Proof Assistants

Thomas Bauereiss (tb592), Leo Stefanesco (lads2)

ACS / Part III CST – 2025-2026

Who are you?

Proof Assistants

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- precise formal notion
- machine-checked

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- develop
- maintain & evolve
- *partly* automated

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This is about developing computer tools [...] to help researchers and students in new ways. — Kevin Buzzard, 2022 International Congress of Mathematicians

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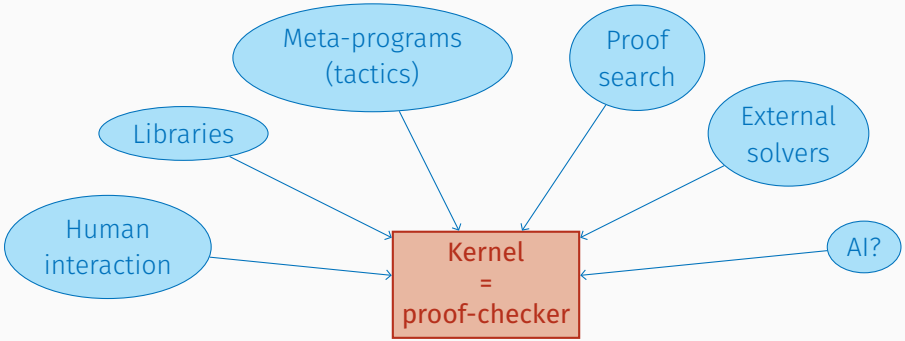
... and programmers too!

The kernel and the rest



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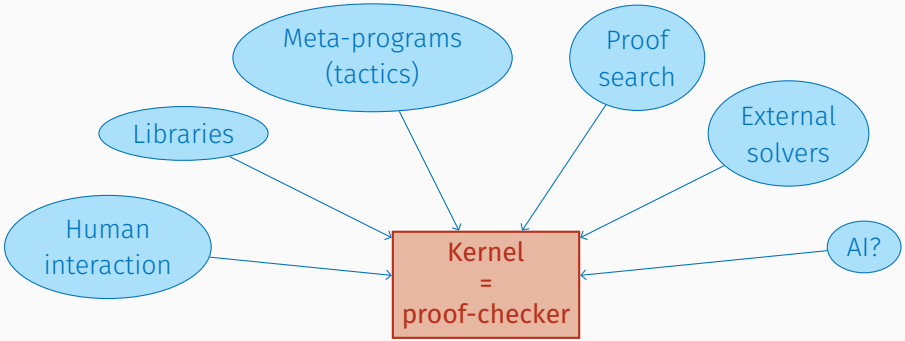

Demo in a minute

Prehistory ('70s) Automath, Mizar, LCF

A short history

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Four colour theorem (2005) first “important” certified proof

CompCert (2005), seL4 (2009) “real-life” certified programs

Odd order theorem (2012), Flyspeck (2014) first big mathematical theorems

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HoTT, Liquid Tensor Experiment (2021) proof assistants for cutting-edge maths

Fiat Crypto (2017-...), Everest (2016-...), Cedar (2023-...), AWS Nitro (2025-...) formal proofs in large tech companies, integration in mainstream applications

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...and many more

Higher-order logic

HOL Light

PVS

A family picture

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Dependent type theory

Coq → Rocq

general purpose

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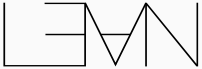

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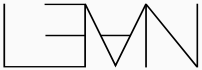

goals basic autonomy & familiarity, transferable knowledge

subject basic PL theory *à la* Part IB – Semantics

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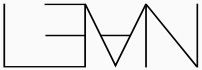

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Resources on the course webpage!

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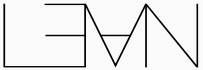

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Thanks to Meven Lennon-Bertrand (now at Inria/IRIF) for co-lecturing last year's course and providing material for this year's course.

Structure

- 6 Isabelle/HOL lectures (Bauereiss)
- 5 Lean lectures (Stefanesco)
- 4 practical sessions (bring your computer)

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Assignments: two small projects, one in Isabelle/HOL, one in Lean.

Install the proof assistants

TODAY !

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Instructions on the course webpage.