

A Quick Guide to L^AT_EX

What is L^AT_EX?

L^AT_EX (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 T_EX created by Donald Knuth (his first version appeared in 1978). Leslie Lamport created L^AT_EX, a more user-friendly version of T_EX. A team of L^AT_EX programmers created the current version, L^AT_EX 2 ϵ .

Text vs. Math 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 (like $\sin(x)$). 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 $\sin(x)$.

Text Decorations

Your text can be *italics* (`\textit{italics}`), **boldface** (`\textbf{boldface}`), or underlined (`\underline{underlined}`). Your math can contain boldface, **R** (`\mathbf{R}`), or blackboard bold, **R** (`\mathbb{R}`). You may want to use these to express the sets of real numbers (**R** or **R**), integers (**Z** or **Z**), rational numbers (**Q** or **Q**), and natural numbers (**N** or **N**). To have text appear in a math expression, use `\text`. `(0,1]=\{x\in\mathbb{R}:x>0\text{ and }x\leq 1\}` yields $(0,1] = \{x \in \mathbb{R} : x > 0 \text{ and } x \leq 1\}$. (Without the `\text` command it treats “and” as three variables: $(0,1] = \{x \in \mathbb{R} : x > 0 \text{ and } x \leq 1\}$.)

Inline Mathematical Expressions

Place a math expression between dollar signs (\$) to produce an inline expression. For example, typing `\$90^\circ\{\circ\}` is the same as `\frac{\pi}{2}` radians yields 90° is the same as $\frac{\pi}{2}$ radians.

Display Equations

Display equations are mathematical expressions given their own line and centered on the page. They are usually important equations that deserve to be showcased on their own line, or for tall or long equations that don’t fit inline. To produce a display equation, surround the mathematical expression with `[` 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 $\sum_{n=1}^{\infty} \frac{1}{n}$, not this $\sum_{n=1}^{\infty} \frac{1}{n}$.

Spaces and New Lines

L^AT_EX 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 empty line between two paragraphs. Place `\` at the end of a line to create a new line (but not a new paragraph). Use `\noindent` to prevent a paragraph from indenting.

This compiles

like`\`

this.

This compiles

like

this.

Comments

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

Images

You can put images (pdf, png, jpg, or gif) in your document. To do so, you need `\usepackage{graphicx}` at the start of your document, and the images need to be in the same directory as your .tex file. Omit `[width=5in]` if you want the image to be full-sized.

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

Delimiters

description	command	output
parentheses	<code>(x)</code>	(x)
brackets	<code>[x]</code>	$[x]$
curly braces	<code>\{x\}</code>	$\{x\}$

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=1}^\infty` produces $\left\{\sin\left(\frac{1}{n}\right)\right\}_{n=1}^\infty$.

Curly braces are non-printing characters used to gather text with 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	<code>\begin{itemize}</code>	
	<code>\item Thing 1</code>	• Thing 1
	<code>\item Thing 2</code>	• Thing 2
	<code>\end{itemize}</code>	
ordered list	<code>\begin{enumerate}</code>	
	<code>\item Thing 1</code>	1. Thing 1
	<code>\item Thing 2</code>	2. Thing 2
	<code>\end{enumerate}</code>	

Aligned Equations

description	command	output
aligned	<code>\begin{align*}</code>	
equations	<code>f(0) \&= 10\cos(0)\</code>	$f(0) = 10 \cos(0)$
	<code>\&= 10</code>	$= 10$
	<code>\end{align*}</code>	

Symbols in Math Mode

The basics

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

Functions

description	command	output
maps to	<code>\to</code>	\rightarrow
composition	<code>\circ</code>	\circ
piecewise	<code> x =</code>	
function	<code>\begin{cases} x & x \ge 0 \\ -x & x < 0 \end{cases}</code>	$ x = \begin{cases} x & x \ge 0 \\ -x & x < 0 \end{cases}$

Greek and Hebrew letters

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

Set Theory

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

Calculus

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

Logic

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

Linear Algebra

description	command	output
vector	<code>\vec{v}</code>	\vec{v}
vector	<code>\mathbf{v}</code>	\mathbf{v}
norm	<code> \vec{v} </code>	$ \vec{v} $
matrix	<code>\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}</code>	$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$
determinant	<code>\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{vmatrix}</code>	$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{vmatrix}$
determinant	<code>\det(A)</code>	$\det(A)$
trace	<code>\operatorname{tr}(A)</code>	$\operatorname{tr}(A)$
dimension	<code>\dim(V)</code>	$\dim(V)$

Number Theory

description	command	output
divides	<code> </code>	$ $
does not divide	<code>\not </code>	\nmid
div	<code>\operatorname{div}</code>	div
mod	<code>\mod</code>	mod
greatest common divisor	<code>\gcd</code>	gcd
ceiling	<code>\lceil x \rceil</code>	$\lceil x \rceil$
floor	<code>\lfloor x \rfloor</code>	$\lfloor x \rfloor$

Geometry and Trigonometry

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

Symbols in Text Mode

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

description	command	output
dollar sign	<code>\\$</code>	$\$$
percent	<code>\%</code>	$\%$
ampersand	<code>\&</code>	$\&$
pound	<code>\#</code>	$\#$
backslash	<code>\textbackslash</code>	\backslash
left quote marks	<code>‘ ‘</code>	‘ ‘
right quote marks	<code>’ ’</code>	’ ’
single left quote	<code>‘</code>	‘
single right quote	<code>’</code>	’
hyphen	<code>X-ray</code>	X-ray
en-dash	<code>pp. 5--15</code>	pp. 5--15
em-dash	<code>Yes---or no?</code>	Yes---or no?

Resources

TeX Users Group: tug.org
CTAN: ctan.org
Detexify: detexify.kirelabs.org
Mathpix: mathpix.com
The Not So Short Introduction to LaTeX2ε: ctan.org/pkg/lshort
Mac: MacTeX tug.org/mactex,
LaTeXiT www.chachatelier.fr/latexit
Windows: TeXnicCenter www.texniccenter.org,
MiKTeX (miktex.org)
Online: Overleaf www.overleaf.com,
SageMath www.sagemath.org