NOAH FOSTER

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EDUCATION

Brown University Honors B.S. Mathematics-Computer Science B.S. Applied Math *GPA: 3.7* | Expected Graduation Spring 2024

- *Relevant Graduate Coursework*: Advanced Topics in Deep Learning, Deep Learning, Real Analysis, Functional Analysis, Recent Applications of Probability and Statistics, Theory of Probability
- *Relevant Undergraduate Coursework*: Computational Linguistics, Machine Learning, Computational Probability and Statistics, Abstract Algebra, Linear Algebra, Topology, Number Theory, Information Theory, Statistical Inference, Numerical Optimization, Econometrics, Macroeconomics, Microeconomics

RESEARCH EXPERIENCE

Brown University - Computer Science Research Assistant *Providence, RI* | September 2022 - Present

- Investigated the shared geometry of conceptual information in large language and vision transformer models through the construction of a MAGMA-style multimodal model built on CLIP, BEiT and GPT-J as a follow up to the LiMBeR Paper.
- Employed PyTorch, Transformers and Brown's High-Performance Compute Cluster to develope custom transformer interpretability tools to evaluate information exchange between visual embeddings and linguistic decodings leading to emergent capabilities of models in multimodal frameworks under the guidance of Ellie Pavlick at the LUNAR Lab, Brown University.

Cornell University - Computer Science Research Assistant *Ithaca, NY* | June 2023 - September 2023

- Collaborated with Carla Gomes to develop attention-based graphical neural network models, applying transformer-based methods to solve complex problems with exponential search spaces, notably Latin Square-style problems using PyTorch and HPC.
- Conducted extensive experiments and analysis to assess the effectiveness of the generated solutions when compared to traditional search methods, contributing to the advancement of deep reasoning networks in combinatorial generation.

Brown University - Econometrics Research Assistant *Providence, RI* | October 2021 - October 2022

- Conducted groundbreaking research to challenge the conventional wisdom surrounding log-linear regression models in econometrics. Demonstrated the limitations of such models in accurately estimating parameters of interest in economic analysis.
- Employed advanced theoretical statistical techniques, including the Functional Delta Method, Hadamard and Gateaux Differentiation, and Brownian Bridges, to rigorously analyze and prove the asymptotic behavior of proposed estimators. These methods were instrumental in revealing the shortcomings of log-linear regression as an adequate tool for parameter estimation.
- Collaborated closely with Jon Roth to estimate the elasticity of consumption with respect to varying unemployment insurance. Utilized R, Python (with Jupyter and Google Colab) to implement novel our statistical approach and compute empirical results.

PROJECTS

Honors Thesis: Theoretical Justification for Model Composition *Python* | September 2023 - Current

- Collaborating with Chen Sun to build better multimodal models by harnessing the Convergence of Language and Vision Model Geometries leading to state of the art models with minimal training data and improved interpretability.
- Providing better justification for the Convergence of Geometries through theoretical analysis of random manifold projections.

Subnetworks and Superposition *Python* Paper | February 2023 - May 2023

- Developed a method to dissect polysemantic neurons in vision and language models, revealing distinct subnetworks contributing to different semantic functions and allowing for the analysis of the superposition of latent features in neural networks.
- Utilized continuous sparsification with to identify subnetworks at 10x finer densities than state of the art gradient based heuristics.

Homeomorphic Annealing *Python* Git Repository | May 2023 - Present

- Built a library allowing for training neural network layers with discrete weights for 2x faster inference and compact storage
- Designed novel weight-discretization technique enabling faster model training with simple gradient descent methods

WORK & LEADERSHIP EXPERIENCE

Teaching Assistant *Providence, RI | September 2022 - December 2023*

- Computational Linguistics (Fall 2023): Designed, wrote and graded assignments for Ellie Pavlick's for over 140 undergraduates and graduate students, covering statistical and deep learning methods for parsing, translating and generating language.
- Recent Applications of Probability and Statistics (Spring 2023): Supported Stuart Geman in teaching statistical concepts related to SVMs, neural networks, and high-dimensional inference, stochastic calculus, large deviations and exponential models.
- Information Theory (Fall 2022): Assisted Cole Graham in teaching entropy, (lossless and lossy) compression, and theoretical probability and statistics to over 70 advanced undergraduates and graduate students. Held office hours and graded problem sets.

Brown University Cycling Team, *Captain* *Providence, RI* | September 2021 - May 2022

- Led a team of 20+ riders, overseeing all aspects of team management, including organizing practices, races, sponsorships, fundraising, and facilitating collaboration with university and cycling organizations for both novice and experienced racers.

SKILLS & INTERESTS

- **Programming Languages**: Python (PyTorch, TensorFlow), C/C++, R, MATLAB, Julia, Slurm, SQL, Lisp, and LaTeX
- **Interests**: Deep Learning, Machine Learning, NLP, Interpretability, Probability, Mathematics, Statistics, Causal Inference
- **Hobbies**: Cycling (Strava), Skiing, Backpacking, Hiking, Photography