

Yushu Pan

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RESEARCH INTEREST

My research interests lie broadly in **large-scale generative AI** and **causal inference**. I develop methods that integrate causal reasoning to enhance the **controllability, reasoning capabilities, efficiency, and interpretability** of generative models.

My work spans a range of domains, including **multi-modal generation (e.g., VLMs)**, **generative recommendation systems**, and **classification models**, with the goal of making generative AI more robust and controllable in real-world settings.

EDUCATION

- **Columbia University - Ph.D. Research Scientist in Computer Science** Sep 2021 - Expected Dec 2026
GPA: 4.0/4.0 Advisor: [Prof. Elias Bareinboim](#) New York, United States
- **California Institute of Technology - MS in Electrical Engineering** Sep 2019 - Jun 2021
GPA: 4.2/4.3 Advisor: [Prof. Yisong Yue](#) Pasadena, United States
- **Beijing Institute of Technology - BS in Electrical Engineering** Sep 2015 - Jun 2019
GPA: 93/100 Ranking: 1/425 Advisor: [Prof. Yuantao Gu](#) Beijing, China
- **Peking University - Bachelor of Economics** Sep 2017 - Jun 2019
GPA: 3.7/4.0 Beijing, China

PUBLICATIONS

- [C1] Pan, Y. and Bareinboim, E. "[Counterfactual Image Editing with Disentangled Causal Latent Space](#)", (Under-review), 2025.
- [C2] Hwang, I., Pan, Y., Bareinboim, E. "[From Black-box to Causal-box: Towards Building More Interpretable Models](#)", (Under-review), 2025.
- [C3] Pan, Y*, Li, A *, Bareinboim, E. "[Disentangled Representation Learning in Non-Markovian Causal Systems](#)", In 38th Conference on Neural Information Processing Systems (NeurIPS), 2024.
**Contributed equally, Author names in alphabetical order*
- [C4] Pan, Y. and Bareinboim, E. "[Counterfactual Image Editing](#)", In Proceedings of International Conference on Machine Learning (ICML), 2024.
- [C5] Xia, K., Pan, Y., Bareinboim, E. "[Neural Causal Models for Counterfactual Identification and Estimation](#)", In International Conference on Learning Representations, (ICLR), 2023.
- [C6] Pan, Y., Jiao, Y., Li, T., Gu, Y. "[An efficient algorithm for hyperspectral image clustering](#)", IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2019.

INDUSTRIAL EXPERIENCE

- **Long-sequence Recommendation — PhD Research Scientist Intern at Meta** May 2025 – Aug 2025
Meta Platforms, Inc.
 - Led the research and development of **Long-Short Hierarchical Sequential Transduction Units (LS-HSTU)**, a **transformer**-like generative recommender, for long user history interactions.
 - Implemented LS-HSTU in **Triton** and apply it to internal Instagram Reels data, achieving a **47.1% improvement in QPS** (efficiency) while maintaining **comparable normalization entropy** (accuracy) to the production HSTU baseline.
- **Pulmonary Nodules Detection in CT Images - Undergrad Intern** Dec 2017 - Mar 2018
Advisor: [Prof. Yi Zhang](#), West China Hospital
 - Implemented and optimized 3D-convolutional neural networks, and 3D-region proposal U-nets in PyTorch leading to 2x improved lung nodule detection with West China Hospital's CT scans.



SELECTED RESEARCH PROJECTS

- **Image Editing with Multi-Modal Large Models** Mar 2023 - present
Advisor: [Prof. Elias Bareinboim](#), Columbia University
 - Developed CLS-Edit, a **post-training** algorithm for counterfactual image editing with **text-to-image** generative models. Enabled the effect from target edits to other visual features, mitigating biases from pre-trained models. Demonstrated superior performance in **reasoning** and **debiasing** compared to existing baselines.
 - Proposed Augmented Neural Causal Model (ANCM), a **diffusion-based** framework for efficient counterfactual reasoning in image editing. Achieved **high-fidelity** and **semantically counterfactual inference** in image generation.
- **Causal Disentangled Representation Learning** Oct 2023 – Present
Advisor: [Prof. Elias Bareinboim](#), Columbia University
 - Proposed **CRID**, a graphical criterion and algorithm to determine whether learned representations are **causally disentangled** for downstream tasks.
 - Designed a flow-based method for extracting disentangled causal representations and applying them to downstream tasks, including image generation and **domain generalization** in weakly supervised settings.
- **Causal Neural Networks for Counterfactual Identification and Estimation** Sep 2022 – May 2023
Advisor: [Prof. Elias Bareinboim](#), Columbia University
 - Proposed **Neural Causal Models (NCMs)** for counterfactual identification and estimation with deep networks, addressing the limitations of observationally trained models in causal inference.
 - Developed the GAN-NCM structure and showed improved efficiency and accuracy in estimating causal queries over existing baselines.
- **Subspace Methods and Hyperspectral Image Clustering** Mar 2018 -Jun 2019
Advisor: [Prof. Yuantao Gu](#), Tsinghua University
 - Developed a superpixel-based **spectral clustering** algorithm for hyperspectral image analysis, achieving improved accuracy and efficiency over existing baselines on both medical and satellite imagery.

HONORS AND AWARDS

- **Greenwoods Fellowship** Oct 2021
Fu Foundation of Engineering and Applied Science at Columbia University
- **Xu Te Li Scholarship (awarded to top 0.1% of undergraduates)** May 2019
Beijing Institute of Technology
- **National Scholarship** Dec 2017
Chinese Ministry of Education
- **Grand prize in the Excellence 9 Mathematical Competition of China** Oct 2016
Excellence League

TEACHING

- TA, CS 4775, Causal Inference I, Columbia University, Fall 2023-2025. 
- TA, CS 4995, Causal Inference II, Columbia University, Spring 2023.
- TA, ACM 116, Introduction to Probability Models, Caltech, Fall 2020. 

SKILLS

- **Programming Languages:** Python, C, Verilog, VHDL, Matlab
- **Packages:** Triton, Pytorch, Numpy, Pandas, SQL, Lightning, Git
- **ML:** Causal Inference, Diffusion Models, Transformers, LLMs, Multi-Modal Generation, Generative Recommenders