

# Brian Hepler, PhD

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## PROFESSIONAL SUMMARY

Data Scientist with a Ph.D. in Mathematics and over a decade of experience tackling complex analytical problems through advanced mathematical modeling and theoretical research. Recently focused on algorithm development and hands-on machine learning implementation, building on a strong cross-disciplinary foundation in quantum computing, representation theory, and applied data science. Demonstrated ability to translate abstract concepts into impactful, production-ready computational tools, and skilled at communicating technical findings to non-technical stakeholders. Currently seeking data-driven roles within technology and research-oriented industries, leveraging deep technical expertise and proficiency in Python.

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## TECHNICAL SKILLS

- **Languages:** Python, SQL, LaTeX
  - **ML Libraries:** Scikit-learn, PyTorch, XGBoost, NumPy, SciPy, Pandas, Matplotlib, NetworkX
  - **Tools:** Jupyter, Git, ipywidgets, PostgreSQL
  - **Specializations:** Machine Learning, Statistical Modeling, Quantum Computing, Algebraic Topology, Category Theory, Graph Theory, Representation Theory
  - **Certifications:** [Deep Learning Specialization](#) (deeplearning.ai), [Machine Learning Specialization](#) (deeplearning.ai), [SQL for Data Science](#) (Coursera), [Applied Social Network Analysis](#) (Coursera)
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## PROFESSIONAL EXPERIENCE

**Quantum Formalism** — *Remote*

**Mathematics Consultant**

*Nov. 2024 – Present*

- Engineered hands-on computational exercises in Python notebooks demonstrating quantum and classical ML concepts using Scikit-learn, PyTorch, PennyLane, and SciPy.
- Designed and delivered advanced graduate-level curriculum bridging Lie Theory with practical Quantum Computing and Machine Learning applications (Course: [\[Lie Groups with Applications\]](#)).
- Developed visualization tools for dynamic simulation of quantum systems using Matplotlib and ipywidgets; applied concepts like Hamiltonian evolution,  $SU(4)$  decomposition, and error quantification.
- Built prototypes of ML pipelines for quantum gate classification and variational circuit optimization, leveraging gradient-based learning.

**Institut de Mathématiques de Jussieu-Paris Rive Gauche** — *Paris, France*

**Postdoctoral Researcher**

*2023 – Sept. 2024*

- Developed advanced mathematical models leveraging cutting-edge theoretical frameworks to analyze complex systems exhibiting irregular behavior.
- Contributed to a Fondation Sciences Mathématiques de Paris-funded project under the supervision of François Loeser.

**University of Wisconsin–Madison** — *Madison, WI*

**Visiting Assistant Professor**

2019 – 2023

- Developed and published a novel theoretical framework (Publ. RIMS Kyoto Univ.) extending advanced analytical techniques to model complex systems exhibiting irregular behavior.
  - Secured a \$5,000 AMS-Simons research grant by successfully proposing a novel approach to reformulate a complex, 40-year-old mathematical problem, integrating analytical and topological perspectives.
  - Taught and designed curricula for undergraduate and graduate math courses, translating complex concepts into clear frameworks.
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## SELECTED PROJECTS

**Math Research Compass: arXiv Trends Dashboard** (GitHub [\[link\]](#)) (*In Progress*)

- Developed data pipeline to acquire and preprocess metadata for 133k+ Mathematics preprints (past 5 years) from arXiv dataset using Python (arxiv library, Pandas)
- Engineered features and performed NLP analysis on abstracts/titles to identify trending research topics using class-based TF-IDF (Scikit-learn) and advanced topic modeling (BERTopic)
- Analyzed publication volume, growth rates, and interdisciplinary connections between all math subfields
- Initiated development of an interactive visualization dashboard using Shiny and Plotly.

**IEEE Fraud Detection** (GitHub [\[link\]](#))

- Constructed full ML pipeline using XGBoostClassifier for fraud detection in tabular transaction data: preprocessing, feature engineering, modeling.
- Trained classifiers and tuned hyperparameters using grid search; reported model performance with high ROC AUC of 0.9671.

**Hamiltonian Simulation: TFIM via Trotterization** (GitHub [\[link\]](#))

- Simulated time evolution of Ising models using matrix exponentiation and Trotter decomposition.
- Visualized quantum observable dynamics and linked numerical error to Lie bracket theory.

**KAK Decomposition and Quantum ML** (GitHub [\[link\]](#))

- Implemented Khaneja-Glaser algorithm for two-qubit gate decomposition and benchmarked against variational learning models.
  - Demonstrated practical use of Cartan decomposition and automatic differentiation in PennyLane.
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## SELECTED PUBLICATIONS

 (Google Scholar [\[link\]](#))

- Hepler, Brian and Hohl, Andreas. "Moderate Growth and Rapid Decay Nearby Cycles via Enhanced Ind-Sheaves", Publ. RIMS Kyoto Univ., Volume 61, no. 1 (To Appear, 2025)
  - Hepler, Brian. "Deformation Formulas for Parameterized Hypersurfaces", Annales de l'Institut Fourier, Volume 74 (2024) no. 3, pp. 1153–1188.
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## EDUCATION

**Ph.D., Mathematics** — Northeastern University, 2019

*Specialization: Algebraic Topology, Computational Geometry*

**M.S., Mathematics** — Northeastern University, 2014

**B.A., Mathematics** — Boston University, 2012

*Cum Laude with Distinction in Mathematics*