Rahul Kapur

gdrkr@cse.iitb.ac.in — Mumbai, India — HomePage — LinkedIn — Github

Education

Indian Institute of Technology Bombay 2024–2028 (Expected)
Ph.D., Computer Science & Engineering GPA: 9.33/10.0
Coursework: Formal Methods: Foundations(771), in ML(781); Automated Reasoning (433); Model Checking (738)
Problem of Focus: Automated Program Synthesis

University of California, Los Angeles 2021–2023
M.S., Computer Science GPA: 3.82/4.0
Coursework: Graph NNs, ML Algo, Computer Vision, NLP, Adv. Data Mining, Quantum Computing, Automated Reasoning, Pattern Recognition, Cognitive AI, Neuro-physics & AI
Capstone: Multi-agent RL Game for human behavior simulation [Demo] [Paper]

Indian Institute of Technology (BHU), Varanasi 2013–2017
B.Tech., Electronics Engineering GPA: 9.08/10.0
Capstone: Enhancing resiliency of Communication Systems against Jamming Attacks using OFDM and MIMO

Ph.D. Research Agenda

Guided by Prof. Supratik and Prof. S. Akshay

I am working on automated program synthesis problem. In context of propositional logic, I am working on developing theory and tools: don't care based optimization, unique definability, variable order-free techniques and knowledge-compilation based approaches (AIG). Lift this to first-order theories. Examples are Presburger arithmetic and first-order strings, NRA. Our goal is to come up with techniques that push the scalability frontier significantly.

Projects during Ph.D.

Formal Methods in Machine Learning **2024**

Shield synthesis for reinforcement learning agents, where the shield may occasionally be unable to observe the environment's actions (but it can always observe the agent's actions). [Code]

Model Checking **2025**

Model Checking using UPPAAL tool: Train crossing, Two doors, Fischer protocol

Projects during and after Master's

Multi-agent RL for Behavior Simulation **2022–2023**
(RL, Game, AI4Social Good) *Individual Project*
Simulated agent-product exchange, extended A2C for multi-agent convergence and strategy emergence with an aim to study isolation during COVID pandemic. [Demo] [Paper]

Universal Approximation in Neural Networks **2021**
(ML Theory) *Group Project*

Theoretical study of UA theorem for various NN architectures. [Paper]

Zero-Seed Alignment for Multilingual KG Completion **2022**
(Graph Neural Networks) *Group Project*
Novel techniques for zero-shot knowledge graph alignment; improved over TransE on DBPL-5 dataset. [Presentation] [Code] [Paper]

GANs with BERT Variants for Limited Supervision **2022**
(Natural Language Processing) *Group Project*
Combined GANs and BERT variants for text classification with limited annotation; ALBERT outperformed BERT at 50% annotation. [Code] [Paper]

TextGCN Optimization **2022**
(Data Mining, GCN) *Group Project*
3 methods to improve TextGCN efficiency and effectiveness for text classification. [Code] [Paper]

Visual Domain Adaptation for Lesion Segmentation **2021**
(Finetuning, Computer Vision) *Group Project*
Applied 7 adaptation techniques to CNN backbone in DALS for improved segmentation accuracy. [Code][Paper]

Research Talks

- AIG-Based Don't Care Based Optimization of Skolem Functions, FSTTCS 2025
- Can we interpret synthesized factorization circuits? Open Problem Session on Automated Functional Synthesis, ACM IndiCS 2025
- Automated Synthesis: Towards Correct-by-construction systems, RISC 2025
- XOR constraints in CryptoMiniSat (Course Presentation): Automated Reasoning 2025

Awards and Honors

- Excellence in teaching award, CS 228M Logic in CS, Winter 2025
- Best Research Presentation at RISC 2025
- Vashee Awards Student Grant (Ph.D. Admission Time) – INR 1,80,000/-
- Invitation to attend Dagstuhl Seminar, Germany on Knowledge Compilation
- Top 10 in B.Tech Electronics Engineering at IIT BHU

Research Publications

- **R. Kapur**, 2021: "Method and System for controlling machine learning based operations in a computing device." Indian Patent App No.:- 201911045766, Publication Date: 14-05-2021
- R.K. Mundotiya, M.K. Singh, **R. Kapur**, S. Mishra, A.K. Singh: "Linguistic Resources for Bhojpuri, Magahi, and Maithili…" ACM TALIP, 20(6), 2021.

Industry Experience

Software Engineer, Samsung R&D Institute, Noida 3 Years (2017-20)

- Maintained 4 modules within Samsung Email app (Android); resolved 250+ front-end issues
- Delivered patent on ML-based operations in computing devices
- Led 3-intern NLP project for Samsung Email
- Ported System UI QuickSettings Module in Samsung DeX framework (Android Q $\rightarrow$ R), managed 0.1M+ LoC migration

Skills

Formal Methods: SAT, Z3, CDCL, MONA, ABC (Berkeley), Digital Circuits
Programming: C++ (Make, CMake), Python, Java, Verilog
Machine Learning: PyTorch, TensorFlow, Multi-agent RL systems, OpenAI Gym
Tools: Git, LaTeX, Linux(Ubuntu), Android, AWS EC2

Research Presence

- Conducted OPAC Session on Functional Synthesis @ IndiCS Seminar on Automated Synthesis @ Infosys Mysore, 2025
- Attended: Indian SAT+SMT Winter School (2024-25) Neurosymbolic Summer School, Massachusetts 2024, Cooperative AI Summer School, San Jose 2024
- Participant to Conferences: SAT 2024, FSTTCS 2024, ATVA 2025
- Visiting Student at Simons Institute of Berkeley, Stanford University CSE

Teaching Experience

Served as Teaching Assistant to the following courses:

- CS 781: Formal Methods in Machine Learning, IIT Bombay: Autumn 2025
- CS 228M: Logic in Computer Science, IIT Bombay: Winter 2025, Winter 2026
- CS 105: Discrete Structures, IIT Bombay: Autumn 2024
- CS 32: Intro to Computer Science (C++), UCLA: Winter 2023, Summer 2023
- Machine Learning Foundations @ Break Through Tech AI, UCLA: Summer 2023
- Statistics 10C: Intro to Statistical Reasoning, UCLA: Spring 2022