LINGXIAO ZHAO

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EDUCATION

- **Carnegie Mellon University** — Pittsburgh, PA, USA
  Ph.D. in Machine Learning Joint Public Policy — Aug. 2018 to Now
  Advisors: Prof. Leman Akoglu, Prof. Aarti Singh
- **Carnegie Mellon University** — Pittsburgh, PA, USA
  M.S. in Electrical and Computer Engineering — Aug. 2016 to Dec. 2017
  GPA: 3.90/4.00
- **Xi'an Jiaotong University** — Xi'an, Shaanxi, China
  B.S. in Electrical Engineering — Aug. 2012 to July 2016
  GPA: 91.05/100, Rank: 7/370

WORKING EXPERIENCE

- **Reserach Intern at Nvidia** Advised by *Dr. Haggai Maron.* — May 2022 to Aug. 2022
- **Reserach Intern at Snap Inc.** Advised by *Dr. Neil Shah.* — May 2021 to Aug. 2021
- **Research Intern at IBM** Advised by *Dr. Charu Aggarwal.* — May 2020 to Aug. 2020

RESEARCH INTEREST

Graph is a powerful representation that captures interactions between identities. GNNs achieve state-of-art performance in a variety of graph-based tasks, while being not well-understood. My work focuses on solving some fundamental problems of GNNs, such as breaking depth-limitation, relaxing homophily requirement, learning better structure, and improving expressiveness.

PUBLICATIONS

Published Papers

1. Sign and Basis Invariant Networks for Spectral Graph Representation Learning, **2023 ICLR**
   Derek Lim*, Joshua Robinson*, **Lingxiao Zhao**, Tess Smidit, Suvrit Sra, Haggai Maron, Stefanie Jegelka. (* equal contribution)
2. A Practical, Progressively-Expressive GNN, **2022 NeurIPS**
   Lingxiao Zhao, Louis Härtel, Neil Shah, Leman Akoglu
3. Hyperparameter Sensitivity in Deep Outlier Detection: Analysis and a Scalable Hyper-Ensemble Solution, **2022 NeurIPS**
   Xueying Ding, **Lingxiao Zhao**, Leman Akoglu
4. Graph-level Anomaly Detection with Unsupervised GNNs, **2022 ICDM Short**
   Lingxiao Zhao, Saurabh Sawlani, Arvind Srinivasan, Leman Akoglu
5. Density of States for Fast Embedding Node-Attributed Graphs
   2022 Knowledge and Information System Joural
   Lingxiao Zhao, Saurabh Sawlani, Leman Akoglu
6. From Stars to Subgraphs: Uplifting Any GNN with Local Structure Awareness, **2022 ICLR**
   Lingxiao Zhao, Wei Jin, Leman Akoglu, Neil Shah
7. Graph Condensation for Graph Neural Networks, **2022 ICLR**
   Wei Jin, **Lingxiao Zhao**, Shichang Zhang, Yozen Liu, Jiliang Tang, Neil Shah
8. On Using Classification Datasets to Evaluate Graph Outlier Detection: Peculiar Observations
   2021 Big Data Journal
   Lingxiao Zhao, Leman Akoglu

9. Fast Attributed Graph Embedding via Density of States , **2021 ICDM**
   Saurabh Sawlani, **Lingxiao Zhao**, Leman Akoglu
10. Graph unrolling networks: Interpretable neural networks for graph signal denoising
    2021 IEEE Transactions on Signal Processing
    Siheng Chen, Yonina C. Eldar, **Lingxiao Zhao**
11. Beyond Homophily in Graph Neural Networks: Limitations and Effective Designs, **2020 NeurIPS**
    Jiong Zhu, Yujun Yan, **Lingxiao Zhao**, Mark Heimann, Leman Akoglu, Danai Koutra
12. Connecting Graph Convolutional Net and Graph-Regularized PCA, **2020 ICML Workshop**
    Lingxiao Zhao, Leman Akoglu
13. PairNorm: Tackling Oversmoothing in GNNs, **2020 ICLR**
    Lingxiao Zhao, Leman Akoglu
14. A Quest for Structure: Jointly Learning Graph and Semi-Supervised Classification, **2018 CIKM**
    Xuan Wu*, Lingxiao Zhao*, Leman Akoglu. (* equal contribution)

SELECTED RESEARCH PROJECTS

A Practical, Progressively Expressive GNN Jan. 2022 to June. 2022
Proposed the first practical and highly expressive GNN improved from higher-order GNNs

- Greatly boosted the scalability of higher-order GNNs by moving from tuples to sets.
- Proved the design is progressively expressive and is no less powerful than k-1 WL.
- Proposed k-bipartite bidirectional message passing with lower cost and faster convergence, which unifies line graphs, higher-order GNNs, and message passing based GNNs.

From Stars to Subgraphs: Uplifting Any GNN Mar. 2021 to Oct. 2021
Proposed the first general framework to boost expressiveness of any GNN

- Designed a general framework to uplift any GNN, by generalizing MPNN's aggregation field from stars to subgraphs and encoding subgraphs with the (base) GNN.
- Proved the expressiveness is strictly better than 1-WL, while being not less powerful than 3-WL.
- Designed effective and efficient realizations: different encodings and distance-to-centroid feature.
- Designed SubgraphDrop that greatly reduces memory cost and still keeps same performance.

Tackling oversmoothing problem in GNNs March 2019 to Sept. 2019
Proposed the first normalization layer in GNNs, for solving oversmoothing

- Studied oversmoothing thoroughly with SGC, which decouples the effect of oversmoothing on performance drop of increasing layers from overfitting and vanishing gradient problems.
- Proposed an efficient and effective normalization layer, PairNorm, that "pushes" oversmoothed node representations away from each other. PairNorm greatly improves robustness of depth.
- Studied a new setting: Semi-Supervised Learning with large percentage missing feature problem, where PairNorm greatly boost performance for all three types of GNN (SGC,GCN,GAT).

HONORS and AWARDS

- **NeurIPS 2022 Travel Grant** Oct. 2022
- **SIGIR Student Travel Grant** for attending CIKM 2018 Sep. 2018
- 2^{nd} Prize in Challenge Cup (National Innovation Competition) Nov. 2015
- Outstanding Student Pacesetter (Only **10** students in **3800** undergraduates) Oct. 2015
- National Scholarship (Rank **4/370** and **5/370**, respectively) Oct. 2015, Oct. 2014
- **Outstanding Winner** (highest) In MCM/ICM[1] (Only 19 teams **(0.19%)** worldwide) April. 2014

[1]The Mathematical Contest in Modeling/The Interdisciplinary Contest in Modeling: comap.com