Eashan Gupta

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University of Illinois Urbana-Champaign **2023-2027**
Ph.D. in Computer Science *GPA: 3.95/4.0*

University of Illinois Urbana-Champaign **2021-2023**
Master of Science in Computer Science *GPA: 3.95/4.0*

Indian Institute of Technology Bombay **2016-2020**
Bachelors of Technology in Computer Science with Honours *GPA : 9.13/10.0*

Research Interests

Networks, Distributed Systems, Theoretical Computer Science, Reinforcement Learning

Publications

- DBO: Fairness for Cloud-Hosted Financial Exchanges [paper]
  Eashan Gupta, Prateesh Goyal, Ilias Marinos, Chenxingyu Zhao, Radhika Mittal, Ranveer Chandra
  ACM SIGCOMM 2023 Conference, New York, NY
- Rethinking Cloud-hosted Financial Exchanges for Response Time Fairness [paper]
  Prateesh Goyal, Ilias Marinos, **Eashan Gupta**, Chaitanya Bandi, Alan Ross, Ranveer Chandra
  ACM HotNets'22: Proceedings of the 21st ACM Workshop on Hot Topics in Networks, Austin, TX
- Some Upper Bounds on the Running Time of Policy Iteration on Deterministic MDPs [paper]
  R. Goenka, **Eashan Gupta**, S. Khyalia, P. Agarwal, M.S. Wajid, S. Kalyanakrishnan

Work Experience & Internships

Research Intern, Microsoft Research, Redmond **May 2022-Aug 2022**
Networking Research Group [paper]

- Simulated and refined protocols to host Financial Exchanges on Cloud based on Response Time Fairness
- Implemented a **PoC** prototype of a Cloud-hosted Financial Exchange using a **DPDK** platform
- Proved the feasibility of enforcing fairness on **Azure** data centres to mitigate inherent latency variations
- Implemented a prototype system with an end-to-end latency of $150\mu s$ and ensure a fairness ratio of more than 99% for a 2-client system and $125k$ trades per second

Nutanix Technologies, Bangalore **July 2020-July 2021**
Nutanix is the leading Enterprise Cloud provider based in San Jose, California

- Software developer at Nutanix in the teams Microservices Platform and Karbon (**MSP/Karbon**)
- Used **Kubernetes** to deploy microservices on a Hyper-converged Infrastructure using virtual machines
- Worked to support the Karbon platform on **VMware's hypervisor ESX** other than AHV (in-house)
- Added multiple features to the Karbon controller like migration to **CoreDNS** on k8s upgrade; network segmentation for efficient traffic handling; redacting logs; tracking metrics using **Prometheus** and middlewares
- Managed a new version release including testing and publishing to production; Handled Customer Oncalls

Automation of Timing Performance Checks **May-July 2019**
Summer Internship *Tower Research Capital, Gurugram*

- Automated the performance **testing platform** for the software processing the order book data broadcast
- Experimented over various environments using different configurations of **cache allocation technology** and running processes in parallel to observe performance statistics and any dependency patterns

Research Experience

Improving upper bounds of Policy Iteration Algorithm in RL [paper] **Feb-June 2020**
Guide: Prof. Shivaram Kalyanakrishnan *IIT Bombay*

- Proved exponentially better upper bounds for number of steps taken by Policy Iteration Algorithm (**PI**) to

determine the optimal policy in deterministic Markov Decision Processes by counting tadpole subgraphs
- Partially resolved a conjecture about Howard's PI taking at most order Fibonacci steps on 2-action MDPs by establishing upper bounds for DMDPs

Towards validation of RTL passes of the GCC compiler **Jan-June 2020**
Guides: Prof. Amitabha Sanyal & Prof. Supratik Chakraborty *IIT Bombay*
- Analysed the various Register Transfer Language (**RTL**) optimization passes in **GCC-4.7.2** and implemented a **block-by-block** validation technique to validate program transformations done by the passes
- Realized obligations based on the return values, heap memory and function calls of programs in the **Z3 Theorem Prover** tool to prove semantic equivalence between different control flow graphs (**CFGs**)
- Studied the internal workings of GCC-4.7.2 compiler and developed various plugin tools for analysis

NLNet: Configuring Networks with Natural Language **Jan-May 2022**
Guide: Prof. Matthew Caesar *University of Illinois Urbana-Champaign*
- Developed methods to convert high level invariants in natural language to appropriate network function calls to configure a network
- Used AMR parsing to model a classification task based on the network API documentation and improved accuracy using feedback from network verification rules

Optimized DL GPU Task Scheduling for NVIDIA Jetson TX2 [GitHub] | Aug-Dec 2021
Guide: Prof. Tianyin Xu *University of Illinois Urbana-Champaign*
- Showed that the Nimble algorithm in **PyTorch** is hardware dependent and is not always successful in improving GPU performance by experiments on the Jetson TX2, a popular embedded AI systems hardware
- Implemented GPU task scheduling algorithms for deep learning inference models based on greedy longest chains and load balancing in PyTorch and improved **performance** on certain models by upto 16% on TX2
- Proposed a **Dynamic Programming** algorithm along with experiments demonstrating **proof of concept**

Reduction in Games played on recursion schemes **May-July 2018**
Guide: Prof. Roland Meyer | Summer Internship *TU Braunschweig, Germany*
- Worked on the reduction of parity games to safety games played on higher order recursion schemes (**HORS**), using similar results on reduction in games played on collapsible pushdown automata (**CPDA**)
- Studied equivalence between HORS and CPDA using **Krivine machines** and λ-labelled deterministic digraph
- Worked to improve lower bound on the number of counters used in reduction from parity to safety games

Implementation of Abstract Domains for Program Verification **Jan-May 2019**
Guide: Prof. Supratik Chakraborty *IIT Bombay*
- Studied abstract interpretation of program verification using domain specific techniques and fixed point analysis
- Implemented **congruence** and **array** abstract domains in **C++** for integration into the **CAnalyzer** tool
- Engineered the array abstract domain by mapping segments of an array to their abstract values; bounds of the values stored as variable expressions which are used in **context-free** comparisons to complete operations

Technical Skills

Programming	C++, C, Python, Java, Bash, Racket, Haskell, Prolog, MIPS, PostgreSQL, LaTeX
Web Development	HTML5, CSS3, JavaScript, Django, PHP, Bootstrap, jQuery
Softwares	Kubernetes, MATLAB, Simulink, Gnuplot, Git, Android Studio, Arduino, Xilinx
Key Courses:	Advanced Operating Systems, Distributed Systems, Computer Security, ML for Signal Processing, Efficient & Predictive Vision, Knowledge-driven Natural Language Generation, Advances in Intelligent and Learning Agents, Advanced Machine Learning, Functional Programming Languages, Web Search & Information Retrieval, Digital Image Processing, Artificial Intelligence, Computer Graphics, Graph Theory

Teaching & Mentoring Experience

- **Teaching Assistant, Distributed Systems, UIUC** - Manage the course website, grading and assignments. Conduct weekly office hours to handle doubts in person.
- **Teaching Assistant, Applied Machine Learning, UIUC** - Manage the course forum and clear doubts of the students in the online course. Conduct weekly office hours to handle doubts in person.

- **Teaching Assistant** - Selected to manage and clear doubts in a class of 100 first-year students for the basic undergraduate course on Computer Programming and Utilization. Coordinated with the Computer Science Department to conduct regular **lab sessions** & **evaluate exam papers**
- **Teaching Assistant** - Managed the forum for the **online course** Soft Skills on the online platform IITBombayX MOOC. Tasked to create questions and such material for the same course.

Other Notable Projects

Self-Supervised Embedded Speech Emotion Recognition **Aug-Dec 2021**
Guide: Prof. Paris Smaragdis *University of Illinois Urbana-Champaign*

- Implemented and trained a **Siamese NN** to distinguish emotions between 2 input speech samples with **test accuracy** 82% on the **CREMA-D** speech dataset
- Used the trained Siamese neural network to identify emotions of unseen classes with upto 54% accuracy
- Trained a classifier based on embeddings learned from the Siamese NN with upto 81% validation accuracy

Plausible Password Generation using Generative Models **Jan-June 2020**
Guides: Prof. Abir De *IIT Bombay*

- Explored and analysed the latest methods used to evaluate and guess passwords
- Devised and implemented methods to evaluate a password based on the metrics of **guessability** and **memorability** and used them to compare the generative models developed
- Designed methods to take old passwords as input and generate new stronger passwords using different generative models implemented using **RNNs**, variational autoencoders (**VAEs**) and **Grammar VAEs**

Near-Optimal Arm Identification in Continuum-Armed Bandits **July-Nov 2019**
Guide: Prof. Shivaram Kalyanakrishnan *IIT Bombay*

- Derived a general lower bound for the probability of choosing an epsilon-optimal arm from the continuous-armed bandits problem, based on simple regret for any mean probability distribution of the arms
- Explored various fixed and adaptive sampling strategies and experimented empirically over various mean functions to observe simple regret

Monadic Parser for Core Functional Language **July-Nov 2019**
Guide: Prof. Amitabha Sanyal *IIT Bombay*

- Modernised the parser implementation for core language in **Haskell** to a monadic parser
- Studied the various monads to use them to use them for structured error handling and parsing

Team Member, ADCS, Advitiy **Feb-Dec 2017**
Advitiy is the 2^{nd} student satellite of IITB, technically advanced and efficient version of the 1^{st}, Pratham

- Developed a simulation for a simple Feedback Control System for a motor in **MATLAB** and **Simulink** based on the **PID controller** to understand the control law currently employed in Pratham
- Performed **battery simulations** for the satellite in MATLAB to analyze its charging and discharging cycles to validate the control law employed in Pratham and check overall functioning of the satellite

Othello | *Prof. Amitabha Sanyal, IIT Bombay* Jan-April 2018

- Developed the single player mode for the game of Othello in **Racket**, a multi-paradigm programming language, using concepts of **dynamic weights** and **functional programming**
- Determined a winning probability of 0.88 of our single player algorithm against natural greedy algorithm

Awards and Scholastic Achievements

- Secured **All India Rank 38** in **IIT JEE Advanced** among 200 thousand candidates (2016)
- Secured **All India Rank 122** in **IIT JEE Mains** among 1.2 million candidates (2016)
- Received Gold medal for being in the **top 35** students in **Indian National Physics Olympiad** (2016)
- Amongst the **top 30** students selected to attend Orientation cum Selection Camp of **INAO**, Indian National Astronomy Olympiad (2016)
- Recipient of **Kishore Vaigyanik Protsahan Yojna Fellowship** (KVPY) with an **All India Rank** of **121**, instituted by the Department of Science and Technology, Government of India (2015)
- Recipient of **National Talent Search Examination** Scholarship awarded by the Govt. of India (2014)
- Amongst the **top 1%** students in **NSEC**, National Standard Examination in Chemistry (2016)