Short-Term Scientific Mission Grant
- APPLICATION FORM[1] -

Action number: CA20111

Applicant name: Matteo Manighetti

Details of the STSM

 Title: Leveraging a λProlog engine for type class resolution in Coq and Lambdapi

Start and end date: 15/10/2022 to 29/10/2022

Goals of the STSM

Purpose and summary of the STSM.

(max.200 word)

Most modern proof assistants contain a type class mechanism. Typeclasses allow users to use generic notation by introducing constraints for some type occurrences. However, the implementation of type classes can differ a lot in different proof assistants, and information that is relevant for typeclass resolution is usually left out of the proofs themselves. Despite this differences, typeclass resolution is usually based around computations that closely resemble a prolog-like computation; proof assistants include an engine capable of doing backtracking proof search for this purpose. Elpi is an embeddable λProlog engine that has already successfully been integrated into Coq, and a prototype integration of Elpi into Lambdapi exists. The goal of this STSM will be to modify Coq so that it uses Coq-Elpi as its typeclass resolution engine; based on this work, we will also expand the prototype Lambdapi-Elpi with a proposal for typeclass management. By abstracting away the typeclass management, we aim to improve the interoperability of the two systems.

Working Plan

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

(max.500 word)

The work is divided into three parts: the adaptation of Coq's typeclasses, the proposal for Lambdapi typeclasses and the common Elpi code. The work on Coq consists of implementing a mechanism to delegate typeclass resolution to external engines like Coq-Elpi. This could also be usable by others willing to experiment on improving TC resolution. Lambdapi currently lacks typeclasses, therefore the work here is twofold. We will implement a command to flag arguments of theorems as to be inferred automatically by some typeclass reslution engine, and we will improve the link with Elpi so that it can accomodate a typeclass resolution engine. Finally, we will implement a typeclass resolution engine in

---

[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.

Elpi which is system independent, and generates a generic typeclass certificate. On top of this engine, we will implement a "backend" generating a Coq typeclass instance out of the certificate, and a similar kind of elaboration for lambdaPi. In future work, the project could continue by hacking the extraction from Coq to Deducti to also reuse the typeclass resolution directives. In addition, the system could be reused for or linked with other tools that include systems symilar to typeclasses. A first candidate for this exploration is the ongoing work by Hondet on PVS import in Dedukti.

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 expected output of the STSM is the implementation of the two prototype systems. Given the maturity of the Coq-Elpi implementation, priority will be given to Coq's typeclass management. At this stage, we expect that importing of proofs using typeclasses into Dedukti/Lambdapi will be done on a manual basis, and we do not aim for a full automation of this process. This lays the groundwork for an advancement in the sharing of proofs between Coq and Lambdapi. Typeclasses are a tool that is not part of the logic of proof assistants, and no logical translation tool is considered in this project. They are rather a kind of metadata that directly concerns the usage of proofs from a proof assistant's library into another; therefore, this work sits in the scope of WG4.