The LEO-II Project

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Project Objectives

The LEO-II project develops a resolution-based theorem prover for classical higher-order logic which can cooperate with automated first-order provers. LEO-II predominantly addresses higher-order aspects in its reasoning process in order to quickly transform higher-order clauses into essentially first-order clauses. The subsequently growing set of essentially first-order clauses in the search space can then eventually be efficiently refuted by a first-order prover.

As an external reasoner LEO-II shall support interactive proof assistants such as Isabelle/HOL, HOL, and OMEGA by automating subproblems and thereby reducing the interaction effort (costs). It focuses on (but is not limited to) subproblems as they arise in program verification. LEO-II is implemented in Objective CAML and its problem representation language is HOTPTP.

Research Topics

- ▶ Minimize cut-simulation effect [3] by using
  - primitive equality instead of Leibniz equality
  - built-in extensionality rules instead of axioms
  - etc.
- ▶ Perfectly shared datastructures and indexing techniques for higher-order logic [5]
- ▶ Towards
  - higher-order rewrite- and simplification orderings
  - extensional higher-order superposition
- ▶ Prover architectures and search strategies supporting
  - extensional higher-order resolution / superposition
  - cooperation with first-order provers [1]
- ▶ Experiments in selected problem domains
  - hardware and software verification
  - mathematics, especially set-theory
  - logical puzzles

Interacting with LEO-II

LEO-II versus LEO

	LEO [2, 4]	LEO-II
calculus	extensional higher-order resolution	extensional higher-order resolution / superposition
datastructures	KEIM generic datastructures	highly specialized datastructures
termsharing	no sharing	perfectly shared terms
termindexing	basic termindexing	improved indexing techniques
modi	automatic + interactive	automatic + interactive
architecture	agent-based cooperation with FO-ATP	in experimental stage
strategy	extended set of support	extended set of support and others
language	POST	HOTPTP
implementation	LISP (as part of OMEGA system)	Objective CAML (as standalone system)

Literature on LEO and LEO-II

[1] C. Benzmüller et al. Can a higher-order and a first-order theorem prover cooperate? LPAR 2005.
[2] C. Benzmüller. System description: LEO. ESHOL WS at LPAR 2005.
[3] C. Benzmüller, C. Brown, and M. Kohlhase. Cut-simulation in impredicate logics. IJCAR 2006.
[4] C. Benzmüller and M. Kohlhase. LEO – a higher-order theorem prover. CADE 1998.
[5] F. Theiss and C. Benzmüller. Term indexing for the LEO-II prover. IWIL WS at LPAR 2006.