# Blake Bullwinkel


Contact Information

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## Education

**Harvard University**, Cambridge, MA — May 2022
M.S. in Data Science. GPA: 3.95/4
Advisor: Pavlos Protopapas
Thesis: *Generative Adversarial Network Methods for Solving Differential Equations*

**Williams College**, Williamstown, MA — June 2020
B.A. in Mathematics, Chinese. GPA: 3.83/4 (*cum laude*)

**University of Oxford**, Oxford, UK — June 2019
Attended as part of the selective, year-long Williams-Exeter Program at Oxford.

## Publications

R Pellegrin*, **B Bullwinkel***, M Mattheakis, P Protopapas. *Transfer Learning with Physics-Informed Neural Networks for Efficient Simulation of Branched Flows.* NeurIPS Workshop on Machine Learning and the Physical Sciences, 2022.

**B Bullwinkel***, D Randle*, P Protopapas, D Sondak. *DEQGAN: Learning the Loss Function for PINNs with Generative Adversarial Networks.* ICML Workshop on AI for Science (AI4Science), 2022.

**B Bullwinkel**, K Grabarz, L Ke, Sc Gong, C Tanner, J Allen. *Evaluating the Fairness Impact of Differentially Private Synthetic Data.* ICML Workshop on Theory and Practice of Differential Privacy (TPDP), 2022.

## Research Experience

**AI Safety and Alignment**, Harvard University — Sept 2023–Present
Fall Research Course. Advisors: Weiwei Pan, Finale Doshi-Velez, Claude Bruderlein

- Leading a team of graduate students to characterize and quantify emergent properties of LLMs that may be harmful (e.g., hallucinations, value misalignment, data memorization) in the context of an LLM-based simulator for humanitarian negotiation training.

**Multimodal Adversarial Attacks**, Harvard University — Sept 2023–Present
Fall Research Course. Advisors: Siddarth Swaroop, Weiwei Pan, Finale Doshi-Velez

- Researching adversarial attacks on LLMs and Vision Language Models (VLMs) that exploit white-box optimization and soft prompting.

**Physics-Informed Neural Networks**, Harvard University — Feb 2021–May 2022
Master's Thesis. Advisors: Pavlos Protopapas, David Sondak

- Developed a GAN-based method for obtaining accurate solutions to a wide range of ordinary and partial differential equations.
- Implemented multi-head architectures and transfer learning algorithms to more efficiently simulate branched flows, a universal wave phenomenon.
- Maintained research code in a user-friendly PyTorch package.

**Interpretable Machine Learning**, Harvard University — Feb 2022–May 2022
Spring Research Course. Advisors: Weiwei Pan, Yaniv Yacoby

- Investigated how non-identifiability in additive models can cause misleading model interpretations in the healthcare domain.
- Characterized a particular form of non-identifiability that arises when generalized additive models are trained on data with interaction effects.

**Differential Privacy and Fairness**, Microsoft — Sept 2021–Dec 2021
IACS Capstone Project. Advisors: Joshua Allen, Chris Tanner

- Led a collaboration among graduate students and Microsoft researchers to understand the fairness impact of training ML models on differentially private synthetic data.
- Proposed a simple pre-processing technique to synthesize data that promote more fair model predictions.

**Epidemiological Modeling**, Williams College Feb 2020
Senior Mathematics Colloquium. Advisor: Julie Blackwood

- Applied compartmental models to early COVID-19 data published by the Chinese National Health Commission to estimate key disease parameters and simulate an outbreak on a college campus with a quarantine policy.

## Professional Experience

**Microsoft**, Redmond, WA Aug 2022–Present
*Data & Applied Scientist*

- Introduced a method to predict the root-cause of performance bugs and customer incidents using GPT-3.5 text embeddings (accepted to Microsoft's internal *Machine Learning and Data Science Conference*)
- Deployed an LLM-powered Azure web app that answers questions about internal documentation using retrieval augmented generation.
- Built a pipeline to detect and prioritize kernel-mode memory leaks across the Azure fleet, saving around 2TB of memory per day (received *Quality Stars* award for FY23 Q3).
- Trained ML models that help deployment teams assess the risk of Azure Host OS updates.

**PepsiCo R&D**, Valhalla, NY Summer 2021
*Data Science & Analytics Intern*

- Developed a Python package for anomaly detection of water usage time series data.
- Trained time series models to forecast water usage efficiency, lowering the mean validation error by 43% in comparison to a moving average baseline.
- Developed an automated data pipeline with actionable insights in Power BI, adopted by beverage plants nationwide.

**Marble** June 2020–Jan 2022
*Co-Founder*

- Led the development of an iOS mobile app that provides carbon footprint estimates for grocery products.
- Built Google Firebase backend with 150,000+ products scraped from supermarket websites.
- Accepted into the Harvard i-lab Venture Program for three consecutive semesters.

**Zola Electric**, Amsterdam, Netherlands Summer 2019
*Digital Platforms Intern*

- Performed time series analysis to identify and explain transaction delays in solar electricity startup's software platform.

## Teaching Experience

**Graduate Teaching Fellow**, Harvard University Feb 2022–May 2022

- CS 109b: Advanced Topics in Data Science
- Prepared teaching materials and held office hours for students studying non-linear statistical methods and deep learning models, including CNNs, RNNs, LSTMs, autoencoders, GANs, and transformers.

**Undergraduate Teaching Assistant**, Williams College 2017–2020

- CHIN 201: Intermediate Chinese I (Fall 2017)
- CHIN 202: Intermediate Chinese II (Spring 2018)
- CHIN 301: Upper-Intermediate Chinese I (Fall 2019)
- CHIN 302: Upper-Intermediate Chinese II (Spring 2020)
- In 1:1 sessions, met weekly with students for casual discussions to practice spoken language, review vocabulary, and learn grammar structures.

## Service & Outreach

**TEALS Program**, Microsoft August 2023–Present
*Volunteer Teacher*

- Delivering lectures and engaging with high school students to assist in teaching of AP Computer Science Principles at Global Impact Academy in Fairburn, GA.

**IACS ComputeFest**, Harvard University Jan 2022
*Volunteer Teaching Assistant*

- Worked alongside professors to run workshop focused on teaching fundamental data science skills, including Python programming, probability theory, linear algebra, and statistics.

## Honors & Awards

**Certificate of Distinction in Teaching**, Harvard University 2022
Awarded based on student ratings (mean 4.67/5) for teaching of CS 109b.

**IACS Student Scholarship**, Harvard University 2021
Awarded to support data science thesis research at IACS ($20,000 award).

**Goldberg Prize in Mathematics**, Williams College 2020
Awarded to the graduating senior who delivers the best mathematics colloquium.

**Linen Senior Prize in Chinese**, Williams College 2020
Awarded to the top graduating Chinese major.

**Putnam Competition**, MAA 2019
Scored 18.

**Carolyn Altes Scholarship**, AWCA 2019
Awarded on the basis of academics and potential to contribute to society.

**Linen Grant**, Williams College 2017
Awarded on the basis of academics to support summer study in China.

**Davis UWC Scholar**, Davis United World College Scholars Program 2016
Awarded to recognize commitment to building cross-cultural understanding.

**Class of '16 Student Speaker**, UWCSEA East 2016
Elected by peers to deliver the Class of '16 graduation student address.

## Skills & Interests

**Programming**: Python (NumPy, pandas, sklearn, TensorFLow, PyTorch), R, SQL, KQL, HTML/CSS, JavaScript

**Tools/Platforms**: Conda, Jupyter, Git, Docker, Kubernetes, Azure, AWS

**Language**: Working proficiency in written and spoken Chinese (Mandarin)

**Interests**: Running, rowing, writing (Medium blog), Rubik's cube solving (WCA profile)

## References

Dr. **Pavlos Protopapas**

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Dr. **Weiwei Pan**

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Dr. **Mihai Stoiciu**

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Dr. **Julie Blackwood**

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