Algebra HSLU Kevin Häusler

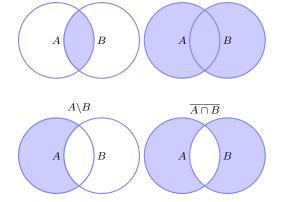## Zahlen

*	Bedeutung	Beispiel
$\mathbb{N}$	Natürliche Zahlen = ganze Positive	{1;2;3;}
$\mathbb{N}_0$	Natürliche Zahlen mit 0	{0;1;2;}
$\mathbb{Z}$	Ganze Zahlen = N + ganze Negative	{-1;0;1;}
$\mathbb{Q}$	Rationale Zahlen = Bruchzahlen	$\frac{3}{7}\ \frac{5}{9}\ \frac{2}{3}$
	Irrationale Zahlen = Nachkommastellen	0.3281
$\mathbb{R}$	Reele Zahlen = Q + Irrationale Zahlen	Alle

Mengen Operationen

*	Bedeutung
$\varnothing$ oder {}	Leere Menge, enthält keine Elemente
$x \in A$	Beschreibt Element x ist in Menge A
$x \notin A$	Beschreibt Element x ist nicht in Menge A
$A \subset B$	A ist eine Teilmenge von B
$A \cap B$	Schnittmenge von A und B
$A \cup B$	Vereinigungsgsmenge von A und B
$A \backslash B$	Differenzbildung, Menge von A ohne B

$A \cap B$ $A \cup B$

$A\backslash B$ $\overline{A \cap B}$

Aussagenlogik

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What is LaTeX?

LaTeX(usually pronounced "LAY teck," sometimes "LAH teck," and never "LAY tex") is a mathematics typesetting program that is the standard for most professional mathematics writing. It is based on the typesetting program TeX created by Donald Knuth of Stanford University (his first version appeared in 1978). Leslie Lamport was responsible for creating LaTeX a more user friendly version of TeX. A team of LaTeX programmers created the current version, LaTeX 2ε.

Math vs. text vs. functions

In properly typeset mathematics variables appear in italics (e.g., $f(x) = x^2 + 2x - 3$). The exception to this rule is predefined functions (e.g., $\sin(x)$). Thus it is important to **always** treat text, variables, and functions correctly. See the difference between x and x, -1 and -1, and $sin(x)$ and $\sin(x)$.

$$\alpha Z \frac{1}{2}$$

There are two ways to present a mathematical expression— *inline* or as an *equation*.

Inline mathematical expressions

Inline expressions occur in the middle of a sentence. To produce an inline expression, place the math expression between dollar signs (`$`). For example, typing `$90^{\circ}$ is the same as $\frac{\pi}{2}$ radians` yields $90°$ is the same as $\frac{\pi}{2}$ radians.

Equations

Equations are mathematical expressions that are given their own line and are centered on the page. These are usually used for important equations that deserve to be showcased on their own line or for large equations that cannot fit inline. To produce an inline expression, place the mathematical expression between the symbols `\[` and `\]`. Typing `\[x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\]` yields

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Displaystyle

To get full-sized inline mathematical expressions use `\displaystyle`. Use this sparingly. Typing
`I want this $\displaystyle \sum_{n=1}^{\infty}`
`\frac{1}{n}$, not this $\sum_{n=1}^{\infty}`
`\frac{1}{n}$.` yields

I want this $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n}$, not this $\sum_{n=1}^{\infty} \frac{1}{n}$.

Images

You can put images (pdf, png, jpg, or gif) in your document. They need to be in the same location as your .tex file when you compile the document. Omit `[width=.5in]` if you want the image to be full-sized.

```
\begin{figure}[ht]
\includegraphics[width=.5in]{imagename.jpg}
\caption{The (optional) caption goes here.}
\end{figure}
```

Text decorations

Your text can be *italics* (`\textit{italics}`), **boldface** (`\textbf{boldface}`), or <u>underlined</u> (`\underline{underlined}`).

Your math can contain boldface, $\mathbf{R}$ (`\mathbf{R}`), or blackboard bold, $\mathbb{R}$ (`\mathbb{R}`). You may want to used these to express the sets of real numbers ($\mathbb{R}$ or $\mathbf{R}$), integers ($\mathbb{Z}$ or $\mathbf{Z}$), rational numbers ($\mathbb{Q}$ or $\mathbf{Q}$), and natural numbers ($\mathbb{N}$ or $\mathbf{N}$).

To have text appear in a math expression use `\text`. `(0,1]=\{x\in\mathbb{R}:x>0\text{ and }x\le 1\}` yields $(0,1] = \{x \in \mathbb{R} : x > 0 \text{ and } x \le 1\}$. (Without the `\text` command it treats "and" as three variables: $(0,1] = \{x \in \mathbb{R} : x > 0 and x \le 1\}$.)

Spaces and new lines

LaTeX ignores extra spaces and new lines. For example,

`This     sentence will        look`

```
fine after      it is      compiled.
```

This sentence will look fine after it is compiled.

Leave one full empty line between two paragraphs. Place \\ at the end of a line to create a new line (but not create a new paragraph).

```
This
```

```
compiles
```

```
like\\
```

```
this.
```

This compiles

like
this.

Use `\noindent` to prevent a paragraph from indenting.

Comments

Use % to create a comment. Nothing on the line after the % will be typeset. `$f(x)=\sin(x)$` %this is the sine function yields $f(x) = \sin(x)$

Delimiters

description	command	output
parentheses	`(x)`	(x)
brackets	`[x]`	$[x]$
curly braces	`\{x\}`	$\{x\}$

To make your delimiters large enough to fit the content, use them together with `\right` and `\left`. For example, `\left\{\sin\left(\frac{1}{n}\right)\right\}_{n}^{\infty}` produces
$$\left\{\sin\left(\frac{1}{n}\right)\right\}_{n}^{\infty}.$$

Curly braces are non-printing characters that are used to gather text that has more than one character. Observe the

differences between the four expressions `x^2`, `x^{2}`, `x^2t`, `x^{2t}` when typeset: x^2, x^2, x^2t, x^{2t}.

Lists

You can produce ordered and unordered lists.

description	command	output
unordered list	`\begin{itemize}` `\item` `Thing 1` `\item` `Thing 2` `\end{itemize}`	• Thing 1 • Thing 2
ordered list	`\begin{enumerate}` `\item` `Thing 1` `\item` `Thing 2` `\end{enumerate}`	1. Thing 1 2. Thing 2

Symbols (in *math* mode)

The basics

description	command	output
addition	`+`	$+$
subtraction	`-`	$-$
plus or minus	`\pm`	$\pm$
multiplication (times)	`\times`	$\times$
multiplication (dot)	`\cdot`	$\cdot$
division symbol	`\div`	$\div$
division (slash)	`/`	$/$
circle plus	`\oplus`	$\oplus$
circle times	`\otimes`	$\otimes$
equal	`=`	$=$
not equal	`\ne`	$\ne$
less than	`<`	$<$
greater than	`>`	$>$
less than or equal to	`\le`	$\le$
greater than or equal to	`\ge`	$\ge$
approximately equal to	`\approx`	$\approx$
infinity	`\infty`	∞
dots	`1,2,3,\ldots`	$1, 2, 3, \ldots$
dots	`1+2+3+\cdots`	$1 + 2 + 3 + \cdots$
fraction	`\frac{a}{b}`	$\frac{a}{b}$
square root	`\sqrt{x}`	$\sqrt{x}$
nth root	`\sqrt[n]{x}`	$\sqrt[n]{x}$
exponentiation	`a^b`	a^b
subscript	`a_b`	a_b
absolute value	`|x|`	$|x|$
natural log	`\ln(x)`	$\ln(x)$
logarithms	`\log_{a}b`	$\log_a b$
exponential function	`e^x=\exp(x)`	$e^x = \exp(x)$
degree	`\deg(f)`	$\deg(f)$

Functions

description	command	output
maps to	\to	$\to$
composition	\circ	$\circ$
piecewise	|x|=	
function	\begin{cases}	$|x| = \begin{cases} x & x \geq 0 \\ -x & x < 0 \end{cases}$
	x & x\ge 0\\	
	-x & x<0	
	\end{cases}	

Greek and Hebrew letters

command	output	command	output
\alpha	α	\tau	τ
\beta	β	\theta	θ
\chi	χ	\upsilon	υ
\delta	δ	\xi	ξ
\epsilon	ϵ	\zeta	ζ
\varepsilon	ε	\Delta	Δ
\eta	η	\Gamma	Γ
\gamma	γ	\Lambda	Λ
\iota	ι	\Omega	Ω
\kappa	κ	\Phi	Φ
\lambda	λ	\Pi	Π
\mu	μ	\Psi	Ψ
\nu	ν	\Sigma	Σ
\omega	ω	\Theta	Θ
\phi	ϕ	\Upsilon	Υ
\varphi	φ	\Xi	Ξ
\pi	π	\aleph	$\aleph$
\psi	ψ	\beth	$\beth$
\rho	ρ	\daleth	$\daleth$
\sigma	σ	\gimel	$\gimel$

Set theory

description	command	output
set brackets	\{1,2,3\}	$\{1,2,3\}$
element of	\in	$\in$
not an element of	\not\in	$\notin$
subset of	\subset	$\subset$
subset of	\subseteq	$\subseteq$
not a subset of	\not\subset	$\not\subset$
contains	\supset	$\supset$
contains	\supseteq	$\supseteq$
union	\cup	$\cup$
intersection	\cap	$\cap$
big union	\bigcup_{n=1}^{10}A_n	$\bigcup_{n=1}^{10} A_n$
big intersection	\bigcap_{n=1}^{10}A_n	$\bigcap_{n=1}^{10} A_n$
empty set	\emptyset	$\emptyset$
power set	\mathcal{P}	$\mathcal{P}$
minimum	\min	$\min$
maximum	\max	$\max$
supremum	\sup	$\sup$
infimum	\inf	$\inf$
limit superior	\limsup	$\limsup$
limit inferior	\liminf	$\liminf$
closure	\overline{A}	$\overline{A}$

Calculus

description	command	output
derivative	\frac{df}{dx}	$\frac{df}{dx}$
derivative	\f'	f'
partial derivative	\frac{\partial f}{\partial x}	$\frac{\partial f}{\partial x}$
integral	\int	$\int$
double integral	\iint	$\iint$
triple integral	\iiint	$\iiint$
limits	\lim_{x\to \infty}	$\lim_{x\to \infty}$
summation	\sum_{n=1}^{\infty}a_n	$\sum_{n=1}^{\infty} a_n$
product	\prod_{n=1}^{\infty}a_n	$\prod_{n=1}^{\infty} a_n$

Logic

description	command	output
not	\sim	$\sim$
and	\land	$\wedge$
or	\lor	$\vee$
if...then	\to	$\to$
if and only if	\leftrightarrow	$\leftrightarrow$
logical equivalence	\equiv	$\equiv$
therefore	\therefore	$\therefore$
there exists	\exists	$\exists$
for all	\forall	$\forall$
implies	\Rightarrow	$\Rightarrow$
equivalent	\Leftrightarrow	$\Leftrightarrow$

Linear algebra

description	command	output
vector	\vec{v}	$\vec{v}$
vector	\mathbf{v}	$\mathbf{v}$
norm	||\vec{v}||	$\lVert\vec{v}\rVert$
matrix	\left[\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6\\ 7 & 8 & 0 \end{array} \right]	$\left[\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array} \right]$
determinant	\left| \begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array} \right|	$\left\vert \begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array} \right\vert$
determinant	\det(A)	$\det(A)$
trace	\operatorname{tr}(A)	$\operatorname{tr}(A)$
dimension	\dim(V)	$\dim(V)$

Number theory

description	command	output
divides	|	$\mid$
does not divide	\not |	$\nmid$
div	\operatorname{div}	div
mod	\mod	$\bmod$
greatest common divisor	\gcd	$\gcd$
ceiling	\lceil x \rceil	$\lceil x \rceil$
floor	\lfloor x \rfloor	$\lfloor x \rfloor$

Geometry and trigonometry

description	command	output
angle	\angle ABC	$\angle ABC$
degree	90^{\circ}	$90°$
triangle	\triangle ABC	$\triangle ABC$
segment	\overline{AB}	$\overline{AB}$
sine	\sin	sin
cosine	\cos	cos
tangent	\tan	tan
cotangent	\cot	cot
secant	\sec	sec
cosecant	\csc	csc
inverse sine	\arcsin	arcsin
inverse cosine	\arccos	arccos
inverse tangent	\arctan	arctan

Symbols (in *text* mode)

The followign symbols do **not** have to be surrounded by dollar signs.

description	command	output
dollar sign	\$	$
percent	\%	%
ampersand	\&	&
pound	\#	#
backslash	\textbackslash	\
left quote marks	``	"
right quote marks	''	"
single left quote	`	'
single right quote	'	'
hyphen	X-ray	X-ray
en-dash	pp. 5--15	pp. 5–15
em-dash	Yes---or no?	Yes—or no?

Resources

Great symbol look-up site: Detexify
LaTeX Mathematical Symbols
The Comprehensive LaTeX Symbol List
The Not So Short Introduction to LaTeX 2ε
TUG: The TeX Users Group
CTAN: The Comprehensive TeX Archive Network

LaTeX for the Mac: MacTeX
LaTeX for the PC: TeXnicCenter and MiKTeX
LaTeX online: WriteLaTeX.

Dave Richeson, Dickinson College, http://divisbyzero.com/