

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 *format*, or collection of macro commands, for T_EX, the standard for most professional mathematics and scientific writing. T_EX is a powerful typesetting engine created by Donald Knuth of Stanford University (his first version appeared in 1978). Leslie Lamport was responsible for creating L^AT_EX, a popular set of user commands for T_EX. A team of L^AT_EX programmers created the current version, L^AT_EX 2_ε.

Mathematics

Math vs. text vs. functions

In properly typeset mathematics, the variables appear in italics (for example, $f(x) = x^2 + 2x - 3$). The exception to this rule is predefined functions (for example, $\sin(x)$). 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 $\sin(x)$.

There are two ways to present a mathematical expression – *inline* or as a *display*.

Inline mathematical expressions

Inline math expressions occur as part of the normal flow of text. 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.

Displayed mathematical expressions

Displays 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 displayed mathematics, place the mathematical expression between the symbols \[and \]. Typing
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
 yields

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

Display style

To get full-size inline math, use \displaystyle . Use this sparingly. Typing this $\sum_{n=1}^{\infty} \frac{1}{n}$ and not this $\sum_{n=1}^{\infty} \frac{1}{n}$ yields

this $\sum_{n=1}^{\infty} \frac{1}{n}$, and 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}[tbp]
\includegraphics[width=.5in]{imagename.jpg}
\caption{The (optional) caption goes here.}
\end{figure}
```

Text decorations

Your text can be *italic* (\textit{italic}), **bold** (\textbf{bold}), or underlined ($\underline{underlined}$).

Your math can contain bold, \mathbf{R} (\mathbf{R}), or blackboard bold, \mathbb{R} (\mathbb{R}). You may want to use 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}).

For text appearing inside 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:
($0,1] = \{x \in \mathbb{R} : x > 0 \text{ and } x \leq 1\}$.)

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 full empty line between two paragraphs. Place \backslash 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 \backslash 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)
square brackets	[x]	[x]
curly braces	\{x\}	{x}

To automatically make delimiters large enough to fit the content, use them together with \left and \right . For example, $\left\{ \frac{1}{n} \right\}_{n=1}^{\infty}$ 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 , $x^{\wedge}2$, $x^{\wedge}2t$, $x^{\wedge}2t$ 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	• Thing 1
	\item Thing 2	• Thing 2
	$\end{itemize}$	
ordered list	$\begin{enumerate}$	
	\item Thing 1	1. Thing 1
	\item Thing 2	2. Thing 2
	$\end{enumerate}$	

Symbols (in math mode)

The basics

description	command	output
addition	+	+
subtraction	-	-
plus or minus	\pm	±
multiplication (times)	\times	×
multiplication (dot)	\cdot	·
division symbol	\div	÷
division (slash)	/	/
circle plus	\oplus	⊕
circle times	\otimes	⊗
equal	=	=
not equal	\neq	≠
less than	<	<
greater than	>	>
less than or equal to	\leq	≤
greater than or equal to	\geq	≥
approximately equal to	\approx	≈
infinity	\infty	∞
dots	1,2,3,\ldots	1,2,3,...
dots	1+2+3+\cdots	1 + 2 + 3 + ...
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)	$\deg(f)$



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Functions

description	command	output
maps to	<code>\to</code>	\rightarrow
composition	<code>\circ</code>	\circ
piecewise function	<code> x =\begin{cases} x & x\geq 0 \\ -x & x<0 \end{cases}</code>	$ x = \begin{cases} x & x \geq 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>	\limsup
limit inferior	<code>\liminf</code>	\liminf
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{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array}</code>	$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$
determinant	<code>\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array}</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>\mid</code>	\mid
does not divide	<code>\nmid</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)

These 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>	$X\text{-ray}$
en-dash	<code>pp. 5--15</code>	$\text{pp. } 5\text{--}15$
em-dash	<code>Yes---or no?</code>	Yes---or no?

Getting started with Overleaf and L^AT_EX

L^AT_EX collaborative authoring online: <https://overleaf.com>

Overleaf L^AT_EX documentation: <https://overleaf.com/learn>

Learn L^AT_EX in 30 minutes:

https://overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes

Comprehensive T_EX Archive Network: <http://www.ctan.org/>

T_EX Users Group: <http://www.tug.org/>

Want to work offline? Local install options for Linux or Windows:

T_EX Live; MacOS: MacT_EX; Windows: MiK_TE_X

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