

Short-Term Scientific Mission Grant - APPLICATION FORM¹ -

Action number: CA20111

Applicant name: David M. Cerna

Details of the STSM

Title: Exploring anti-unification over typed languages and equational theories.

Start and end date: 01/08/2024 to 10/08/2024

Goals of the STSM

Purpose and summary of the STSM.

(max.200 word)

This STSM aims to support ongoing work with David's collaborator, Temur Kutsia (RISC, JKU), and researchers from the University of Brasilia currently visiting RISC, for example, Gabriela Ferreira. This work focuses on developing anti-unification methods for combining equational anti-unification algorithms, developing algorithms for anti-unification over typed languages, and generalizing existing anti-unification methods for use in applications such as program analysis and synthesis. The current focus is to generalize the framework presented in [Cerna and Kutsia, 2019], formulate a typed version of the algorithm presented in [Ayala-Rinconet et al., 2024] capable of modeling exception handling, and consider extensions of the framework presented in [Cerna and Kutsia, 2019] to intersection types, see [Ferreira et al., 2024]. Concerning equational theories, the combination of disjoint theories has not been adequately addressed, nor has optimizations for important, e.g., theories such as A and C. The latter was partially addressed in [Cerna and Kutsia, 2020], though using a heuristic approach. With Temur's current PhD student, David plans to re-visit this work using a quantitative framework similar to that presented in [Ehling and Kutsia 2024].

Working Plan

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

(max.500 word)

The plan is to hold regular meetings over the 10-day visit with Temur Kutsia, Gabriela Ferreira, and Georg Ehling. The topics of these meetings will be those mentioned in the previous section. Also, David plans to dedicate a day to working with Temur and Cleopatra Pau (a postdoc of Temur) on a project proposal concerning methods for restricting the size of the solution set when computing equational generalizations. The point of this visit is to hold several focused discussions on the topics mentioned

¹This 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.

above and to work towards writing up ideas and solutions discussed over the past several months.

References:

[Ayala-Rincon et al., 2024] Mauricio Ayala-Rincón, David M. Cerna, Andres Felipe Gonzalez Barragan, Temur Kutsia, *Equational Anti-Unification over Absorption Theories*. IJCAR 2024.

[Ehling and Kutsia 2024] Georg Ehling and Temur Kutsia. *Solving Quantitative Equations*. IJCAR 2024

[Parsert and Polgreen, 2024] *Reinforcement Learning and Data-Generation for Syntax-Guided Synthesis*. AAI 2024

[Cerna and Kutsia, 2023] David M. Cerna, Temur Kutsia: Anti-unification and Generalization: A Survey. IJCAI 2023

[Winter et al., 2022] Emily Rowan Winter, Vesna Nowack, David Bowes, Steve Counsell, Tracy Hall, Sæmundur Oskar Haraldsson, John R. Woodward, Serkan Kirbas, Etienne Windels, Olayori McBello, Abdurahman Atakishiyev, Kevin Kells, and Matthew W. Pagano. *Towards developer-centered automatic program repair: findings from Bloomberg*. ESEC/FSE. ACM 2022.

[Cerna and Kutsia, 2020] David M. Cerna, Temur Kutsia, *Higher-order pattern generalization modulo equational theories*. Math. Struct. Comput. Sci. 2024

[Cerna and Kutsia, 2019] David M. Cerna, Temur Kutsia, *A Generic Framework for Higher-Order Generalizations*. FSCD 2019

[Pientka, 2009] Brigitte Pientka. *Higher-order term indexing using substitution trees*. ACM Trans. Comput. Log., 2009.

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)

David expects that at least one of the topics mentioned above will be partially addressed during the 10 days and that some progress toward a technical report will be made. Work completed during these ten days will likely be submitted to one of the major reasoning conferences with a submission deadline of January 2025. Regarding contribution to the action's objectives, anti-unification is an important operation (as outlined in [Cerna and Kutsia, 2023]) with applications within many of the tools addressed in the MoU objectives list and deliverables. For example, it is used for the extraction of substitutions from substitution trees [Pientka, 2009], for applications of machine learning to synthesis problems [Parsert and Polgreen, 2024], and program repair [Winter et al., 2022]. Working Groups: WG2 & WG5.