Sarabjeet Singh

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I am a fourth year PhD student at the University of Utah, working on accelerating security primitives, ranging from efficient memory integrity verification to Post Quantum Cryptography. Particularly, my work is focused on advancing applications of Homomorphic Encryption.

Professional Experience

- **NVIDIA Research** — **Salt Lake City, USA**
  Co-op. Project: Homomorphic Encryption at Modern GPU Datacenter Scale — *May'22 - August'22*
- **AMD Research** — **Salt Lake City, USA**
  Co-op. Project: Processing In Memory — *May'20 - August'20*
- **University of Utah** — **Salt Lake City, USA**
  Research Assistant. Advisor: Prof. Rajeev Balasubramonian — *August'20 - Present*
- **University of Utah** — **Salt Lake City, USA**
  Graduate Assistant — *August'19 - May'20*
- **Ashoka University, Sonipat** — **Sonipat, India**
  Junior Research Fellow — *September'18 - June'19*
- **Indian Institute of Technology, Gandhinagar** — **Gandhinagar, India**
  Junior Research Fellow — *January'18 - August'18*
- **Hexagon Capability Center India Hyderabad** — **Hyderabad, India**
  Software Analyst, Hexagon PPM — *August'17 - December'17*

Publications

- **EPIC: Efficient Packing for Inference using Cheetah**
  Sarabjeet Singh, *Shreyas Singh, Rajeev Balasubramonian*
  6th Workshop on Cognitive Architectures, hosted in conjunction with HPCA 2022
  Homomorphic Encryption data packing technique to improve weight reuse in encrypted CNN inference.

- **HyGain: high performance, energy-efficient hybrid gain cell based cache hierarchy**
  Sarabjeet Singh, *Neelam Surana, Kailash Prasad, Pranjali Jain, Joycee Mekie, Manu Awasthi*
  ACM Transactions on Architecture and Code Optimization (TACO) 2022

- **CANDLES: Channel-Aware Novel Dataflow-Microarchitecture Co-Design for Low Energy Sparse Neural Network Acceleration**
  Sumanth Gudaparthi, ***Sarabjeet Singh***, *Surya Narayanan, Rajeev Balasubramonian, Visvesh Sathe*
  IEEE International Symposium on High-Performance Computer Architecture (HPCA 2022)

- **Efficacy of Statistical Sampling on Contemporary Workloads: The Case of SPEC CPU2017**
  Sarabjeet Singh, *Manu Awasthi*
  2019 IEEE International Symposium on Workload Characterization (IISWC), Orlando, FL, 2019

- **Memory Centric Characterization and Analysis of SPEC CPU2017 Suite**
  Sarabjeet Singh, *Manu Awasthi*
  ACM/SPEC International Conference on Performance Engineering (ICPE) 2019, pp. 285-292.

- **PANE: Pluggable Asynchronous Network-on-Chip Simulator**
  Sneha N Ved, ***Sarabjeet Singh***, *Joycee Mekie*
  ACM Journal on Emerging Technologies in Computing Systems (JETC) 15, no. 1 (2019): 7

Current/Past Research Projects

- **Packing and Dataflow for Homomorphic Encryption based Machine Learning accelerator**
  Sarabjeet S., *Shreyas S., Sumanth G. (AMD), Xiong F. (Rutgers Uni), Rajeev B.* *Aug'21 - **Present***
  Novel data packing technique and dataflow that greatly reduces the calls to costly FHE operations.

- **XCRYPT: Accelerating Lattice Based Cryptography with Memristor Crossbar Arrays**
  Sarabjeet S., *Xiong F. (Rutgers), Ananth K., Lia J., Anirban N., Mahdi B., Rajeev B., Elaine S. (CMU)*
  Novel PQC specific techniques to perform efficient polynomial multiplications on memristor based accelerator.

- **Efficient Integrity Verification using Custom DIMM**
  Sarabjeet S., *Shreyas S., Rajeev B., Siddharth C. (NVIDIA), Frank M. (Intel)* *Jan'21 - **Present***
  Reducing cost of integrity verification with near-memory support.

- **Secure AI using Samsung's AxDIMM (Finalists for Samsung AxDIMM contest)**
  Sarabjeet S., *Ananth K., Shreyas S., Lin J., Rajeev B.* *Oct'21 - June'22*

- **Efficient Metadata for Memory Protection**
  Sarabjeet Singh, *Meysam Taassori, Rajeev Balasubramonian, Siddharth Chhabra (Intel)* *Aug'20 - Mar'21*

- **AMBOP: Adaptive Multiple Best Offset Prefetcher**
  Archit Checker, Arup Mondal, ***Sarabjeet Singh***, *Manu Awasthi* *Mar'19 - Aug'19*

Education

- **University of Utah** **Salt Lake City, USA**
  PhD in Computer Science, *2019 - Present*

- **Indian Institute of Technology, Gandhinagar** **Gandhinagar, India**
  B.Tech. Minor in Computer Science and Engineering, *2013 - 2017*
  B.Tech. Major in Mechanical Engineering

Awards/Service/Outreach

- One of the finalist for **Samsung's Open Innovation Contest for AxDIMM Technology**.
- **Computer Architecture Student Association (CASA)** Founding Member, Steering Committee (2020-2022)
- **GradSAC, University of Utah** Member (2020-2021)
- **Journal review**: IEEE Micro 2022.
- **Teaching Mentor:** CS 6810 Computer Architecture (Fall 2020), CS 3810 Computer Organization (Spring 2022)

Blogs/Academic Projects

- **Post Quantum Cryptography**, ACM SigArch Computer Architecture Today Blog
- **Characterizing impact of NoC communication on CNN accelerators**, Advanced Computer Architecture (Spring 2020)
- **Exploring Federated Learning**, Neuromorphic Architectures (Fall 2019)

Technical and Personal skills

- **Programming Languages:** High-level programming languages (C, C++, Python), Assembly language (MIPS), Shell scripting, SQL
- **Familiar Tools:** System Simulators (Sniper, ZSim, Gem5, NVMain, DRAMSim2, USIMM), Interconnection Network Simulators (booksim2, PANE), Performance Analysis Tools and Instrumentation Tools
- **Interests:** Outdoor recreational activities, Boxing, Snowboarding, Men's Mental Health, Animal Welfare

Graduate Coursework

Neuromorphic Architectures, Advanced Computer Architecture, Parallel and High Performance Computing, Digital VLSI Design, Data Structures & Algorithm for Scalable Computing, Computer Architecture, Distributed Systems, Operating System, Advanced Algorithms

References

- Up to 3 references available on request