

Reconstructing MetiTarski Proofs in Isabelle/HOL

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Outline

- 1 MetiTarski
- 2 Sledgehammer

- Automatic theorem prover (ATP)
- Proves universally quantified inequalities involving:
 - ▶ polynomials
 - ▶ real-valued special functions: *log*, *exp*, *sin*, *cos*, *sqrt* etc.
- Using:
 - ▶ resolution
 - ▶ a decision procedure for the theory of real closed fields (RCF)
- The special functions are *approximated* by polynomials. So MetiTarski is incomplete. (Without the approximations, the problem is undecidable.)

Motivation

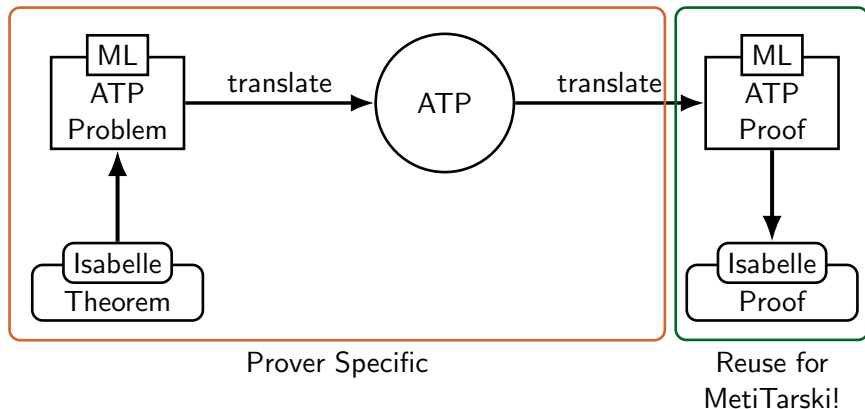
- Long-term goal: use MetiTarski inside Imandra to solve geometric problems
- Why translate MetiTarski proofs to Isabelle proofs?
 - ▶ No formal guarantee that the MetiTarski proofs are correct.
 - ▶ Isabelle is more trustworthy than MetiTarski
 - ▶ If proof reconstruction is available, MetiTarski can be included as an automated tool in Isabelle

The Problem

Side by side picture of an MT and Isabelle proofs

Sledgehammer

- Automatic proof tool in Isabelle.
- Sledgehammer operation:



The Translation

Generating Isabelle Proofs

MetiTarski Proof Steps

- ① `decision`: invokes the RCF decision procedure
- ② `arithmetic`: algebraic simplification

Summary

- What's been done:
 - ▶ Translation from Isabelle Lemmas to termified ATP Proofs
 - ▶
- Still to do:
 - ▶