



Research Group

The Learning and Reasoning (LARS) research group is affiliated with the [Department of Electronic Engineering at Tsinghua University](#). It is based at the [Tsinghua Electronic Engineering Urban Science and Computing Research Center](#) and conducts research in the field of machine learning, particularly focusing on knowledge-guided graph learning methods. The group is dedicated to addressing key scientific problems related to learning, reasoning, simulation, and prediction in applications such as biomedical networks and urban networks from a theoretical and methodological perspective.

Cooperating Supervisor

Quanming Yao (<https://lars-group.github.io/index.html>) is currently an assistant professor in the Department of Electronic Engineering at Tsinghua University and a recipient of the National High-level Young Talents Plan. He obtained his Ph.D. degree from the Department of Computer Science at Hong Kong University of Science and Technology. Following that, he served as a Chief Researcher at the Fourth Paradigm, where he established and led a machine learning research team. His main research interests lie in machine learning and AI for science, with a special focus on knowledge-guided graph learning methods. He has published over 80 top-tier papers, including in journals such as Nature Computational Science, Nature Communication, JMLR, IEEE TPAMI, and conferences such as ICML, NeurIPS, and ICLR. His work has received nearly ten thousand citations. His co-teaching algorithm for noisy labels is considered a milestone in robust learning, and his survey on few-shot learning is the most highly cited paper in ACM Computing Surveys in the past five years. His series of methods for automated graph learning (including TPAMI 2023) have consistently ranked first on the Open Graph Benchmark list. His work on using biomedical networks to solve drug interactions has been published in a Nature sub-journal.

He has served as an area chair for machine learning conferences such as ICML, NeurIPS, and ICLR, and he is an editorial board member for flagship journals such as Neural Network and Machine Learning. He has received numerous prestigious awards both domestically and internationally, including the Early Career Award from the International Neural Network Society, Outstanding Young Scientist from the Hong Kong Academy of Sciences, Outstanding Young Scientist Award from the Wu Wenjun Artificial Intelligence Society, and the Google Global Ph.D. Fellowship. He has also been included in the Global Chinese AI Youth Scholars List (Top 25 in machine learning), Forbes 30 Under 30 Elite List, and the Top 2% Scientists Worldwide. Lastly, he has been invited to deliver an early career report on "Human like learning methods for structured data" at the AAAI 2024 conference.

Recent Representative Work:

- [1]. **Quanming Yao**, Zhenqian Shen, Yaqing Wang*, Dejing Dou. Property-Aware Relation Networks for Few-Shot Molecular Property Prediction. IEEE Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**). 2024
- [2]. Haiquan Qiu, Yongqi Zhang, Yong Li, **Quanming Yao***. Understanding Expressivity of GNN in Rule Learning. International Conference on Learning Representations (**ICLR**). 2024
- [3]. Yongqi Zhang, **Quanming Yao***, Ling Yue, Xian Wu, Ziheng Zhang, Zhenxi Lin, Yefeng Zheng. Emerging Drug Interaction Prediction Enabled by Flow-based Graph Neural Network with Biomedical Network. **Nature Computational Science**. 2023.
- [4]. Yongqi Zhang, **Quanming Yao***, James T. Kwok. Bilinear Scoring Function Search for Knowledge Graph Learning. IEEE Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**). 2023.
- [5]. **Quanming Yao**, Yaqing Wang, Bo Han, James T. Kwok. Efficient Low-rank Tensor Learning with Nonconvex Regularization. Journal of Machine Learning Research (**JMLR**). 2022.
- [6]. Huan Zhao, Quanming Yao, Weiwei Tu. Search to aggregate neighborhood for graph neural network. International Conference on Data Engineering (**ICDE**). 2021
- [7]. Yaqing Wang, **Quanming Yao***, James T. Kwok, Lionel Ni. Generalizing from a Few Examples: A Survey on Few-Shot Learning. ACM computing surveys (**CSUR**). 2020.



Research Direction

Mainly focus on knowledge-guided graph learning methods, aiming to address challenges and problems in graph learning and explore breakthroughs.

- Challenges and Problems: Machine learning has evolved from manual feature engineering and shallow models to deep networks and large-scale models, heavily relying on brute-force expansion of data and model size to achieve learning performance. However, this research path is not suitable for graph learning due to the discreteness of graph data and the interactive nature of graphs. How can we break away from the existing path and realize the next generation of graph learning techniques?
- Breakthrough approach: Knowledge guidance, mining the knowledge embedded in graph data (symbolic logic and physical laws), shifting the problem from a complex data space to a well-structured knowledge space, and achieving efficient learning through the combination and generalization of knowledge.
- Roadmap:
 - Generalizing model architectures with the inductive nature of knowledge, designing methods for modeling and searching heterogeneous graph learning, and improving model transferability.
 - Transforming parameter space with the extensibility of knowledge, designing algorithms for small-sample molecular property prediction, and enhancing sample utilization efficiency.
 - Interpreting prediction results with the logic of knowledge, designing an explanatory framework based on logical subgraphs, and revealing the model's reasoning process.
- Related Technologies:
 - Automated Machine Learning, Graph Neural Network, Knowledge Graph, Meta Learning, Few-shot Learning, In-context Learning, Neural Architecture Search

Enrollment Information

- Full-time Ph.D. Program
 - Duration: 4-5 years
 - Quota: 1 domestic direct Ph.D. or regular Ph.D. position per year, 1 international student position per year
- Full-time Master's Program
 - Duration: 2 years
 - Quota:
 - ◆ 1 Engineering Master's position per year, 1 international student position per year
 - ◆ Tsinghua-JHU Dual Master's program: 1 position per year (pls refer to the link for details): [JHU-BME](#), [Tsinghua](#)

Recruitment Positions

The following positions are available (with a work contract with Tsinghua University)

- 1 Postdoctoral Fellow (pls refer to the link for details):: <https://www.ee.tsinghua.edu.cn/rczp/bshzp.htm>
 - Meet the eligibility criteria for Tsinghua University's postdoctoral application
 - Strong interest in exploring cutting-edge technologies, excellent analytical and problem-solving skills, capable of independent research work



- Demonstrated self-motivation and perseverance
- Strong academic communication skills, with experience in publishing high-level academic papers in relevant fields
- Enthusiasm for research work, excellent teamwork spirit, and ability to assist and guide research group members
- 1-2 Research Engineers
 - Bachelor's degree or higher in Computer Science, Mathematics, or Electronic Information
 - Minimum one year of machine learning research and development experience, proficient in programming, and familiar with at least one machine learning framework (such as TensorFlow, PyTorch)
 - Enthusiasm for research work and excellent teamwork spirit
 - Candidates with published papers are preferred.

How to Apply

Please send their personal resumes (including educational background, list of publications, internship experiences, etc.), transcripts (for undergraduate applicants), representative papers or projects to the email address (please indicate the position applied for and your name in the email subject line): qyaoaa@mail.tsinghua.edu.cn

If the resume passes the initial screening, an interview will be arranged. The interview requires the preparation of a PowerPoint presentation covering the following:

- Personal background and motivation for application
- Detailed analysis of 1-2 research experiences/achievements, demonstrating logical thinking and innovation
- Discussion of personal planning and ideas for learning and work, considering strengths and weaknesses
- Please **prepare in consideration of the research group background**. The overall interview duration is 1 hour, with approximately 30 minutes allocated for the PowerPoint presentation.

FAQ

1. I have already graduated from my undergraduate/master's program and would like to apply for a Ph.D./Master's position in this group.
 - Undergraduate students need to have a recommendation for graduate studies or participate in graduate entrance examination. Master's students can consider applying for a regular Ph.D. program (participate in the department's interview in September each year).
2. I want to apply to top overseas institutions. Can I participate in academic research as a research engineer?
 - Yes, research engineers in the research group primarily engage in academic-related research and receive sufficient academic guidance from the research group.
 - Members of the research group have successful experiences in applying to top overseas universities, including EPFL, UCLA, Maryland, HKUST, NTU, and others (details can be found at <https://lars-group.github.io/pages/group.html>).