

# Eashan Gupta

University of Illinois, Urbana-Champaign

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## University of Illinois Urbana-Champaign

*Ph.D. in Computer Science*

Advisor: [Prof. Radhika Mittal](#)

**2023-2027**

*GPA: 3.97/4.0*

## University of Illinois Urbana-Champaign

*Master of Science in Computer Science*

**2021-2023**

*GPA: 3.97/4.0*

## Indian Institute of Technology Bombay

*Bachelors of Technology in Computer Science with Honours*

**2016-2020**

*GPA : 9.13/10.0*

## Research Interests

I am a second-year PhD student at UIUC, advised by Prof. Radhika Mittal. My research interests broadly include Networks and Distributed Systems. I am currently exploring methods to optimize Networks for Machine Learning workloads and collective communication in datacenters.

## 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*
- Upper Bounds for All and Max-gain Policy Iteration Algorithms on Deterministic MDPs [[paper](#)]  
R. Goenka, **Eashan Gupta**, S. Khyalia, P. Agarwal, M.S. Wajid, S. Kalyanakrishnan

## Research Experience

### Collective Tuning as a New Congestion Control Knob for ML workloads

*Guide: Prof. Radhika Mittal | Research project*

**Ongoing**

*UIUC*

Working on a system to tune communication collectives like all-reduce dynamically and react to network congestion in shared GPU clusters. Current collective communication mechanisms maintain a static schedule for the long running workloads. Other methods to avoid congested network paths require hardware support, while our solution can be implemented in the software.

### Response Time Fairness for Cloud-Hosted Exchanges

*Internship Guide: Dr. Prateesh Goyal & Dr. Ilias Marinos*

**May 2022-March 2023**

*Microsoft Research Redmond | UIUC*

Financial exchanges are moving to the cloud from their original on-premises deployments. This raises new network challenges related to fairness and low-latency requirements as cloud is designed to only provide best-effort service at scale. Developed a preliminary solution to ensure fairness for financial exchanges on cloud.

- Designed protocols to host financial exchanges on the cloud and enable response time fairness
- Proved the feasibility of fairness on **Azure** data centres to mitigate inherent latency variations
- Implemented a system prototype of a Fair Cloud-hosted Financial Exchange using **DPDK**, operating at a high transaction rate of 125k trades per second with sub-100μs end-to-end p999 latency

### Improving upper bounds of Policy Iteration Algorithm in RL

*Guide: Prof. Shivaram Kalyanakrishnan*

**Feb-June 2020**

*IIT Bombay*

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

## Professional Experience

### 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

### Core Engineering Team, Tower Research Capital, Gurugram

May-July 2019

*Automation of Timing Performance Checks*

*Summer Internship*

- 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

## 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)

## Coursework

- **Relevant Courses (IIT Bombay):** Graph Theory, Functional Programming Languages, Advances in Intelligent and Learning Agents, AI and Machine Learning, Web Search and Information Retrieval, Digital Image Processing, Computer Graphics
- **Relevant Courses (UIUC):** Advanced Computer Networks, High-speed & Programmable Networks, Advanced Operating Systems, Advanced Distributed Systems, Applied Parallel Programming, Computer Security, ML for Signal Processing, Efficient & Predictive Vision, Knowledge-driven Natural Language Generation

## Teaching & Mentoring Experience

- **Graduate Teaching Assistant** -
  - CS 425 (Spring'23) - Distributed Systems with Prof. Radhika Mittal at UIUC
  - CS 441 (Coursera) (Fall'21, Spring'22, Fall'22) - Applied Machine Learning with Prof. Marco Morales
- **Undergraduate Teaching Assistant** - Selected to manage a class of 100 first-year students for the basic undergraduate course of CS101. Coordinated with the Computer Science Department to conduct regular lab sessions and 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.

## Notable Projects

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### 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  $\lambda$ -labelled deterministic digraph
- Worked to improve lower bound on the number of counters used in reduction from parity to safety games

### Optimized DL GPU Task Scheduling for NVIDIA Jetson TX2

[[GitHub](#)] — Aug-Dec 2021

Guide: Prof. Tianyin Xu | Course Project

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

### Implementation of Abstract Domains for Program Verification

Jan-May 2019

Guide: Prof. Supratik Chakraborty | Research Project

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

### NLNet: Configuring Networks with Natural Language

Jan-May 2022

Guides: Prof. Matthew Caesar, Prof. Heng Ji | Course Project

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

### Team Member, ADCS, Advitiy

Feb-Dec 2017

Advitiy is the 2<sup>nd</sup> student satellite of IITB, technically advanced and efficient version of the 1<sup>st</sup>, 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 AI

Jan-April 2017

Guide: Prof. Amitabha Sanyal | Course Project

IIT Bombay

- 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

## Extracurriculars

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- Attended **Vijyoshi camp** conducted by IISER, Kolkata which serves as a forum for interactions between bright young students and leading researchers and promotes research among them
- Successfully completed one year training in **lawn tennis** under **NSO**, IIT Bombay
- Stood **first** in the inter-school **stone painting** competition
- Among top 5 teams in XLR8 competition, building a bluetooth controlled bot during freshman year