# André Duarte

*Curriculum Vitae*

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## Education

**2018–present**  **Ph.D. in Computer Science**, *University of Manchester*, United Kingdom
**Automated Theorem Proving — Formal Methods Group**
Three to four-year research project in the field of automated logical reasoning, culminating in a written thesis and defence. The project title is "Efficient reasoning in equational theories". The objective is to develop new techniques to deal with particularly troublesome mathematical theories – such as commutative operators, arithmetic, or formalisations of software – while retaining the full power of a general-purpose automated reasoner. Developed new theoretical results which improved the state of the art, and implemented them in a major theorem prover for first-order logic.

**2015–2017**  **M.Sc. in Physics**, *Universidade de Coimbra*, Portugal
**Specialization in Computational Modelling and Simulation**.
Two-year cycle of studies conferring the degree of Master of Science, comprising one year of classes and one year of research, culminating in a written thesis and defence. Researched models of dense stellar matter. Pursued extra classes in mathematics. Average grade of 18.2 out of 20, equivalent to 3.72/4.00 on the ECTS scale. Thesis graded at 19 out of 20.

**2012–2015**  **B.Sc. in Physics**, *Universidade de Coimbra*, Portugal
Three-year cycle of studies conferring the degree of Bachelor of Science, comprising lectures, lab work and projects. Pursued extra classes in mathematics. Joined a research group in order to gain research experience. Average grade of 15.5 out of 20, equivalent to 3.32/4.00 on the ECTS scale.

**2009–2012**  **Secondary Studies in Sciences**, *Escola Secundária Infanta D. Maria*, Portugal
Secondary education in Sciences and Technology. Final aggregate average of 18.2 out of 20.

## Professional Experience

**2013–present**  **Tutoring**
I have over a thousand hours of experience in tutoring students, both online and in person. I have assisted students in a variety of subjects – mainly physics, mathematics, and programming – at a variety of levels, from high school to Master's. I find this work extremely rewarding, and I have received high praise from students over the years.

**2018–present**  **Teaching assistant**, *University of Manchester*
I have worked as a graduate teaching assistant at the University of Manchester concurrent with my PhD. This involved teaching tutorial and lab sessions, face-to-face assignment marking, offline marking, office hours, and giving written feedback. During the pandemic, this shifted to online learning over many different platforms. I have taught "Imperative Programming, Algorithms, and Data Structures", "Automated Reasoning and Verification", "Logic and Modelling", "Mathematical Techniques for Computer Science", "Introduction to AI", "Programming Languages and Paradigms" (clickable links).

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| 2018–present | **Doctorate research**, *Formal Methods Group*, Department of Computer Science, University of Manchester |

Researcher in the field of automated reasoning. Studied equational reasoning in first-order logic for select logical theories of interest.

Automated theorem provers can be thought of as general-purpose tools for solving any problem which can be described in a given logical language. However, if they only rely on logical deductions from axioms, they may be prohibitively slow even for apparently "easy" problems (such as simple arithmetic). We investigate the possibility of combining *general-purpose* logical deduction with *domain-specific* knowledge about select theories. Our work so far has resulted in improvements to the state of the art of the theory of first-order automated reasoning, and has resulted in practical enhancements that have already been adopted by the community (e.g. the provers E, Vampire). Our work has been peer-reviewed and published in top venues in the field, and received recognition in the form of awards (see publications). We have implemented these and other algorithms and techniques in iProver, our theorem prover for first-order logic (written in OCaml).

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| 2016–2017 | **Master's degree research**, *Compact Stars Research Group*, Physics Department, University of Coimbra |

Researcher in the field of compact stars in a Master's thesis project. Studied hybrid models of neutron stars and proto-neutron stars.

Neutron stars are very interesting objects in theoretical physics, in that processes happen in their interior which do not happen anywhere else in the universe. We can therefore use them to test our theories of fundamental physics, as follows: formulate a theory, calculate how neutron stars behave according to that theory, and compare with real observations. This way we can rule out certain theories of fundamental physics if they do not predict stars as we observe them to be. In particular, we studied models with bound and unbound quarks, in phase equilibrium, and calculated models of neutron stars at different stages of life (implemented in C++).

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| 2014–2016 | **Assistant researcher**, *Computational Biology Group*, Physics Department, University of Coimbra |

Researcher in a group doing work on topics related to computational biology. Studied phase-field models of sprouting angiogenesis.

Diseases such as diabetic retinopathy are caused when problems in blood vessels lead to insufficient blood flow to tissues. In the case of this disease, retinal cells die of lack of oxygen. This is the leading cause of blindness in people aged 20 to 64. The goal was to develop an accurate model of blood vessels in the eye and of the surrounding tissue. By refining this model in close collaboration with biologists, we could then run the physical/chemical simulation to "perform experiments", such as predicting how the blood vessels react to different drugs or to the stimulation of production of certain biochemicals.

## Publications

André Duarte and Konstantin Korovin. "Ground Joinability and Connectedness in the Superposition Calculus". In: *IJCAR: 11th International Joint Conference on Automated Reasoning (part of FLoC: 8th Federated Logic Conference), Haifa, Israel*. **Awarded "Best Paper by a Student"** (link). 2022. URL: https://link.springer.com/content/pdf/10.1007/978-3-031-10769-6.pdf#page=178.

André Duarte and Konstantin Korovin. "AC Simplifications and Closure Redundancies in the Superposition Calculus". In: *TABLEAUX: 30th International Conference on Automated Reasoning with Analytic Tableaux and Related Methods, Birmingham, UK*. 2021. URL: https://arxiv.org/pdf/2107.08409.pdf.

André Duarte and Konstantin Korovin. "Implementing Superposition in iProver (System Description)". In: *IJCAR: 10th International Joint Conference on Automated Reasoning, Paris, France*. 2020. URL: https://andrepd.eu/pubs/cade20.pdf.

André Duarte and Konstantin Korovin. "Experimenting with superposition in iProver". In: *ARW: 26th Automated Reasoning Workshop, London, UK*. 2019, p. 27. URL: https://andrepd.eu/pubs/arw19.pdf.

André Duarte. "Two Phase Model for Warm Stellar Matter: an Equation of State for Compact Stars". Master thesis. Universidade de Coimbra, 2017. URL: https://andrepd.eu/pubs/msc.pdf.