

# Cade Brown

SOFTWARE DEVELOPER · MATHEMATICIAN · DIGITAL ARTIST

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## Summary

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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

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](https://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](mailto:me@cade.site).

## Publications

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### **Design, Optimization, and Benchmarking of Dense Linear Algebra Algorithms on AMD GPUs** (Remote)

CADE BROWN, A. ABDELFAH, S. TOMOV, J. DONGARRA

2021-09

- Optimized the MAGMA linear algebra library for AMD GPUs (73% faster time-to-solution).
- **IEEE HPEC 2020: [ieeexplore.ieee.org/document/9286214](https://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. LUSZCZEK

2022-07

- I was a dataset sponsor for the ORNL Smoky Mountain Conference, for other researchers to use.
- **URL: [cade.site/smcefr](https://cade.site/smcefr)**

## Talks

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### **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 reproducibility in scientific ML models 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 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 CUDA scientific libraries to produce portable code for AMD GPUs

## Program Committees

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

Oak Ridge, TN, USA

## Experience

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### Innovative Computing Lab @ UTK

*Knoxville, TN, USA*

RESEARCH ASSISTANT (HPC)

2019-

- **Accelerated High-Performance-Computing (HPC) workloads** for BLAS and LAPACK libraries targeting supercomputers
- **Developed scientific machine learning platform** for reproducibility of scientific surrogate networks using FAIR principles
- **Ported and performance tuned** 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)*

MACHINE LEARNING INTERN

2022

- **Accelerated 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*

RESEARCH ASSISTANT (HCI)

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

- **Trained and validated a machine learning model** for automated detection of health anomalies, given medical metrics
- **Deployed a web application** for healthcare professionals to use the model
- **Used: Python, Tensorflow, Django, Heroku, Google Cloud SDK**

### Oak Ridge National Lab (ORNL)

*Oak Ridge, TN, USA*

RESEARCH INTERN (HPC)

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 super-computer
- **Used: C/C++, CUDA, Python, MPI, SDL, Blender**
- **URL: [simplesummit.github.io](https://simplesummit.github.io)**

### 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
- **Used: Python, Django, hardware, HTML/JS/CSS**

## Education

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### University of Tennessee Knoxville (UTK)

*Knoxville, TN, USA*

BACHELOR'S DEGREE IN COMPUTER SCIENCE

2019-2023\*

- FIRST Robotics Alumni Scholarship

## Projects

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### My Personal Website

*Knoxville, TN, USA*

CADE BROWN

2015-

- My research blog, digital artwork, and more. Contains useful links, tutorials, and posts.
- **URL: [cade.site/blog](https://cade.site/blog)**

## **kscript: a dynamic programming language**

*Knoxville, TN, USA*

CADE BROWN

2018-2020

- **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](http://kscript.org) | [term.kscript.org](http://term.kscript.org) (online REPL) | [docs.kscript.org](http://docs.kscript.org) (documentation)**

## **mycc: A C compiler using LLVM**

*Knoxville, TN, USA*

CADE BROWN

2021

- **A C compiler that I wrote** for a compilers' class to replace the professors's lab by using 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](https://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](https://github.com/cadebrown/blok)**

## **CARVE: Cade Andgreg's RISC-V Emulator**

*Knoxville, TN, USA*

CADE BROWN, GREGORY CROISDALE

2020

- A free web RISC-V 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](http://carve.cade.site)**

## **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](http://mpfr.org)**

## **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](http://cade.site/robotvideo)**