Kushal Bose

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Electronics and Communication Sciences Unit
Indian Statistical Institute
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Education

Indian Statistical Institute, Kolkata, India (2019 - 2026)
Doctor of Philosophy (Ph.D) in Computer Science.

- Senior Research Fellow: July 2021 - April 2026 (*Expected*)
- Junior Research Fellow: July 2019 - July 2021

Advisor: Prof. Swagatam Das.

Thesis title: Innovations in Graph Neural Network Design: Addressing Oversmoothing, Heterophily, and Information Propagation. (Submitted in July 2025)

Indian Statistical Institute, Kolkata, India (2017 - 2019)
Master of Technology (M. Tech.) in Computer Science.

Heritage Institute of Technology, Kolkata, India (2011 - 2015)
Bachelor of Technology (B. Tech.) in Electronics and Communication Engineering.

Research Interests

Graph Neural Networks, Non-Euclidean Data Analysis, Hyperbolic Spaces, Geometric Deep Learning,

Publications on Graph Machine Learning

Paper: | Code: | arXiv:

[1] **Kushal Bose** and Swagatam Das. "Learning from Heterophilic Graphs: A Spectral Theory Perspective on the Impact of Self-Loops and Parallel Edges". Just Accepted in the *IEEE Transactions on Artificial Intelligence*, 2026. (IEEE TAI)

[2] Indronil Ojha, **Kushal Bose**, and Swagatam Das. "FairSplit: Mitigating Bias in Graph Neural Networks through Sensitivity-based Edge Partitioning". In the *ACM Conference on Information and Knowledge Management*, 2025 (ACM CIKM).

[3] **Kushal Bose**, Saptarshi Banerjee, and Swagatam Das . "Can Graph Neural Networks Tackle Heterophily? Yes, With a Label-Guided Graph Rewiring Approach!". In *IEEE Transactions on Neural Networks and Learning Systems*, 2025 (IEEE TNNLS).

[4] **Kushal Bose** and Swagatam Das. "Can graph neural networks go deeper without over-smoothing? Yes, with a randomized path exploration!". In *IEEE Transactions on Emerging Topics and Computational Intelligence*, 2025 (IEEE TETCI).

[5] Indronil Ojha, **Kushal Bose**, and Swagatam Das. "Affinity-based Homophily: Can we measure homophily of a graph without using node labels?". In *International Conference on Learning Representations*, Tiny Papers (Invited to present), 2024 (ICLR).

[6] **Kushal Bose** and Swagatam Das. "HyPE-GT: where Graph Transformers meet Hyperbolic Positional Encodings", (Under Revision).

[7] **Kushal Bose** and Swagatam Das. "Asynchronous Message Passing for Addressing Oversquashing in Graph Neural Networks", (Under Review)

[8] **Kushal Bose**. "Rewiring with Parallel Edges: An Analysis through the Lens of Graph Spectrum". (Under Review)

[9] **Kushal Bose**. "On Connection between `CLS` Token and Virtual Node: Are they both sides of the same coin ?". (Under Review)

[10] Indronil Ojha, **Kushal Bose**, and Swagatam Das. "AffNet: Designing Multi-headed Affinity and Adaptive Thresholding for Efficient Link Prediction". (Under Revision)

[11] Aniruddha Mandal, **Kushal Bose**, and Swagatam Das. "Revisiting Oversquashing in Graph Neural Networks: A Memory-augmented Message Passing Approach". (Under Review)

Other Collaborations

Paper: | Code: | arXiv:

[1] Sujoy Nath, Arkaprabha Basu, **Kushal Bose**, and Swagatam Das. "From Complexity to Clarity: Transforming Chest X-ray Reports with Chained Prompting (Student Abstract)". In *Association for the Advancement of Artificial Intelligence*, 2025 (AAAI).

[2] Supratik Sarkar, **Kushal Bose**, and Swagatam Das. "Proof-Carrying Generation: Externally Verifiable Multi-Agent Systems". (Under Review).

[3] Sagar Ghosh, **Kushal Bose**, and Swagatam Das. "Transformers Are Universally Consistent: A Sequence-to-Sequence Regression Estimation Perspective". (Under Review)

[4] Sagar Ghosh, **Kushal Bose**, and Swagatam Das. "On the universal statistical consistency of expansive hyperbolic deep convolutional neural networks". (Under Revision)

[5] Arghya Pratihar, **Kushal Bose**, and Swagatam Das. "Topology-Driven Clustering: Enhancing Performance with Betti Number Filtration". (Under Review)

[6] Arkaprabha Basu, **Kushal Bose**, Sankha Subhra Mullick, Anish Chakrabarty, Swagatam Das. "Fortifying fully convolutional generative adversarial networks for image super-resolution using divergence measures". (Under Revision)

[7] Shubhayan Pan, Saptarshi Chakraborty, Debolina Paul, **Kushal Bose**, Swagatam Das. "Kernelizing Convex Clustering: A Study on Convergence, Finite Sample Bounds, and Performance Insights". (Under Review)

Awards

- Junior Research Fellowship (2019 - 2021), and Senior Research Fellowship (2021 - present) awarded by the Indian Statistical Institute.
- ISI Kolkata graduate student travel grant, 2025. (*to attend CIKM 2025 in Seoul, South Korea*)

Professional Services

- Organizing committee member of the Winter School on Deep Learning (2022 - 2025) hosted by the Electronics and Communication Sciences Unit, Indian Statistical Institute, Kolkata. (https://sites.google.com/view/wsdl2025)
- Acts as a regular reviewer in journals: IEEE Transactions on Neural Networks and Learning Systems (2022 onwards), IEEE Transactions on Cybernetics (2022 onwards), and A* conferences: NeurIPS (Position track) and LoG (2025 onwards), etc.

Technical Skills

Python, C/C++, Pytorch, Pytorch-geometric, DGL, NetworkX.

Talks & Presentations

- Course Lectures for WSDL: Variational Autoencoder (2022), Introduction to Graph Neural Networks (2023, 2024), Knowledge Distillation (2024 - 2025).

References

Swagatam Das
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Indian Statistical Institute, Kolkata
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