SMT-based constraint solving in Lean 4

The cvc.lean library: safety and ergonomics

Adrien Champion – *he/him*

repository
github.com/anzenlang/cvc.lean

information, slides, and relevant links
anzenlang.io

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cvc.lean: context

- collaboration with *Cesare Tinelli* at the University of Iowa, and the cvc5 team
- Lean 4 library exposing the cvc5 (C++) SMT solver's API --- using C-level FFI
- focus on safety and ergonomics
- public but unstable, not officially released: everything can change (and will improve)
- offshoot of the lean-smt project

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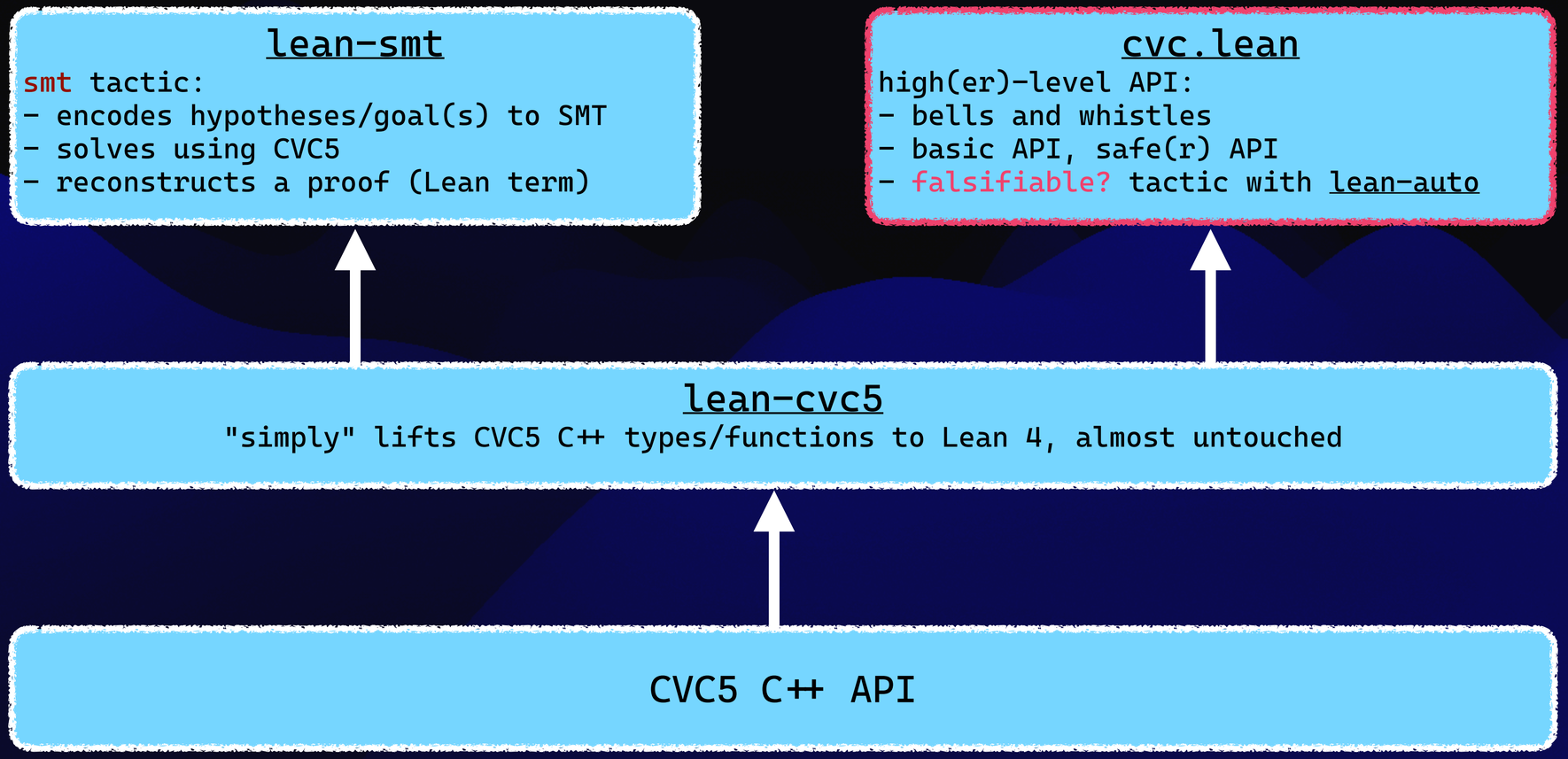
cvc5 libraries: architecture



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Let me just show you

- access the (documented) demo file here:

  github.com/anzenlang/cvc.lean/blob/2025_02_demo/CvcTest/Demo/2025February.lean

- or retrieve this link (and the slides) at anzenlang.io/blog

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Advanced features

- interpolation
- quantifier-elimination
- partial information retrieval in *unknown* mode
- proof / unsat-core retrieval in *unsat* mode
- sat-core in *unsat* mode

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Towards an even safer API

- stronger constraints on polymorphic functions such as add/mul/*etc.*
- push the Safe.SmtM environment further
  - InitM: pre-SmtM, only allows setOption-like commands
    and setLogic which would go to SmtM (which would not allow these commands)
  - ask for a proof that produceModels is set when running getValue/getModel?
- more flexible unsafe/safe(r) API-s
  - using untyped terms can be reasonable in some contexts
  - ergonomic, safe bridges between the two API-s would let users benefit from safety where appropriate for their use-case

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Thank you!

Useful links

- information, slides, relevant links for this talk: anzenlang.io
- cvc.lean: github.com/anzenlang/cvc.lean

- lean-cvc5 (very low-level cvc5 FFI): github.com/abdoo8080/lean-cvc5
- lean-smt: github.com/ufmg-smite/lean-smt

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