

Coend calculus as a deductive system

Summary

Category theory formalised in a proof assistant is a popular tool to study mathematical structures for the semantics of programming languages from a formal perspective. This PhD explores a fragment of it with focus on the so-called "coend calculus". We aim at developing the basic building blocks of coend calculus in a proof assistant, while at the same time substantiating the idea that the rules of this calculus can be seen as a deductive system of some sort.

Research field:	Information and communication technology
Supervisors:	Dr. Niccolò Veltri Dr. Fosco Loregian
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Software Science
Application deadline:	Applications are accepted between October 01, 2022 00:00 and October 23, 2022 23:59 (Europe/Zurich)

Description

"Coend calculus" is the set of elementary theorems allowing to express natural transformations, Yoneda lemma, Kan extensions, etc. as suitable universal objects [ref]. We aim to turn into a precise statement the intuitive idea that these rules can be regarded as rewriting rules of a deductive system. This is tightly connected with several approaches to proof theory employing 2-dimensional category theory [4, 5]. A further goal of the project is the formalisation in a proof assistant (e.g. Agda, cf. [2]) of basic category-theoretic notions, relying solely on coend calculus: all elementary notions of category theory can be expressed using ends and coends as a unifying concept [1, 3].

Supervisor

Main Supervisor: Niccolò Veltri
Co-Supervisor: Fosco Loregian

Responsibilities and tasks

The student's primary responsibility is research on this PhD project. The student may contribute to the teaching activities of the lab as a course assistant.

Qualifications

Candidates must have a MSc degree in computer science or mathematics.

The applicants should fulfil the following requirements

The successful candidate is knowledgeable in at least one and interested in all of the following: logic (proof theory), category theory, functional programming.

Bibliography

- [1] Loregian, F. (Co)end Calculus (London Mathematical Society Lecture Note Series). Cambridge: Cambridge University Press, 2021. doi:10.1017/9781108778657
- [2] Hu, Jason Z. S., Carette, J. "Formalizing Category Theory in Agda". CPP '21: 10th ACM SIGPLAN International Conference on Certified Programs and Proofs, 2021.
- [3] Cordier, Jean-Marc, and Timothy Porter. "Homotopy coherent category theory." Transactions of the American Mathematical Society 349.1 (1997): 1-54.
- [4] Seely, Robert A. G. "Modelling computations: a 2-categorical framework." LICS. 1987.



[5] Hirschowitz, Tom. "Cartesian closed 2-categories and permutation equivalence in higher-order rewriting." Logical Methods in Computer Science 9 (2013).



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