SARA MAHDIZADEH SHAHRI

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BRIEF BIOGRAPHY

My work bridges computer architecture and software systems, demonstrating the importance of that bridge in enabling efficient and equitable web services via solutions that span the compute stack.

Modern web services require data centers that scale to hundreds of thousands of servers, i.e., hyperscale. Traditionally, hyperscale web services have adopted a performance-first approach, where they primarily prioritize sending quick responses to the end users. Indeed, my earlier work presents hardware solutions to address important hardware performance bottlenecks imposed by hyperscale web services. However, building web systems using the performance-first approach often compromises key equity metrics. For example, web systems often improve performance by introducing request priorities/biases, which can compromise user-level equity. My dissertation work is the first to introduce equity as a first-order hardware/software system design metric, to rethink the data center computing stack across hardware and software systems to enable efficient and equitable hyperscale web services.

My research has been recognized with the 2022 Carnegie Institute of Technology Dean's Fellowship and the 2021 Rackham Merit Ph.D. Fellowship.

EDUCATION

Ph.D., Electrical and Computer Engineering — *Carnegie Mellon University*
Advisor: Prof. Akshitha Sriraman — *Aug 2022 - Present*
Carnegie Institute of Technology Dean's Fellowship
Dissertation title: Introducing Equitable Hyperscale Systems

Ph.D., Computer Science and Engineering — *University of Michigan*
Advisor: Prof. Baris Kasikci — *Aug 2021 - Aug 2022*
GPA: 4 out of 4
Rackham Merit Fellowship

M.Sc., Computer Science and Engineering — *Pennsylvania State University*
Advisor: Dr. Aasheesh Kolli — *Aug 2018 - Dec 2020*
GPA: 4 out of 4

B.Sc. Computer Engineering — *Sharif University of Technology*
Advisor: Prof. Hamid Sarbazi-Azad — *Sep 2013 - Feb 2018*
GPA: 18.51 out of 20
Ranked 2nd in Computer Hardware Engineering

AWARDS AND HONORS

Carnegie Institute of Technology Dean's Fellowship — *2022*
Awarded $83,000 towards tuition, stipend, and travel

University of Michigan Rackham Merit Fellowship — *2021*
Awarded $92,000 towards tuition, stipend, and travel

Ranked 2nd in Computer Hardware Engineering — *2018*
Among all graduated students in 2018 in Computer Hardware Engineering

Among 7 Top-selected Replacement Policies Participated in 2nd CRC — *2017*
The Cache Replacement Championship (CRC) Co-located with ISCA 2017

Awarded Certificate for Top 25% of Contestants in FPGA National Contest — *2016*
Competition on Trax game

Ranked 201st in National University Entrance Exam — *2013*
More than 300,000 students participated in the entrance exam for mathematics and physics.

PEER-REVIEWED CONFERENCE/JOURNAL PUBLICATIONS

- Shixin Song, Tanvir Ahmed Khan, **Sara Mahdizadeh Shahri**, Akshitha Sriraman, Niranjan K Soundararajan, Sreenivas Subramoney, Daniel A Jimnez, Heiner Litz, Baris Kasikci. *Thermometer: Profile-guided BTB Replacement for Data Center Applications.* In proceedings of the 49^{th} International Symposium on Computer Architecture (**ISCA 2022**). Jun 2022. [link]
  Acceptance rate: 67/400 = 16.8%.

  Provides a comprehensive characterization of the branch behavior for data center applications and proposes a novel BTB replacement technique that realizes the holistic branch behavior using a profile-guided analysis.

- Akshay Krishna Ramanathan, **Sara Mahdizadeh Shahri**, Yi Xiao, Vijaykrishnan Narayanan. *Achieving Crash Consistency by Employing Persistent L1 Cache.* In proceedings of Design, Automation & Test in Europe Conference & Exhibition (**DATE 2022**). Mar 2022. [link]

  Proposes a Non-Volatile Cache (NVC) architecture design that employs a hybrid volatile, non-volatile memory cell employing monolithic 3D and Ferroelectric technology in L1 data cache to guarantee crash consistency with almost no performance overhead.

- **Sara Mahdizadeh Shahri**, Seyed Armin Vakil Ghahani, Aasheesh Kolli. *(Almost) Fence-less Persist Ordering.* In proceedings of International Symposium on Microarchitecture (**MICRO 2020**). Oct 2020. [link]
  Acceptance rate: 82/424 = 19.3%.

  Introduces light-weight extensions to the x86 persistency model to provide some ordering guarantees without an intervening fence operation.

- Seyed Armin Vakil Ghahani, **Sara Mahdizadeh Shahri**, Mohammad-Reza Lotfi-Namin, Mohammad Bakhshalipour, Pejman Lotfi-Kamran, and Hamid Sarbazi-Azad. *Cache Replacement Policy Based on Expected Hit Count.* In IEEE Computer Architecture Letters (**CAL 2017**). Oct 2017. [link]

  Proposes a novel cache replacement policy based on expected hit count.

PEER-REVIEWED WORKSHOP PUBLICATIONS & POSTERS

- Sahana Rangarajan, **Sara Mahdizadeh Shahri**, Jaylen Christopher Wang, Pratyush Patel and Akshitha Sriraman. *Designing Equitable Data Center Scheduling Systems.* Career Workshop for Inclusion and Diversity in Computer Architecture (**CWIDCA 2022**) in conjunction with MICRO. Oct 2022.

- Zefeng Wang, **Sara Mahdizadeh Shahri**, Vyas Sekar, Assane Guane and Akshitha Sriraman. *Designing Web Applications for Rural Communities.* Career Workshop for Inclusion and Diversity in Computer Architecture (**CWIDCA 2022**) in conjunction with MICRO. Oct 2022.

- **Sara Mahdizadeh Shahri**, Shixin Song, Tanvir Ahmed Khan, Akshitha Sriraman and Baris Kasikci. *Web Applications: Past, Present, Future.* Career Workshop for Inclusion and Diversity in Computer Architecture (**CWIDCA 2021**) in conjunction with MICRO. Jun 2021.

  Enables early insight into the futuristic hardware bottlenecks to build more efficient hardware by proposing a framework to characterize the evolution of data center applications over time and mimic the predicted trends.

- **Sara Mahdizadeh Shahri**, Aasheesh Kolli. *Delivering Correct and Fast Persistency Guarantees.* The First Young Architect Workshop (**YArch 2019**) co-located with HPCA. Feb 2019. [link]

  Provides crash consistency for applications that use dynamic libraries using binary instrumentation.

PROFESSIONAL EXPERIENCE

Graduate Research Assistant, Carnegie Mellon University *Aug 2022 - Present*
Advisor: Prof. Akshitha Sriraman

Introducing equity as a first-order hardware/software system design metric and building data center computing stack to enable efficient and equitable hyperscale web service.

Graduate Research Assistant, University of Michigan *Aug 2021 - Aug 2022*
Advisor: Prof. Baris Kasikci

Characterizing performance bottlenecks of emerging datacenter applications on modern processorsto address the bottlenecks and make open-source web services more representative of real-world web services.

Software Engineer Intern, Google *May 2022 - Aug 2022*
Team: Cloud Technical Infrastructure
Supervisors: Shay Gal-on, Tao Chen

Enabling early insights in the process of architecting future hardware by providing a framework for projecting the performance bottlenecks of applications on a new platform.

Software Engineer Intern, Google *May 2021 - Aug 2021*
Team: Cloud Dataflow
Supervisors: Aaron Li, Yuta Labur

Improving the container startup latency for workers in Google Dataflow Service by initiating startup of containers right away without the need for entire container images to be pulled locally.

Graduate Research Assistant, Pennsylvania State University *Aug 2018 - Aug 2021*
Advisor: Dr. Aasheesh Kolli

Architecting new hardware to enable fast recoverable data structures by leveraging emerging non-volatile memory technologies.

Undergraduate Research Assistant, Sharif University of Technology *Sep 2016 - Feb 2018*
Advisor: Prof. Pejman Lotfi-Kamran, Prof. Hamid Sarbazi-Azad

Designing new cache replacement policy to improve the performance of modern processors.

INVITED TALKS

Thermometer: Profile-guided BTB Replacement for Data Center Applications

- Google *August 2022*

Data center applications: Past, Present, Future

- ADA Annual Symposium 2022 *May 2022*
- Career Workshop for Inclusion and Diversity in Computer Architecture (CWIDCA) *Oct 2021*

(Almost) Fence-less Persist Ordering

- International Symposium on Microarchitecture (MICRO) *Oct 2020*

Delivering Correct and Fast Persistency Guarantees

- The First Young Architect Workshop (YArch) *Feb 2019*

TEACHING EXPERIENCE

Graduate Teaching Assistant, Pennsylvania State University

- Graduate Computer Architecture, Dr. Aasheesh Kolli *Fall 2019*

Undergraduate Teaching Assistant, Sharif University of Technology

- Digital Systems Design, Prof. Alireza Ejlali *Fall 2017*
- Computer Structure and Language, Dr. Hossein Asadi *Fall 2017*
- Computer Architecture, Prof. Hossein Asadi *Spring 2016*
- Logic Design, Prof. Alireza Ejlali *Spring 2016*
- Advanced Logic Design, Prof. Alireza Ejlali *Fall 2016*

PROFESSIONAL SERVICE (INVITED)

- External Review Committee Member for ASPLOS'22.
- Artifact Evaluation Committee Member for OSDI'22, ATC'22 and MICRO'22.

PROJECTS

- Using Paxos To Build A Linearizable KV-Storage *Dec 2020*

- Key-Value store based on linearizable and causal consistency *Nov 2020*
- Parallel distributed file system *Dec 2019*
- In-order/ OoO Architectural Simulator *Dec 2019*
- Dynamic binary instrumentation for persistency guarantees *May 2019*
- Reducing Power Consumption according to Real-Time Constraints *Jan 2018*
- Trax Game & NoC Simulator(MemoCode 2011), Verilog *Apr 2016*
- Great Little War Game *Jan 2015*
- Billiard *Jan 2014*

TECHNICAL SKILLS

Programming Languages	C/ C++, Python, Shell, Go, Verilog, Assembly
System Skills	Low-level Systems Programming, Kubernetes, Performance Characterization, Scripting
Hardware Simulators	Gem5, DRAMsim2, CACTI, ChampSim
Tools and Frameworks	LLVM, DynamoRIO, Pin, Linux perf, Intel PMU tools, Intel PT, gRPC, Google Protobuf

REFERENCES

1. Prof. Akshitha Sriraman (akshitha@cmu.edu)
   Assistant Professor, Carnegie Mellon University
2. Dr. Aasheesh Kolli (aasheesh@google.com)
   Research Scientist, Google
3. Prof. Baris Kasikci (barisk@umich.edu)
   Assistant Professor, University of Michigan
4. Shay Gal-on (shayg@google.com)
   Research Scientist, Google
5. Tao Chen(taoc@google.com)
   Research Scientist, Google
6. Aaron Li (aaronleeiv@google.com)
   Research Scientist, Google
7. Yuta Labur (ylabur@google.com)
   Research Scientist, Google