Typst Math for Undergrads

This is a Typst port of *LaTeX Math for Undergrads* by Jim Hefferon. The original version is available at https://gitlab.com/jim.hefferon/undergradmath.

Meaning of annotations

2023-03-31 ❌ This is unavailable. Last check date is 2023-03-31.

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

x^2 `x^2`	$\sqrt{2}$, $\sqrt[n]{3}$ `sqrt(2)`, `root(n, 3)`
$x_{i,j}$ `x_(i, j)`	$\frac{2}{3}$, 2 / 3 `2 / 3`, 2 \/ 3 or 2 `slash` 3

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

$$\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$

Getting script letters is 2023-03-31 ❌.

Greek

α `alpha`	ξ, Ξ `xi, Xi`
β `beta`	o `omicron`
γ, Γ `gamma, Gamma`	π, Π `pi, Pi`
δ, Δ `delta, Delta`	ϖ `pi.alt`
ϵ `epsilon.alt`	ρ `rho`
ε `epsilon`	ϱ `rho.alt`
ζ `zeta`	σ, Σ `sigma, Sigma`
η `eta`	ς `\u{03C2}`
θ, Θ `theta, Theta`	τ `tau`
ϑ `theta.alt`	υ, Υ `upsilon, Upsilon`
ι `iota`	ϕ, Φ `phi.alt, Phi`
κ `K`	φ `phi`
λ, Λ `lambda, Lambda`	χ `chi`
μ `mu`	ψ, Ψ `psi, Psi`
ν `nu`	ω, Ω `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)`	$\vee$ `or`
$\supset$ `supset`	$\mathbb{C}$ `CC, bb(C)`	$\wedge$ `and`
$\supseteq$ `supset.eq`	$\varnothing$ `diameter`	$\vdash$ `tack.r`
$\in$ `in`	$\emptyset$ `nothing`	$\models$ `models`
$\notin$ `in.not`	$\aleph$ `alef`	$\setminus$ `without`

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

Remark Using `diameter` for `\varnothing` may cause some confusion. However, LaTeX also uses $\varnothing$ (`\u{2300}`) instead of $\emptyset$ (`\u{2205}`), see newcm §13.3. Another solution is to use `text(font: "Fira Sans", nothing)`, but the resultant glyph ∅ is subtly different from the widely used one. Ultimately, The choice is always **your decision**.

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)`
Σ^* `Sigma^*`	$\hat{a}$ `hat(a)`	$\vec{a}$ `arrow(a)`

If the decorated letter is i or j then some decorations need `\u{1D6A4}` and `\u{1D6A5}`, as in $\vec{\imath}$ 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, ...}`. 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`	arcsin `arcsin`
cos `cos`	cosh `cosh`	arccos `arccos`
tan `tan`	tanh `tanh`	arctan `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`	lim inf `liminf`
ln `ln`	arg `arg`	lim sup `limsup`
lg `lg`	gcd `gcd`	lim `lim`

Other symbols

$<$ `<, lt`	$\angle$ `angle`	$\cdot$ `dot.op`
$\leq$ `<=, lt.eq`	$\measuredangle$ `angle.arc`	$\pm$ `plus.minus`
$>$ `>, gt`	ℓ `ell`	$\mp$ `minus.plus`
$\geq$ `>=, gt.eq`	$\parallel$ `parallel`	$\times$ `times`
$\neq$ `!=, eq.not`	$45°$ `45 degree`	$\div$ `div`
$\ll$ `<<, lt.double`	$\cong$ `tilde.eqq`	$*$ `*, ast.op`
$\gg$ `>>, gt.double`	$\ncong$ `tilde.eqq.not`	$\mid$ `divides`
$\approx$ `approx`	$\sim$ `tilde.op`	$\nmid$ `divides.not`
$\asymp$ `\u{224D}`	$\simeq$ `tilde.eq`	$n!$ `n!`
$\equiv$ `ident`	$\nsim$ `tilde.not`	∂ `diff`
$\prec$ `prec`	$\oplus$ `plus.circle`	∇ `nabla`
$\preccurlyeq$ `prec.eq`	$\ominus$ `minus.cirle`	$\hbar$ `planck.reduce`
$\succ$ `succ`	$\odot$ `dot.circle`	$\circ$ `circle.stroked.tiny`
$\succcurlyeq$ `succ.eq`	$\otimes$ `times.circle`	$\star$ `star.op`
$\propto$ `prop`	$\oslash$ `\u{2298}`	$\surd$ `sqrt("")`
$\doteq$ `\u{2250}`	$\upharpoonright$ `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 in S | a "is odd"}`.

Arrows

$\to$ `->, arrow.r`	$\mapsto$ `|->, arrow.r.bar`
$\not\to$ `arrow.r.not`	$\longmapsto$ `arrow.r.long.bar`
$\longrightarrow$ `arrow.r.long`	$\leftarrow$ `<-, arrow.l`
$\Rightarrow$ `=>, arrow.r.double`	$\leftrightarrow$ `<->, arrow.l.r`
$\not\Rightarrow$ `arrow.r.double.not`	$\downarrow$ `arrow.b`

$\Longrightarrow$ `arrow.r.double.long`	$\uparrow$ `arrow.t`
$\rightsquigarrow$ `arrow.squiggly`	$\updownarrow$ `arrow.t.b`

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.

$\int$ `integral`	$\iiint$ `integral.triple`
$\iint$ `integral.double`	$\oint$ `integral.cont`
$\bigcup$ `union.big`	
$\bigcap$ `sect.big`	

Fences

$()$ `()`	$\langle\rangle$ `angle.l angle.r`	$\lvert\rvert$ `abs("")`
$[]$ `[]`	$\lfloor\rfloor$ `floor("")`	$\lVert\rVert$ `norm("")`
$\{\}$ `{}`	$\lceil\rceil$ `ceil("")`	

Fix the size with the `lr` function.

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

To have them grow with the enclosed formula, also use the `lr` function.

$$\left\langle i, 2^{2^i} \right\rangle \quad \texttt{lr(angle.l i, 2\^(2\^i) angle.r)}$$

Fences scale by default if entered directly as codepoints, and don't scale automatically if entered as symbol notation.

$$\left(\frac{1}{n^\alpha}\right) \quad \texttt{(1 / n\^(alpha))}$$

$$(\frac{1}{n^\alpha}) \quad \texttt{paren.l 1 / n\^(alpha) paren.r}$$

The `lr` function also allows to scale unmatched delimiters and one-side fences.

$$\left.\frac{\mathrm{d}f}{\mathrm{d}x}\right|_{x_0} \quad \texttt{lr(frac(dif f, dif x) |)\_(x\_0)}$$

Arrays, Matrices Get a matrix with the `mat` function. You can pass an array to it.

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

In Typst, array is a sequence of values, while in LaTeX, array is a matrix without fences, which is `$mat(delim: #none, ..)$` in Typst.

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

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

$$f_n = \begin{cases} a & \text{if } n = 0 \\ r \cdot f_{n-1} & \text{else} \end{cases}$$

```
$ f_n = cases(
  a &"if" n = 0,
  r dot.op f_(n - 1) &"else"
) $
```

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 `$ ... $` with at least one space separating the math content and the `$`.

$$S = k \cdot \lg W \quad \texttt{\$ S = k dot.op lg W \$}$$

You can break into multiple lines.

$$\sin(x) = x - \frac{x^3}{3}! + \frac{x^5}{5}! - \cdots$$

```
$ sin(x) = x - x^3 / 3! \
    + x^5 / 5! - dots.h.c $
```

Align equations using `&`

$$\nabla \cdot \boldsymbol{D} = \rho$$
$$\nabla \cdot \boldsymbol{B} = 0$$

```
$ nabla dot.op bold(D) &= rho \
  nabla dot.op bold(B) &= 0 $
```

(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.

$$f : \mathbb{R} \to \mathbb{R}$$
$$9.8 \text{ m/s}^2$$

```
f: RR -> RR
"9.8" "m/s"^2
```

$$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

```
lim_(h -> 0) (f(x + h) -
  f(x)) / h
```

$$\int x^2 \,\mathrm{d}x = x^3 \,/\, 3 + C$$

```
integral x^2 dif x = x^3 \/ 3
  + C
```

$$\nabla = \boldsymbol{i}\frac{\mathrm{d}}{\mathrm{d}x} + \boldsymbol{j}\frac{\mathrm{d}}{\mathrm{d}y} + \boldsymbol{k}\frac{\mathrm{d}}{\mathrm{d}z}$$

```
nabla = bold(i) dif / (dif
  x) + bold(j) dif / (dif y) +
  bold(k) dif / (dif z)
```

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

$$\sigma^2 = \sqrt{\textstyle\sum (x_i - \mu)^2 \,/\, N}$$

```
sigma^2 = sqrt(sum(x_i -
  mu)^2 \/ N)
```

$$E(X) = \mu_X = \textstyle\sum (x_i - P(x_i))$$

```
E(X) = mu_X = sum(x_i -
  P(x_i))
```

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.

```
1 / sqrt(2 sigma^2 pi)
  e^(- (x - mu)^2 / (2 sigma^2))
```

For more See also the Typst Documentation at https://typst.app/docs.