OSAMA YOUSUF

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SEH 5954, 800 22nd St NW, Washington, DC 20052

EDUCATION

Since 01/21 **PhD Candidate, Computer Engineering**, Specialization: Machine Learning and Intelligent Systems
George Washington University, Washington, DC, USA
CGPA: 4.00/4.00, Expected Graduation: 12/24
Dissertation proposal: Memristive Neural Networks: Modeling, Prototyping, and Hardware-Software Co-Design

08/16 - 07/20 **Bachelor of Science, Computer Science**, Minor: Mathematics
Habib University, Karachi, Pakistan
CGPA: 3.92/4.00
Thesis: AI-based Outfit Recommendation using Transfer Learning

06/18 – 08/18 **International Honors Program**
Stanford University, Stanford, CA, USA
Secured Habib University's Study Abroad Scholarship

WORK EXPERIENCE

Since 01/22

Alternative
Computing
Group

Research Associate, National Institute of Standards and Technology, Gaithersburg, MD
(supporting collaborative project with George Washington University and Western Digital Research)
- Proposed streaming low-rank decomposition algorithms for making in-situ training of hardware neural networks feasible at software-equivalent accuracy in a memory efficient fashion
  - Currently working on a pipelined hardware architecture based on systolic arrays to support the development of a training co-processor capable of efficiently performing streaming decompositions
- Led application-level development and experimental debugging and testing for an FPGA-based hardware prototyping platform to support algorithmic testing and benchmarking on memristive crossbars
  - Preliminary hardware results demonstrate multi-task classification and continual learning with extreme quantization to 2-bit weights suitable for mapping on emerging memristive devices (manuscript in preparation)

Since 01/21
ADAM Lab

Graduate Research Assistant, George Washington University, Washington, DC
- Developed a machine learning framework for studying hardware neural network acceleration based on memristive crossbars using PyTorch
  - Unique features include interfacing with acceleration cores in C++ and federated learning using pyBind11
- Proposed and incorporated statistical modeling techniques to simulate neural networks with noisy weights to better understand non-ideal hardware neural networks; developed quantitative metrics to study model quality
  - Currently investigating the impact of oscillatory network gradients on hardware network training accuracy
- Published and presented research findings in 10+ top-tier journals and conferences related to hardware-software co-design with emerging device technologies

07/20 - 01/21 **Frontend Software Engineer**, Stellic, Karachi, Pakistan
- Worked for the experience engineering team for Stellic – an ed-tech startup based in the United States
- Designed RESTful APIs using an Angular (JavaScript) and Django (Python) technology stack with the backend team, and worked closely with the design team to add robust features to the product
  - Led adding support for various time zones in the product, leading to at least 5 new clients signing with Stellic

02/20 - 07/20 **Analyst Software Engineer**, Afiniti, Karachi, Pakistan
- Worked for the Global Production Support team at Afiniti, an AI-based product for businesses to maximize contact center conversion
- Provided extensive post-deployment support to clients by monitoring live deployments for maximum uptime
  - Automated internal workflows in product monitoring processes using Python and Bash, improving the average time to identify majority of real-time problems in deployments from minutes to seconds

05/19 - 08/19
π^* AI Lab

Research Intern, Texas A&M University, College Station, TX
- Led development of a reinforcement learning framework for the CARLA simulator compatible with OpenAI's Gym library in Python
  - Implemented Q-learning and Deep-Q learning networks in the framework
  - Designed and compared the performance of different reward functions
  - Developed accompanying racetracks in the simulator to study algorithms under a variety of traffic conditions

SKILLS

Programming	Python, C/C++, HTML/CSS/JavaScript, C#, Bash (Linux Shell Scripting), SQL, Verilog
Tools & Libraries	**Data Processing:** NumPy, Pandas **Machine Learning:** PyTorch, scikit-learn, OpenAI Gym **Data Visualization:** matplotlib, Wolfram Mathematica, MATLAB **Hardware Prototyping:** Vivado, hls4ml, Uboot, Synposys Design Vision, FPGA programming **Web Technologies:** Flask, AngularJS, WebGL **Miscellaneous:** MySQL, PostGreSQL, Git, pyBind11, Jupyter Notebooks

PUBLICATIONS

- **Yousuf, O.,** Hossen, I., Glasmann, A.L., Najmaei, S., Adam, G.C. *Neural Network Modeling Bias for Hafnia-based FeFETs.* Proceedings of the International Symposium on Nanoscale Architectures (NANOARCH), doi: 10.1145/3611315, 2023.
- **Yousuf, O.,** Hossen, I., Daniels, M. W., Lueker-Boden, M., Dienstfrey, A., Adam, G.C. *Device Modeling Bias in ReRAM-based Neural Network Simulations.* In IEEE Journal on Emerging and Selected Topics in Circuits and Systems, doi: 10.1109/JETCAS.2023.3238295, 2023.
- Zhao, J., Huang, S., **Yousuf, O.,** Gao, Y., Hoskins, B. D., Adam, G.C. *Gradient Decomposition Methods for Training Neural Networks with Non-Ideal Synaptic Devices.* In Frontiers in Neuroscience: Neuromorphic Computing, doi: 10.3389/fnins.2021.749811, 2021.
- Hoskins, B. D., Ma, W., Fream, M., **Yousuf, O.,** Daniels, M. W., Goodwill, J., Madhavan, A., Tung, H., Branstad, M., Liu, M., Madsen, R., McClelland, J., Adam, G.C., Lueker-Boden, M. *A System for Validating Resistive Neural Network Prototypes.* In Proceedings of the International Conference on Neuromorphic Systems (ICONS), doi: 10.1145/3477145.3477260, 2021.

POSTERS & PRESENTATIONS

- **Yousuf, O.,** Hoskins, B. D., Ramu, K., Fream, M., Borders, W.A., Madhavan, A., Daniels, M. W., Lueker-Boden, M., Dienstfrey, A., McClelland, J., Adam, G.C. *Daffodil: A Robust Prototyping System for Resistive Device Characterization and Neural Network Implementation.* Poster Presentation at NIST Prep Symposium, November 2023.
- **Yousuf, O.,** Hossen, I., Daniels, M. W., Lueker-Boden, M., Dienstfrey, A., Adam, G.C. *Investigating Bias in the Modeling of ReRAM Devices.* Poster Presentation at International Conference on Memristive Materials, Devices & Systems (MEMRISYS), November-December 2022.
- **Yousuf, O.,** Daniels, M. W., Dienstfrey, A., Adam, G.C. *Towards a Hardware-Aware Decomposition Method for ReRAM Neural Network Training.* Oral Presentation at International Conference on Neuromorphic Systems (ICONS), July 2022.
- **Yousuf, O.,** Daniels, M. W., Dienstfrey, A., Adam, G.C. *Streaming Gradient Tracking using Non-negative Matrix Factorization.* Poster Presentation at GW Research Showcase, George Washington University, April 2022.
- **Yousuf, O.,** Zhao, J., Daniels, M. W., Hoskins, B. D., Ma, W., Maden, R., Lueker-Boden, M., Adam, G. C. *Algorithmic improvements and optimizations for training memristor-based neural networks.* Poster Presentation at Innovation Bazaar by Western Digital: University Track, Neuromorphic Computing, October 2021.
- Daniels, M. W., Hoskins, B. D., Madhavan, A., **Yousuf, O.,** Adam, G. C., Branstad, M., Tung, H., Madsen, R., Lueker-Boden, M., McClelland, J., Stiles, M. D. *Quasisystolic Arrays for Pipelined and Resource-Efficient Neural Network Training.* Best Poster at Sigma Xi NIST: AI, Machine Learning, Engineering, Nanotechnology, and Math, March 2021.