A Graphical Simplification Tactic over algebraic expressions

Offered by: Benjamin Werner `benjamin.werner@inria.fr`
Location: Inria-X team Partout, LIX, Ecole polytechnique

Context

Coq is a well-known proof system, based on type theory whose development is organized by Inria. Actema is a prototype of a novel user interface for building formal proofs, developed at LIX; it builds on theoretical tools coming from Deep Inference, and is based on the idea that the user can easily point to subterms of either the goal or hypotheses. A description can be found in [1]. A first version of Actema, restricted to first-order logic can be tested online (http://actema.xyz/). A new version acts as a front-end for Coq (https://github.com/Champitoad/coq-actema/)

Goal

This Coq-Actema implementations includes Actema as a front-end, which has been adapted by Pablo Donato and Mathis Bouverot to present Coq proof states, and export the Actema actions back to Coq. Specialized tactics, written by Benjamin Werner and Mathis Bouverot, translate these actions into the type theory of Coq.

One target of such an interface is to become a pedagogical tool. Laurent Théry [4] has designed and described a proof tactic for Coq which performs algebraic simplifications in a school like manner (going from 3 + a - z = 2 a to 3 - z = a to take a simple example). It makes sense to make this tactic graphical, allowing the user to point to the elements to be simplified.

The aim of the internship is to understand how this approach could be adapted to, and expanded by, the Actema approach, and to implement it.

Assessment

There should be a fair balance between theory and implementation in the work to be done. Knowledge of Coq, logic, and a taste for functional programming are mandatory.

Bibliography

[1] Kaustuv Chaudhuri. Subformula Linking for Intuitionistic Logic with Application to Type Theory *CADE 2021.*

[2] Pablo Donato, Pierre-Yves Strub, Benjamin Werner. A Drag-and-Drop Proof Tactic. CPP 2022. https://hal.science/hal-03823357v2

[3] Pablo Donato, Benjamin Werner, Kaustuv Chaudhuri. Integrating Graphical Proofs in Coq. Talk at CoqPL 2023. https://www.lix.polytechnique.fr/Labo/Pablo.DONATO/abstracts/coqpl23.pdf

[4] Laurent Théry. Simplifying Polynomial Expressions in a Proof Assistant. Rapport de Recherche Inria 5614. https://inria.hal.science/inria-00070394 2005