Yu (Demi) Qin

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EDUCATION

Tulane University, *New Orleans, LA*
Ph.D. in Computer Science *Sep. 2018 – Aug. 2024*
Dissertation Topic: *Metric Learning on Topological Descriptors*
Advisors: Prof. Brian Summa and Prof. Carola Wenk GPA: 3.8/4.0

Chongqing University, *Chongqing, China*
Bachelor of Science in Computer Science *Aug. 2014 – Jun. 2018*
Graduated top of the class in B.S. Computer Science (1/145) GPA: 3.8/4.0

PROFESSIONAL EXPERIENCE

Hitachi America, Ltd.

Advisors: Dr. Frank Kloster, Dr. ChiHeem Wong *Jul. 2023 – Feb. 2024*
Research Intern at IoT Edge Lab

- Developed the first dynamic production graphs to model complex supply chain network using **Graph Neural Networks (GNN)** in collaboration with Stanford University's Dr. Jure Leskovec's lab. This framework forecasts future transactions between firms, predicts inventory levels, and estimates the Bill of Materials (BoM).
- Achieved 6-50% improvement in inferring production functions over baselines and an 11-62% enhancement in forecasting future transactions on real and synthetic data. Work presented at the Stanford Graph Learning Workshop 2023 [Slide], and submitted to NeurIPS 2024.
- Developed an interpretable sequence prediction model utilizing a custom **Recurrent Neural Network (RNN)** enhanced with an attention mechanism. This method precisely forecasts product consumption and uncovers underlying patterns in inventory data, enhancing BoM estimations with improved accuracy.

National Renewable Energy Laboratory (NREL)

Advisors: Graham Johnson, Dr. Kristi Potter *Jun. 2022 – Present.*
Graduate Intern at Data, Analysis, and Visualization Group

- Developed an innovative and efficient method for detecting extreme climate events using **Topological Data Analysis (TDA)** applied to time-series wind data (i.e. wind speed in various heights) from global climate simulations. Achieved a significant computational speed-up, reducing the detection time from quadratic to linear complexity, resulting in at least a 10-fold increase in efficiency. Work presented and published at EnergyVis 2023 workshop [Slide] [Video].
- Accelerated Analysis of Large-Scale Power Systems: Transformed complex datasets from simulated power systems experiencing various outage scenarios into a computationally efficient topological framework. Developed a topology-enhanced **GNN** model that effectively predicts power outages, with a case study focused on the Texas power grid.

Tulane University

Advisors: Prof. Brian Summa, Prof. Carola Wenk *Sep. 2018 – Present.*
Research Assistant

- Led the development and deployment of **large data analysis and visualization** systems integrating machine learning and TDA, focusing on scalable models for fast interactive queries, clustering and classification across various complex data types.
- Proposed and implemented advanced machine learning models (**GAN, CNN, and GNN**) in TDA, enhancing the extraction and representation of shapes and geometry in large datasets, improving both efficiency and accuracy. These models have been applied for various applications including medical imaging, scalar fields, simulation data, graph structures, and 3D shapes[Slide].

SELECTED RESEARCH PROJECTS

Visualizing Topological Importance: A Class-Driven Approach

Paper, *Slide* *Jan. 2022 – Mar. 2023*

- Innovated novel method to uncover important topological/shape features in classification through deep metric learning with explainable machine learning techniques and TDA. Outperforms classical and existing topological classification approaches especially in graph classification with interpretability. Work presented and published at TopoInVis 2023.

Scalable, Content-Based, Domain-Agnostic Search of Scientific Data through Concise Topological Representations

Website, *Paper* *Aug. 2021 – Sep. 2023*

- Initiated and developed the first approach for generating binary topological representations using **GAN** with domain-oblivious training. This method reduced topological clustering time from hours to milliseconds while maintaining high quality. This binary representation enables rapid interactive queries across various data domains, particularly for unstructured data. It offers high speed and lower memory usage while maintaining high comparison quality. Work presented and published at IEEE VIS 2021.

Quantifying Morphologic Phenotypes in Prostate Cancer-Developing Topological Descriptors for Machine Learning

Website, *Paper* *Sep. 2018 – Feb. 2023*

- Developed classical and **Convolutional Models** (**ResNet**) machine learning approaches in prostate cancer medical image classification. Improved 10% in the accuracy of prostate cancer severity. Utilized innovative topological descriptors applied to whole-slide pathology images, facilitating the quantitative discernment of previously undetected structural characteristics in cancerous cells.
- Led the development and maintenance of an advanced laboratory annotation system [Link] for medical imaging using web UI framework **DEACT** and web-based data management platform **Girder**, developed a custom shape analysis plug-in. Significantly improved the system's capabilities for detailed image annotation, equipping researchers with sophisticated tools for comprehensive morphological analyses.

PUBLICATIONS

[1] **Qin, Yu**, Brittany Terese Fasy, Carola Wenk, and Brian Summa. *"Rapid and Precise Topological Comparison with Merge Tree Neural Networks,"* Under review at IEEE VIS 2024.

[2] Chang, Serina, ChiHeem Wong, **Yu Qin**, Zhiyin Lin, Frank Kloster, Qi Xiu, and Jure Leskovec, *"Learning production functions from dynamic graphs,"* Under review at NeurIPS 2024.

[3] **Qin, Yu**, Brittany Terese Fasy, Carola Wenk, and Brian Summa. *"Visualizing Topological Importance: A Class-Driven Approach."* In Topological Data Analysis and Visualization (TopoInVis), pp. 93-103. IEEE, 2023.

[4] **Qin, Yu**, Graham Johnson, and Brian Summa. *"Topological Guided Detection of Extreme Wind Phenomena: Implications for Wind Energy."* In Workshop on Energy Data Visualization (EnergyVis), pp. 16-20. IEEE, 2023.

[5] **Qin, Yu**, Brittany Terese Fasy, Carola Wenk, and Brian Summa. *"A domain-oblivious approach for learning concise representations of filtered topological spaces for clustering."* IEEE Transactions on Visualization and Computer Graphics (IEEE VIS 2021) 28, no. 1 (2021): 302-312.

[6] **Qin, Yu**, Fasy, Brittany Terese, Brian Summa, and Carola Wenk. *"Comparing distance metrics on vectorized persistence summaries."* In Topological Data Analysis and Beyond Workshop at the 34th Conference on Neural Information Processing Systems (NeurIPS 2020). 2020.

[7] Liu, Yanjun, Junjian Huang, **Yu Qin**, and Xinbo Yang. *"Finite-time synchronization of complex-valued neural networks with finite-time distributed delays."* Neurocomputing 416 (2020): 152-157.

[8] Liu, Yanjun, **Yu Qin**, Junjian Huang, Tingwen Huang, and Xinbo Yang. *"Finite-time synchronization of complex-valued neural networks with multiple time-varying delays and infinite distributed delays."* Neural Processing Letters 50 (2019): 1773-1787.

SKILLS

Programming Languages: Python (Pandas, NumPy, Scikit-learn), C++, Java, Julia, R, JavaScript
Machine Learning: PyTorch, TensorFlow, PyG
Data Visualization: D3.js, React, Matplotlib, R Shiny, ParaView, ggplot, Power BI
Databases: MongoDB, MySQL, Redshift
Parallel Computing: OpenMP, MPI
Development Tools: Anaconda, Git, Docker, AWS

SERVICES and AWARDS

- **Symmetry and Geometry in Neural Representations** (**NeurReps**) at NeurIPS 2023 - Program Committee
- **Grace Hopper Celebration** (**GHC**) 2023 - GHC Scholar
- **IEEE Visualization Conference** (**VIS**) 2021 & 2022 & 2023 - Student Volunteer with the Travel Fund
- **Neural Information Processing Systems** (**NeurIPS**) 2022 -Student Volunteer with Travel Fund
- **Women in Machine Learning** (**WiML**) 2022 & 2023 - Mentor in the PhD Mentoring Program
- **National Scholarship** (**China**) 2017