Jiong Zhu

Contact Information

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Research Interests

Graph Representation Learning and **Graph Neural Networks (GNNs)**, especially on their *limitations*, *robustness*, *fairness* and *real-world applications* (e.g., recommendation systems, anomaly detection, and knowledge discovery) under complex and large-scale environments. Recently, I have been working on improving GNN performance beyond homophily on *heterophilous graphs* (i.e., connected nodes may have dissimilar labels and features), and exploring the interplay between heterophily and robustness of GNNs.

Education

University of Michigan, Ann Arbor, MI, USA

- **Ph.D. in Computer Science and Engineering** **Aug. 2019 - Dec. 2023 (Expected)**
  Advisor: Danai Koutra
- **M.S. in Electrical and Computer Engineering** **Aug. 2017 - Apr. 2019**
  Cumulative GPA: 4.0 / 4.0

Xi'an Jiaotong University, Xi'an, Shaanxi, China

- **B.Eng. in Automation (Honors Engineering Program)** **Aug. 2013 - Jun. 2017**
  Thesis: *Vehicle Detection and Height Estimation Based on Deep Neural Networks*
  Advisor: Zejian Yuan
- **Special Class for Gifted Young** **Aug. 2011 - Jun. 2013**
  A honors program for nationwide selected middle school graduates.

National Taiwan University, Taipei, Taiwan, R.O.C.

- **Undergraduate Semester Exchange Program** **Feb. 2016 - Jun. 2016**
  Computer Science and Information Engineering Department

Publications

In Peer-reviewed Conference Proceedings

[1] *Graph Neural Networks with Heterophily*
Jiong Zhu, Ryan A Rossi, Anup Rao, Tung Mai, Nedim Lipka, Nesreen K Ahmed, and Danai Koutra
AAAI 2021 - AAAI Conference on Artificial Intelligence. [link]

[2] *Beyond Homophily in Graph Neural Networks: Current Limitations and Effective Designs*
Jiong Zhu, Yujun Yan, Lingxiao Zhao, Mark Heimann, Leman Akoglu, and Danai Koutra
NeurIPS 2020 - Conference on Neural Information Processing Systems. [link]

[3] *GroupINN: Grouping-based Interpretable Neural Network for Classification of Limited, Noisy Brain Data*
Yujun Yan, Jiong Zhu, Marlena Duda, Eric Solarz, Chandra Sripada, and Danai Koutra
KDD 2019 - ACM SIGKDD Conference on Knowledge Discovery and Data Mining. [link]

Preprints under Review

[4] *On the Relationship between Heterophily and Robustness of Graph Neural Networks*
Jiong Zhu, Junchen Jin, Donald Loveland, Michael T Schaub, and Danai Koutra
arXiv:2106.07767. [link]

Industry Experiences

Adobe Inc., San Jose, CA, USA **Jun. 2020 - Aug. 2020**
Data Science Research Intern (Remote), Adobe Research *Mentor: Ryan Rossi*

- Goal: To propose GNN models with improved performance on heterophilous graphs.

- Designed CPGNN, a GNN framework which adapts to the homophily level in the graphs by incorporating an end-to-end trainable compatibility matrix in the message passing process.
- Paper published in AAAI 2021; US and CN patents pending.

Selected Research Projects

On the Relationship between Heterophily and Robustness of Graph Neural Networks
Submission under Review

- Goal: To explore the relation between heterophily and robustness in GNNs and its implications.
- Showed theoretically and empirically that effective structural attacks on homophilous graphs increase heterophily, and extended the analysis of change in homophily to heterophilous graphs.
- Demonstrated that a key design principle which improves GNN performance under heterophily can also inherently offer increased empirical and certifiable robustness, with up to 32.92% gain in performance against state-of-the-art attacks and 3.4x gain in certifiable robustness metrics.

Beyond Homophily in Graph Neural Networks: Current Limitations and Effective Designs
Published at NeurIPS 2020

- Goal: To reveal and address the limitations of GNN models under heterophilous graphs.
- Identified three effective designs backed by theoretical analysis that boost learning from the graph structure under heterophily, and proposed a new model, H_2GCN, based on the designs.
- Extensive empirical analysis shows up to 40% gain in accuracy by the designs in heterophily.

Teaching Experiences

University of Michigan, Ann Arbor, MI, USA

- *Graduate Student Instructor*, EECS 598-008: Advanced Data Mining **Winter 2019**
  Teaching assistant for the graduate-level course with 45 students. Duties include leading discussion sessions, designing and grading assignments, and answering questions.
- *Lecturer*, Big Data Summer Institute **Summer 2021**
  Gave asynchronous lectures on data mining to undergraduates with a discussion session.

Academic Services

Workshop Organizer:

- GLB 2021: Workshop on Graph Learning Benchmarks at WebConf 2021

Program Committee: CIKM 2021, AAAI 2021
Reviewer: TKDE, WebConf 2021 (sub-reviewer)

Invited Presentations

Beyond Homophily in Graph Neural Networks: Current Limitations and Effective Designs

- *Poster*, Google Workshop on Scalable Algorithms for Semi-supervised and Unsupervised Learning, CA, USA (Virtual) **Oct. 2021**
- *Poster*, Graph Exploitation Symposium (GraphEx), MA, USA (Virtual) **May. 2021**

Outreach

AI4ALL, instructor of AI introduction lectures to Michigan high-school students. **2021**

Honors and Awards

KDD 2019 Student Travel Award, awarded by ACM SIGKDD **2019**
National Second Prize in CUMCM (Contemporary Undergraduate Mathematical Contest in Modeling), awarded to the top 5.7% of 22233 teams **2014**
Pengkang Scholarship, awarded to top 2% students by XJTU **2014**

Technical Skills

Programming: Python, C++, MATLAB, .NET (C# and Visual Basic)
Graph Analysis: NetworkX, SNAP and Pegasus
GPGPU Computing: TensorFlow, PyTorch
Distributed Computing: Hadoop