jsCoq/SerAPI: New Interfaces for Interactive Theorem Proving

Internship proposal — 2018

Centre de recherche en informatique, MINES ParisTech

The MINES ParisTech Centre de recherche en informatique (CRI) offers an internship to explore new user interaction possibilities in proof assistants. The focus will be on extending the User Interface (UI) capabilities of the popular Coq [3] interactive proof assistant, based on the *Calculus of Inductive Constructions*, a dependently-typed functional language. Coq comes with a powerful proof tactic language and has been key to several mechanization milestones such as the formalization of Feit-Thompsom theorem or the development of CompCert verified compiler, among others.

Interactive Theorem Proving (ITP) poses new challenges to UIs. The complexity of proofs and underlying programming language goes well beyond what regular Interactive Development Environments (IDE) typically support; literate programming and custom notation and syntax are pervasive; and good layered display capabilities are essential to an effective understanding of the tool's output in the frequent "input-response cycle" used during proof design.

The jsCoq [2] project (developed at CRI) is a port of Coq to the modern web browser platform, allowing web pages to embed interactive proof scripts. The browser platform opens up new possibilities of interaction, display, distribution, and education. SerAPI [1] is a new lightweight protocol designed to help machine-based interaction with Coq, such as used within IDEs and code-analysis tools. SerAPI is based on generic programming techniques and is developed in close collaboration with upstream tool developers.

This internship is a good opportunity to become familiar with the implementation of modern proof assistants and challenges of interactive proofs. We are quite open on concrete goals; we would love to discuss more with interested students. Some ideas are:

Protocol Work to provide better support for document-oriented environments, parallel proof checking, and large-scale proof projects; to improve the query protocol, which powers code completion, display, and proof analysis tools; to implement Microsoft's language server protocol or Jupyter notebook compatibility;

UI Work to develop a proof UI using Jupyter's web libraries; to improve integration with documentation generation tools; to improve search, pattern, type, and goal display; to study and improve the proof workflow on common use cases.

All our projects are open source and available at github.

Desirable Requisites: We recommend basic familiarity with Coq and its proof workflow, and either fluency in Ocaml or knowledge in JavaScript and UI web development.

Compensation: MINES ParisTech internships may be funded, typically along the lines fixed by law (about 400 euros per month).

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References

[1] E. J. Gallego Arias. "SerAPI: Machine-Friendly, Data-Centric Serialization for Coq". preprint. Oct. 2016. URL: https://github.com/ejgallego/coq-serapi/.

[2] E. J. Gallego Arias, B. Pin, and P. Jouvelot. "jsCoq: Towards Hybrid Theorem Proving Interfaces". In: *Proceedings of the 12th Workshop on User Interfaces for Theorem Provers, Coimbra, Portugal, 2nd July 2016*. Ed. by S. Autexier and P. Quaresma. Vol. 239. Electronic Proceedings in Theoretical Computer Science. Open Publishing Association, 2017, pp. 15–27. DOI: 10.4204/EPTCS.239.2.

[3] The Coq development team. *The Coq proof assistant reference manual*. Version 8.5pl1. LogiCal Project. 2016. URL: http://coq.inria.fr.