

Qianru ZHANG (HKU)

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AI for Urban/Social/Biology/Physical Science, Graph Data Mining, LLMs

RESEARCH INTERESTS

My research area delves into the theoretical foundations of algorithm design for graphs, with a specific focus on optimizing models utilizing graph convolutional networks (GCN), contrastive learning, transformers, diffusion models, reinforcement learning, and large language models (LLMs) to enhance efficiency and effectiveness. By delving into the underlying principles and mathematical frameworks of these techniques, I aim to develop innovative algorithms capable of effectively capturing and leveraging the inherent structural properties of graph/image data. This theoretical approach empowers graph-based models to achieve heightened accuracy, scalability, and interpretability. Through rigorous theoretical analysis and experimentation, my goal is to advance our comprehension of graph algorithms and their applications across diverse domains, including spatial-temporal graphs, recommendation systems, and bioinformatics. My research lines are divided into three groups as follows:

Conducted Research Work: My research focuses on ML methods for **spatial-temporal graph data mining**. I have made significant contributions, published in top conferences like WWW'23, KDD'21, ICML'23. Applied ML models for anomalous trajectory detection at DiDi (ICDE'23). Explored phase transition phenomena in representation learning of social networks (ICDE'24). Modeled sports data (SDM'22, TKDD'24 via minor revision).

Ongoing Work: I have also ventured into the realm of **discovering physical science**. I have designed new algorithms for guiding diffusion models to generated images that are more related to the purpose, with a recent paper submission to ICML'24 (**We contribute the first 1 million Biology and Physical datasets.**).

Future Work: I will focus on three key thrusts. First, I aim to develop an integrated and versatile ML pipeline to accelerate simulations across the physical sciences, **including physics and biology**. Second, building upon this foundation, I will work on **ML-based methods for accelerating the mechanical and molecular design in physical sciences**. Lastly, I will focus on developing knowledge-grounded and generalizable representations that **facilitate scientific discovery**.

SUMMARY OF ACHIEVEMENTS

- Published 11 top-conference papers including ICDE'24, AAAI'24, ICML'23, WWW'23, ICDE'23, SDM'22, KDD'21 and so on.
 - △ Besides, another 1 paper receiving minor revision (TKDD'24)
 - △ Google Scholar statistics: **citations 309, h-index:5, i10-index:4**
- Top 40 Recipients of the Baidu Research Fellowships Worldwide with total over 5,000 applications
- Invited talks titled with “Robust and Efficient Spatial-Temporal Graph Learning” @ Tsinghua University and @Westlake University
- Obtained PGS scholarship at HKU and National scholarship, Merit student at Jiangsu province
- Experience in industry: **Special Offer** (There is only 1 winner in ICBU department of Alibaba each year) as an NLP algorithm engineer

EDUCATION

- 2020.9 - Present PhD at **The University of Hong Kong**, Computer Science
Supervisor: Prof.Yiu, Siuming
- 2017.9 - 2019.12 Master's Degree at **The University of Hong Kong**, Computer Science
Supervisor: Prof.Kao, Benjamin CM
- 2012.9 - 2016.6 Bachelor's Degree at **NanJing University of Posts and Telecommunications**,
Telecommunication

PUBLICATIONS, * DENOTES EQUAL CONTRIBUTION

Published (with Obtained Revision) Papers (AI for Urban/Social Science)

- Qianru Zhang**, Chao Huang, Lianghao Xia, Zheng Wang, Zhonghang Li, and Siuming Yiu (2023). “Automated Spatial-Temporal Graph Contrastive Learning for Region Representation”. In: *Proceedings of the 32th ACM World Wide Web Conference, WWW’23 with the highest rank (2.75/3)*.
- Qianru Zhang**, Chao Huang, Lianghao Xia, Zheng Wang, Siuming Yiu, and Ruihua Han (2023). “Multi-View Spatial-Temporal Graph Learning with Adversarial Contrastive Adaptation”. In: *Proceedings of the 40th International Conference on Machine Learning, ICML’23*.
- Qianru Zhang**, Zheng Wang, Cheng Long, Chao Huang, Siuming Yiu, Yiding Liu, Gao Cong, and Jieming Shi (2023). “Online Anomalous Subtrajectory Detection with Road Network Enhanced Reinforcement Learning”. In: *Proceedings of the 39th IEEE International Conference on Data Engineering, ICDE’23*.
- Qianru Zhang**, Zheng Wang, Cheng Long, and Siuming Yiu (2022). “On Predicting and Generating a Good Break Shot in Billiards Sports”. In: *Proceedings of the 22th SIAM International Conference on Data Mining, SDM’22*.
- Qianru Zhang**, Lianghao Xia, Xuheng Cai, Siuming Yiu, Chao Huang, and Christian S. Jensen (2024). “Robust Graph Augmentation for Recommendation”. In: *Proceedings of the 40th IEEE International Conference on Data Engineering, ICDE’24*.
- Qianru Zhang**, Wang Zheng, Cheng Long, and Siuming Yiu (2024). “Billiards Sports Analytics: Datasets and Tasks”. In: *Minor Revision via ACM Transactions on Knowledge Discovery from Data (TKDD’24)*.
- Ruihua, Han, Shuai Wang, Shuaijun Wang, Zeqing Zhang, **Qianru Zhang**, Hao Qi, and Jia Pan (2022). “Accelerated Collision-Free Robot Motion Planner with Dual Proximal Methods”. In: **IEEE RA-L’23**.
- Xingwei, He, **Qianru Zhang**, Along Jin, Jun Ma, Yuan Yuan, and Siuming Yiu (2024). “Improving Factual Error Correction by Learning to Inject Factual Errors”. In: *Proceedings of the 38th AAAI Conference on Artificial Intelligence, AAAI’24*.
- Xukui, Li, Wei Chen, **Qianru Zhang**, and Lifa Wu (2020). “Building Auto-Encoder Intrusion Detection System based on Random Forest Feature Selection”. In: **Computers and Security’20**.
- Zheng, Wang, Long Cheng, Cong Gao, and **Qianru Zhang** (2021). “Error-Bounded Online Trajectory Simplification with Multi-Agent Reinforcement Learning”. In: *Proceedings of the 27th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, KDD’21*.
- Zheng, Wang, Liu Mingrui, Long Cheng, **Qianru Zhang**, and Miao Chunyan (2022). “On Predicting Anomalous Loan Payment Behavior with Mobility Records”. In: *Proceedings of the IEEE International Conference on Big Data, BigData’22*.

Preprint Papers (AI for Physical Science)

Qianru Zhang, Chenglei Yu, Yudong Yan, Xiangyu Kuang, Yi Ma, Yuansheng Cao, Siuming Yiu, and Tailin Wu (2024). ***xDDPM: explainable Denoising Diffusion Probabilistic Model for scientific modeling***. **Under review by ICML.**

Preprint and Collaborated Papers (AI for Urban Science/LLMs)

Qianru Zhang, Xubin Ren, Lianghao Xia, Siuming Yiu, Cheng Long, and Chao Huang (2024). ***Large Language Model (LLM) for Spatial-Temporal Graph Learning.*** **Under review by KDD.**

Qianru Zhang, Jieming Shi, and Siuming Yiu (2024). ***A Weakly Supervised Framework for Effective and Efficient Detour Extraction on Large Trajectory Data.*** **Under review by TKDE.**

Qianru Zhang, Lianghao Xia, Zhonghang Li, Jiabin Tang, Siuming Yiu, Chao Huang, and Christian S. Jensen (2024). ***Graph-less Spatial-Temporal Neural Networks for Traffic Prediction.*** **Under review by TKDE.**

Qianru Zhang, Lianghao Xia, Zhonghang Li, Siuming Yiu, Chao Huang, and Yi Ma (2024). ***Spatial-Temporal Prompt Tuning.*** **Under review by VLDB.**

Qianru Zhang, Lianghao Xia, Siuming Yiu, and Chao Huang (n.d.). ***Masked Graph Autoencoder for Spatial-Temporal Graph Neural Networks.*** **Under review by KDD.**

ACADEMIC SERVICES AND INVITED TALKS

2023.10, 2023.9	WWW'24 Reviewer, ICLR'24 Reviewer
2023.4, 2022.4	Nerips'23 Reviewer, Time Series Session Chair SDM'22
2023.5, 2023.4, 2022.4	Talk at WWW'2023, ICDE'2023, SDM'2022
2023.11	Invited talk at South China Normal University
2023.12	Invited talk at Tsinghua University
2023.12	Invited talk at Westlake University

EMPLOYMENT HISTORY

2019.7 - 2020.8	Natural Language Processing Engineer, <u>Special Offer</u> , Alibaba Group , China
2019.3 - 2019.5	Intern Algorithm Engineer, WeBank , China

TEACHING ASSISTANT

2021.1 - 2021.5	COMP7405 Techniques in Computational Finance, HKU
2022.1 - 2022.5	FITE7405 Techniques in Computational Finance, HKU
2023.1 - 2023.5	FITE7405 Techniques in Computational Finance, HKU
2024.1 - 2024.5	FITE7405 Techniques in Computational Finance, HKU

MISCELLANEOUS EXPERIENCE

2023.12	Top 40 Recipients of the Baidu Research Fellowships Worldwide
2023.4	Student Travel Award of WWW'23, <u>with total around 10 international winners</u>
2020.9-2024.8	Postgraduate Scholarship (PGS)
2016.6	Outstanding Graduate (Top 5%)
2015.9	First-class Scholarship
2013.9	National Scholarship (Top 1%), First-class Scholarship (Top 5%)