Rishi Agarwal

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Education

Indian Institute of Technology Bombay	Mumbai, India
B.Tech in Computer Science and Engineering with Honors	Jul 2018 – Present
Minor in Artificial Intelligence and Data Science	
B.Tech (Major) CPI: 9.87/10	

Professional Experience

Big Data Experience Lab, Adobe Research	Bangalore, India
Research Intern, Advisors: Vishwa Vinay , Kuldeep Kulkarni & Aniruddha Mahapatra	May – Aug. 2021
GEMS: Scene Expansion using Generative Models of Graphs	
TU Braunschweig	Germany
Research Intern, Advisors: Prof. Roland Meyer & Prof. Krishna S.	Apr. – June 2020
Parameterized Verification of Concurrent Programs	

Publications

Total citations: 67, h-index: 3, i10-index: 2 (Google Scholar)

1. Title: **GEMS: Scene Expansion using Generative Models of Graphs**
   Authors: **Rishi Agarwal**, Tirupati Saketh Chandra, Vaidehi Patil, Aniruddha Mahapatra, Vishwa Vinay, Kuldeep Kulkarni (Working paper)

2. Title: **A Compressed Sensing Approach to Group-testing for COVID-19 Detection**   [paper]
   Authors: Sabyasachi Ghosh, **Rishi Agarwal**, Mohammad Ali Rehan, Shreya Pathak, Pratyush Agarwal, Yash Gupta, Sarthak Consul, Nimay Gupta, Ritika Goyal, Ajit Rajwade, Manoj Gopalkrishnan
   IEEE Open Journal on Signal Processing (**IEEE OJSP**)

3. Title: **Tapestry: A Single-Round Smart Pooling Technique for COVID-19 Testing**   [paper]
   Authors: Sabyasachi Ghosh, Ajit Rajwade, Srikar Krishna, Nikhil Gopalkrishnan, Thomas E. Schaus, Anirudh Chakravarthy, Sriram Varahan, Vidhya Appu, Raunak Ramakrishnan, Shashank Ch, Mohit Jindal, Vadhir Bhupathi, Aditya Gupta, Abhinav Jain, **Rishi Agarwal**, Shreya Pathak, Mohammed Ali Rehan, Sarthak Consul, Yash Gupta, Nimay Gupta, Pratyush Agarwal, Ritika Goyal, Vinay Sagar, Uma Ramakrishnan, Sandeep Krishna, Peng Yin, Dasaradhi Palakodeti, Manoj Gopalkrishnan

Research Experience

ColabRank: Collaborating with Humans to Rank better

Bachelor's Thesis, Advisor: Prof. Abir De   June 2021 – Present

- ○ Formulated a novel problem of ranking with human assistance in order to combine strengths of humans and machines
- ○ Used an efficient stochastic greedy algorithm to solve the optimization problem and proved approximation guarantees

Strategic Ranking in Two-Sided Markets

R&D Project, Advisors: Prof. Abir De & Vishwa Vinay   Aug. 2021 – Present

- ○ An ongoing work to design a two-sided market which incentivizes agents on one side of the market to improve

Machine Teaching in Recommender Systems

Research Project, Advisor: Prof. Abir De   Sept. 2021 – Present

- ○ An ongoing work to apply the principle of machine teaching with the goal of personalizing recommendations

GEMS: Graph Expansion Model for Scenes

Research Intern, Advisors: Vishwa Vinay , Kuldeep Kulkarni & Aniruddha Mahapatra   May 2021 – Present

- Formulated a novel problem of expanding scene graphs in order to generate a diverse set of enriched scenes
- Designed a model taking inspiration from molecular graph generation models, and new metrics for evaluation

Tapestry - Group testing for COVID-19   [paper] [medrxiv] [news]

R&D Project, Advisors: Prof. Manoj Gopalkrishnan & Prof. Ajit Rajwade   Apr. – Dec. 2020

- Worked on improving traditional laboratory testing methods by exploiting **compressed sensing** techniques
- Implemented algorithms to generate pooling matrices and reconstruct data from compressed measurements
- One of the **top 10 finalists** from 200+ contenders in the **X-Prize** Open Innovation. Paper accepted at **IEEE** (OJSP)

Adversarial Attacks and Robust Defense Models   [code] [slides]

Advanced Machine Learning, Advisor: Prof. Sunita Sarawagi   Spring 2021

- Implemented a variety of gradient based attacks and compared effectiveness against several defense models
- Implemented defense models taking inspiration from stability training, adversarial training and analysis by synthesis

Frame Skipping for Deep Reinforcement Learning   [report] [code] [slides]

Advanced Reinforcement Learning, Advisor: Prof. Shivaram Kalyanakrishnan   Spring 2021

- Implemented Deep Q-learning algorithm to train agents capable of playing a variety of Atari-2600 games
- Analysed the impact of frame skipping and action repetition on the performance of agents empirically

Parameterized Verification of Concurrent Programs

Research Internship, Advisors: Prof. Roland Meyer & Prof. Krishna S.   Apr. – June 2020

- Proposed a way to show that parameterized verification under **Release and Acquire semantics** is in EXPSPACE
- Put forward a method to show that the reachability problem for a system consisting of an arbitrary number of identical processes is PSPACE hard and presented the analysis of the study

Major Academic Achievements

- Secured **All India Rank 8** and **State Rank 1** in **IIT JEE-Advanced** out of 230,000 candidates   *(2018)*
- Secured **All India Rank 54** in **JEE-Main** out of 1.1 million candidates, scoring **100%** marks in mathematics   *(2018)*
- Secured **Rank 1** out of 213 students in the course 'Foundations of Intelligent and Learning Agents'   *(2020)*
- Awarded **4 Advanced Performer grades** (given to top 1% students) for exceptional performance
- Received the **Institute Academic Award** for **Academic Excellence** at IIT Bombay   *(2018)*
- Awarded a scholarship by Pace Junior Science College for **meritorious performance**   *(2018)*

Positions of Responsibility

Teaching Assistant for Design & Analysis of Algorithms (CS 218)   Jan – May 2021
Instructor: Prof. Nutan Limaye

Teaching Assistant for Discrete Structures (CS 207)   July – Dec 2020
Instructor: Prof. Manoj Prabhakaran

Academic Mentor   Aug. 2021 – Present
Department Academic Mentorship Program
One of the **34** selected students responsible for mentoring sophomore students

Department Placement Coordinator   Aug. 2021 – Present
Placement Cell, IIT Bombay
One of the **6** selected students responsible for smooth conduct of the placement of **200+** CS students

Selected Projects

P2P Cryptocurrency Network   [code]
Blockchains, Cryptocurrencies & Smart Contracts, Advisor: Prof. Vinay Ribeiro   Autumn 2021
- Simulated a peer to peer bitcoin network and analyzed the impact of hashing power and network propagation delays
- Implemented attacks including **selfish mining** and **stubborn mining**, and analysed their impact on the network

Language Processor
Implementation of Programming Languages, Advisor: Prof. Uday Khedkar   Spring 2021
- Built a compiler for a subset of C/C++ using flex and yacc to generate equivalent spim assembly language programs

Auto Summarizer   [report] [code] [slides]
Natural Language Processing, Advisor: Prof. Pushpak Bhattarchayya   Autumn 2020
- Designed a sequence to sequence architecture using LSTMs for the task of abstractive summarization
- Used a variety of pretrained models including Bert, Bart, Pegasus, BertSum for summarization

Patient Management System   [code]
Database Information Systems, Advisors: Prof. Umesh Bellur & Prof. S. Sudarshan   Spring 2021
- Designed a novel application for managing the hospital affairs and helping patients maintain their health records
- Designed an efficient database using normalization and indexing, and built a webapp using **Flask** and **SQL**

Multicore Cache Coherence   [code] [slides]
Computer Architecture, Advisor: Prof. Bernard Menezes   Autumn 2020
- Implemented a variety of snooping based protocols used for cache coherence in **parallel computing**
- Built a multi-core simulator and compared the performance of these protocols on synthetic memory request traces

Maze Solver   [code–1] [code–2]
Intelligent Learning Agents, Advisor: Prof. Shivaram Kalyanakrishnan   Autumn 2020
- Created a puzzle solver using a variety of algorithms for MDP (Markov Decision Process) planning and control

Robust Video Denoising   [report] [code]
Advanced Image Processing, Advisor: Prof. Ajit Rajwade   Spring 2020
- Built a **compressed sensing** based tool to denoise videos in a robust fashion capable of removing serious mixed noise from the video data using low rank matrix completion problem
- Implemented an innovative way of performing median filtering using adaptive step size, an efficient Forward-Backward algorithm to solve the optimization problem and proved the algorithm converges

Proof-Reading Rewriter   [code]
Software Systems Lab, Advisor: Prof. Amitabha Sanyal   Autumn 2019
- Built an online writing assistant to aid error free writing using techniques from Natural Language Processing
- Incorporated features like spell check, **context sensitive grammar check**, word suggestion, **sentence transformation** from active voice to passive voice and optical character recognition

Volleyball   [code]
Programming Abstractions & Paradigms, Advisor: Prof. Amitabha Sanyal   Autumn 2019
- Created an interactive GUI in Racket for Volleyball game which can be played by one or two players
- Designed and validated an efficient greedy algorithm to find the best move of the computer

Enigma Machine with Prefix-matching Cryptanalysis   [code]
Programming Abstractions & Paradigms, Advisor: Prof. Amitabha Sanyal   Autumn 2019
- Developed a tool which can decode messages encoded using monoalphabetic substitution
- Designed and implemented efficient search algorithms using heuristics based on frequency analysis

Technical Skills

Programming Languages: C/C++, Python, Julia, Bash, AWK, Racket, SWI-Prolog, MATLAB, Java

AI/ML Libraries: PyTorch, TensorFlow, Numpy, Scikit-Learn, Spacy, OpenAI, Matplotlib, Scipy, Pandas

Web Development: HTML, CSS, JavaScript, Bootstrap, Flask, SQL, Ionic, Angular, React

Software skills: Z3 solver, Git, LaTeX, Beamer, Solidity, NS3, Arduino, Wireshark, AutoCAD, CMake, Solidworks

Relevant Courses

AI, ML & Statistics: Advanced ML, Advanced Reinforcement Learning, Information Retrieval & Web Mining, Natural Language Processing, Advanced Image Processing, Intelligent Learning Agents, AI & ML, Data Analysis

TCS & Mathematics: Cryptography & Network Security, Blockchains, Cryptocurrencies & Smart Contracts, Automata Theory, Logic, Discrete Structures, Numerical Analysis, Linear Algebra, Differential Equations, Calculus

Computer Science: Implementation of Programming Languages, Database and Information Systems, Computer Architecture, Operating Systems, Abstractions and Paradigms for Programming, Design and Analysis: Data Structures and Algorithms, Computer Networks, Digital Logic Design, Computer Programming

Extracurricular Activities

○ Built the **fastest** car in XLR8, an arduino based bot making competition held by Electronics and Robotics Club   *(2018)*

○ **Brown belt in Karate** (3rd Kyu) conferred by International Japan Karate-Do Association (India)

○ Successfully completed a swimming course organized by the National Sports Organization (NSO), IIT Bombay *(2018-19)*