Ubaid Bakhtiar

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Ph.D. Candidate, Electrical and Computer Engineering, University of Maryland, College Park

Research Summary

General-purpose processors and specialized accelerators often fail to achieve the theoretical gains offered by sparsity due to underutilized hardware resources. To close the gap between peak and achievable performance, my research focuses on developing novel data scheduling, multi-tenancy, and dynamic reconfiguration techniques and integrate into sparse applications (AI and scientific computing) accelerators to mitigate the high resource underutilization and consequently, fully exploit the benefits of sparsity. I have published first-author publications in top-tier computer architecture conferences such as MICRO and DAC.

Education

Ph.D. in Electrical and Computer Engineering   Aug 2022 – Present
University of Maryland, College Park
B.Sc in Electrical Engineering   August 2018 — May 2022
Lahore University of Management Sciences (LUMS), Pakistan

Publications

- <u>**Ubaid Bakhtiar**</u>, Amirmahdi Namjoo and Bahar Asgari. **Chasoň: Supporting Cross HBM Channel Data Migration to Enable Efficient Sparse Algebraic Acceleration**
  International Symposium on Microarchitecture (MICRO) 2025 — Acceptance Rate: 20.7%
- <u>**Ubaid Bakhtiar**</u>, Helya Hosseini and Bahar Asgari. **Acamar: A Dynamically Reconfigurable Scientific Computing Accelerator for Robust Convergence and Minimal Resource Underutilization**
  International Symposium on Microarchitecture (MICRO) 2024 — Acceptance Rate: 22.7%
- <u>**Ubaid Bakhtiar**</u>, Donghyeon Joo and Bahar Asgari. **Pipirima: Predicting Patterns in Sparsity to Accelerate Matrix Algebra**
  Design Automation Conference (DAC) 2025 — Acceptance Rate: 23%
- Helya Hosseini, <u>**Ubaid Bakhtiar**</u>, Donghyeon Joo and Bahar Asgari. **Segin: Synergistically Enabling Fine-Grained Multi-Tenant and Resource Optimized SpMV**
  IEEE Computer Architecture Letters (CAL) 2025 — Acceptance Rate: 20%
- <u>**Ubaid Bakhtiar**</u>, Sanjali Yadav, Donghyeon Joo, Ramyad Hadidi and Bahar Asgari. **Lyra: Efficiently Supporting Unstructured Sparse LLMs on FPGAs via Variable Matrix Partitioning**
  Under review in International Symposium on Computer Architecture (ISCA) 2026
- <u>**Ubaid Bakhtiar**</u>, Jeremy Xu Sha, Helia Hosseini, and Bahar Asgari. **Procyon: Promoting Fine-Grained Multi-Tenancy to Optimize Sparse Streaming Accelerators**
  Under review in Design Automation Conference (DAC) 2026
- Helya Hosseini, <u>**Ubaid Bakhtiar**</u>, Donghyeon Joo and Bahar Asgari. **Lepus: Leveraging Sparsity to Upend Its Challenges**
  Under review in International Symposium on Computer Architecture (ISCA) 2026

Core Competencies

- **Hardware Prototyping:** Hands-on experience in developing custom accelerators for sparse scientific and machine learning workloads. Skilled in high-level synthesis, placement, and routing on FPGA fabrics, with extensive prototyping of baseline and novel architectures.
- **Performance Modeling:** Development of in-house, cycle-accurate simulators to evaluate architectural tradeoffs in data scheduling, multi-tenancy, and sparsity-aware execution. Experience of performance analysis frameworks such as Xilinx Runtime, CACTI, and Synopsys DC, NVIDIA Nsight Compute and Intel VTune Profiler.
- **Algorithm & Architecture Co-Design:** Identified bottlenecks in sparse stencil solvers and gen AI workloads, bridging algorithmic inefficiencies with architectural design choices to mitigate resource underutilization.

- **Performance optimization.** Expertise in analyzing and optimizing dataflow, memory bandwidth utilization, and compute-resource mapping to close the gap between theoretical peak and achieved performance in sparse accelerators.
- **Tools & Frameworks:** C/C++, Python, Verilog, Xilinx Vitis, TAPA, Rapidstream.

Research Experience

- **Research Assistant** – Computer Architecture and Systems Lab (CASL), UMD   May 2023 – Present
  - Research Area: Computer Architecrure and Domain Specific Designs
  - Research Advisor: Dr. Bahar Asgari
  - Crafting domain-specific architectures to address computational challenges in sparse and AI workloads, devise methods to improve their performance, and conduct simulation and prototyping on modern architectures such as CPUs, GPUs, and FPGAs.

Technical Skills

- **Languages:** C, C++, Verilog, Python, OpenCL, MIPS/RISC Assembly, MATLAB
- **Hardware Platforms:** AMD Alveo Accelerator Cards, AMD ZYNQ SoC, RISC, CPU, GPU
- **Frameworks:** High-level synthesis, Xilinx Vitis, Xilinx Runtime TAPA, Rapidstream, Intel MKL, Nvidia cuSparse
- **Simulations:** In-house cycle-accurate simulator, CACTI, Synopsys DC, GPGPU-SIM, Nvidia Nsight Compute
- **Deployment:** Linux CLI, Docker, Jupyter, Git
- **Topics:** HW/SW Co-design, Hardware for generative AI, Scientific computing accelerator, AI/ML

Awards and Honors

- **Student Travel Grant**, ACM/IEEE 58th International Symposium on Microarchitecture (MICRO 2025)
- **Winner 2-Minute Video Contest**, Student Young Fellow at DAC 2025.
- **Student Travel Grant**, ACM/IEEE 57th International Symposium on Microarchitecture (MICRO 2024)
- **Summer Research Fellowship**, University of Maryland-College Park (Summer 2023)
- **Dean's Honor List Award**, LUMS (2019-20)

Professional Services

- Student Volunteer @ SPICE: A Workshop Co-Located with International Symposium on Microarchitecture 2025
- Paper reviewer, IEEE Micro Magazine 2025
- Paper reviewer, ACM Transactions on Reconfigurable Technology and Systems 2025
- Graduate Research Assistant, Computer Architecture & Systems Lab, University of Maryland-College Park
- Graduate Teaching Assistant, Advance Digital Computer Design, University of Maryland-College Park (Fall 2023)
- Graduate Teaching Assistant, Digital Computer Design, University of Maryland-College Park (Fall 2022, Spring 2023)
- Teaching Assistant Feedback Control Systems, LUMS (Spring 2022)
- Teaching Assistant Electromagnetic Fields and Waves, LUMS (Fall 2021)
- Teaching Assistant Engineering Models, LUMS (Fall 2021)
- Teaching Assistant Circuits-II, LUMS (Spring 2021)

Relevant Coursework

- ENEE646   Digital Computer Design (UMD-Fall 2022)
- CMSC818J   Domain Specific Architecture (UMD-Fall 2023)
- CMSC838L   Programming Languages and Computer Architecture (UMD-Spring 2024)
- CMSC722   Artificial Intelligence Planning (UMD-Fall 2024)
- CMSC828G   Systems for Machine Learning (UMD-Spring 2025)