DOCUMENT TITLE

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Abstract. Here is a template for writing AMS style documents using Typst. At the end, I also appended a cheat sheet for typing math symbols.

1. Introduction

Typst is a new document typesetting system with many features. Its syntax draws heavily on Markdown and it is also designed for conveniently typesetting mathematical equations.

2. Basic Syntax

The Typst syntax is designed to be simple and easy to read when it is unrendered. It is heavily inspired by Markdown, but it also has new syntax for mathematical equations and some extra features.

- Bold text: `*lorem ipsum*` renders **lorem ipsum**
- Italic text: `_lorem ipsum_` renders *lorem ipsum*.
- Literal text: `` `lorem ipsum` `` renders `lorem ipsum` (note that any special characters inside grave accents are not rendered)
- Hyperlink text: `#link("www.google.com")[Example URL]` renders Example URL.

Typst can also render lists.

- Unordered list: begin consecutive lines with dash `-`
- Ordered list: begin consecutive lines with dash `+`
  1. Create nested lists by indenting
  2. Customize using the `#enum(...)` function. For example, `#enum(numbering: "(I)")` creates roman numerals:
     (I) Numeral
     (II) Numeral

3. Document Structure

Begin a major section by typing `= Section Title` on an isolated line. This is the Typst equivalent of `\section{Section Title}` in LaTeX. To begin a subsection, type `== Subsection Title` on an isolated line.

3.1. Subsection Title.

Here is a subsection.

3.2. Numbering Subsections.

Use global document settings to control how subsections are numbered, as described in the Headings documentation.

3.3. References.

It is possible to reference document objects like sections, subsections, figures, equations, and citations. Label an object by adding `<label_name>` after its definition. The placement is similar to LaTeX `\label{...}`, but check the docs for specifics. Reference the object later using `@label_name`. For example, Section 3 has the label `@doc_structure`.

4. Mathematics

Like LaTeX, you can render inline equations with `$...$`. To write a multiline equation, just use the same syntax on an isolated line:

$$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-\frac{x^2}{2}} dx = 1$$

In any multiline equation, use `\` to create a line break and use `&` to control vertical alignment, similar to the `\align{...}` LaTeX environment.

$$\begin{aligned} \left(\int_{-\infty}^{\infty} e^{-x^2} dx \right)^2 &= \left(\int_{-\infty}^{\infty} e^{-(x^2+y^2)} \, dx \, dy \right) \\ &= 2\pi \int_{0}^{\infty} e^{-r^2} r \, dr \\ &= \pi \end{aligned}$$

The left hand size is written as `(integral_(-oo)^(oo) e^(-x^2) d x)^2`. Typst can tell the difference between symbol grouping parenthesis, like the exponent `e^(-x^2)`, and mathematical parenthesis, like those surrounding the integral. It automatically matches and resizes mathematical parenthesis for their content. It also automatically renders fractions `$(numerator...)/(denominator...)$`, such as

$$\frac{1 + 3 + 5 + 9 + ...}{2 + 4 + 6 + 8 + ...}$$

and inline fractions can be written as `$a\/b$`, which renders a/b.

Finally, some additional resources on typesetting math:

- Typst Math Documentation: the primary documentation.
- UndergradMath Reference: a good cheat sheet for math commands, which I've also copied at the end of this document.

4.1. Equation Numbering.

At the time of writing, Typst only natively supports *global* equation numbering (every equation gets a number). I wrote a special function `#eq[...]`, which is included in `template.typ`, which is ok but still not perfect (see the source for commentary).

$$\begin{aligned} \mathbb{E}_{Z \sim \mathcal{N}(0, I_d)}[\|Z\|] &= \mathbb{E}\left[\left(\|Z\|^2 \right)^{\frac{1}{2}} \right] \\ &\leq \mathbb{E}\left[\|Z\|^2 \right]^{\frac{1}{2}} \qquad (1) \\ &= \sqrt{d} \qquad (2) \end{aligned}$$

5. References, Figures, and other external files

The current template includes a file `refs.bib`. Any BibTeX citations in this file are imported to the main document by the command `#bibliography("refs.bib")` which appears at the end

of `main.typ`. This command also renders the bibliography. By default, citations are numbered (eg. [1]).

References

1. Knuth, D. E.: The Art of Computer Programming, Vol. 1: Fundamental Algorithms. Addison-Wesley (1997)

Typst Math for Undergrads

This is a Typst port with typst 0.10.0 of *LaTeX Math for Undergrads* by Jim Hefferon. The original version is available at https://gitlab.com/jim.hefferon/undergradmath.

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 `$cal(A)$`.

$$\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$

Get script letters, such as $\mathscr{P}$ from `$cal(P)$`, by changing the `stylistic-set` parameter of `text()` to the corresponding set.

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	`sigma.alt`
θ, Θ	`theta`, `Theta`	τ	`tau`
ϑ	`theta.alt`	υ, Υ	`upsilon`, `Upsilon`
ι	`iota`	ϕ, Φ	`phi.alt`, `Phi`
κ	`kappa`	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 $\varnothing$ 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 `dotless.i` and `dotless.j`, as in $\vec{\imath}$ with `arrow(dotless.i)`. 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 $\{0, 1, 2, ...\}$, 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`

If an operator you wish to use does not exist, you can create one using `math.op`. For example, to create the cosec operator:

```
#let cosec = math.op("cosec")
$ cosec x = 1/(sin x) $
```

$$\operatorname{cosec} x = \frac{1}{\sin x}$$

Other symbols

$<$	`<`, `lt`	$\angle$	`angle`	$\cdot$	`dot`
$\leq$	`<=`, `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.equiv`	$*$	`*`, `ast`
$\gg$	`>>`, `gt.double`	$\ncong$	`tilde.nequiv`	$\mid$	`divides`
$\approx$	`approx`	$\sim$	`tilde`	$\nmid$	`divides.not`
$\asymp$	`\u{224D}`	$\simeq$	`tilde.eq`	$n!$	`n!`
$\equiv$	`equiv`	$\nsim$	`tilde.not`	∂	`diff`
$\prec$	`prec`	$\oplus$	`plus.circle`	∇	`nabla`
$\preccurlyeq$	`prec.eq`	$\ominus$	`minus.cirle`	$\hbar$	`planck.reduce`
$\succ$	`succ`	$\odot$	`dot.circle`	$\circ$	`compose`
$\succcurlyeq$	`succ.eq`	$\otimes$	`times.circle`	$\star$	`star`
$\propto$	`prop`	$\diagup$	`\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 $\int_{x=0}^{3} x^2\,dx$ `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.

```
∫ integral          ∬ integral.double
∭ integral.triple   ∮ integral.cont
⋃ union.big         ⋂ sect.big
```

Fences

```
() ()   ⟨⟩ angle.l angle.r   || abs("")
[] []   ⌊⌋ floor("")         ||| norm("")
{} {}   ⌈⌉ 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 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 are: `quad` for $\rightarrow\quad\leftarrow$ and `wide` for $\rightarrow\qquad\leftarrow$, which are useful between parts of a display. Get arbitrary space with the `h` function. For example, use `#h(-0.1667em)` for `\!` in LaTeX.

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

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

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 `&`

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

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

$$f : \mathbb{R} \to \mathbb{R} \qquad \texttt{f: RR -> RR}$$

$$9.8\mathrm{m/s}^2 \qquad \texttt{"9.8" "m/s"\^2}$$

$$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h} \qquad \texttt{lim\_(h -> 0) (f(x + h) - f(x)) / h}$$

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

$$\nabla = \boldsymbol{i}\frac{\mathrm{d}}{\mathrm{d}x} + \boldsymbol{j}\frac{\mathrm{d}}{\mathrm{d}y} + \boldsymbol{k}\frac{\mathrm{d}}{\mathrm{d}z} \qquad \texttt{nabla = bold(i) dif / (dif x) + bold(j) dif / (dif y) + bold(k) dif / (dif z)}$$

Discrete mathematics examples For modulo, there is a symbol $\equiv$ from `equiv` 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

$$\sigma^2 = \sqrt{\sum (x_i - \mu)^2 / N} \qquad \texttt{sigma\^2 = sqrt(sum(x\_i - mu)\^2 \/ N)}$$

$$E(X) = \mu_X = \sum (x_i - P(x_i)) \qquad \texttt{E(X) = mu\_X = sum(x\_i - P(x\_i))}$$

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

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

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