Cade **Brown**

Software Developer · Mathematician · Digital Artist

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Summary

Hey! I'm Cade Brown and I'm a computer science researcher. My main areas of research are:

- **Machine Learning (ML)**: theory, implementation, and deployment of neural networks
- **High-Performance Computing (HPC)**: distributed/parallel programming and optimization
- **Numerical programming and linear algebra**, specifically on GPUs and distributed systems
- **Computer Vision (CV)**: algorithms and methods for visual processing

Additionally, I also experience and interest in **Human-Computer Interaction (HCI)**, **Programming Language Theory (PLT)**, and robotics. I'm interested in applying mathematical modeling and computing to solve problems in a wide range of fields that it gets difficult to list, so check out my blog for more information: **cade.site/blog**.

Outside of my professional interests, I have personal interests in novel approaches to digital art (ML-generated, data-driven art), philosophy (AI ethics, metaphysics), and all kinds of music. If any of these things interest you (professionally or personally), drop me a line at: **me@cade.site**.

Publications

Design, Optimization, and Benchmarking of Dense Linear Algebra Algorithms on AMD GPUs *(Remote)*
Cade Brown, A. Abdelfattah, S. Tomov, J. Dongarra *2021-09*
- Ported and performance tuned the MAGMA linear algebra library for AMD GPUs (60x faster for some BLAS, 73% faster Eigensolvers)
- **IEEE HPEC 2020: ieeexplore.ieee.org/document/9286214**

Surrogate ML/AI Model Benchmarking for FAIR Principles' Conformance *(Remote)*
P. Luszczek, Cade Brown *2022-09*
- **IEEE HPEC 2022** (pending)

SMCEFR: Sentinel-3 Satellite Dataset *Oak Ridge, TN, USA*
Cade Brown, P. Luzsczek *2022-07*
- This dataset was sponsored for the ORNL Smoky Mountain Conference, as a data challenge for other researchers
- **URL: cade.site/smcefr**

Talks

TuneSM: Autotuning GPU Kernels With Cortex *(Remote)*
Cade Brown @ NVIDIA (internal) *2022*
- Overview of my project at NVIDIA, using ML models to optimize other ML models. (under NDA)

SABATH: ML Surrogate Platform *(Remote)*
Cade Brown @ MLCommons Science *2022*
- Demonstrated the SABATH layer for ML model reproducibility in scientific applications to MLCommons Science

Challenge #6: Sentinel-3 Satellite Dataset *Oak Ridge, TN, USA*
Cade Brown @ Smoky Mountain Conference (ORNL) *2022*
- Introduced the SMCEFR dataset and data challenge questions for researchers at Smoky Mountain Conference at ORNL

MAGMA -> hipMAGMA: Adding HIP Compatibility To A Scientific C++ Library *Knoxville, TN, USA*
Cade Brown @ ICL Annual Conference *2018*
- Demonstrated how HIP can be used on traditional CUDA scientific libraries to produce portable code that runs on AMD GPUs

Program Committees

2022 **Dataset Sponsor**, 2022 Smoky Mountain Conference (ORNL) *Oak Ridge, TN, USA*

Experience

Innovative Computing Lab @ UTK
Knoxville, TN, USA

HPC Research Assistant — *2019-*

- **Accelerating High-Performance-Computing (HPC) workloads** for BLAS and LAPACK libraries targeting supercomputers
- **Developing scientific machine learning platform** for reproducibility of scientific surrogate models using FAIR principles
- **Porting and performance tuning** numerical linear algebra routines for diverse hardware (CPU, GPU, Multi-GPU, ...)
- **Used: CUDA, C/C++, Fortran, Python, MPI, OpenMP, HIP/ROCm, DPC++/OneAPI, PyTorch**

NVIDIA
(Remote)

Compiler Research Intern — *2022*

- **Accelerating training and inference** of machine learning models (LLMs, CNNs, etc) with research compilers
- **Improved GPU kernel code generation** for tensor operations using polyhedral compilation techniques
- **Created ML-assisted code optimization** and autotuning framework to improve selection heuristics
- **Used: CUDA, C/C++, Python, LLVM/MLIR, NumPy, PyTorch, Tensorflow, Matplotlib**

PAIRS Lab @ UTK
Knoxville, TN, USA

HCI Research Assistant — *2021-2022*

- **Developed research prototypes** of developer productivity software aimed at automated error solving
- **Evaluated and improved** graph database queries for terabyte-scale dataset of source code for analytics
- **Used: Java, Python, REST, ArangoDB**

Qardian Labs
Knoxville, TN, USA

Machine Learning Consultant — *2020*

- **Developed a machine learning model** for automated detection of heart health anomalies, given key metrics
- **Deployed a web application** for healthcare professionals to use the model
- **Used: Python, Tensorflow, Django, Heroku**

Oak Ridge National Lab (ORNL)
Oak Ridge, TN, USA

Research Intern — *2017-2018*

- **Developed interactive scientific simulations** running in real-time in a distributed cluster computer (SimpleSummit/Bubbles)
- **Aided in physical fabrication** for the cluster computer design, 3D-printed by MDF to hold 8x NVIDIA Jetsons
- **Implemented and ran benchmarks** to measure scalability of the Lustre parallel filesystem on Titan supercomputer
- **Used: C/C++, CUDA, Python, MPI, SDL, Blender**
- **URL: simplesummit.github.io**

Free Software Foundation (FSF/GNU)
(Remote)

Open Source Contributor — *2016-2017*

- **Implemented arbitrary precision arithmetic** for scientific functions in MPFR
- **Assisted other researchers** in mailing lists for problems encountered
- **URL: mpfr.org**

Agilaire LLC
Knoxville, TN, USA

Software Consultant — *2015*

- **Designed and implemented** pilog, a Raspberry Pi data logger and server that records and reports air quality metrics
- **Lead and architected** the programming department, consisting of 3-5 other developers
- **Used: Java, Python, OpenCV, hardware**

Education

University of Tennesee Knoxville (UTK)
Knoxville, TN, USA

Bachelor's Degree in Computer Science — *2019-2023**

- FIRST Robotics Alumni Scholarship
- Trey Brown Engineering Scholarship
- Col. Lockett Engineering Scholarship
- UT Volunteer Scholarship

Projects

kscript: a dynamic programming language
Knoxville, TN, USA

Cade Brown — *2018-2020*

- This is a programming language I wrote from scratch, similar to Python but faster for some things and a *better syntax*
- **Used: C/C++, Python, GMP, FFTW, FFMPEG/libav*, WebAssembly (WASM), GNU readline**
- **URL: kscript.org | term.kscript.org (online REPL) | docs.kscript.org (documentation)**

mycc: A C compiler using LLVM

Knoxville, TN, USA

Cade Brown *2021*

- This is a C compiler (well, a subset of C) that I wrote for a compilers class to update the teacher's example to use modern LLVM and C++ constructs
- Supports external linking, arrays, functions, and can implement matrix multiplication, cat program, and more examples
- **Used: C/C++, LLVM/JIT**
- **URL: github.com/cadebrown/mycc**

Blok: Minecraft-style Game From Scratch

Knoxville, TN, USA

Cade Brown *2020*

- I wrote this from scratch to show how to make a Minecraft-style voxel game from scratch, including world generation, chunk rendering, mesh generation, input, and so forth in C/C++
- **Used: OpenGL, GLFW, AssImp, FreeType, PortAudio**
- **URL: github.com/cadebrown/blok**

CARVE: Cade Andgreg's RISC-V Emulator

Knoxville, TN, USA

Cade Brown, Gregory Croisdale *2020*

- A free web IDE to run and debug RISC-V assembly, with memory/stack explorer and helpful hints
- **Used: C/C++, Python, JavaScript, HTML/CSS, WebAssembly (WASM), RISC-V**
- **URL: carve.cade.site**

My Research/Personal Blog

Knoxville, TN, USA

Cade Brown *2015-*

- My online presence, including blog posts, papers, diagrams, and more
- **URL: cade.site/blog**

Semi-Autonomous Robot Design

Knoxville, TN, USA

FIRST Robotics #3966 *2015-2018*

- I was the lead programmer on my robotics team, which included design and implementation of semi-autonomous robots that compete against other teams.
- **Video: cade.site/robotvideo**