John Graham Reynolds

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github.com/johngrahamreynolds
huggingface.co/MarioBarbeque

TECHNICAL EXPERTISE

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, Streamlit, Gymnasium, SB3, Numpy, Scikit-learn
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
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

Catastrophic Forgetting in Mathematical Reasoning   *Published Research - arXiv:2512.13706*   2025

- Independently authored *"Mitigating Catastrophic Forgetting in Mathematical Reasoning Finetuning through Mixed Training"*
- Investigated catastrophic forgetting when finetuning Flan-T5-Base (250M parameters) on DeepMind Mathematics dataset, demonstrating **64.5 percentage point drop** in NLI performance during math-only specialized training
- Developed **mixed training strategies** that completely eliminate catastrophic forgetting while maintaining equivalent math improvement: balanced 1:1 mixing matches math-only **+8.9 point increase** while preserving 86.2% NLI accuracy
- Systematically explored math:NLI mixing ratios from 1:1 to 15:1, demonstrating that even minimal NLI exposure (6.2%) provides effective regularization against catastrophic forgetting

CyberSolve-LinAlg - Finetuned FLAN-T5-Large Model   *Published on Hugging Face*   2024-2025

- Parallelized multiple Nvidia A100 GPUs to finetune FLAN-T5-Large (780M parameters) on Google DeepMind Mathematics dataset, achieving **90.8% accuracy** on linear equation solving benchmarks
- Implemented distributed training workflow on Azure Databricks processing **2M+** mathematical problems using PyTorch and Hugging Face Accelerate
- Optimized training pipeline using Nvidia Apex fused kernels for normalization layers and AdamW optimizer, reducing training time and GPU memory overhead
- **Created novel evaluation dataset** to measure partial correctness in mathematical reasoning, enabling fine-grained analysis of model performance beyond binary accuracy metrics
- Deployed interactive app on Hugging Face Spaces using Streamlit with GPU-optimized inference, enabling real-time mathematical problem solving with user-friendly interface

PROFESSIONAL EXPERIENCE

AI/Machine Learning Engineer - Intern   Jan 2026 – May 2026
NASA Johnson Space Center - Artemis Program, Orion Spacecraft   *Houston, TX*

- Developing **multimodal AI system to index and retrieve historical Orion spacecraft documentation**, enabling semantic search across technical reports, design documents, and institutional knowledge from previous mission phases
- Architecting **RAG-based information retrieval pipeline with agentic augmentation** for automated document cataloging, relationship mapping, and context-aware query handling across heterogeneous data sources
- Building **production-grade inference application** integrating foundational language models with vector databases and retrieval systems to surface relevant design decisions and technical context for engineering teams

Data/Machine Learning Infrastructure Engineer   Jan 2022 – Jan 2026
Vanderbilt University Medical Center - Data Platform Services   *Nashville, TN*

- Architected and managed **$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 Streamlit 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   Jan 2019 – May 2020
Johns Hopkins University   *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   Sept 2017 – Jan 2019
Johns Hopkins University   *Baltimore, MD*

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

Awards & Recognition

Johns Hopkins Bloomberg Distinguished Professor STAR Award   2018
$4000 research grant, nominated by Professor Charles L. Bennett

Harvard Prize Book   2015
Excellence in academic achievement and character

Research Interests

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

AI/ML for Mathematics & Games
Pretraining, SFT, RL for Mathematical Reasoning: Theorem Proving, Computational Reasoning; RL for Board Games, Video Games

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

Extracurricular Interests

Marathon Running   700+ miles in 2025
Top 15% Derby Festival miniMarathon - 2025, Top 32% San Diego Marathon - 2025   *Training into 2026*