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## LaTeX math and equations



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



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



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



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```
\documentclass{article}
 \usepackage{amsmath}
 \begin{document}
 \begin{equation*}
   1 + 2 = 3
 \end{equation*}
 \begin{equation*}
   1 = 3 - 2
 \end{equation*}
 \begin{align*}
                           、应该是换行 , 但是 为什么会
&= 这个符号 是要在 & 这个地
*行対其
   1 + 2 &= 3\\
   1 &= 3 - 2
 \end{align*}
 \end{document}
Output Equation:
1 + 2 = 3
1 = 3 - 2
Output Align:
1 + 2 = 3
                           是为了对等式进行对齐
     1 = 3 - 2
```

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.

#### 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) &= x^2\\
    g(x) &= \frac{1}{x}\\
    F(x) &= \int^a_b \frac{1}{3}x^3
\end{align*}

\end{document}
```

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Output: 
$$f(x)=x^2$$
  $g(x)=rac{1}{x}$   $F(x)=\int_{b}^{a}rac{1}{3}x^3$ 

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**

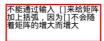
Furthermore it's possible to display matrices in LaTeX. There is a special matrix environment for this purpose, please keep in mind that the matrices only work within math environments as described above:

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

Output: 
    \begin{bmatrix}
      1 & 0 \\
0 & 1
\end{bmatrix}
```

## 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:



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

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

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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)

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 seperated 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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