Introduction to LaTeX
Lecture I: Hello, LaTeX

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Introduction to LATEX
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What is LaTeX

From Wikipedia, the free encyclopedia[1]

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 stylize text throughout a document (such as **bold** and *italic*), and to add citations[1] and cross-references.

A TeX distribution such as TeXLive 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 stylized as LaTeX.

---

[1]LaTeX - https://en.wikipedia.org/wiki/Latex

A brief History of TeX and LaTeX

Donald Kunuth from Stanford University is the specialist in programming art. In year 1977, he had just received his first samples from the new typesetting system of the publisher's, and its quality was so far below that of the first edition of Volume 2 that he couldn't stand it. Kunuth decided to implement a mathematical composition system by himself (since he is a computer scientist). He figured that this would take about 6 months (Ultimately, it took nearly 10 years). The system is named as TeX, of both the meaning of Greek letters $\tau\epsilon\chi$, and "technical".

LaTeX was created in 1983 by Leslie Lamport, when he was working at SRI. He needed to write TeX macros for his own use, and thought with a little extra effort he could make a general package usable by others. Then LaTeX developed rapidly and now there are thousands of packages written in TeX macros available for direct usage.

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Installation of LaTeX

Though there are some other distributions of LaTeX(like MikTeX), TeXLive is recommended in this lecture.

Windows & Linux

Download TeXLive on the tuna mirrors

`https://mirrors.tuna.tsinghua.edu.cn/CTAN/systems/texlive/Images/`

MacOS

Download MacTeX on the tuna mirrors

`https://mirrors.tuna.tsinghua.edu.cn/CTAN/systems/mac/mactex/`

Linux (Debian/Ubuntu)

Enter the command (fast with apt source mirror)

```
sudo apt-get install texlive-full
```

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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/

Follow the instructions on
https://www.zhihu.com/question/36038602

Visual Studio Code

https://code.visualstudio.com/

Follow the instructions on
https://zhuanlan.zhihu.com/p/38178015

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

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Write LaTeX on Overleaf (Online)

Another alternative choice is to write LaTeX online with the technology of Overleaf. It's free for personal usage and supports share editing which is very useful in group work.
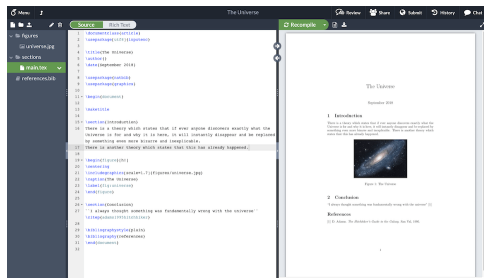

Figure 1: Layout of the Overleaf Online LaTeX Editor.

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Documentation of LATEX

If you've installed a full version of TEXLive (as strongly recommended), the full LATEX documentation is already on your computer.

Open the command line and input the command

Command

1   texdoc <docname>

You can also use the online version on (▶ Link)

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

           tex about TEX
       article about documentclass `article`
        beamer about documentclass `beamer` (used to create slides)
           pgf about packages `tikz` and `pgf` (used to draw graphs)

Try to texdoc about all new things and then you'll be an expert in LATEX.

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A Simple Document

A typical (simplest) LaTeX example is presented here.

Example

```
1   \documentclass[a4paper]{article}
2   \usepackage{amsmath} % Define various maths
    ↪   environments
3   \usepackage{amssymb} % Define various maths symbols
4   \usepackage{geometry} % Adjust the margin, paper size,
    ↪   and etc.
5   \usepackage[shortlabels]{enumerate} % Provide different
    ↪   style of lists
6   \usepackage{graphicx} % Insert image of all types
7   % Use other packages and setup them here
8   \title{A simple \LaTeX\ document}
9   \author{XX XXX}
10  \date{\today}
11
12  \begin{document}
13      \maketitle
14      Hello, \LaTeX !
15  \end{document}
```

Code started with \ is called a command, and a pair of

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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

    report Write a report

    beamer Produce a lecture silde like this!

Some options can be added, for example, a typical case can
be `\documentclass[11pt,twoside,a4paper]{article}`

Some details about the article class will be introduced 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 is one of 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` or other sizes - 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

Other classes

This project is open sourced and you can read the source code ▶ Link to learn much (I promise) about the beamer class and some very interesting features of LaTeX itself. There may also be a lecture about the beamer class in the future.

When writing a long report, report class can be used to provide some more layers of document (such as chapter) and different type settings. It's very similar to the article class, so it won't be specified.

There are some other document classes such as minimal, book, letter and etc., but I think you may never use them.

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The Preamble of a Document

As in the simple example of a document, you should notice that there is a pair of

Command

```
1  \begin{document}
2    % some contents
3  \end{document}
```

This is called the body of the document, and everything before the body, including the \documentclass line, is called the preamble of the document.

In the preamble, you define the type of document you are writing and the language, load extra packages you will need, and set several parameters. For instance, a simplified document of the example above preamble would look like this:

Example

```
1  \documentclass[a4paper]{article}
2  \title{A simple \LaTeX\ document}
3  \author{xx xxx}
```

Title, Author and Date

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It's very useful to generate a title on the first page of a document, in order to achieve it, these commands should first be added in the preamble.

Example

```
1  \title{title}
2  \author{author name}
3  \date{\today}
```

You can simply use \date{\today} to display your system date now.

Then in the body (will be introduced in the next section), use the command \maketitle to generate the title, or title page if you added the option titlepage in the \documentclass.

Magic of Packages

LaTeX is a macro-based language, where most of useful commands are not built-in commands. These commands are defined in various packages, which should be included in the preamble.

Command

\usepackage[options]{package}

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

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

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

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Common Packages

Here I provide a list of commonly used packages, you can start from using them after the lecture.

```
1   \usepackage{hyperref}       % Extensive support for
    ↪ hypertext
2   \usepackage{float}          % Improved interface for
    ↪ floating objects
3   \usepackagep[margin=2.5cm]{geometry} % Flexible document
    ↪ dimensions
4   \usepackage[shortlabels]{enumerate}  % Enumerate with
    ↪ redefinable labels
5   \usepackage{multirow}       % Tabular cells spanning
    ↪ multiple rows
6   \usepackage{multicol}       % Intermix single and multiple
    ↪ columns
7   \usepackage{ulem}           % Package for underlining
8   \usepackage{graphicx}       % Enhanced support for graphics
9   \usepackage{subfig}         % Figures broken into
    ↪ subfigures
10  \usepackage{amsmath}        % AMS mathematical facilities
11  \usepackage{amssymb}        % AMS symbols
12  \usepackage{amsfonts}       % AMS fonts
13  \usepackage{mathrsfs}       % Support for using RSFS fonts
    ↪ in maths
14  \usepackage{latexsym}       % LaTeX symbols
```

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Main Body of Document

The main body of your document which starts with `\begin{document}` and ends with `\end{document}` can be also called the `document` environment. All of the contents you'd like to display should be in it, and it MUST be unique in the whole file.

Example

```
1    \begin{document}
2        \maketitle
3        \newpage   %start the following contents in a new
     ↪   page
4        \tableofcontents %automatically generate a table of
     ↪   content
5        \newpage
6        Hello, \LaTeX !
7        % TODO: Add more contents
8        ...
9    \end{document}
```

The position and order of title page and table of contents can be arbitrary, and there can be multiple table of contents in one document.

The abstract Environment

When you are writing a paper, an abstract is often necessary in the beginning of the document.

Example

```
1   \begin{abstract}
2     This is a lecture about how to getting start in
      ↪ \LaTeX!
3   \end{abstract}
```

Abstract

This is a lecture about how to getting start in LaTeX!

The styling of the abstract will be based on the documentclass you are using. The example shows an abstract in the beamer class, which will be slightly different from that in the article class.

Comments

As in other programming languages, comments are useful when you want to make your code readable. Adding a % can make the whole line after it into a comment.

Example

% This is a comment

If you need multiline comments, use the comment environment provided by the comment package. (Add \usepackage{comment} to your preamble.)

Example

```
1  \begin{comment}
2   some comments
3   some other comments
4  \end{comment}
```

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Note that in the compiling, anything after a % is omitted, including the newline character, so there is no space between "comment" and "no" in the second line.

Example

```
1    A line
2    with space between ``line'' and ``with''
3
4    A line ended with comment% comments
5    no space between ``comment'' and ``no''
```

A line with space between "line" and "with"
A line ended with commentno space between "comment" and "no"

PS: One newline, or any number of space and tab characters are usually considered as a single "spacing" in LATEX compilers. Two or more continuous newlines will cause a line break. We'll discuss it later in the lecture.

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Sections

Commands to organize a document vary depending on the document type, the simplest form of organization is the sectioning, available in all formats.

Command

```
1  \section{name}
2  \subsection{name}
3  \subsection{name}
```

```
1  \section*{name}
2  \subsection*{name}
3  \subsection*{name}
```

The default style (can be changed with `\renewcommand`) of sections is like

1 Example Section Name

1.1 Example Subsection Name

1.1.1 Example Subsubsection Name

If an asterisk (*) is added, the sequence number will be hidden, and it won't be added to the table of contents.

Note: (Sub)sections are commands, and the whole contents between two (sub)sections is belonged to the former (sub)section.

Other Structures - Chapter, Part and Paragraph

Command

```
1  \chapter{name}
2  \part{name}
3  \paragraph{name}
4  \subparagraph{name}
```

```
1  \chapter*{name}
2  \part*{name}
3  \paragraph*{name}
4  \subparagraph*{name}
```

In document classes such as report and book, some outer structures of section (\chapter and \part) can be used.

\paragraph and \subparagraph are used for the title of small paragraphs in a (sub)section.

If an asterisk (*) is added, the effect will be the same as in the sections (sequence numbers will be hidden).

Levels of Document Structures

There are up to 7 levels of depth for defining sections depending on the document class:

Level	Command
-1	\part{part}
0	\chapter{chapter}
1	\section{section}
2	\subsection{subsection}
3	\subsubsection{subsubsection}
4	\paragraph{paragraph}
5	\subparagraph{subparagraph}

\part and \chapter are not available in some document classes.

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Common Syntax of LaTeX Commands

All LaTeX commands have the following syntax

Command

`\commandName<specialArgs>[optionalArgs]{requiredArgs}`

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

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

requiredArgs 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.

Define New Commands

In LaTeX, you can define a new command (must not already exist) with

Command

```
\newcommand{\commandName}[args]{definition}
```

The definitions of new commands are usually put in the preamble. If there are no arguments, you can omit the optional [args]; or use #num to fill in the arguments.

Example

```
1   \newcommand{\examplelatexcommand}[1]{%
2   This lecture is #1!%
3   }%
4
5   \examplelatexcommand{interesting}
6   \examplelatexcommand{great}
```

This lecture is interesting! This lecture is great!

Here I use the comment character % in the end of each line of the definition to prevent adding newlines in the new

Renew Commands

You can also redefine a command (must already exist) with

Command

`\renewcommand{\commandName}[args]{definition}`

Example

```
1  \newcommand{\examplelatexcommand}[1]{...}%
2  \renewcommand{\examplelatexcommand}[1]{%
3  This lecture is not #1!%
4  }%
5
6  \examplelatexcommand{interesting}
7  \examplelatexcommand{great}
```

This lecture is not interesting! This lecture is not great!

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`\renewcommand` is often used to change the style of `section`, `subsection` and etc., for example

Example

```
1  \renewcommand{\thesection}{\Roman{section}.}
2  \renewcommand{\thesubsection}{\Roman{section}.\arabic{subse
```

This example changes the section number to capital roman numbers and subsection number to arabic numbers. Here's a list of available styles:

`\arabic` prints the value as an Arabic number, e.g. 2.

`\alph` prints the value as an alphabetic character (minuscule), e.g. b.

`\Alph` prints the value as an alphabetic character (capital letter), e.g. B.

`\roman` prints the value as a Roman number (minuscules), e.g. ii.

`\Roman` prints the value as a Roman number (capital letters), e.g. II.

`\fnsymbol` prints the value as a symbol in a sequence, this is meant to be used for symbolic footnotes, e.g. †.

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Common Syntax of LaTeX Environments

All LaTeX environments have the following syntax

Command

```
1   \begin{environmentName}<specialArgs>[optionalArgs]{required
2     % ...
3   \end{environmentName}
```

`specialArgs`, `optionalArgs`, `requiredArgs` are similar to those in a `command`

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

Define New Environments and Renew Environments

You can define a new environment (must not already exist) with

Command

\newenvironment{environmentName}[args]{before begin}{after end}

The difference of defining an environment from defining a command is that you should specify two code blocks, one is inserted before the \begin clause and the other is inserted after the \end clause.

Another issue is that arguments can only been used in the first of them (before \begin). If you need to save some arguments, use \newcommand to define a macro, but it may cause problems in nested usages.

Redefine an environment (must already exist) with

Command

\renewenvironment{environmentName}[args]{before begin}{after

For example, the examples in this lecture are provided by a self-defined `latexexample` environment:

Example

```latex
1   \newenvironment{latexexample}
2   {\VerbatimOut{\jobname.tmp}}
3   {\endVerbatimOut
4   \begin{example}
5   ~
6   \inputminted{latex}{\jobname.tmp}
7
8   \input{\jobname.tmp}
9   \end{example}
10  }
11  \begin{latexexample}
12    some code here
13  \end{latexexample}
```

It is a `verbatim` environment, which accepts LATEX code as plain text and deals with them later.