

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 expertise are:

- **Machine Learning (ML)**: theory, implementation, and deployment
- **High-Performance Computing (HPC)**: distributed/parallel programming and optimization
- **Numerical programming and linear algebra**, specifically on GPUs

Additionally, I also experience and interest in Human-Computer Interaction (HCI), Programming Language Theory (PLT), machine-generated art, and process automation. I'm interested in applying mathematical modelling 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), music (I'm actually in a signed band: Dymorphic Demiurge), and futurology (the study of technological progress and the future). 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. ABDELFAH, 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**

SLATE Port to AMD and Intel Platforms

(Internal)

ABDELFAH, A., M. AL FARHAN, CADE BROWN, M. GATES, D. SUKKARI, A. YARKHAN, AND J. DONGARRA

2021-04

- **Tech Report: icl.utk.edu/publications/swan-016**

SMCEFR: Sentinel-3 Satellite Dataset

Oak Ridge, TN, USA

CADE BROWN, P. LUSZCZEK

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, an internal technical talk for members of the ML compiler group

SABATH: Progress On ML Surrogate Platform

(Remote)

CADE BROWN @ MLCOMMONS SCIENCE

2022

- Explained the SABATH layer for ML model reproducibility in scientific applications to MLCommons working group committee

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

- Explained how HIP can be used on traditional CUDA scientific libraries to produce portable code that runs on AMD GPUs

Experience

Innovative Computing Lab @ UTK

HPC RESEARCH ASSISTANT

Knoxville, TN, USA

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

COMPILER RESEARCH INTERN

(Remote)

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

HCI RESEARCH ASSISTANT

Knoxville, TN, USA

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

MACHINE LEARNING CONSULTANT

Knoxville, TN, USA

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)

RESEARCH INTERN

Oak Ridge, TN, USA

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
- **Used:** C/C++, CUDA, Python, MPI, SDL
- **URL:** simplesummit.github.io

Free Software Foundation (FSF/GNU)

OPEN SOURCE CONTRIBUTOR

(Remote)

2016-2017

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

FIRST Robotics #3966

PROGRAMMING LEAD

Knoxville, TN, USA

2015-2018

- **Designed and implemented** semi-autonomous robots and control software for competitions against other teams
- **Lead and architected** the programming department, consisting of 3-5 other developers with delegated work
- **Used:** Java, Python, OpenCV, hardware

Agilaire LLC

SOFTWARE CONSULTANT

Knoxville, TN, USA

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

Honors & Awards

2018 **International Finalist**, Intel Science and Engineering Fair (ISEF)

Pittsburgh, PA, USA

2018 **National Security Agency Future Computing Award**, ISEF

Pittsburgh, PA, USA

2018 **Grand Reserve Champion**, Southern Appalachian Science and Engineering Fair (SASEF)

Knoxville, TN, USA

2018 **Intel Excellence in Computer Science**, SASEF

Knoxville, TN, USA

2017 **Guinness World Record**, Largest Computer Programming Lesson

USA

Program Committees

2022 **Dataset Sponsor**, 2022 Smoky Mountain Conference (ORNL)

Oak Ridge, TN, USA

Education

University of Tennessee Knoxville (UTK)

B.S. IN COMPUTER SCIENCE

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

Knoxville, TN, USA

2019-2023*

Projects

kscript: a dynamic programming language

CADE BROWN

Knoxville, TN, USA

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

CADE BROWN

Knoxville, TN, USA

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

CADE BROWN

Knoxville, TN, USA

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

CADE BROWN, GREGORY CROISDALE

Knoxville, TN, USA

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

CADE BROWN

Knoxville, TN, USA

2015-

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