Igor Moreno Santos

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"Programming can be Mathematics" - Conal Elliott

Summary

I'm a former Postdoc at Università della Svizzera italiana (USI) in Lugano (Switzerland) working at the LuCE research lab, led by professor Matthias Hauswirth. My research interests are Programming Language theory, design, and implementation, as well as Computer Science Education. I also have over 6 years of industry experience as a Software Engineer.

Experience

10/2023–09/2024 (1 year) **Postdoc Researcher**, *Università della Svizzera italiana (USI)*, Lugano, Switzerland.
Advised by Matthias Hauswirth. Formalize new Notional Machines. Experiment with the mechanization of soundness proofs. Improve teaching material using sound Notional Machines.

10/2017–09/2023 (6 years) **Ph.D. Teaching Assistant**, *Università della Svizzera italiana (USI)*, Lugano, Switzerland.
Advised by Matthias Hauswirth. Implemented various small programming language interpreters and Notional Machines in Haskell and proved soundness using equational reasoning. Implemented tools based on static analysis of Java source code using JDT. Co-advised Master and Bachelor thesis projects.

04/2016–03/2017 (1 year) **Software Engineer**, *Università della Svizzera italiana (USI)*, Lugano, Switzerland.
Backend development with Scala and Java as part of the Benchflow research project.

03/2015–02/2016 (1 year) **Software Engineer**, *Appybros*, Lugano, Switzerland.
Backend development with JavaScript and MongoDB. Requirement analysis.

04/2012–08/2012 (4 months) **Software Engineer**, *Dolphin Engineering Sagl*, Lugano, Switzerland.
Full-stack development of a dashboard using the Yii PHP framework.

09/2010–04/2011 (8 months) **Consultant**, *International Labour Organization (ILO)*, Geneva, Switzerland.
Reviewed, improved, and updated the ILO Employment Sector portal based on Oracle Stellent.

06/2009–05/2010 (1 year) **Software Engineer**, *Topológica*, Brasília, Brazil.
Development of a custom SCADA system in Java using Swing and Hibernate. Development of a multithreaded system for building automation using JNI (and C), PostgreSQL, and communicating with a Programmable Logic Controller (PLC) via UDP.

01/2009–05/2009 (4 months) **Software Engineer**, *Flow eCommerce*, Brasília, Brazil.
Reimplementation of a web application in PHP. Data migration using Groovy scripts.

11/2007–07/2008 (9 months) **Intern - Tester**, *International Labour Organization (ILO)*, Geneva, Switzerland.
Development of automated tests in Java. Development of a parser for Stellent CMS templates to automatically generate template documentation.

07/2005–08/2007 (2 years) **Software Engineer**, *AgênciaClick Isobar*, Brasília, Brazil.
Full-stack developer (SQL, PHP, JavaScript, HTML, CSS). Requirement analysis and team lead.

Teaching

Teaching Assistant

5 semesters **Programming Fundamentals 2**, *Bachelor (2nd semester)*, 18/19, 19/20, 20/21, 21/22, 23/24.
Fundamentals of object-oriented programming in Java. Introduction to design patterns. Co-author of the course material.

3 semesters **Programming Styles**, *Master (1st semester)*, 20/21, 21/22, 22/23.
Exploration of various aspects of programming languages and software design. Mostly focused on aspects of functional programming using Java, JavaScript, Python, and Haskell. Co-author of the course material.

2 semesters **Programming Fundamentals 1**, *Bachelor (1st semester)*, 18/19, 19/20.
Course following the approach of How to Design Programs (HtDP) based on sublanguages of Racket.

1 semester **Languages & Compilers**, *Bachelor (6th semester)*, 17/18.
Course focused mostly on the front-end of compilers and teaching Haskell.

Education

2023 **Ph.D. in Computer Science**, *Università della Svizzera italiana (USI)*, Lugano, Switzerland.
Dissertation: *Sound Notional Machines - A Foundation and Its Applications.* (Adviser: Matthias Hauswirth).
My research leveraged techniques from programming language theory to establish a foundation for *notional machines*, pedagogic devices widely used in Computer Science Education. This foundation can be used to design, implement, evaluate, and reason about notional machines and their relationship with the aspect of programs under their focus. As part of the research, I implemented various small language interpreters and notional machines in Haskell and proved soundness using equational reasoning.

2017 **M.Sc. in Computer Science**, *Università della Svizzera italiana (USI)*, Lugano, Switzerland.
Extra credits obtained at *Ecole polytechnique fédérale de Lausanne (EPFL)* on courses focused on programming language theory and implementation, algorithms, concurrent and distributed systems.
Thesis: *A Programming Language With Backward Functions.* (Adviser: Nate Nystrom).
My thesis, awarded the SwissEngineeringTicino prize (2018), focused on the design and implementation of a programming language feature that can express pattern matching, views, resolution of simple equations and boolean formulas, and for-comprehensions. The compiler was implemented in Scala.

2012 **B.Sc. in Computer Science**, *Università della Svizzera italiana (USI)*, Lugano, Switzerland.
Extra credits obtained at *Universidade de Brasília (UnB), Brasília, Brazil.*
Bachelor project: *Deferred Methods - A Framework for Parallelizing Small Tasks in a Shared-memory, Multi-threaded Programming Model.* (Adviser: Walter Binder).
The implementation relied mostly on JVM bytecode generation using ASM.

Publications

Preprint [DOI] **Sound Notional Machines**.
Igor Moreno Santos, Matthias Hauswirth, Johan Jeuring

Koli Calling '24 [to appear] **Assessing the Understanding of Expressions: A Qualitative Study of Notional-Machine-Based Exam Questions**.
Joey Bevilacqua, Luca Chiodini, Igor Moreno Santos, Matthias Hauswirth

SIGCSE '24 [Poster] [DOI] **Using Notional Machines to Automatically Assess Students' Comprehension of Their Own Code**.
Joey Bevilacqua, Luca Chiodini, Igor Moreno Santos, Matthias Hauswirth

SPLASH-E '22 [DOI] **Expressions in Java: Essential, Prevalent, Neglected?**.
Luca Chiodini, Igor Moreno Santos, Matthias Hauswirth

ITiCSE '21 [DOI] **A Curated Inventory of Programming Language Misconceptions**.
Luca Chiodini, Igor Moreno Santos, Andrea Gallidabino, Anya Tafliovich, André L. Santos, Matthias Hauswirth

SPLASH-E '19 [DOI] **Experiences in bridging from functional to object-oriented programming**.
Igor Moreno Santos, Matthias Hauswirth, Nate Nystrom

Natural Languages

Portuguese	Native	Italian	B1 / B2	Spanish	A1 / A2
English	C1 / C2	French	A2 / B1	German	A1 / A2