Gokulan Ravi

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Education

2015-Present **5th Year, Dual Degree (B.Tech+M.Tech) in Computer Science & Engg.**, *CGPA : 7.98/10*, *Indian Institute of Technology Madras*, Chennai.

2014-15 **XII - CBSE**, *Maharishi International Residential School*, Chennai, 95.8%.

2012-13 **X - CBSE**, *Maharishi International Residential School*, Chennai, *CGPA :9.8*.

Work in Progress for Publications

Bottleneck analysis of systolic array and novel architectures for DL inference,
Vinod Ganesan, Dr. Pratyush Kumar.

- Bottleneck analysis of various microarchitectural components and dataflow patterns of systolic-array based accelerator for CNNs.
- Amdahl's law analysis for systolic array.
- We open-source our cycle-accurate systolic array, implemented in Bluespec System Verilog, as a universal simulator for systolic array.

Cross-layer solution to thwart side-channel attacks,
Vinod Ganesan, Rahul Bodduna, Dr. Chester Rebeiro.

- Cross-layer solution, which configures the microarchitecture dynamically, to prevent side-channel attacks on secure applications.
- Using annotations at the high-level language, the solution provides security at finest granularity of code, providing a performance vs security trade-off to be configurable at high-level language.

Academic Projects

May-Jul 2018 **Snoop-based cache coherence protocol for Shakti C-Class processor with Prof. Kamakoti**.

- Shakti[1]is an open source hardware initiative of IIT Madras based on RISC-V ISA.
- Shakti C-Class processor is a in-order 5-stage pipeline core, targeted for micro-controllers.
- Implemented snoop-based MOESI cache coherence protocol for multi-core C-Class processor.
- Tilelink interconnect standard was used to communicate with memory, implemented Tilelink-Cacheable (TL-C) conformation level of the fabric.
- The entire implementation and verification was done in Bluespec System Verilog.

Jan-May 2019 **Directory-based cache coherence protocol for Shakti C-Class processor with Prof. Kamakoti**.

- Extended the previous work to implement directory-based MOESI cache coherence protocol.
- Customized TL-C protocol to support client-client transactions, since original TL-C supported only client-server transactions.
- Explored various tradeoffs at the fabric level in implementing the transactions.

Oct 2018 - Feb 2019 **GPU kernels for weight sharing on CNNs, course project with Dr. Pratyush Kumar**.

- Exploited weight sharing property of CNNs, ie. few unique values repeating across different convolution filter maps in GPU Programming course.
- Implemented custom GPU kernel, which performed lesser multiply operations than a vanilla convolution. Included optimizations for avoiding shared bank conflicts in shared memory, efficient scheduling using CUDA streams.
- Explored various implementations, but a lot of additional bookkeeping was needed, and didn't provide significant performance benefits.

[1] http://shakti.org.in/

Jun 2019 - Present **A systolic-array based co-processor for Shakti C-Class with Dr. Pratyush Kumar**.
- Contributed in implementing a systolic-array based co-processor for accelerating DL inference.
- The accelerator is completely paramterized, supports multiple dataflows and can be used as cycle-accurate simulator.
- Acts as co-processor to Shakti C-Class processor, compatible with 64-bit AXI4 bus. Memory transfer decoupled from core by DMA, generates interrupt to core on completion of convolution.
- TensorFlowLite ported to systolic array for DNNs to directly execute tiny networks on systolic array.

Scholastic Achievements

2019 **Embedded Security Challenge, Cyber Security Awareness Week**.
Placed 1^{st} in India region (8^{th} international) in Embedded Security Challenge, Cyber Security Awareness Week, organised by NYU Tandon School of Engineering. We proposed a framework to automate the process of reverse engineering binaries, with minimal manual intervention.

2018 **Inter-IIT Tech Meet 2018**.
Secured 3^{rd} place in Coding Hackathon across teams from 23 IITs, held at IIT Bombay. Developed a chatbot to diagnose general medical ailments with symptoms using a chat for people in remote locations in India, which have limited access to medical infrastructure.

2015 **Joint Entrance Examination(JEE)**.
Secured All-India-Rank 488 in JEE Advanced 2015 and All-India-Rank 250 in JEE Main 2015.

2013,14 **Kishore Vaigyanik Protsahan Yojana - Science Talent Search Program**.
Awarded fellowship twice in 2013 (Rank 178) and 2014 (Rank 530).

2013 **NTSE**.
Selected for fellowship under "National Talent Search Examination", conducted by NCERT.

Professional Experience / Positions of Responsibility

Jul 2016 - Feb 2017 **Mobile App Developer, Shaastra 2017, the annual technical festival of IIT Madras**.
Contributed in building android app for Shaastra 2017 edition. The app provided a mobile-friendly experience of Shaastra 2017 website, with additional features like push notifications and event reminders. The app had 1000 downloads on Google Play Store.

Apr 2017 - Mar 2018 **Webops Core, Shaastra 2018**.
- Lead a team of 20 members in catering the technical requirements of Shaastra 2018 edition.
- Built website, mobile app, and other internal requirements of different verticals of Shaastra team.
- Automated various emailing tasks, and built solutions for collecting payments, hospitality management and unified registration across events.

May-Jul 2017 **Internship - Project on Automated Model Generation at Quiklo, fin-tech company**.
- Built an automation system to extract text from images of bank balance sheets and convert them to excel files.
- Used Google Cloud Vision API to extract text from images, and processed them to correlate correct values across rows.
- The entire implement was abstracted by a Jetty Server, and processed as HTTP requests.

2017-2018 **Instructor, Webops Club, Center for Innovation**.
- Organised various workshops and tutorial sessions in web and android app development as instructor for Webops Club, Center for Innovation, a student-run research laboratory at IIT Madras.
- **Python Workshop** at Coimbatore, outreach event of Shaastra 2017 which had 100 attendees.
- **Python Workshop**, Shaastra 2017, 200 attendees.
- **Android app development**, IIT Tirupati, April 2017, mentorship program under IIT Madras.
- **Web development**, Shaastra 2018, 600 attendees
- **Python Workshop** at Mumbai and Pune, December 2018, outreach event of Shaastra 2019.
- **Summer School 2017, 2018** and special sessions during the semester on MEAN stack, Android app development for IIT Madras students.

Jul-Nov 2019 **Graduate Teaching Assistant for Nand2Tetris course under Prof. Kamakoti**.
Teaching assistant for Fundamentals of Computer Systems Design & Lab course, which covered the Nand2Tetris module, for 2^{nd} year CSE undergraduates.

Coursework

Mathematics	Discrete Mathematics, Basic Graph Theory, Probability Statistics and Stochastic Processes
Core courses	Data structures and algorithms, Languages Machines and Computations, Computer Organization and Architecture, Operating Systems, Compiler Design, Paradigms of Programming
Hardware	Computer Architecture, Parallel Computer Architecture
Security	Secure Systems Engineering, Network Security
HPC	Concurrent Programming, GPU Programming
VLSI	CAD for VLSI, Design for Testability and Testable Design
Networks	Introduction to Computer Networks, Wireless Communication Network
AI	Pattern Recognition and Machine Learning, Deep Learning
Misc.	Program Analysis, Cloud Computing

Skills

Languages	C (OpenMP and MPI), C++, CUDA, Python (PyTorch), Java, x86 Assembly Language
HDL	Bluespec
Web Dev.	HTML, CSS, JavaScript(AngularJS and NodeJS), MEAN Stack, MySQL, MongoDB
Misc. Tools	LLVM, Gem5, Intel PIN