Kaichen Xu

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EDUCATION

Emory University 09/2025 – 08/2026
Major: Master of Science in Computer Science

Zhongnan University of Economics and Law (ZUEL) 09/2020 – 06/2024
Major: Bachelor of Science in Statistics **GPA**: 3.85/4.00 (92.21/100)

RESEARCH INTERESTS

Generative Model; Computational Biology and Bioinformatics; Theory of Deep Learning

PUBLICATIONS

*: equal contribution

[1] **Kaichen Xu**, Yihang Du, and et al. Causality-Induced Positional Encoding for Transformer-Based Representation Learning of Non-Sequential Features. In *Proceedings of the International Conference on Neural Information Processing Systems **(NeurIPS)***, 2025

[2] **Kaichen Xu***, Qilong Wu*, and et al. Multimodal Anomalous Tissue Region Detection Enhanced with Spatial Transcriptomics. In *Proceedings of the AAAI Conference on Artificial Intelligence **(AAAI)***, 2025.

[3] **Kaichen Xu**, Yan Lu, and et al. Detecting and Dissecting Anomalous Anatomic Regions in Spatial Transcriptomics with STANDS. ***Nature Communications***, 2024.

[4] **Kaichen Xu***, Yueyang Ding*, and et al. Domain Adaptive and Fine-grained Anomaly Detection for Single-cell Sequencing Data and Beyond. In *Proceedings of the International Joint Conference on Artificial Intelligence **(IJCAI)***, 2024.

[5] **Kaichen Xu***, Kainan Liu*, and et al. Detecting and Subtyping Anomalous Single Cells with M2ASDA. In *ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB)*, 2024.

[6] Tao Deng, Mengqian Huang, **Kaichen Xu**, and et al. LEGEND: An Integrative Algorithm for Identifying Co-expressed and Cofunctional Genes in Multimodal Transcriptomic Sequencing Data. *Genomics Proteomics Bioinformatics*, 2025.

[7] Tao Deng, Mengqian Huang, **Kaichen Xu**, and et al. MIXER: Identifying Co-expressed Genes in Multimodal Transcriptomic Sequencing Data. In *ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB)*, 2024.

RESEARCH EXPERIENCES

Causality-Induced Positional Encoding for Transformer-Based Representation Learning of Non-Sequential Features

- Observed that sequential order can be regarded as a special case of causal dependency, and proposed to generalize positional encoding by learning hidden causal structures among non-sequential features.
- Developed CAPE, a novel framework that integrates causal discovery with transformer architectures, enabling self-attention to capture causal strength and specificity without predefined feature ordering.
- Conducted extensive theoretical analysis and real-world experiments, demonstrating CAPE's effectiveness in significantly improving representation learning on diverse causal datasets.
- Successfully published research at **NeurIPS 2025**.

Detecting and Dissecting Anomalous Anatomic Regions in Spatial Transcriptomics with STANDS

- Explored three interrelated challenges of disease heterogeneity analysis on Spatial Transcriptomics. Revealed the population-level and individual-specific pathogenic factors significantly affected the discovery of cancer microenvironment.
- Proposed STANDS, a novel framework based on multi-modal Generative Adversarial Networks. Achieved the state-of-the-art model in the identification of pathological anatomic tissues by fusing spatial gene expression data with H&E images.
- Designed a program website (https://catchxu.github.io/STANDS/) to introduce our method and provide running tutorials.
- Successfully published research at **Nature Communications** as an undergraduates.

Domain Adaptive and Fine-grained Anomaly Detection for Single-cell Sequencing Data and Beyond

- Discovered and mathematically theorized that domain shifts prevalent in multi-sample and multi-domain datasets can impact the accuracy of anomaly detection. Also provided new insights into the limitations of existing anomaly detection methods.
- Inspired by the theories about Maximum Mean Discrepancy (MMD) and Ramanujan's master theorem, proposed an innovative framework, ACSleuth, for discovering anomalous cell types and subtypes in single-cell sequencing data. Extensive experiments and theoretical analysis demonstrate its superiority over existing methods and robustness to domain shifts.
- Successfully published research at **IJCAI 2024** as an undergraduates.

WORK EXPERIENCES

The Chinese University of Hong Kong (Shenzhen) **Shenzhen, China**
Research Assistant 06/2025 – Present

- Conducted computational biology research under Dr. Jin Liu.
- Led a research project as first author, preparing a manuscript for submission to **Nature Machine Intelligence**.

Zhongnan University of Economics and Law **Wuhan, China**
Research Assistant 03/2023 – Present

- Conducted researches about computational biology and theory of deep learning under Dr. Xiaobo Sun.
- Led and collaborated on projects resulting in publications as first author or co-first author in **Nature Communications**, **IJCAI**, **AAAI**, and **NeurIPS**.

LEADERSHIP EXPERIENCES

Organizer and Speaker of Internet Academic Seminar Group about Machine Learning 09/2023 – Present

- Led weekly online seminars on machine learning technologies, engaging over 30 participants from various universities.
- Delivered a presentation once a month on the latest technical papers, sharing personal insights and innovative ideas. Inspired by them, the participants published over 10 conference papers in the field of computer science or computational biology.

Server Administrator and Mentor at Sunlab 09/2023 – Present

- Managed the lab's servers and computing resources, ensuring high reliability, and efficient access for the entire research team.
- Conducted over 30 one-on-one interviews with lab candidates. Provided tailored mentorship and guidance to newly joined students, leading to a sophomore successfully publishing a paper at IJCAI 2025.

Teaching Assistant for Machine Learning (Master) and Optimization Theory (Bachelor) 09/2024 – 01/2025

- Provided personalized academic consulting to over 20 graduates and 50 undergraduates, effectively guiding them through complex concepts and resolving learning challenges.
- Taught specialized section on language models in computational biology, based on personal research experience.

ACADEMIC PRESENTATIONS

Oral Academic Seminar for introducing our work STANDS, Peking University	12/2024
Oral Presentation at International Joint Conference on Artificial Intelligence (IJCAI)	08/2024
Oral Academic Seminar at Dept. of Comp. Sci. & Dept. of Biomed. Info., Emory University	10/2023
Oral Academic Presentation at Dept. of Comp. Sci., Indiana University	07/2023

AWARDS & HONORS

National Collegiate Market Research and Analysis Competition Third Prize (Top 2% in China)	04/2023
Undergraduate Comprehensive Commendation for "Research Star" (Top 1 in ZUEL)	12/2022
Contemporary Undergraduate Mathematical Contest in Modeling First Prize (Top 2% in Hubei province)	10/2022
Kangteng National Collegiate Business Case Analysis Competition Third Prize (Top 0.6% in China)	06/2022
Zhongnan University of Economics and Law Mathematics Competitions First Prize (Top 1 in ZUEL)	12/2021

TECHNICAL SKILLS

Programming Languages: Python (PyTorch, TensorFlow, Pandas, NumPy, Scanpy, AnnData, etc.), R, C/C++, PHP
Technologies and Tools: Latex, Linux, GitHub, MATLAB, MySQL, Markdown, HTML/CSS, PS, AI