Carson Molder

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Summary

PhD student in Computer Science at UT Austin researching the machine learning models to optimize the computer memory hierarchy. At Google, used ML to tune microarchitectural parameters. Experience with multiple microarchitectural simulators, deep learning, and reinforcement learning.

Education

PhD Computer Science, University of Texas at Austin (3.95 GPA, advised by Calvin Lin) expected 2026

MS Computer Science, University of Texas at Austin (3.95 GPA) expected 2024

BS Computer Engineering, University of Arkansas (4.0 GPA, advised by Justin Zhan) 2021

- *Summa cum laude*, Minors in Mathematics and Physics

Research Experience

Speedway Group, UT Austin 2021 — present
Advisor: Calvin Lin

- Researching the use of reinforcement learning in temporal and spatial prefetching, closing the gap between practical, heuristic-based schemes and impractical, neural network-based schemes
- Developing novel methods that leverage prefetcher and system information to manage a prefetcher's aggressiveness online, improving system performance in memory-intensive applications
- Studied the headroom of schemes to dynamically select the best-performing prefetcher, and choose the best-performing cache partitioning across cores
- Tuned a neural network prefetcher on a distributed cluster, maximizing accuracy while reducing size

CORGi Research Group, Carnegie Mellon University 2020 — 2022
Advisor: Nathan Beckmann

- Created a neural network cache admission policy that reduced writes by 10x and increased cache efficiency by 10% on large-scale storage workloads
- Optimized a cache simulator in Python for admission policies, accelerating runtime by 5x

Data Science and Artificial Intelligence Lab, University of Arkansas 2019 — 2021
Advisor: Justin Zhan

- Created a multimodal neural network that delineates how the volumetrics and diffusion features of brain regions affect adolescent intelligence
- Created a texture model that predicts bone, tumor, and gray matter in MRIs/X-rays with 93% accuracy
- Constructed a bioinformatics pipeline with biology faculty to evaluate the network structure of mitochondria from cell images, with novel levels of detail

Honors Research Experience, University of Arkansas 2017 — 2018

- Evaluated semiconductors that could increase the maximum operating temperature of circuits by over 200%, which is useful for applications like electric vehicle battery control systems
- Awarded "Best Overall Research Project" and "Best Overall Research Paper" at the 10th Annual Honors Engineering Symposium for our final presentation and manuscript

Publications

"Baleen: ML Admission & Prefetching for Flash Caches," D. Wong, H. Wu, C. Molder, S. Gunasekar, J. Lu, S. Khandkar, A. Sharma, D. Berger, N. Beckmann and G. Ganger. *FAST '24*. Feb 2024.

"MitoCellPhe reveals mitochondrial morphologies in single fibroblasts and clustered stem cells," A.B. Bakare *et. al. American Journal of Physiology.* Sep 2021.

"Learning Medical Materials from Radiography Images," C. Molder, B. Lowe, and J. Zhan. *Frontiers in Artificial Intelligence*. Jun 2021.

Manuscripts

"Using Deep Learning to Analyze Materials in Medical Images," C. Molder. Honors Thesis. Apr 2021.

"Enhancing Optocoupler Effectiveness at High Temperatures with Luminescent Wide-Bandgap Semiconductors," D. Eagar and C. Molder. *Proceedings of the 10th Annual Honors Engineering Symposium.* Apr 2018.

Industry Experience

CPU Design Intern, Apple — May 2023 — Aug 2023

- Implemented new simulator infrastructure in an industry-grade CPU simulator
- Studied and analyzed CPU frontend optimizations

Software Engineering Intern, Google — May 2022 — Aug 2022

- Added temporal and memory address-localized statistics tracking to the gem5 system simulator
- Implemented and evaluated a reinforcement learning model to control prefetchers in gem5
- Collaborated with engineers to submit 20+ code contributions to Google's internal gem5 repository

Teaching Experience

Elements of Data Analytics (CS 329E), Teaching Assistant — Spring 2023

Programming for Performance (CS 377P), Teaching Assistant — Fall 2022

- Gave guest lecture on caches and memory hierarchy

Elements of Data Analytics (CS 329E), Teaching Assistant — Fall 2021

Outreach

Directed Reading Program (DiRP), University of Texas at Austin — 2022 — 2023

- Led a computer architecture paper reading group with 5 undergraduate students, reading seminal papers and teaching key concepts

Tutoring — 2021

- Tutored two high school students on artificial intelligence research basics, including neural network concepts, implementations in Python, and scientific writing

Army Education Outreach Program UNITE, University of Arkansas — 2020

- Mentored a group of high school students from underrepresented communities for eight weeks
- Created a college recommendation system for prospective students

Awards

First Ranked Senior Scholar, College of Engineering, University of Arkansas — Apr 2021

Outstanding Computer Engineering Senior, College of Engineering, University of Arkansas — Apr 2021

NSF Graduate Research Fellowship Honorable Mention — Mar 2021

- Recognized for strong fellowship application among 13,000 applicants

Best Overall Research Project and Paper, Honors Engineering Symposium — Apr 2018

- Awarded "Best Overall Project" out of 18 research groups for my work with semiconductors
- Received the "Best Presentation" and "Best Paper" awards in the "Materials" group

Chancellor's List, University of Arkansas — Dec 2017 — May 2021

- Awarded twice-yearly to students who earned a 4.0 GPA for the previous semester

Grants and Scholarships

NSF Graduate Research Fellowship 2023 — present

Honors College Research Team Grant, University of Arkansas 2019 — 2020

- Supported my research in the Data Science and Artificial Intelligence Lab
- Covered costs for research equipment, technology, books, and printing

Charles D. Brock Endowed Scholarship in Engineering 2019 — 2021

Taft, O'Neal, Geels Scholarship 2019 — 2020

Robert and Rosa M. Baker Scholarship 2019 — 2020

Arkansas Academy of Computing Scholarship 2019

Honors College Fellow, University of Arkansas 2017 — 2021

- Awarded for four years to the top 1% of the incoming U of A freshman class
- Covered tuition, room and board, expenses for study abroad, research, technology, and more

Arkansas Governor's Distinguished Scholar 2017 — 2021

- Awarded for four years to the top 3% of Arkansas high school seniors for academic success

Skills

Programming Languages: C++, C, Python, Perl, Verilog, Assembly

Programming Libraries: TensorFlow, PyTorch, Numpy, Pandas, SciPy, Scikit-learn, Matplotlib, Ray

Software: gem5, ChampSim, Linux, Git, Mercurial, bash/tcsh/fish, Anaconda, Jupyter, LaTeX

Experiences

Honors College Seminar, "Little Things" 2020

- Studied how small objects like bubblegum, lip balm, and paper clips shaped the human experience

Razorback Marching Band 2017 — 2020

- Played mellophone (a variant of the French horn) with other students in a 380+ member ensemble
- Prepared halftime shows for every home football game, performing to crowds of 60,000+ people

Honors College Forum, "Flagship U!" 2020

- Met with the U of A chancellor and his executive team to discuss the major aspects and challenges of running a public flagship university

SignBuilder 2019

- Created a web application for designing and creating custom highway sign graphic
- Performed a self-motivated, individual project, using the JavaScript libraries React and Fabric.js

Blockchain Hackathon, Walton College of Business 2017

- Created a prototype of a blockchain system to track food ingredients from farm to store for Tyson Foods with 4 teammates
- Placed in the final 3 teams after a competitive presentation pitch

Activities and Interests

French horn, highways and transportation, world history, classic rock music, college sports, geography, strategy games, technology news and blogs