SHREYAS SAMAGA

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EDUCATION

Purdue University, USA **2021 – Present**

PhD in Computer Science. Advisor Prof. Tamal Dey

Projects:

- Contributed to a foundational paper on Topological Deep Learning and its published library TopoModelX
- Proposed GRIL (Generalized Rank Invariant Landscape), a 2-parameter persistence-based vectorization which got accepted as a spotlight work at the Topology, Algebra, Geometry in ML Workshop at ICML 2023
- Proved GRIL is differentiable to build one of the first bifiltration learning pipelines resulting in D-GRIL, and showed that it can be applied to graph learning in various domains, including drug discovery
- Devised and implemented algorithms for complexes of persistence modules which can be used to compute persistent sheaf cohomology among other things
- Proposed quasi zigzag persistence as a framework to extract topological information from spatiotemporal data and showed applications in sleep stage detection, among other domains
- Currently working on characterizing hallucination in LLMs using topological information

Indian Institute of Science Education and Research Bhopal, India **2015 – 2020**

BS-MS Dual Degree Program majoring in Mathematics.

EXPERIENCE

Amazon, USA **May 2025 – Aug 2025**

- Built a scalable anomaly prediction framework for telemetry data using time-series foundation models, which can be used to predict network-related issues across Amazon Fulfilment Centers
- The framework, a step towards proactive maintenance strategy, achieves an F1 score of 67% in predicting anomalous behavior in telemetry data when validated against historical high severity events

Lawrence Berkeley National Laboratory, USA **Jun 2023 – Aug 2023**

- Worked on topological analysis of Zeolites (microporous crystals) using multiparameter persistent homology to capture their structure
- Used gradient based tree learning for dimensionality reduction of the Persistence Images of Zeolites to reduce the redundancy in the captured topological information

INRIA Saclay, France **May 2023 – Jun 2023**

- Proved that GRIL (Generalised Rank Invariant Landscape) is stratifiably smooth and computed the gradient

Adobe Inc., India **May 2022 – Aug 2022**

- Used the topological information present in the self-attention maps of language models like BERT, when modelled as weighted graphs, to improve the performance on GLUE Benchmark tasks by about 3%
- Explored the idea of topological distillation for self-attention maps in a teacher-student learning framework

Ethereum Foundation, Remote Work **May 2021 – Aug 2021**

- Identified critical network links that an adversarial attack could exploit to disrupt the network's functionality
- Applied TDA techniques to Eth 2.0 network to strengthen the structural and health analysis of the network

IIT Delhi, India **May 2020 – Oct 2020**

- Evaluated the effect of hypertension and diabetes on COVID-19 mortality in India using machine learning models. People with diabetes are 2.11 times more likely to have a fatal outcome

- Predicted the mortality of COVID-19 using machine learning models with an AUC-ROC of 0.92 based on non-invasive blood parameter data and published the results

AWARDS AND SCHOLARSHIPS

- Purdue Graduate Student Travel Grant to present our work at SoCG 2024 in Athens, Greece 2024
- NSF Travel Grant to present at Symposium on Computational Geometry (SoCG) 2023 in Dallas, TX 2023
- Research Grant for Beacon Chain Network Topological Analysis, Ethereum Foundation 2021
- Director's Gold Medal (Awarded to the student with best all-round performance through undergrad) 2020
- Department Gold Medal (Awarded to the student with the highest GPA in the department in the batch) 2020
- CNR Rao Education Foundation Prize (Awarded to the student with the highest GPA in freshman year) 2016
- INSPIRE (Awarded by Govt. Of India to students in the top one percentile in Grade XII) 2015

TECHINICAL SKILLS

Python, C++, C, R
NumPy, Pandas, Scikit-learn, PyTorch, PyTorch Geometric, Huggingface, Slurm, Linux, Git

PUBLICATIONS AND PREPRINTS

- Tamal K. Dey, **Shreyas N. Samaga** (author order acc. last name). Quasi Zigzag Persistence: A Topological Framework for Analyzing Time-Varying Data. *arXiv:2502.16049*
- Mustafa Hajij, Mathilde Papillon, Florian Frantzen, Jens Agerberg, Ibrahem AlJabea, Rubén Ballester, Claudio Battiloro, Guillermo Bernárdez, Tolga Birdal, Aiden Brent, Peter Chin, Sergio Escalera, Simone Fiorellino, Odin Hoff Gardaa, Gusurankar Gopalakrishnan, Devendra Govil, Josef Hoppe, Maneel Reddy Karri, Jude Khouja, Manuel Lecha, Neal Livesay, Jan Meissner, Soham Mukherjee, Alexander Nikitin, Thodore Papamarkou, Jaro Prilepok, Karthikeyan Natesan Ramamurthy, Paul Rosen, Aldo Guzmán-Sáenz, Alessandro Salatiello, **Shreyas N. Samaga**, Simone Scardapane, Michael T. Schaub, Luca Scofano, Indro Spinelli, Lev Telyatnikov, Quang Truong, Robin Walters, Maosheng Yeng, Olga Zaghen, Ghada Zamzmi, Alia Zia, Nina Miolane (order acc. last name after first three authors). TopoX: A Suite of Python Packages for Machine Learning on Topological Domains. *Journal of Machine Learning Reseaarch, 25(374), 1-8*
- Soham Mukherjee*, **Shreyas N. Samaga***, Cheng Xin, Steve Oudot, Tamal K. Dey. D-GRIL: End-to-End Topological Learning with 2-parameter Persistence. *arXiv:2406.07100*
- Tamal K. Dey, Florian Russold, **Shreyas N. Samaga** (author order acc. last name). Efficient Algorithms for Complexes of Persistence Modules with Applications. *40th International Symposium on Computational Geometry (SoCG 2024). Schloss Dagstuhl-Leibniz-Zentrum für Informatik*
- Cheng Xin*, Soham Mukerhjee*, **Shreyas N. Samaga**, Tamal K. Dey. GRIL: A 2-parameter Persistence based Vectorization for Machine Learning. *Proceedings of 2nd Annual Workshop on Topology, Algebra and Geometry in Machine Learning (TAG-ML), in Proceedings of Machine Learning Research 221:313-333.*
- Mustafa Hajij, Ghada Zamzmi, Theodore Papamarkou, Nina Miolane, Aldo Guzmán-Sáenz, Karthikeyan Natesan Ramamurthy, Tolga Birdal, Tamal K. Dey, Soham Mukherjee, **Shreyas N. Samaga**, Neal Livesay, Robin Walters, Paul Rosen, Michael T. Schaub. Topological Deep Learning: Going Beyond Graph Data. *arXiv:2206.00606*
- Samarth Bhatia, Yukti Makhija, Sneha Jayaswal, Shalendra Singh, Prabhat Singh Malik, Sri Krishna Venigalla, Pallavi Gupta, **Shreyas N. Samaga**, Rabi Narayan Hota, Ishaan Gupta. Severity and mortality prediction models to triage Indian COVID-19 patients. *PLOS Digital Health, 1(3):e0000020*
- Sneha Kumar Jayaswal, Shalendra Singh, Prabhat Singh Malik, Sri Krishna Venigalla, Pallavi Gupta, **Shreyas N. Samaga**, Rabi Narayan Hota, Surinder Singh Bhatia, Ishaan Gupta. Detrimental effect of diabetes and hypertension on the severity and mortality of COVID-19 infection: A multi-center case-control study from India. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 15(5):102248*
- **Shreyas N. Samaga**. On the homotopy type of choice spaces. *arXiv:1807.07841*