Short-Term Scientific Mission Grant

• APPLICATION FORM[1] -

Action number: CA20111

Applicant name: Luc Chabassier

Details of the STSM

Title:An interface for category theory in coq, applied to univalent foundations

Start and end date: 04/09/2023 to 15/09/2023

Goals of the STSM

Purpose and summary of the STSM

(max.200 word)

I am working on a graphical interface for category theory proofs in Coq, to allows mathematicians using proof assistants to do diagrammatics proofs in a manner closer to what they would do on paper. Benedikt is formalising category theory in Coq as part of his work on univalent fundations, and has shown interest in using my tool. By working with him I hope to get quick feedback on how the interface could be improved for real use cases.

Working Plan

Description of the work to be carried out by the applicant.

(max.500 word)

By the time of the STSM, I should have most of the features requested by Benedikt (and other researchers I am collaborating with) implemented, allowing for a quicker iteration on interface and user experience. So the plan is to have Benedikt use the plugin for some developement of a proof in category theory in Coq under my supervision, so that I can notice the pain points, and how to improve the integration into a typical workflow. Hopefully, since at that point no new features should be needed, updating the plugin should be doable almost as we go along, enabling a quick feedback loop. One of the main points that will beneficiate from this interaction is the lemma earching interface. Since this interface is for working with diagrams, lemmas are first translated into diagrams, and their application can be done in a purely graphical way. As such, most of the usual ways a looking for lemmas (ie using Search in Coq), do not apply since lemmas are not formulas anymore, but graphs.

[1] This form is part of the application for a grant to visit a host organisation located in a different country than the country of affiliation. It is submitted to the COST Action MC via-e-COST. The Grant Awarding Coordinator coordinates the evaluation on behalf of the Action MC and informs the Grant Holder of the result of the evaluation for issuing the Grant Letter.

Expected outputs and contribution to the Action MoU objectives and deliverables.

Main expected results and their contribution to the progress towards the Action objectives (either research coordination and/or capacity building objectives) and deliverables.

(max.500 words)

The main working group it contributes to is working group 4. Indeed, by creating a proof-assistant backed implementation of the graphical language of categorical diagrams, we enable mathematicians to write and inspect proofs using a language they know, instead of the proof assistant one. Furthermore, the procedure that creates graphs from lemmas allows on to inspect a formalized library graphically, even if this library was not written with my tool (seamless interaction with the underlying proof assistant is the goal). Finally, it could be of pedagogical interest to teach category theory.

There are other working groups that this work may be of relevance for. Since programming languages semantics often use notions and tools from category theories, researchers from working group 3 may be interested by progress in this tool, even though right now I am mostly working with mathematicians. Furthermore, since the plugin is modular and mostly independant of the underlying proof assistant, its graphical script is a sort of interoperable language for diagrammatic proofs. As such, it may be some some interest to working group 1. This aspect is also the one that is the most relevant for the recently started ANR Coreact, with which I am involved. Finally, the interface includes a small automatic solver for simple diagrammatic deduction, which may be relevant for working group 2.

As I am involved in the ANR Coreact, which connects researcher working on category theory on proof assitants in France, and Benedikt is part of the researchers working on univalent foundations, which uses a lot of category theory. Through this STSM, I hope to also bring these two communities closer.