

README

This book / repository contains the lecture notes and supplementary materials for the hobby course “Introduction to Formal Mathematics with Lean 4”, offered in Fall 2025 at Beijing Institute of Technology.

It is best to download the repository and read it alongside a Lean 4 environment, so that you can try out the code examples and exercises interactively. We maintain an online version of the lecture notes with embedded Lean code if you prefer to read it in your browser. A printed PDF version is also provided as a souvenir, though no special effort has been made to resolve the hyperlinks.

Portals

- Course repository: <https://github.com/sun123zxy/2025fall-lean4-teach>
- Online lecture notes: <https://sun123zxy.github.io/2025fall-lean4-teach/>
- Online compiler: <https://live.lean-lang.org>
- Community (Lean Zulip): <https://leanprover.zulipchat.com/>
- Lean 4 tactics cheatsheet: <https://leanprover-community.github.io/papers/lean-tactics.pdf>

Installation

First make sure you have installed Git, VSCode and Lean 4 extension for VSCode correctly. Then execute the following commands in your terminal:

```
git clone git@github.com:sun123zxy/2025fall-lean4-teach.git
cd 2025fall-lean4-teach
lake exe cache get
```

To update the repository, make sure you have discarded any local changes (otherwise you may need to merge manually). Then execute the following commands in your terminal:

```
git pull
```

Compiling the Book

Both the online and the PDF version of this book are generated by SUNQUARTEX, a publishing system based on Quarto and LaTeX. Refer to <https://github.com/sun123zxy/sunquartex> for more information.

References

We recommend the following resources for further study of Lean and formalized mathematics.

Introductory videos and articles:

- CAV2024: <https://leodemoura.github.io/files/CAV2024.pdf>
- Terence Tao at IMO 2024: AI and Mathematics: <https://www.youtube.com/watch?v=e049IoFBnLA>
- Lean 的前世今生: <https://zhuanlan.zhihu.com/p/183902909>
- Natural Number Game: <https://adam.math.hhu.de/#/g/leanprover-community/nng4>
- Computational Trilogy - nLab: <https://ncatlab.org/nlab/show/computational+trilogy>

Bibles for further study:

- Mathematics in Lean (MIL): https://leanprover-community.github.io/mathematics_in_lean/

A comprehensive tutorial for mathematicians to get started with Lean and the mathlib library. Focuses on building up mathematical structures.

- Theorem Proving in Lean 4: https://leanprover.github.io/theorem_proving_in_lean4/
Strong emphasis on logic and dependent type theory. Excellent for both mathematicians and computer scientists.

- Lean Language Manual: <https://lean-lang.org/doc/reference/latest/>

Comprehensive, precise description of Lean: a reference work in which Lean users can look up detailed information, rather than a tutorial intended for new users.

- Type Theory - nLab: <https://ncatlab.org/nlab/show/type+theory>

If you want to understand the theoretical foundations of Lean, this is a good place to start.

- Other bibles: <https://lakesare.brick.do/all-lean-books-and-where-to-find-them-x2nYwjM3AwBQ>

Courses and lecture notes:

- Kevin Buzzard's 2024 course on formalising mathematics in the Lean theorem prover: <https://github.com/ImperialCollegeLondon/formalising-mathematics-2024>