

Formalizing Rewriting in Isabelle

A Course in the Advanced Track of
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Summary. Students of this course will acquire *working knowledge* with the state-of-the-art proof assistant *Isabelle/HOL* [1,2], focusing on the formalization of term rewriting. They will further learn about the *certification* approach, as it is used in the international confluence¹ and termination competitions.² To this end, students will be introduced to several of the techniques that have been used in the development of *IsaFoR* and *CeTA* [3].³

Mode. There will be four 90 min sessions. As a rough estimate, the first half of each session will be spent on new concepts, while the second half will consist of hands-on exercises that will help to solidify the new knowledge.

The course will cover to following two main topics:

- Isabelle basics: types, functions, induction, code generation, deep embedding of term rewriting.
- Development of a loop certifier: the certification approach, formalization of abstract properties, development of a sound matching algorithm, a basic checker, and, in turn, piecewise improvements.

Prerequisites. We assume basic familiarity with term rewriting, functional programming, and logic. (Although motivated students could probably survive with only one of these topics.)

References

- [1] T. Nipkow and G. Klein. *Concrete Semantics - With Isabelle/HOL*. Springer, 2014. (Only part I of the book is relevant for this course.)
- [2] T. Nipkow, L. Paulson, and M. Wenzel. *Isabelle/HOL: A Proof Assistant for Higher-Order Logic*. LNCS 2283. Springer, 2002.
- [3] R. Thiemann and C. Sternagel. Certification of termination proofs using CeTA. In *TPHOLS 2009*, volume 5674 of *LNCS*, pages 452–468, 2009.

¹<http://coco.nue.riec.tohoku.ac.jp/>

²http://termination-portal.org/wiki/Termination_Competition

³<http://cl-informatik.uibk.ac.at/software/ceta>