	$\amalg$
\div	$\div$	\bigtriangledown	$\bigtriangledown$		

3.2.6 Standard Functions and Embedded Text

\arccos	arccos	\arcsin	arcsin	\arctan	arctan
\arg	arg	\cos	cos	\cosh	cosh
\cot	cot	\csc	csc	\deg	deg
\det	det	\exp	exp	\gcd	gcd
\hom	hom	\inf	inf	\ker	ker
\lg	lg	\lim	lim	\liminf	lim inf
\limsup	lim sup	\ln	ln	\log	log
\max	max	\min	min	\Pr	Pr
\sec	sec	\sin	sin	\sinh	sinh
\sup	sup	\tan	tan	\tanh	tanh

3.2.7 Relations

\leq	$\leq$	\geq	$\geq$	\equiv	$\equiv$
\prec	$\prec$	\succ	$\succ$	\sim	$\sim$
\preceq	$\preceq$	\succeq	$\succeq$	\simeq	$\simeq$
\ll	$\ll$	\gg	$\gg$	\asymp	$\asymp$
\subset	$\subset$	\supset	$\supset$	\approx	$\approx$
\subseteq	$\subseteq$	\supseteq	$\supseteq$	\cong	$\cong$
\sqsubseteq	$\sqsubseteq$	\sqsupseteq	$\sqsupseteq$	\bowtie	$\bowtie$
\in	$\in$	\ni	$\ni$	\propto	$\propto$
\vdash	$\vdash$	\dashv	$\dashv$	\models	$\models$
\smile	$\smile$	\mid	$\mid$	\doteq	$\doteq$
\frown	$\frown$	\parallel	$\parallel$	\perp	$\perp$

\not<	≮	\not>	≯	\not=	≠
\not\leq	≰	\not\geq	≱	\not\equiv	≢
\not\prec	⊀	\not\succ	⊁	\not\sim	≁
\not\preceq	⋠	\not\succeq	⋡	\not\simeq	≄
\not\subset	⊄	\not\supset	⊅	\not\approx	≉
\not\subseteq	⊈	\not\supseteq	⊉	\not\cong	≇
\not\sqsubseteq	⋢	\not\sqsupseteq	⋣	\not\asymp	≭

3.2.8   Negated Relations

3.2.9   Arrows

\leftarrow	←	\longleftarrow	⟵	\uparrow	↑
\Leftarrow	⇐	\Longleftarrow	⟸	\Uparrow	⇑
\rightarrow	→	\longrightarrow	⟶	\downarrow	↓
\Rightarrow	⇒	\Longrightarrow	⟹	\Downarrow	⇓
\leftrightarrow	↔	\longleftrightarrow	⟷	\updownarrow	↕
\Leftrightarrow	⇔	\Longleftrightarrow	⟺	\Updownarrow	⇕
\mapsto	↦	\longmapsto	⟼	\nearrow	↗
\hookleftarrow	↩	\hookrightarrow	↪	\searrow	↘
\leftharpoonup	↼	\rightharpoonup	⇀	\swarrow	↙
\leftharpoondown	↽	\rightharpoondown	⇁	\nwarrow	↖
\rightleftharpoons	⇌				

3.2.10   Openings

\lbrack	[	\lfloor	⌊	\lceil	⌈
\lbrace	{	\langle	⟨		

3.2.11   Closings

\rbrack	]	\rfloor	⌋	\rceil	⌉
\rbrace	}	\rangle	⟩		

3.2.12   Alternative to some symbols

≠	\rbrack or \neq	(\not=)
≤	\le	(\leq)
≥	\ge	(\geq)
{	\{	(\lbrace)
}	\}	(\rbrace)
→	\to	(\rightarrow)
←	\gets	(\leftarrow)
∋	\owns	(\ni)
∧	\land	(\wedge)
∋	\owns	(\vee)
∨	\lor	(\neg)
│	\vert	(—)
‖	\Vert	(|)
⟺	\iff	(\Longleftrightarrow, but with extra space at each end)
:	\colon	(:, but with less space around it and less likelihood of a line break after it.)

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Command	Accent
\underline{a}	$\underline{a}$
\overline{a}	$\overline{a}$
\hat{a}	$\hat{a}$
\check{a}	$\check{a}$
\tilde{a}	$\tilde{a}$
\acute{a}	$\acute{a}$
\grave{a}	$\grave{a}$
\dot{a}	$\dot{a}$
\ddot{a}	$\ddot{a}$
\breve{a}	$\breve{a}$
\bar{a}	$\bar{a}$
\vec{a}	$\vec{a}$

3.2.13   Accent

You should bear in mind that when a character is underlined in a mathematical manuscript, then it is normally typeset in bold face without any underlining. Underlining is used very rarely in print.

3.2.14   Other Physical and Mathematical Symbols

$$\text{\\binom\{n\}\{k\}} \quad \binom{n}{k}$$

3.3 Matrix

3.3.1 pmatrix

$$\sigma^0 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

3.3.2 vmatrix

$$\sigma^0 = \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$$

3.3.3 bmatrix

$$\sigma^0 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

3.3.4 aligned

$$\left. \begin{aligned} u_x &= v_y \\ u_y &= -v_x \end{aligned} \right\} \quad \text{Cauchy-Riemann Equations}$$

Spacing in math mode:

$\backslash$**quad** ,

3.4 cases

$$|x| = \begin{cases} x & if \ x \geq 0 \\ -x & if \ x < 0 \end{cases}$$

3.5 Example

3.5.1 Integral

$$\int_0^{+\infty} x^n e^{-x} \, dx = n!$$

Note the extra space before the d, which is produce by $\backslash$,. Compare to case without $\backslash$,:

$$\int_0^{+\infty} x^n e^{-x} dx = n!$$

$$\int_0^1 \int_0^1 x^2 y^2 \, dx \, dy$$

In multiple integral, use $\backslash$! to remove a thin strip of unwanted space to improve the appearance. Compare to case without $\backslash$!:

$$\int_0^1 \int_0^1 x^2 y^2 \, dx \, dy$$

Chapter 4

Tikz

This section introduce how to use tika package to produce wanted plots.

4.0.1 Simple shapes

coordinate

Coordinates can be specified in round brackets in an arbitrary TEX dimension either using Cartesion coordinates (comma separated), e.g. 1cm in the x direction and 2pt in the y direction
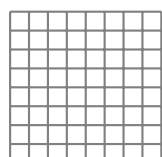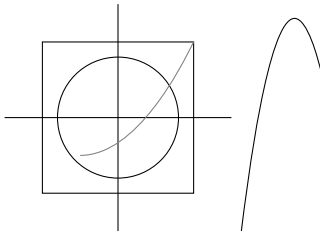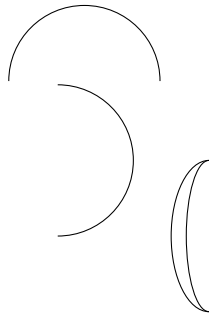
1CM, 2PT

circle and ellipse

rectangle

rectangle   rectangle   rectangle   rectangle

The *rectangle* command requires the absolute corner coords. You are giving the increments in the second coordinates. So we can see in the third above plot, it looks like a line, because the second coordinate is not given as increments.

grid

parabola, sin, cos

sin and **cos** add a sine or cosine curve in the interval $[0, \pi/2]$ such that the previous current point is at the start of the curve and the curve ends at the given end point following it.

arc

Arrow

To draw the arrow head whthin the line, use *decorate* option.
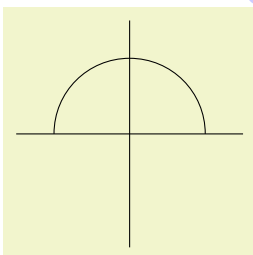(need `\usetikzlibrary{decorations.markings}`)

control points
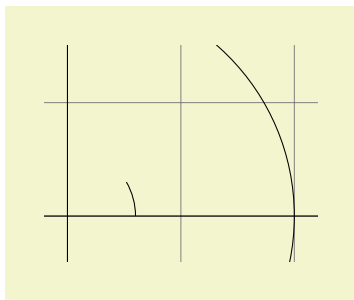
Control points in drawing.

```
\begin{tikzpicture}
    \filldraw [gray] (0,0) circle (2pt)
                     (1,1) circle (2pt)
                     (2,1) circle (2pt)
                     (2,0) circle (2pt);
    \draw (0,0) .. controls (1,1) and (2,1) .. (2,0);
\end{tikzpicture}
```

```
\begin{tikzpicture}
    \draw (-1.5,0) -- (1.5,0);
    \draw (0,-1.5) -- (0,1.5);
    \draw (-1,0) .. controls (-1,0.555) and (-0.555,1) .. (0,1)
                .. controls (0.555,1) and (1,0.555) .. (1,0);
\end{tikzpicture}
```

If you use relative control points, then the first one is relative to the start node, while the second one is relative to the end node.

shade
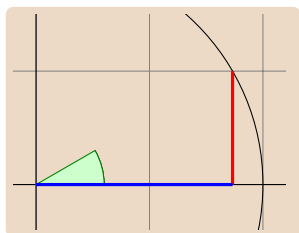
`\shade` and `\shadedraw`

The default shading is a smooth transition from gray to white. To use other colors, specify them in options:

+ sign

`+(1cm,0cm)` means "1cm upwards from the previous specified position"; while `++(0cm,2cm)` means "2cm to the right of the previous specified position, making this the **new** specified position."

Note the difference between `+` and `++` (see the code).

Using `++`:

Using `+`:

Intersection

`(<p> |- <q>)` is "the intersection of a vertical line through p and a horizontal line through q."
    An intersection between a line going up from (1,0) and aline going from the origin throught (30:1cm).

```
\draw[very thick,orange] (1,0) -- (intersection of 1,0--1,1 and 0,0--30:1cm);
```
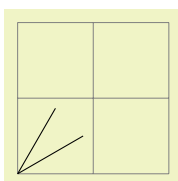
Miscellaneous

4.0.2 Coordinate Systems

- canvas

- xyz

- canvas polar

- xyz polar

- barycentric

$$\frac{\alpha_1 \vec{v}_1 + \alpha_2 \vec{v}_2 + \cdots + \alpha_n \vec{v}_n}{\alpha_1 + \alpha_2 + \cdots + \alpha_n}$$

- node

- intersection

- perpendicular

Any **canvas** coordinate system requires explict dimensions (units) while **xyz** coordinate systems don't.
e.g.

```
\begin{tikzpicture}
  \draw [help lines] (0,0) grid (2,2);

  \draw (0,0) -- (canvas polar cs:angle=30,radius=1cm);
  \draw (0,0) -- (xyz polar cs:angle=60, radius=1);
\end{tikzpicture}
```
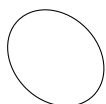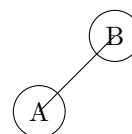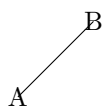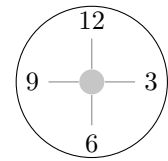
4.0.3 Options

line width

rotate

scale

xscale, yscale

4.0.4 node

label and pin

12

9   clock   3

6

12

9 ——●—— 3

6

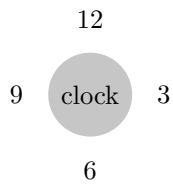### 4.0.5   Styles

tikzstyle:

- every path

- every node

  - every *<shape >*node
  - every *<part name >*node part
  - every label
  - every pin
  - every pin edge

- every to

- every curve

- every line

- every edge

- every snake

- every matrix

  - every cell

- tree

  - every child
  - every child node
  - level *<number >*

- every plot

When defining tikzstyle, there is no space allowed between the defined style and the definition.
    `\tikzstyle arrowstyle=[scale=1]` **Corrected**.
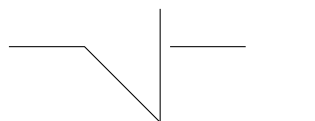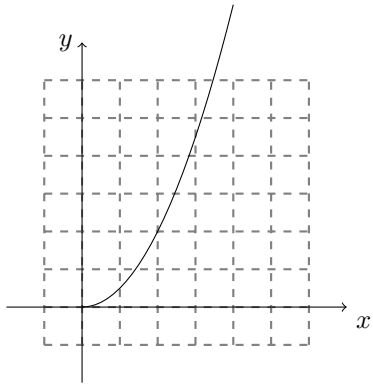`\tikzstyle arrowstyle = [scale=1]` *Wrong.*
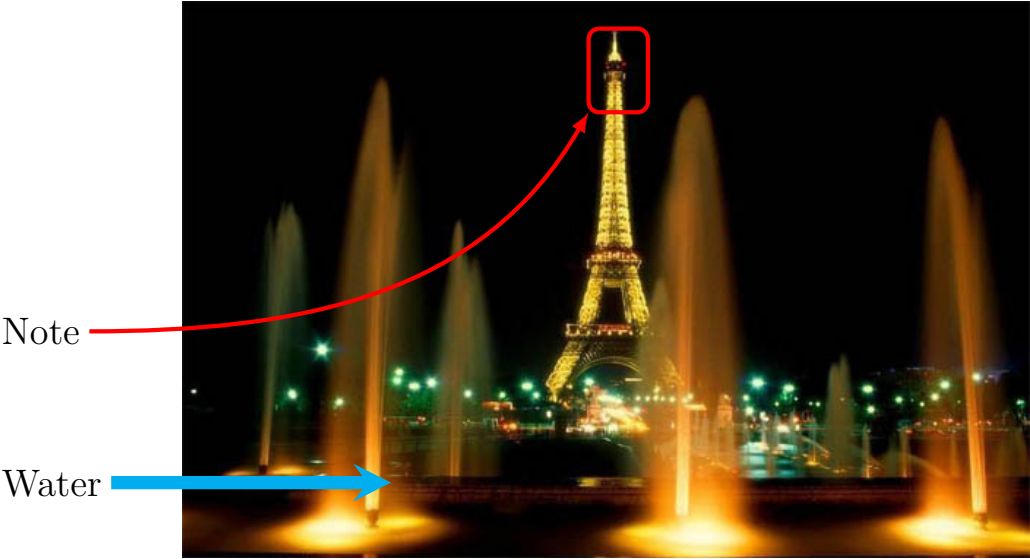
4.0.6   plot

gnuplot

Tikz use *gnuplot* to plot function, so to get right plot, we need to install *gnuplot* firstly. After first complining, we will get a *.x.gnuplot file, run *gnuplot* against this file, then compile tex file again, we will get wanted plots.
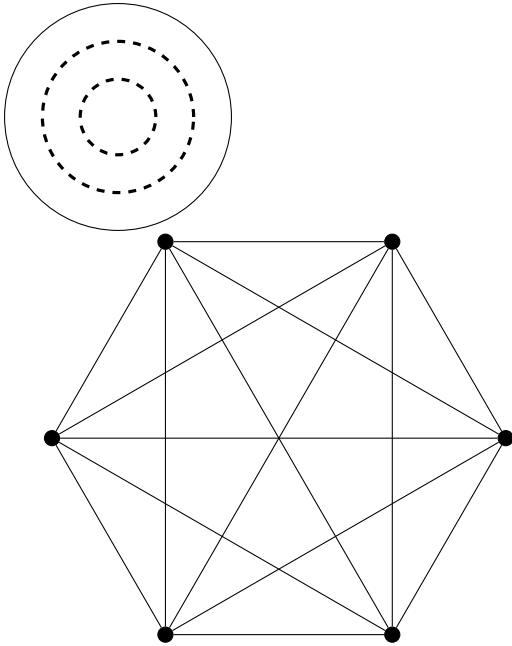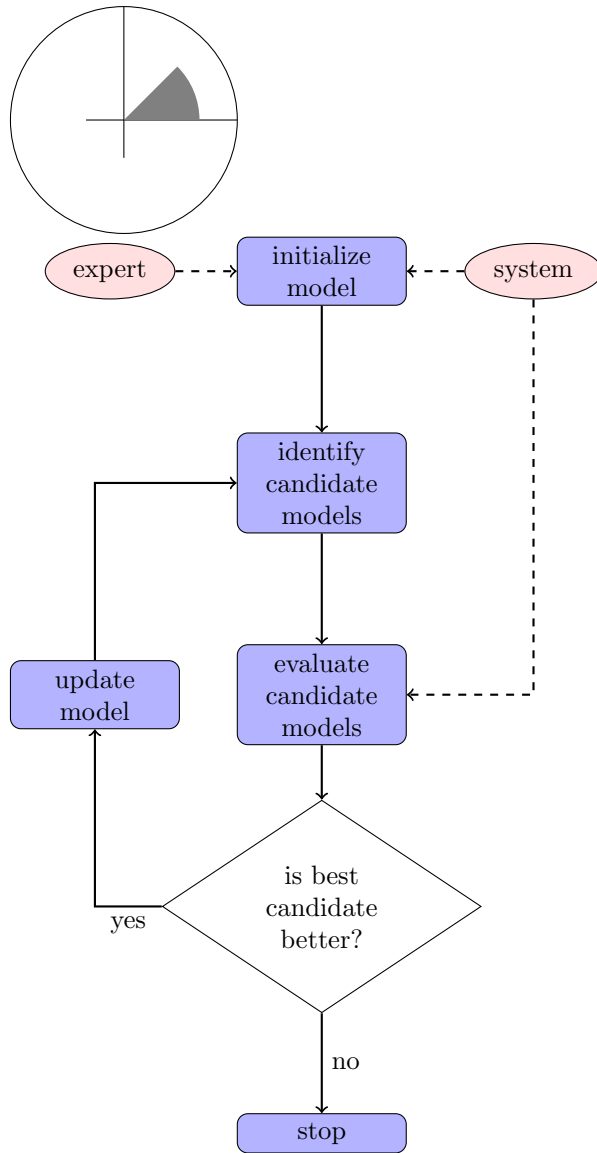
difference between `--plot` and `plot`

note on plots

Note

Water

4.1   Examples

Chapter 5

Customization

5.1 Renewcommand

You can modify default command by the command `\renewcommand` to make it fit your personal situation.

\renewcommand{\abstractname}{Executive Summary} *% Modify the title of your abstract*
\renewcommand{\labelitemi}{$\triangleright$}
\renewcommand{\labelitemii}{\ding{43}}
\renewcommand{\labelitemiii}{\ding{44}}
\renewcommand{\labelitemiv}{\ding{45}}

5.1.1 Configuration

Color

\pagecolor[green!50!black!30]   *% set page bg color*

Length

\setlength{\paperwidth}{48in}
\setlength{\paperheight}{36in}
\setlength{\sepwid}{0.024\paperwidth} *% Separation width (white space) between columns*
\setlength{\onecolwid}{0.22\paperwidth} *% Width of one column*
\setlength{\twocolwid}{0.464\paperwidth} *% Width of two columns*
\setlength{\threecolwid}{0.708\paperwidth} *% Width of three columns*
\setlength{\topmargin}{−0.5in} *% Reduce the top margin size*
\addtolength{**voffset**}{−2.5cm}

5.2 New Command

\newcommand{\SB}{Stony Brook}

Note that if type only `\SB`, then the macro will eat up the following space, producing ugly layout. To avoid that, you have to invoke it with an empty statement after it: `\SB{}`.

The reason behind this is that LaTeX ignores space directly after the macro(which just stop the scanning for the macro's name). You need to break that using either a protected space `\SB\` or an empty statement {}.An empty statement is recommanded, as using a protected space can generate nasty effects – for example, if that protected space is directly followed by a line break. In that case LaTeX might pring two spaces instead. Using an empty statement prevents this.

`\def` command in **plain TeX** also do the work.

def\intwrtx #1{**int**_{−**infty**}^{+**infty**} #1 \,dx}

e.g.

$$\int_{-\infty}^{+\infty} f(x)\,dx.$$

5.2.1 New Length

```
\newlength{\onecolwid}{10cm}
```

or

```
\newlength{\onecolwid}
\setlength{\onecolwid}{10cm}
```

5.2.2 New count

\newcount{\opaqueness}

5.2.3 New dimension

\newdimen{\offset}

5.3 Color

```
\definecolor{mygreen}{rgb}{0,0.6,0}
\definecolor{mygray}{rgb}{0.5,0.5,0.5}
\definecolor{mypurple}{rgb}{0.58, 0, 0.82}
```

5.3.1 xcolor

```
\colorlet{LightRubinRed}{RubineRed!70!} % xcolor; 70% or the intersity of
% original RubineRed color. Or you can think of it as a mixture of 70% RubineRed
% and 30% white.
\colorlet{mycolor1}{green!10!orange!90!}
\definecolor{mycolor2}{HTML}{00F9DE}      % HTML model, the character A,B,C,D,E and F must
```

The color models that only **xcolor** support are:
- **cmy** cyan, magenta, yellow

- **hsb** hue, saturation, brightness

- **HTML** RRGGBB

- **Gray** Grey scale, a number between 1 and 15.

- **wave** Wave length. Between 363 and 814

Chapter 6

Advanced

6.1 Style

6.1.1 Page Numbers

How to change the numbering of pages:

```
\seccounter[page]{123}
```

How to remove all page numbers:

```
\pagestyle{empty}[page]{123}
```

6.1.2 Citation

How do I choose the square bracket or superscript style for citations:

6.1.3 Fonts

```
\setmainfont{Times New Roman}    % serif fonts, for latin alphabetics
\setsansfont{helverica} % latin non−serif alphabetics, usually for titles
\setmonofont{courier}    % same−width fonts, usually for code layout

% Chinese corresponding
\setCJKmainfont{simsun}
\setCJKsansfont{}
\setCJKmonofont{}

% example: Linux Libertine
\setmainfont{LinLibertine\_R.otf}[
    BoldFont       = LinLibertine\_RZ.otf,
    ItalicFont    = LinLibertine\_RI.otf,
    BoldItalicFont = LinLibertine\_RZI.otf,
]
% sans−serif: Linux Biolinum
\setsansfont{LinLibertine\_R.otf}[
    BoldFont       = LinBiolimum\_RB.otf,
    ItalicFont    = LinBiolimum\_RI.otf,
    BoldItalicFont = LinBiolimum\_RBO.otf,
]
% typewriter type: Linux Libertine Mono
\setmonofont{LinLibertine\_M.otf}[
    BoldFont       = LinBiolimum\_MB.otf,
    ItalicFont    = LinBiolimum\_MI.otf,
    BoldItalicFont = LinBiolimum\_MBO.otf,
```

```
\setCJKmainfont[
    BoldFont    = Source Han Sans CN Medium,
    ItalicFont  = Adobe Kaiti Std R]
{Source Han Sans CN Light}
\setCJKsansfont[    % same as main
    BoldFont    = Source Han Sans CN Medium,
    ItalicFont  = Adobe Kaiti Std R]
{Source Han Sans CN Light}
\setCJKmonofont[
    BoldFont    = Source Han Sans CN Medium,
    ItalicFont  = Adobe Kaiti Std R]
{Source Han Sans CN Light}
```

6.2 Mode

Using mode in LaTeX allow one to choose different document class in one tex file, for example:

```
\mode<presentation>{
    some preamble...
}

\mode<article>{
    preamble for article ...
}
```

Then if you compile a tex file (use the above one as input), then if the documentclass is **beamer**, then mode **presentation** will be used; if the documentclass is *article*, then mode *article* will be choosed.

6.3 Adding note using tikz

Freshness is the most important property for food ⟨of course not for dry product ⟩. And a good cooker will always keep food's freshness and even enlarge the freshness using all kinds of methods. If you don't know how to cook a food, then the most obvious and simplest way is to boil it with water, which will sustain most of its freshness.

If one try to us spicy to hide a other flavor, th he must not a cooker.

Chapter 7

Fantacy in LaTeX

7.1 Display

When you find something abnormal about mathmetics (wrong color), check that if there is blank $$ pair without anything in it.

7.2 Package

Updating package, if you update your texlive, and then encounter some errors that you never met before, then it is the problem of old-packages. Remember to update corresponding packages so that everything work properly. Especially when you install a new system and a new texlive but import old personal configuration.

In LaTeX, you can load a package many times, but the option list of each package loading must be a subset of the options given at the first loading (exception *fontenc*)

However sometimes packages might be loaded in the document class already, or there are constraints in the package order that prevents the reordering of the packages. Then \PassOptionsToPackage helps. It can even be loaded before \documentclass. It gives the specified options to the package without loading the package.

Adding the options to the global options can also be a solution, but it is not the best strategy, because also other unrelated packages see that options. Unknown global options are ignored by package, but known are then executed with unintended side effects.

7.2.1 physics & imakeidx

If I put package imakeidx before physics, then the compiler will complain something like this:

```
(/usr/share/texlive/texmf-dist/tex/latex/imakeidx/imakeidx.sty
(/usr/share/texlive/texmf-dist/tex/latex/xkeyval/xkeyval.sty
(/usr/share/texlive/texmf-dist/tex/generic/xkeyval/xkeyval.tex
(/usr/share/texlive/texmf-dist/tex/generic/xkeyval/xkvutils.tex)))
(/usr/share/texlive/texmf-dist/tex/latex/tools/multicol.sty))
(/home/weibin/texmf/tex/latex/physics/physics.sty
(/home/weibin/texmf/tex/latex/l3packages/xparse/xparse.sty
(/home/weibin/texmf/tex/latex/l3kernel/expl3.sty
(/home/weibin/texmf/tex/latex/l3kernel/expl3-code.tex
! Missing number, treated as zero.
<to be read again>

                \pdftex_shellescape:D
```

But if I put physics before imakeidx, then no error happen.

7.2.2 tikz & graphicx

It looks like **tika** package will load *graphicx* package automatically, so if you load *graphicx* package manually with some options, it will cause problem. For example, if I load them as

`\usepackage[dvips]{graphicx}`

`\usepackage{tikz}`

it will result in:

`Non-PDF special ignored!`

On the other hand, if I load them as:

`\usepackage{tikz}`

`\usepackage[dvips]{graphicx}`

We get such error:

`! LaTeX Error: Option clash for package graphicx.`

So this should be the conflicts between different options used in loading *graphicx* package. If you load only the **tikz** package, then everything works perfectly.
! Paragraph ended before
Gin@iii was complete.
You will encounter this error if you load *graphics* rather than *graphicx*.

7.2.3 xcolor

xcolor option error:

`! LaTeX Error: Option clash for package xcolor.`

Package *pgf* also load *xcolor*, so *xcolor* should be loaded before *pgf* or other packages that loads *pgf*.

7.3 Environment

7.3.1 gathered

No blank line allowed with *gathered* environment, otherwise, it will show error message:

`! Missing $ inserted.`

`<inserted text> $`

7.4 Options

7.4.1 aligned

In the *aligned* environment, if you begin you equation with **square bracket**, they will not be output normally, because aligned env. is set by the *amsmath* package to scan ahead for a positioning augument such as [t] of [p]. Material that's found there but doesn't meet this format is simply discarded.

The possible solutions are:

- Insert `\relax` before the left square bracket. It will stop the bracket from being interpreted as an argument.

- Insert {} before the left square brackedt.

7.5   order of commands

7.5.1   label and caption

If you put `\label` command before the `\cpation` command, then `\ref` will not show the correct citation; if you just exchange their place, then you get everything work well, weird.

Chapter 8

Bibliography

Things about citing bibliography.