John Graham Reynolds

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github.com/johngrahamreynolds
huggingface.co/MarioBarbeque

TECHNICAL EXPERTISE

Quantum & Physics : Tensor Networks, Quantum Computing, Quantum Information Theory, Quantum Field Theory, General Relativity, String Theory, Statistical Physics

Pure Mathematics : Tensor Calculus, Differential Geometry, Abstract Algebra, Information Theory, Complex Analysis, Optimization Theory

ML/AI Expertise : Transformers, CNNs, Natural Language Processing, Computer Vision, Language Modeling, Reinforcement Learning, Generative AI

Coding & Tools : Python, Mathematica, C/C++, SQL, Bash/Zsh, LaTeX, Git, Docker, Linux/macOS/Windows

ML/AI Frameworks : PyTorch, Hugging Face, LangChain, Cirq, PennyLane, Gymnasium, SB3, Numpy, Scikit-learn

Cloud & Platform : Azure, Databricks, Terraform, Delta Lake, Apache Spark, GitHub/GitLab, HPC Systems

EDUCATION

University of Texas at Austin   Austin, TX
Master of Science in Artificial Intelligence   *Aug 2025 – Dec 2026, expected*

- **Relevant Coursework:** Deep Learning, Natural Language Processing; Spring '26: Advanced Deep Learning, Machine Learning
- **Research Focus:** Tensor Networks, Quantum Information Theory, Machine Learning for Quantum Systems

Johns Hopkins University   Baltimore, MD
Bachelor of Science in Physics, Mathematics   *Aug 2016 – May 2020*

- **Advanced Physics Research:** Quantum Mechanics, Quantum Field Theory, General Relativity, String Theory
- **Advanced Mathematics Research:** Differential Geometry, Abstract Algebra, Complex Analysis, Tensor Calculus

RESEARCH & PROJECTS

Tensor Networks for Quantum Systems   *Research Project*   2025–Present

- Developing **tensor network algorithms** for simulating quantum many-body systems and emergent holographic geometry, bridging quantum information theory, machine learning optimization techniques, and quantum gravity
- Implementing **MPS, PEPS, MERA** and other hybrid neural tensor networks using Python/PyTorch/TensorNetwork/Cirq/Qiskit for quantum simulation and entanglement analysis
- Exploring connections between tensor network state representations and the **AdS/CFT correspondence** as theoretical and phenomenological evidence of holography
- Investigating overlap between tensor networks, canonical quantum circuit algorithms (Deutsch–Jozsa, Grover's algorithm), and quantum machine learning algorithms (VQE, QCNN, QAOA)
- **Open-source implementation:** github.com/johngrahamreynolds/holographic_tensor_networks

CyberSolve-LinAlg - Fine-tuned FLAN-T5 Model   *Published on Hugging Face*   2024-2025

- Parallelized multiple Nvidia A100 GPUs to fine-tune 800M parameter FLAN-T5 on Google DeepMind Mathematics dataset, achieving **90.7% accuracy** on linear equation solving benchmarks
- Optimized training pipeline using Nvidia Apex fused kernels for normalization layers and AdamW optimizer, reducing training time and GPU memory overhead
- Implemented distributed training workflow on Azure Databricks processing **2M+** mathematical problems using PyTorch and Hugging Face Accelerate
- **Created novel evaluation dataset** to measure partial correctness in mathematical reasoning, enabling fine-grained analysis of model performance beyond binary accuracy metrics

Professional Experience

Data/Machine Learning/Infrastructure Engineer
Vanderbilt University Medical Center - Data Platform Services

Jan 2022 – *Present*
Nashville, TN

- Architected and manage **$600K annual** Azure cloud infrastructure supporting 100+ Databricks workspaces across Vanderbilt research and corporate departments, serving **400+ researchers, engineers, and data scientists**
- **Spearheaded development of Vanderbilt's first AI Assistant** prototype, architecting enterprise-grade NLP system using Mistral-7B LLM with LangChain RAG on vector-indexed institutional data and production-ready beta inference app
- Engineered petabyte-scale data lake using Apache Spark, Azure Data Factory, and Delta Lake with large-scale ETL pipelines processing **150+ data sources** from SQL Server, RESTful APIs, and other systems
- Developed and maintained custom Python pipeline orchestration package with optimized wheel builds, enabling efficient deployment and management of production data workflows across multiple engineering teams
- Built production DataOps and MLOps infrastructure with Docker containers, GitLab CI/CD pipelines, and Terraform
- Led cloud migration from Bicep to Terraform while mentoring **2 engineers I recommended for hire**

Theoretical Physicist & Graduate Researcher
Johns Hopkins University

Jan 2019 – May 2020
Baltimore, MD

- Conducted **quantum black hole research** under Professor David Kaplan investigating black hole information loss paradox using advanced mathematical techniques from quantum field theory and general relativity
- Developed computational methods using Python and Mathematica to solve coupled systems of nonlinear partial differential equations arising from quantum gravity models
- Applied tensor calculus and differential geometry to analyze information flow across black hole event horizons
- Collaborated with theoretical physics group on quantum entanglement and holographic principle applications

CLASS Telescope Engineer
Johns Hopkins University

Sept 2017 – Jan 2019
Baltimore, MD

- Designed cryogenic systems for cosmology telescope using Python and SolidWorks, achieving target **temperature of 100mK (-273°C)**
- Deployed telescope infrastructure at 17,000ft research site in Chilean Andes

Awards & Recognition

Johns Hopkins Bloomberg Distinguished Professor STAR Award
$4000 research grant, nominated by Professor Charles L. Bennett

2018

Harvard Prize Book
Excellence in academic achievement and character

2015

Research Interests

Quantum Computing, Quantum Information Theory, & Quantum Gravity
Tensor Networks, Quantum Algorithms, Quantum Many-Body Systems, ML for Quantum Systems

Theoretical Physics Notes & Solutions
Notes on String Theory and Quantum Gravity: github.com/johngrahamreynolds/string_solutions

Extracurricular Interests

Marathon Running
Top 15% Derby Festival miniMarathon, Top 32% San Diego Marathon

680+ miles in 2025