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

Action number: CA20111

Grantee name: Sandra Alves

Details of the STSM

Title: Higher-order effectful programming languages and quantitative type systems

Start and end date: 16/06/2024 to 22/06/2024

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)

The goal of this STSM was to work towards our long term objective of obtaining a quantitative system for a general framework extended with different algebraic effects. To that effect, the first task we needed to address was to chose the appropriate language to develop our general framework: given the previous experience of the team involved, we selected the bang-calculus.

Secondly, we have revisited our previous results on the study of global memory in both call-by-value and call-by-name and took this opportunity to revise and improve on previous results: these results are reported in a journal paper, which is currently been evaluated for publication.

The next step was to transport the results on call-by-name and call-by-value with a global memory to a bang-calculus with global state: we have define the untyped language, an appropriate deterministic operational semantics and we have identify and state the desired properties of the language with respect to this operational semantics that we wish to ensure.

Finally, while not all the properties on the untyped language are yet proved, we have also initiate the sketch of the type language and the type system, so that the appropriate notion of correct computation can be proved. Our goal is also to be able to obtain interesting quantitative information about the dynamics of these programs from the type system. Because of our previous experience we have been able to have a first version, and to state the desired properties that the system should guarantee.

[1] This 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.

Although we want to explore different algebraic effects (such as non-determinism, exceptions, I/O, etc.), being able to incorporate our previous results in the bang-calculus is already a very challenging task, and a necessary one, on our quest for a general framework.

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)

The visit was very successful towards achieving the planned goals and outcomes: we have defined the main language, the type language and the type system, as well as stated the main results we wish to prove.

Given that the main design choices for the framework have been done during the visit, we can now continue (remotely) the work related to proving the soundness and correctness of the untyped language with respect to the reduction relation, and the soundness and correctness of the typed language.This will lead us towards our preliminary goal of incorporating effects in a global framework that subsumes call-by-name and call-by-value. We expect to report these results in a conference paper, to be submitted in the fall.

Once we have successfully incorporated effects in a general reduction paradigm, we will continue towards our ultimate goal of incorporating different computational effects in the same framework. One of the outcomes of this visit was to understand how this has been achieved from an algebraic point of view, and how this can be transported to a quantitative type system. This is a challenging outcome that we plan to continue developing in future visits.

During the visit we have also discussed the possibility of organising (in Porto) an EPN event devoted to quantitative type-systems and its relevance to resource aware computation. This event will not only bring together different members of the EPN cost action working on similar topics, but also allow for the members of the particular project of this STSM to continue the work initiated in this visit.