

JOSHUA J. BAKITA

<https://jbakita.me/>

EDUCATION

- Doctor of Philosophy in Computer Science**, *University of North Carolina at Chapel Hill* Aug. 2019 - May 2024
- Master of Science in Computer Science**, *University of North Carolina at Chapel Hill* Aug. 2018 - May 2019
- Courses of Note: Real-Time Sys, Computer Vision, OS Impls, Data Ctr. Sys & Programming, Data Ctr. Software Dynamics
- Bachelor of Science in Computer Science**, *University of North Carolina at Chapel Hill* Aug. 2014 - May 2018
- **Graduated with Honors** | 3.57 Computer Science Course GPA | Fall 2016 Honors Study Abroad in London
 - Courses of Note: Digital Logic & Computer Design, 2D Graphics, OS, Computer Security, Data Compression

RESEARCH EXPERIENCE

- Dept. Computer Science - UNC Chapel Hill**, *Research Assistant with Dr. James H. Anderson* Aug. 2018 - Current
- Research goal: Enable real-time heterogeneous systems to operate safely and efficiently for autonomous vehicles
 - **Linux kernel contributor**, LITMUS-RT maintainer, and kernel module developer (pubs: Journal of RTS'21)
 - Exploring safe **GPU sharing for real-time systems** (pubs: RTSS'21, RTAS'19, ECRTS'18, **OSPRT'18**)
 - Produced a sub-1%-overhead GPU core partitioning library and reverse engineered GPU scheduling (pub: **RTAS'23**)
 - Built transparent GPU memory oversubscription scheme **3x** faster than demand paging in Linux (pub: **RTSS'22**)
 - Tech lead for the MC² project, a patch enabling Linux to predictably schedule and isolate mixed-criticality real-time tasks on multicore systems. Work published as **1st author at RTAS'21**. Some components of my work include:
 - Analyzing how isolation in caches, DRAMs, and memory buses on multicore ARM and x86 affects exec. time variability
 - Developing novel ways to isolate, e.g. NUMA-based **O(1) page coloring** in Linux's allocator (O(n) prior state-of-the-art)
 - Rewrote MC² to allow for predictable execution times when using SMT, boosting schedulable utilization by 22%
 - Constructed techniques to allow real-time systems to use SMT to address **FAA need** (pubs: RTAS'22, ECRTS'19)
- General Motors Research**, *Research & Development Intern*, Remote June 2020 - Aug. 2020
- Developed and evaluated lossless GPU parallelization techniques in **CUDA** and **C++** for autonomous vehicle perception DNNs
 - New approach enables **one device to do the work of two** at comparable latency by reducing ctx. switches in the GPU MMU
- Dept. Computer Science - UNC Chapel Hill**, *Undergrad Research Assistant with Dr. Henry Fuchs* June 2015 - Dec. 2015
- Led a team of 5 undergraduates to apply embedded wearable accelerometers for motion tracking
 - Personal contributions in **C** on Arduino and **Java** on Android plus a high-efficiency bluetooth data transmission protocol

TEACHING EXPERIENCE

- Dept. Computer Science - UNC Chapel Hill**, *Instructor of Record for COMP 211* Jan. 2023 - May 2023
- Developing curriculum and teaching **C**, **Linux**, and more in *Systems Programming Fundamentals*, the 3rd intro CS course
 - Leading a team of 6 undergraduate and 1 graduate teaching assistants in order to teach **154 students**
- Dept. Computer Science - UNC Chapel Hill**, *Teaching Assistant for COMP 524* Jan. 2019 - May 2019
- Taught **Haskell**, **Rust**, **Julia**, and **Go** to illustrate fundamental programming language concepts
 - Graded assignments and tests, taught selected classes, and held up to 20 hours of office hours a week for students
 - Honored with "**Teaching Assistant of the Year**" award by CS undergraduates and faculty. Nominated by >30% of class

PUBLICATIONS

- J. Bakita**, J. H. Anderson, "Hardware Compute Partitioning on NVIDIA GPUs", *Proceedings of the 29th IEEE Real-Time and Embedded Technology and Applications Symposium*, to appear, May 2023.
- J. Bakita**, J. H. Anderson, "Enabling GPU Memory Oversubscription via Transparent Paging to an NVMe SSD", *Proceedings of the 43rd Real-Time Systems Symposium*, pp. 370-382, Dec 2022.
- S. Osborne, **J. Bakita**, J. Chen, T. Yandrofski, J. H. Anderson, "Minimizing DAG Utilization by Exploiting SMT", *Proceedings of the 28th IEEE Real-Time and Embedded Technology and Applications Symposium*, pp. 267-280, May 2022.
- T. Amert, Z. Tong, S. Voronov, **J. Bakita**, F.D. Smith, and J. H. Anderson, "TimeWall: Enabling Time Partitioning for Real-Time Multicore+Accelerator Platforms", *Proceedings of the 42nd Real-Time Systems Symposium*, pp. 455-468, Dec 2021.
- J. Bakita**, S. Ahmed, S.H. Osborne, S. Tang, J. Chen, F.D. Smith, and J. H. Anderson, "Simultaneous Multithreading in Mixed-Criticality Real-Time Systems", *Proceedings of the 27th IEEE Real-Time and Embedded Technology and Applications Symposium*, pp. 278-291, May 2021.
- C. Hobbs, Z. Tong, **J. Bakita**, and J. H. Anderson, "Statically Optimal Dynamic Soft Real-Time Semi-Partitioned Scheduling", *Real-Time Systems, special issue of outstanding papers from the 27th International Conference on Real-Time Networks and Systems*, pp. 97-140, 57.1, April 2021.

S. Osborne, **J. Bakita**, and J. H. Anderson, “Simultaneous Multithreading Applied to Real Time”, *Proceedings of the 31st Euromicro Conference on Real-Time Systems*, pp. 3:1-3:22, July 2019.

M. Yang, S. Wang, **J. Bakita**, T. Vu, F.D. Smith, J. H. Anderson, and J.-M. Frahm, “Re-thinking CNN Frameworks for Time-Sensitive Autonomous-Driving Applications: Addressing an Industrial Challenge”, *Proceedings of the 25th IEEE Real-Time and Embedded Technology and Applications Symposium*, pp. 305-317, April 2019.

J. Bakita, N. Otterness, J. H. Anderson, and F.D. Smith, “Scaling Up: The Validation of Empirically Derived Scheduling Rules on NVIDIA GPUs”, *Proceedings of the 14th Annual Workshop on Operating Systems Platforms for Embedded Real-Time Applications*, pp. 49-54, July 2018.

M. Yang, N. Otterness, T. Amert, **J. Bakita**, J. H. Anderson, and F.D. Smith, “Avoiding Pitfalls when Using NVIDIA GPUs for Real-Time Tasks in Autonomous Systems”, *Proceedings of the 30th Euromicro Conference on Real-Time Systems*, pp. 20:1-20:21, July 2018.

TECHNICAL EXPERIENCE

Waymo, *Software Engineering Intern*, Remote May 2021 - Aug. 2021

- Worked on the Onboard Compute Optimization Team to improve planner GPU utilization and CPU SIMD efficiency
- Reimplemented edge construction for on-vehicle planner search graph on GPU using **C++** and **CUDA**

Microsoft Corporation, *Software Engineering Intern*, Redmond, WA May 2018 - Aug. 2018

- Worked in **C++** on the Web Platform Team to help build the Edge browser (>**100 million active users**) + Windows app APIs
- Implemented CSS parser, DOM interface, and **GPU-accelerated rendering** for background-blend-mode and mix-blend-mode (used by .04% and .111% of all web pages per Bing, both are top 55% most used CSS properties)
- Wrote web platform interoperability tests in **HTML**, **CSS**, and **JavaScript** to benchmark and beat Chrome’s implementation

Microsoft Corporation, *Software Engineering Intern*, Issaquah, WA May 2017 - Aug. 2017

- Redesigned architecture for lead unsubscribe, **increasing speed 2x** for customer and protecting from **over \$3B** in fines
- Worked in **C#** and **SQL** on enrichment and privacy management systems processing over **16 million leads** weekly
- Upgraded, unified, and simplified logging in lead enrichment and privacy sync systems to enable business alerting

House of Commons of the United Kingdom, *Parliamentary Intern for James Berry MP*, London, UK Sep. 2016 - Dec. 2016

Capital One Financial Corporation, *Software Engineering Intern (TDP)*, McLean, VA June 2016 - Aug. 2016

- Refactored free CreditWise tool (>**11 million active users**) to **speed up deployment 10x**, startup by 2x, and testing by ~2x
- Full stack development in **Java**, Spring MVC, **CSS**, **HTML**, and **AngularJS** on Apache Tomcat in **AWS EC2**
- Optimized test workflow, removed all proprietary libraries, and significantly slimmed backend codebase size

Wildfire Games, *Open-Source Game Developer* June 2013 - Aug. 2014

- Led a team to develop an online multiplayer matchmaking lobby and ranking system based on XMPP for 0 A.D. RTS
- Worked with **C++**, **JavaScript**, and XML client-side, **Python** and **Erlang** server-side

SELECTED PROJECTS

MIPS I Processor: Full, consumable implementation of the MIPS I instruction set using Verilog on the Nexys 4 FPGA

SafeShare: A vehicle-sharing platform built on mathematically verifiable trust via the Ethereum blockchain

- **Won Best Use of the Blockchain, Best Hack Addressing Inequality** and two other awards at HackDuke 2017

SGI Keyboard Driver: A Linux kernel module implementing support for SGI’s serial keyboards (partially reverse engineered)

UNC Energy Dashboard: A way to monitor and react to energy usage on-campus | **Won Microsoft Challenge** at HackNC ‘15

Share Sphero: Cross-platform, multi-user, shared real-time control of the Sphero robot using Web Sockets and HTML5

SERVICE

Graduate and Professional Student Government, *Senator* Aug. 2020 - Current

- Sole elected representative of the graduate students in the Computer Science Department to the university administration
- President Pro Tempore of the Senate, Sept. 2022 - Current
- Chair of Senate Finance Committee, Aug. 2021 - Sept. 2022

Computer Science Students Association, *President* Aug 2021 - Current

Computer Science Students Association, *Officer* May 2020 - Aug 2021

- Represent the graduate students in the Computer Science Department to department faculty
- Led efforts to reduce undergraduate cheating, helped rework PhD background requirements, and increased transparency

UNC Renewable Energy Special Projects Committee (RESPEC), *Voting Member* Sep. 2014 - May 2019

- Collaborated with a committee of over 15 students to **manage over \$1M** for renewable energy initiatives on campus

UNC Computer Science Club, *President* May 2017 - Aug. 2018

Rancho 3M Christian School and Orphanage, *Missions Trip Volunteer*, Guadalupe, Mexico 2010,11,13,15,16,19

Eagle Scout; Boy Scouts of America, *Troop 94* 2007 - 2014