

Report on the outcomes of a Short-Term Scientific Mission¹

Action number:

Grantee name:

Details of the STSM

Title: Translating from Lean to Dedukti

Start and end date: 18/03/2024 to 24/03/2024

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

(max. 500 words)

I introduced Sebastian Ullrich and his colleagues from the Lean FRO to my tool for translating from Lean to Dedukti (lean2dk), asked various questions regarding my current implementation of this tool in Lean, and discussed the problem of how to encode of proof irrelevance in Dedukti. They introduced me to an independent typechecker for Lean 4 called "Lean4Lean" that was recently implemented in Lean by Mario Carneiro.

We discussed some initial plans for an algorithm that handles the proof irrelevance problem by "patching" Lean terms that make use of definitional proof irrelevance in their typing to instead use propositional proof irrelevance via the injection of type casts (using a proof irrelevance axiom) in places where proof irrelevance is used. This patching, which would occur before translating the Lean terms, should make Lean proofs more amenable to translation both to Dedukti itself and eventually to other systems from Dedukti. With Sebastian's help, I then began implementing this plan by investigating Lean4Lean's code base, devising test cases, and starting work on a refactor of Lean4Lean to enable this kind of patching (which will necessarily occur in parallel to the typechecking of Lean terms).

Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall

¹This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

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(max. 500 words)

With the help of Sebastian and his colleagues, I was able to complete a large portion of the effort to refactor Lean4Lean's typechecking code to allow for the patching of Lean terms. We came up with an algorithm for recursively constructing the proof of equality between terms that use proof irrelevance in Lean's definitional equality check. I became familiar with Lean4Lean's code base and also wrote a number of test cases to handle some particular instances of patching. Along the way, we also cleaned up some aspects of my implementation of lean2dk and discussed some ways to improve my usage of Lean's tooling. During the course of this STSM, I also met other members of the Lean FRO and discussed my project with them, which seems to also be of interest to the Lean community at large. Establishing a general term-patching framework in lean2dk may also be of value to me beyond the problem of proof irrelevance, as there are other difficult-to-encode aspects of Lean's typing that could potentially be patched in a similar way. Following this STSM, I will remain in contact with Sebastian regarding the remainder of the implementation of this project, and will also keep the Lean community as a whole informed on my progress with lean2dk.