Eashan Gupta

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

Research Interests

Program Verification, Reinforcement Learning, Theoretical Computer Science, Artificial Intelligence

Work Experience

Nutanix Technologies, Bangalore **July 2020-Present**
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**)
- Studied and used the tool **Kubernetes** (K8s) to deploy microservices on a k8s cluster in combination with a **Hyper-converged Infrastructure** using virtual machines
- Added multiple features to the microservices platform controller like managing and redacting logs, tracking metrics using **Prometheus** and middlewares and adding a health tracker to the K8s cluster
- Fixed multiple bugs in the system including handling of concurrent requests and versioning errors
- Automated testsuites for various scenarios related to **DNS** entries, **CoreDNS** and **system upgrades**

Internships and Research Experience

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

Improving upper bounds of Howard's Policy Iteration Algorithm **Feb-June 2020**
Guide: Prof. Shivaram Kalyanakrishnan *IIT Bombay*

- Proved exponentially better upper bounds for the number of steps taken by Howard's Policy Iteration Algorithm (**HPI**) to determine the optimal policy in deterministic Markov Decision Processes (**DMDPs**)
- Worked to prove polynomial upper bounds for number of steps taken by HPI; reduced the problem of the maximum number of steps taken by HPI for DMDPs to counting cycles in simple digraphs
- Studied literature concerning the structure of policy space of MDPs and bounds on various PI algorithms
- Conducted various empirical experiments on lower order AUSOs to observe the family of randomized PI

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

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**

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**)
- Proposed a new approach to model games on recursion schemes using **computation trees** of the HORS
- 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

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

- 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

Notable Projects

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

Handwriting synthesis using RNNs **Mar-May 2019**
Guide: Prof. Sunita Sarawagi *IIT Bombay*

- Explored and analyzed the various deep learning frameworks for handwriting synthesis
- Trained an **LSTM** to generate strokes for individual letters of the alphabet
- Devised and implemented an algorithm to train the LSTM and an encoder-decoder model in an **adversarial** fashion and used it to string letters smoothly to form complete handwritten words

Lightweight Probabilistic Deep Networks **Oct - Nov 2018**
Guides: Prof. Suyash Awate & Prof. Ajit Rajwade *IIT Bombay*

- Used probabilistic output layers and **Dirichlet** categorical classifier to account for uncertainties in deep networks
- Implemented assumed density filtering using **Keras** and modified DN layers to propagate activation uncertainties
- Performed experiments on some standard databases and measured cross-entropy to compare results

Compiler Design **Jan-April 2019**
Prof. Uday Khedkar *IIT Bombay*

- Developed a compiler and an interpreter for a subset of C language to generate its assembly code
- Used **lex** and **yacc** for parsing, creating abstract syntax trees, control flow graphs and symbol tables

Cache Timing Attacks on DSA **Oct-Nov 2018**
Guide : Prof. Bernard Menezes *IIT Bombay*

- Explored and examined various cache timing attacks on implementations of cryptographic algorithms
- Verified the possibility of exploiting the **OpenSSL** library and recover bits of the key in **DSA**
- Studied lattice attacks and hidden number problem to extract the security key using recovered bits

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)

Teaching & Mentoring Experience

- **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.

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 Undertaken

Theoretical CS	Automata Theory, Digital Logic Design, Discrete Structures, Graph Theory, Logic for Computer Science, Design & Analysis of Algorithms, Interpretation of Programming Languages, Design & Implementation of Functional Programming Languages, Number Theory and Cryptography
Systems	Database & Information Systems, Computer Architecture, Operating Systems, Cryptography and Network Security, Computer Graphics
AI & ML	Advances of Intelligent Learning Agents, Advanced Machine Learning, Web Search & Information Retrieval, Fundamentals of Intelligent Learning Agents, Artificial Intelligence and Machine Learning, Data Analysis & Interpretation, Fundamentals of Digital Image Processing, Fundamentals of Intelligent Learning Agents
Mathematics	Calculus, Linear Algebra, Differential Equations, Numerical Analysis
Others	Accounting and Finance, Operations Management, Economics, Operations Analysis

Extracurricular

- 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
- Among top 5 teams in XLR8 competition, building a blue tooth controlled bot during freshman year
- Successfully completed one year training in **lawn tennis** under **NSO**, IIT Bombay
- Consistent scholarly performance at school level in all classes and awarded Scholar Badge for the same
- Stood **first** in the inter-school of **stone painting** competition