

GABRIEL EARLE

Austin, Texas

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“AI Research Scientist | PhD Mathematician | Senior AI Engineer”

PROFESSIONAL SUMMARY

PhD mathematician and AI engineer specializing in the design of production-oriented AI systems. Expert architect of end-to-end AI platforms combining large language models, agentic workflows, and knowledge engines to perform automated reasoning and domain-specific decision support. Research areas include transformer architectures, machine learning, statistical modeling, numerical methods, and scientific computing.

SELECTED AI SYSTEMS AND RESEARCH

LLM-Powered Building-Code Compliance Platform

- Designed and implemented an end-to-end AI platform using LLMs, agentic reasoning, ontology generation, knowledge graphs, semantic retrieval, and automated code compliance analysis. Reduced manual interpretation of complex engineering standards and ambiguity in compliance checks.

AI/ML Research

- Conducted original research in neural network training, and applications to statistical simulations for drug discovery. Developed previously unknown methods for applying machine learning to molecular dynamics simulations.

Mechanistic Interpretability, Transformer, & Large Language Model Research

- Conducted original research on transformer architectures, mechanistic interpretability, probabilistic modeling, sampling methods, and machine learning theory. Advanced understanding in how transformers learn representations of semantic concepts.

TECHNICAL SKILLS

AI Systems and Machine Learning

- LLMs, Agentic AI, RAG, Fine-Tuning, Transformers, Deep Learning, Generative AI, Neural Networks, Model Quantization, Technical Strategy

Knowledge Engineering

- Knowledge Graphs, Ontologies, Semantic Search, Neo4j, Vector Databases

Architecture

- Multi-Agent Systems, AI Pipelines, Document Intelligence, Automated Reasoning

Programming

- Python, PyTorch, TensorFlow, Julia, Java, C++, MATLAB

AI Infrastructure

- OpenAI API, Gemini API, Claude API, OCR, PyMuPDF, Pydantic, AWS

Mathematics & Modeling

- Probability, Statistics, Statistical Modeling, Numerical Analysis, Optimization, Scientific Computing

WORK HISTORY

Founder and AI Engineer: Constructed Mind LLC

Austin, Texas

August 2025 - Present

AI Project Development

- Built an end-to-end AI system combining large language models, agentic workflows, knowledge graphs, retrieval-augmented generation, and multimodal reasoning to automate building-code compliance analysis.
- Designed a knowledge-engineering platform capable of translating regulatory language into executable reasoning and verification procedures.
- Developed graph-based semantic representations, ontology generation pipelines, retrieval systems, and autonomous AI agents for technical decision support.
- Implemented multimodal AI workflows integrating text, diagrams, floor plans, and 3D building information models.
- Researched transformer architectures, mechanistic interpretability, and advanced retrieval methods to improve reasoning accuracy, transparency, and reliability.
- Technologies: Python, Machine Learning, Generative AI, LLMs, Agentic AI, Knowledge Graphs, Neo4j, RAG, Transformers, Vision-Language Models

Visiting Assistant Professor, Department of Mathematics & Statistics

University of Massachusetts Amherst

September 2021 - August 2025

RESEARCH ACTIVITIES at UMass

- Investigated transformer architectures and open-source large language models, developing a strong understanding of modern machine learning systems, neural networks, and AI model implementation.
- Conducted research in statistical modeling, stochastic systems, and scientific computing, developing novel sampling algorithms for high-dimensional simulation and rare-event analysis.
- Designed and analyzed advanced numerical methods using probability theory, optimization, Monte Carlo methods, and large-scale computational experimentation.
- Authored peer-reviewed research on state-of-the-art algorithms for sampling and simulation in complex systems.
- Used Python for scientific computing, simulation, data analysis, and algorithm evaluation.
- Conference speaker at research seminars and project meetings
- Collaborated with international research teams

Ph.D. & Post-Doctoral Researcher, Department of Mathematics

Duke University, Durham NC

August 2014 – August 2021

- Initiated projects for research groups to pursue. Gave feedback on research and advanced the projects with personal research findings
- Designed and carried out original research projects, discovering and implementing useful algorithms that advanced the field of sampling in statistics
- Developed applications of statistical theory to molecular dynamics
- Presented posters and talks on research at major conferences across the nation.
- Connected with leading figures in mathematics and related fields, establishing a cross-disciplinary professional network for research and outreach

EDUCATION

Duke University, Durham NC

December 2020

- Ph.D. in Mathematics; Advisor: Dr. Jonathan Mattingly, the Kimberly J. Jenkins Distinguished University Professor of New Technologies
- Dissertation: Stratified MCMC Sampling for Non-Reversible Dynamics

University of Texas at Austin

May 2014

- Dean's Scholars Honors Program; Bachelor of Science in Mathematics
- National Merit Scholarship
- Texas Undergraduate Research Journal, "A Generalized Method of Lie Symmetries for Dynamic Equations on Time Scales, and Applications",
- Took the four Math graduate qualifying exams as a sophomore: Probability, Algebra, Analysis, Topology
- Independent Study with Dr. Robert Gompf, the Jane and Roland Blumberg Centennial Professor Emeritus in Mathematics

North Hills Preparatory School, Irving Texas

- S.A.T. Perfect score of 800 in both English and Math
- Independent Study 2009-2010 with Dr. Michael Artin, Emeritus Professor of Mathematics at M.I.T.
- Led the North Hills team to 2nd place Statewide in the University Interscholastic League (UIL) Competition in Physics and Chemistry
- Individual Regional First Place in Physics, Chemistry and Math, Fourth place in State

PROFESSIONAL ACTIVITIES

SEMINAR CO-HOST; CONTRIBUTING AUTHOR

Society for Industrial & Applied Mathematics Annual Conference, Amherst MA

July 2022

- Improved state-of-the-art research in the field of statistics and sampling, authored multiple papers with other leading mathematicians
- Presented key results at a national conference to a global community of experts in mathematics and engineering
- Fostered community among the leading members of the research community, bringing together several disciplines through a seminar themed around my field

SELECTED PUBLICATIONS:

- Earle, G. J.; Mattingly, J. C. (2024). Convergence of stratified MCMC sampling of non-reversible dynamics. Stochastics and Partial Differential Equations: Analysis and Computations, 12(4), 2289–2329. <https://doi.org/10.1007/s40072-024-00325-0>
- Earle, G.; Van Koten, B. (2023). Aggregation methods for computing steady states in statistical physics. Multiscale Modeling & Simulation, 21(3), 1170–1209. <https://doi.org/10.1137/22m1530628>
- Earle, G.; Van Koten, B. (2025, February 7). Relative entropy methods for calculating committors. arXiv.org. <https://doi.org/10.1137/25M1757708>, SIAM/ASA Journal on Uncertainty Quantification 14 (2), 621-660

COMMUNITY VOLUNTEERING & LEADERSHIP EXPERIENCE

- NC Writers' Network, Durham NC. **Discussion Organizer** May 2015 - Present
 - Provided insightful feedback on a variety of both creative and professional pieces from an array of writers across interests
 - Wrote short and long pieces while incorporating feedback to improve them, growing skills and engagement with the community
- Active role in volunteering initiatives important to the local community and culture. Examples: Get Out the Vote, Humane Society, Duke Catholic Center
- Eagle Scout, Boy Scouts of America