Garrett Bingham

garrettbingham.com
garrett@gjb.ai
+1 385.205.1925
linkedin.com/in/garrettbingham
github.com/garrettbingham
Last Updated: July 1, 2024

EDUCATION

The University of Texas at Austin — Austin, TX · 2019 - 2023
Ph.D., Department of Computer Science — Advisor: Risto Miikkulainen

Yale University — New Haven, CT · 2015 - 2019
B.S., Computer Science & Mathematics, *cum laude*

RESEARCH AND WORK EXPERIENCE

Google DeepMind — Mountain View, CA · Oct 2023 - Present
Research Scientist

- Curated datasets used to train Gemini models.

Cognizant AI Labs — San Francisco, CA · May 2020 - Oct 2023
Machine Learning Researcher

- Developed AQuaSurF, a technique for efficient activation function optimization through surrogate modeling.
- Fisher eigenvalues and function outputs are used to accurately predict performance, accelerating search for better activation functions.
- AQuaSurF is orders of magnitude more efficient than comparable methods and scales up to large datasets like ImageNet.

- Developed AutoInit, an approach for analytic signal-preserving weight initialization for neural networks.
- AutoInit improves performance of convolutional, residual, and transformer networks across a range of activation function, dropout, weight decay, learning rate, and normalizer settings.
- In neural architecture search and activation function discovery, AutoInit automatically calculates specialized weight initialization strategies for thousands of unique architectures and hundreds of unique activation functions.
- AutoInit improves performance in vision, language, tabular, multi-task, and transfer learning scenarios.

Neural Networks Research Group — Austin, TX · Aug 2019 - May 2023
Graduate Research Assistant

- Developed PANGAEA, a process combining evolutionary and gradient-based optimization to design deep network activation functions.
- Activation functions discovered by PANGAEA give statistically significant increases in performance over 31 baseline functions.

- Demonstrated that evolutionary algorithms can design novel deep learning activation functions that outperform ReLU.
- Replacing ReLU with an evolved activation function in Wide ResNet gives a statistically significant increase in accuracy on CIFAR-100.
- Showed that an evolutionary algorithm discovers better activation functions more quickly than random search.

Amazon Robotics AI — Seattle, WA · May - Aug 2019
Software Development Engineer Intern

- Migrated production large-scale video classification workflow to internal computation framework, optimizing for specific use cases.
- Parallelized 10TB dataset construction and preprocessing; used cached results from prior datasets to incrementally build new ones.
- Created model versioning scheme to allow framework to substitute precomputed per-epoch results instead of requiring two weeks of retraining for every experiment.
- Assisted visiting scientists with onboarding and added GPU support to the framework.

Language, Information, and Learning at Yale (LILY) Lab — New Haven, CT · Aug 2018 - May 2019
Natural Language Processing Researcher

- Developed BiDARTS, a novel approach to automatically design bidirectional recurrent neural network architectures.
- BiDARTS approached state-of-the-art accuracy on word token part of speech tagging across 60 treebanks (91.32% vs. 91.83%).

- Empirically demonstrated that random search outperforms current gradient-based approaches to neural network architecture design.
- Improved English-Swahili and English-Tagalog cross-lingual document retrieval relevance scores by 5.2% by training support vector regressor to predict query-specific document cutoffs. Research done for IARPA MATERIAL Program.

Reservoir Labs New York, NY · Jun - Aug 2018
Machine Learning Engineer Intern
- Utilized polyhedral compiler to speed up neural network inference time by 12% without sacrificing accuracy.
- Implemented methods to translate TensorFlow operations to equivalent C code, increasing percentage of optimizable operations from 84% to 99% for Inception V3/V4 and from 58% to 95% for ResNet V2 50.
- Designed algorithm to optimize disjoint subgraphs of the neural network, decreasing optimization time to less than one minute.
- Improved robustness by developing algorithms that guarantee the optimized neural network remains acyclic.

University of North Carolina Wilmington Wilmington, NC · May - Jul 2017
NSF Research Experience for Undergraduates Intern
- Developed novel face recognition algorithm which classifies by weighting predictions made in multiple random feature subspaces.
- Improved accuracy from 60.9% to 78.8% on MORPH-II and from 90.3% to 94.8% on ORL datasets vs. related algorithms.
- Corrected 2,700 errors in the 55,000 entry MORPH-II face image dataset that previously published research missed.

PUBLICATIONS

Journal Articles

1. G. Bingham and R. Miikkulainen. Discovering Parametric Activation Functions. *Neural Networks*, 2022

Refereed Conference Papers

2. Z. Wang*, G. Bingham*, A. W. Yu, Q. V. Le, T. Luong, and G. Ghiasi. HaloQuest: A Visual Hallucination Dataset for Advancing Multimodal Reasoning. In *European Conference on Computer Vision (ECCV)*, 2024
3. G. Bingham and R. Miikkulainen. Efficient Activation Function Optimization through Surrogate Modeling. *Advances in Neural Information Processing Systems (NeurIPS)*, 2023
4. G. Bingham and R. Miikkulainen. AutoInit: Analytic Signal-Preserving Weight Initialization for Neural Networks. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 37, 2023
5. G. Bingham, W. Macke, and R. Miikkulainen. Evolutionary Optimization of Deep Learning Activation Functions. In *Genetic and Evolutionary Computation Conference (GECCO '20), July 8–12, 2020, Cancún, Mexico*, 2020
6. R. Zhang, C. Westerfield, S. Shim, G. Bingham, A. R. Fabbri, W. Hu, N. Verma, and D. Radev. Improving Low-Resource Cross-Lingual Document Retrieval by Reranking with Deep Bilingual Representations. In *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics*, pages 3173–3179, 2019
7. B. Yip, G. Bingham, K. Kempfert, J. Fabish, T. Kling, C. Chen, and Y. Wang. Preliminary Studies on a Large Face Database. In *2018 IEEE International Conference on Big Data (Big Data)*, pages 2572–2579. IEEE, 2018

Technical Reports

8. Gemini Team, Google. Gemini 1.5: Unlocking Multimodal Understanding across Millions of Tokens of Context. *arXiv:2403.05530*, 2024
9. G. Bingham. Optimizing Neural Networks through Activation Function Discovery and Automatic Weight Initialization. *Ph.D. Dissertation*, 2023
10. G. Bingham. Part of Speech Tagging with Neural Architecture Search. *Yale University Senior Project*, 2019
11. G. Bingham. Random Subspace Two-Dimensional LDA for Face Recognition. *arXiv:1711.00575*, 2017
12. G. Bingham, B. Yip, M. Ferguson, C. Nansalo, C. Chen, Y. Wang, and T. Kling. MORPH-II: Inconsistencies and Cleaning. *University of North Carolina Wilmington NSF REU*, 2017

PRESENTATIONS

Oral Presentations

13. G. Bingham. Optimizing Neural Networks through Activation Function Discovery and Automatic Weight Initialization. Ph.D. Dissertation Defense. The University of Texas at Austin. Austin, TX. April 3, 2023
14. G. Bingham. AutoInit: Analytic Signal-Preserving Weight Initialization for Neural Networks. AAAI 2023. Washington, DC. February 7-14, 2023
15. G. Bingham. Automated Activation Function Design with Evolutionary Computation. Ph.D. Proposal. The University of Texas at Austin. Austin, TX. December 1, 2020
16. G. Bingham. Evolutionary Optimization of Deep Learning Activation Functions. BEACON Congress. August 12-14, 2020
17. G. Bingham. Evolutionary Optimization of Deep Learning Activation Functions. GECCO 2020. Cancún, Mexico. July 8-12, 2020
18. G. Bingham. Evolutionary Optimization of Deep Learning Activation Functions. Ph.D. Research Preparation Exam. The University of Texas at Austin. Austin, TX. April 21, 2020
19. G. Bingham. Random Subspace Two-Dimensional LDA for Face Recognition. NES Mathematical Association of America Meeting. Sacred Heart University. Fairfield, CT. November 17-18, 2017

Poster Presentations

20. G. Bingham. Efficient Activation Function Optimization through Surrogate Modeling. NeurIPS 2023. New Orleans, LA. December 10-16, 2023
21. G. Bingham. AutoInit: Analytic Signal-Preserving Weight Initialization for Neural Networks. AAAI 2023. Washington, DC. February 7-14, 2023
22. G. Bingham. Random Subspace Two-Dimensional LDA for Face Recognition. Council on Undergraduate Research REU Symposium. The Westin Alexandria. Alexandria, VA. October 22-23, 2017
23. G. Bingham. Random Subspace Two-Dimensional LDA for Face Recognition. REU Research Showcase. The University of North Carolina Wilmington. Wilmington, NC. July 24, 2017

PATENTS

24. G. Bingham and R. Miikkulainen. System and Method for Evaluating Weight Initialization for Neural Network Models, Mar. 23 2023. US Patent App. 17/855,955
25. G. Bingham and R. Miikkulainen. System and Method For Generating Parametric Activation Functions, Feb. 17 2022. US Patent App. 17/399,470
26. One patent pending

SOFTWARE

27. G. Bingham. AQuaSurF. https://github.com/cognizant-ai-labs/aquasurf, 2023
28. G. Bingham. Act-Bench. https://github.com/cognizant-ai-labs/act-bench, 2023
29. G. Bingham et al. AutoInit. https://github.com/cognizant-ai-labs/autoinit, 2021

REVIEWING

Journals

- ACM Journal on Emerging Technologies in Computing Systems
- IEEE Transactions on Evolutionary Computation
- Nature Machine Intelligence

Conferences

- AAAI (Association for the Advancement of Artificial Intelligence) 2023
- GECCO (Genetic and Evolutionary Computation Conference) 2021, 2022
- ICML (International Conference on Machine Learning) 2022, 2023
- NeurIPS (Neural Information Processing Systems) 2022

AWARDS

University Graduate Continuing Fellowship, The University of Texas at Austin, 2021 - 2022, $44,000. (declined)