Cheng Xin

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Bio: Cheng Xin received his Ph.D. in Computer Science from Purdue University under the supervision of Dr. Tamal K. Dey, specializing in fundamental research in **topological data analysis** and **machine learning**. He is currently a postdoctoral researcher in the Computer Science Department at Rutgers University, advised by Dr. Jie Gao, with publications in top-tier conferences including **NeurIPS, ICML, CVPR, and SoCG**. His research focuses on creating **trustworthy**, **robust**, and **theoretically grounded** AI systems by developing mathematically rigorous foundations that bridge **topology**, **geometry**, and **machine learning**. His recent work includes topological frameworks for **interpretable AI**, **non-Euclidean representation learning**, and large-scale benchmarks for **3D/video generation**.

RESEARCH INTERESTS

Topological Machine Learning, Non-Euclidean Geometry in ML, Multiparameter Persistence Modules, Interpretable AI, AI for Science

RESEARCH & EDUCATION

Department of Computer Science, Rutgers University — Oct 2023 – Present

- Postdoctoral Researcher, Advisor: Prof. Jie Gao
  - Developing topological frameworks for **interpretable AI**: *TopInG* achieves improved prediction accuracy and interpretability on molecular benchmarks [**ICML 2025**]
  - Pioneering **non-Euclidean representation learning**: Neuc-MDS and Johnson-Lindenstrauss extensions with provable theoretical guarantees [**NeurIPS 2024, 2025**]
  - Contributing to large-scale benchmarks for **3D/video generation**: DL3DV-10K dataset [**CVPR 2024**]
  - Designing algorithms for **multi-agent learning** in social settings [**ICML 2024**]

Department of Computer Science, Purdue University — Aug 2020 – Aug 2023

- Ph.D. in Computer Science, Advisor: Prof. Tamal K. Dey
  - Dissertation: Decomposition and Stability of Multiparameter Persistence Modules

Department of Computer Science and Engineering, The Ohio State University — Jan 2017 – Aug 2020

- Ph.D. in Computer Science, Advisor: Prof. Tamal K. Dey
  - Developed generalized persistence algorithms for multiparameter persistence modules

Department of Computer Science, Lehigh University — Jan 2014 – May 2016

- M.S. in Computer Science, Advisor: Prof. Xiaolei Huang
  - Thesis: Machine Learning Techniques for Cervigram Image Analysis
  - Research Focus: Medical image analysis, machine learning applications

Tongji University, Shanghai, China — Sep 2009 – Jul 2013

- B.Eng. in Software Engineering

INVITED TALKS

- "TopInG: Topologically Interpretable Graph Learning via Persistent Rationale Filtration", Conference on Topological Data Analysis: Recent Developments and Applications, University of Missouri, November 2025.
- "Understanding through Shape of Data: Topological Data Analysis for Interpretable AI", Management Science and Information Systems Department Colloquium, Rutgers University, October 2024
- "Exploring Representations Beyond Euclidean Geometry", John Hopcroft Center Seminar, Shanghai Jiao Tong University, June 2024
- "Generalized persistence algorithm for decomposing multi-parameter persistence modules", Applied Algebraic Topology Network Seminar, July 2020
- "Multiparameter Persistence and Its Applications", Theory Seminar, Department of Computer Science, Rutgers University, November 2023

TEACHING EXPERIENCE

- Lecturer of graduate course, Design and Analysis of Algorithms, 2025 Fall (45 students)
- Teaching Assistant of undergraduate course, Data Structures and Algorithms, 2023 Spring (200 students)
- Teaching Assistant of graduate course, Computational Geometry, 2020 Fall (30 students)

PUBLICATIONS

[1] **Cheng Xin**, Fan Xu, Xin Ding, Jie Gao, and Jiaxin Ding. "TopInG: Topologically Interpretable Graph Learning via Persistent Rationale Filtration". In: *the 42nd International Conference on Machine Learning **(ICML)***. 2025.

[2] Chengyuan Deng, Jie Gao, Kevin Lu, Feng Luo, and **Cheng Xin**†. "Johnson-Lindenstrauss Lemma Beyond Euclidean Geometry". In: *the 39th Advances in Neural Information Processing Systems **(NeurIPS)***. 2025. URL: https://neurips.cc/virtual/2025/loc/san-diego/poster/118378.

[3] Chengyuan Deng, Jie Gao, Kevin Lu, Feng Luo, Hongbin Sun, and **Cheng Xin**†. "Neuc-MDS: Non-Euclidean Multidimensional Scaling Through Bilinear Forms". In: *Advances in Neural Information Processing Systems **(NeurIPS)***. Vol. 37. 2024, pp. 121539–121569.

[4] Shahrzad Haddadan, **Cheng Xin**, and Jie Gao. "Optimally Improving Cooperative Learning in a Social Setting". In: *Proceedings of the 41st International Conference on Machine Learning **(ICML)***. Vol. 235. Proceedings of Machine Learning Research. PMLR, 21–27 Jul 2024, pp. 17148–17188.

[5] Lu Ling, Yichen Sheng, Zhi Tu, Wentian Zhao, **Cheng Xin**, Kun Wan, Lantao Yu, Qianyu Guo, Zixun Yu, Yawen Lu, et al. "Dl3dv-10k: A large-scale scene dataset for deep learning-based 3d vision". In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)***. 2024, pp. 22160–22169.

[6] Simon Zhang, **Cheng Xin**, and Tamal K. Dey. "Expressive Higher-Order Link Prediction through Hypergraph Symmetry Breaking". In: *Transactions on Machine Learning Research* (2024). ISSN: 2835-8856.

[7] **Cheng Xin**. "Decomposition and Stability of Multiparameter Persistence Modules". Thesis. Purdue University Graduate School, 2023. DOI: 10.25394/PGS.23848995.v1.

[8] **Cheng Xin**, Soham Mukherjee, Shreyas N. Samaga, and Tamal K. Dey. "GRIL: A 2-parameter Persistence Based Vectorization for Machine Learning". In: vol. 221. Proceedings of Machine Learning Research. PMLR, 28 Jul 2023, pp. 313–333.

[9] Tamal K. Dey and **Cheng Xin**†. "Generalized persistence algorithm for decomposing multiparameter persistence modules". In: *Journal of Applied and Computational Topology* 6.3 (Sept. 2022), pp. 271–322. ISSN: 2367-1734. DOI: 10.1007/s41468-022-00087-5.

[10] Tamal K. Dey and **Cheng Xin**†. *Rectangular Approximation and Stability of 2-parameter Persistence Modules*. 2021. arXiv: 2108.07429 [cs.CG].

[11] Tamal K. Dey and **Cheng Xin**†. "Computing Bottleneck Distance for 2-D Interval Decomposable Modules". In: *34th International Symposium on Computational Geometry **(SoCG)***. Vol. 99. Leibniz International Proceedings in Informatics (LIPIcs). 2018, 32:1–32:15.

[12] Tao Xu, Han Zhang, **Cheng Xin**, Edward Kim, L Rodney Long, Zhiyun Xue, Sameer Antani, and Xiaolei Huang. "Multi-feature based benchmark for cervical dysplasia classification evaluation". In: *Pattern recognition* 63 (2017), pp. 468–475.

[13] Tao Xu, **Cheng Xin**∗, L. Rodney Long, Sameer Antani, Zhiyun Xue, Edward Kim, and Xiaolei Huang. "A New Image Data Set and Benchmark for Cervical Dysplasia Classification Evaluation". In: *Machine Learning in Medical Imaging*. Cham: Springer International Publishing, 2015, pp. 26–35. ISBN: 978-3-319-24888-2.

† indicates authors are alphabetically ordered; ∗ represents co-first author.

INDUSTRIAL EXPERIENCE

Electronic Arts, Redwood City, CA, USA — May 2018 – Aug 2018

- Machine Learning Scientist Intern, Big Data Group
  - Large-scale Machine Learning Models on Spark
  - Graph Learning on relational database, attributes evaluation and selection, dataset compression

Amazon, Seattle, Washington, USA — May 2015 – Aug 2015

- Software Development Engineer Intern, AWS Infrastructure Group
  - Data management system for network messages supporting receiving, parsing, storing, and retrieving messages

SKILLS

- Python, Pytorch, Spark, Keras, Java, C, C++, MATLAB, R

INTERESTS

- Rock Climbing, Hiking, GO (weiqi)

REFERENCES *Note: Confidential recommendation letters available via **Interfolio Dossier** Delivery.*

- **Dr. Tamal K. Dey**
  Professor, Department of Computer Science, Purdue University
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  ✉ Official: tamaldey@purdue.edu
  ✆ Phone: 614-843-6691

- **Dr. Jie Gao**
  Professor, Department of Computer Science, Rutgers University
  ✉ Letter: send.Gao.E7F50DC017@interfoliodossier.com
  ✉ Official: jg1555@cs.rutgers.edu
  ✆ Phone: 848-445-7295

- **Dr. Feng Luo**
  Professor, Department of Mathematics, Rutgers University
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