

# LINGXIAO ZHAO

<http://lingxiaozhao.com>

lingxiao@cmu.edu

## EDUCATION

**Carnegie Mellon University**

*Ph.D. in Information Systems*

Advisor: Prof. Leman Akoglu

Pittsburgh, PA, USA

Aug. 2018 to Now

**Carnegie Mellon University**

*M.S. in Electrical and Computer Engineering*

GPA: 3.90/4.00

Pittsburgh, PA, USA

Aug. 2016 to Dec. 2017

**Xi'an Jiaotong University**

*B.S. in Electrical Engineering*

GPA: 91.05/100, Rank: 7/370

Xi'an, Shaanxi, China

Aug. 2012 to July 2016

## RESEARCH INTEREST

Graph is a powerful representation that captures interactions between identities. Graph neural networks (GNNs) achieve state-of-art performance in a variety of graph-based tasks, while they are not well-understood. Recently my work focuses on solving some fundamental problems of GNNs, such as breaking depth-limitation, relaxing homophily requirement, and learning better structure. In the meantime, I'm passionate about applying designed algorithms to large-scale real-world graph-structured problems.

## PUBLICATIONS

### Preprint Papers

1. *PairNorm: Tackling Oversmoothing in GNNs*  
Under review at ICLR 2020. Oct. 2019  
<https://arxiv.org/pdf/1909.12223.pdf>  
**Lingxiao Zhao**, Leman Akoglu
2. *Counterfactual Explanations for Anomalies: A Complementary View to Diagnostics*  
Working, 2018.  
Tuan M. V. Le, **Lingxiao Zhao**, Leman Akoglu

### Published Papers

1. *A Quest for Structure: Jointly Learning the Graph Structure and Semi-Supervised Classification*  
27th **ACM CIKM** (17%), Turin, Italy, Oct. 2018.  
<https://arxiv.org/pdf/1909.12385.pdf>  
Xuan Wu\*, **Lingxiao Zhao**\*, Leman Akoglu. (\* equal contribution)

## RESEARCH PROJECTS

### New projects in working

Oct. 2019 to Now

*With Prof. Leman Akoglu*

- Facing heterophily: making GNNs robust to heterophily [*with Prof. Danai Koutra*]
- Oversmoothing continue: more interesting ideas and applications!
- Structure-learning continue: an efficient approach of learning the graph structure for GNNs.

### 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).
- PairNorm is an efficient and effective “patch” for all type of GNNs. We explore more in future.

### **Optimal Counterfactual Explanation for Anomaly Detection**

March 2018 to Sept. 2018

*Supervised By Prof. Leman Akoglu*

- Proposed to explain tree-based anomaly detection model using counterfactual explanation.
- Designed a cluster and correlation sensitive cost function for optimal counterfactual.
- Designed a density-based “possible-world” constraint for optimal counterfactual.
- Built the constrained optimization problem as MINLP and solve it using BARON.
- Proposed a natural gradient & evolution strategy based method to estimate the “gradient” of discontinuous tree-ensemble models. And designed an approximation solver using augmented Lagrangian based on the estimated gradient. Boost the runtime a lot.

### **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.
- Paper is accepted by CIKM 2018, co-first author. Presented in CIKM 2018, Italy.

## **COMPUTING SKILLS**

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

**Frameworks:** Pytorch, Tensorflow

**Large-Scale Computing:**

- Streaming: MapReduce, Hadoop, Spark, Pig
- Parallel: Python/Matlab/Java Parallel

**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
- The 1<sup>st</sup> Prize of Mathematical Modeling in Shaanxi Province Oct. 2014

---

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