Jamie Mahowald

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Education

The University of Texas at Austin | Austin, TX | Aug. 2021 – May 2025
- BS in Mathematics, GPA: 3.98/4.00
- BA in Plan II Honors, minor in Latin

Positions

- **Post-bachelor student** | Los Alamos National Laboratory (LANL) | May 2025 – May 2026
- **Student technician** | Applied Research Laboratories at UT Austin (ARL:UT) | Aug. 2024 – May 2025
- **Research intern** | Oden Institute for Computational Engineering & Sciences | Jun. – Aug. 2024
- **Research intern** | Library of Congress, John W. Kluge Center | Jan. – Apr. 2024
- **Research intern** | Comparative Constitutions Project (www.constituteproject.org) | May – Aug. 2023

Honors and awards

- Phi Beta Kappa, UT Austin, Spring 2025.
- Special honors in Mathematics (senior honors thesis distinction), UT Austin, Spring 2025
- Kuhn Scholarship, UT Austin, Fall 2024.
- Best Long Paper, *Computational Humanities Research* (CHR), Fall 2024
- Plan II Travel Grant, UT Austin, Summer 2024.
- Chris R. Bjornson Scholarship, Archer Center, Spring 2024.
- Plan II Continuing Scholarship, UT Austin, Fall 2022.

Publications

Peer-reviewed:
- J. Mahowald, B.C.G. Lee. "Retrieval-Augmented Search for Large-Scale Map Collections with ColPali." *ACM SIGIR Conference on Human Information Interaction and Retrieval (CHIIR)*, 2025. https://arxiv.org/abs/2510.25718.
- J. Mahowald, R. Srinivasan, and Z. Wang. "Toward Dataset Distillation for Regression Problems." *Efficient Systems for Foundation Models Workshop, International Conference on Machine Learning (ICML)*, 2025. https://openreview.net/forum?id=bM4MbgGnpx.
- J. Mahowald and B. C. G. Lee. "Integrating Visual and Textual Inputs for Searching Large-Scale Map Collections with CLIP." *Computational Humanities Research*, vol. 5, 2024. DOI: 10.48550/arXiv.2410.01190. Best Long Paper Award.

Preprint / in review:
- J. Mahowald, B. Bell. "Efficient Analysis of the Distilled Neural Tangent Kernel." https://doi.org/10.48550/arXiv.2602.11320.
- J. Mahowald and T. Bui-Thanh. "Generalization Limits of In-Context Operator Networks for Higher-Order Partial Differential Equations." Under review, *SIAM Undergraduate Research Online*, 2025.

Senior thesis:
- "Toward Dataset Distillation for Regression Problems." Plan II Honors Program, UT Austin, 2025. DOI: [10.26153/tsw/60640](10.26153/tsw/60640).

Research projects

Efficient Analysis of the Distilled Neural Tangent Kernel

Los Alamos National Laboratory | June 2025 – Present

Advisors: Brian Bell (LANL), Juston Moore (LANL)
- Developing a surrogate method to compute the neural tangent kernel using dataset distillation and random projection. Reduced computational complexity by 10^4-10^6 for multi-million parameter vision models while retaining >95% surrogate fidelity.
- Analyzing model performance in the kernel regime, characterizing calibration error, matrix conditioning, effective rank for approximated kernels, and adversarial robustness in the kernel regime.

- Introduced an algorithm for cluster-aware distillation of gradients.

Strengthening LLM guardrails using meta-learning
Los Alamos National Laboratory | September 2025 – Present
With: Michael Geyer, Selma Peterson, Nick Hengartner, Brian Bell (LANL)
- Developing a three-part framework for harmful fine-tuning and evaluation of LLM guardrail methods on several benchmarks.
- Contributing to the derivation of statistical guarantees on a language model's probability to produce harmful responses under guardrail-preserving meta-learning.

Retrieval-Augmented Search for Large-Scale Map Collections
Personal project | Aug. – Dec. 2025
With: Benjamin Lee (University of Washington)
- Extended earlier Library of Congress work by implementing the ColPali retrieval-augmented generation model, improving search precision over CLIP-based methods.
- Developed an efficient embeddings and search pipeline for 560,000+ historical maps.
- Deployed a production search engine using AWS at http://mapras.com.

Convergence Theory for Dataset Distillation in Regression Problems
Applied Research Laboratories at UT Austin | Aug. 2024 – May 2025
Advisors: Atlas Wang (UT Austin), Ravi Srinivasan (ARL:UT)
- Developed dataset distillation methods for regression problems, addressing a gap in existing research which primarily focused on classification tasks.
- Reduced the operator learning problem to its regression setting to understand when and why distillation preserves relevant information. Derived sufficient near-convexity conditions under which distillation converges to an optimum, providing convergence guarantees and actionable hyperparameter selection criteria.

Generalization Limits of In-Context Operator Networks
Oden Institute for Computational Engineering & Sciences | Jun. – Aug. 2024
Advisor: Tan Bui-Thanh (UT Austin)
- Characterized empirical limits to out-of-distribution generalization of In-Context Operator Networks, a recent class of in-context learners for differential equations.
- Developed numerical data-generation schemes for high-order PDEs and systematically tested out-of-distribution performance to characterize when these networks reliably solve new problem instances.
- Trained full-parameter models on the Frontera supercomputer (TACC) using MPI and OpenMP parallel workflows.

Machine learning for archival map search
John W. Kluge Center, Library of Congress | Jan. – Apr. 2024
Advisor: Benjamin Lee (University of Washington)
- Created a zero-shot feature search engine for the Library of Congress's 560,000-item Geography & Map collection using OpenAI's CLIP transformer, enabling researchers to search maps by visual features and textual queries without manual metadata creation.
- Published a labeled dataset, fine-tuned model, and embedding library as open-source contribution.
- Received Best Long Paper award at the Computational Humanities Research conference.

Talks and presentations
- "Efficient computation of the neural tangent kernel at ImageNet-scale using dataset distillation." Laboratory Directed Research and Development (LDRD) program appraisal, Los Alamos National Laboratory. October 2025.
- "Toward efficient computation of path kernels with dataset distillation." Cybersecurity Science Research Program, Los Alamos National Laboratory. August 2025.
- "Toward dataset distillation for scientific data." Briefing to US Intelligence Community leadership. Applied Research Laboratories, University of Texas at Austin. April 2025.

- "Generalization limits of in-context operator networks for differential equations." Multi-institutional research seminar (UT Austin, Georgia Tech, Los Alamos National Laboratory). February 2025.
- "Better visual search methods with machine learning." Critical Datasets Reading Group, Library of Congress. June 2024.

Technical skills

Machine Learning: Deep learning, optimization, kernel methods, operator learning, LLM safety, compression.
Programming: Python (PyTorch, TensorFlow, JAX, Scikit-learn), parallel programming (MPI, OpenMP)
Scientific Computing: High-performance computing, numerical methods for PDEs, data analysis and visualization, MATLAB, Mathematica, Julia, C/C++.

Leadership and service

Texas Undergraduate Law Journal | Managing Editor | Sep. 2021 - Apr. 2024
- Managed editorial operations and peer review process for undergraduate legal research
- Wrote analytical articles on technology policy, intellectual property, and business law

UT Student Government, Governmental Relations Agency | State Liaison | Jul. 2022 - May 2023
- Organized town halls connecting UT students with Texas state legislators

References

- Brian Bell. Scientist. A-4: Advanced Research in Cyber Systems (group), Los Alamos National Laboratory. bwbell@lanl.gov.
- Juston Moore. Group leader. AI for Nuclear Deterrence (group), X Computational Physics (division), Los Alamos National Laboratory. jmoore01@lanl.gov.
- Benjamin Lee. Assistant Professor. University of Washington Information School. bcgl@uw.edu.
- William Beckner. Montgomery Professor of Mathematics. The University of Texas at Austin. beckner@math.utexas.edu.
- Ravi Srinivasan. Research scientist. Signal and Information Sciences Laboratory, Applied Research Laboratories at UT Austin. ravi.srinivasan@utexas.edu.
- Tan Bui. William J Murray Jr. Fellow in Engineering. Oden Institute for Computational Engineering and Sciences, UT Austin. tanbui@oden.utexas.edu.