Sahil Manchanda

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Research Interests

Machine learning for Graphs, Learning Combinatorial optimization, Graph generative modeling, Mixed Integer Programs, Synthetic Datasets, Heterogenous Learning, Few-Shot learning, Large Language Models(LLMs), AI for material science and hardware, Generative AI

Technical Skills

Languages Python, C++

Skills Machine Learning, Graph Neural Networks, Deep Learning, Mixed Integer Programming, Transfer Learning, NLP, Reinforcement Learning, Graph Transformers, Data Distillation, Generative Modeling, GPT, Transformers, Imitation Learning, Learning faster approximations, ML based heuristic discovery.

Tools PyTorch, Torch-geometric, Hugging Face, Git, CPLEX, SCIP, NumPy, SciPy, Scikit-learn, Pandas, SQL, Databases

Education

2019 – Cont	**Ph.D**, *Computer Science and Engineering*, **Indian Institute of Technology Delhi**, 10.0/10.0
2015 – 2017	**Master**, *Computer Science and Engineering*, **Indian Institute of Technology Guwahati**, 9.14/10.0
2010 – 2014	**Bachelor**, *Information Technology*, **Indraprastha University, Delhi**, 78.4%
2010	**Senior Secondary Education**, *CBSE New Delhi*, 97%
2008	**Secondary Education**, *CBSE New Delhi*, 91.8%

Work Experience

June 2023 - Oct 2023	**Qualcomm AI Research**, Amsterdam Research intern: Machine Learning for Combinatorial Optimization. Worked on Deep Learning for Chip Design.
Dec 2022	**University of Tokyo**, Japan Visiting Researcher, Graph Neural Networks, Advisor: Prof. Toyotaro Suzumura
Sep 2020 – Mar 2021	**NAVER Labs**, France Research intern, Machine Learning and Optimization for Vehicle Routing. Worked on Meta-Learning for Neural Combinatorial Optimization.
Aug 2017 – Jan 2019	**Conduent Labs India/Xerox Research Centre India**, Bangalore, India Research Engineer, Machine Learning and Statistics. Worked on developing Machine learning solutions for fleet management. Granted US Patent.
June 2014 – July 2015	**Adobe Systems**, India Adobe Acrobat Team

Achievements

2024	Outstanding reviewer award for ACM CODS COMAD. Awarded to top 3 out of 49 Program Committee members.
2023	ACM IARCS(USD 1000) and Google Travel Grant(USD 2900) for ICML 2023.
2023	Outstanding Teaching Assistanship Award: Database Systems and Graph Neural Networks at IIT Delhi.
2023	Among top 200 young researchers selected across the world to attend the Heidelberg Laureate Forum 2023 in Germany.
2023	Google Travel Grant(USD 3000) for AAAI 2023.
2023	Outstanding Teaching Assistanship Award: Computer Networks course(UG + PG) at IIT Delhi.
2022	Qualcomm Innovation Fellowship Recipient (USD 10000).
2015	Graduate Aptitude Test in Engineering : All India rank 273 among 115425 candidates.

2010	CBSE Merit certificate : Received Merit Certificates for Computer Science and Mathematics for being in top 0.1 % of the successful candidates all over India.

Patents

Filed in 2022	**Method and system for meta-learning of neural combinatorial optimization heuristics** JM Andreoli, S Michel, S Manchanda (<u>Link</u>)
Granted in 2022	**US Patent: Trained pattern analyzer for roll out decision** S Manchanda, A Rajkumar, S Kaur, N Unny. (<u>Link</u>)

Publications

LoG 2023	**Generative Modeling for labeled Graphs under Data Scarcity** [**pdf**] S Manchanda*, S Gupta*, S Ranu, S Bedathur
ICML 2023	**GRAFENNE: Continual learning on Graphs with Heterogeneous and Dynamic Feature Sets** [**pdf**] S Manchanda*, S Gupta*, S Ranu and S Bedathur
ICML 2023	**Stridernet: A Graph Reinforcement Learning Approach to Optimize Atomic Structures on Rough Energy Landscapes** [**pdf**] V Bihani, S Manchanda, S Sastry, S Ranu and NMA Krishnan
AAAI 2023	**Lifelong Learning to Solve Mixed Integer Programs** [**pdf**] S Manchanda, S Ranu
ECML -PKDD 2022	**On the Generalization of Neural Combinatorial Optimization Heuristics** [**pdf**] S Manchanda, S Michel, D Drakulic, J Andreoli
AAAI 2022	**TIGGER: Scalable Generative Modelling for Temporal Interaction Graphs** [**pdf**] S Gupta, S Manchanda, S Ranu, S Bedathur
NeurIPS 2021	**NeuroMLR: Robust and Reliable Route Recommendation on Road Networks** [**pdf**] J Jain, V Bagadia, S Manchanda and S Ranu
NeurIPS 2020	**GCOMB: Learning heuristics over large graphs via deep reinforcement learning** [**pdf**] S Manchanda, A Mittal, A Dhawan, S Medya, S Ranu and A Singh
CYBCONF 2017	**Representation learning of drug and disease terms for drug repositioning** [**pdf**] S Manchanda, A Anand

PrePrints

Arxiv 2023	**MIRAGE: Model Agnostic Graph Distillation** [**pdf**] S Manchanda*, M Gupta*, H Kodamana, S Ranu
Arxiv 2023	**NeuroCUT: A Neural Approach for Robust Graph Partitioning** [**pdf**] R Shah, K Jain, S Manchanda, S Medya, S Ranu

Research Projects Details

2023-2024	**MIRAGE: Model Agnostic Graph Distillation.** [**pdf**] Advisor: *Prof.Sayan Ranu*, IIT Delhi. ○ Developed GNN agnostic method for graph dataset distillation. ○ Method generates a condensed dataset by mining computational trees of nodes in the graph dataset. ○ Achieved condensation ratio of less than 1% with minimal drop in performance.
2022-2023	**NeuroCUT: A Neural Approach for Robust Graph Partitioning** Advisor: *Prof.Sayan Ranu*, IIT Delhi. ○ Developed learning based method to solve k-way graph partitioning problem with versatile objectives ○ Model generalizes to unseen number of partitions.

2022-2023 **StriderNET: A Graph Reinforcement Learning Approach to Optimize Atomic Structures on Rough Energy Landscapes**
Advisor: *Prof.Sayan Ranu and Prof.Anoop Krishnan*, IIT Delhi.
○ Learned reinforcement learning based Graph policy network to displace atoms to low energy configuration.
○ Model generalizes to unseen atomistic system sizes.
○ Achieved significantly better results compared to existing baselines.

2022-2023 **Continual learning on Graphs with Heterogeneous and Dynamic Feature Sets**
Advisor: *Prof.Sayan Ranu and Prof.Srikanta Bedathur*, IIT Delhi.
○ Investigated *forgetting* in continual setup in Graph Neural Networks where node features/node feature sets in graph change over time.
○ Developed a GNN framework that can learn continuously with feature updates with low amount of forgetting.
○ Proposed method also scales efficiently to extremely high feature missing rates.

2021-2022 **LifeLong learning to solve Mixed Integer Programs**
Advisor: *Prof.Sayan Ranu*, IIT Delhi.
○ Analysed catastrophic forgetting in SoA methods in the continual setup.
○ Developed method to learn to solve MIPs in continual fashion. Tackled forgetting using Elastic Weight Consolidation and Knowledge distillation.
○ Achieved significantly better results compared to existing baselines.

2021-2022 **Few-Shot generative modeling of labeled graphs**
Advisor: *Prof.Sayan Ranu and Prof.Srikanta Bedathur*, IIT Delhi.
○ Analyzed limitations of existing deep graph generative methods on *extremely low volume* of training datasets such as AIDS active molecules, rare cancer active molecule datasets etc.
○ Developed a Few-shot learning method to tackle this problem which learns to transfer knowledge from auxiliary datasets from similar domains.
○ Improved over SoA baselines by over 50% on various graph metrics on different domains such as Chemical, Molecular and Physical simulation systems.

2020-2021 **Generalization of Neural Combinatorial Optimization Heuristics**
Advisor: *Dr. Jean-Marc Andreoli and Dr. Sofia Michel*, NAVER Labs, Europe.
○ Analyzed limitations of existing deep NCO methods on the generalization aspect.
○ Developed a decaying step-size-based meta-learning framework to tackle generalization issue.
○ The proposed framework adapts to out-of-distribution instances quickly with an extremely small number of fine-tuning instances.

2020-2021 **Robust and reliable route recommendation in road networks**
Advisor: *Prof.Sayan Ranu*, IIT Delhi.
○ Developed an inductive model using Lipschitz embeddings on GCN to learn road embeddings.
○ Explored the importance of local-learning over end-to-end learning for enhancing the adversarial robustness of the model.
○ Model improved over existing work by 25% in terms of accuracy 25% in and 20% in terms of reachability. More effective in terms of answering queries over unseen data.

2020-2021 **Learning Budget-constrained Combinatorial Algorithms over Large Graphs**
Advisor: *Prof.Sayan Ranu*, IIT Delhi.
○ Predict individual quality of nodes using Graph convolution network(GCN) and identify potential nodes.
○ Deep Q network to predict nodes that collectively form a good solution by using GCN scores and locality of nodes as features. Importance Sampling for fast locality computation.
○ Achieved quality similar to the state of the art while being more than 2 orders of magnitude faster.

2019 **Labeled Graph generative modeling**
Advisor: *Prof. Sayan Ranu*, IIT Delhi.
○ Extended GraphRNN(NeurIPS 2018) for graph generative modeling for handling node and edge labels.
○ Developed domain-agnostic method which works on different domains such as social networks, biological, chemical etc.

2017-2018 **Vehicle Health Monitoring**
Advisor: *Dr. Arun Rajkumar*, Conduent Labs.
- Developed item-set mining based model for recommending rollout of vehicles for a US based fleet agency.
- The method mines defect patterns which led to failures in the past when fleet supervisors made rollout decision.
- Showed performance improvement of over 15%.

2017-2018 **Mobility Analytics Platform - Descriptive platform for transportation network**
Advisor: *Dr. Narayanan Unny*, Conduent Labs.
- Developed algorithms for estimating passenger alighting in bus/metro network using check-in data in a flat fare environment.
- Designed solution to support heterogeneous data -fare collection(paper ticket /smart card) and vehicle location data.
- Developed various functionalities using fare collection data and GTFS(vehicle schedule) such as estimating direction of vehicles, identification of missing vehicle stop times, alignment of real trips to scheduled trips.

2016-2017 **Representation learning of drug and disease terms for drug repositioning**
Advisor: *Prof. Ashish Anand*, IIT Guwahati.
- Learned word vector representation of drug and disease terms from unstructured bio-medical text(PubMed)
- Enhanced vector representations using similarity information from structured data such as side-effect based drug similarity and gene based disease similarity etc.
- Used matrix completion approach to predict drug-disease associations.

Talks Delivered

2023 Heidelberg Laureate Forum, Germany. Topic: Learning to Solve Graph optimization problems

2022 NAVER Labs, France. Topic: Learning to Solve Mixed Integer Programs

2022 ARCS, Coimbatore, India. Topic: Robust and Reliable Route Recommendation

Mentorship Experience

2022-2023 Mentored Bachelor thesis of Rishi Shah and Krishnanshu Jain, IIT Delhi

Miscellaneous

2020-2021 Student member, PhD interviews organizing team, CSE, IIT Delhi

2019-Cont Teaching assistant at IIT Delhi - Computer networks, Data Structures and Algorithms, Database systems

PC Chair KDD Applied Data Science Track.

Reviewer NeurIPS,AAAI, LoG, ECML-PKDD, AutoML, AISTATS, TKDD, KDD, TKDE, and WSDM

Subreviewer SIGMOD, VLDB, EDBT, AAAI, WSDM, ICLR, CODS-COMAD,ICDM, KDD, ICDE, TKDE

2016-2017 Student representative (M.Tech) - Department Post Graduate Programme Committee, Dept. of CSE, IIT, Guwahati.

References

- Prof. Sayan Ranu, Associate Professor, IIT Delhi sayanranu@iitd.ac.in
- Prof. Srikanta Bedathur, Professor, IIT Delhi srikanta@iitd.ac.in
- Dr. Jean-Marc Andreoli, Principal Scientist, NAVER Labs, Europe jean-marc.andreoli@naverlabs.com
- Dr. Narayanan Unny, Director, Big Data Labs, American Express, narayanan.unny@gmail.com
- Prof. Ashish Anand, Professor, IIT Guwahati anand.ashish@iitg.ernet.in
- Dr. Sofia Michel, Scientist, NAVER Labs, Europe, sofia.michel@naverlabs.com
- Dr. Sourav Medya, Asst. Professor University of Illinois at Chicago (UIC) medya@uic.edu