

Charles Godfrey

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Skills

Machine Learning: large language models, retrieval augmented generation (RAG), agentic patterns, model interpretability, computer vision, reinforcement learning, A/B testing and experimentation design

MLOps & System Design: distributed training, model serving architectures, LLM-automated evaluation and analytics

Tools & Technologies:

- **ML Frameworks:** PyTorch, HuggingFace, DeepSpeed, lightgbm, scikit-learn
- **Data Science:** NumPy, SciPy, Pandas, Matplotlib, Seaborn, Jupyter
- **Cloud & Infrastructure:** AWS (EC2, S3, SageMaker), Docker, Git, Linux
- **Databases & Search:** OpenSearch, Postgres, Redis, vector similarity search
- **Monitoring:** MLFlow, Tensorboard, DataDog

Experience

Senior Applied Machine Learning Scientist, Thomson Reuters Labs

December 2024 - Present

Driving accuracy and quality improvements of agentic AI assistants for tax and accounting professionals

- Lead benchmarking data curation efforts, collaborating with domain experts to identify representative user needs, corresponding agent tasks and design rigorous annotation processes
- Specify and track comprehensive evaluation framework combining human expert assessment and automated LLM-based metrics
- Conduct systematic error analysis and literature review of state-of-the-art methods to identify improvement opportunities, implement and evaluate experimental system variants

Applied Machine Learning Scientist, Thomson Reuters Labs

October 2023 - December 2024

- Conducted experiments to measure and improve quality of a retrieval augmented generation (RAG) based AI assistant for tax professionals, resulting in over \$12M in new sales within the first 6 months after launch. Only individual contributor scientist on the project at the outset.
 - Technical lead for human evaluations to assess quality of AI assistant responses; error-analysis report on first evaluation helped define research and development agenda leading up to beta release
 - Iteratively improved language model prompts for chat interaction, significantly reducing rate of harmful AI assistant outputs to meet product MVP requirements on a tight timeline (4 months between start of project and beta release)
 - Designed and evaluated system updates significantly improving citation quality (near unanimous win in human expert AB testing) and expanding the retrieval content sets to cover a wider range of tax topics
- Upgraded a ranking algorithm for passages of editorial content to be displayed in search results
 - Designed and implemented a hybrid search algorithm fusing keyword and vector (text embedding) relevance scores
 - Worked closely with product team to tune a relevance threshold parameter, and with engineering team to ensure continued compatibility of model API with surrounding application
 - Improved rate at which best available passage (based on human annotated data) is ranked first by over 3%

Research Associate, Machine Learning, Pacific Northwest National Laboratory October 2021 - October 2023
National Security Directorate, Mathematics of Data Science Team

- Improved MosaicBERT language model training efficiency by 50% through cluster environment optimization, enabling higher accuracy models within fixed compute budgets
- Enhanced multispectral satellite image segmentation performance (+5% IoU) by implementing multi-GPU distributed training
- Reduced neural image compressor training time from 3 minutes to 6 seconds per epoch through modernized data pipeline, enabling rapid hyperparameter optimization
- Researched ML system safety and security, developing datasets to evaluate out-of-distribution performance of computer vision models
- Effectively communicated research findings to senior leadership and project sponsors through technical reports and presentations

Program Associate, Mathematical Sciences Research Institute March-May 2019

- Participated in the Birational Geometry and Moduli Spaces semester program
- Presented research on logarithmic Chow-to-Hodge cycle maps at the institute's graduate student seminar

Education

PhD in Mathematics, The University of Washington-Seattle June 2021

- Thesis: *Higher Direct Images of Ideal Sheaves, Correspondences in Log Hodge Cohomology and Globally F-Full Varieties*
- Completed the **eScience Institute's Advanced Graduate Data Science Option** (PhD-level courses in machine learning, data visualization and statistical inference, implemented machine learning methods like LASSO, kernel regression and k-means clustering in raw NumPy and SciPy)
- Department of Mathematics Graduate Fellowship (2018-2019)

Student, MSRI Mathematics of Machine Learning Summer Graduate School July 29-August 9 2019

- Attended mini-courses and problem sessions on statistical learning, convex optimization, deep learning and reinforcement learning
- Presented an expository account of recent work on linear stochastic bandits

Master's of Science in Mathematics, The University of Washington-Seattle June 2018

Bachelor's of Science in Mathematics and Physics, The University of Wisconsin-Madison May 2014

Mentoring

Intern Mentor, Thomson Reuters Labs May 2024 - September 2024

- Mentored a master's student running experiments on LLM contextual non-compliance (knowing when to not attempt to answer a question)
- Helped the intern get up to speed on the project, connected them with a variety of scientists, engineers and leaders for a series of one-on-one meetings, met regularly to discuss technical work as well as career development

Industry Mentor, Math-to-Industry Boot Camp July 2023-August 2023

- Mentored a team of math PhD students evaluating the usefulness of GPT-type large language models for scientific knowledge retrieval and the robustness of Segment Anything for person (e.g. pedestrian) detection
- To facilitate this capstone project, implemented a Segment Anything inference endpoint using TorchServe and provided a notebook demonstrating inference using the HuggingFace API

- Mentored undergraduate research projects on foundations of quantum mechanics and mathematical epidemiology

Publications

Main Track

1. Davis Brown, **Charles Godfrey**, Nicholas Konz, Jonathan Tu and Henry Kvinge. [Understanding the Inner Workings of Language Models Through Representation Dissimilarity](#). In *EMNLP 2023*.
2. Kelsey Lieberman, James Diffenderfer, **Charles Godfrey** and Bhavya Kailkhura. [Neural Image Compression: Generalization, Robustness, and Spectral Biases](#). In *NeurIPS 2023* (was also selected for an oral presentation at the *ICML 2023 Workshop Neural Compression: From Information Theory to Applications*).
3. **Charles Godfrey**, Davis Brown (equal contribution), Tegan Emerson and Henry Kvinge. [On the Symmetries of Deep Learning Models and their Internal Representations](#). In *NeurIPS 2022*. **Code available at github.com/pnnl/modelsym**.

Workshop

1. Nicholas Konz, **Charles Godfrey**, Madelyn Shapiro, Jonathan Tu, Henry Kvinge and Davis Brown. [Attributing Learned Concepts in Neural Networks to Training Data](#). In *The 1st Workshop on Attributing Model Behavior at Scale at NeurIPS 2023*, **selected for oral presentation**.
2. **Charles Godfrey**, Henry Kvinge, Elise Bishoff, Myles McKay, Davis Brown, Tim Doster and Eleanor Byler. [How many dimensions are required to find an adversarial example?](#). In *The 3rd Workshop of Adversarial Machine Learning on Computer Vision at CVPR 2023*, **selected for oral presentation**.
3. **Charles Godfrey**, Michael Rawson, Henry Kvinge and Davis Brown. [Fast computation of permutation equivariant layers with the partition algebra](#). In *ICLR 2023 Workshop on Physics for Machine Learning*.
4. Davis Brown, **Charles Godfrey** (equal contribution), Cody Nizinski, Jonathan Tu, Henry Kvinge. [Robustness of edited neural networks](#). In *ICLR 2023 Workshop on Mathematical and Empirical Understanding of Foundation Models*.
5. Henry Kvinge, Davis Brown and **Charles Godfrey**. [Exploring the Representation Manifolds of Stable Diffusion Through the Lens of Intrinsic Dimension](#). In *ICLR 2023 Workshop on Mathematical and Empirical Understanding of Foundation Models*, **featured in The Gradient**.
6. **Charles Godfrey**, Elise Bishoff, Myles McKay and Eleanor Byler. [Impact of architecture on robustness and interpretability of multispectral deep neural networks](#). In *SPIE Defense + Commercial Sensing 2023*.
7. Elizabeth Coda, Nico Courts, Colby Wight, Loc Truong, WoongJo Choi, **Charles Godfrey**, Tegan Emerson, Keerti Kappagantula and Henry Kvinge. [Fiber bundle morphisms as a framework for modeling many-to-many maps](#). In *ICLR 2022 Workshop on Geometrical and Topological Representation Learning*.

Preprints

1. **Charles Godfrey**, Ping Nie, Natalia Ostapuk, David Ken, Shang Gao and Souheil Inati. [Likert or Not: LLM Absolute Relevance Judgments on Fine-Grained Ordinal Scales](#) (2025).
2. [Correspondences in log Hodge cohomology](#) (2023).
3. Henry Kvinge, Grayson Jorgenson, Davis Brown, **Charles Godfrey** and Tegan Emerson. [Neural frames: A Tool for Studying the Tangent Bundles Underlying Image Datasets and How Deep Learning Models Process Them](#) (2022).

4. **Charles Godfrey**, Elise Bishoff, Myles McKay, Davis Brown, Grayson Jorgenson, Henry Kvinge and Eleanor Byler. [Testing predictions of representation cost theory with CNNs](#) (2022). Code available at https://github.com/pnnl/frequency_sensitivity.
5. Takumi Murayama and **Charles Godfrey**. [Pure subrings of Du Bois singularities are Du Bois singularities](#) (2022).
6. [Higher direct images of ideal sheaves](#) (2022).

Invited Talks

1. June 2023 [ICERM Mathematical and Scientific Machine Learning Workshop](#).
2. February 2023 [Boston College Math and Machine Learning Seminar](#).
3. January 2023 [Joint Mathematics Meetings](#) (Boston, MA).
4. November 2022 [Purdue Algebraic Geometry Seminar](#).
5. October 2020 AMS Fall Eastern Sectional Special Session on Algebraic Singularities in Arbitrary Characteristic.