

Indradyumna Roy

CONTACT INFORMATION

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PREVIOUS & CURRENT RESEARCH

Research Statement (May 2024)

TL;DR: Designing scalable neural graph retrieval systems applicable across multiple modalities (molecules, images, text). Graphs are encoded into sets of embeddings, with similarity measured via transportation distance between query-corpus sets. Previous work improved relevance modeling with neural surrogates aligned to combinatorial graph interactions [AAAI22, NeruIPS22, NeurIPS24a, NeurIPS24b] and optimized scalability using data-driven LSH for asymmetric scoring [NeurIPS23]. Current efforts on extending LSH compatibility to transportation-based relevance measures under different (symmetric or asymmetric) cost functions.

EDUCATION

Indian Institute of Technology, Bombay, India.

PhD in Computer Science and Engineering. Jul'21– Present.

Topic: Scalable and Multi-modal Neural Graph Retrieval.

Advisors: Abir De, Soumen Chakrabarti.

CGPA: 10/10.

Indian Institute of Technology, Bombay, India.

Master of Technology in Computer Science and Engineering. Jul'15– Jun'17.

CGPA: 9.12/10.

Jadavpur University, Kolkata, India.

Bachelor of Engineering in Computer Science and Engineering. Jul'09– Jun'13.

CGPA: 8.19/10.

AWARDS

- [1] **Google Ph.D Fellowship (2024)**
Awarded USD 10,000 for the year 2024.
- [2] **Google Student Travel Grant**
Awarded USD 3,000 for attending NeurIPS 2023
- [3] **Qualcomm Innovation Fellowship**
Winner, QIF India 2022.
Super-Winner, QIF India 2023
- [4] **Prime Minister's Research Fellowship**
PMRF Scholar. Jan'22– Nov'23

PUBLICATIONS

Google Scholar Profile DBLP Profile

- [1] Eeshaan Jain*, **Indradyumna Roy***, Saswat Meher, Soumen Chakrabarti, Abir De. *Graph Edit Distance with General Costs Using Neural Set Divergence*. In Neural Information Processing Systems (NeurIPS), 2024.

TL;DR: We propose **GraphEdx**, the first-of-its-kind neural GED framework that incorporates variable edit costs, capable of modeling both symmetric and asymmetric graph (dis)similarities, allowing for more flexible and accurate GED estimation compared to earlier methods.

- [2] Ashwin Ramachandran, Vaibhav Raj, **Indradyumna Roy**, Soumen Chakrabarti, Abir De. *Iteratively Refined Early Interaction Alignment for Subgraph Matching based Graph Retrieval*. In Neural Information Processing Systems (NeurIPS), 2024.

TL;DR: We propose **EinsMatch**, an early interaction graph neural network, where the approximate injective alignments between any given graph pair gets progressively refined with successive rounds, resulting in significantly better retrieval performance than existing methods.

- [3] **Indradyumna Roy**, Rishi Agarwal, Soumen Chakrabarti, Anirban Dasgupta, Abir De. *Locality Sensitive Hashing in Fourier Frequency Domain For Soft Set Containment Search*. In Neural Information Processing Systems (NeurIPS), 2023. (**Spotlight**)

TL;DR: We propose **FourierHashNet**, an asymmetric LSH for hinge distance, which first transforms the hinge distance into a bounded dominance similarity measure, which is then Fourier-transformed into an expectation of inner products of functions in the frequency domain. Finally, the expectations are approximated with an importance-sampled estimate, which allows for the use of traditional Random-Hyperplanes LSH.

- [4] **Indradyumna Roy**, Soumen Chakrabarti and Abir De. *Maximum Common Subgraph Guided Graph Retrieval: Late and Early Interaction Networks*. In Neural Information Processing Systems (NeurIPS), 2022.

TL;DR: We propose neural architectures for two distinct variants of the MCS metric. The customized late interaction models for each variant, outperform SOTA in terms of retrieval accuracy and speed. Furthermore, an unified early interaction network is proposed, which works well for both variants and affords an additional boost in accuracy at the cost of some retrieval speed.

- [5] **Indradyumna Roy**, Venkata Sai Velugoti, Soumen Chakrabarti and Abir De. *Interpretable Neural Subgraph Matching for Graph Retrieval*. In AAAI Conference on Artificial Intelligence (AAAI), 2022.

TL;DR: We propose **IsoNet**, a novel interpretable neural edge alignment formulation, which enables identification of the underlying subgraph in a corpus graph, which is relevant (isomorphic) to the given query graph. Training for ISONET is done using only binary relevance labels on graph pairs, without any fine-grained ground truth information about node or edge alignments.

- [6] **Indradyumna Roy**, Abir De, Soumen Chakrabarti. *Adversarial Permutation Guided Node Representations for Link Prediction*. In AAAI Conference on Artificial Intelligence (AAAI), 2021.

TL;DR: **PermGNN** casts the link prediction objective as an adversarial game, which allows for usage of order-sensitive RNNs as neighborhood feature aggregators. We ensure permutation insensitivity by optimizing a min-max ranking loss function with respect to the smooth surrogates of adversarial permutations.

- [7] Soham De, **Indradyumna Roy**, Tarunima Prabhakar, Kriti Suneja, Sourish Chaudhuri, Rita Singh, Bhiksha Raj,. *Plagiarism Detection in Polyphonic Music using Monaural Signal Separation*. In InterSpeech (ICSA), 2012.

TL;DR: We present a novel feature space for audio derived from compositional modelling techniques, commonly used in signal separation, that provides a mechanism to account for polyphony without incurring an inordinate amount of computational overhead.

REVIEWING	AISTATS (Reviewer, 2025). ICLR (Reviewer, 2025). LoG (Reviewer, 2025). NeurIPS (Reviewer, 2024). AAAI (Reviewer, 2022-24). TACL (Sub-Reviewer, 2022).
CURRENT & PREVIOUS APPOINTMENTS	Google DeepMind. Host: Vinod Nair Student Researcher. Jun'23– Nov'23 Indian Institute of Technology, Bombay, India. Project Research Assistant. Jan'20– Jun'21 Samsung R&D Institute India-Bangalore, Karnataka India. Software Engineer. Jul'17– Aug'19 Synopsys India Pvt. Ltd., Bangalore, Karnataka India. R&D Engineer. Aug'13– Jul'15
OTHER ACTIVITIES	[1] Invited talk on Neural Graph Retrieval at IBM Research Zurich [PPT] [2] Guest Lecture on Graph Neural Networks for CS728, IIT Bombay [PPT] [3] Attended Machine Learning Summer School (MLSS24) at OIST, Okinawa. [4] Attended ML for Drug Discovery Summer School (ML4DD) at Montreal. [5] Winner of the Kinase Selectivity Challenge Hackathon organized by Valence Labs [LINK]
TECHNICAL SKILLS	Programming Languages: C++, Python, JAX Tools and Libraries : L ^A T _E X, TensorFlow, PyTorch, PyTorch Geometric
TEACHING	Teaching Assistant for following courses : [1] CS101: Computer Programming and Utilization (July'15– Dec'15) [2] CS302+CS306: Implementation of Programming Languages (Jan'16– May'16) [3] CS601: Algorithms & Complexity (July'16– Dec'16) [4] CS152-CS156: Abstractions & Paradigms for Programming (Jan'17– May'17) [5] CS768: Learning with Graphs (July'21– Dec'21, July'23– Dec'23) [6] CS419M: Introduction to Machine Learning (Jan'22– May'22, Jan'23– May'23) [7] CS335+CS337: Artificial Intelligence and Machine Learning (Jul'22– Dec'22)
REFERENCES	[1] Abir De Assistant Professor, Department of Computer Science and Engineering Indian Institute of Technology Bombay [2] Soumen Chakrabarti Professor, Department of Computer Science and Engineering Indian Institute of Technology Bombay [3] Anirban Dasgupta Professor, Department of Computer Science and Engineering Indian Institute of Technology Gandhinagar [4] Vinod Nair Research Scientist, Google DeepMind