

# LINGXIAO ZHAO

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## EDUCATION

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

## WORKING EXPERIENCE

- **Research Intern at Nvidia** Advised by *Dr. Haggai Maron.* May 2022 to Aug. 2022
- **Research 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-the-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

### Preprint Papers

1. [Sign and Basis Invariant Networks for Spectral Graph Representation Learning](#), 2022  
Derek Lim\*, Joshua Robinson\*, **Lingxiao Zhao**, Tess Smidt, Suvrit Sra, Haggai Maron, Stefanie Jegelka. (\* equal contribution)

### Published Papers

1. [A Practical, Progressively-Expressive GNN](#), **2022 NeurIPS**  
**Lingxiao Zhao**, Neil Shah, and Leman Akoglu
2. [Hyperparameter Sensitivity in Deep Outlier Detection: Analysis and a Scalable Hyper-Ensemble Solution](#), **2022 NeurIPS**  
Xueying Ding, **Lingxiao Zhao**, Leman Akoglu
3. [Graph-level Anomaly Detection with Unsupervised GNNs](#), **2022 ICDM Short**  
**Lingxiao Zhao**, Saurabh Sawlani, Arvind Srinivasan, Leman Akoglu
4. Density of States for Fast Embedding Node-Attributed Graphs  
*2022 Knowledge and Information System Journal*  
**Lingxiao Zhao**, Saurabh Sawlani, Leman Akoglu
5. [From Stars to Subgraphs: Uplifting Any GNN with Local Structure Awareness](#), **2022 ICLR**  
**Lingxiao Zhao**, Wei Jin, Leman Akoglu, Neil Shah
6. [Graph Condensation for Graph Neural Networks](#), **2022 ICLR**  
Wei Jin, **Lingxiao Zhao**, Shichang Zhang, Yozen Liu, Jiliang Tang, Neil Shah
7. [On Using Classification Datasets to Evaluate Graph Outlier Detection: Peculiar Observations](#)  
*2021 Big Data Journal*  
**Lingxiao Zhao**, Leman Akoglu

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

## SELECTED RESEARCH PROJECTS

### 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, with Prof. Leman Akoglu*

- 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).

### Optimal Graph Learning for Semi-Supervised Learning

Sep. 2017 to Feb. 2018

*Supervised By Prof. Leman Akoglu, Project Link: <https://pg-learn.github.io>*

- Designed a hyper-loss over validation set measuring task-based “optimal” graph for SSL.
- Proposed an algorithm minimizing the hyper-loss based on hyper-gradient of the graph.
- Boosted the runtime 10x faster by using tensor-form update and efficient sparse operation.
- Paralleled it by incorporating and modifying HyperBand, an adaptive resource allocation alg.

## HONORS and AWARDS

- **SIGIR Student Travel Grant** for attending CIKM 2018 Sep. 2018
- **2<sup>nd</sup> 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<sup>1</sup> (Only 19 teams (**0.19%**) worldwide) April. 2014

<sup>1</sup>The Mathematical Contest in Modeling/The Interdisciplinary Contest in Modeling: [comap.com](http://comap.com)