Zeyu Zhou

zhou1059@purdue.edu (765) 418-0346 www.linkedin.com/in/zyzhou3

Research Keywords

Trustworthy ML (robustness, fairness), Distribution Shift, Causality, Generative Models

Educational Background

Purdue University, West Lafayette, IN May 2025

PhD in Electrical and Computer Engineering (ECE) Major GPA: 3.97/4.0

- Began PhD in Physics in 2019 and transferred to ECE in 2021

Wuhan University, Hubei, China June 2019

Bachelor of Science in Physics GPA: 3.86/4.0

Cornell University, Ithaca, NY December 2017

- Visiting student for one semester in the Department of Physics

Selected Publications

Zhou, Z., Bai, R., & Inouye, D. I. (2024). Improving Practical Counterfactual Fairness with Limited Causal Knowledge. ICLR 2024 Workshop on Navigating and Addressing Data Problems for Foundation Models.

Zhou, Z.*, Bai, R.*, Kulinski, S.*, Kocaoglu, M., & Inouye, D. I. (2024). Towards Characterizing Domain Counterfactuals For Invertible Latent Causal Models. ICLR 2024. (*equal contributions)

Zhou, Z., Azam, S. S., Brinton, C. G. & Inouye, D. I. (2023). Efficient Federated Domain Translation. ICLR 2023.

Zhou, Z., Gong, Z., Ravikumar, P. & Inouye, D. I. (2022). Iterative Alignment Flows. AISTATS 2022.

Work Experience

Machine Learning Quant Research Intern June 2023 – August 2023

***Bloomberg**, New York, NY*

- Developed recurrent neural network and transformer-based multivariate time series estimation models for real-world financial datasets characterized by significant noise, high missing rates, and potential absence of strong temporal signals; achieved a 40% improvement over existing approaches and a 20% improvement over traditional machine learning baselines.
- Conducted comprehensive research aimed at enhancing the model's capability of out-of-distribution generalization by leveraging domain knowledge including the option pricing formula under the Black-Scholes model.
- Modeled intraday pricing for a universe of equity options, many with sparse trading price data, serving as important input for next generation of improved Bloomberg volatility data products with tens of millions of annual revenue, along with a possible new stand-alone data product for trading and risk management.
- Collaborated with quant and product teams to define research problems with real-world impact; designed models tailored to data's characteristics and effectively communicated results to a diverse audience including senior stakeholders.

Applied Scientist Intern June 2022 – September 2022

***Amazon** SCOT, Seattle, WA*

- Built deep generative models to learn the data generating process from noisy and large real-world datasets at Amazon; tested and validated the scalability and robustness of the training framework.
- Provided a solid metric for evaluating downstream causal inference models for heterogeneous treatment effect (HTE) in the difficult real-world scenario where the ground truth is unknown and changing rapidly, by comparing the estimated HTE with that computed from the ground truth in synthetic datasets.
- Explored how to use generative models to capture the fixed effects in real-world datasets, which is essential for the downstream models to mitigate hidden confounding effects.
- Collaborated with a diverse team composed of economists, software engineers, and applied scientists; earned trust from others through well-structured presentation, clear communication, and the delivery of convincing results.

Research Experience

Graduate Research Assistant June 2020 – Present

Advisor: Prof. David Inouye, Purdue University, West Lafayette, IN

Domain Counterfactual Generation

- Provide a practical yet theoretically grounded approach to estimating domain counterfactuals, which hypothesizes that causal variables are unobserved, and there is only access to observational data and domain labels.
- Derive a necessary and sufficient characterization of domain counterfactual equivalence; prove all invertible latent causal models can be split into disjoint equivalence classes with respect to their sparsity.
- Propose a novel model design of deep generative models for domain counterfactual generation inspired by the theory; validate the methods through extensive simulated and image-based experiments.
- Use generated counterfactuals for downstream tasks, including improving fairness and out-of-distribution generalization.

Federated Domain Generalization

- Explore class conditional distribution shift in Federated Learning (FL), which is harder than the conventional non-IID setting of class imbalance or missing classes across clients.
- Propose a federated domain translation method that is easier to train than existing translation models and is more resource-efficient in terms of both communication and computation.
- Utilize the translation model to generate pseudodata for each client which could be useful for multiple downstream tasks; demonstrate that this methodology enables use of state-of-the-art domain generalization methods in a federated setting which enhances accuracy and robustness to increases in the synchronization period.

Unsupervised Domain Adaptation

- Build iterative alignment models by decomposing high dimensional distributions into orthogonal components and solving the 1D alignment problems via closed-form solutions based on optimal transport theory; achieve faster and easier alignment in comparison to most Generative Adversarial Networks (GANs) and flow-based methods.
- Explore domain adaptation via direct distribution alignment using invertible deep generative models.

Deep Generative Models

- Build invertible deep generative models based on neural networks and iterative models; apply the models for tasks including density estimation, generative modeling, and distribution alignment.
- Become proficient with the implementation of flow models, GANs, and VAEs using PyTorch and scikit-learn.

Undergraduate Researcher – Quantum Error Correction August 2018 – May 2019

Advisor: Prof. Wenxian Zhang, Wuhan University, Hubei, China

- Simulated the spin system in MATLAB and tested fault-tolerant quantum computing architectures.

Undergraduate Researcher – Denoising in Accelerator Systems August 2017 – December 2017

Advisor: Prof. Georg Hoffstaetter, Cornell University, Ithaca, NY

- Analyzed the noise to help improve the stability of CBETA, a new type of accelerators at Cornell's Wilson Lab.

Skills

Programming Skills: Python, MATLAB, LaTeX, SQL *Deep Learning Framework*: PyTorch

Other tools: Transformers, PyTorch Geometric, Hadoop

Honors and Awards

- National Scholarship (award top 1% in the major) 2015 – 2016/ 2016 – 2017

Professional Activities

Presentations

Machine Learning Reading Group, Purdue University, West Lafayette, IN

- AI for Science and Physics-inspired AI November 2023
- Diffusion Models October 2022

Conference Reviewer

- ICML2023, AISTATS 2024, ICLR 2024, ICML 2024