Billy McCarthy

wkm2105@columbia.edu | 0851982455

Ireland | *Open to hybrid/remote work*

Profile

PhD in Philosophy (Columbia University) with a strong foundation in mathematics, formal logic, and computer science, currently complemented by a Postgraduate Diploma in Artificial Intelligence (National College of Ireland). Advanced Python skills, intermediate C++, and experience with Lean and higher-order logic. Published research on the foundations of mathematics and automated reasoning demonstrates expertise in rigorous problem-solving and abstract modeling. Applying these skills to machine learning, algorithm design, and system verification, including hands-on experience building a neural network from scratch in C++. Seeking to contribute to AI-driven solutions in data science, machine learning, and computational research environments.

Technical Skills

- **Programming:** Python (advanced), C++ (intermediate), Lean (intermediate)

- **Machine Learning & AI:** Neural networks, supervised learning, scikit-learn, algorithmic foundations

- **Mathematics & Statistics:** Linear algebra, multivariable calculus, probability, statistics, decision theory, set theory, model theory

- **Logic & Formal Methods:** Higher-order logic (advanced), modal logics, proof systems, automated theorem proving

- **Tools & Environment:** Git, LaTeX, Linux (basic)

Projects and Publications

Neural Network from Scratch (in progress)   *C++*
- Self-initiated project to implement a feedforward neural network from first principles.
- Designed and coded core components including matrix multiplication, activation functions, and gradient descent optimization.
- Applied linear algebra and multivariable calculus to implement backpropagation and improve training stability.
- Enhances expertise in machine learning internals and performance-oriented C++ programming.

"Modal Pluralism and Higher-Order Logic" (with Justin Clarke-Doane), *Philosophical Perspectives*, 2022.

"A Benacerraf Problem for Higher-Order Metaphysics", *Nous*, 2025.

"Mathematics in the Age of Mechanical Production", Under Review.

"The Failure of Formalism: From the Artworld to the Mathworld", Under Review.

Education

PgDip in Artificial Intelligence, NCI, Dublin   *Sep 2025 - Aug 2026*
PhD in Philosophy, Columbia University, New York   *2024*
Focus: Foundations of Mathematics, Modal Logic, Philosophy of AI.

MA & MPhil in Philosophy, Columbia University   *2016–2020*
MPhil in Philosophy, University College Cork   *2014*
BA in Philosophy and Mathematics, UCC   *2013*

Experience

Teaching Assistant, Columbia University   *2017 – 2023*
- Supported courses in logic, physics, epistemology, and philosophy of language.
- Led tutorials, held office hours, graded assignments, and mentored students.
- Developed ability to explain abstract and technical concepts with clarity.

Private Tutor – Math and Physics   *September 2024 – Present*
- Tutoring high school and undergraduate students in mathematics and physics.
- Emphasis on conceptual understanding and problem-solving skills.

Academic Organizer & Union Activist, Columbia University   *2016 – 2022*
- Co-organized interdisciplinary conferences, reading groups, and workshops.
- Gained experience in collaborative project management and leadership.

Additional Information

- Audited Columbia CS and ML courses: Intro to CS, Python, Machine Learning
- Applications of AI/ML to formal verification, system design, and automation
- Strong analytical, problem-solving, and communication skills
- Hobbies: cycling, sci-fi reading, strategy games