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- 04 Math

LaTeX math and equations

方程 矩阵 分数

Learn to typeset and align equations, matrices and fractions in LaTeX. Overview of basic math features, with live-rendering and sandbox in your browser.

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1. Inline math
2. Equations
3. Fractions
4. Matrices
5. Scaling of Parentheses, Brackets etc.

在LaTeX中，有两种方式排版数学公式，一种是在环境变量equation中直接使用；另一种是将 dollar 符号直接包裹起来

There are two major modes of typesetting math in LaTeX one is embedding the math directly into your text by *encapsulating* your formula in *dollar signs* and the other is using a predefined *math environment*. You can follow along and try the code in the sandbox below. I also prepared a quick reference of math symbols (</symbols/math-symbols/>).

Using inline math - embed formulas in your text

所谓的内联的math公式，就是直接在你的text中嵌入进入

To make use of the inline math feature, simply write your text and if you need to typeset a single math symbol or formula, surround it with dollar signs:

```
...
This formula  $f(x) = x^2$  is an example.
...
```

Output equation: This formula $f(x) = x^2$ is an example.

The equation and align environment

这个地方有笔误 少个空格

The most useful *math environments* are the *equation environment* for typesetting single equations and the *align environment* for multiple equations and automatic alignment:

对于单个等式，一般使用环境变量 equation；
对于 多个等式，一般使用环境变量 align，并且可以实现在行内自动对齐

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```
\documentclass{article}
```

```
\usepackage{amsmath}
```

使用包

```
\begin{document}
```

```
\begin{equation*}
```

$$1 + 2 = 3$$

```
\end{equation*}
```

```
\begin{equation*}
```

$$1 = 3 - 2$$

```
\end{equation*}
```

```
\begin{align*}
```

$$1 + 2 \quad \&= \quad 3 \\$$

$$1 \quad \&= \quad 3 - 2$$

```
\end{align*}
```

```
\end{document}
```

Output Equation:

$$1 + 2 = 3$$

$$1 = 3 - 2$$

Output Align:

$$1 + 2 = 3$$

$$1 = 3 - 2$$

& 是为了对等式进行对齐

The *align* environment will align the equations at the *ampersand* &. Single equations have to be *seperated* by a *linebreak* `\\`. There is no alignment when using the simple *equation* environment. Furthermore it is not even possible to enter two equations in that environment, it will result in a *compilation error*. The asterisk (e.g. *equation**) only indicates, that I don't want the equations to be numbered.

加 * 表示不想对等号进行编号

Fractions and more

LaTeX is capable of displaying any mathematical notation. It's possible to typeset integrals, fractions and more. Every command has a specific syntax to use. I will demonstrate some of the most common LaTeX math features:

```
\documentclass{article}
```

```
\usepackage{amsmath}
```

```
\begin{document}
```

```
\begin{align*}
```

$$f(x) \quad \&= \quad x^2 \\$$

$$g(x) \quad \&= \quad \frac{1}{x} \\$$

$$F(x) \quad \&= \quad \int_a^b \frac{1}{x^3} dx$$

```
\end{align*}
```

```
\end{document}
```

平方
分数
积分

Output:

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

$$g(x) = \frac{1}{x}$$

$$F(x) = \int_b^a \frac{1}{3} x^3$$

It is also possible to combine various commands to create more sophisticated expressions such as:

`\frac{1}{\sqrt{x}}`

Output: $\frac{1}{\sqrt{x}}$

The more complex the expression, the more error prone this is, it's important to take care of opening and closing the braces `}`. It can take a long time to debug such errors. The *Lyx* program offers a great formula editor, which can ease this work a bit. Personally, I write all code by hand though, since it's faster than messing around with the formula editor.

Matrices

Furthermore it's possible to display matrices in LaTeX. There is a special matrix environment for this purpose, please keep in mind that the matrices only work within math environments as described above:

```
\begin{matrix}
1 & 0 \\
0 & 1
\end{matrix}
```

Output: $\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}$

Brackets in math mode - Scaling

To surround the matrix by brackets, it's necessary to use special statements, because the plain `[]` symbols do not scale as the matrix grows. The following code will result in wrong brackets:

```
[
\begin{matrix}
1 & 0 \\
0 & 1
\end{matrix}
]
```

不能通过输入 `[]` 来给矩阵加上括号，因为 `[]` 不会随着矩阵的增大而增大

Output: $\left[\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix} \right]$

To scale them up, we must use the following code:

```
\left[
\begin{matrix}
1 & 0 \\
0 & 1
\end{matrix}
\right]
```

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Output: $\left[\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix} \right]$

This does also work for parentheses and braces and is not limited to matrices. It can be used to scale for fractions and other expressions as well:

`\left(\frac{1}{\sqrt{x}}\right)`

这种使用方法不仅仅局限于矩阵

Output: $\left(\frac{1}{\sqrt{x}}\right)$

Summary

- LaTeX is a *powerful* tool to typeset math
- *Embed formulas in your text by surrounding them with dollar signs \$*
- *The equation environment* is used to typeset *one* formula
- *The align environment* will align formulas at the *ampersand & symbol*
- Single formulas *must* be separated with *two backslashes *
- Use the *matrix environment* to typeset matrices
- Scale parentheses with `\left(\right)` automatically
- All mathematical expressions have a unique command with unique syntax
- Notable examples are:
 - `\int^a_b` for integral symbol
 - `\frac{u}{v}` for fractions
 - `\sqrt{x}` for square roots
- Characters for the *greek alphabet* and other *mathematical symbols* such as `\lambda`

Next Lesson: Lesson 5 (/tutorials/figures/)

Sandbox

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