

Postdoc: metaprogramming a principled category theory library with Coq/Hierarchy-Builder

January 18, 2023

Context

This is a 1–year long postdoc position to take place at the Inria center in Sophia Antipolis (Nice), under the supervision of Enrico Tassi and Cyril Cohen (STAMP Team). The postdoc researcher will work in the context of the ANR project CoREACT *Coq-based Rewriting: towards Executable Applied Category Theory*. There is also the opportunity to continue this postdoc contract with a follow up one of 2-years to take place in the ENS Lyon.

One of the main goals of CoREACT is to develop and maintain an interactive Coq-based wiki system for categorical rewriting theory, aimed at both certifying and preserving knowledge in this area of research in a modern and freely accessible format.

Inspired by prior work on formalised category theory in Coq, Coq/HoTT, UniMath, Agda, as well as Lean3/mathlib, we employ Hierarchy Builder (HB) [3] to organise and apply category-theoretical knowledge in a concise way, with maximal sharing of notations, and with fast automated inference of structure. Indeed, HB provides a domain-specific language to concisely declare abstract interfaces such as mathematical structures, piece by piece, to explain how they are related to each other, and to declare examples. HB compiles this language to Coq definitions, notations and structures, and also to hints for Coq’s unification and inference mechanisms in order to automatically recover structures. HB is implemented using the Elpi [4] extension language for Coq.

Tasks

The post doc will both work at improving the support in HB for categorical structures and in building the foundations of a Coq library for HB, so that we can import results from HoTT [6], Unimath [1], Agda [5] and Lean [2] category libraries.

Perspectives

Once this infrastructure is set up, other members of the CoREACT ANR start developing high-level tactics to work efficiently in the various kinds of categories to be encountered, and use those tools to develop a formal library of categorical rewriting theory. This will be one of the main tasks of the PostDoc to be recruited on the ENS Lyon site.

Requirements

We expect the candidate to be knowledgeable about Coq and the fundamentals of Category theory. In addition, knowledge about Logic Programming and HOAS (Twelf/Beluga, λ -Prolog, etc) is a plus, as well as knowledge of the SSreflect tactic language.

Position information

- Location: Inria Sophia Antipolis Research center, STAMP Team
<https://team.inria.fr/stamp/>
- Beginning and duration: March 1st, 2023, for 1 year
- Gross salary: 2746€/month
- Application deadline: February 12th, 2023
- Application link:
<https://jobs.inria.fr/public/classic/fr/offres/2022-05646>

References

- [1] Benedikt Ahrens, Peter Lefanu Lumsdaine, and Vladimir Voevodsky. Categorical Structures for Type Theory in Univalent Foundations . In Valentin Goranko and Mads Dam, editors, *26th EACSL Annual Conference on Computer Science Logic (CSL 2017)*, volume 82 of *26th EACSL Annual Conference on Computer Science Logic (CSL 2017)*, pages 8:1 – 8:16, Stockholm, Sweden, August 2017. LIPIcs.
- [2] Kevin Buzzard, Chris Hughes, Kenny Lau, Amelia Livingston, Ramon Fernández Mir, and Scott Morrison. Schemes in lean. *Experimental Mathematics*, 31(2):355–363, 2022.
- [3] Cyril Cohen, Kazuhiko Sakaguchi, and Enrico Tassi. Hierarchy Builder: Algebraic hierarchies Made Easy in Coq with Elpi (System Description). In Zena M. Ariola, editor, *FSCD 2020*, volume 167 of *LIPIcs*, pages 34:1–34:21, Dagstuhl, Germany, 2020. Schloss Dagstuhl–Leibniz-Zentrum für Informatik.

- [4] Cvetan Dunchev, Ferruccio Guidi, Claudio Sacerdoti Coen, and Enrico Tassi. ELPI: Fast, Embeddable, λ Prolog Interpreter. In Martin Davis, Ansgar Fehnker, Annabelle McIver, and Andrei Voronkov, editors, *Logic for Programming, Artificial Intelligence, and Reasoning*, volume 9450 of *LNCS*, pages 460–468. Springer Berlin Heidelberg, 2015.
- [5] Jason Z. S. Hu and Jacques Carette. Proof-relevant category theory in agda. *CoRR*, abs/2005.07059, 2020.
- [6] The Univalent Foundations Program. Homotopy type theory: Univalent foundations of mathematics, 2013.