Theoretic

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1 Summary

This package provides opinionated functions to create theorems and similar environments.

```
#theorem[This is a theorem.]
#proof[
    Ends with Equation? No Problem:
    $ norm(x) = sqrt( sum_(k = 1)^d x_k ) . $
]
#theorem(title: "Foo", label: <thm:foo>)[
    This is a named theorem.
]
#proof(title: [@thm:foo[-]])[
    - Ends with a list or enum? Easy.
]
```

Theorem 1.1 This is a theorem.

Proof. Ends with Equation? No Problem:

$$\|x\| = \sqrt{\sum_{k=1}^d x_k}.$$

Theorem 1.2 (Foo) This is a named theorem.

Proof of Theorem 1.2.

• Ends with a list or enum? Easy.

1.1 Setup

Put the following at the top of your document:

```
#import "@preview/theoretic:0.2.0" as theoretic: theorem, proof, qed
#show ref: theoretic.show-ref // Otherwise, references won't work.

// set up your needed presets
#let corollary = theorem.with(kind: "corollary", supplement: "Corollary")
#let example = theorem.with(kind: "example", supplement: "Example", number: none)
// ..etc
```

See #theoretic.theorem() (Section A.10) for a detailed description of customization options.

2 Features

- Except for #show ref: theoretic.show-ref, no "setup" is necessary. All configuration is achieved via parameters on the #theoretic.theorem() function. Use theorem.with(..) for your preset needs.

 → #theoretic.theorem()
- Automatic numbering. If your headings are numbered, it will use top-level heading numbers as the first component, otherwise it will simply number your theorems starting with Theorem 1.

```
#theorem(number: "!!")[
  Number can be overridden per-theorem.
]
#theorem(number: 400)[
  If a `number` is passed (as opposed to a string or content),
]
#theorem[
  ...subsequent theorems will pick it up.
]
```

Theorem!! Number can be overridden pertheorem.

Theorem 2.400 If a number is passed (as opposed to a string or content),

Theorem 2.401 ...subsequent theorems will pick it up.

• Flexible References via specific supplements.

```
→ #theoretic.show-ref()
```

```
@thm:foo vs @thm:foo[-] vs @thm:foo[--] vs
@thm:foo[!] vs @thm:foo[!!] vs @thm:foo[!!!]
vs @thm:foo[?] vs @thm:foo[Statement]
```

Theorem 1.2 (Foo) vs Theorem 1.2 vs 1.2 vs Foo (Theorem 1.2) vs Foo (1.2) vs Foo vs Theorem vs Statement 1.2 (Foo)

• Custom outlines: Outline for headings *and/or* theorems.

 \rightarrow #theoretic.toc()

- Filter for specific kinds of theorem to create e.g. a list of definitions.
- ► Optionally sorted alphabetically!
- ► Theorems can have a different title for outlines (theorem(toctitle: ...)) and can even have multiple entries in a sorted outline.
- ► Highly customizable!

- → #theoretic.toc-entry()
- (And this customization can be reused for regular outlines) \rightarrow #theoretic.show-entry-as()
- Exercise solutions:

- → #theoretic.solutions()
- Every theorem environment accepts a second positional argument, which gets used as the solution.
- ► Solutions section automatically hides itself if there are no solutions to show.

```
#theorem(kind: "exercise", supplement:
"Exercise")[
  Go look for the solution of this exercise
at the end of this document.
][
  // no cheating! //
]
```

Exercise 2.402 Go look for the solution of this exercise at the end of this document.¹

• Automatic QED placement!

→ #theoretic.proof() & #theoretic.qed()

In most cases, it should place the QED symbol appropriately automatically:

```
#proof[This is a proof. $x=y$]
#proof[
  This is a proof.
  $ x = y $
]
```

¹Solution in Appendix

```
#proof[
 #set math.equation(numbering: "(1)")
 This is a proof.
 x = y
#proof[
 This is a proof.
  #proof[
 This is a proof.
  - #lorem(3)
#proof[
 This is a proof.
 + #lorem(3)
   + #lorem(3)
     + #lorem(3)
       + #lorem(3)
]
```

```
Proof.
       This is a proof. x = y
                                        Proof.
       This is a proof.
                  x = y
                                        Proof. This is a proof.
                                       (1)
                  x = y
                                        Proof. This is a proof.
▶ Lorem ipsum dolor.
                   x = y
                                        Proof. This is a proof.
▶ Lorem ipsum dolor.
                                        Proof. This is a proof.
1. Lorem ipsum dolor.
  1. Lorem ipsum dolor.
     1. Lorem ipsum dolor.
        1. Lorem ipsum dolor.
```

→ #theoretic.restate()

Specifically, it works for lists, enums, and unnumbered block equations, which may be nested. If your proof ends wit some other block, you should might want to place a #qed() manually. For proper alignment with a block equation, use

```
#set math.equation(numbering: (..) => {qed()}, number-align: bottom)
placed directly in front of the equation.
```

· Restate any theorem.

```
theoretic.restate(<thm:foo>)
// the prefix links to the original

Theorem 1.2 (Foo) This is a named theorem.
```

3 Examples

Example 3.1 (A complicated example showing some configuration possibilities)

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

Theorem 1 Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed.

Proof of Theorem 1.

1. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam. *QED.*

Theorem 2 Name Lorem ipsum dolor sit amet, consectetur.

Example 3 Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do.

Example 4 (Named Example) To avoid having examples and such show up in the toc, use the toc.exclude parameter.

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

```
#set text(font: "Besley*", size: 9pt)
#let theorem = theorem.with(
  fmt-prefix: (s, n, t) \Rightarrow {
    text(font: "Besley* Narrow Semi")[#s #n]
    if t!= none {
      box(fill: oklch(70%, 0.17, 307.4deg, 20%), outset: (y: 4pt), inset: (x: 2pt), radius:
2pt, text(fill: oklch(44.67%, 0.15, 307.4deg), font: "Besley* Semi", t))
   h(1em)
  block-args: (
    stroke: (left: 0.5pt + oklch(44.67%, 0.15, 307.4deg)),
    outset: (left: 4pt, right: 0pt, y: 4pt),
#let ex = theorem.with(
 kind: "example",
  supplement: "Example",
  fmt-prefix: (s, n, t) \Longrightarrow {
   text(font: "Besley*", stretch: 85%)[#s #n]
    if t!= none [ (#t)]
   h(1em)
 },
 fmt-body: (b, _) => { emph(b) },
#let qed = qed.with(suffix: smallcaps[#h(1fr)_qed._])
#let proof = proof.with(fmt-suffix: qed.with(force: false))
\#lorem(20)
#theorem(label: <e.g>)[#lorem(9)]
#proof(title: [@e.g])[+ #lorem(18)]
#theorem(title: "Name")[#lorem(6)]
#ex[#lorem(10)]
#ex(title: "Named Example")[
 To avoid having examples and such show up in the toc, use the `toc.exclude` parameter.
\#lorem(20)
```

A Detailed Documentation of all Exported Symbols A.1 fmt-body

Function to format the body

Default value of theorem.fmt-body.

Parameters

```
fmt-body(
  body: content,
  solution: content
) -> content

body   content

Theorem content.

solution   content
```

A.2 fmt-prefix

Function to run at beginning of theorem.

Default value of theorem.fmt-prefix.

```
#fmt-prefix([Theorem], [1.34], none)...
#fmt-prefix([Theorem],
[1.34], [Pythagoras])...
Theorem 1.34 ...
Theorem 1.34 (Pythagoras) ...
```

Parameters

```
fmt-prefix(
   supplement: content,
   number: content none,
   title: content none
) -> content
```

A.3 proof

This is just theorem() with different defaults.

```
#proof[#lorem(5)]
#proof(title: [@pythagoras[!]])[#lorem(6)]

Proof. Lorem ipsum dolor sit amet. 

Proof of Pythagoras (Theorem A.3). Lorem ipsum dolor sit amet, consectetur.
```

```
proof(
  kind: content,
  supplement: content,
  number: string,
  fmt-prefix: function,
  fmt-suffix: function,
  ..args: arguments
) -> content
kind
       content
Default: "proof"
supplement
              content
Default: "Proof"
number
         string
Default: none
fmt-prefix
            function
Default: proof-fmt-prefix
fmt-suffix
            function
Default: qed.with(force: false)
..args
        arguments
Same as for theorem().
```

A.4 proof-fmt-prefix

Function to run at beginning of proof.

Default value of proof.fmt-prefix.

```
#proof-fmt-prefix([Proof], none, none)...
#proof-fmt-prefix([Proof],
none, [@pythagoras])...
Proof. ...
Proof of Theorem A.3 (Pythagoras). ...
```

```
proof-fmt-prefix(
   supplement: content,
   number: content none,
   title: content none
) -> content
```

A.5 qed

Place a QED mark and clear the _thm_needs_qed flag, so that the theorem environment itself won't place one.

See proof.fmt-suffix.

Parameters

```
qed(
   suffix: content,
   force: boolean
) -> content
```

```
force boolean
```

Whether to place suffix no matter the _thm_needs_qed flag.

Default: true

A.6 restate

Re-state a theorem.

It will reuse the original kind, supplement, number, title, and body. It will *not* re-emit the solution or label, and it will use toctitle: none to avoid duplicate toc entries.

It is currently not able to pick up any of the other configuration of the original theorem, therefore pass restate.is if you modified e.g. any of the fmt-s.

```
#let proposition = theorem.with(
   kind: "proposition",
   supplement: "Proposition",
   fmt-body: (b, s) => { text(fill: red, {b;s})
)
#proposition(title: "Funky!", label: <funky>)
[Blah _blah_ blah.]
Restated:
#restate("funky")
Restated with explicit kind:
#restate(<funky>, is: proposition)
```

```
Proposition A.1 (Funky!) Blah blah blah.

Restated:

Proposition A.1 (Funky!) Blah blah blah.

Restated with explicit kind:

Proposition A.1 (Funky!) Blah blah blah.
```

```
restate(
    label: label string,
    is: function
) -> content

label label or string

Label of the theorem to restate.

is function

Theorem function to use.

Default: theorem
```

A.7 show-entry-as

Helper function to adapt actual outlines to look the same as those made with toc(). This is useful if you want to have e.g. a list of figures and a list of definitons adn want them to share their style.

Note: Fot typst versions <= 0.12, this function is a bit "hacky" and might not always work. (It deconstructs the outline.entry based on heuristics.)

```
#import theoretic: show-entry-as, toc-entry

#outline(target: figure, title: [Typst Default])

#show outline.entry: show-entry-as(toc-entry.with(hanging-indent: 60pt, /*...*/))
#outline(target: figure, title: [Using `theoretic.toc-entry`])

#figure(
   caption: [Example Figure],
   block(height: 2em, width: 100%, fill: gradient.linear(..color.map.viridis))
)
```

Parameters

```
show-entry-as(toc-entry: function)
```

```
toc-entry function
```

Customize toc-entry() used.

Expects a function taking five positional arguments (level, target, prefix, body, page).

A.8 show-ref

Show-rule-function to be able to @ labelled theorems.

Use via `#show ref: show-ref` at the beginning of your document.

```
#show ref: theoretic.show-ref
#theorem(label: <fact>, supplement: "Fact")
[#lorem(2)]
                    <pythagoras>,
#theorem(label:
                                      title:
"Pythagoras")[#lorem(2)]
#theorem(label: <zl>, title: "Only Named",
number: none)[#lorem(2)]
#theorem(label: <y>, number: "Y")[#lorem(2)]
#theorem(label: "5", number: none)[#lorem(2)]
                                         and
           consequence
                          of
                                @fact
@pythagoras[!!]...
```

```
Fact A.2 Lorem ipsum.
```

Theorem A.3 (Pythagoras) Lorem ipsum.

Theorem (Only Named) Lorem ipsum.

Theorem Y Lorem ipsum.

Theorem Lorem ipsum.

As a consequence of Fact A.2 and Pythagoras (A.3)...

The reference can be controlled via the supplement passed:

	Вотн	WITHOUT TITLE	WITHOUT NUMBER	Neither
@ref (Full)	Theorem A.3 (Pythagoras)	Fact A.2 / Theorem Y	Theorem (Only Named)	Theorem
@ref[-] (Compact)	Theorem A.3	Fact A.2 / Theorem Y	Theorem (Only Named)	Theorem
@ref[] (Number)	A.3	A.2 / Y	(Only Named)	Theorem
@ref[!] (Inverted)	Pythagoras (Theorem A.3)	Fact A.2 / Theorem Y	Only Named (Theorem)	Theorem
@ref[!!] (Compact Inverted)	Pythagoras (A.3)	Fact A.2 / Theorem Y	Only Named	Theorem
@ref[!!!] (Name)	Pythagoras	Fact A.2 / Theorem Y	Only Named	Theorem
@ref[?] (Kind)	Theorem	Fact / Theorem	Theorem	Theorem
@ref[Custom] (Custom Supplement)	Custom A.3 (Pythagoras)	Custom A.2 / Custom Y	Custom (Only Named)	Custom

Note: the fact that references and links in this document are underlined in gray is achieved with a separate @show link: it => underline(..) rule, and not because of this function.

Parameters

```
show-ref(it: ref)
```

A.9 solutions

List all solutions, if any.

See Section B for how it looks. Currently not customizable, working on it.

Parameters

```
title content
Title/heading to use.
Default: "Solutions"
```

A.10 theorem

Theorem Environment

```
#set heading(numbering: none)
#theorem[If the headings are not numbered,
theorem numbering starts at 1.]

= Heading
#theorem(title: "Pythagoras")[
  Given a right-angled triangle, the length
  of the hypothenuse squared is equal to the
  sum of the squares of the remainig sides'
  lengths.
]
```

Theorem 1 If the headings are not numbered, theorem numbering starts at 1.

Heading

Theorem 2 (Pythagoras) Given a right-angled triangle, the length of the hypothenuse squared is equal to the sum of the squares of the remaining sides' lengths.

Parameters

```
theorem(
  fmt-prefix: function,
  fmt-body: function,
  fmt-suffix: function none,
  block-args: dict,
  kind: string,
  supplement: content,
  number: auto none integer content,
  title: none content,
  toctitle: auto content array,
  label: label string,
  body: content,
  ..solution: content
) -> content
```

```
fmt-prefix function

Default: fmt-prefix
```

```
fmt-body function

Default: fmt-body
```

fmt-suffix function or none

Will be called at the end of the theorem if _thm_needs_qed hasn't been cleared. (E.g. by qed())

Default: none

block-args dict

Arguments to pass to the <code>#block[]</code> containing the theorem.

Default: (:)

kind string

Used for filtering e.g. when creating table of theorems.

Default: "theorem"

supplement content

What to label the environment.

It is recommended to keep kind and supplement matching (except for "subtypes", e.g. one might have the kind of "Example" and "Counter-Example" both as "example")

Default: "Theorem"

number auto or none or integer or content

- If auto, will continue numbering from last numbered theorem.
- If integer, it will contune the numbering of later theorems from the given number.
- If content, it is shown as-is, with no side-effects.

```
#let corollary = theorem.with(
   kind: "corollary",
   supplement: "Corollary")

#corollary[#lorem(2)]

#corollary(number: none)[Skip number]
#corollary[Resume numbering]

#corollary(number: "X")[Custom "number"]
#corollary[Resume numbering]

#corollary(number: 10)[Set number]
#corollary[Continue from set number]
```

Default: auto

Corollary A.3 Lorem ipsum.

Corollary Skip number

Corollary A.4 Resume numbering

Corollary X Custom "number"

Corollary A.5 Resume numbering

Corollary A.10 Set number

Corollary A.11 Continue from set number

title none or content

Title of the Theorem. Usually shown after the number.

Default: none

toctitle auto or content or array

Title of the Theorem to be used in outlines.

- auto to use the title.
- none to hide it from the outlines.

If you pass an array, in *sorted* outlines (toc.sort) it will be split into multiple entries. All but the first one are marked as secondary.

```
#theorem(
  title: [A to Z],
  toctitle: ([AAAAA], [ZZZZZZZ])
)[
  Compare how this appears in different
outlines!
]
```

Theorem A.12 (A to Z) Compare how this appears in different outlines!

Default: auto

label label or string

Label (for references)

note: Simply putting a <label> after the #theorem[] does not work for referencing.

Default: none

body content

Theorem body

..solution content

Optional Solution. Pass zero or one positional arguments here.

```
#theorem[#lorem(5)][This will show up
wherever `#theoretic.solutions()` is
placed.]
```

Theorem A.13 Lorem ipsum dolor sit amet.²

See solutions().

²Solution in Appendix

A.11 toc

Create an outline that includes named theorems.

Can be styled with show rules for outline.entry(). See the source code of this manual for an example.

```
#heading(outlined: false, level: 3)[
   Contents
]
#toc(depth: 1)
```

Contents							
1 Summary							
Theorem 1.2 Foo							
2 Features							
3 Examples							
Example 3.1 A complicated example							
showing some configuration							
possibilities 4							
Theorem 2 Name							
Example 4 Named Example 4							
A Detailed Documentation of all Exported							
Symbols							
Proposition A.1 Funky!							
Theorem A.3 Pythagoras							
Theorem Only Named							
Theorem 2 Pythagoras							
Theorem A.12 AAAAA / ZZZZZZZ A8							
Theorem A.14 Z							
Theorem A.15 A							
B Solutions							

Parameters

```
toc(
  depth: integer,
  exclude: list (string),
  level: integer auto,
  toc-entry: function,
  sort: bool
) -> content
```

```
depth integer
```

Maximum depth of headings to conisder

Default: 2

exclude list (string)

list of theorem.kinds to ignore.

```
#heading(outlined: false, level: 3)[
   Table of Examples
]
#toc(
   depth: 0,
   exclude: ("proof", "solution", "theorem")
)
```

Table of Examples

Default: ("proof", "solution")

level integer or auto

Fake level to use for theorems.

Set this to some level greater than the depth if to avoid conflict in your show rules for outline.entry.

If auto, it will use depth + 1.

Default: auto

toc-entry function

Customize toc-entry() used.

Expects a function taking five positional arguments (level, target, prefix, body, page).

Default: toc-entry

sort bool

Whether to sort the entries alphabetically.

Only respected if depth is 0.

If true, this will also split entries where toctitle is an array into separate entries.

```
#theorem(title: "Z")[Blah blah.]
#theorem(title: "A")[Blah blah.]
#heading(outlined: false, level: 3)[
    Sorted Table of Theorems
]
#set text(size: 9pt)
#toc(
    depth: 0,
    sort: true,
    toc-entry: toc-entry.with(hanging-indent: 60pt),
)
```

```
Theorem A.14 (Z) Blah blah.
Theorem A.15 (A) Blah blah.
Sorted Table of Theorems
Example 3.1
      A complicated example showing
      some configuration possibilities . . . 4
Theorem 2
      Example 4
      Named Example . . . . . . . . . 4
Theorem
      Theorem A.3
      Pythagoras \dots \dots A5
Theorem 2
      Theorem A.12 (ZZZZZZ)......A8
```

Default: false

A.12 toc-entry

Create a toc entry.

Pass this to toc() using .with(..) to customize the fmt- parameters used.

This is used because since Typst 0.13, it is no longer possible to call outline.entry outside of an actual ourline element, and one "cannot outline metadata".

This manual uses

```
set par(justify: false)
let indents = (0pt, 15pt, 37pt)
let hang-indents = (15pt, 22pt, 54pt)
let text-styles = ((weight: 700), (size: 10pt), (size: 9pt, weight: 500), (size: 9pt, fill:
luma(20%)),)
theoretic.toc(toc-entry: theoretic.toc-entry.with(
  indent: (level) => { indents.at(level - 1) },
  hanging-indent: (level) => { hang-indents.at(level - 1) },
  fmt-prefix: (prefix, level, _s) => {
    set text(..text-styles.at(level - 1), number-width: "tabular")
    prefix
    h(4pt)
},
fmt-body: (body, level, _s) => {
    set text(..text-styles.at(level - 1))
```

```
body
 },
  fmt-fill: (level, _s) \Longrightarrow {
   if level == 2 {
      set text(..text-styles.at(2))
      box(width: 1fr, align(right, repeat(gap: 9pt, justify: false, [.])))
  fmt-page: (page, level, _s) => {
   set text(..text-styles.at(level - 1), number-width: "tabular")
   box(width: 18pt, align(right, [#page]))
 above: (level) => {
   if level == 1 {
     auto // paragraph spacing
   } else {
      7pt
  below: auto,
))
```

```
toc-entry(
  level: int,
  target: location,
  prefix: content none,
  body: content,
  page: content,
  secondary: boolean,
  indent: relative length function,
  hanging-indent: relative length function,
  above: relative length function,
  below: relative length function,
  fmt-prefix: function,
  fmt-body: function,
  fmt-fill: function,
  fmt-page: function
```

secondary boolean

This is true for entries where the toc-title is an array, the entry was split and this is *not* the first one (in order specified).

Default: false

```
indent relative length or function
```

How much to indent each entry.

- If length, it will be multiplied with level 1.
- If function, will be called with the level as argument.

Default: 1em

```
hanging-indent relative length or function or auto
```

How much more to indent subsequent lines (in addition th toc-entry.indent).

If the prefix is shorter than this, this will lead to a gap between prefix and body; If the prefix is longer, the body will start immediately after the prefix.

- If function, will be called with the level as argument.
- If auto, will use the width of the prefix

```
#let example-entry = theoretic.toc-
entry.with(1, here(), [Section 1.],
lorem(6), [0])
#let example-entry-2 = theoretic.toc-
entry.with(2, here(), [Section 1.1.],
lorem(6), [0])

// aligned with end of prefix
#example-entry(hanging-indent: auto)
#example-entry-2(hanging-indent: lem)
#example-entry-2(hanging-indent: 1em)
#example-entry(hanging-indent: 80pt)
#example-entry-2(hanging-indent: 80pt)
```

Default: auto

```
above relative length or function
```

• If function, will be called with the level as argument.

Default: 0.7em

```
below relative length or function
```

• If function, will be called with the level as argument.

Default: 0.7em

```
fmt-prefix function

Default: (prefix, level, secondary) => {
  if prefix != none {
    prefix
    h(0.5em, weak: false)
}
}
```

```
fmt-body function

Default: (body, level, secondary) => { if secondary [(#body) ] else [#body ] }
```

```
fmt-fill function

Default: (level, secondary) => { box(width: lfr, repeat[.~]) }
```

```
fmt-page function

Default: (page, level, secondary) => { page }
```

A.13 thm-counter counter

Counts theorems.

In most cases, it is not neccesary to reset this manually, it will get updated accordingly if you pass an integer to theorem.number.

B Solutions

Solution of Exercise 2.402. Yay! you found it!

Solution of Theorem A.13. This will show up wherever #theoretic.solutions() is placed.