Khaled Abdelaal

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EDUCATION

The University of Oklahoma　　　　　　　　　　　　　　　　　　　　　　　Norman, OK
PhD in Computer Science (High-Performance Computing)　　　　　　　　　　*May 2024 (Expected)*

Lehigh University　　　　　　　　　　　　　　　　　　　　　　　　　　Bethlehem, PA
Master of Science in Computer Engineering　　　　　　　　　　　　　　　　*2020*

Mansoura University　　　　　　　　　　　　　　　　　　　　　　　Mansoura, Egypt
Master of Science in Automatic Control Systems Engineering　　　　　　　　*2017*
- **Thesis:** A Clustering Scheme for Power Management in Asymmetric Multicore Processors

Mansoura University　　　　　　　　　　　　　　　　　　　　　　　Mansoura, Egypt
Bachelor of Science in Computers and Systems Engineering　　　　　　　　　*2013*

TECHNICAL SKILLS

Programming Languages: C/C++, Python, Bash Scripting
Parallel Programming Frameworks: CUDA, OpenMP, HIP, SYCL/DPC++
Compiler Frameworks: LLVM, IGC
Dense and Sparse Linear Algebra Libraries : cuBLAS, cuSparse, MKL, SciPy, SuiteSparse, Eigen
Graph Analysis: networkx, cuGraph
Profiling and Performance Analysis: perf, nvprof, nsight systems, nsight compute, heaptrack
Data Analysis: pandas, cuDF
Documentation: Doxygen, Sphinx

EXPERIENCE

Graduate Research and Teaching Assistant　　　　　　　　　　　Aug. 2022 – Present
The University of Oklahoma　　　　　　　　　　　　　　　　　　　　　*Norman, OK*
- Led research in High-Performance Computing, Graph Processing, and Applied Machine Learning.
- Designed extensible Graph Neural Network-based classifier (98% accuracy) for sparse matrix structure detection, agnostic to node order and reliable against random sub-sampling.
- Innovated robustness evaluation framework, analyzing graph structure variations based on model generation parameters and noise tolerance.
- Optimized storage formats for Kroncker Graph operands in SpMV through performance evaluation of tools like Intel MKL, TACO, SciPy, and cuSparse.
- Utilized CUDA, cuSparse, PyTorch, MKL, TACO, SciPy; proficient in Python, C/C++.

GPU Compiler Engineering Intern　　　　　　　　　　　　　　May 2023 – Aug. 2023
Intel Corporation　　　　　　　　　　　　　　　　　　　　　*Santa Clara, CA (Remote)*
- Spearheaded runtime optimization strategies for diverse GPU workloads using Intel Graphics Compiler (IGC).
- Collaborated with cross-functional teams to integrate GPU performance-enhancing techniques.
- Successfully optimized GPU workloads (at least 3x speedup), contributing to enhanced performance and efficiency.
- Utilized OpenCL Runtime, Level Zero Runtime, and SYCL DPC++ to streamline development and boost application performance.

GPU Compiler Engineering Intern　　　　　　　　　　　　　　May 2022 – Aug. 2022
Intel Corporation　　　　　　　　　　　　　　　　　　　　　*Santa Clara, CA (Remote)*
- Developed and ported multiple workloads to leverage the new DPC++ extension "invoke simd," assessing its impact on programmability and performance.
- Evaluated the benefits of "invoke simd" compared to existing programming models like SPMD and Intel's ESIMD.
- Conducted rigorous testing of Intel Graphics Compiler's existing support for "invoke simd," identifying and reporting bugs and issues to the backend, debug, and code generation teams.

- Collaborated closely with development teams to identify and communicate issues in Intel Graphics Compiler, ensuring seamless integration and robust support for the new extension.

Graduate Teaching Assistant
Aug. 2021 – May 2022

The University of Oklahoma *Norman, OK*

- Led interactive lab sessions for a significant number of students, ensuring comprehension of complex programming principles.
- Demonstrated strong organizational skills in grading lab reports and projects, providing timely feedback to aid student learning.
- Created a supportive learning environment through well-structured office hours, addressing individual queries and concerns.

HPC Research Intern
June 2021 – Aug. 2021

Argonne National Laboratory *Lemont, IL (Remote)*

- Conducted pioneering research in high-performance computing, focusing on optimizing memory traffic in matrix-based applications.
- Achieved up to a 12x reduction in memory traffic using a novel compression and caching technique, surpassing baseline performance.
- Developed a unified parallel framework that seamlessly envelops parallel code written in CUDA, Sycl, and HIP within OpenMP, enhancing code portability and optimization capabilities.

Graduate Research Assistant
Aug. 2020 – June 2021

The University of Oklahoma *Norman, OK*

- Conducted in-depth research on optimizing affine programs on GPGPUs, focusing on automatic selection of near-optimal tile sizes.
- Utilized Integer Linear Programming and the Polyhedral model to guarantee a remarkable performance around 75% of the best empirically found tile configuration performance.
- Developed an innovative Pattern-Aware Vectorization technique for Sparse Matrix Computations, leveraging pattern exploration and vector code generation to accelerate computations.
- Achieved a noteworthy 4.95x speedup over clang auto-vectorization for specific applications using the Facebook graph from SNAP.
- Expertly employed C/C++, SIMD, Python, and Bash Scripting to implement and validate research methodologies, showcasing a comprehensive skillset in diverse technologies.

Graduate Research and Teaching Assistant
Jan. 2018 – Jan. 2020

Lehigh University *Bethlehem, PA*

- Conducted in-depth research in computer architecture, with a specific focus on emerging memory systems (NVM) and In-Memory Processing.
- Designed and simulated a novel hybrid technique for stuck-at fault detection in Phase-Change Memories, yielding an average 9.4% performance enhancement over baseline methods.
- Successfully implemented this technique within the gem5 memory controller module, a widely used architectural open-source simulator.
- Actively participated in Intel's Computer-Assisted Programming for Heterogeneous Architectures (CAPA) program, contributing to advancements in heterogeneous computing.
- Conducted comprehensive benchmarking and performance evaluations using diverse benchmark suites such as PARSEC, SPEC2006/2017, and more.
- Utilized programming languages including C, C++, and Python to realize research objectives.
- Played a pivotal role as a full teaching assistant for ECE033: Introduction to Computer Engineering.

Assistant Lecturer
Dec. 2013 – Present (on leave)

Mansoura University *Mansoura, Egypt*

- Instructed a total of 5 undergraduate courses in Computer Science and Engineering, encompassing an average of 95 students, distributed across 3 to 4 sections.
- Led teaching efforts for a diverse set of courses, including CSE3214 Programming Languages 2, CSE3223 Programming Languages 3, CSE3412 Network Design & Programming, CSE3422 Distributed Computer Systems, and Web Development (Summer training).

- Directed comprehensive teaching activities, spanning lab design, recitations, office hours, and assessment tasks like grading assignments, projects, and exams.
- Demonstrated a commitment to fostering a productive and interactive learning experience, both in and outside the classroom.

PUBLICATIONS

- *Khaled Abdelaal* and Richard Veras. 2024. **A Framework for Analyzing the Performance of Sparse Matrix and Graph Operations**. Under Review.

- *Khaled Abdelaal* and Richard Veras. 2023. **A Framework for Analyzing the Robustness of Graph Models** IEEE High Performance Extreme Computing Conference (HPEC), Virtual Event, USA, 2023.

- *Khaled Abdelaal* and Richard Veras. 2023. **Observe Locally, Classify Globally: Using GNNs to Identify Sparse Matrix Structure**. In Advances in Computational Intelligence: 17th International Work-Conference on Artificial Neural Networks, IWANN 2023, Ponta Delgada, Portugal, June 19–21, 2023, Proceedings, Part I. Springer-Verlag, Berlin, Heidelberg, 149–161. https://doi.org/10.1007/978-3-031-43085-5_12

- Johannes Doerfert, Marc Jasper, Joseph Huber, *Khaled Abdelaal*, Giorgis Georgakoudis, Thomas Scogland, and Konstantinos Parasyris. 2023. **Breaking the Vendor Lock: Performance Portable Programming through OpenMP as Target Independent Runtime Layer**. In Proceedings of the International Conference on Parallel Architectures and Compilation Techniques (PACT '22). Association for Computing Machinery, New York, NY, USA, 494–504. https://doi.org/10.1145/3559009.3569687

- *Khaled Abdelaal* and Martin Kong. 2021. **Tile size selection of affine programs for GPGPUs using polyhedral cross-compilation**. In Proceedings of the ACM International Conference on Supercomputing (ICS '21). Association for Computing Machinery, New York, NY, USA, 13–26.https://doi.org/10.1145/3447818.3460369

- *Khaled Abdelaal*, Richard Veras, and Martin Kong. **"Pattern-Aware Vectorization for Sparse Matrix Computation"**. Poster presented at: 2021 IEEE International Parallel and Distributed Processing Symposium (IPDPS) PhD Forum; April 2021; Portland, OR, USA.

- Chao Zhang, *Khaled Abdelaal*, Angel Chen, Xinhui Zhao, Wujie Wen, and Xiaochen Guo. 2020. **ECC cache: a lightweight error detection for phase-change memory stuck-at faults**. In Proceedings of the 39th International Conference on Computer-Aided Design (ICCAD '20). Association for Computing Machinery, New York, NY, USA, Article 59, 1–9. https://doi.org/10.1145/3400302.3415650

- *Khaled M. Attia*, Mostafa A. El-Hosseini, Hesham A. Ali, **Dynamic power management techniques in multi-core architectures: A survey study**, Ain Shams Engineering Journal, Volume 8, Issue 3, 2017, Pages 445-456, ISSN 2090-4479, https://doi.org/10.1016/j.asej.2015.08.010.

AWARDS

- **NSF Travel Grant for CLUSTER 2023 Conference in Santa Fe, NM**

- **Travel Support provided by Internet2 through funds from NSF Award #2100003, "CI: CoE: Demo Pilot: Advancing Research Computing and Data: Strategic Tools, Prcatices, and Professional Development" to attend PEARC23 Conference in Portland, OR** : 7/22/2023 to 7/27/2023

- **Intel Graphics Academic GPU Donation: Intel ARC 770 to support Doctoral Research** : July, 2023

- **The University of Oklahoma Gallogly College of Engineering Scholarship** : 2022/2023

- **The University of Oklahoma School of Computer Science Alumni Graduate Fellowship Award** Awarded to CS graduate students in good academic standing actively involved in a teaching assistantship (Awarded for 2 years: 2021/2022 - 2022/2023)

- **The University of Oklahoma Provost's Certificate of Distinction in Teaching** Awarded to the top 10% of all graduate assistants across campus by student evaluations for courses taught during the Fall 2021 semester.

- **The University of Oklahoma Gallogly College of Engineering PhD Recruitment Excellence Fellowship** (Academic Year 2020-2021)

- **Mansoura University Best Engineering Graduation Project Award** (Academic Year 2012-2013)

- **Second Place in Mansoura University First Scientific Conference** 2013

- Graduated with Honors in 2013 from Computers and Systems Engineering Department, Mansoura, Egypt