Geoffrey Cruttwell

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Academic Positions

- **Mount Allison University** — Sackville, NB
  Associate Professor — *2017 – present*
- **Dalhousie University** — Halifax, NS
  Adjunct Professor — *2013 – present*
- **Mount Allison University** — Sackville, NB
  Assistant Professor — *2012 – 2017*
- **University of Ottawa** — Ottawa, ON
  Postdoctoral Fellow — *2011*
  - Supervisor: Richard Blute
- **University of Calgary** — Calgary, AB
  Postdoctoral Fellow — *2009–2011*
  - Supervisor: Robin Cockett

Education

- **Dalhousie University** — Halifax, NS
  PhD (Mathematics) — *2005 - 2009*
  - Thesis: "Normed Spaces and the Change of Base for Enriched Categories"
  - Supervisor: Richard Wood
- **Dalhousie University** — Halifax, NS
  MSc (Mathematics) — *2004 - 2005*
  - Thesis: "A Study of CCD Lattices in a Functor Category"
  - Supervisor: Richard Wood
- **University of Waterloo** — Waterloo, ON
  Bachelor of Mathematics — *1999 - 2004*
  - Graduated on Dean's Honour List
  - Minored in Philosophy

Awards, Grants & Honours

NSERC Discovery Grant ($17,000/year)	2019–2025
Mount Allison Paul Pare Excellence Award	2023
NSERC Discovery Grant ($15,000/year)	2013–2019
Mount Allison Student's Union Excellence in Teaching Award	2013

Publications (available at www.reluctantm.com/gcruttw/)

Peer-Reviewed Research Articles

22. **Reverse tangent categories** (with JS Lemay), to be published in CSL 2024.

21. **Differential bundles in Commutative Algebra and Algebraic Geometry** (with JS Lemay), *Theory and Applications of Categories*, **39** (36), pg. 1077–1120, 2023.

20. **Monoidal reverse differential categories** (with J. Gallagher, JS Lemay, and D. Pronk), *Mathematical Structures in Computer Science*, Vol. 32, Issue 10, 1313–1363, 2022.

19. **Double fibrations** (with M. Lambert, D. Pronk, and M. Szyld), *Theory and Applications of Categories*, **38** (35), pg. 1326–1394, 2022.

18. **Categorical Foundations of Gradient-Based Learning** (with B. Gavranovic, N. Ghani, P. Wilson, F. Zanasi), to be published in Proceedings of ESOP 2022, 2022.

17. **Latent fibrations: fibrations for categories of partial maps** (with R. Cockett, J. Gallagher, and D. Pronk), *Theory and Applications of Categories*, **36** (16), pg. 423–491, 2021.

16. **Differential equations in a tangent category I** (with R. Cockett and JS Lemay), *Applied Categorical Structures*, issue 5, 2021.

15. **Integral and differential structure on the free C^∞-ring modality** (with R. Lucyshyn-Wright and JS Lemay), published in *Cahiers de topologie and geometrie differentielle categoriques*, Volume LXII(2), pg. 116–176, 2021.

14. **Categorical semantics of a simple differential programming language** (with Jonathan Gallagher and Dorette Pronk), published in *Applied Category Theory 2020*, EPTCS 333 pg. 289–310, 2021.

13. **Reverse derivative categories** (with R. Cockett, J. Gallagher, JS Lemay, B. MacAdam, G. Plotkin, D. Pronk), in *28th EACSL Annual Conference on Computer Science Logic*, 18:1–16, 2020.

12. **Affine geometric spaces in tangent categories** (with R. Blute and R. Lucyshyn-Wright), *Theory and Applications of Categories*, **34** (15), pg. 405–437, 2019.

11. **A simplicial foundation for differential and sector forms in tangent categories** (with R. Lucyshyn-Wright), *Journal of Homotopy and Related Structures*, pg. 1–59, 2018.

10. **Differential bundles and fibrations for tangent categories** (with R. Cockett), *Cahiers de Topologie et Geométrie Différential Catégoriques*, **59** (1), pg. 10–92, 2018.

9. **Connections in tangent categories** (with R. Cockett), *Theory and Applications of Categories*, **32** (26), pg. 835–888, 2017.

8. **Cartesian differential categories revisited**, *Mathematical structures in computer science*, Vol. 27 (1), pg. 70–91, 2017 (first appeared online in 2015).

7. **The Jacobi identity for tangent categories** (with R. Cockett), *Cahiers de Topologie et Geométrie Différential Catégoriques*, Vol. LVI (4) pg. 301–316, 2015.

6. **Differential structure, tangent structure, and SDG** (with R. Cockett), *Applied Categorical Structures*, Vol. 22, pg. 331-417, 2014.

5. **Forms and exterior differentiation in Cartesian differential categories**, *Theory and Applications of Categories*, Vol. 28, pg. 981–1001, 2013.

4. **Differential Restriction Categories** (with R. Cockett and J. Gallagher), *Theory and Applications of Categories*, Vol. 25, pg 537-613, 2011.

3. **A Unified Framework for Generalized Multicategories** (with M. Shulman), *Theory and Applications of Categories*, Vol. 24, pg 580-655, 2010.

2. **CCD in Presheaf Categories**, (with F. Marmolejo, R. Wood), *Theory and Applications of Categories*, Vol. 18, pg 157-171, 2007.

1. **Dimensions of Fractals in the Large** (with M.R. Allen, K. Hare, J.O. Ronning), *Chaos, Solitons and Fractals*, Vol. 31, Issue 1, pg 5-13, 2007.

Book Chapters

1. **Assignment structure in upper-year mathematics courses** in *Mount A Teaches* (L. Wasylkiw and J. Tomes, eds.), pages 181–188, Friesen Press, 2016.

Student supervision

Postdoctoral fellows:

- September 2021 – April 2022: **Michael Lambert**: research on double categories.

- April 2021 – March 2022: **Jean-Simon Lemay**: research on cotangent categories and algebraic geometry.

- March 2020 – June 2022: **Martin Szyld**: research on double fibrations (co-supervised with Dorette Pronk).

- March 2019 – August 2021: **Jonathan Gallagher**: research on tangent categories and orbifolds (co-supervising with Dorette Pronk).

- September 2015 – June 2017: **Rory Lucyshyn-Wright**: research on tangent categories and differential forms (co-supervised with Robert Rosebrugh).

PhD students:

- September 2020 – present: **Marcello Lafranchi**: research on applications of tangent categories to physics and non-commutative geometry (at Dalhousie University, co-supervising with Dorette Pronk).

- January 2014 – August 2018: **Evangelia Aleiferi**; research on Cartesian Bicategories and Double categories (at Dalhousie University, co-supervised with Richard Wood).

Undergraduate students:

- May 2023 – April 2024: **Eli Vandenburg**, research on examples and theory of connections in algebraic geometry.

- May 2020 – August 2020: **Isaac Lee and Chaoyi Liang**, research on building computational tools to investigate finite categories.

- May 2018 – August 2018: **Shane Grogan**, research on links between category theory and psychology.

- May 2017 – April 2018: **Jonathan Bradet-Legris and Hayley Reid**, research on differential categories and the forward difference operator.

- May 2014 – August 2014: **Rejean LeBlanc**, research on enumerating finite categories.

- May 2013 – August 2013: **Martin Sers**, research on generalizing constructions of the real numbers.

Invited conference and workshop talks

- **"Algebraic geometry and tangent categories"**, ALT Coimbra Seminar, September 2022.

- **"Learning and derivatives, categorically"**, Cognitive Science 2022, workshop on Category Theory for Cognitive Science, July 2022.

- **"Algebraic geometry: a different path up the mountain"**, Foundational Methods in Computer Science 2022, June 2022.

- **"Categorical differential structures and their role in abstract machine learning"**, Topos Institute colloquium, July 2021.

- **"Towards cotangent categories"**, Mathematical congress of the Americas, Special session on Categories and Topology, July 2021.

- **"Tangent categories tutorial I: Multivariable Calculus"**, Foundational Methods in Computer Science 2019, Kananaskis,AB, May 2019.

- **"The usefulness of double categories"**, Foundational Methods in Computer Science 2016, Vancouver, BC, June 2016.

- **"Counting finite categories"**, American Mathematical Society fall meeting (Special session on New directions in category theory), Dalhousie University, October 2014.

- **"Differential categories and differential algebra"**, Association for Symbolic Logic annual meeting (Differential categories and differential lambda-calculi session), University of Waterloo, May 2013.

- **"Combining differential categories and manifolds"**, Foundational Methods in Computer Science 2011, Kananaskis, AB, June 2011.

- **"A unified framework for generalized multicategories"**, Canadian Mathematical Society summer meeting (Tensor Categories Session), Fredericton, June 2010.

- **"A unified framework for generalized multicategories"**, International Category Theory Conference 2009, Cape Town (South Africa), June 2009.

Selected contributed conference talks

- **"Affine objects in tangent categories"**, International Category Theory Conference 2018, Ponta Delgada Portugal, July 2018.

- **"Differential equations in tangent categories"**, International Category Theory Conference 2017, Vancouver BC, July 2017.

- **"General connections in tangent categories"**, Foundational Methods in Computer Science 2017, Ottawa, ON, June 2017.

- **"A simplicial foundation for de Rham cohomology in a tangent category"**, International Category Theory Conference 2016, Halifax NS, August 2016.

- **"Bundles, pullbacks and fibrations for tangent categories"**, Foundational Methods in Computer Science 2015, Hamilton NY, June 2015.

- **"Connections in tangent categories"**, International Category Theory Conference 2014, Cambridge, UK, June 2014.

Professional and Service Activities

- **Department head**: Mathematics and Computer Science Department, Mount Allison University, 2022–2024.

- **Managing Editor**: Theory and Applications of Categories journal, 2020–present.

- **Conference organizer**: Math/CS Science Atlantic conference, October 2022.

- **Faculty council secretary**: Mount Allison University, July 2020–June 2022.

- **Program committee member**: Applied Category Theory 2021, Applied Category Theory 2022, Applied Category Theory 2023.

- **Conference co-organizer**: BIRS Workshop on Tangent categories and their applications, June 2021.

- **Acting department head**: Mathematics and Computer Science Department, Mount Allison University, 2018–2019.

- **Confereence co-organizer**: 26th workshop on Foundational Methods in Computer Science. Organized scientific and logistic aspects of a workshop at Mount Allison university; 33 participants, May 2018.

- **Co-director**: AARMS 2016 Summer School. Organized scientific and logistic aspects of a summer school for approximately 40 students from various countries around the world at Dalhousie University, 2016.

- **Conference Co-organizer**: 21st workshop on Foundational Methods in Computer Science. Organized scientific and logistic aspects of a workshop at Mount Allison university; 30 participants, June 2013.

- **Mount Allison University Committee member:**

  - Joint research administration review committee, September 2020–May 2021.
  - Academic appeals committee, July 2019–present.
  - Academic senate member, 2018–2019.
  - Planning Committee, 2015–2019.
  - Budget Advisory Committee, 2018–2019.
  - Faculty Council executive, 2015–2017.
  - Research and Creative activies committee, 2013–2015.
  - Re-admission Appeals committee, 2014–2015.
  - MAFA Donations commitee, 2014–2015.

- **Co-treasurer and board member**: Mount Allison University club, 2014 and 2015.

- **Referee and reviewer**. Referee for publications in *Theory and Applications of Categories*, *Mathematical structures in Computer Science*, *Theoretical Computer Science*, *Journal of Mathematical Economics*, *Journal of Homotopy and Related Structures*, *Logic in Computer Science (LICS)* and reviewer for *Mathematical Reviews*.