Cody Rivera

Curriculum Vitae
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Education

2022–present	**Ph.D. in Computer Science**, *University of Illinois Urbana-Champaign*, Urbana, IL GPA: 3.97/4.0. *Advisor: Tianyin Xu.*
2022–2024	**M.S. in Computer Science**, *University of Illinois Urbana-Champaign*, Urbana, IL GPA: 3.97/4.0. *Advisor: Madhusudan Parthasarathy.*
2018–2022	**B.S. in Computer Science and Mathematics**, *University of Alabama*, Tuscaloosa, AL GPA: 4.0/4.0. *Summa Cum Laude, University Honors.*

Research Experience

2024–present	**Graduate Research Assistant, XLab**, *University of Illinois Urbana-Champaign*, Urbana, IL *Advisor: Tianyin Xu.* Verify liveness properties of interacting Kubernetes cloud cluster controllers. Extend the Anvil verification framework to support compositional verification and verify example controller interactions.
2022–2024	**Graduate Research Assistant**, *University of Illinois Urbana-Champaign*, Urbana, IL *Advisor: Madhusudan Parthasarathy.* Developed a discipline for predictable automated verification on top of intrinsic, or local, definitions. Demonstrated this discipline by verifying functional correctness of a suite of data structure operations.
2022–2024	**Graduate Research Assistant**, *University of Illinois Urbana-Champaign*, Urbana, IL *Advisor: Mahesh Viswanathan.* Extended dReal, an approximate SMT solver on the Reals, with integration. Evaluated the extended solver on verification and synthesis queries in domains such as differential privacy and algorithmic fairness.
2019–2022	**Undergraduate Research Assistant, High-Performance Data Analytics and Computing (HiPDAC) Lab**, *University of Alabama*, Tuscaloosa, AL *Advisor: Dingwen Tao.* Researched parallel algorithms and engineered GPU kernels for tasks including compression and linear algebra operations to improve the performance of scientific computing codes.
Summer 2021	**Science Undergraduate Laboratory Internship (SULI) Program Intern**, *Argonne National Laboratory*, Virtual Internship *Advisor: Sheng Di.* Improved the performance of custom lossy decompression on multidimensional floating-point datasets by implementing optimized parallel Huffman decoding on GPUs.

Publications

Drafts and Preprints

C. Rivera, B. Bhusal, R. Chadha, A.P. Sistla, and M. Viswanathan, "Checking δ-Satisfiability of Reals with Integrals," Conditionally Accepted to a Conference, 2024.

Conference Publications

PLDI 2024   A. Murali, **C. Rivera**, and P. Madhusudan, "Predictable Verification using Intrinsic Definitions," *Proceedings of the ACM on Programming Languages,* Volume 8, Issue PLDI, 2024, pp. 1804-29. **ACM Europe Best Paper Award**.

IPDPS 2022   **C. Rivera**, S. Di, J. Tian, X. Yu, D. Tao, and F. Cappello, "Optimizing Huffman Decoding for Error-Bounded Lossy Compression on GPUs," *The 36th IEEE International Parallel and Distributed Processing Symposium*, Virtual Event, May 30-June 3, 2022, pp. 717-27.

Cluster 2021   J. Tian, S. Di, X. Yu, **C. Rivera**, K. Zhao, S. Jin, Y. Feng, X. Liang, D. Tao, and F. Cappello, "Optimizing Error-Bounded Lossy Compression for Scientific Data on GPUs," *2021 IEEE International Conference on Cluster Computing*, Virtual Event, September 7-10, 2021, pp. 283-93.

IPDPS 2021   J. Tian, **C. Rivera**, S. Di, J. Chen, X. Liang, D. Tao, and F. Cappello, "Revisiting Huffman Coding: Toward Extreme Performance on Modern GPU Architectures," *The 35th IEEE International Parallel and Distributed Processing Symposium*, Virtual Event, May 17-21, 2021, pp. 881-91.

PACT 2020   J. Tian, S. Di, K. Zhao, **C. Rivera**, M. H. Fulp, R. Underwood, S. Jin, X. Liang, J. Calhoun, D. Tao, and F. Cappello, "cuSZ: An Efficient GPU-Based Error-Bounded Lossy Compression Framework for Scientific Data," *The 29th International Conference on Parallel Architectures and Compilation Techniques*, Atlanta, GA, Oct 3-7, 2020, pp. 3-15.

Other Publications

;login: X. Sun, J. Gu, **C. Rivera**, T. Chajed, J. Howell, A. Lattuada, O. Padon, L. Suresh, A. Szekeres, T. Xu, "Anvil: Building Kubernetes Controllers That Do Not Break," *USENIX ;login:*, 2024.

JPDC   **C. Rivera**[*], J. Chen[*], N. Xiong, S. Song, and D. Tao, "TSM2X: High-Performance Tall-and-Skinny Matrix-Matrix Multiplication on GPUs," *Journal of Parallel and Distributed Computing*, Volume 151, 2021, pp. 70-85.

Awards

June 2024   **ACM Europe Best Paper Award**, *PLDI 2024, For "Predictable Verification Using Intrinsic Definitions"*

October 2023   **Travel Grant**, *Midwest Programming Languages Summit, University of Michigan*

January 2023   **PLMW Travel Grant**, *POPL 2023, ACM SIGPLAN*

2022–2027   **Graduate College Fellowship**, *University of Illinois Urbana-Champaign*

2022–2027   **SURGE Fellowship**, *Grainger College of Engineering, University of Illinois Urbana-Champaign*

2022–2023   **Wing Kai Cheng Fellowship**, *Siebel School of Computing and Data Science, University of Illinois Urbana-Champaign*

June 2022   **Travel Grant**, *Oregon Programming Languages Summer School, University of Oregon*

May 2022   **Outstanding Undergraduate Award**, *Department of Computer Science, University of Alabama*

Fall 2021   **R&D 100 Award**, *For "SZ: A Lossy Compression Framework for Scientific Data"*

2018–2022   **Fellowship Award**, *Randall Research Scholars Program, University of Alabama*

2018–2022   **Presidential Scholarship**, *University of Alabama*

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[*]Equal contribution

Software

Anvil
A framework for implementing Kubernetes controllers and verifying liveness properties in Verus, a Rust verification tool. Verified implementations of builtin controllers and features supporting compositional verification are under development. [URL: `https://github.com/anvil-verifier/anvil`]

IDS Artifact
A suite of 42 operations over 10 data structures verified for functional correctness in Boogie to demonstrate intrinsic definitions. Data structures include lists, trees, and a List/BST overlay similar to that in the Linux I/O scheduler. [URL: `https://github.com/codyjrivera/ids-artifact`]

cuSZ
A GPU version of SZ, an error-bounded lossy compressor for scientific data, implemented in CUDA C++. Incorporates optimized kernels for custom Huffman codebook construction and decoding. [URL: `https://szcompressor.org/`]

TSM2X
A collection of two GPU algorithms for multiplying irregular-shaped tall-and-skinny matrices: TSM2L and TSM2R. The CUDA C++ implementations obtain average speedups of 1.9x over the vendor-supplied CUBLAS library. [URL: `https://github.com/codyjrivera/tsm2x-imp`]

Technical Skills and Coursework

Programming Languages: C, C++, Python, Java, Dafny, Boogie, Rust, OCaml, JavaScript, TypeScript

Platforms and Tools: Z3, Verus, CUDA, OpenMP, Google Cloud, Kubernetes, HTML, CSS, LaTeX

Relevant Coursework:
- **University of Illinois:** Proof Automation, Compiler Construction, Logic in Computer Science, Formal Software Development Methods, Trustworthy AI Systems, Programming Language Design, Distributed Systems
- **University of Alabama:** Programming Languages, Compiler Construction, Real Analysis I and II, Abstract Algebra I and II, General Topology, Algebraic Topology

Teaching Experience

Fall 2024
Graduate Teaching Assistant (CS 421: Programming Languages and Compilers), *University of Illinois Urbana-Champaign*, Urbana, IL

Fall 2020
Spring 2020
Fall 2019
Undergraduate Teaching Assistant (CS 100: Computer Science I for Majors), *University of Alabama*, Tuscaloosa, AL

Other Experience

Summer 2020
Student Training in Engineering Program (STEP) Intern, *Google*, Virtual Internship
Developed GrowPod, a web app that allows users to join, create, and administer community gardens using Google Cloud App Engine and Angular.

Workshops and Summer Schools

October 2023
Midwest Programming Languages Summit, *University of Michigan*, Ann Arbor, MI
Poster: "Predictive Verification using Intrinsic Definitions of Data Structures."

January 2023
Programming Languages Mentoring Workshop, *POPL 2023*, Boston, MA

June 2022
Oregon Programming Languages Summer School, *University of Oregon*, Eugene, OR