William Troiani

Curriculum Vitae - DiPLO Postdoctoral Position

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I am a mathematician working at the interface of **linear logic**, **algebraic geometry**, and the **semantics of computation**, with published work spanning proof theory, geometric semantics, categorical logic, and the continuous / functional-analytic study of computation through **singular learning theory**. I already have established ties to **LIPN / Universite Sorbonne Paris Nord** through co-supervision, teaching, and student supervision.

RESEARCH AREAS

Linear logic and proof theory; cut-elimination; semantics of programming languages; differential linear logic; lambda calculus; categorical logic; algebraic geometry; singular learning theory; real-analytic singularities.

APPOINTMENTS

2025–2026 **Research Scientist (Theory), Timaeus**. Research on singular learning theory, the geometry of computation, and implications for AI safety.

2024–2025 **ARC-funded Postgraduate Researcher, University of Melbourne**. Logic, geometry, and semantics of computation. Supervisors: Daniel Murfet and David Ridout.

2017–2018 **DST-funded Research Assistant, University of Melbourne**. Mathematical logic and theoretical computer science. Supervisor: Daniel Murfet.

EDUCATION

2020–2024 **PhD in Mathematics, University of Melbourne**. Thesis: *Algebraic Geometry and Linear Logic*. Study abroad and co-supervision at Universite Sorbonne Paris Nord / LIPN. Supervisors: Daniel Murfet and Thomas Seiller.

2017–2019 **MSc in Mathematics and Statistics, University of Melbourne**. Thesis: *Simplicial Sets are Algorithms*. Supervisor: Daniel Murfet.

2013–2016 **BSc in Mathematics and Statistics, University of Melbourne**. Specialisation in pure mathematics.

PUBLICATIONS AND RESEARCH WRITING

Journal articles and accepted papers

The Internal Logic and Finite Colimits. *Logica Universalis* 18(3):315–354, 2024. Internal-language methods in topos theory and constructive descriptions of finite colimits.

Gentzen-Mints-Zucker Duality, with Daniel Murfet. *Mathematical Structures in Computer Science* 36 (2026), e7. Relates intuitionistic sequent calculus and simply typed lambda calculus as local and global views of the same computational structure.

Linear Logic and the Hilbert Scheme, with Daniel Murfet. *Mathematical Structures in Computer Science* 36 (2026), e8. A geometric semantics for shallow MELL in which cut-equivalent proofs determine explicitly isomorphic schemes.

Elimination and Cut-Elimination in Multiplicative Linear Logic, with Daniel Murfet. Accepted / to appear in *Mathematical Structures in Computer Science*; arXiv:2207.10871. Associates ideals to proof structures and interprets cut-elimination via Buchberger-style elimination.

PUBLICATIONS AND RESEARCH WRITING (CONTINUED)

Conference paper and preprints

Programs as Singularities, with Daniel Murfet. ODYSSEY 2025; arXiv:2504.08075. Connects the Ehrhard-Regnier derivative with singular learning theory via noisy Turing-machine codes, error syndromes, and real-analytic singularities.

Linear Logic and Quantum Error Correcting Codes, with Daniel Murfet. arXiv:2405.19051, 2024. Interprets multiplicative proof-net reduction through stabilizer codes, quantum cooling, and error correction.

Simplifying normal functors: an old and a new model of lambda-calculus, with Morgan Rogers and Thomas Seiller. HAL preprint, 2024. Revisits Girard's normal functors from complementary categorical and syntactic viewpoints.

PhD thesis: Algebraic Geometry and Linear Logic. University of Melbourne, 2024. Develops algebraic-geometric and categorical semantics for linear logic, with an emphasis on cut-elimination and exponentials.

MSc thesis: Simplicial Sets are Algorithms. University of Melbourne, 2019. Interprets simplicial and higher-dimensional constructions in computational terms.

TEACHING, SUPERVISION, AND LOCAL EXPERIENCE

- **Sep 2022** - Undergraduate student seminar on category theory, **Universite Sorbonne Paris Nord**.
- **Sep 2023** - Supervised an undergraduate research project, **Universite Sorbonne Paris Nord**.
- **2025** - Mentor, Noisy Turing Machine Research Group, University of Melbourne.
- **Nov 2023** - Organised *Derivatives in Logic and Learning*, a bonus seminar on Differential Linear Logic.

SELECTED TALKS AND RESEARCH ACTIVITY

- **2023** - CHoCoLa seminar, ENS Lyon: *Computation in logic as the splitting of idempotents in algebraic geometry; two models of multiplicative linear logic.*
- **2022** - Axe Complexites seminar, LIPN: *Quantum error correcting codes and cut-elimination.*
- **2022** - Institut de Mathematiques de Marseille: *Proofs, rings, and ideals.*
- **2021–2025** - Lecture series and informal courses on logic, category theory, Godel's incompleteness theorem, and the Ax-Grothendieck theorem.

AWARDS AND FUNDING

AMSI Summer Research Scholarship (2016); AMSI Travel Grant (2016); University of Melbourne Vacation Research Scholarship (2015); ARC-funded postgraduate research position (2024–2025); Research Scientist appointment under the ARIA-funded programme *Mathematics for Safe AI* at Timaeus (2025–2026).

ACADEMIC REFERENCES

Daniel Murfet
Timaeus

Richard Blute
University of Ottawa

Morgan Rogers
LIPN

Thomas Seiller
LIPN

Marcy Robertson
University of Melbourne

Reference contact details can be supplied directly in the application email or on request.