Shaizeen Aga

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Research Interests

My interests lie in three vital axes of computing: security, performance and energy efficiency, and ease of programmability. I am interested in designing architectural support to provide security guarantees efficiently. I am keen to explore near-data computing techniques to process the data deluge we face in a performance and energy efficient manner. I am also interested in designing runtime and hardware support to ease programmability.

Education

2013–Present **Ph.D, Computer Science and Engineering**, *University of Michigan, Ann Arbor*.

Advisor: Professor Satish Narayanasamy

2011–2013 **MS, Computer Science and Engineering**, *University of Michigan, Ann Arbor*.

2005–2009 **BTech, Information Technology**, *College of Engineering, Pune, India*.

Class rank 2nd in Information Technology Department

Honors and Awards

Aug 2017 **Rising Stars in EECS Invited Participant, 2017**.
An invite-only academic career workshop for nearly 60 top women scholars in EECS.

Dec 2016 **Best demo at Center for Future Architectures Research (CFAR) Annual Workshop**.
Awarded for **Compute Caches** which enables in-place computation in caches. This workshop showcased nearly 50 projects in computer architecture related topics from several leading institutions.

Nov 2016 **1st place at University of Michigan CSE Graduate Students Honors Competition**.
A yearly competition which recognizes research of broad interest and exceptional quality.

2011-2013 **Recipient of K.C. Mahindra Scholarship**.
Awarded to select few students across India for graduate studies.

2011-2013 **Recipient of BP Corporation Scholarship**.
Awarded to select few students across India for graduate studies.

2009 **1st place in Parallel Computing at Imagine Cup, a worldwide student technical competition organized by Microsoft**.

2006-2009 **Microsoft Student Partner at College of Engineering, Pune, India**.
Student technology leader, conducted seminars for fellow students.

2005-2009 **Recipient of Dhirubhai Ambani Scholarship**.
Awarded to select few students across India for undergraduate studies.

- **Winner of elocution competitions at school and national level**.
- **Class rank 1st throughout schooling**.

Publications

Selected Research Publications

June 2017 **[1] InvisiMem: Smart Memory Defenses for Memory Bus Side Channel**

Shaizeen Aga and Satish Narayanasamy. *In 44th International Symposium on Computer Architecture **(ISCA)**, Toronto, ON, Canada.*

Feb 2017 **[2] Compute Caches**

Shaizeen Aga, Supreet Jeloka, Arun Subramaniyan, Satih Narayanasamy, David Blaauw, and Reetuparna Das. *In IEEE Symposium on High Performance Computer Architecture **(HPCA)**, Austin, Texas.*

Dec 2015 **[3] Efficiently Enforcing Strong Memory Ordering in GPUs**

Abhayendra Singh, **Shaizeen Aga** and Satish Narayanasamy. *In International Symposium on Microarchitecture **(MICRO)**, Waikiki, Hawaii.*

Nov 2015 **[4] CilkSpec: Optimistic Concurrency for Cilk**

Shaizeen Aga, Sriram Krishnamoorthy and Satish Narayanasamy. *In International Conference for High Performance Computing, Networking, Storage and Analysis **(SC)**, Austin, TX.*

June 2015 **[5] zFence: Data-less Coherence for Efficient Fences**

Shaizeen Aga, Abhayendra Singh and Satish Narayanasamy. *In 29th International Conference on Supercomputing **(ICS)**, Newport Beach, CA.*

Patents

2017 **[6] Trusted computing system with enhanced memory**

Satish Narayanasamy and **Shaizeen Aga**. *US Patent Pending*

2016 **[7] Method for exploiting parallelism in task-based systems using an iteration space splitter**

Behnam Robatmili, **Shaizeen Aga**, Dario Suarez Gracia, Arun Raman, Arvind Natarajan, Gheorghe Calin Cascaval, Pablo Montesinos Ortego, Han Zhao. *US Patent 9501328*

2016 **[8] Ordering constraint management within coherent memory systems**

Shaizeen Aga, Abhayendra Singh and Satish Narayanasamy. *US Patent 9367461*

Academic and Professional Experience

Jan '12-Now **Graduate Student Research Assistant** *University of Michigan, Ann Arbor*
Some of my projects here are:

Efficient secure hardware [1, 6]: In this work, I implemented a low-overhead hardware design that provides strong defenses against memory bus side-channels using compute capable 3D memories wherein we harness logic layer close to memory to implement cryptographic primitives. This design is one to two orders of magnitude lower in performance, space, energy, and memory bandwidth overhead compared to prior solutions.

Caches as data-parallel accelerators [2]: This work transforms on-chip caches from passive to active compute units by enabling in-place computation in them. This unlocks massive data parallelism (~100X wrt SIMD processor) and saves significant amount of data movement energy (~10X wrt SIMD processor). This accelerates new-age applications, which process massive amounts of data in a data-parallel fashion considerably (1.9X performance, 2.4X energy savings).

Efficient fences for multi-cores [5, 8]: In this work, I designed and implemented an efficient fence instruction by decoupling coherence permission from data which enables stronger and more intuitive memory model like Sequential Consistency in hardware at a low cost (2.93%).

Stronger memory models for GPUs [3]: Herein, we investigate memory model implications for GPUs and propose a low-overhead GPU-specific non-speculative Sequential Consistency design.

May- Aug'14 **Interim Engineering Intern** *Qualcomm Research Silicon Valley (QRSV)*
Manager: *Calin Cascaval*
Optimizing a heterogeneous benchmark: I worked here on optimizing a heterogeneous (CPU + mobile GPU) benchmark (ray tracing). Using algorithmic changes and ARM Neon instructions I attained 2-30X speedup. I also implemented an alternate algorithm which attained 40X speedup.

June-Aug'12 **Intern** *Pacific Northwest National Laboratory*
Mentor: *Sriram Krishnamoorthy*
Smart runtime via optimistic concurrency[4]: Cilk multi-core runtime system makes it easy for programmers to express parallelism; its synchronization primitives, however, tend to be over-constrained causing poor performance. With speculation guided by a smart predictor, I improved Cilk's performance by 1.6X on 30 cores while retaining Cilk's ease of programmability.

Jan-July'11 **Senior Technology Associate** *Morgan Stanley*
Jan'10- **Technology Associate** *Morgan Stanley*
Dec'11 **Manager:** *Vinod Alva*
Design and development of data warehouse: I was a part of Firm Market Risk Data Warehousing team here. My work primarily involved design and development of a Data Warehouse catering to regulatory (FED/FSA) requirement and analytical needs of the risk managers, optimizing queries and building analytical (OLAP) cubes for reporting purposes. I was a key contributor to a major re-structuring project (reduced the data transformation and load cycle by 65%).
I also served as a mentor and I was involved in hiring initiatives as well.

June'08- **Intern** *NVIDIA Graphics Pvt Ltd*
Mar'09 **Manager:** *Philips Koshy*
Accelerating true motion estimation: I ported a True motion estimation algorithm onto the NVIDIA parallel computing platform CUDA to get 180X speedup.

Teaching Experience

2013, 2014 **Graduate Student Instructor**, *University of Michigan, Ann Arbor*.

I taught Parallel Computer Architecture; a graduate course on recent advancements in parallel architectures.

Other Projects

2012 **Speculatively relaxing memory model constraints by dynamic classification of cache blocks**.

Using dynamic classification of cache blocks, I relaxed memory consistency model constraints to improve performance of Sequentially Consistent hardware. This project earned **top grade in Winter 2012 class of Parallel Computer Architecture** at University of Michigan.

2011 **Design and implementation of P6 microarchitecture based core in Verilog**.

I designed and implemented the memory interface of the core and host of other components. Also implemented an **Adaptive Instruction Prefetcher** which gave significant performance benefits earning **top grade in Fall 2011 class of Computer Architecture** at University of Michigan.

2009 **Optimizing maximum likelihood method of phylogenetic tree construction algorithm**.

Using Microsoft's Task Parallel library, I improved the performance of computationally intensive Maximum Likelihood method of Phylogenetic tree construction which is used in drug design. This project won **1st place in Parallel Computing** at **Microsoft's Imagine Cup 2009**.

Service

2014-15 **Moderator** for the **computer architecture reading group** at University of Michigan that meets weekly to discuss recent papers from top-tier computer architecture conferences.

2015-Now **Mentor** to **incoming graduate women students** at University of Michigan.

2007-09 **Co-ordinator** and **Member** of **Debate Club** at College of Engineering Pune, India.

2008-09 **Volunteer** with Akanksha; a NGO working for **education of under-privileged kids**.