

# ANANTH KRISHNA PRASAD

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## AREAS OF INTEREST

Computer Architecture — Performance Architecture — Processing-in-Memory — Hardware-Software Code-sign — Memory System Design — Accelerating Server-Scale Applications — ML/AI Acceleration, Dataflow

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## 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% accuracy 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 published 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
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## 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.

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## 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

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## 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