Zhiyuan (Leo) ZHAO

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Personal Statement

I'm a second-year Machine Learning Ph.D. student in Department of Computational Science and Engineering at Georgia Institute of Technology. I am affiliated with AdityaLab and advised by Dr. B Aditya Prakash. **My research focuses on time-series forecasting with leveraging attention, causality, graph models, and physics regularization methods.** These research results have made real-world influences such as Flu and COVID-19 forecasting challenges organized by CDC.

I am also interested in pre-trained foundation models and applications of LLMs in time series tasks. Previously, my research spanned **physics-informed neural networks** with the advice of Prof. Aarti Singh, and **federated learning** under the advice of Prof. Gauri Joshi at Carnegie Mellon University.

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 Courses:** Mathematical Foundation of Machine Learning, Probabilistic Graph Model, Natural Language Processing, 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 Courses:** 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

Publications

Pre-Print & In-Submission

Zhiyuan Zhao*, Haoxin Liu*, Jindong Wang, Harshavardhan Kamarthi, B.Aditya Prakash. "LSTPrompt: Large Language Models as Zero-Shot Time Series Forecasters by Long-Short-Term Prompting." 2024. (In submission ACL 2024)

Haoxin Liu, Harshavardhan Kamarthi, Lingkai Kong, **Zhiyuan Zhao**, Chao Zhang, B.Adtiya Prakash. "Time-Series Forecasting for Out-of-Distribution Generalization Using Invariant Learning." 2024. (In submission ICML 2024)

Zhao, Zhiyuan, Haoxin Liu, Alexander Rodríguez, and B.Aditya Prakash. "Performative Time-Series Forecasting." *arXiv preprint arXiv:2310.06077*. 2023. (In submission KDD 2024)

Conference

Zhao, Zhiyuan, Xueying Ding, and B.Aditya Prakash."PINNsFormer: A Transformer-Based Framework For Physics-Informed Neural Networks." *International Conference on Learning Representations (ICLR)*. 2024.

Zhao, Zhiyuan, and Gauri Joshi. "A dynamic reweighting strategy for fair federated learning." *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 Projects

LLMs for Zero-Shot Time-Series Forecasting Atlanta, GA

Advisor: Prof. B.Aditya Prakash
Georgia Institute of Technology, Department of Computational Science and Engineering *Dec 2023 – Present*

- Introduced a novel prompting strategy LSTPrompt, which leverages ideas of *Chain-of-Thought* and "Take deep breath" to effectively prompts LLMs for zero-shot time-series forecasting tasks
- Empirically validate the effective
- Ongoing: Time-series forecasting using multi-modal large models

Performative Time-Series Forecasting Atlanta, GA

Advisor: Prof. B.Aditya Prakash
Georgia Institute of Technology, Department of Computational Science and Engineering *Aug 2022 – Present*

- Introduced a novel research problem: Performative Time-Series Forecasting (PeTS), which studies giving robust forecasts under the setting of performativity. Proposed a solution Feature Performative-Shifting (FPS), which anticipates performativity and forecasts predictions through the delayed response
- Theoretically showed FPS results in a tighter PAC bound. Empirically showed lower relative MAE/RMSE and higher correlation with FPS than without FPS on various models
- Ongoing: Performative time-series forecasting with causality

Transformer-based Physics-Informed NN Framework Atlanta, GA

Advisor: Prof. B.Aditya Prakash
Georgia Institute of Technology, Department of Computational Science and Engineering *Feb 2023 – Present*

- Proposed a Transformer-based framework PINNsFormer that enables capturing temporal dependencies in PINNs. Formulated a novel non-linear activation function Wavelet that anticipates real Fourier integral
- Showcased PINNsFormer's ability in mitigating PINNs' failure modes, generalization ability for high-dimensional PDEs, and flexibility in incorporating existing training schemes
- Ongoing: Time-series forecasting with physics-informed knowledge

Experience

Research Associate, Carnegie Mellon University Pittsburgh, PA

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

Service

Journal Reviewer: IEEE Intelligent Systems

Conference Reviewer: KDD 2024, ICLR 2024, NeurIPS 2023/2022, ICML 2024/2022, 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, Tensorflow, OpenCV, Tensorflow, LaTeX, SQL, Git