Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA20111

Grantee name: Horatiu Cheval

Details of the STSM

Title:Domain theory for program verification in Lean

Start and end date: 04/09/2023 to 10/09/2023

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)

We had several meetings with prof. Vlad Rusu and his collaborator at INRIA, prof. David Nowak. During these meetings, we discussed their Coq implementation of coinduction, partial recursive functions, and their Coq formalization of order theoretical results on which these implementations are based upon. We also explored ways to formalize these results in Lean, and debated on how to make the formalization best suited for Lean (for example, we learned how the Lean mathematical library, mathlib, represents different aspects from order theory). Given that metaprogramming will be involved in the planned deliverables, we also briefly compared the existing metaprogramming frameworks of Lean and Coq.

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 also be described in this section.

(max. 500 words)

We set the goal of building an analogous Lean implementation of coinduction to the Coq one realized

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by David Nowak and Vlad Rusu. Given that Lean does not natively support coinduction, this would make a valuable contribution to the Lean ecosystem. This will require both significant formalized mathematical work, and engineering effort for the metaprogramming part. As such, we intend to eventually also publish an article describing this work. The new mathematical developments required about order theory will also be valuable as a contribution to the Lean mathematical library, mathlib. The collaboration we established during this STSM will be continued via periodical online meetings with Vlad Rusu and David Nowak.