

Yushu Pan

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RESEARCH INTEREST

My research interests lie at the intersection of causal inference and machine learning, under the supervision of Prof. [Elias Bareinboim](#). I am particularly interested in causal generative models and causal representation learning.

EDUCATION

- **Columbia University** Sep 2021 - Expected Jun 2026
Ph.D. Student in Computer Science New York, United States
 - GPA: 4.0/4.0 Advisor: [Elias Bareinboim](#)
- **California Institute of Technology** Sep 2019 - Jun 2021
Master of Science in Electrical Engineering Pasadena, United States
 - GPA: 4.2/4.3 Advisor: [Yisong Yue](#)
- **Beijing Institute of Technology** Sep 2015 - Jun 2019
Bachelor in Electrical Engineering Beijing, China
 - GPA: 93/100 Ranking: 1/425 Advisor: [Yuantao Gu](#)
- **Peking University** Sep 2017 - Jun 2019
Bachelor in Economics Beijing, China
 - GPA: 3.7/4

PUBLICATIONS

- [1] Li, A^{*}, [Pan, Y^{*}](#), 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*
- [2] [Pan, Y.](#) and Bareinboim, E. "[Counterfactual Image Editing](#)", In Proceeding of International Conference on Machine Learning ([ICML](#)), 2024.
- [3] Xia, K., [Pan, Y.](#), Bareinboim, E. "[Neural Causal Models for Counterfactual Identification and Estimation](#)", In International Conference on Learning Representations, ([ICLR](#)), 2023.
- [4] [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.

PROJECTS

- **Image Editing in Modern AI with Causality** Mar 2023 - present
Advisor: Elias Bareinboim, Columbia University
 - Developed a new causal framework for image editing tasks. Theoretically proved that current image editing methods cannot provide precise edits, suggesting that the causal reliability of current state-of-the-art methods is not guaranteed.
 - Proposed ‘**ctf-consistent estimators**’ that ensure causal consistency between the features users prioritize for practical applications. Developed an algorithm called **Augmented Neural Causal Model (ANCM)** that efficiently provides ctf-consistent estimators and generates high-fidelity counterfactual images in extensive experiments.
 - (Ongoing) Incorporate ‘ctf-consistent estimators’ with **text-to-image** pre-trained models (e.g., StableDiffusion, Latent Diffusion Model) to perform causal image editing using text prompts.

• Causal Disentangled Representation Learning

Oct 2023 - present

Advisor: Elias Bareinboim, Columbia University

- Formalized a general version of the causal representation learning problem and developed graphical criteria to determine whether a pair of user-chosen variables are disentangled non-Markovian settings, considering arbitrary interventional and observational distributions from multiple heterogeneous domains.
- Developed an algorithm called **CRID**, which systematically determines whether two sets of latent factors are disentangleable given the selection diagram and intervention targets.
- Developed a VAE-based algorithm to practically estimate causal disentangled representations and leverage them for image generation and downstream classification tasks.

• Neural Causal Model for Counterfactual Identification and Estimation

Sep 2022 - May 2023

Advisor: Elias Bareinboim, Columbia University

- Developed a class of causal models using neural networks, called **Neural Causal Models (NCMs)**, for counterfactual identification, estimation, and efficient sampling.
- Theoretically proved that deep models are incapable of making causal inferences when trained solely on observational data. Demonstrated that NCMs can naturally incorporate causal assumptions as inductive biases, enabling them to perform identification and estimation.
- Developed a GAN-based implementation of Neural Causal Models (NCM) and conducted experiments to demonstrate the accuracy and efficiency of the GAN-NCM approach.

• Data-Driven Optimization for ML Algorithms

Jan 2020 - Sep 2021

Advisor: Yisong Yue, Caltech

- Developed a data-driven continuous optimization approach for structure learning. Designed a meta-learning architecture and a reinforcement learning-based method to achieve auto-hyperparameter tuning.

• Subspace Methods and Hyperspectral Images Clustering

Mar 2018 - Jun 2019

Advisor: Yuantao Gu, Tsinghua University

- Designed a highly accurate SuperPixel and Angle-based HyperSpectral Image Clustering (SPAHSIC) algorithm with low time complexity, utilizing superpixel segmentation and principal angles between subspaces for hyperspectral image clustering. Performed SPAHSIC on medical and satellite hyperspectral images.

HONORS AND AWARDS

• Greenwoods Fellowship

Oct 2021

Fu Foundation of Engineering and Applied Science at Columbia University

• Xu Te Li Scholarship

May 2019

Beijing Institute of Technology

- 0.1% excellent undergrad students

• 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 / Fall 2024. 
- 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, CAD
- **Packages:** Pytorch, Tensorflow, Scikit-learn, Keras
- **Languages:** English (fluent), Chinese (native)