Zhiyuan (Leo) ZHAO

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Education

Georgia Institute of Technology — Atlanta, GA
Ph.D. in Machine Learning — *Aug 2027 (Expected)*

- **GPA:** 4.0/4.0
- **Primary Advisor:** B. Aditya Prakash
- **Research Interest:** Machine Learning, Time Series, Computational Epidemiology
- **Core Course:** Mathematical Foundation of Machine Learning, Probabilistic Graph Model, Computational Data Analysis, Data Science for Epidemiology

Carnegie Mellon University — Pittsburgh, PA
M.S. in Electrical and Computer Engineering — *May 2021*

- **GPA:** 3.94/4.0
- **Primary Advisor:** Gauri Joshi
- **Thesis:** Towards Fairness in Federated Learning
- **Core Course:** Intro to Machine Learning/Deep Learning, Algorithms for Large-scale Distributed Machine Learning and Optimization, Computer Vision, Image and Video Processing, Convex Optimization, SLAM

The Ohio State University — Columbus, OH
B.S. in Mathematics, Applied Track, Magna Cum Laude — *Aug 2019*

- **GPA:** 3.9/4.0
- **Thesis:** Robust Constant Modulus Algorithm of Equalizer in Telecommunication System

Publication

PrePrint

Zhao, Zhiyuan, Alexander Rodríguez, and B. Aditya Prakash. "Performative Time-Series Forecasting." *arXiv preprint arXiv:2310.06077*. 2023.

Zhao, Zhiyuan, Xueying Ding, and B. Aditya Prakash. "PINNsFormer: A Transformer-Based Framework For Physics-Informed Neural Networks." *arXiv preprint arXiv:2307.11833*. 2023.

Conference

Zhao, Zhiyuan, and Gauri Joshi. "A dynamic reweighting strategy for fair federated learning." *ICASSP 2022-2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. IEEE, 2022.

Wen, Senhao, **Zhiyuan Zhao**, and Hanbing Yan. "Detecting malicious websites in depth through analyzing topics and web-pages." *Proceedings of the 2nd International Conference on Cryptography, Security and Privacy*. 2018.

Workshop

Zhao, Zhiyuan, et al. "Physics Informed Machine Learning with Misspecified Priors: An analysis of Turning Operation in Lathe Machines." *AAAI 2022 Workshop on AI for Design and Manufacturing (ADAM)*. 2022.

Research Project

Performative Time-Series Forecasting — Atlanta, GA
Advisor: Prof. B. Aditya Prakash
Georgia Institute of Technology, School of Computer Science — *Aug 2022 – Present*

- Introduced a novel research problem: Performative Time-Series Forecasting (PeTS), which studies giving robust forecasts under the setting of performativity (feedback loops that predictions can influence the predicted outcome)
- Proposed a solution to PeTS, namely Feature Performative-Shifting (FPS), which anticipates performativity and forecasts predictions through the delayed response
- Theoretically showed FPS results in a tighter PAC bound for ideal forecasting scenarios (delayed responses are known), and a trade-off for practical forecasting scenarios (delayed responses are unknown)
- Evaluated FPS on COVID-19 METR-LA traffic dataset. FPS achieves approx. 50% and 20% lower relative MAE/RMSE than conventional time-series methods for ideal and practical scenarios

- Accomplished a first-author conference paper, submitted to AAAI, 2024
- Ongoing: Performative time-series forecasting with causal graph discovery

Transformer-based Physics-Informed NN Framework Atlanta, GA

Advisor: Prof. B. Aditya Prakash *Feb 2023 – Present*

Georgia Institute of Technology, School of Computer Science

- Proposed a novel Transformer-based framework PINNsFormer that equips PINNs with better generalization ability through the capability to capture temporal dependencies in PDEs
- Formulated a novel non-linear activation function Wavelet that anticipates real Fourier integral. Theoretically showed Wavelet's universal approximation ability
- Showcased PINNsFormer's ability in mitigating PINNs' failure modes, generalization ability for high-dimensional PDEs, and flexibility in incorporating existing training schemes
- Accomplished a first-author conference paper, submitted to ICLR, 2024
- Ongoing: Physics-informed time-series forecasting with transformer-based frameworks

Tackling Failure Modes and Misspecifications in Physics-Informed NN Pittsburgh, PA

Advisor: Prof. Aarti Singh *July 2021 – Sep 2022*

Carnegie Mellon University, Machine Learning Department

- Implemented vanilla Physics-Informed Neural Networks (PINNs) for ODE/PDE solution approximation
- Derived theoretical upper bound for the convergence rate of PINNs under misspecified ODE/PDE formulation
- Proposed a frequency-reduced combined with the slice training method, resulting in faster convergence and lower error flow compared to existing *Seq2Seq* method (MSE reduces from 10^{-3} to 10^{-6}, within 0.1 $\times$ training epochs)
- Investigated a combined PINNs+ConvLSTM model that explores extrapolation ability of PINNs
- Designed a system for anomaly detection by leveraging PINN with Augmented Lagrangian regularization
- Accomplished a first-author workshop paper, published on AAAI workshop, ADAM, 2022

Fairness in Federated Learning Pittsburgh, PA

Advisor: Prof. Gauri Joshi *Dec 2020 – Oct 2021*

Carnegie Mellon University, Department of Electrical and Computer Engineering

- Implemented `FedAvg` (first federated learning algorithm), `q-FFL`, and `Power-of-Choice` as baselines
- Proposed a novel optimization objective `DRFL` that dynamically adjusted clients' weights and corresponding algorithm `DR-FedAvg`, outperformed all baselines in resulting fairness (more uniformly distributed in clients' accuracy), increased lower worst-case accuracy boundary by from 0.65 to 0.75
- Accomplished a first-author conference paper, published on ICASSP, 2022

Experience

Research Associate, Carnegie Mellon University Piitsburgh, PA

Topic: Misspecificed Physics-Informed Neural Networks. Advisor: Prof. Aarti Singh *June 2021 – July 2022*

Service

Journal Reviewer: IEEE Intelligent Systems

Conference Reviewer: ICRL 2024, NeurIPS 2022/2023, ICML2022, KDD 2023 EpiDAMIK Workshop

Social Challenge Contribution:

- CDC FluSight Forecasting Hub: Influenza Hospitalization Forecasting *Aug 2022 – Present*
- CDC COVID-19 Forecasting Hub: COVID-19 Mortality Forecasting *Aug 2022 – April 2023*

Teaching Assistant:

- Data Science for Epidemiology *Fall 2023*
- Intro. to Machine Learning for Engineers *Spring 2021*

Technical Skill

Programming Language: Python, C/C++, MatLab, Verilog, VHDL

Frameworks & Tools: Pytorch, OpenCV, Tensorflow, LaTex, MATLAB, SQL, Git