Nicholas A. Gabriel
[website] [github]

Research and Work Experience:

The George Washington University   **Washington, DC**
Research Assistant   *May 2019 - September 2025*

Neural operators for many-body complex systems: [paper] [github]

Proposed a novel AI framework for multiscale modeling of complex systems. Developed modules based on transformers, graph neural networks, and neural operators for multimodal processing of graphs and timeseries. Demonstrated scalability in both system size and model size on benchmarks with millions of nodes. Trained the largest physics-informed neural operator to date, ROMA-H (1.4B params), using the NVIDIA GH200 Superchip.

Graph learning for foreign influence detection: [paper] [github]

Developed a framework for detecting foreign influence on social media using graph neural networks and feature attribution. Identified models and features that can generalize across influence operation campaigns.

Data Collection/Web Scraping: [github]

Led data collection efforts for social media tracking of foreign influence and extremist communities. Wrote data collection tools for social media using Python Selenium, Beautiful Soup, and Gmail API.

LLM Finetuning: [github]

Finetuned a GNN+LLM architecture for GraphRAG on the STaRK-Prime Q&A benchmark. Added support for QLoRA finetuning and distributed training with FSDP using `peft` and `accelerate`, respectively.

Brookhaven National Laboratory   **Upton, NY**
Intern   *June 2016 - August 2016*

Developed software for simulation and statistical analysis of radioactive sources for calibration of the PROSPECT experiment antineutrino detector. Primary deliverables: Bash scripts, NumPy and SciPy code, and CERN ROOT modules.

Massachusetts General Hospital   **Boston, MA**
AAPM Undergraduate Fellow   *June 2015 - August 2015*

Prototyped an interface for real-time gaze tracking during proton radiotherapy treatment of ocular melanoma. Implemented PyQT and OpenCV for the frontend and backend of the interface, respectively.

Education:

The George Washington University   **Washington, DC**
Ph.D. Physics   *2025*

The George Washington University   **Washington, DC**
M.S. Physics   *2020*

University of Mary Washington   **Fredericksburg, VA**
B.S. Mathematics (with honors), B.S. Physics   *2017*

Technical Skills:

Languages/Libraries: Python, C, Bash, Hugging Face, BLAS, TeX, CUDA C, MATLAB, Mathematica

Software:

  Python: Pandas/Dask, NumPy, PyTorch, JAX, PyG, Jraph, scikit-learn, statsmodels, SpaCy, NLTK, Gensim, Selenium, Beautiful Soup, torchtune, LLama

  Linux/SWE/HPC: Git, SSH, Vim, Conda, Slurm, SQL, Elasticsearch, cloud computing

ML/AI: Transformers, physics-informed neural networks, neural operators, graph neural networks, geometric deep learning, sequential modeling, NLP, LLM, fine-tuning, LoRA/QLoRA, RAG, GraphRAG multimodal learning, uncertainty quantification, Explainable AI

Math/Stats: Differential Geometry, Numerical Analysis, Functional Analysis, Partial Differential Equations, Multivariate Timeseries Analysis, Graph Theory, Experimental Design

Publication List:

1. **N.A. Gabriel**, N.F. Johnson, G.E. Karniadakis (2025) "Connecting the geometry and dynamics of many-body complex systems with message passing neural operators" In Review: *Nature Communications*

2. **N.A. Gabriel**, D.A. Broniatowski, N.F. Johnson (2023) "Inductive detection of influence operations via graph learning" *Scientific Reports*

3. **N.A. Gabriel**, N.F. Johnson (2022) "Using Neural Architectures to Model Complex Dynamical Systems" *Advances in Artificial Intelligence and Machine Learning*

4. N. Velasquez, R. Leahy, N. Restrepo, Y. Lupu, R. Sear, **N.A. Gabriel** et. al. (2021) "Online hate network spreads malicious COVID-19 content outside the control of individual social media platforms" *Scientific Reports*

5. N.F. Johnson, N. Velásquez, N. Restrepo, R. Leahy, **N.A. Gabriel** et. al. (2020) "The online competition between pro-and anti-vaccination views" *Nature*

6. R.F. Sear, N. Velásquez, R. Leahy, N. Restrepo, S. El Oud, **N.A. Gabriel** et. al. (2020) "Quantifying COVID-19 content in the online health opinion war using machine learning" *IEEE Access*

Invited Presentations:

1. **Yale University** (Lu Group meeting, 45m presentation) [slides]
   "Message Passing Neural Operators for Many-body Complex Systems", 8/13/2025

2. **The George Washington University** (ENIGMA seminar, 45m presentation) [slides]
   "Multiscale Operator Learning for complex social systems", 10/4/2023

3. **Brown University** (CRUNCH group meeting, 40m presentation) [slides] [video]
   "Multiscale Operator Learning for complex social systems", 9/15/2023

4. **IC2S2 2022** (Conference talk, 15m presentation) [slides]
   "Automated Detection of Information Operations Using Graph Neural Networks", 7/21/2022

5. **Brookhaven National Laboratory** (PROSPECT group meeting, 20m presentation) [report]
   "Mass calibration for PROSPECT", 8/10/2016