Documentation For Package xjtlumath

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June 16, 2021

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Part I
General Information

1 What is this package?

This LaTeX package was originally intended to be used by the materials dept. of XJTLU math club. Yet I found that my university lack LaTeX templates for students, therefore I decided to extend it into a template for all users.

The package contains several useful commands and environments for mathematical documents, and redefines some existing styles so that they suit the university's style.

2 History

At the year 2020, I joined the materials dept. of XJTLU math club. This department makes materials about math and distribute them to students to help them. At that time, the materials were being prepared with Microsoft Word and MathType. I saw that it was a good opportunity to enhance the materials with the power of LaTeX, so I proposed to prepare the documents using LaTeX.

The proposition was passed and our team started to transfer our working environment. During this process, I wrote a tiny package, a predecessor of this package, which was used in our works. Many people in our department knew nearly nothing about LaTeX, and as I promised that the new preparation process would not be very hard, I managed to define the overall procedure, shared some necessary knowledge about LaTeX, and taught them how to use the package.

I admit that I was a bit irresponsible at that time. Truly I described how the working procedure was and how should my package be used, but I shared few about LaTeX. My package and workflow simplified some concepts so that the team didn't need to care about some parts of LaTeX such as the documentclass and preamble, though LaTeX itself is still a lot different from Word. I underestimated the difficulty for my colleagues to learn basic LaTeX typing skills so it was a torment for some of them. I some kind of realized this problem in the later stages, but I was occupied by my own businesses, and didn't pay enough attention to it.

The final results were generally successful and mostly good enough. Yet I feel sorry for my colleagues because this thing was in fact not that easy for them. In addition, I recently took part in the 15^{th} anniversary of XJTLU math club and this somehow strengthened my sense of belonging to the math club. For these reasons, I decided to leave something for XJTLU's students in the future. I rewrote the whole package and added a series of tutorials that covers the basics of LaTeX as well as making materials, so that people in the material dept. will do much less to make a material in LaTeX. The tutorials are in the form of a stories, since I think this method adds more fun to the studying.

Apart from that, the general students of XJTLU or even other LaTeX users may find this package and documentation useful. So its final form was decided to be a template with documentation that is published as a GitHub repository under my personal account. This is because the math club it self doesn't have a GitHub account currently. I will transfer this repository to its official account once it has established one.

3 How to read this document

For members of the materials department who are new to LaTeX and this package, the tutorial part, except the tutorial 4, should be read thoroughly in the order they are present, since some content relies on the previous ones.

For team leaders, tutorial 4 is then as important as the first three. It teaches about how to manage a team's work and some high level controls.

For someone who knows LaTeX and who just wants to take advantage of this package, the tutorials may serve as a reference to the functionality provided by this package. The templates part gives description about what all the templates do.

For someone who wants to improve this package, see the implementation detail, or finds some bugs about this package, the Internal Documentation is a good place to go. Feel free to contact me at guanyuming.he20@student.xjtlu.edu.cn. I appreciate any response, suggestion, or correction regarding this tiny package. I hope one day, XJTLU can have a big LaTeX community and many LaTeX packages and templates, but that is a work that needs everyone's contribution.

Part II
Tutorials

4 Tutorial 1: Ashley's First Material

Ashley joined the material department recently. Now he is assigned to write a part of the material that covers basic calculus. He is very excited because this will be his first material as well as his first try on LaTeX. First, he needs to know how to use LaTeX and the package on his PC. In this tutorial, we will follow Ashley and see what he learns in the material preparation.

4.1 Installation and Configuration

To use LaTeX, Ashley needs a TeX distribution (and probably an editor) installed on his computer. There are several popular distributions listed on the LaTeX official website: https://www.latex-project.org/get/. The installation and configuration of these distributions are quite easy and Ashley completed them in a few minutes.

Then, Ashley wants to have an editor for writing LaTeX documents. He learns that TeXstudio is a good one, so he downloads and installs it.

What Ashley needs to do now is to obtain a copy of this package and install it. (TBD)

4.2 Basic Writings

Ashley, waiting breathlessly to begin his first work, clicks open the Templates folder and navigates into the material-book folder. He opens encapsulation.tex and notices that it is like this:

```
... Some code ...

\input{chapters.tex}

... Some code ...
```

As the file name suggests, this is for making a material that -is to be published as a book. A book contains some chapters, and in the material writing, each chapter is a specific part of the material topic. For example, Ashley's work is part of the calculus material, so he needs to start a chapter for his work. He opens chapter.tex and finds a blank document. He then adds the following command to start his first chapter and runs LaTeX on encapsulation.tex to check the output (On the left is the result of his command(s), appearing in a different font family, and on the right is his commands, with a gray background):

1 Key points in calculus

```
\chapter{Key points in calculus}
```

`\chapter{...}` is a LaTeX *command*, which starts with a `\`. The words being wrapped with the curly brackets `{}` form an *argument* for the command. At this place, they are the caption of the chapter. Ashley notices that LaTeX automatically enlarges the font and makes them bold. Being different with many other typesetting software, LaTeX only needs the logical idea of what to do (e.g. there will be a chapter named xxx at some place), and it will control the appearance for the author.

Ashley is satisfied with that result. He then types some of paragraphs. In LaTeX, paragraphs are separated by one blank line.

```
\chapter{Key points in calculus}
What does Ashley write in these
paragraphs? Well, in fact, I don't know.
 You may find him and ask him yourself.

But, wait a minute, how do I find Ashley
 when he doesn't really exist? Well,
this is a good question.
```

1 Key points in calculus

What does Ashley write in these paragraphs? Well, in fact, I don't know. You may find him and ask him yourself.

But, wait a minute, how do I find Ashley when he doesn't really exist? Well, this is a good question.

Ashley notices that paragraphs are automatically indented by LaTeX. Yet he also notices that the paragraph directly under the chapter is not indented.

Apart from chapter, LaTeX also provides these sectioning commands:

- section
- subsection
- subsubsection
- paragraph
- subparagraph

You may notice that paragraph is included here. In fact, the sectioning command `\paragraph` generates a title for the paragraphs like other sectioning commands.

When Ashley turns to the whole output, he sees that his chapter appears in the table of contents:

Contents


```
\chapter{Key points in
calculus}
```

LaTeX generates the table of contents for all sectioning commands[1]. For this reason, Ashley has to run LaTeX twice on encapsulation.tex for a correct table of contents.

[1] whose depth are below the table of contents (toc) depth. The actual process of how toc is generated is a bit complex, so I will not cover it here

When Ashley once writes a very long caption for a section, the table of contents become quite ugly. To solve this, Ashley can specify a short form of the section that is used in the table of contents, as shown below:

Contents

1 **A Short Name** 1

```
\chapter[A Short Name]{A very very long Caption}
```

4.3 Adjust fonts

So far, Ashley knows how to instruct LaTeX to do some basic things. Although he feels full of energy and is writing at full speed, he soon encounters some problems. Ashley wants to emphasize some keywords such as "limit". He later learns that the command `\emph` instructs LaTeX to emphasize the text passed to it, as shown below.

Calculus is the study of *limits*.

```
Calculus is the study of \emph{limits}.
```

This thing is quite LaTeX, as Ashley only tells LaTeX to emphasize it, and has no control of how LaTeX does it. Although most of times it is enough, Ashley wants more. He wonder how can one explicitly control the appearance of the texts, since LaTeX cannot cover all needs in every situations. LaTeX does provide certain default operations on fonts, and Ashley can use them to control the size, family, and style of his texts.

Ashley can tell LaTeX to adjust the font size like:
very very small the size of scripts the size of foot notes small font just being normal a bit bigger large text very big huge damn huge

```
Ashley can tell \LaTeX{} to adjust the font size like:
{\tiny very very small} {\scriptsize the size of scripts} {\footnotesize the size of foot notes} {\small small font} {\normalsize just being normal} {\large a bit bigger} {\Large large text} {\LARGE very big} {\huge huge} {\HUGE damn huge}
```

This time Ashley sees something different from the command `\emph{}`. The texts here are inside curly brackets, and the commands are just given inside the brackets along with the texts. Something enclosed by a pair of curly brackets is said to be inside a *group*. Commands called inside the group influence the whole group.

Apart from the sizes, Ashley is also able to control the style and family of fonts. As shown in Table 1, LaTeX provides these commands to control font style and family:

Many of these commands provide both an used-in-group version and a normal version. Ashley can choose which version to use depend on his needs.

Ashley also wants to learn how to change the color of fonts. He is surprised that this package documentation does not provide such a description. After contacting with the package author, he learns that this topic is not covered

Command	Used in a group	Action
`\textrm{...}`	`{\rmfamily...}`	Text in Roman family
`\textsf{...}`	`{\sffamily...}`	Text in sans serif family
`\texttt{...}`	`{\ttfamily...}`	Text in `typewriter` family
`\textmd{...}`	`{\mdseries...}`	Text in medium series
`\textbf{...}`	`{\bfseries...}`	Text in **bold** series
`\textup{...}`	`{\upshape...}`	Text in upright shape
`\textit{...}`	`{\itshape...}`	Text in *italic* shape
`\textsl{...}`	`{\slshape...}`	Text in *slanted* shape
`\textsc{...}`	`{\scshape...}`	Text in SMALL CAPS shape
`\emph{...}`	`{\em...}`	Text *emphasized*
`\textnormal{...}`	`{\normalfont...}`	Text in default font

Table 1: Standard font-changing commands and declarations

because the materials are printed in black and white, so it would be nearly useless to change colors.

4.4 Typing Mathematical Formulae

It comes the most exciting part of Ashley's work — typing formulae! Even though he had little experience in LaTeX before, he already learned that LaTeX produces high-quality math formulae, as he previously saw at some sites like Math Stack Exchange (https://math.stackexchange.com/) and ZhiHu (https://www.zhihu.com/).

Because of his previous experience on these sites, he knows a little bit about how to write formulae in LaTeX.

Generally, formulae in LaTeX are classified into two types: *inline* and *displayed*. Formulae of the former type are enclosed in a pair of dollar sign: `$...$`, while formulae of the latter type are enclosed in a pair of double dollar sign: `$$...$$`. These delimiters are the original TeX ones. LaTeX provides additionally two pairs of delimiters for inline and displayed math, respectively: `\(...\)` and `\[...\]`. In fact, the TeX shorthand `$$...$$` for displayed math should be avoided, as it may lead to strange problems in LaTeX.

As their name suggest, an inline formula is in a line of texts, while a displayed formula is displayed outside of the main texts.

The derivative of a function f can be written as f', or as

$$\frac{\mathrm{d}f}{\mathrm{d}x}$$

```
The derivative of a function $f$ can
 be written as $f'$, or as
\[
\frdt{x}
\]
```

Here, Ashley uses a command provided by xjtlumath: `\frdt`. This command

takes two argument, where the first one is optional with the default value f. They represent the function and the variable, respectively. When Ashley wants to typeset the derivative of g to x, he will write `\frdt[g]{x}`, which gives $\frac{\mathrm{d}g}{\mathrm{d}x}$. The optional argument is passed to the command in the embrace of a pair of two square brackets. As careful as Ashley, you may notice that in inline mode, a formula is shrunk to some extent so that it can fit in one line.

Ashley is quite satisfied with the rendering effect. He then writes some equations and texts. But when he wants to reference a equation, a problem arises. How does he address the equation he wants to reference? Here Ashley is introduced with another way of giving a displayed math: the equation environment.

The fundamental theorem of calculus can be expressed in the form of Equation 1

$$\int_a^b f(x)\,\mathrm{d}x = F(b) - F(a) \tag{1}$$

```
The fundamental theorem of calculus can
be expressed in the form of Equation \
ref{eq:fundthmcal}
\begin{equation}
\int_a^b f(x) \dx = F(b) - F(a) \label{
eq:fundthmcal}
\end{equation}
```

Ashley understands the equation by his previous knowledge: the underscore (`_`) introduces the subscript (a) to the integral symbol $\int$ (`\int`), while the caret (`^`) introduces the superscript (b) to it. The command `\dx` is provided by xjtlumath. If Ashley types dx directly, the result will be like this $\int f(x)dx$, which is ugly. `\dx` refines the result. Note that `\dx` can only be used to represent the integral variable, because it adds a little space before it. If Ashley needs to use other variables, he needs to use the command `\dd`. xjtlumath also provides the same facility for multiple integrals.

$$\int f(t)\,\mathrm{d}t, \quad \iint f(x,y)\,\mathrm{d}x\,\mathrm{d}y, \quad \iiint f(x,y,z)\,\mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z$$

$$\iint f\,\mathrm{d}r\,\mathrm{d}\theta, \quad \iiint f\,\mathrm{d}z\,\mathrm{d}r\,\mathrm{d}\theta, \quad \iiint f\,\mathrm{d}\rho\,\mathrm{d}\theta\,\mathrm{d}\phi$$

```
\[
\int f(t) \dd t,\quad
\iint f(x,y) \dxdy,\quad
\iiint f(x,y,z) \dxdydz
\]
\[
\iint f \drdt,\quad
\iiint f \dzdrdt,\quad
\iiint f \drdtdp
\]
```

However, Ashley knows nothing about cross-referencing in LaTeX as well as the equation environment. Let's explain them to Ashley. In LaTeX, an environment is started by the `\begin` command and ends at the `\end` command. The name of the environment is passed to the pair of commands. The equation environment gives a displayed math equation that is *counted*. The `\label` command at the end of the equation catches the counter as well as some other information like its location and store it in the label represented by the name

given to `\label`. To use the label, Ashley needs the `\ref` command, which prints the counter[2].

The equation environment gives a numbered counted, while `\[\]` doesn't. Using a label inside this causes the label to be directed to another counter, so use a label only when that thing is counted.

4.5 Space Management

The space management in LaTeX is a bit more complex than just typing white spaces. Ashley is a careful person, he soon finds that the space after a sentence is a little bit larger than the space between words (you may zoom in the .pdf file to see this). LaTeX decides a space as a space at the end of a sentence if

1. A full stop (.) or right quotation mark (') is immediately followed by the space, and
2. if it is a full stop being followed, the letter immediately before the full stop is in lowercase.

Most sentences end according to the above rules, though there are some exceptions. For example, LaTeX may take a Mr. as the sign of a sentence ending, and thus produces wrong spacing. Under such circumstances, Ashley needs to configure LaTeX manually by `~` and `\@`.

In another world, Mr. Ashley was once loved by Miss Scarlett. In this world, Mr. Ashley has a PC. He loves programming on his PC.

```
In another world, Mr.~Ashley was once
loved by Miss Scarlett. In this world,
Mr.~Ashley has a PC\@. He loves
programming on his PC.
```

Ashley is happy as he learned how to manage the spaces. Yet soon he finds another problem.

Some commands like LaTeXseems to eat the space after it.

```
Some commands like \LaTeX seems to eat
the space after it.
```

To solve this problem, Ashley needs to add an empty group (`{}`) at the end of the command.

As for mathematical formulae, things become different. LaTeX ignores all white spaces in math mode, whether it is inline or displayed. To add extra spaces, Ashley has to use the commands shown in Table 2.

4.6 Lists and Other Environments

Now Ashley has learned about dealing with texts, he continues his writing. Soon he has to break again as he is working on a list. At first, he hard-codes the list like this:

[2] and in addition generates a clickable hyperlink, which on click navigates to the location of the equation, and which is the effect of the hyperref package loaded by the template.

Command	Effect (approximately)
`\,`	$\frac{3}{18}$ quad (␣)
`\:`	$\frac{4}{18}$ quad (␣)
`\;`	$\frac{5}{18}$ quad (␣)
`\` (\ followed by a space)	a space
`\quad`	Width of 'M' in current font (␣)
`\qquad`	2 quad (␣␣)

Table 2: Spacing in Math Mode

1. Something
2. Something
3. Something

```
1. Something

2. Something

3. Something
```

Yet this solution looks rather silly. In addition, if Ashley wants to change the number, he needs to do it manually. He wonders if LaTeX has some more convenient way to do it.

Fortunately there is. LaTeX provides several environment to deal with lists. One example is shown below.

1. Something
2. Something
3. Something

```
\begin{enumerate}
\item Something
\item Something
\item Something
\end{enumerate}
```

Now Ashley has nearly everything he needs to know. He is content with what he has written and feels happy. The only thing that matters for him is that he wants to show theorems, definitions, and other things in a more fancy fashion so that his readers can focus on these.

xjtlumath provides some fancy environments just for this purpose.

Definition 4.1: Absolute Convergence

An infinite series $\sum_{n=0}^{\infty} a_n$ is said to be absolutely convergent iff

$$\sum_{n=0}^{\infty} |a_n|$$

converges

```
\begin{definition}[Absolute Convergence]
An infinite series $\infseries{n}{0}$ is said to be absolutely convergent iff
\[
\sum_{n=0}^\infty |a_n|
\]
converges
\end{definition}
```

xjtlumath loads amsthm, which gives the proof environment. When Ashley uses this environment to write proofs, he finds that a q.e.d. sign appears at the end of the environment.

Now we prove the mean value theorem for definite integrals. That is, for a continuous function f that is bounded on $[a,b]$, the definite integral $\int_a^b f(x)\,\mathrm{d}x = f(c)(b-a)$, where $c \in [a,b]$.

Proof. Let m, M be the infimum and supermum of $f([a,b])$, respectively. Therefore, $m \le f \le M$, and

$$\int_a^b m\,\mathrm{d}x \le \int_a^b f(x)\,\mathrm{d}x \le \int_a^b M\,\mathrm{d}x$$

, which gives

$$m(b-a) \le \int_a^b f(x)\,\mathrm{d}x \le M(b-a)$$

$$m \le \frac{\int_a^b f(x)\,\mathrm{d}x}{b-a} \le M \tag{2}$$

Since that f is continuous, it can reach every value between the infimum and supermum of its range. That is, $\exists c \in [a,b], f(c) = \int_a^b f(x)\,\mathrm{d}x$. Substitute $f(c)$ back to equation 2 gives what the theorem states. □

```
Now we prove the mean value theorem for definite integrals. That is, for a continuous function $f$ that is bounded on $[a,b]$, the definite integral $\int_a^b f(x) \dx = f(c)(b-a)$, where $c \in [a,b]$.
\begin{proof}
Let $m,M$ be the infimum and supermum of $f([a,b])$, respectively.
Therefore, $m\le f \le M$, and
\[
\int_a^b m \dx \le \int_a^b f(x) \dx \le \int_a^b M \dx
\]
, which gives
\begin{align}
m(b-a) \le &\int_a^b f(x) \dx \le M(b-a) \nonumber\\
m \le &\frac{\int_a^b f(x) \dx}{b-a} \le M \label{eq:meanvalint}
\end{align}

Since that $f$ is continuous, it can reach every value between the infimum and supermum of its range. That is, $\exists c \in [a,b], f(c) = \int_a^b f(x) \dx$. Substitute $f(c)$ back to equation \ref{eq:meanvalint} gives what the theorem states.
\end{proof}
```

Ashley is able to control where the q.e.d. sign appears by using the `\qedhere` command provided by proof. If this command is given before, then it will not appear at the end.

Proof. Some words...

$$a+b=c \qquad \square$$

Som words...

```
\begin{proof}
Some words...
\[
a+b=c \qedhere
\]
Som words...
\end{proof}
```

Besides of definition and proof, Ashley is also able to use theorem, proposition, corollary, lemma, axiom, and example. Except for proof, these environments own their individual counters, and Ashley can simply use label to reference them.

However, one colleague of Ashley, Chao, complains that the English caption of these environments conflicts with the Chinese material he is writing. For this purpose, xjtlumath additionally provides Chinese version environments in replace of them in Chinese materials. Appending a 'c' to the environments' names gives the names of the Chinese version environments.

These facilities greatly help Ashley in his material preparation, and he will finish his work soon...

5 Tutorial 2: Delilah and Complex Math Formulae

Delilah is working on a part of a material about linear algebra. As her work proceeds, she will obtain the ability to deal with complex mathematical formulae in LaTeX, especially those methods provided by the ams packages loaded in xjtlumath.

5.1 Multiple Lined Formulae

A system of linear equations is a fundamental part of linear algebra. When Delilah tries to type a group of equations, she encounters a problem. In the predefined `\[\]` and environment equation, she finds no option to start a new line. Even the line-break options of LaTeX like `\\` and `\newline` do not work there. Of course the equations should not be put in one line, so what should she do now? Later she learns that the environment *aligned* is designed to allow a system of equations to be aligned in multiple lines:

$$\begin{aligned} x+y &= 1\\ x-y &= 2 \end{aligned}$$

```
\[
\begin{aligned}
x+y &= 1\\
x-y &= 2
\end{aligned}
\]
```

Here, the ampersand sign `&` is used before the symbols according to which the equations are to be aligned. The line break sign `\\` starts a new line of equation. Note that other line-break operations cannot be used here.

Delilah likes the result, but she feels that the equations are too lonely. She thinks that adding a large curly bracket for them will comfort them. LaTeX supports a syntax to put things before and after a group of things.

$$\left\{\begin{aligned} x+y &= 1\\ x-y &= 2 \end{aligned}\right.$$

```
\[
\left\{
\begin{aligned}
x+y &= 1\\
x-y &= 2
\end{aligned}
\right.
\]
```

The `\left` command defines what is to be put on the left, and the `\right` command defines what is to be put on the right. Delilah does not want to put anything on the right, so she writes `.` for nothing.

For a group of equations that requires no alignment, or for a single equation that is too long to fit in one line, the environment *gathered* that does no alignment is a better choice:

$$\cos z = 1 - \frac{z^2}{2!} + \frac{z^4}{4!} - \frac{z^6}{6!} + \cdots = \sum_{n=0}^{\infty} \frac{(-1)^n z^{2n}}{(2n!)}$$

```
\[
\begin{gathered}
\cos {z} = 1 - \frac{z^2}{2!} + \frac{z
^4}{4!} - \cdots \\
= \sum_{n=0}^\infty {\frac{(-1)^n z^{2n}}{(2n
!)}}
\end{gathered}
\]
```

After writing several groups of equations, Delilah wants to reference one of them. She uses the equation environment instead of `\[\]`, but finds out that the equations are numbered as a whole.

$$x + y = 1$$
$$x - y = 2 \quad (3)$$

```
\begin{equation}
\begin{aligned}
x+y &= 1\\
x-y &= 2
\end{aligned}
\end{equation}
```

So it is difficult for her to reference a single equation in a group. amsmath provides the environment align for this purpose:

$$x + y = 1 \quad (4)$$
$$x - y = 2 \quad (5)$$

```
\begin{align}
x+y &= 1\\
x-y &= 2
\end{align}
```

If she doesn't want to number a single equation, she needs to append `\nonumber` at the end of that line.

$$x + y = 1 \quad (6)$$
$$z = 10$$
$$x - y = 2 \quad (7)$$

```
\begin{align}
x+y &= 1\\
z &= 10 \nonumber\\
x-y &= 2
\end{align}
```

Without the "ed" suffix, *gather* is also a standalone environment that does what gathered do. But there is a major difference between the normal version and "ed"ed version. Delilah finds it impossible to put the bracket again before a align or gather, because they don't need to be surrounded by mathematical environments. Also, their width are fixed to be the width of texts, while their "ed"ed versions can be of any width.

As the same as the equation environment, their starred versions give no number by default.

$$x + y = 1$$
$$x - y = 2$$

```
\begin{align*}
x+y &= 1\\
x-y &= 2
\end{align*}
```

Delilah is able to put multiple groups of equations in one align, just by adding ampersands between the groups.

$$x + y = 1 \qquad a + b = 3$$
$$x - y = 2 \qquad a - b = 4$$

```
\begin{align*}
x+y &= 1  & a+b &= 3\\
x-y &= 2  & a-b &= 4
\end{align*}
```

The space between the groups is adjusted automatically by align.

5.2 Matrices

Matrices are vital to linear algebra, as they represent linear mappings from a vector space to another in specific bases. Also, the coefficient matrix and the augmented matrix are convenient in operating linear equations.

amsmath provides several environments for typing matrices.

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix}$$

```
\[
\begin{bmatrix}
1&2&3&4\\
5&6&7&8\\
9&10&11&12\\
13&14&15&16
\end{bmatrix}
\]
```

The environments pmatrix, Bmatrix, vmatrix, and Vmatrix produce delimiters of `()`, `{}`, `||`, and `|| ||`, respectively.

To use matrices in inline mode, Delilah uses the environment smallmatrix, which has no p,b,B,v,V versions in amsmath, as it is the author's responsibility to decide the delimiters.

The matrix $\left(\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}\right)$ is so small and cute!

```
The matrix $\left(\begin{smallmatrix} a&b\\c&d \
\end{smallmatrix}\right)$ is so small and cute!
```

When Delilah tries to put fractions inside a matrix, she finds something annoying.

$$\begin{bmatrix} 1 & \frac{1}{2} & \frac{1}{3} \\ 1 & \frac{1}{4} & \frac{1}{5} \end{bmatrix}$$

```
\[
\begin{bmatrix}
1&\frac{1}{2}&\frac{1}{3}\\
1&\frac{1}{4}&\frac{1}{5}\\
\end{bmatrix}
\]
```

The fractions above and below are so close that they touch each other! This is not what Delilah wants and she is surprised that LaTeX doesn't detect this and do something. Fortunately, in amsmath environments, an optional argument is allowed to be passed to \\ to define the actual vertical space between lines. For fractions, 2ex is a good option. Also, the fractions are in inline mode. The `\dfrac` command gives displayed fractions.

$$\begin{bmatrix} 1 & \dfrac{1}{2} & \dfrac{1}{3} \\[2ex] 1 & \dfrac{1}{4} & \dfrac{1}{5} \end{bmatrix}$$

```
\[
\begin{bmatrix}
1&\dfrac{1}{2}&\dfrac{1}{3}\\[2ex]
1&\dfrac{1}{4}&\dfrac{1}{5}
\end{bmatrix}
\]
```

Sometimes a matrix is too large to be displayed fully. At these times, the use of ellipses (plural of ellipsis, not ellipse) is important. When Delilah writes the inverse of a matrix, she uses ellipses.

$$A^{-1} = \frac{1}{\det A} \begin{bmatrix} C_{11} & C_{21} & \cdots & C_{n1} \\ C_{12} & C_{22} & \cdots & C_{n2} \\ \vdots & \vdots & \ddots & \vdots \\ C_{n2} & C_{n2} & \cdots & C_{nn} \end{bmatrix}$$

```
\[
A^{-1} = \frac{1}{\det A}
\begin{bmatrix}
C_{11} & C_{21} & \cdots & C_{n1} \\
C_{12} & C_{22} & \cdots & C_{n2} \\
\vdots & \vdots & \ddots & \vdots \\
C_{n2} & C_{n2} & \cdots & C_{nn}
\end{bmatrix}
\]
```

5.3 Texts and Operator Names

To put text inside math environments, Delilah uses the `\text` command provided by amsmath.

Definition 5.1: Null Space

The null space of an $m \times n$ matrix A, written as $\operatorname{Nul} A$, is the set of all solutions of the homogeneous equation $A\mathbf{x} = \mathbf{0}$. In set notation,

$$\operatorname{Nul} A = \{\mathbf{x} : \mathbf{x} \text{ is in } \mathbb{R}^n \text{ and } A\mathbf{x} = \mathbf{0}\}$$

```
\begin{definition}[Null Space]
The null space of an $m \times n$
matrix $A$, written as $\Nul A$, is
 the set of all solutions
of the homogeneous equation $A\vec{
x} = \vec{0}$. In set notation,
\[
\Nul A = \{\vec{x}:\vec{x} \text{
is in } \mathbb{R}^n \text{ and } A
\vec{x} = \vec{0} \}
\]
\end{definition}
```

The commands like `\Nul`, `\sin`, ... are math operators. Part of predefined math operators in LaTeX are shown in Table 3.

Result	Command	Result	Command	Result	Command
arccos	`\arccos`	arcsin	`\arcsin`	arctan	`\arctan`
cos	`\cos`	sin	`\sin`	tan	`\tan`
cot	`\cot`	sec	`\sec`	csc	`\csc`
cosh	`\cosh`	sinh	`\sinh`	tanh	`\tanh`
lim	`\lim`	lim inf	`\liminf`	lim sup	`\limsup`
ln	`\ln`	log	`\log`	lg	`\lg`
max	`\max`	min	`\min`	sup	`\sup`
inf	`\inf`				
ker	`\ker`	det	`\det`	exp	`\exp`

Table 3: Some Predefined Math Operators

In fact, operator `\Nul` and `\Span` are defined by xjtlumath as in the forms in the year 1 linear algebra textbook of XJTLU. Also, xjtlumath changes the default `\vec` command in LaTeX so that vectors appear in bold form rather than with a arrow above them.

Some operators, like `\lim`, are designed to support taking limits. That is, in displayed mode, when one tries to give one of such operators a subscript using `_`, the subscript will appear at the bottom of the operator.

$$\lim_{x \to 0} f(x)$$

```
\[
\lim_{x\to 0} f(x)
\]
```

Delilah is able to explicitly control the limit style by using `\limits` and `\nolimits`. Note that these two commands can only be used after a operation that supports taking limits.

$\lim_{x\to 0} f(x)$ $\lim_{x\to 0} f(x)$

```
$\lim\limits_{x \to 0}f(x)$
\[
\lim\nolimits_{x\to 0} f(x)
\]
```

5.4 Symbols

The standard LaTeX font in math environments is neat and clean. Yet in some special occasions Delilah would like to change the font of some symbols. For example, to represent some conventional sets, she uses the blackboard font.

$\mathbb{R}\quad \mathbb{N}\quad \mathbb{Q}\quad \mathbb{Z}$

```
\[
\mathbb{R}\quad \mathbb{N}\quad \mathbb{Q}\quad \mathbb{Z}
\]
```

Writing `\mathbb` every time is somehow irritating. For this purpose, xjtlumath defines shorthands for them.

$\mathbb{R}\quad \mathbb{Q}\quad \mathbb{Z}\quad \mathbb{N}\quad \mathbb{N}^+$

```
\[
\setr \quad \setq \quad \setz \quad \setn \quad \setnp
\]
```

Other font controlling methods are like what we have talked about in subsection 4.3. For example, `\mathrm` gives font in Roman family, and `\mathbf` gives font in **bold** series.

$\mathrm{Like normal text}\quad \mathbf{bold}$

```
\[
\mathrm{Like normal text} \quad \mathbf{bold}
\]
```

6 Tutorial 3: Yue Handling Floats

Yue is preparing her material for the monthly of math club. She wants to make her material interesting and easy to understand, so she utilizes many figures and tables.

Figures, tables and many other things that occupy an (often large) area of random width and height are treated as *floats* in LaTeX. Floats are common in today's documents, yet they cause great troubles in typesetting. In this section, we will work along with Yue to see how floats are handled in LaTeX.

6.1 Inserting Images

To insert images in LaTeX, package graphicx (loaded by the template files) is a good option. It provides the `\includegraphics` that accepts the input image filename and some optional specifiers.


```
\includegraphics[width=\textwidth]{assets/
examplelogo.jpg}
```

Yue soon finds out that simply using this command is not a good option, because if there is not enough vertical space for the image, it will be placed on the next page, leaving a large vacant area, which is quite ugly. Also, she is unable to provide the image with a caption or to reference it.

So, Yue wraps the image with the figure environment that makes the image a *figure*.

Figure 1: Example Logo

Figure 1 shows the figure Yue uses.

```
\begin{figure}
\includegraphics[width=\textwidth]{assets/
examplelogo.jpg}
\caption{Example Logo}
\label{fig:example}
\end{figure}
Figure \ref{fig:example} shows the figure Yue
 uses.
```

LaTeX automatically gives a number to it so that Yue is able to reference it. Note that due to implementation reasons, `\label` should only be placed immediately after a `\caption` lest the reference be wrong.

6.2 Tables

Even if using figures does require an extra environment, it is still quite simple and Yue soon becomes familiar with it. Dealing with tables, however, is more complex in LaTeX.

To generate a table-like content in LaTeX, Yue has to use special environments. tabular and array are two specific examples of them. In fact, the two

environments are alike in most of the aspects, with one major difference being that array is often used in math mode.

The syntax of array and tabular resembles the one of matrix environments used by Delilah, though here Yue has to explicitly specify the column behavior.

Entry 1	Entry 2
a	b

```
\begin{tabular}{|c|c|}
\hline
Entry 1 & Entry 2\\
\hline
a & b\\
\hline
\end{tabular}
```

Yue doesn't quite understand what `|c|c|` means, so she searches on the Internet for this. It tells her that this argument passed to tabular specifies each column. The letter c tells tabular that the contents in this column should be centered. And two other alignment specifier l and r are available for "left" and "right", respectively. The vertical bar indicates that at this place a vertical line should be inserted (c.f. The `\hline` command that instructs a horizontal line to be inserted at the top of the current row)

The width of a column is determined by the width of the contents when either c,l, and r is given. Yue is able to control the width of a column by using another specifier "p", in which the content is left-aligned.

Entry 1	Entry 2
a	b

```
\begin{tabular}{|c|p{2cm}|}
\hline
Entry 1 & Entry 2\\
\hline
a & b\\
\hline
\end{tabular}
```

When there is many columns with the same specifier, Yue can use this syntax `*{num}{spe}` to repeat the specifiers, where num is the number of repetitions, and spe is the specifier.

a	a	a	a	a	a	a
a	a	a	a	a	a	a

```
\begin{tabular}{|*{7}{c|}}
\hline
a&a&a&a&a&a&a\\
\hline
a&a&a&a&a&a&a\\
\hline
\end{tabular}
```

Yue doesn't like line-separated tables because she considers them not tidy. She wants to use space to separate contents. She can use `@{\hspace{}}` between column specifiers to specify the inter-column space and use `\vspace{}`

immediately before \\ to add extra space before the next row.

a b b
a b b

c d d

```
\begin{tabular}{c@{\hspace{1cm}}cc}
a & b & b\\
a & b & b\vspace{.5cm}\\
c & d & d\vspace{.5cm}\\
\end{tabular}
```

In fact, inside `@{}` Yue can use not only spaces, but any other contents.

crime scene <POLICE, stay away> people
crime scene <POLICE, stay away> people

```
\begin{tabular}{c@{ <POLICE, stay away> }c}
crime scene & people \\
crime scene & people \\
\end{tabular}
```

Like the environment figure, the environment table is designed to accept a table-like content.

a b
c d

Table 1: Example Table

Table 1 shows a table.

```
\begin{table}
\begin{tabular}{cc}
a & b \\
c & d \\
\end{tabular}
\caption{Example Table}
\label{tab:example}
\end{table}
Table \ref{tab:example} shows a table.
```

Now that Yue understands how to manipulate table-like contents in LaTeX, she soon resumes to her work. At some point, she has to create a super big table that contains at least 20 columns, and she finds that it sticks out of the page. When she tries to use `\small` to reduce the size of the texts, she finds that she has to copy it for every entry of the table, which means hundreds times of repetition. To control the overall style, Yue needs to give the controlling commands between the beginning of table and the beginning of tabular.

a	a	a	a	a	a	a	a	a	a	a	a	a	a
a	a	a	a	a	a	a	a	a	a	a	a	a	a

```
\begin{table}
\small
\begin{tabular}{|*{14}{c|}}
\hline
a&a&a&a&a&a&a&a&a&a&a&a&a&a\\
\hline
a&a&a&a&a&a&a&a&a&a&a&a&a&a\\
\hline
\end{tabular}
\end{table}
```

6.3 Placement of Floats

Yue used to use Microsoft Word, which places floats wherever the user wants to place it at. Everything had been fine since she had turned to LaTeXfor some time, but now Yue has a problem. A figure "disappeared" from the output. After checking her code and the output again and again, she accidentally finds that the figure appears in the next page. This really confuses her. Due to the internal algorithm of TeX, it is technically impossible to arrange every float at where the user wants to place them. According to *the LaTeX Companion*,

> "Floats are often problematic in the present version of LaTeX, because the system was developed at a time when documents contained considerably less graphical material than they do today."

Yet LaTeX does give some option to allow the Yue to control the placement of a float to some extend. For a figure or table environment, Yue is able to pass to it an optional argument that specify the desired placement. There are five placement specifiers and they can be combined together in any order.

! Ignores some LaTeX limitation[3] when trying to place the float.

h Tries to place the float exactly at where the the environment is issued. If the attempt fails and no other specifier other that ! is given, the specifier will be changed to t.

t Tries to place the float at the top of the page.

b Tries to place the float at the bottom of the page.

p Tries to place the float at a float page (a page that is generated by LaTeX to place floats)

LaTeX tries to place a float according to the specifiers in the order of the above list from the top to the bottom. Generally all floats of a document can be handled properly. But should a float proves impossible to handle, the author should adjust (probably reduce) its width and height.

6.4 Table of Floats

As mentioned at the beginning, in Yue's material, there are many floats. She wonders if there is a way to provide a quick reference to them.

Like `\tableofcontents`, LaTeX provides the following two commands to print a list of all figures and a list of all tables used in a document, respectively.

`\listoffigures and \listoftables`

The name of a float that appears on the list is defined by the caption of the float. If the captions appears to be too long, Yue can pass to caption an optional argument that will instead be shown on the list. Also, don't forget to compile the file at least twice for the lists to show properly.

[3] LaTeX has some limitations when it tries to place floats. For example, if the height of a float is larger than a degree of page height, then it cannot be placed at the bottom of a page.

6.5 A Suggestion About Images

Yue is suggested to use vector graph for images, as vector graph is lossless when the image is scaled along with the output file.

There are several packages that enables drawing images directly in LaTeX, yet they all require great efforts. It is suggested to use modern tools to generate appropriate images (e.g. Mathematica is able to export the math plots drawn.).

7 Tutorial 4: The Story of ZiYou and Abigail

ZiYou and Abigail are the team leaders of the material about Calculus for the final exam. As team leaders, they have to deal with more problems than their colleagues. In this section, we will know about how ZiYou and Abigail manage to solve these problems and how their affection of each other grows.

7.1 Managing Notes In LaTeX

In a review to the work of one of the team members, ZiYou finds several places that may not be clear enough for the readers. He decides to add some description to these unclear texts. These descriptions should not defer the reading of the main text, so ZiYou adjudicates on making them *notes*. Two general ways for adding notes in LaTeX are using *footnotes* and using *marginpars*.

A footnote in LaTeX provides an annotation for a piece of text in the footer of the current page, and generates a number of the note which will appear as the superscript of the text being annotated. To use footnotes, ZiYou uses the command `\footnote`.

This is something unclear[a]. And some other texts are here.

[a] This means that ...

```
This is something unclear\footnote{
This means that ...}. And some other
 texts are here.
```

Different from ZiYou, Abigail prefers to use marginpars for annotation. A marginpar appears in the margin of the current page, but does not possess a number like a footnote does.

This is something unclear. And some other texts are here.

That is, we have to ...

```
This is something unclear\
marginpar{That is, we have to
...}. And some other texts are
here.
```

A marginpar appears in the margin, and is at the same height as the text where the marginpar is given. When Abigail sees that ZiYou uses footnotes rather than marginpars, she asks him to change them because she thinks that marginpars are better. Certainly ZiYou doesn't agree with her, but he confers with what she claims, that the noting styles should agree with each other in a document.

To give a resolution about what noting style is to be used, ZiYou suggests that they play Tic Tac Toe, and Abigail thinks this is a good idea. After a few minutes, Abigail narrowly wins the game. ZiYou jokes that maybe she should let him win the next time, whereupon Abigail smilingly replies, "That remains to be seen". Nevertheless, she has a dim feeling that ZiYou deliberately lets her be the winner, but can't prove it from ZiYou's regretful expression.

7.2 Merging Works Of The Team

ZiYou and Abigail only need to collect the chapter.tex from the team members. They rename the files according to each person in a way that they can easily identify who is responsible for each file. After that, they input each file into the chapter.tex of an empty template. The final output can then be generated from the encapsulation.tex of the template.

Directly copying the contents is not a good option for inputting the files. ZiYou is about to search this on the Internet when Abigail discovers in the encapsulation.tex that the chapter.tex is directed into this file by the command `\input`. The following code shows what is written in encapsulation.tex.

```
\input{chapter.tex}
```

The argument passed to this command is the relative path of the target file. Abigail doesn't know what the term relative path means, so ZiYou, who has certain knowledge in computer science, explains to her that, the relative directory is the path of a file relative to the file in which the path is used. In this example, the file in which the relative directory is used is encapsulation.tex, and as a consequence of the two files being in the same folder, the relative directory of the chapter.tex is simply its name. If ZiYou and Abigail decide to put the files of the team members into a folder named Files for organization, then the directory should contain the folder's name plus a `/` or `\`, depending on the file system, at the beginning.

Not until they have completed the inputting had ZiYou had a glimpse at the search result on the Internet, where he finds another command, `\include`. After seeing this webpage in detail, he then tells Abigail that `\include` is a better choice here, for it somehow improves the compilation speed. Abigail has no clue about what compilation is and isn't interested in such technical stuffs, but she trusts ZiYou. She also kind of likes it when ZiYou, patiently and tenderly, explains what she doesn't understand to her. So she pretends to be curious and asks ZiYou to explain compilation to her.

So the final form of their chapters.tex is like this:

```
\include{Files/The first file}

\include{Files/The second file}

\include{Files/The third file}
...
```

Note that the file extension (.tex) is not allowed to be used in `\include`, while it can be used in `\input`. Also, they have to make sure that the team members have not taken advantage of `\include`, as it cannot be used in a file that is included by another. Fortunately, they can ascertain it since none of them knows about the command.

7.3 Background, Headers, and Footers

ZiYou and Abigail notice that the template for materials automatically adds the background, and the header and footer for each page. The encapsulation.tex loads the package background for background, and the package fancyhdr for headers and footers.

The headers and footers are set in the encapsulation.tex by the following code: (A line begins with a % is *commented*, so it will have no effect on the output .pdf file.)

```
% Define the header and footer for pages.

% Place the number of the current page.
\fancyhead[LEH,ROH]{\bfseries\thepage}

% Beautify the display of chapter and section marks.
\renewcommand{\chaptermark}[1]{%
\markboth{#1}{}}
\renewcommand{\sectionmark}[1]{%
\markright{\thesection\ #1}}

\fancyhead[LOH]{\bfseries\rightmark}
\fancyhead[REH]{\bfseries\leftmark}

% Add copyright in the footer
\fancyfoot[COF,CEF]{\bfseries\copyright{} The XJTLU Math Club
— All rights reserved}
```

The header is controlled by the command `\fancyhead` and the footer is controlled by the command `\fancyfoot`. By inspecting the optional arguments, ZiYou makes a guess that L and R represent left and right, E and O represent even and odd (page number), and H and F represent header and footer, respectively. A look into the documentation of fancyhdr confirms this. He asks Abigail if she likes the page style. Abigail thinks that the author has a good taste, so they decide not to change this.

The background is set to the logo of math club. In fact, adding this graph somehow makes the document ugly, and even I didn't understand why this must be added to all materials. The head of the department at that time told me that this is a defense for those who use the materials in a prohibited way.

I really hope that this environment can improve to a state that even the materials are distributed by the most free licenses, there will be no one to steal our intelligent property.

7.4 Index And Bibliography

ZiYou and Abigail would like to listen to the readers' opinions about the previous materials so that they can refine the coming one according to them. A few number of the readers pointed out that it took them a lot of efforts to find

specific terms in the materials and they would appreciate it if a list of important terms is added.

Abigail recalls that once when she tried to find something in a calculus textbook's appendix, she flipped the pages too much and turned to a section called Index, where terms are listed according to their pages. So ZiYou makes a search on the Internet and found that Indexing in LaTeX can be easily done by a few commands.

First, for any important terms that they want to list in the Index page, they mark it with the command `\index`. To print the Index page, the command `\printindex` needs to be called, and before the document environment the command `\makeindex` should be called. In the encapsulation.tex, simply uncomment the relating lines of code to do that. Finally, for the Index page to be printed, they have to, first, run LaTeX once on encapsulation.tex, then, run MakeIndex once on the file, and finally, run LaTeX twice on the file. The following example show the result of using Index.

Index

limit, vi, 3
derivative, 3-5

```
% At page vi
\index{limit}
% At page 3
\index{limit}
\index{derivative}
% At page 4
\index{derivative}
% At page 5
\index{derivative}
```

ZiYou makes definite integral and indefinite integral two separate index entries, while Abigail argues that they should be under the same term integral. To use subterms, the following syntax should be applied.

Index

integral, 5
    definite integral, 11
    indefinite integral, 7

```
% At page 5
\index{integral}
% At page 7
\index{integral!definite integral}
% At page 11
\index{integral!indefinite integral}
```

Abigail remembers that for the sake of academic integrity, they should add reference for each work of other people. BibTeX is a good tool handling references (bibliographies). To use this tool, they have to prepare a BibTeX database. This is a file with the extension .bib, in which entries are contained. Filling in the entries is a tedious work, but fortunately most academic websites provides the facility to allow an user to directly download a .bib file for the source he wants to use. The following code shows a typical database entry:

```
@article{may1979alpha,
        title="Alpha-particle-induced soft errors in dynamic
        memories",
```

```
        author="T.C. {May} and M.H. {Woods}",
        journal="IEEE Transactions on Electron Devices",
...
}
```

ZiYou and Abigail need not to worry about the details in the entry. The only thing they need to remember is the label of the entry, the one immediately after the `{`, because it is to be used in the `\cite` command to produce a reference to that source. Each source that is referenced in the document appears in the Bibliography page, which is controlled by the two following commands:

```
\bibliography{file-list}
\bibliographystyle{style}
```

, where file-list is a list of database files, and style is the bibliography style according to which the bibliography is to be printed. https://www.overleaf.com/learn/latex/Bibtex_bibliography_styles shows all predefined BibTeX styles.

7.5 Twosided printing

Now ZiYou and Abigail have finished combining the separate documents and are planning a break after the work, but there is something more waiting for them.

By default, when the documentclass is book, LaTeX uses twosided printing. At first ZiYou and Abigail didn't notice this (they didn't know) until Abigail saw that the pages of the output are not aligned. That is, at one page the content sticks out to the left and at the next page the content sticks out to the right. Abigail doesn't want to trouble ZiYou again, so she makes a search herself and finds that this is what is called twoside, which is used particularly for books.

Abigail tries to comprehend this by opening a book and inspecting its layout. She notices that a portion of the inner part[4] of the pages are stuck together to keep them form a book. She guesses that twoside leaves extra spaces for each page at the inner part. The result, however, contradicts with her instinct. On twoside mode, LaTeX shrinks the inner part of each page. This is because LaTeX wants to give more space for the margins that reside on the outer parts.

ZiYou learns this from Abigail so they start another review for it. They soon find a problem. For table of contents and some other pages like preface, the template uses roman numbering. For the main text, the page numbering is changed to arabic. The layout of a page, however, is not decided by if it will appear on the left or right. Rather, it is entirely decided by the number of the page. If, say, the roman number ends at iii, then when the arabic number starts at 1, the corresponding page will appear on the left, which is a disaster. To solve this problem, ZiYou finds the command `\cleardoublepage` that is designed for

[4]When one opens a book, the first page appearing on the right is numbered 1, and all odd pages appears on the right side have odd numbers as a consequence.

twoside mode. It ensures that the content after the command will appear at a page on the right by (possibly) adding a new page. The new page would be empty, of course. But Abigail thinks that a reader may misinterpret this as a sign of a printing failure. To explicitly identify this behavior, in xjtlumath (in precise, the subpackage xjtlumaterial loaded by the template), the command is renewed to add the sentence "This page is intentionally left blank" at each empty page this command adds.

7.6 An End Of Their Story

The very story of ZiYou and Abigail about their material writing comes to an end, yet as said in one old saying, "An end is also a beginning," their other stories just begin. Abigail admires ZiYou's broad knowledge in computer science and enjoys it when ZiYou teaches her about it. ZiYou also is inspired by Abigail's energy, particularly in the working. He feels lucky to find such a girl as interesting and beautiful as Abigail, whose humor has made ZiYou laughing several times.

So the two ordered seats in a romantic restaurant to celebrate their collaboration, while I, sitting alone in my dormitory, work hard to complete this documentation. Nevertheless, I hope you, the members of the math club in the future, can find not only knowledge and experience, but also love as ZiYou and Abigail do, except not in an imaginary story.

Part III
Templates

This part describes all templates given. They are inside the folder `Templates`.

8 For Material Use

In this section all templates are made for writing materials. They are inside the folder `For Materials`.

8.1 Book in English

The folder `Book_en-us` gives the template for writing a material in English that is to be published as a book. Long materials should be prepared in the form of this template. It loads all xjtlumath packages so all functionalities provided by this package are available.

At the beginning of the environment document, page numbering is changed to roman, page style is set to plain and the table of contents is given. You may add a title page before this. Also, other prefaces like acknowledge and dedication should be included here.

The there begins the main text, where page numbering is arabic and the style is fancy, which is defined by several previous fancyhdr commands.

At the end of the document environment, you may uncomment some commands to use index and bibliography (One command is required at the beginning for index).

8.2 Book in Chinese

The folder `Book_zh-cn` gives the template for writing a material in Chinese that is to be published as a book. It is the same as the previous one except that the documentclass is ctexbook provided by package ctex for Chinese styles.

8.3 Article in English

The folder `Article_en-us` gives the template for writing a material in English that is to be published as an article. Materials of moderate size should be prepared in the form of this template. It loads all xjtlumath packages so all functionalities provided by this package are available.

It is similar to the template for English books, except that some options for twoside are adjusted to fit oneside.

8.4 Article in Chinese

The folder `Article_zh-cn` gives the template for writing a material in Chinese that is to be published as an article. It is the same as the previous one except that the documentclass is ctexart provided by package ctex for Chinese styles.

9 For General Use

In this section all templates are made for general use. They are inside the folder `General Use`.

Currently they are the same as the templates for materials, except that they don't load the package xjtlumaterial.

Part IV
Internal Documentation

This part is the internal documentation for xjtlumath. It is automatically generated by the tool doc. This part is for the maintenance of the package and is not recommended to be read by the general users of the package unless they want to know the implementation details about the package.

10 Package xjtlubase

This packages is the base for some components of xjtlumath. <*base>

```
\ProvidesPackage{xjtlubase}[2021 by Guanyuming He]
\NeedsTeXFormat{LaTeX2e}

\RequirePackage{ifthen}
```

`englishorchinese` This boolean is used for determine if the document is writing in English or in Chinese. True for English, false for Chinese. The default value is true.

```
\newboolean{englishorchinese}
\setboolean{englishorchinese}{true}
```

</base>

11 Package xjtlumaththm

This package defines the thm environments. <*thm>

```
\ProvidesPackage{xjtlumaththm}[2021 by Guanyuming He]
\NeedsTeXFormat{LaTeX2e}

\RequirePackage{xjtlubase}
\RequirePackage{amsthm}
\RequirePackage[framemethod=TikZ]{mdframed}

\mdfsetup{nobreak=false}
```

These counters are used for the thm environments.

```
\newcounter{thmcnt}[section]
\newcounter{deficnt}[section]
\newcounter{lemmacnt}[section]
\newcounter{propcnt}[section]
\newcounter{corocnt}[section]
\newcounter{axiomcnt}[section]
\newcounter{examcnt}[section]
```

`\newmdthmenv` This environment is used to create thm environments using package mdframed.

```
\newcommand{\newmdthmenv}[3]{%
% #1 caption
\newenvironment{#1}[1][]{%
\stepcounter{#2}%
\ifstrempty{#1}%
{%
\mdfsetup{%
frametitle={%
\tikz[baseline=(current bounding box.east),outer sep=0pt]%
\node[anchor=east,rectangle,fill=blue!20]
{\strut #3~\thesection.\arabic{#2}};}
}%
}%
{
\mdfsetup{%
frametitle={%
\tikz[baseline=(current bounding box.east),outer sep=0pt]%
\node[anchor=east,rectangle,fill=blue!20]
{\strut #3~\thesection.\arabic{#2}:~##1};}
}
}
\mdfsetup{innertopmargin=0,linecolor=blue!20,linewidth=2pt,topline=true,frametitleaboveskip=-1em}
\begin{mdframed}[]\relax%
}%
{%
\end{mdframed}
}%
}
```

Definition of the thm environments

```
\newmdthmenv{theorem}{thmcnt}{Theorem}
\newmdthmenv{proposition}{procnt}{Proposition}
\newmdthmenv{corollary}{corocnt}{Corollary}
\newmdthmenv{lemma}{lemmacnt}{Lemma}
\newmdthmenv{definition}{deficnt}{Definition}
\newmdthmenv{axiom}{axiomcnt}{Axiom}
\newmdthmenv{example}{examcnt}{Example}
```

</thm>

12 Package xjtlumathstyle

This package defines new math styles and refines some existing ones. <*style>

```
\ProvidesPackage{xjtlumathstyle}[2021 by Guanyuming He]
\NeedsTeXFormat{LaTeX2e}

\RequirePackage{xjtlubase}
\RequirePackage{amsmath}
\RequirePackage{amssymb}
```

Improved 'd' in integrals

```
\newcommand{\dd}{\ensuremath{\,\mathrm{d}}}
\newcommand{\dx}{\ensuremath{\dd x}}
```

New name for nabla in gradients

```
\newcommand{\grad}{\ensuremath{\nabla}}
```

Simplify writing FRactional DerivaTives (1 function 2 variable)

```
\newcommand{\frdt}[2][f]{\ensuremath{\frac{\mathrm{d}#1}{\mathrm{d}#2}}}
\newcommand{\frpdt}[2][f]{\ensuremath{\frac{\grad #1}{\grad #2}}}
```

Infinite series (1: sequence 2: subscript 3: starting count)

```
\newcommand{\infseries}[3][a]{\ensuremath{\sum_{#2=#3}^{\infty}{#1_{#2}}}}
```

Multiple integrals

```
\newcommand{\dxdy}{\ensuremath{\dx \dd y}}
\newcommand{\dxdydz}{\ensuremath{\dx \dd y \dd z}}
```

Polar coordinates

```
\newcommand{\drdt}{\ensuremath{\dd r \dd \theta}}
```

Cylindrical

```
\newcommand{\dzdrdt}{\ensuremath{\dd z \dd r \dd \theta}}
```

Spherical

```
\newcommand{\drdtdp}{\ensuremath{\dd \rho \dd \theta \dd \phi}}
```

Linear algebra part
Bold font for vectors

```
\renewcommand{\vec}[1]{\ensuremath{\mathbf{#1}}}
```

operators

```
\DeclareMathOperator{\Nul}{Nul}
\DeclareMathOperator{\Span}{Span}
```

Miscellaneous

```
\newcommand{\setr}{\ensuremath{\mathbb{R}}}
\newcommand{\setq}{\ensuremath{\mathbb{Q}}}
\newcommand{\setz}{\ensuremath{\mathbb{Z}}}
\newcommand{\setn}{\ensuremath{\mathbb{N}}}
\newcommand{\setnp}{\ensuremath{\mathbb{N}^+}}
```

</style>

13 Package xjtlumaterial

This package defines some styles and also refines some commands for material writings. <*material>

```
\ProvidesPackage{xjtlumaterial}[2021 by Guanyuming He]
\NeedsTeXFormat{LaTeX2e}
```

`\cleardoublepage` Renew the command to add "This page is intentionally left blank" for any empty pages added.

```
\renewcommand{\cleardoublepage}{\clearpage%
\if@twoside%
\ifodd\c@page\else%
    \vspace*{5cm}
    \begin{center}
        This page is intentionally left blank.
    \end{center}
    \thispagestyle{empty}
    \newpage
     \if@twocolumn%
     \hbox{}\newpage%
     \fi%
    \fi%
\fi}
```

</material>

14 Package mydoc

This package is only used for writing the documentation.

```
\ProvidesPackage{mydoc}

\RequirePackage{calc}
```

Lengths used for presenting examples

```
\newlength{\examtop}
\newlength{\exambot}
\newlength{\exammid}

\setlength{\examtop}{.5em}
\setlength{\exambot}{.6em}
\setlength{\exammid}{5pt}
```

Examples may be allowed to stick into margins, so we define two length here to represent textwidth and the length of text plus margin. Their values are defined later, because we cannot decide the page layout in the package file.

```
\newlength{\textandmarginlen}
\newlength{\textonlylen}
```

Boxes that stick into the margin raise "overfull hbox" warnings. To suppress these, set the length hfuzz to a bigger value. Note that in XeLaTeX the warnings may still be shown.

```
\newlength{\originalhfuzz}
\setlength{\originalhfuzz}{\hfuzz}
\newcommand{\enlargehfuzz}{\setlength{\hfuzz}{\maxdimen}}
\newcommand{\restorehfuzz}{\setlength{\hfuzz}{\originalhfuzz}}
```

used to save verbatim like contents inside a box

```
\newlength{\safeverblen} \newsavebox{\safeverbbox}
```

`safeverb` 1: width

```
\newenvironment{safeverb}[1]{%
\setlength{\safeverblen}{#1}%
\begin{lrbox}{\safeverbbox}%
\begin{minipage}[c]{\safeverblen}%
}%
{%
\end{minipage}%
\end{lrbox}%
\usebox{\safeverbbox}%
}
```

`Internalminiexam` verbatim like contents cannot be used inside a place where command/environment parameters are being parsed, so we must put them inside a environment. 1: left width 2: full width (right width = full − left − mid sep) 3: left content. Right content is included inside this env.

```
\newenvironment{Internalminiexam}[3]%
```

```
{%
\vspace{\examtop}%
\par\noindent% no par indent
%
\begin{minipage}[c]{#1}%
\sffamily%
#3%
\end{minipage}%
%
\hspace{\exammid}% mid sep
%
\begin{safeverb}{#2-#1-\exammid}%
}%
{%
\end{safeverb}%
\vspace{\exambot}%
}
```

`Internalparexam` 1: left width 2: full width (right width = full − left − mid sep) 3: left content. Right content is included inside this env.

```
\newenvironment{Internalparexam}[3]%
{%
\vspace{\examtop}%
\par\noindent% no par indent
%
\parbox[c]{#1}{\sffamily #3}%
%
\hspace{\exammid}% mid sep
%
\begin{safeverb}{#2-#1-\exammid}%
}%
{%
\end{safeverb}%
\vspace{\exambot}%
}
```

1: left width 2: left content

```
\newenvironment{miniexammar}[2]
{\begin{Internalminiexam}{#1}{\textandmarginlen}{#2}%
\enlargehfuzz}%
{\end{Internalminiexam}\restorehfuzz}
\newenvironment{miniexamtext}[2]
{\begin{Internalminiexam}{#1}{\textonlylen}{#2}}%
{\end{Internalminiexam}}

\newenvironment{parexammar}[2]
{\begin{Internalparexam}{#1}{\textandmarginlen}{#2}%
\enlargehfuzz}%
{\end{Internalparexam}\restorehfuzz}
```

```
% 1: left width 2: left content
\newenvironment{parexamtext}[2]
{\begin{Internalparexam}{#1}{\textonlylen}{#2}}%
{\end{Internalparexam}}
```

Fake commands becuase some commands cannot or should not be used in the examples

```
\newcommand{\faketoc}{%
{\LARGE \bfseries Contents}%
\par \noindent
\vspace{.6cm}%
}
```

1: number 2: content 3: page

```
\newcommand{\fakecontentsline}[3]{%
\hspace{1.5em}#1\hspace{2em}#2\dotfill#3%
}
```

1 number 2 indent 3 content 4 before skip 5 end skip

```
\newcommand{\fakesectioning}[5]
{%
\vspace{#4}
\par\noindent%
\hspace{#2}{\bfseries\Large #1}\hspace{1.5em}%
{\bfseries\Large #3}\hfill%
\vspace{#5}%
\par\noindent
}
```

```
% with default value 2 number 3 content
\newcommand{\fakesectioningdef}[2]{\fakesectioning{#1}{0pt}{#2}{10pt}{15pt}}
```

Show lengths in LaTeX

```
\newcommand{\showwidth}[1]{\rule{.3pt}{.8em}\rule{#1}{.3pt}\rule{.3pt}{.8em}}
```

Calculate lengths at the beginning of the doc

```
\AtBeginDocument{%
\setlength{\textonlylen}{\textwidth}%
\setlength{\textandmarginlen}{\textwidth+\marginparsep+\marginparwidth}
}
```