Impressions and results of «Interactions between Proof Assistants and Mathematics» Sep 2023, Regensburg

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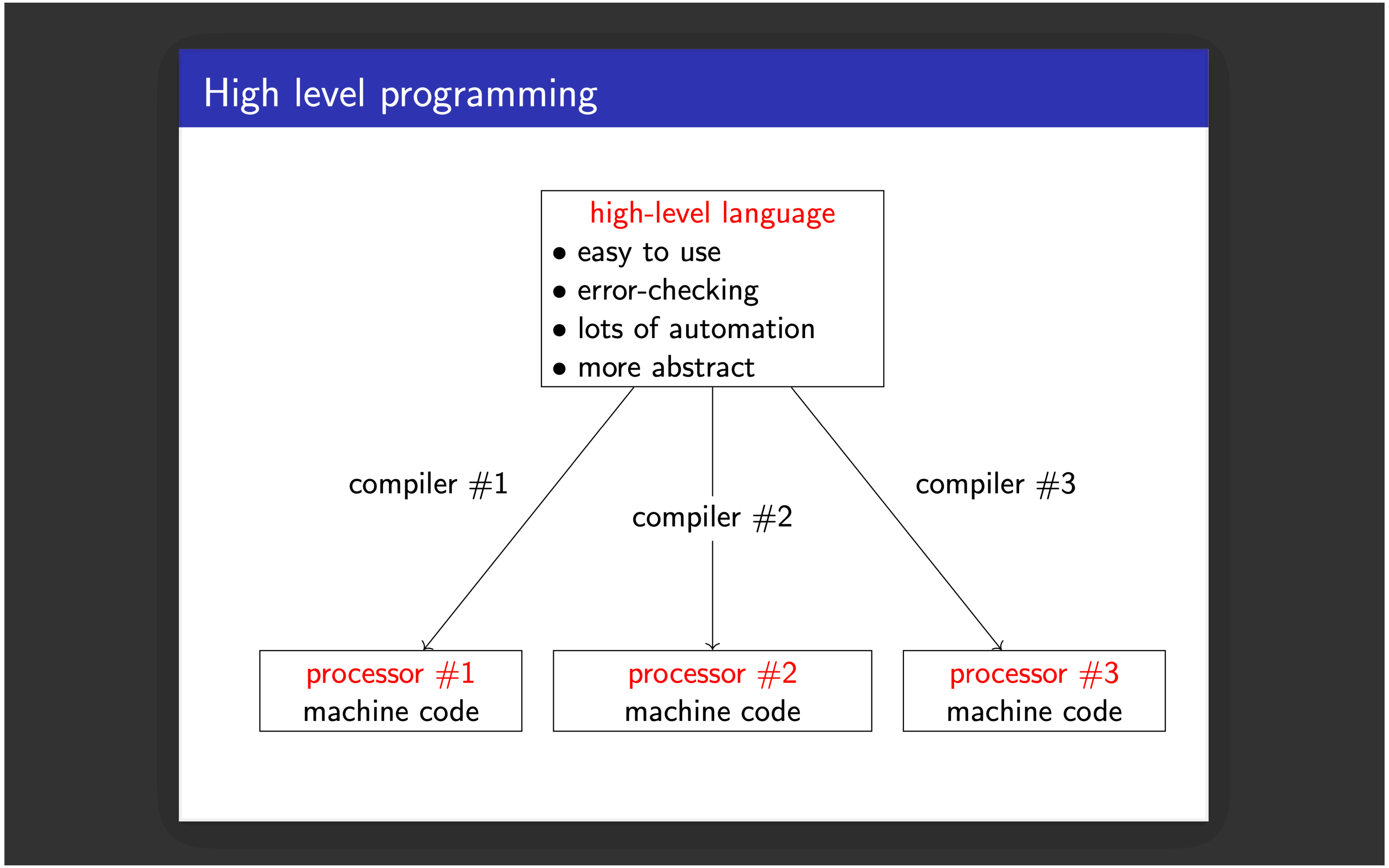
ITP-2023 school

- Two weeks — Sep 18–29, 2023, Regensburg
- About 50 participants, mostly MS and PhD students (mostly mathematicians)
- Lectures + contributed talks (by participants)
- Topics:
    - Proof assistants (Coq, Lean, Rzk, a little bit of Agda, a little bit of LISA)
    - Mathematics (most with formalization exercises):
        - HoTT, ∞-categories, synthetic algebraic geometry, algebraic type theory, modal type theory, algebraic automata theory
    - History and development of theorem provers (HOL Light)

ITP-2023 highlight #1: modal type theories

- Lecture by Mike Shulman
- Great exposition
- Good intuition
- Provoked discussions about modalities for ∞-categories and adding modalities in Rzk
- Later, I found an interesting paper that builds further on this: arxiv/2301.13780



Find Shulman's slides and Agda code at itp-school-2023.github.io/program

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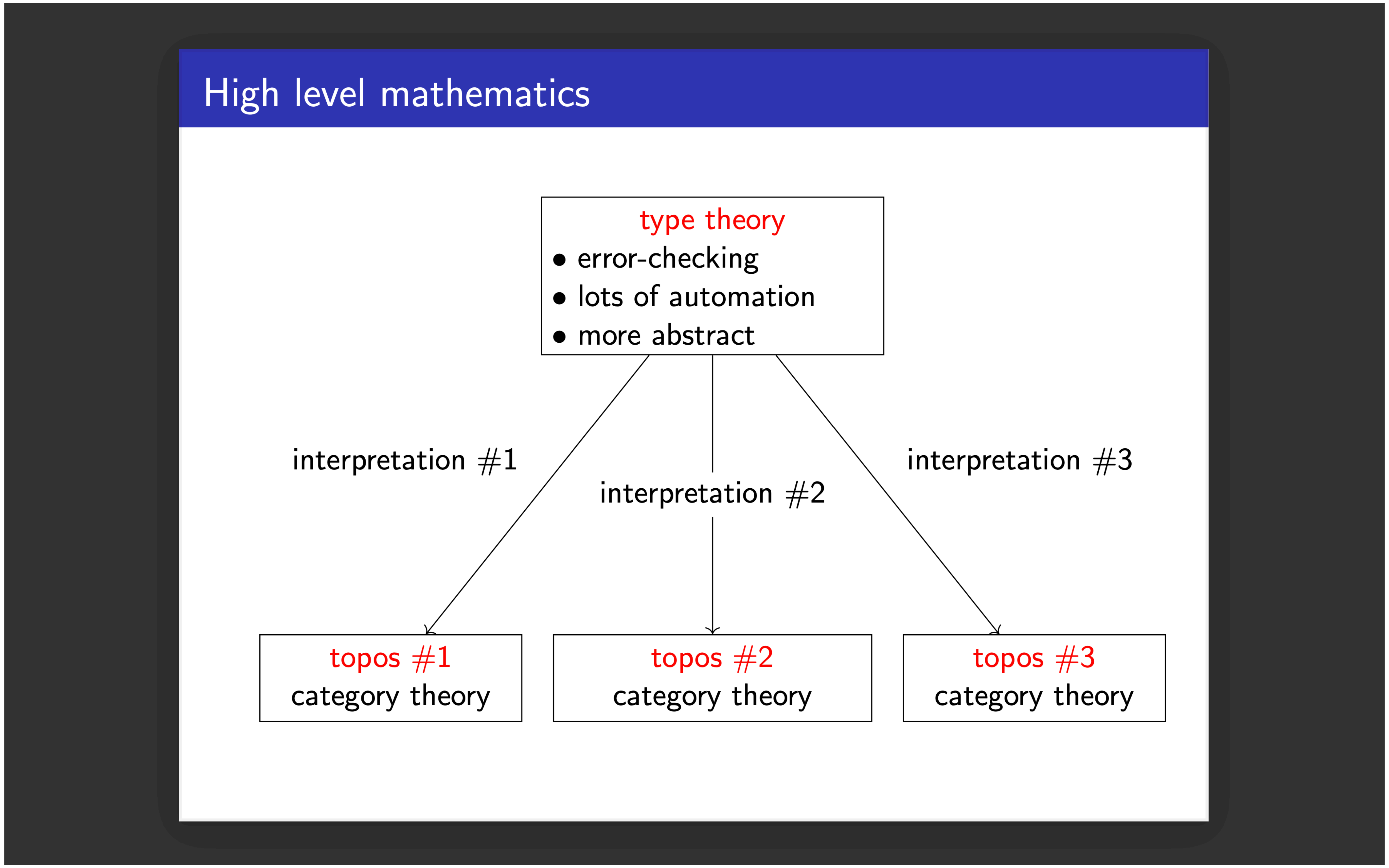

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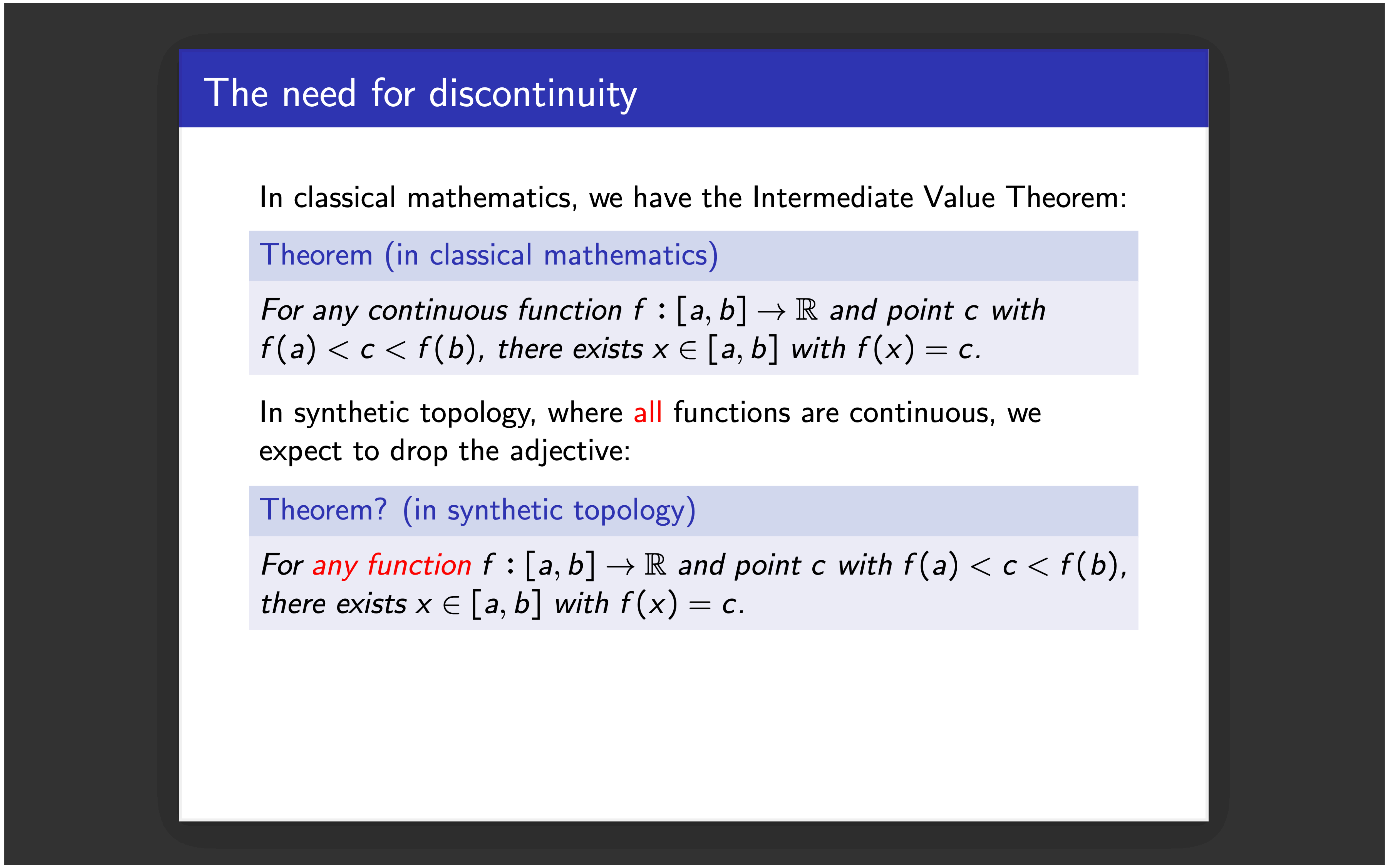

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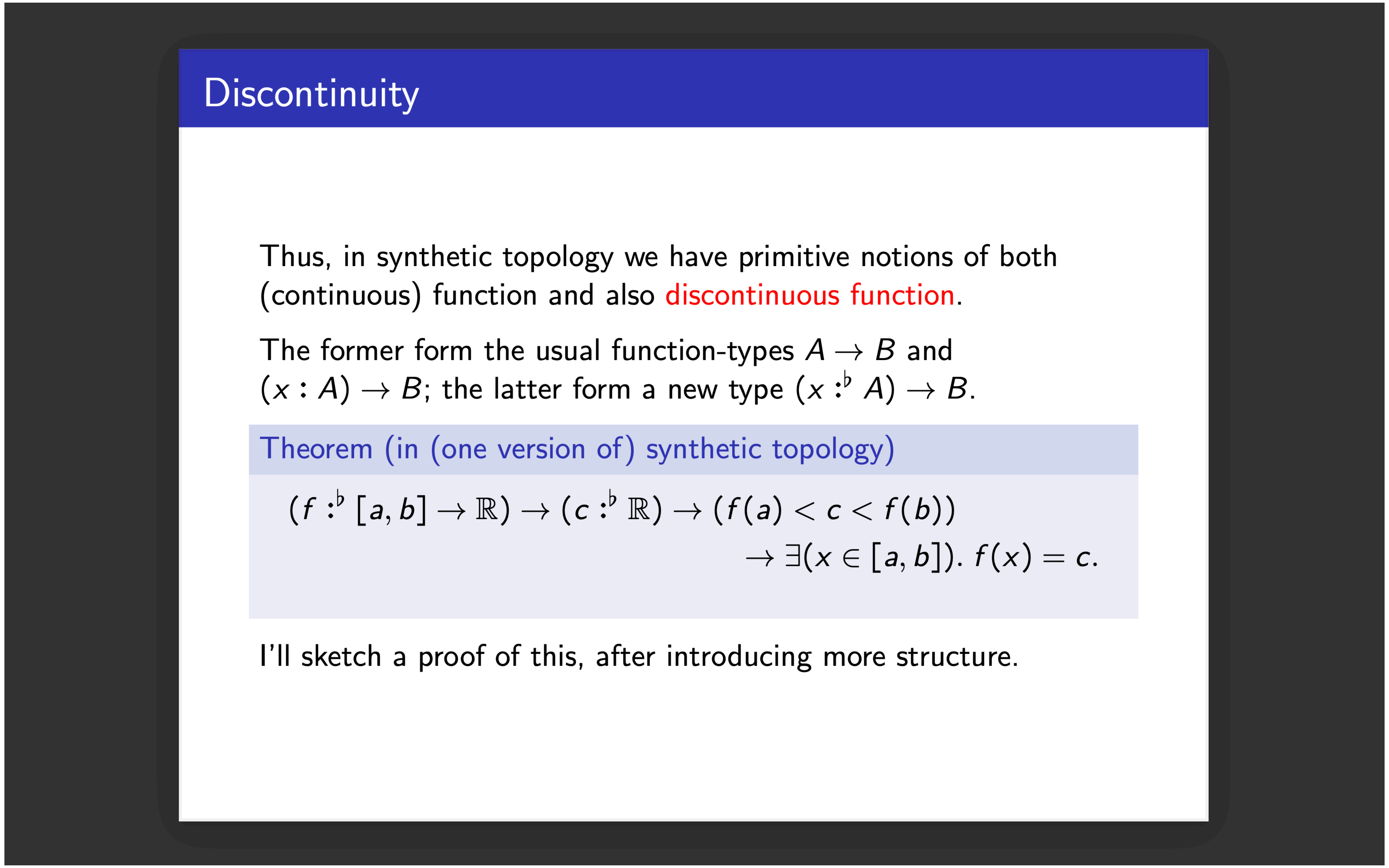

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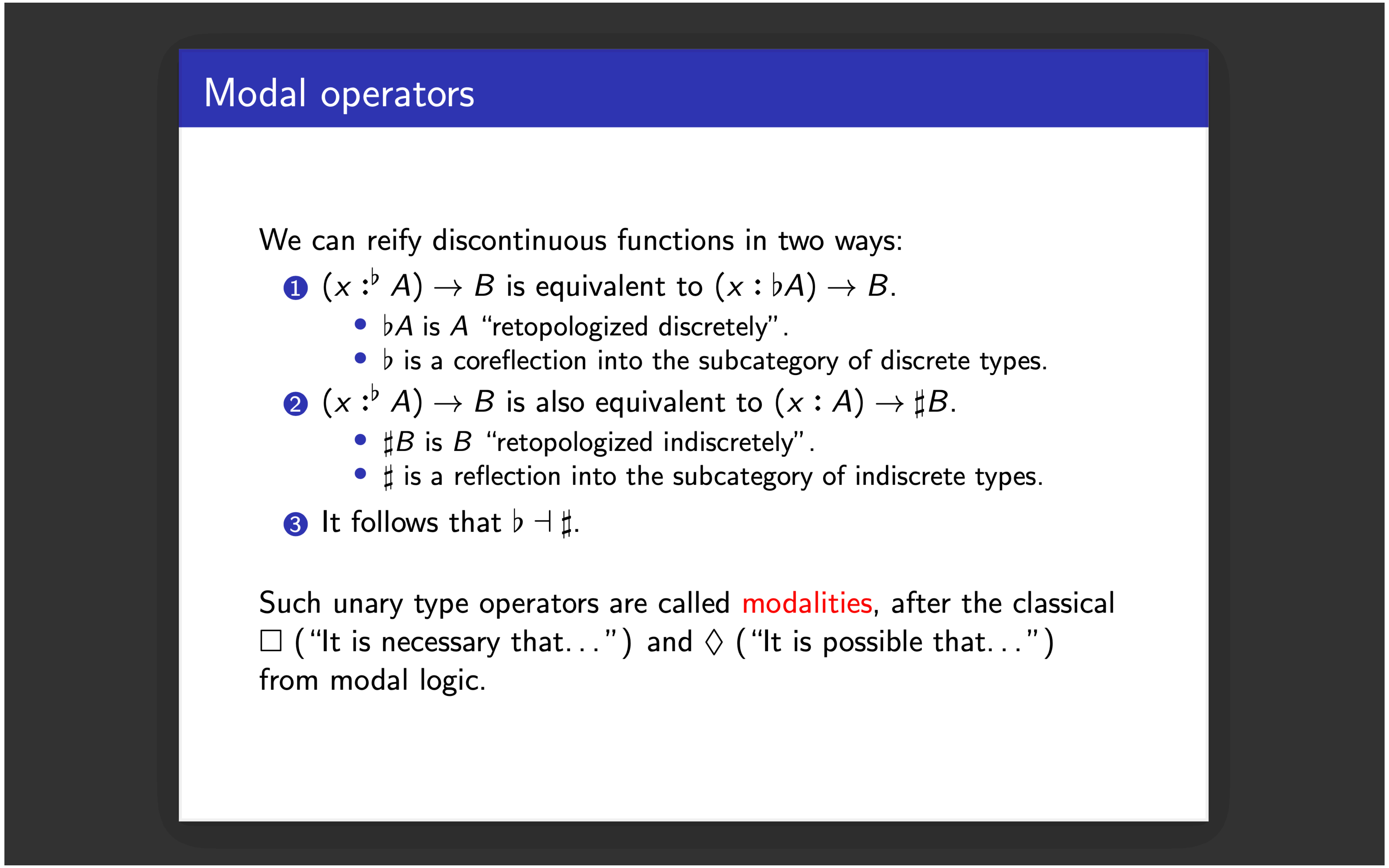

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ITP-2023 highlight #2: Lean

- Tutorials by Jannis Limperg
- Good examples
- Interactive sessions
- I was particularly interested in syntactic choices, such as **calc** mode

```
/- ## Calc Mode -/

example {f g : α → β → γ} (fg : f = g) (ab : a = b) (bc : b = c)
    (xy : x = y) : f a x = g c y := by
  calc
    f a x = f b x := by rw [ab]
    _     = f c x := by rw [bc]
    _     = f c y := by rw [xy]
    _     = g c y := by rw [fg]
```

Find Limperg's material on GitHub at [JLimperg/regensburg-itp-school-2023]

ITP-2023 highlight #3: Rzk and sHoTT (before)

- Rzk version 0.5.4
- 3 users (Emily, Jonathan, and Fredrik Bakke)
- Formalized the ∞-categorical Yoneda lemma
  - joint with Emily Riehl and Jonathan Weinberger
  - emilyriehl/yoneda
  - arxiv/2309.08340
- Started HoTT Book formalisation (for students):
  - rzk-lang.github.io/hottbook

ITP-2023 highlight #3: Rzk and sHoTT (after)

- Rzk version 0.6.4 (latest is 0.6.7) — 8 releases in 8 working days :)
- Rzk Language Server integrated with VS Code (thanks to Abdelrahman)
- 15+ active users, see contributions to rzk-lang.github.io/sHoTT
  - rzk-lang.github.io/sHoTT/CONTRIBUTORS
- 30+ participants in Rzk Zulip: rzk-lang.zulipchat.com
- Many people (more than I expected) interested in Rzk and its further development
- Many directions for future work:
  - (Directed) Higher-inductive types, Modalities, (∞,∞)-categories
  - Better IDE support