ERIC M SCHMID

ML Research Associate/Functional Programmer

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SUMMARY

I am a ML/Quantitative Analytics Research Associate with expertise in developing machine learning models for cryptocurrency forecasting, utilizing tools such as PyTorch and scikit-learn, while also being skilled in functional programming languages including Haskell and dependently typed languages like Agda, Coq, and Idris. My diverse background spans quantitative finance, software development, and academic research, with a particular focus on applying deep learning and transformer architectures to financial markets while pursuing a PhD in Mathematical Sciences on applied algebraic topology and reinforcement learning.

EDUCATION

02/2025 - Present
Dublin, Ireland (remote)

PhD in Mathematical Sciences

GCAS College

- Topic: AI and Applied Algebraic Topology (sheaf- theoretic multi-agent Reinforcement Learning systems)
- Title: "Sheaves for Decentralized Control"
- Co-advisors: Prof. Fernando Tohmé, Prof. Neil Ghani (University of Strathclyde), Dr. Toby St. Clere Smithe (Topos Institute)

09/2021 - 03/2025
Chicago, IL

MS in Applied Mathematics

DePaul University

- GPA: 4.0
- Effron Family Scholarship for Pure Mathematics
- The Joseph Sugre Endowed Graduate Scholarship in Mathematics
- Research Assistantship, Fall 2024
- Teaching Assistant for Linear Algebra

09/2023 - 12/2023
Chicago, IL

Graduate Coursework in Computer Science

University of Chicago

- Coursework: Introduction to Python Programming (GPA: 4.0)

09/2008 - 12/2013
New York, NY

BA in Individualized Study (Interdisciplinary Studies)

New York University

- Dean's List for Fall 2008 & Spring 2009
- Concentration: Continental Philosophy and Visual Art
- Minor: Mathematics
- GPA: 3.589

EXPERIENCE

10/2024 - Present
Chicago, IL

ML/Quantitative Analytics Research Associate

Navier

- Develop and implement machine learning models for cryptocurrency price forecasting using PyTorch and scikit-learn
- Design and optimize deep learning architectures for time series prediction
- Implement backtesting frameworks to evaluate model performance
- Conduct statistical analysis of market data using Python's data science stack
- Create automated data pipeline for real-time model updates and predictions

06/2023 - 10/2024
Chicago, IL

Co-founder

Bourbaki Capital

- Led a team of developers and analysts, setting team priorities
- Developed software using Python and interacted with Amazon AWS API
- Designed and implemented a websocket listener for market data
- Utilized Python library HFTbacktest for backtesting quantitative financial models

09/2022 - 12/2022
Chicago, IL

Teaching Assistant

DePaul University

EXPERIENCE

09/2021 - 12/2021

Chicago, IL

- Teaching Assistant

  DePaul University

SKILLS

AWS **CSS** **Deep Learning** **ECommerce** **GitHub** **Grunt** **Haskell** **HTML** **Java** **Java Spring** **JavaScript** **jQuery** **Linear Algebra** **Unix Shell Scripting** **Numpy** **Pandas** **Python** **PyTorch** **Scikit-Learn** **Scipy** **SQL** **Time Series** **XGBoost** **PostgreSQL** **Agda** **Coq** **Idris** **OCaml** **Azure** **Functional Programming**

COURSES

Introduction to Python Programming, Numerical Analysis I, Real Analysis I, Finite-Dimensional Vector Spaces, Probability & Statistics I, Abstract Algebra I & II, Point-Set Topology, Mathematical Modeling, Complex Analysis, Group Theory, Number Theory, Commutative Algebra, Category Theory, Mathematical Logic (Model Theory), Algebraic Topology, Calculus I-III, Statistics, Linear Algebra, Discrete Mathematics, Non-Euclidean Geometry

PROJECTS

“Will the market go up, down or stay neutral?": Stock Market Prediction Model, Development and Evaluation of a Neural Financial Forecasting System

03/2025

https://github.com/ericschmid-uchicago/finance_oracle

The code implements a neural network system that combines transformers and GRUs with attention mechanisms to predict stock market movements by integrating technical indicators, macroeconomic data, market microstructure metrics, and financial news sentiment analysis through FinBERT embeddings.

- This project presents the development, optimization, and evaluation of a neural network-based financial prediction model designed to forecast stock market movements. The model integrates market technical indicators, macroeconomic data, market microstructure metrics, and news sentiment analysis using transformer and GRU architectures. Hyperparameter optimization was performed to maximize predictive accuracy, resulting in a model with 46% accuracy on out-of-sample data, better than random guessing when answering the question: Will the market go up, down or stay neutral?. Our model significantly outperformed random guessing (33.33% for three-class classification problem on whether the market goes up, down or stays neutral?). Temperature scaling was applied to improve prediction calibration, and a probabilistic trading recommendation framework was implemented to guide investment decisions based on prediction confidence.

PROJECTS

Macroeconomic Effects on Bitcoin Price Using Topological Data Analysis and Distance-to-Default Metrics (in Python)

10/2024 - 12/2024 Chicago, IL
https://github.com/ericschmid-uchicago/macroeconomic-trends-on-bitcoin

Developed a machine learning model integrating topological data analysis, financial risk metrics, and macroeconomic indicators to predict Bitcoin price movements with performance exceeding random chance.

- Developed ML model predicting Bitcoin trends using Topological Data Analysis and Distance-to-Default metrics, achieving 21% better-than-random AUC (0.6089 in a three-category classification problem)
- Created novel validation approach using shifted 30-day moving averages to reduce volatility impact while avoiding look-ahead bias
- Built XGBoost classifier with time series cross-validation for 3 price categories, achieving 5.9% better accuracy than random chance
- Applied SHAP analysis to identify predictive features, combining TDA metrics with Treasury yields and federal debt data from Yahoo Finance and FRED API

TypeLoopS1 – Educational Haskell Program Demonstrating Algebraic Topology

03/2025
https://github.com/ericschmid-uchicago/TypeLoopS1

TypeLoopS1 – A Haskell-based educational project illustrating algebraic topology concepts by modeling the fundamental group of a circle at the type level.

- Developed a Haskell-based educational tool illustrating the fundamental group of the circle π_1(S^1), leveraging type-level programming to model algebraic topology concepts.
- Encoded mathematical properties using advanced type system features, providing compile-time verification and enhancing code reliability.
- Created a resource bridging functional programming and algebraic topology, facilitating intuitive understanding of abstract mathematical concepts through executable examples.

AutoDiff (in Idris)

02/2025
https://github.com/ericschmid-uchicago/AutoDiff

AutoDiff – A higher-order automatic differentiation library implemented in Idris, supporting both forward and reverse modes for computing derivatives of any order.

- **Dual Approach:** Implements both forward-mode automatic differentiation using dual numbers and reverse-mode (backward) differentiation using computational graphs, catering to functions with varying input dimensionality.
- **Higher-Order Derivatives:** Capable of computing derivatives of any order, facilitating advanced mathematical analysis and optimization tasks.
- **Pure Idris Implementation:** Developed entirely in Idris without external dependencies, ensuring compatibility across Idris versions and promoting functional programming practices.
- **Custom Data Structures:** Utilizes tailored data structures to maintain efficiency and accuracy in derivative computations, enhancing performance and reliability.
- **Educational Resource:** Serves as a learning tool for understanding automatic differentiation concepts within a dependently typed functional programming language, bridging theoretical and practical aspects.

idris-autodiff-c (in OCaml)

02/2025
https://github.com/ericschmid-uchicago/idris-autodiff-c

idris-autodiff-c – A translator converting Idris automatic differentiation deep embeddings into efficient C code.

- **Bidirectional Differentiation Support:** Translates both forward-mode and backward-mode automatic differentiation implementations from Idris to C, accommodating various computational needs.
- **Comprehensive Mathematical Operations:** Supports a wide range of operations, including arithmetic, trigonometric, exponential, logarithmic, and power functions, ensuring versatility in generated C code.
- **Higher-Order Derivatives:** Capable of computing derivatives up to the third order, facilitating advanced mathematical analyses and optimizations.
- **Safety Measures:** Incorporates automatic safety checks, such as division by zero prevention, enhancing the reliability of the generated code.
- **Automated Testing:** Generates complete test programs to validate the correctness of the translated C code, ensuring functional integrity

PROJECTS

Open Game (Theory) Engine to PyTorch Compiler (in Python)

02/2025
https://github.com/ericschmid-uchicago/opengames2pytorch

Open Game Engine to PyTorch Compiler – An automated translation tool converting domain-specific game-theoretic models into executable PyTorch implementations.

- **Automatic DSL to PyTorch Translation:** Systematically converts complex game-theoretic models from domain-specific languages into PyTorch code, facilitating integration with modern machine learning workflows.
- **Preservation of Game-Theoretic Semantics:** Ensures that the original semantics of game-theoretic constructs are maintained during translation, preserving the integrity of strategic models.
- **Enhanced Computational Efficiency:** Optimizes translated models for computational performance within the PyTorch framework, enabling efficient analysis and simulation.
- **Support for Advanced Game Theory Concepts:** Accommodates sophisticated game-theoretic constructs, allowing for the modeling and analysis of complex strategic interactions.
- **Multi-Stage Transformation Pipeline:** Employs a structured compilation process, including parsing, semantic mapping, and code generation, to ensure accurate and efficient translation from the source language to PyTorch.

SELECTED PUBLICATIONS

The value of innovation: the economics of targeted drugs for cancer

Targeted Oncology

Cara C. Tigue, Karen A. Fitzner, Motasem Alkhatib, Eric Schmid & Charles L. Bennett

03/2007 https://link.springer.com/article/10.1007/s11523-007-0043-8

I analyzed the economic implications of targeted cancer drugs, examining their substantial costs ($13,000-$100,000 annually) relative to their clinical benefits and addressing concerns about healthcare resource allocation in an era of breakthrough but expensive oncology therapeutics.
Co-authored research paper published in Targeted Oncology examining the economic considerations of 16 FDA-approved targeted cancer therapies
Analyzed cost-effectiveness ratios and insurance reimbursement considerations for novel cancer drugs ranging from $13,000-$100,000 per patient annually
Evaluated economic sustainability challenges of targeted therapies in oncology while acknowledging their breakthrough clinical value
Recommended methodology improvements for cost-effectiveness studies to better inform healthcare resource allocation decisions

A Very Short Introduction to Topos Theory (adapted from Prof. Pettigrew's notes)

Preprint

Eric Schmid

2024 https://philarchive.org/archive/SCHAVS-8

A quick overview of category theory and topos theory including slice categories, monics, epics, isos, diagrams, cones, cocones, limits, colimits, products and coproducts, pushouts and pullbacks, equalizers and coequalizers, initial and terminal objects, exponential objects, subobjects, subobject classifiers, the definition of a topos, algebras of subobjects, functors, natural transformations and adjoint functors.
This paper is refashioned and adopted from Richard Pettigrew's university notes.

SELECTED PUBLICATIONS

Prolegomenon to a Treatise

Bauer Verlag

Eric Schmid

2022 https://www.semcoop.com/prolegomenon-treatise

Co-edited by Ben Green, with forewords by Rocco Gangle, Will Fraser, Michael Stumpf, Connor Tomaka, Fernando Zalamea, afterwords by Alexander Boland, Laszlo Horvath, Hunter Hunt-Hendrix, Inigo Wilkins, Tim Pierson and postscript by Mattin.
The apparent primary goal of Eric's treatise is to define something called 'the Real', with the help of a patchwork of theoretical materials drawn from contemporary mathematics, mathematical physics, 'neurophysics' and continental theory. Other topics in the text, especially those dealing with genesis and manifestation, seem relevant to Eric's conception of total art, which refines the spirit of Fluxus for the contemporary moment under the heading of 'minor rationalism'. ––Ravenna Hunt-Hendrix
How could one reconcile the proposition of univalent foundations in mathematics and the traces of activity marked by the proper name of Dieter Roth? Could the formal inventions of the former help elaborate the field of the latter? The Prolegomenon begins to establish some compelling coordinates by which one could begin to approach such a question. Could one carry such formalizing work forward? As a text with foundational aspirations, what would the status of such work be? ––Tim Pierson
In my view, what is most important in Schmid's treatise is how it exercises a panoply of important sections from contemporary philosophy, science and mathematics in order to suggest how the epistemic relation between 'abstract' and 'concrete' that is manifest, in particular, in type theory (especially its timely homotopic incarnation) may be constructively employed and made effective without having to ground itself in correspondence to any correlative ontological relation between 'form' and 'matter'. ––Rocco Gangle

CONFERENCES

Logic, Methodology of Science, and its Applications 08/2024

Co-organized with Connor Tomaka
Morning Conference + Evening Performances
Emily Harvey Foundation, New York, NY (August 17, 2024)
Featuring speakers: Andrei Rodin, Colin McLarty, David Corfield, Rocco Gangle, Matt Teichman, Ryan Simonelli, Alyssa Van Denburg, Corey Thuro, Kristopher Brown, Reza Negarestani

Introduction to Philosophy of Science 12/2022

Co-organized with Ben Green and Connor Tomaka
Zoom conference in conjunction with Eric Schmid's Prolegomenon to a Treatise
Hosted by Triest at Emily Harvey Foundation, New York, NY (December 3, 2022)
Featuring speakers: Rocco Gangle, Ian James, Giuseppe Longo, Colin McLarty, Reza Negarestani

AWARDS

- **Dean's List for Fall 2008 & Spring 2009, New York University**
- **Effron Family Scholarship for Pure Mathematics, DePaul University**
- **The Joseph Sugre Endowed Graduate Scholarship in Mathematics, DePaul University**
- **Research Assistantship, Fall 2024, DePaul University**
- **Teaching Assistant for Linear Algebra, DePaul University**

EXPOSITORY PAPERS AND NOTES

Notes on Varieties and Commutative Algebra

Eric Schmid

2024 https://ericschmid-uchicago.github.io/notes/Schmid_notes_on_varieties_FINAL.pdf

Expository Paper

Introduction to Sheaf Theory and Sheaf Cohomology

Eric Schmid

2025 https://ericschmid-uchicago.github.io/notes/sheaf_final-10.pdf

Expository Paper