

Nicholas A. Gabriel

Education:

The George Washington University

Ph.D. Physics

M.S. Physics

Washington, DC

exp. 2024

2020

University of Mary Washington

B.S. Mathematics (with honors), B.S. Physics

Fredericksburg, VA

2017

Thesis: "Maxwell's Equations, Gauge Fields, and Yang-Mills Theory" [[thesis](#)]

Research and Work Experience:

The George Washington University

Research Assistant, Advisor: Dr. Neil Johnson

Washington, DC

January 2019 - present

Graph learning for foreign influence tracking: (AFOSR: FA-9550-20-1-0382)

- Collected data for >10,000 Influence Operations (IO) accounts released by Twitter across six separate campaigns originating from Russia, China, and Iran.
- Collected a comprehensive baseline of $\approx 10,000$ high/low IO interaction accounts using the Twitter API.
- Extracted and expanded URLs from Tweets using the URLExpander library.
- Computed co-URLs from 12M tweets using Cython.
- Calculated graph-based and content-based indicators from co-URLs and URLs, respectively.
- Compared graph learning models and censorship thresholds on several cross-campaign benchmarks.
- Determined the most effective content-based and graph-based indicators for identifying IO accounts using Integrated Gradients and an empirically derived neutral IG baseline.
- Analyzed coordinated link-sharing behavior across six IO campaigns and baseline Twitter accounts.
- Reported hundreds of URLs which were removed or retained in each IO dataset at the optimal censorship threshold.
- Detailed findings in a 31 page manuscript available on arXiv. [[paper](#)] [[github](#)]

Graph and operator learning for social dynamics: (AFOSR: FA-9550-20-1-0382 and FA-9550-20-1-0383)

- Implemented a framework for graph-informed operator learning in JAX. [[github](#)]
- Ported code for hyperbolic graph network layers from PyTorch to JAX.
- Applied framework to forecast the evolution of extremist communities.
- Demonstrated the efficacy of operator learning, hyperbolic graph learning, and inverse physics-informed learning for autoregressive forecasting of complex social systems. [[slides](#)] [[video](#)]

Data Collection/Web Scraping:

- Wrote data collection tools for social media using Python Selenium, BeautifulSoup, and Gmail API. [[github](#)]
- Parsed and cleaned text data using SpaCy and NLTK.
- Integrated data sources from different platforms (Twitter, Facebook, Instagram, Gab) into a single dataset using Pandas.

Brookhaven National Laboratory

Intern, Advisor: Dr. David Jaffe

Upton, NY

June 2016 - August 2016

Developed software for simulation and statistical analysis of radioactive sources for mass calibration of the PROSPECT experiment antineutrino detector.

Primary deliverables:

- Bash scripts to run parallel batch Monte Carlo simulations of alpha particle transport in SRIM.
- NumPy and SciPy code to adaptively resample the detector geometry.
- CERN ROOT modules for interpolation of Monte Carlo data and calculation of alpha energy deposition spectrum.
- Two presentation given to PROSPECT collaborators detailing feasibility and accuracy of volumetric calibration using alpha particle sources. [[report](#)]

Prototyped a gaze tracking interface for use in proton radiotherapy treatment of ocular melanoma:

- Performed calibration of optical and infrared sensors for gaze tracking.
- Developed computer vision software for segmentation and pupil tracking using OpenCV
- Embedded gaze tracking sessions in a PyQt GUI which allows a physician to easily view and modify pupil segmentation parameters, view deviations from treatment plan in real time, and automatically save raw optical and segmented data.
- Worked with doctors and medical physicists to guide the design of the application.
- Wrote documentation and instructions for use of the GUI.

Technical Skills:

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

Software:

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

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

Mathematics/Statistics: Differential Geometry, Numerical Analysis, Functional Analysis, Group Theory, Timeseries Analysis, Graph Theory, Bayesian Methods

Invited Presentations:

1. **The George Washington University** (ENIGMA seminar, 45m presentation) [[slides](#)]
"Multiscale Operator Learning for complex social systems", 10/4/2023
2. **Brown University** (CRUNCH group meeting, 40m presentation) [[slides](#)] [[video](#)]
"Multiscale Operator Learning for complex social systems", 9/15/2023
3. **IC2S2 2022** (Conference talk, 15m presentation) [[slides](#)]
"Automated Detection of Information Operations Using Graph Neural Networks", 7/21/2022
4. **Brookhaven National Laboratory** (PROSPECT group meeting, 20m presentation) [[report](#)]
"Mass calibration for PROSPECT", 8/10/2016