

Documentation For Package xjtlumath

Guanyuming He

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Part I

General Information

1 What is this package?

This \LaTeX package was originally intended to be used for 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 15th 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.

Part II

Tutorials

3 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.

3.1 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 \TeX studio 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)

3.2 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.

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.

```
\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.
```

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

1	Key points in calculus	1
---	-------------------------------------	---

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

\LaTeX generates the table of contents for all sectioning commands¹. For this reason, Ashley has to run \LaTeX twice on `encapsulation.tex` for a correct table of contents.

¹whose 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	<code>\chapter[A Short Name]{A very very long Caption}</code>
---	---------------------------	---	---

3.3 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 implicitly 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

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

Table 1: Standard font-changing commands and declarations

contacting with the package author, he learns that this topic is not covered because the materials are printed in black and white, so it would be nearly useless to change colors.

3.4 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: $\$ \dots \$$, while formulae of the latter type are enclosed in a pair of double dollar sign: $\$ \$ \dots \$ \$$. These delimiters are the original \TeX ones. \LaTeX provides additionally two pairs of delimiters for inline and displayed math, respectively: $\backslash (\dots \backslash)$ and $\backslash [\dots \backslash]$. In fact, the \TeX shorthand $\$ \$ \dots \$ \$$ 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

$$\frac{df}{dx}$$

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

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 $\frac{dg}{dx}$. 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

$$\int_a^b f(x) \, dx = F(b) - F(a) \quad (1)$$

```

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.

$$\begin{array}{lll} \int f(t) \, dt, & \iint f(x, y) \, dx \, dy, & \iiint f(x, y, z) \, dx \, dy \, dz \\ \iint f \, dr \, d\theta, & \iiint f \, dz \, dr \, d\theta, & \iiint f \, d\rho \, d\theta \, d\phi \end{array}$$

```

\[\intint f(t) \, \mathrm{d}t, \quad \int\!\!\!\int f(x,y) \, \mathrm{d}x \mathrm{d}y, \quad \int\!\!\!\int\!\!\!\int f(x,y,z) \, \mathrm{d}x \mathrm{d}y \mathrm{d}z\]
\[\int\!\!\!\int f \, \mathrm{d}r \mathrm{d}t, \quad \int\!\!\!\int\!\!\!\int f \, \mathrm{d}z \mathrm{d}r \mathrm{d}t, \quad \int\!\!\!\int\!\!\!\int f \, \mathrm{d}r \mathrm{d}t \mathrm{d}p\]
\]
```

However, Ashley knows nothing about cross-referencing in L^AT_EX as well as the equation environment. Let's explain them to Ashley. In L^AT_EX, 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 counter².

The equation environment gives a numbered counter, 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.

3.5 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 `\LaTeX` seems 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.

3.6 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

²and 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)
$\backslash,$	$\frac{3}{18}$ quad (\mathbb{I})
$\backslash:$	$\frac{4}{18}$ quad (\mathbb{I})
$\backslash;$	$\frac{5}{18}$ quad (\mathbb{I})
\backslash (\backslash followed by a space)	a space
$\backslash\text{quad}$	Width of 'M' in current font (\mathbb{I})
$\backslash\text{quad}$	2 quad ($\mathbb{I}\mathbb{I}$)

Table 2: Spacing in Math Mode

like this:

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 3.1: 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  $\sum_{n=0}^{\infty} a_n$  is said to be
absolutely convergent iff
\[
\sum_{n=0}^{\infty} |a_n|
\]
converges
\end{definition}
```

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

I didn't replace the environment for the original proof environment, as proofs are often much longer than these.

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

4 Tutorial 2: Delilah and Linear Algebra

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`.

4.1 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:

$$\cos z = 1 - \frac{z^2}{2!} + \frac{z^4}{4!} - \frac{z^6}{6!} + \dots$$

$$= \sum_{n=0}^{\infty} \frac{(-1)^n z^{2n}}{(2n!)}$$

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

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.

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

```
\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:

$$\begin{aligned} x + y &= 1 \\ x - y &= 2 \end{aligned} \quad \begin{matrix} (3) \\ (4) \end{matrix}$$

```
\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.

$$\begin{aligned} x + y &= 1 \\ z &= 10 \\ x - y &= 2 \end{aligned} \quad \begin{matrix} (5) \\ \\ (6) \end{matrix}$$

```
\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 them. Delilah finds it impossible to put the bracket again before a *align* or *gather*, because they don't need to but surrounded by mathematical environments. Also, their width are fixed to be the width of texts, while their “ed” versions can be of any width.

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

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

```
\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.

$$\begin{aligned}x + y &= 1 & a + b &= 3 \\x - y &= 2 & a - b &= 4\end{aligned}$$

```
\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.

4.2 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 $| | \quad | |$, 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 $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ 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.

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

```
\[
\begin{bmatrix}
1&\dfrac{1}{2}&\dfrac{1}{3}\\
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}
```

4.3 Texts and Operator Names

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

Definition 4.1: Null Space

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

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

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

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

\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	\liminf	\liminf	\limsup	\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.