# **Typst Math for Undergrads**

This is a Typst port of <u>ETEX Math for Undergrads</u> by Jim Hefferon. The original version is available at <a href="https://gitlab.com/jim.hefferon/undergradmath">https://gitlab.com/jim.hefferon/undergradmath</a>.

# Meaning of annotations

This is unavailable. Last check date is  $2023-03-24 \times 2023-03-24$ .

Get this in a tricky way. Need a simpler method.

No idea Don't know how to get this.

**Rule One** Any mathematics at all, even a single character, gets a mathematical setting. Thus, for "the value of x is 7" enter the value of x is \$7\$.

**Template** Your document should contain at least this.

-- document body here --

#### **Common constructs**

$$\begin{array}{lll} x^2 \ x^{2} & \sqrt{2}, \ \sqrt[\eta]{3} \ \text{sqrt(2), root(n, 3)} \\ x_{i,j} \ x_{\_}(\text{i, j}) & \frac{2}{3}, 2 \ / \ 3 \ \text{2 / 3, 2 } \ / \ 3 \ \text{or 2 slash 3} \end{array}$$

Calligraphic letters Use as in \$cal(A)\$.

ABCDEF GHIJKLMNOPQRSTUVWXYZ

Getting script letters is  $2023-03-24 \times$ .

## Greek

lpha alpha	$\xi,\Xi$ xi,Xi	
eta beta	o omicron	
$\gamma,\Gamma$ gamma, Gamma	$\pi,\Pi$ pi,Pi	
$\delta,\Delta$ delta, Delta	arpi pi.alt	
$\epsilon$ epsilon.alt	ho rho	
arepsilon epsilon	arrho rho.alt	
$\zeta$ zeta	$\sigma, \Sigma$ sigma, Sigma	
$\eta$ eta	ς \u{03C2} 😽	
$ heta, \Theta$ theta, Theta	au tau	
artheta theta.alt	$v,\Upsilon$ upsilon, Upsilon	
$\iota$ iota	$\phi,\Phi$ phi.alt,Phi	
$\kappa    \mathrm{K}$	arphi phi	
$\lambda,\Lambda$ lambda, Lambda	$\chi$ chi	
$\mu$ mu	$\psi,\Psi$ psi, Psi	
u nu	$\omega,\Omega$ omega, Omega	

## Sets and logic

$\cup$ union	$\mathbb{R}$ RR, bb(R)	$\forall$ forall
$\cap$ sect	$\mathbb{Z}$ ZZ, bb(Z)	$\exists$ exists
$\subset$ subset	$\mathbb{Q}$ QQ, bb(Q)	$\neg$ not
$\subseteq$ subset.eq	$\mathbb{N}$ NN, bb(N)	∨ or
⊃ supset	$\mathbb{C}$ CC, bb(C)	$\wedge$ and
$\supseteq$ supset.eq	Øø🗞	⊢ tack.r
$\in$ in	$\emptyset$ nothing	⊨ models
∉ in.not	ℵ alef	\ without

Negate an operator, as in  $\not\subset$ , with subset.not. Get the set complement  $A^c$  with  $A^c(sans(c))$  (or  $A^c$  with  $A^c(complement)$ , or  $\overline{A}$  with overline(A)).

**Remark:** The character  $\emptyset$  from \varnothing in  $\LaTeX$  is an alternative character of  $\emptyset$  from nothing in Typst (\emptyset in  $\LaTeX$ ). See the Version 3.93 section

of README at <a href="https://www.ctan.org/tex-archive/fonts/newcomputermodern">https://www.ctan.org/tex-archive/fonts/newcomputermodern</a>. You can create the \varnothing character with a let binding using specific fonts.

### **Decorations**

```
f' f', f prime \dot{a} dot(a) \tilde{a} tilde(a) f'' f prime.double \ddot{a} diaer(a) \bar{a} macron(a) \Sigma^* Sigma^* \hat{a} hat(a) \vec{a} arrow(a)
```

If the decorated letter is i or j then some decorations need  $\u\{1D6A4\}$   $\mathbb{S}$  and  $\u\{1D6A5\}$   $\mathbb{S}$ , as in  $\vec{i}$  with arrow( $\u\{1D6A4\}$ ). Some authors use boldface for vectors: bold(x).

Entering overline(x + y) produces  $\overline{x+y}$ , and hat(x + y) gives  $\widehat{x+y}$ . Comment on an expression as here (there is also overbrace(..)).

$$\underbrace{x+y}_{|A|}$$
 underbrace(x + y, |A|)

**Dots** Use low dots in a list  $\{0,1,2,\ldots\}$ , entered as  $\{0,1,2,\ldots\}$ . Use centered dots in a sum or product  $1+\cdots+100$ , entered as 1+ dots.h.c + 100. You can also get vertical dots dots.v, diagonal dots dots.down and anti-diagonal dots dots.up.

# Roman names Just type them!

$\sin$ sin	$\sinh$ sinh	rcsin arcsin
$\cos$ cos	$\cosh$ $\cosh$	rccos arccos
tan tan	anh tanh	rctan arctan
$\sec$ sec	$\coth$ coth	$\min$ min
$\csc$ csc	$\det$ det	$\max$ max
$\cot$ cot	$\dim$ dim	$\inf$ inf
$\exp$ exp	ker ker	$\sup$ sup
$\log$ log	$\deg$ deg	$\liminf$ liminf
$\ln$ ln	rg arg	$\limsup$ limsup
lg lg	$\gcd$ gcd	$\lim$ lim

# Other symbols

< <, lt	ot angle	· dot.op
$\leq$ <=, lt.eq	$\measuredangle$ angle.arc	$\pm$ plus.minus
> >, gt	$\ell$ ell	$\mp$ minus.plus
$\geq$ >=, gt.eq	∥ parallel	imes times
$\neq$ eq.not	$45^{\circ}$ 45 degree	÷ div
$\ll$ <<, lt.double	$\cong$ tilde.eqq	* *, ast.op
$\gg$ >>, gt.double	$ ot\cong$ tilde.eqq.not	divides
pprox approx	$\sim$ tilde.op	∤ divides.not
\u{224D}      \    \     \     \     \     \     \     \     \     \     \     \    \    \     \     \     \     \     \     \     \     \     \     \    \    \    \     \     \     \     \     \     \     \     \     \    \    \\     \    \\     \    \\     \	$\simeq$ tilde.eq	n! n!
$\equiv$ ident	$ \sim$ tilde.not	$\partial$ diff
$\prec$ prec	$\oplus$ plus.circle	abla nabla
≼ prec.eq	$\ominus$ minus.cirle	$\hbar$ planck.reduce
y succ  y	⊙ dot.circle	∘ circle.stroked.tiny
$\succcurlyeq$ succ.eq	$\otimes$ times.circle	⋆ star.op
$\propto$ prop	🕖 \u{2298} 😽	$\sqrt{sqrt("")}$
No idea 🖭	harpoon.tr	√ checkmark

Use a divides b for the divides relation,  $a \mid b$ , and a divides.not b for the negation,  $a \nmid b$ . Use | to get set builder notation  $\{a \in S \mid a \text{ is odd}\}$  with  $\{a \text{ in S } \mid a \text{ "is odd"}\}$ .

## Arrows

```
ightarrow ->, arrow.r.bar 
ightarrow arrow.r.not 
ightarrow arrow.r.long.bar
```

$$\begin{array}{lll} \longrightarrow \text{ arrow.r.long} & \leftarrow <-, \text{ arrow.l} \\ \Rightarrow =>, \text{ arrow.r.double} & \leftrightarrow <->, \text{ arrow.l.r} \\ \Rightarrow \text{ arrow.r.double.not} & \downarrow \text{ arrow.b} \\ \Rightarrow \text{ arrow.r.double.long} & \uparrow \text{ arrow.t.b} \\ \Rightarrow \text{ arrow.squiggly} & \uparrow \text{ arrow.t.b} \\ \end{array}$$

The right arrows in the first column have matching left arrows, such as arrow.l.not, and there are some other matches for down arrows, etc.

**Variable-sized operators** The summation  $\sum_{j=0}^{3} j^2$  sum\_(j = 0)^3 j^2 and the integral  $\int_{x=0}^{3} x^2 \, \mathrm{d}x$  integral\_(x = 0)^3 x^2 dif x expand when displayed.

$$\sum_{j=0}^{3} j^2 \qquad \int_{x=0}^{3} x^2 \, \mathrm{d}x$$

These do the same.

#### **Fences**

Fix the size with the lr function.

$$\left[\sum_{k=0}^{n} e^{k^2}\right] \text{ lr([sum_(k = 0)^n e^(k^2)], size: #50%)}$$

To have them grow with the enclosed formula, also use the lr function (although some of them scale by default).

$$\left\langle i,2^{2^{i}}
ight
angle$$
 lr(angle.l i, 2^(2^i) angle.r)

The 1r function also allows to scale unmatched delimiters and one-side fences.

$$\frac{\mathrm{d}f}{\mathrm{d}x}\Big|_{x_0}$$
 lr(frac(dif f, dif x) |)\_(x\_0)

Arrays, Matrices In Typst, <u>array</u> is a sequence of values, while in  $\LaTeX$ , array is a matrix without fences, which is 2023-03-24 % in Typst.

Definition by cases can be easily obtained with the function cases.

$$f_n = \begin{cases} a & \text{if } n = 0 \\ r \cdot f_{n-1} & \text{else} \end{cases} \quad \begin{array}{c} \$ \text{ f_n = cases(} \\ a \text{ \&"if" n = 0,} \\ r \text{ dot.op f_(n - 1) \&"else"} \\ \end{array} \right.$$

Get a matrix with the mat function. You can pass an array to it.

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$
 \$ mat(a, b; c, d) \$

For the determinant use |A|, text operator det det or #set math.mat(delim: "|").

**Spacing in mathematics** Improve  $\sqrt{2}x$  to  $\sqrt{2}x$  with a thin space, as in sqrt(2) thin x. Slightly wider are medium and thick (the three are in ratio 3:4:5). Bigger space is quad

for  $\rightarrow$   $\leftarrow$ , which is useful between parts of a display. Get arbitrary space with the h function. For example, use h(2em) for \qquad in  $\LaTeX$  and h(-0.1667em) for \!.

**Displayed equations** Display equations in a block level using \$ ... \$ with at least one space separating the math content and the \$.

$$S = k \cdot \lg W$$
 \$ S = k dot.op lg W \$

You can break into multiple lines.

$$\sin(x) = x - \frac{x^3}{3}! \\ + \frac{x^5}{5}! - \cdots \\ + x^5 / 5! - \text{dots.h.c} \ \$$$

Align equations using &

$$\begin{array}{lll} \nabla \cdot \pmb{D} = \rho & \text{\$ nabla dot.op bold(D) \&= rho \setminus} \\ \nabla \cdot \pmb{B} = 0 & \text{nabla dot.op bold(B) \&= 0 \$} \end{array}$$

(the left or right side of an alignment can be empty). Get a numbered version by #set math.equation(numbering: ..).

Calculus examples The last three here are display style.

$$\begin{split} f: \mathbb{R} &\to \mathbb{R} & \text{f: RR -> RR} \\ 9.8 \text{ m/s}^2 & \text{"9.8" "m/s"^2} & \\ &\lim_{h\to 0} \frac{f(x+h)-f(x)}{h} & \lim_{} (\text{h -> 0) (f(x+h) -} \\ &\int x^2 \, \mathrm{d}x = x^3 \, / \, 3 + C & \text{integral x^2 dif x = x^3 \/ 3} \\ \nabla &= i \frac{\mathrm{d}}{\mathrm{d}x} + j \frac{\mathrm{d}}{\mathrm{d}y} + k \frac{\mathrm{d}}{\mathrm{d}z} & \text{nabla = bold(i) dif / (dif y) +} \\ &\text{bold(k) dif / (dif z)} \end{split}$$

**Discrete mathematics examples** For modulo, there is a symbol  $\equiv$  from ident and a text operator mod from mod.

For combinations the binomial symbol  $\binom{n}{k}$  is from binom(n, k). This resizes to be bigger in a display.

For permutations use  $n^{\underline{r}}$  from n^(underline(r)) (some authors use P(n,r), or  ${}_nP_r$  from ""\_n P\_r).

# Statistics examples

$$\begin{split} \sigma^2 &= \sqrt{\sum(x_i - \mu)^2 \, / \, N} & \text{sigma^2 = sqrt(sum(x_i - mu)^2 \/ N)} \\ E(X) &= \mu_X = \sum(x_i - P(x_i)) & \text{E(X) = mu_X = sum(x_i - P(x_i))} \end{split}$$

The probability density of the normal distribution

$$\frac{1}{\sqrt{2\sigma^2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

comes from this.

**For more** See also the Typst Documentation at <a href="https://typst.app/docs">https://typst.app/docs</a>.