

# LINGXIAO ZHAO

<http://lingxiao.zhao.com>

lingxiao@cmu.edu

## EDUCATION

- **Carnegie Mellon University** Pittsburgh, PA, USA  
*Ph.D. in Machine Learning Joint Public Policy*  
Aug. 2018 to Now  
Advisor: Prof. Leman Akoglu
- **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

- **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. From Stars to Subgraphs: Uplifting Any GNN with Local Structure Awareness  
*Under submission to 2022 ICLR*  
**Lingxiao Zhao**, Wei Jin, Leman Akoglu, Neil Shah
2. Graph Condensation for Graph Neural Networks  
*Under submission to 2022 ICLR*  
Wei Jin, **Lingxiao Zhao**, Shichang Zhang, Yozhen Liu, Jiliang Tang, Neil Shah
3. Deep Graph-Level Anomaly Detection  
*Under submission*  
Saurabh Sawlani, **Lingxiao Zhao**, Leman Akoglu

### Published Papers

1. On Using Classification Datasets to Evaluate Graph Outlier Detection: Peculiar Observations  
*2021 Big Data Journal*  
**Lingxiao Zhao**, Leman Akoglu
2. Fast Attributed Graph Embedding via Density of States  
*2021 IEEE ICDM*  
Saurabh Sawlani, **Lingxiao Zhao**, Leman Akoglu
3. Graph unrolling networks: Interpretable neural networks for graph signal denoising  
*2021 IEEE Transactions on Signal Processing*  
Siheng Chen, Yonina C. Eldar, **Lingxiao Zhao**
4. Beyond Homophily in Graph Neural Networks: Current Limitations and Effective Designs  
*2020 NeurIPS*  
Jiong Zhu, Yujun Yan, **Lingxiao Zhao**, Mark Heimann, Leman Akoglu, Danai Koutra

5. Connecting Graph Convolutional Networks and Graph-Regularized PCA  
*2020 ICML Workshop*, under submission to 2022 ICLR  
**Lingxiao Zhao**, Leman Akoglu
6. PairNorm: Tackling Oversmoothing in GNNs  
*ICLR* (26.5%), Addis Ababa, Ethiopia, April 2020  
**Lingxiao Zhao**, Leman Akoglu
7. A Quest for Structure: Jointly Learning the Graph Structure and Semi-Supervised Classification  
 27th *ACM CIKM* (17%), Turin, Italy, Oct. 2018.  
 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**

Sept. 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.

## COMPUTING SKILLS

**Languages:** Python, MATLAB, Java, C, C++, L<sup>A</sup>T<sub>E</sub>X, Bash

**Frameworks:** Pytorch, Tensorflow

**Large-Scale Computing:** MapReduce, Hadoop, Spark, Pig

**Web:** HTML, CSS, Bootstrap, Jekyll

## 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

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