

An Informal Introduction to LaTeX

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What is LaTeX? Why should I use LaTeX?

What is LaTeX?

- LaTeX is a high-quality typesetting system designed for producing technical and scientific documentation.
- LaTeX is like a Program system.

Why should I use LaTeX?

- LaTeX is free.
- Many scientific organizations and publishers worldwide only accept manuscripts in LaTeX.
- Although it may take your time, it is really easy to learn and you will be well-paid.

How to install and set up LaTeX?

How to install LaTeX?

- There are two major distributions: MikTeX (for Windows only) and TeXLive (for Linux, Windows, Mac).
- For new users, I suggest you install a full version of TeXLive.

How to make the LaTeX system working?

- You need an editor, e.g. TeXworks, to write codes and compile codes.
- If the editor you choose doesn't work properly, then you may need to configure the editor so that it can find paths to LaTeX commands.

Remark: If you prefer working online there are now several online LaTeX systems.

How to use LaTeX?

- The best way to learn it is to start to use it. For examples, write your homework, papers, presentation, CV and other documents by using LaTeX.
- There are many templates for different types of documents.
- For each type of document, there is a suitable document class: article, amsart, book, letter, beamer, moderncv, etc.
- ```
\begin{document}{ article }
\begin{document}{ beamer }
\begin{document}{ moderncv }.....
```

# The basic structure of a LaTeX file

- A LaTeX file always starts with `\documentclass{}`, follows by the preamble where you may put your customized global commands, and enters the body containing your content. The body of a LaTeX file should be placed between

`\begin{document}` and `\end{document}`.

- A simple example:

```
\documentclass{beamer}
%%
\usetheme{Warsaw}
\usecolortheme{dolphin}
\title{Tips on Beamer, Tikz and Bibtex}
%\subtitle{Tips on LaTeX}
\author{Fei Ye \inst{1} and Moshe Cohen \inst{2}}
\institute[HKU]{\inst{1, 2} Department of Mathematics\ \ University of Hong Kong}
\date{\color{blue}March 28, 2012}
%%
\begin{document}
.....
\end{document}
```

# What should be put in the preamble?

The preamble contains all global commands used or required by commands in the body.

- Frequently used packages, for example

```
\usepackage{amsmath,amsfonts,amssymb,amsxtra,amsthm}
\usepackage{graphicx}
\usepackage{listings}
\usepackage[colorlinks=true, linkcolor=cyan, urlcolor=cyan]{hyperref}
\usepackage{color}
\usepackage{tikz}
```

- Page style setups, for example

```
\usepackage{fancyhdr}
\pagestyle{fancy}
\lhead{Title} \chead{Name} \rhead{\today}
\usepackage{lastpage}
\lfoot{} \cfoot{\thepage} \pageref{LastPage} } \rfoot{}
```

# What should be put in the preamble?

- Page dimension setups

```
\usepackage{geometry}
\textwidth=18cm
\setlength{\topmargin}{0.5in} \addtolength{\topmargin}{-\headheight}
\setlength{\oddsidemargin}{0in}
\textheight = 42\baselineskip
```

- Spaces setups

```
\usepackage[parfill]{parskip}
\setlength{\parindent}{2em}
\setlength{\parskip}{0.2em}
\renewcommand{\baselinestretch}{1.0}
```

- Theorem, Definitions, etc. setups

```
\theoremstyle{plain}
\newtheorem{thm}[section]{Theorem}
\newtheorem{lemma}[thm]{Lemma}
\newtheorem{prop}[thm]{Proposition}
\newtheorem{cor}[thm]{Corollary}
\theoremstyle{definition}
\newtheorem{Def}[thm]{Definition}
\newtheorem{rmk}[thm]{Remark}
```



# What should be put in the preamble?

- Customized shorthand commands

```
\newcommand{\vol}{\textup{Vol}}
\newcommand{\ceil}[1]{\lceil #1 \rceil}
\newcommand{\mc}[1]{\mathcal{#1}}
\newcommand{\mb}[1]{\mathbb{#1}}
\renewcommand{\d}{\textup{d}}
\renewcommand{\O}{\mc{O}}
```

- Color setups

```
\definecolor{blue}{rgb}{0,0,1}
\def\blue{\color{blue}}
\definecolor{red}{rgb}{1,0,0}
\def\red{\color{red}}
\definecolor{green}{rgb}{0,1,0}
\def\green{\color{green}}
\definecolor{gold}{rgb}{.5,.5,.2}
\def\gold{\color{gold}}
\definecolor{purple}{rgb}{.5,0,.5}
\def\purple{\color{purple}}
```

# What should be put in the preamble?

- Setup title, authors, address, etc.

```
\title{A Brief Introduction to LaTeX}
%\subtitle{Tips on LaTeX}
\author{Fei Ye}
\address{Department of Mathematics, The University of Hong Kong
Pokfulam, Hong Kong}
\email{fye@maths.hku.hk}
\date{\color{blue} February 27, 2014}
```

- Bibliography style

```
\bibliographystyle{alpha}
\bibliographystyle{plain}
```

# What should be put in the preamble?

- Font selection:

```
\usepackage[T1]{fontenc}
\usepackage{textcomp}
\usepackage{charter}
\usepackage[charter]{mathdesign}
\usepackage{libertine}
\usepackage[libertine]{newtxmath}
```

- Setup font sizes

```
\newcommand{\sihao}{\fontsize{14pt}{14pt}\selectfont}
\newcommand{\xiaosi}{\fontsize{12pt}{12pt}\selectfont}
```

# Using fonts in your computer

When you write a document in a language other than English, a universal solution is to use Xe<sub>La</sub>TeX instead of LaTeX. They share most of the commands. The main difference is that Xe<sub>La</sub>TeX can use any font in your computer, while LaTeX can only use its own fonts. For example, to create files in Chinese using Xe<sub>La</sub>TeX, you may put the following in the preamble

```
\usepackage{fontspec , xltextra , xunicode}
\usepackage[CJKnumber , CJKchecksingles]{xeCJK}
\setCJKmainfont{Songti SC}
\setCJKsansfont{STFangsong}
\setCJKmonofont{Kai : style=Regular}
\setCJKfamilyfont{song}{Songti SC}
\setCJKfamilyfont{fs}{STFangsong}
\setCJKfamilyfont{kai}{Kaiti SC : style=Regular}
\setCJKfamilyfont{hei}{Hei}
\newcommand{\song}{\CJKfamily{song}}
\newcommand{\kai}{\CJKfamily{kai}}
\newcommand{\hei}{\CJKfamily{hei}}
\newcommand{\fs}{\CJKfamily{fs}}
```

# LaTeX was made to typeset mathematics

- You can write mathematics in-line. For all  $x_i \in \mathcal{A}$ , there exists some  $c \in \mathbb{Z}$  such that  $x_i^2 \equiv f(x_i + c)^2 \pmod{p}$ , with  $p$  prime.

For all  $x_i \in \mathcal{A}$ , there exists some  $c \in \mathbb{Z}$  such that  $x_i^2 \equiv f(x_i + c)^2 \pmod{p}$ , with  $p$  prime.

- You can also separate equations, as in the following:

$$a^2 + b^2 = \begin{cases} c^2 & \text{when } c \text{ is the hypotenuse} \\ & \text{of a right triangle,} \\ \sum_{i=1}^n \Delta(\varepsilon_i^{\sin(\alpha)}) & \text{when this makes no sense.} \end{cases} \quad (1)$$

```
\begin{equation}
a^2+b^2=
\begin{cases}
c^2 & \text{when } c \text{ is the hypotenuse} \\
& \text{of a right triangle,} \\
\sum_{i=1}^n \Delta(\varepsilon_i^{\sin(\alpha)}) & \text{when this makes} \\
& \text{no sense.}
\end{cases}
\end{equation}
```

# An example of matrices

$$D = \begin{bmatrix} \alpha_1 & 0 & \cdots & 0 \\ 0 & \beta_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \mathbf{R} \end{bmatrix} + \begin{pmatrix} 0 & 0 & \cdots & \mathcal{O}_1 \\ 0 & \nabla^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ \mathbb{C} & 0 & \cdots & \varepsilon_{(m+1)^2} \end{pmatrix} \quad (\star)$$

$$\neq \begin{pmatrix} a \\ b \end{pmatrix}.$$

```
\[\begin{split}
D &= \left[\begin{matrix} \alpha_1 & 0 & \cdots & 0 \\ 0 & \beta_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \mathbf{R} \end{matrix} \right] + \begin{pmatrix} 0 & 0 & \cdots & \mathcal{O}_1 \\ 0 & \nabla^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ \mathbb{C} & 0 & \cdots & \varepsilon_{(m+1)^2} \end{pmatrix} \\
&\neq \begin{pmatrix} a \\ b \end{pmatrix}. \end{split} \tag{\bigstar}]
```

# Comment out, strike out and todo

When editing, you can comment out codes, strike out, change colors of the display text or create sidenotes.

- Comment out one line codes using %.
- Comment out a large piece using

```
\iffalse Whatever in between will not be displayed.\fi
```

- ~~Strike out text~~ using the package and the command

```
\usepackage[normalem]{ulem}
\sout{Strike out text}
```

- Use **color** to **highlight changes**. Colors can be defined using **RGB**, e.g., green bean color. `\definecolor{greanbean}{RGB}{193,237,204}`
- Use todo to create sidenotes.

```
\usepackage{todonotes}
This is wrong!\todo{fix it !!!!}
```

# Frames and Blocks

- The main input of beamer are frames. A frame may be plain or contains some blocks.

Theorem 2.1 (Author Year [Laz04])

*Frames are back-bones of beamer slides.*

This is a block [Par91]

You can also use block environment for definitions, theorems, etc.

```
\begin{itemize}
\item The main input of beamer are frames.
\item \begin{thm} Frames are back-bones of beamer slides. \end{thm}
\item \begin{block}{This is a Block} block environment for definitions,
theorems, etc. \end{block}
\end{itemize}
```



## Title bar for this particular frame

It's as easy as beginning and ending each frame. Titles are easy, too.

```
%\begin{frame} <-- take out %
\frametitle{Title bar for this particular frame}
It's easy to create a title for each frame.
%\end{frame} <-- take out %
```

### Advices for giving a presentation using slides

- When you give a presentation using slides, try to keep the text short.
- You should explain in more detail as you speak.
- Don't just read what's on the slides.

# Some tips of working with beamer

- Print out handouts of your beamer by using

```
\documentclass[handout]{beamer}.
```

- Include a university logo by adding

```
\pgfdeclareimage[height=0.5cm]{university-logo}{hku-logo.pdf} and
\logo{\pgfuseimage{university-logo}} .
```

- Include graphics: e.g. `\includegraphics[scale=0.3]{hku-logo.pdf}` .



Output: The University of Hong Kong

- If you encounter strange errors, then you may try

```
\begin{frame}[fragile] .
```

- A beamer quickstart [http:](http://www.math.umbc.edu/~rouben/beamer/quickstart.html)

[//www.math.umbc.edu/~rouben/beamer/quickstart.html](http://www.math.umbc.edu/~rouben/beamer/quickstart.html)



The University of Hong Kong

# Overlay area

This is a number  $\frac{m}{N}$  such that .....

**Here are the codes:**

```
\begin{overlayarea}{\textwidth}{3cm}
 \only<1>{There is a number {\blue \Large \mathfrak{m}} such that}
 \only<2>{There is a number {\red \Huge \mathcal{N}} such that}
\end{overlayarea}
```

# Overlay area

This is a number  $N$  such that .....

**Here are the codes:**

```
\begin{overlayarea}{\textwidth}{3cm}
 \only<1>{There is a number {\blue \Large \mathfrak{m}} such that}
 \only<2>{There is a number {\red \Huge \mathcal{N}} such that}
\end{overlayarea}
```

# What is TikZ?

- TikZ is a TeX package (use pgf as an engine) allow we draw nice 2D pictures.
- A cool example:

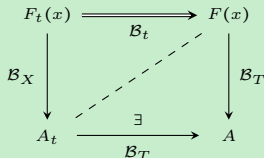


Figure: A simple commutative diagram by Stefan Kottwitz

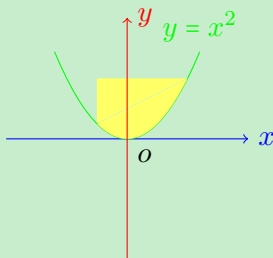
```
\begin{tikzpicture} [font=\tiny]
 \matrix (m) [matrix of math nodes,
 row sep=3em, column sep=4em,
 minimum width=2em]
 {F_t(x) & F(x) \\
 A_t & A \\
 };
 \path[-stealth]
 (m-1-1) edge node [left] {\mathcal{B}_X} (m-2-1)
 (m-1-1) edge [double] node [below] {\mathcal{B}_t} (m-2-2)
 (m-2-1) edge node [below] {\mathcal{B}_T} (m-2-2)
 (m-2-1) edge node [above] {\exists} (m-2-2)
 (m-1-2) edge node [right] {\mathcal{B}_T} (m-2-2)
 (m-2-1) edge [dashed, -] (m-2-2);
\end{tikzpicture}
```

- More cool examples:

<http://www.texample.net/tikz/examples/>.

# A simple template

To use TikZ, we first need to add `\usepackage{tikz}` to the preamble. The following is example to plant TikZ picture in pdf by integrating TikZ sources into TeX files.



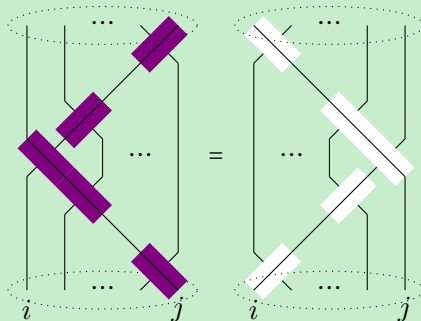
```
\centering
\begin{tikzpicture} [scale=0.8, domain
 =-2:2]
\draw[blue, ->] (-2, 0)--(2, 0) node[
 right]{x};
\draw[domain=-1:1] plot (\x, {{(\x)^2}}
 node[above]{$y=x^2$};
\fill [yellow] (-0.5, 0.25)--(-0.5, 1)--
 (1, 1) -- plot [domain=-0.5:1] (\x,
 {{(\x)^2}});
\draw[red, ->] plot (0, \x) node[right]{$
 y$};
\draw (0, 0) node[below right]{O};
\end{tikzpicture}
\end{figure}
```

```
\begin{figure} [htbp]
```

# “foreach” allows for some inline coding

The `\foreach \x` command lets you repeat several steps

```
\foreach \x/ \y in {0/3,1/2,3/0}
{
 \draw (\x,\y) -- (\x+1,\y+1);
 \draw[color=purple, line width=10] (\x+1,\y) -- (\x,\y+1);
 \draw (\x+1,\y) -- (\x,\y+1);
}
```



# What is BibTeX

BibTeX stands for a tool and a file format used to process references in LaTeX

- A BibTeX tool that I love very much is called JabRef  
<http://jabref.sourceforge.net/>.
- BibTeX format consists of entries and tags: e.g.

```
@article{A12,
 author = "A, B",
 Title = {Something Great},
 publisher = {Springer},
 Year = 2012,
}
```

- You can find bibtex formatted references online very easily and store (e.g. through JabRef) the information in a file yourfilename.bib. A bib file is like a database.



# How to use BibTeX

- Change display style of the bibliography: `\bibliographystyle {}` .  
Some packages (e.g. bibunits, natbib etc.) can create more fancy styles.
- To cite references: get the citation key and cite using `\cite{A12}`.  
Citation keys can be self-defined or automatically generated (if you use JabRef).
- Generate bibliography: L-B-L-L. Put your bib file (e.g. bibliography.bib) in the same folder. Input the command `\bibliography{bibliography}` at the right place. Compile your LaTeX file in the order: latex/pdflatex → bibtex → latex/pdflatex → latex/pdflatex.

# Obtaining bibliographies from MathSciNet

If you are on a departmental computer, you can access MathSciNet through the  $\mathcal{AMS}$ :

<http://www.ams.org/mathscinet/>

From there you can look up any published article or book.

Click the MR number to take you to the reference and “Select alternative format” from the drop-down menu to choose “BibTeX”

Copy and paste into your .bib file, change the reference tag, and delete (or comment out using %) the MRNUMBER line.

# Creating your .bib file

Open a new file in a TeX editor and save as `bibliographyname.bib`

If you read an article off arXiv.org, you can prepare your own reference:

```
@unpublished{KroMro,
 AUTHOR = {Kronheimer, P. B. and Mrowka, T. S.},
 TITLE = {Khovanov homology is an unknot-detector},
 NOTE = {arXiv:1005.4346},
 YEAR = {2010},
 archivePrefix = arXiv,
 eprint = 1005.4346,
 primaryClass = math.GT,
}
```

Make sure you put this file in the same folder as your .tex file.

Keep this .bib file updated with every book and paper you read, and you will never have to look for the references!

# Include bibliography into $\text{\LaTeX}$ file

Find the file with extension .bbl and open it. Copy everything in there and paste in the end part of the  $\text{\LaTeX}$ file.

```
\begin{thebibliography}{Par91}
```

```
\bibitem[Laz04]{Lazarsfeld2004}
```

```
Robert Lazarsfeld, \emph{Positivity in algebraic geometry. {II}}, Ergebnisse
der Mathematik und ihrer Grenzgebiete. 3. Folge. A Series of Modern Surveys
in Mathematics [Results in Mathematics and Related Areas. 3rd Series. A
Series of Modern Surveys in Mathematics], vol.~49, Springer-Verlag, Berlin,
2004, Positivity for vector bundles, and multiplier ideals. \MR{2095472
(2005k:14001b)}
```

```
\bibitem[Par91]{Pardini1991}
```

```
Rita Pardini, \emph{Abelian covers of algebraic varieties}, J. Reine Angew.
Math. \textbf{417} (1991), 191--213. \MR{1103912 (92g:14012)}
```

```
\end{thebibliography}
```

```
\bibliographystyle{alpha}
\bibliography{MyBibFile}
```



Robert Lazarsfeld.

*Positivity in algebraic geometry. II*, volume 49 of *Ergebnisse der Mathematik und ihrer Grenzgebiete. 3. Folge. A Series of Modern Surveys in Mathematics [Results in Mathematics and Related Areas. 3rd Series. A Series of Modern Surveys in Mathematics]*.

Springer-Verlag, Berlin, 2004.

Positivity for vector bundles, and multiplier ideals.



Rita Pardini.

Abelian covers of algebraic varieties.

*J. Reine Angew. Math.*, 417:191–213, 1991.

# Thank You!