ANANTH KRISHNA PRASAD

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AREAS OF INTEREST

Computer Architecture — Performance Architecture/Analysis — Processing-in-Memory — Hardware-Software Codesign — Memory System Design — Accelerating Big Data/Server-Scale Applications

EXPERIENCE

Silicon Performance Architect Intern, PhD May 2022 - August 2022
Reality Labs, Meta
Manager: Dr. Ahmad Samih

- **Memory Compression on the Edge** - Implemented and evaluated the performance of an on-chip IP near memory controller for Memory Compression. Observed around 20% off-chip bandwidth reduction across a wide variety of benchmarks from SPEC, NAS and CRONO benchmark suites

Graduate Research Assistant August 2018 - **Present**
Kalhert School of Computing, University of Utah, UT
Advisors: Prof. Rajeev Balasubramonian & Dr. Mahdi Nazm Bojnordi

- **Billion-Scale Approximate Nearest Neighbor Search (ANNS)** - We propose a novel hardware-friendly algorithm for distance-based indexing of data in-memory through novel distance reformulation and pruning mechanism. We design a memory system capable of performing the required operations using a combination of PIM techniques. On a variety of vector datasets, we observe 52.7x/97x throughput/latency improvements over a server-class system, along with a 4.15x energy reduction. **Under review** August 2021 - **Present**

- **LNS for DNN inference** - Logarithmic Number System for end-to-end DNN execution using only LUTs, bit-shifts and adders. The proposed approach shows around 95.2% acccuracy on VGG16 with Imagenet April 2021 - December 2021

- **Error model for Analog Crossbar Accelerators** - Modelled device non-idealities incurred as part of MAC operations performed on Crossbars. Was used as part of XCRYPT publised in Transactions on Computing December 2020 - December 2021

- **Memristive Ranking In Memory** - Hardware/Software mechanism for large-scale data ranking in-memory. Identified bandwidth bottleneck issues with sorting kernels, and proposed viable hardware/software mechanism for performing large-scale data ranking in-memory with a bandwidth complexity of O(1), by reformulating sorting operations as bit-level in-situ operations. Achieved 12.4 - 50.7x throughput gains for high-performance parallel sorting kernels and 2.3 - 43.6x improvements in a set of database applications, with 90% energy reduction. September 2019 - December 2020

- **High Bandwidth Cross Caching** - Polymorphic Memristor-based memory with support for both caching and hashing. Achieved 50% and 12x improvement over state-of-the-art High Bandwidth memory, over Cache and Hash Table/Stringmatch applications respectively. December 2018 - May 2021

Other Projects

- **WCET Estimation for CGRA Hardware**, IISc Bangalore (June 17-18)
- **Energy Efficient-Transfer of Data in CNN accelerators by minimizing wire bit-flips**, Advanced Computer Architecture (Spring 2020)
- **Exploring Federated Learning**, Neuromorphic Architectures (Fall 2019)

PUBLICATIONS

- **Memristive Data Ranking - Ananth Krishna Prasad**, Morteza Rezaalipour, Masoud Dehyadegari, Mahdi Nazm Bojnordi, International Symposium on *High Performance Computer Architecture* 2021.
- **Monarch: A Durable Polymorphic Memory For Data Intensive Applications - Ananth Krishna Prasad**, Mahdi Nazm Bojnordi, IEEE *Transactions on Computers* 2022.
- **Enabling Distance-based Addressing in Non-Volatile Memory systems - Ananth Krishna Prasad**, Mahdi Nazm Bojnordi, Rajeev Balasubramonian, to appear in *Non-Volatile Memories Workshop* 2023.
- **XCRYPT: Accelerating Lattice Based Cryptography with Memristor Crossbar Arrays** - Sarabjeet Singh, Xiong Fan, **Ananth Krishna Prasad**, Lin Jia, Anirban Nag, Rajeev Balasubramonian et al., *IEEE MICRO* 2023

Technical Skills

- **Programming Languages:** C, C++, Verilog/VHDL, Python, Bash, TCL
- **Frameworks:** System simulator and Memory parameterization (gem5, ESESC, Cacti/NVSIM), Performance Analysis(Perf, VTune), CAD flow for Synthesis and P&R (Cadence Spectre/RTL Compiler, Innovus,Virtuoso), Machine Learning Libraries (Tensorflow, PyTorch, FAISS).

Selected Coursework

Neuromorphic Architectures, Advanced Computer Architecture, Parallel and High Performance Computing, Digital VLSI Design, Advanced Algorithms, Operating Systems, Machine Learning.

EDUCATION

Doctor of Philosophy, Computer Science — August 2018 - *Present*
University of Utah GPA 3.904

Bachelors in Technology, Electronics and Communication Engineering — August 2013 - May 2017
Birla Institute of Technology and Science, Pilani (Hyderabad Campus), India
GPA - 8.35 out of 10

Blogposts/Posters

- **Nanoscale Optoelectronic AI Processing**, Ananth Krishna Prasad, Mahdi Nazm Bojnordi May 7, 2021
- **A Case for Optical Deep Neural Networks**, Ananth Krishna Prasad and Mahdi Nazm Bojnordi Oct 2, 2020
- **A Case for the Scope of Reconfigurable Transistors in Computer Architecture**, Ananth Krishna Prasad, Pierre-Emmanuel Gaillardon, Mahdi Nazm Bojnordi May 16, 2019
- High Bandwidth Cross Caching, presented at DAC 2020

Service/Awards

- **Award** Finalist for Samsung's Open Innovation Contest for AxDIMM Technology
- **Reviewer** IEEE Journal on Emerging Technologies Circuits and Systems, 2023.
- **Teaching Mentorship:** CS 5460/6460 Operating Systems, under Prof. Ryan Stutsman
- **Teaching Mentorship:** CS/ECE 3810 Computer Organization, under Prof. Mahdi Nazm Bojnordi

References

Available upon request