

GABRIEL EARLE

Austin, Texas

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“Senior / Principal AI Engineer | Machine Learning Research Scientist | PhD Mathematician | AI Systems Architecture | LLMs | Agentic AI | Knowledge Engineering”

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.

AI Architecture & Research Leadership

- Architect end-to-end AI systems integrating LLMs, multi-agent workflows, knowledge engineering, semantic retrieval, and automated reasoning.
- Lead original research spanning transformer architectures, mechanistic interpretability, probabilistic modeling, and AI/ML theory.
- Translate advances in machine learning and large language models into applied AI systems for engineering documents, technical standards, regulatory knowledge, and scientific computing.

Selected AI Systems & 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, reducing 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, developing previously unavailable methods for applying machine learning to molecular dynamics simulations.

Interpretability, Transformer, & Large Language Model Research

- Conducted original research on transformer architectures, mechanistic interpretability, probabilistic modeling, sampling methods, and machine learning theory, advancing understanding on 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

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 advancing state-of-the-art algorithms for sampling and simulation in complex systems.
- Developed Python software for scientific computing, simulation, data analysis, and algorithm evaluation.
- Collaborated with international research teams and led technical discussions through recurring research seminars and project meetings.

TEACHING ACTIVITIES at UMass

- Mentored undergraduate researchers and taught university mathematics courses, communicating complex technical concepts to diverse audiences.
- Taught multiple undergraduate courses per semester, accommodating various learning styles to assist students in embracing complex subject matter; working one-on-one with students through scheduled in-person office hours to ensure students' comfort and academic success
- Instructed multiple teaching assistants to carry out study sessions with students, checking in regularly and providing feedback to enhance their instruction

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

Duke University, Durham NC

August 2014 – August 2021

- Formed research projects and developed interests by connecting with mentors and joining groups with peers in mathematics
- Presented posters and talks on research at major conferences across the nation, building connections with top authorities in field of study
- Led organization efforts for departmental research group, focused on sharing individual and group research results in an informal setting for the purpose of developing collaborative relationships across departments
- Initiated projects for research groups to pursue, giving and receiving feedback on research and advancing the projects with personal research findings and applications
- Connected with leading figures in mathematics and related fields, establishing a cross-disciplinary professional network for research and outreach
- 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 real-world data, using algorithms in both personal and collaborative research
- Presented research to leaders in the fields of statistics and machine learning, making persuasive arguments for the usefulness of my discoveries

Teaching & Grading Assistant, Department of Mathematics

Duke University, Durham NC

August 2014 - May 2020

- Oversaw detailed documentation of course lectures for potential publication
- Led study sessions for students outside of class, directing problem solving and communication practice
- Prepared and gave lectures to students, demonstrating ability to fill in for instructors and communicate a wide range of material
- Graded homework and exams for various classes, providing detailed feedback designed to guide student growth

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

- Bachelor of Science in Mathematics
- Dean's Scholars Honors Program
- 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

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

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://arxiv.org/abs/2502.04605>
 - Submitted to the SIAM Journal of Uncertainty Quantification

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