Gabriel Ferreira Silva

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Education

Ph.D. in Informatics
Scholarship funding from CAPES. University of Brasília (Brazil). Advisor: Mauricio Ayala-Rincón. 2020–Current

M.Sc. in Mathematics
Scholarship funding from CNPq. University of Brasília (Brazil). Advisor: Mauricio Ayala-Rincón. 2017–2019

- Thesis: "Nominal Unification with Commutative and Associative-Commutative Function Symbols"

B.S. in Computer Science, In-major GPA: 4.4/5.0
University of Brasília (Brazil). Advisor: Marcelo Ladeira. 2014–2017

- Thesis: "A Predictive Analysis of Academic Performance of UnB's Undergraduate Students Using Data Mining"

B.S. in Mathematics
University of Brasília (Brazil). 2018–2020

Publications

[1] M. Ayala-Rincón, M. Fernández, **Gabriel Ferreira Silva**, and D. N. Sobrinho, "A Certified Algorithm for AC-Unification", in *7th International Conference on Formal Structures for Computation and Deduction, FSCD 2022, August 2-5, 2022, Haifa, Israel*, 2022.

[2] M. Ayala-Rincón, W. de Carvalho Segundo, M. Fernández, **Gabriel Ferreira Silva**, and D. Nantes-Sobrinho, "Formalising nominal C-unification generalised with protected variables", in *Mathematical Structures in Computer Science*, 2021.

[3] M. Ayala-Rincón and **Gabriel Ferreira Silva**, "Why We Need Structured Proofs in Mathematics", in *Workshop on Natural Formal Mathematics (NatFoM), part of the 13th Conference on Intelligent Computer Mathematics (CICM)*, 2020.

[4] M. Ayala-Rincón, M. Fernández, **Gabriel Ferreira Silva**, and D. Nantes-Sobrinho, "A Certified Functional Nominal C-Unification Algorithm", in *Logic-Based Program Synthesis and Transformation - 29th International Symposium, LOPSTR 2019, Porto, Portugal, October 8-10, 2019, Revised Selected Papers*, ser. Lecture Notes in Computer Science, 2019.

[5] **Gabriel Ferreira Silva** and M. Ladeira, "A Machine Learning Predictive System to Identify Students in Risk of Dropping Out of College", in *Symposium on Knowledge Discovery, Mining and Learning (KDMiLe)*, 2017.

Teaching and Research Experience

Undergraduate Research Assistant
CAPES funded project "Young Talents for Science". Advisor: Antônio Martins 2013-2014

- Title: A Comparative Study of the Different Generations of Technology Used on Mobile Telephony

Undergraduate Research Assistant
CNPq funded project "Scientific Initiation Program". Advisor: Marcelo Ladeira 2015-2016

- Title: "Earthquake grouping with clustering techniques"

Undergraduate Research Assistant
CNPq funded project "Scientific Initiation Program". Advisor: Marcelo Ladeira 2016-2017

- Title: "A Predictive Analysis of Academic Performance of UnB's Undergraduate Students Using Data Mining"

Undergraduate Teaching Assistant
TA of class: "Basic Computing" First Semester of 2015

Undergraduate Teaching Assistant
TA of class: "Algorithms and Computer Programming" Second Semester of 2015

Graduate Teaching Assistant
TA of class: "Computational Logic" Second Semester of 2020 and First Semester of 2021

Formalising Nominal AC-Unification

Abstract

I discuss my research, which is focused on formalising nominal AC-unification. Completed and remaining research are presented along with publication plans.

Keywords: Nominal AC-Unification, Formalisation, PVS

1. Introduction

Systems with bindings appear frequently in mathematics and computer science, but are not captured adequately in first-order syntax. The nominal setting extends first-order syntax, replacing the concept of syntactical equality by α-equivalence, which let us represent smoothly those systems.

The possibility of representing binders nicely led to the extension of some first-order concepts to the nominal setting; such as rewriting, narrowing, matching and unification. Unification in particular is an important problem in first-order theories, with applications to logic programming, theorem provers, type inference algorithms and so on. Unification with nominal terms is called nominal unification and was solved by Urban, Pitts and Gabbay in [1], by giving a set of inference rules to compute the most general unifier of a nominal unification problem. Extensions of nominal unification to equational theories are actively studied today.

2. Research and Publication Plans

The problem of nominal AC-unification is open and my research plan is, in a nutshell, to give a certified algorithm for it that is terminating, correct and complete.

2.1. Completed Research

To give a certified algorithm for nominal AC-unification, we decided to proceed in two steps: the first was to formalise a known first-order AC-unification algorithm and the second will be to use that formalisation as a

basis and extend it to a certified nominal AC-unification algorithm. We have completed the first step (see [2]).

Remark. *In the beginning of my PhD we also worked in generalising a nominal C-unification algorithm to also handle C-matching, as described in [3].*

2.2. Remaining Research

I plan to finish my 4-year PhD in 8/2023 and the remaining research is adapting our first-order certified algorithm to obtain a certified nominal AC-unification algorithm. We believe adaptations in the proof of termination will be harder (we think we encountered a loop while working with the unification problem $f(X_1, X_2) \approx^? (a\ b) \cdot f(X_1, Y_2)$), while we expect adaptations in correctness/completeness to be straightforward.

2.3. Publication Plans

We plan to write an extended version of [2] and submit it to the Journal of Automated Reasoning. Finally, we plan to submit a paper with our results regarding nominal AC-unification to some conference.

3. Tools We Are Using

We are using the PVS proof assistant to certify our algorithm and the `pf2` LaTeX package to write structured proofs à la Leslie Lamport[4].

References

[1] C. Urban, A. M. Pitts, M. J. Gabbay, Nominal Unification, Theor. Comput. Sci. (2004).

[2] M. Ayala-Rincón, M. Fernández, G. F. Silva, D. N. Sobrinho, A Certified Algorithm for AC-Unification, Formal Structures for Computation and Deduction, FSCD 2022 (2022).

[3] M. Ayala-Rincón, W. de Carvalho Segundo, M. Fernández, G. F. Silva, D. Nantes-Sobrinho, Formalising nominal C-unification generalised with protected variables, Math. Struct. Comput. Sci. (2021).

[4] L. Lamport, How to Write a 21st Century Proof, Journal of fixed point theory and applications (2012).