Theorem Proving in Isabelle

Lutz Schröder

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Literature

Logic in Computer Science

- U. Schöning: Logik für Informatiker, B.I. Wissenschaftsverlag, 1989.
- H. J. Kreowski: Logische Grundlagen der Informatik, Oldenbourg, 1991.
- P. B. Andrews: An Introduction to Mathematical Logic and Type Theory: To Truth Through Proof, Academic Press, 1986
- J. Barwise and J. Etchemendy: Language, Proof and Logic; CSLI, 1999

Isabelle documentation

Get it from

http://www.cl.cam.ac.uk/Research/HVG/Isabelle/

In particular:

- T. Nipkow, L. C. Paulson, M. Wenzel: Isabelle/HOL: A Proof Assistant For Higher Order Logic
- T. Nipkow: Structured proofs in Isar/HOL
- L. C. Paulson: Introduction to Isabelle
- L. C. Paulson: The Isabelle Reference Manual
- T. Nipkow, L. C. Paulson, and M. Wenzel: Isabelle's logics: HOL

Introduction

What the . . . is Isabelle?

Isabelle is a generic theorem prover

- Provides (higher-order) meta-logic
- Built-in basic proof tactics
- Object logics are coded as theories
- Tactics/meta-tactics ('tacticals') can be programmed (in ML)

Object logics??

Yes. E.g.:

- Equational Logic / Conditional Equational Logic
- Which connectives are allowed? (E.g. only $\wedge$, $\Longrightarrow$)
- Which quantifiers? (E.g. only $\forall$)
- Quantification over individuals (FOL)/ functions (HOL)?
- Excluded middle (Classical Logic vs. Intuitionistic Logic)?
- Exotic things: Modal Logic, Linear Logic,. . .

Meta-Logic...?

‘The word ”meta-logic” should not be used
in front of small children’
(J.-Y. Girard)

Meta-Logic...?

- The meta-logic is just a logic
  (IHOL + Type classes)
- Object logics are defined in this logic
- Proofs in the object logic become proofs
  about the object logic:
  FOL says: A holds;
  Isabelle says: A can be proved in FOL

Look at the definition of FOL