Robert Underwood

✉ rr.underwood94@gmail.com • 🌐 robertu94.github.io

🐙 github.com/robertu94

Education

Clemson University   **Clemson, SC**
PhD in Computer Science, GPA 3.92/4.0   *December 2021*
Dissertation: Approachable Error Bounded Lossy Compression
Passed Qualifying Exam: May 2018
Co-Advisers: Dr. Amy Apon, Dr. Jon Calhoun, and Dr. Franck Cappello

Clemson University   **Clemson, SC**
Master of Science in Computer Science, GPA 4.0/4.0   *August 2018*
Concentration: Systems and Implementation

Clemson University, Calhoun Honors College   **Clemson, SC**
Bachelor of Science, Suma Cum Laude in Computer Science, GPA 4.0/4.0   *December 2016*
Honors Thesis: Automation in the Classroom, Adviser: Dr. Jacob Sorber

Research Experience

Argonne National Laboratory   **Lemont, IL**
Assistant Computer Scientist   *2024-*
○ Researched Multi-modal data and systems software for AI
  - coLead of AuroraGPT Data Team with Ian Foster 2024-present
○ Researched applications and approaches of lossy compression to ensure data integrity.
○ Researched limits of compress-ability of lossy compression.
○ Researched data movement and check-pointing systems

Argonne National Laboratory   **Lemont, IL**
Post Doctoral Appointee   *2022-2024*
○ Researched Multi-modal data and systems software for AI
  - coLead of AuroraGPT Data Team with Ian Foster 2024-present
○ Researched applications and approaches of lossy compression to ensure data integrity.
○ Researched data movement and checkpointing systems

Clemson University   **Clemson, SC**
Clemson Data Intensive Computing Environments   *2016-2021*
○ Researched and modeled reliability and performance of applications using lossy compression
○ Developed techniques to understand the impacts of lossy compression on AI applications
○ Designed experiments to analyze performance of high performance computing systems
○ Designed models to understand and improve the reliability of computer infrastructure
○ Researched trade-offs of compressor agnostic tooling for scientific applications

Argonne National Laboratory   **Lemont, IL**
Under Dr. Franck Cappello   *Summer-Fall 2019*

- Researched the design of optimization based techniques for enforcing user-level error bounds
- Designed and implemented LibPressio – a generic abstraction between compression libraries
- Contributed to the design and implementation of SZ – a lossy compression framework – for CPUs and GPUs

Clemson University   **Clemson, SC**
Clemson PERSIST Lab   *2015-2016*

- Designed and developed an automated grading framework using Python, C, Raspberry Pi, and Docker
- System used modular design, supports process isolation, and multiple test formats

Publications

[1] Poulous, A., **Underwood, R.**, Calhoun, J. C., Di, S., Cappello, F., *Sensitivity of Black-Box Statistical Prediction of Lossy Compression Ratios for 3D Scientific Data*. **co-Author (concept, investigation, methodology, advising, software design, authoring, and editing), To Appear**. 2025. DOI: TBD.

[2] Siebenschuh, C., Hippe, K., Gokdemir, O., Brace, A., Khan, A. M., Hossain, K., Babuji, Y., Chia, N., Vishwanath, V., Ramanathan, A., Stevens, R. L., Foster, I., **Underwood, R.,** "AdaParse: An Adaptive Parallel PDF Parsing and Resource Scaling Engine". In: *Eighth Conference on Machine Learning and Systems*. **Author (concept, investigation, methodology, advising, authoring, and editing), To Appear**. 2025. DOI: TBD.

[3] Song, S., **Underwood, R.**, Huang, Y., Di, S., Jiang, P., Cappello, F., *An Efficient and Computation-balanced Lossy Compressor on Wafer-Scale Engine*. **co-Author (concept, investigation, methodology, advising, software design, authoring, and editing), To Appear**. 2025. DOI: TBD.

[4] **Underwood, R.**, Liu, J., Zhao, K., Di, S., Cappello, F., "Evaluating Advanced Scientific Compressors on Climate Datasets". In: *European Geospatial Union*. **Author (concept, investigation, methodology, software design, authoring, and editing), To Appear**. 2025. DOI: TBD.

[5] Zhang, L., Li, R., Ren, C., Di, S., Liu, J., Huang, J., **Underwood, R.**, Grosset, P., Tao, D., Liang, X., Guo, H., Cappello, F., Zhao, K., "LCP: A High-Performance Scientific Lossy Compressor for Particles". In: *Proceedings of the ACM on Management of Data* (2025). **co-Author (investigation, editing)**. DOI: 10.1145/3709700.

[6] Agarwal, T., Di, S., Huang, J., Huang, Y., Gopalakrishnan, G., **Underwood, R.**, Zhao, K., Liang, X., Li, G., Cappello, F., "SZOps: Scalar Operations for Error-bounded Lossy Compressor for Scientific Data". In: *2024 IEEE/ACM 10th International Workshop on Data Analysis and Reduction for Big Scientific Data (DRBSD)*. **co-Author (investigation, methodology, and editing), Published**. 2024. DOI: 10.1109/SCW63240.2024.00042.

[7] Cappello, F., Di, S., **Underwood, R.**, Tao, D., Calhoun, J., Kazutomo, Y., Sato, K., Singh, A., Giraud, L., Agullo, E., Yepes, X., Acosta, M., Jin, S., Tian, J., Vivien, F., Zhang, B., Sano, K., Ueno, T., Grützmacher, T., Anzt, H., "Multifacets of lossy compression for scientific data in the Joint-Laboratory of Extreme Scale Computing". In: *Future Generation Computer Systems* (2024). **co-Author (authoring, and editing)**. ISSN: 0167-739X. DOI: https://doi.org/10.1016/j.future.2024.05.022.

[8] Grützmacher, T., **Underwood, R.**, Di, S., Cappello, F., Anzt, H., "FRSZ2 for In-Register Block Compression Inside GMRES on GPUs". In: *2025 IEEE/ACM 10th International Workshop on Data Analysis and Reduction for Big Scientific Data (DRBSD)*. **co-Author (concept, investigation, methodology, advising, software design, authoring, and editing), Best Paper, Published**. 2024. DOI: 10.1109/SCW63240.2024.00038.

[9] Liu, J., Tian, J., Wu, S., Di, S., Zhang, B., **Underwood, R.**, Huang, Y., Huang, J., Zhao, K., Li, G., Tao, D., Chen, Z., Cappello, F., "High-ratio Scientific Lossy Compression on GPUs with Optimized Multi-level Interpolation". In: *The International Conference for High Performance Computing, Networking, Storage, and Analysis*. **SC'24**. **co-Author (background, motivation, and editing)**. **IEEE/ACM**, Nov. 2024. DOI: TBD.

[10] Maurya, A., **Underwood, R.**, Rafique, M. M., Cappello, F., Nicolae, B., "DataStates-LLM: Lazy Asynchronous Checkpointing for Large Language Models". In: *International Symposium on High-Performance Parallel and Distributed Computing*. **HPDC'24**. **co-Author (investigation and editing), Best Paper**. **ACM**, June 2024. DOI: TBD.

[11] **Underwood, R.**, Madhyastha, M., Burns, R., Nicolae, B., "Evostore: Towards Scalable Storage of Evolving Learning Models". In: *International Symposium on High-Performance Parallel and Distributed Computing*. **HPDC'24**. **First Author**. **ACM**, June 2024. DOI: TBD.

[12] Jian, Z., Di, S., Liu, J., Zhao, K., Liang, X., Xu, H., **Underwood, R.**, Wu, S., Chen, Z., "CliZ: Optimizing Lossy Compression for Climate Datasets with Adaptive Fine-tuned Data Prediction". In: *38th IEEE International Parallel & Distributed Processing Symposium*. **IPDPS'24**. **co-Author (concept, methodology)**. **IEEE**, May 2024. DOI: 10.1109/IPDPS57955.2024.00044.

[13] Wilkins, G., Di, S., Calhoun, J., Kim, K., **Underwood, R.**, Mortier, R., Cappello, F., "FedSZ: Leveraging Floating-Point Lossy Compression for Federated Learning Communications". In: *44th IEEE International Conference on Distributed Computing Systems*. **ICDCS'24**. **co-Author (methodology, editing, resources)**. **IEEE**, May 2024. DOI: 10.1109/IPDPSW63119.2024.00201.

[14] **Underwood, R. R.**, Di, S., Jin, S., Rahman, M. H., Khan, A., Cappello, F., "LibPressio-Predict: Flexible and Fast Infrastructure For Inferring Compression Performance". In: *Proceedings of the SC '23 Workshops of The International Conference on High Performance Computing, Network, Storage, and Analysis*. **SC-W '23**. **co-Author (methodology, editing, resources)**. Denver, CO, USA: **Association for Computing Machinery**, May 2023, pp. 272–280. ISBN: 9798400707858. DOI: 10.1145/3624062.3625124.

[15] **Underwood, R.**, Madhyastha, M., Burns, R., Nicolae, B., "Understanding Patterns of Deep Learning Model Evolution in Network Architecture Search". In: *30th IEEE International Conference on High Performance Computing, Data, and Analytics*. **HiPC'23**. **First Author**. Denver, CO, USA: **IEEE**, Dec. 2023, pp. 272–280. ISBN: 9798400707858. DOI: 10.1109/HiPC58850.2023.00025.

[16] Ganguli, A., **Underwood, R.**, Bessac, J., Krasowska, D., Calhoun, J. C., Di, S., Cappello, F., "A Lightweight, Effective Compressibility Estimation Method for Error-bounded Lossy Compression". In: *2023 IEEE International Conference on Cluster Computing*. **CLUSTER'23**. **First two authors contributed equally**. Denver, CO, USA: **IEEE**, Oct. 2023, pp. 272–280. ISBN: 9798400707858. DOI: 10.1109/CLUSTER52292.2023.00028.

[17] Liang, X., Zhao, K., Di, S., Li, S., **Underwood, R.**, Gok, A. M., Tian, J., Deng, J., Calhoun, J. C., Tao, D., Chen, Z., Cappello, F., "SZ3: A Modular Framework for Composing Prediction-Based Error-Bounded Lossy Compressors". In: *IEEE Transactions on Big Data*. CLUSTER'23 9.2 (Aug. 2023). **Co-author (software design, editing)**, pp. 485–498. ISSN: 0167-739X. DOI: 10.1109/TBDATA.2022.3201176.

[18] **Underwood, R.**, Yoon, C., Gok, A., Di, S., Cappello, F., "ROIBIN-SZ: Fast and Science-Preserving Compression for Serial Crystallography". In: *Syncotron Radiation News*. SRN 9.2 (July 2023). **First Author, Invited, Not Peer Reviewed**, pp. 485–498. ISSN: 0167-739X. DOI: 10.1080/08940886.2023.2245722.

[19] Madhyastha, M., **Underwood, R.**, Burns, R., Nicolae, B., "DStore: A Lightweight Scalable Learning Model Repository with Fine-Grain Tensor-Level Access". In: *Proceedings of the 37th International Conference on Supercomputing*. Vol. 9. **ICS'23** 2. **Co-Author (editing, software, data curation, and visualization)**. Denver, CO, USA: **Taylor, Francis**, June 2023, pp. 133–143. ISBN: 9798400707858. DOI: 10.1145/3577193.3593730.

[20] **Underwood, R.**, Bessac, J., Krasowska, D., Calhoun, J. C., Di, S., Cappello, F., "Blackbox statistical prediction of lossy compression ratios for scientific data". In: *The International Journal of High Performance Computing Applications*. IJHPCA 9.2 (June 2023). **First two authors contributed equally**, p. 10943420231179417. ISSN: 0167-739X. DOI: 10.1177/10943420231179417.

[21] **Underwood, R.**, Nicolae, B., "MPIGDB: A Flexible Debugging Infrastructure for MPI Programs". In: *13th Workshop on AI and Scientific Computing at Scale using Flexible Computing Infrastructures*. Vol. 9. **FlexScience'23** 2. **First Author** Presented at FCRC/HPDC'23. Denver, CO, USA: **ACM**, June 2023, p. 10943420231179417. ISBN: 9798400707858. DOI: 10.1145/3589013.3596675.

[22] Bessac, J., **Underwood, R.**, Di, S., "Discussion on "Saving Storage in Climate Ensembles: A Model-Based Stochastic Approach"". In: *Journal of Agricultural, Biological and Environmental Statistics*. JABES 28.2 (May 2023). **Co-author (investigation, editing)**, pp. 358–364. ISSN: 0167-739X. DOI: 10.1007/s13253-023-00540-7.

[23] **Underwood, R.**, Di, S., Calhoun, J. C., Apon, A., Cappello, F., "OptZConfig: Using Optimization Configure Error Bounded Lossy Compressors". In: *Journal of Agricultural, Biological and Environmental Statistics*. TPDS 28.2 (Dec. 2022). **First Author**, pp. 358–364. ISSN: 0167-739X. DOI: 10.1109/TPDS.2022.3154096.

[24] **Underwood, R.**, Bessac, J., Di, S., Cappello, F., "Understanding the Effects of Modern Compressors on the Community Earth Science Model". In: *2022 IEEE/ACM 8th International Workshop on Data Analysis and Reduction for Big Scientific Data (DRBSD)*. Vol. 28. **TPDS** 2. **First Author, Best Paper**. Denver, CO, USA: **IEEE**, Nov. 2022, pp. 1–10. ISBN: 9798400707858. DOI: 10.1109/DRBSD56682.2022.00006.

[25] Bessac, J., Krasowska, D., Calhoun, J. C., **Underwood, R.**, Di, S., Cappello, F., "Exploring Lossy Compressibility through Statistical Correlations of Scientific Datasets". In: *The 7th International Workshop on Data Analysis and Reduction for Big Scientific Data*. Vol. 28. **DRBSD'21** 2. **Co-Author (advising, design, software, editing)**, Presented at SC21. Denver, CO, USA: **IEEE**, Nov. 2021, pp. 1–10. ISBN: 9798400707858. DOI: 10.1109/DRBSD754563.2021.00011.

[26] **Underwood, R.**, Malvoso, V., Di, S., Calhoun, J. C., Apon, A., Cappello, F., "Productive and Performant Generic Lossy Data Compression with LibPressio". In: *The 7th International Workshop on Data Analysis and Reduction for Big Scientific Data*. Vol. 28. **DRBSD'21** 2. **Frist Author**, Presented at SC21. Denver, CO, USA: **IEEE**, Nov. 2021, pp. 1–10. ISBN: 9798400707858. DOI: 10.1109/DRBSD754563.2021.00005.

[27] Fulp, D., Poulos, A., **Underwood, R.**, Calhoun, J. C., "ARC: An Automated Approach to Resiliency forLossy Compressed Data via Error Correcting Codes". In: *Proceedings of 30th International ACM Symposium on High-Performance Parallel and Distributed Computing*. Vol. 28. **HPDC'21** 2. Co-Author (software, methodology, editing). Denver, CO, USA: **ACM**, June 2021, pp. 1–10. ISBN: 9798400707858. DOI: 10.1145/3431379.3460638.

[28] Tian, J., Di, S., Zhao, K., Rivera, C., Hickman, M., **Underwood, R.**, Jin, S., Liang, X., Calhoun, J., Tao, D., Cappello, F., "cuSZ: An Efficient GPU Based Error-Bounded Lossy Compression Framework for Scientific Data". In: *Proceedings of 29th International Conference on Parallel Architectures and Compilation Techniques*. Vol. 28. **PACT'20** 2. Co-Author (design, editing). Atlanta, Georgia (virtual): **ACM**, Oct. 2020, pp. 1–10. ISBN: 9798400707858. DOI: 10.1145/3410463.3414624.

[29] **Underwood, R.**, Di, S., Calhoun, J. C., Cappello, F., "FRaZ: A Generic High-Fidelity Fixed-Ratio Lossy Compression Framework for Scientific Floating-point Data". In: *proceedings of the 9th international conference on performance engineering*. Vol. 28. **IPDPS'20** 2. **First Author**, Presented virtually at IPDPS 2020. New Orleans, Louisiana (virtual): **IEEE**, May 2020, pp. 1–11. ISBN: 9798400707858. DOI: 10.1109/IPDPS47924.2020.00065.

[30] **Underwood, R.**, Anderson, J., Apon, A., "Measuring Network Latency Variation Impacts to High Performance Computing Application Performance". In: *Proceedings of the 9th International Conference on Performance Engineering*. Vol. 28. **IPDPS'20** 2. **First Author**, Presented at ICPE 2018. Berlin, Germany: **ACM/SPEC**, Apr. 2018, pp. 1–12. ISBN: 9798400707858. DOI: 10.1145/3184407.3184427.

Peer-Reviewed Academic Poster Presentations

Integrating TEZip into LibPressio	**Denver, Colorado**
Supercomputing 2023	*November 2023*
Isita Talukdar, Amarjit Singh, Robert Underwood, Kento Sato, Weikuan Yu	
Understanding the Effects of Sampling on Lossy CR Estimation	**Denver, Colorado**
Supercomputing 2023	*November 2023*
Alexandra Poulos, Robert Underwood, Jon Calhoun, Sheng Di, Franck Cappello	

Statistical Prediction of Lossy Compression Ratios for 3D Scientific Data **Dallas, Texas**
Supercomputing 2022, Best Poster ACM Student Research Competition *November 2022*
David Krasowska, **Robert Underwood**, Julie Bessac, Sheng Di, Frank Cappello

LibPressio: A Unifying Data Compression Interface for Users and Developers **Virtual**
United States Department of Energy Data Days *May 2022*
Robert Underwood, Sheng Di, and Franck Cappello

Approachable Error Bounded Lossy Compression **Virtual**
Supercomputing 2021 *November 2021*
Robert Underwood

Predicting Optimal E.B.L.C. Configuration for Sampled Data **Spokanne, WA**
S.I.A.M. Conference on Computer Science and Engineering *February 2019*
Robert Underwood, Jon Calhoun, and Amy Apon

Significant Software

AuroraGPT-ANL **Core Contributor, Team co-Lead**
https: // github. com/ auroraGPT-ANL/ *2024-present*
o Scalable Data Preparation Pipelines for PRO, ACM, CORE, and other datasets
o Evaluation Question Authoring and Review Platform used for the 1000 JAM
o Not yet released, $\approx 2.4k$ LoC in Python, Javascript, SQL, CSS

DataStates-AI **Core Contributor**
https: // github. com/ DataStates/ datastates-ai *2023-present*
o Fast and Productive Check-pointing for AI models to accelerate various AI for Science workflows
o Contributed initial implementation and integration with DeepHyper Network Architecture Search framework
o Released in June 2024: $\approx 1.6k$ LoC C++, $\approx 3.1k$ LoC Python

LibPressio **Lead Developer**
https: // github. com/ robertu94/ libpressio *2019-present*
o High-performance generic abstraction for compression of dense tensors
o Supports 69+ plugins for compressors and analysis in collaboration with 17 institutions worldwide
o Significant plugins include: LibPressio-Opt (automatic configuration of compression), a parallel compression runtime, a compression performance prediction system, and the external metrics and compressors framework
o Significant integrations include: LCLS-II (light source), Python bindings, HDF5-filters, R bindings, ADIOS2, Spack, Z-checker
o ≈ 275 unique monthly downloads from Github; $\approx 58k$ LoC mostly in C++
o Primary Code Contributors from Argonne National Laboratory, National Center for Atmospheric Research, Texas State University, University of Chicago, University of Iowa, Clemson University, Michigan State University, and Indiana University

SZ   **Core Contributor**
https://szcompressor.org/   *2019-present*

- One of the leading open and transparent Lossy Compression Frameworks for scientific data
- the SZ framework is a R&D 100 Award Winner for 2021
- Contributed an early design of SZ for GPUs and the design of the modular SZ-3 and SZ-4
- Implemented the Python bindings for SZ
- ≈ 420 unique monthly downloads from Github; $\approx 9.9k$ LoC of C++
- Primary Code Contributors from Argonne National Laboratory, University of Chicago, University of Iowa, Clemson University, The Ohio State University, Florida State University, and Indiana University

mpigdb   **Sole Developer**
https://github.com/robertu94/mpigdb   *2023-present*

- Open Source Parallel Debugger for MPI based codes that scales to 64 ranks
- Exposes capabilities of underlying GDB with extensions for MPI including
  - Extensions for parallel debugging, scripting
  - Cross-language debugging with C++ and Python
  - CUDA kernel debugging with CUDA-GDB
- ≈ 190 unique monthly downloads from Github and Crates.io; $\approx 0.4k$ Rust, $\approx 0.1k$ Python

Funding

Funded Proposals

US Dept. of Energy   **11.25M Node Hours**
INCITE '24, Data Team co-Lead   *2024*
AuroraGPT: A Large-Scale Foundation Model for Advancing Science

US Dept. of Energy   **$3m**
Data Reduction '24, co-Author   *2024*
ZF: A novel framework to design trustworthy lossy compressors for scientific data approaching lossy compressibility limits

National Science Foundation, Office of Advanced Cyber Infrastructure   **$3.4m**
Collaborative Research: Frameworks, Proposal Co-Author and Postdoctoral Researcher   *2023*
FZ: A fine-tunable cyberinfrastructure framework to streamline specialized lossy compression development (2311875)

US Dept. of Energy   **$50k**
Laboratory Directed Research and Development, Principal Investigator   *2023*
Science preserving data approximation and I/O optimization using AI for real-time high-resolution tomography on integrated research infrastructure (ANL-2023-0318)

Proposals Under Review

US Dept. of Energy   **2M/yr**
Competitive Programs, Senior Personnel   *2025*
TIDES4AI: Transformative Integration of Scientific Data for AI

US Dept. of Energy   **$50k**
Laboratory Directed Research and Development, co-Principal Investigator   *2025*
Light-source Archives for Materials Discovery & Beamline Applications

Other Proposal Contributions..

Argonne National Laboratory

Contributions   *2022-present*

- Intelligent Learning for Light Source and Neutron Source User Measurements Including Navigation and Experiment Steering (PI: Jana Thayer, ASCR-BES, contributor, $10m, funded)
- Autonomous Active Learning for Inter-atomic Potentials using Large Language Models (PI: Murat Keçeli, LDRD-Seed'24, co-PI, $50k, declined)
- Co-Scientist: An Assistant Synthesizing Knowledge Graphs and Simulations With Large Language Models (PI: Murat Keçeli, AI For Science'24, co-Author, $1.1m, not encouraged by DoE)
- DRD^3R: Data Reduction for Derivatives, Derivatives for Data Reduction (PI: Paul Hovland, Data Reduction '24, co-Author, not encouraged by ANL)
- SciForge: AI-assisted Capture of Science Processes as Programs (PI: Ian Foster, AI For Science '24, Contributor, declined)

Teaching and Mentoring Experience

Argonne National Laboratory

Mentoring *2022-present*

o (2024-2025) Co-Mentored Arham Kahn (PhD Student at the University of Chicago) with Yadu N. Babuji on scalable text reduplication for AI

o (2024) Co-Mentored Carlo Siebenschuh (PhD Student at the University of Chicago) with Ian Foster scalable PDF parsing

o (2024-2025) Co-Mentored Sujata Sinha (PhD Student at Virgina Tech) with Lingja Liu on Lossy Compressability

o (2024-2025) Co-Mentored Shihui Song (PhD Candidate at University of Iowa) with Peng Jiang and Sheng Di on translating compression techniques to Cerebras CS-2 – a dataflow architecture – and using compiler techniques for lossy compression.

o (2024-2025) Co-Mentored Yafan Huang (PhD Candidate at University of Iowa) with Sheng Di on compression for light sources and network architecture search.

o (2024-2025) Co-Mentored Jiannan Tian (PhD Candidate at Indiana University, then Postdoc at University of Kentucky) with Dingwen Tao (until August 2024) and Xin Liang (after August 2024) on compression for light sources and project management.

o (2023-2025) Mentored Alexandra Poulos (PhD Candidate at Clemson University) on aspects of software development, debugging, and research communication in the context of preforming sensitivity analysis on compression estimation techniques.

o (2025) Co-Mentored Youyuan Liu (PhD Student at Temple University) with Sian Jin on Data Reduction for AI

o (2023-2024) Co-Mentored Thomas Grüzmacher (PhD Candidate at Technische Universität Müchen) with Hartwig Anzt on lossy compression on GPUs for Linear Algebra.

o (2022-2024) Co-Mentored Meghana Madhyastha (PhD Candidate in Computer Science at Johns Hopkins University) with Bogdan Nicolae on various aspects of the Datastates project from designing lock-free concurrent data structures to accessing data pointers on GPUs, to navigating subtleties using HPC machines.

o (2023) Co-Mentored Isita Talukdar (Undergraduate Electrical Engineering and Computer Science at University of California Berkley) with Amrajit Singh and Kento Sato of Riken Center for Computational Science on aspects of software development, debugging, and research communication in the context of integrating LibPressio with TeZIP (a complex, heterogenous, AI-based, compressor implemented in Python)

o (2022) Co-Mentored David Krasowska (Undergraduate Computer Engineering at Clemson University) with Julie Bessac on aspects of software development, research communication, and how to quickly understand large code bases in the context of extending a compressor agnostic predictor compress-ability to 3d data sets. David took 1st in the ACM student poster competition at SC22 on a project I mentored him on and supervised the writing of a workshop paper and journal article. He is now a graduate student at Northwestern University under Peter Dinda.

o (2022) Co-Mentored Arkaprabha Ganguli (PhD Candidate in Statistics at Michigan State University) with Julie Bessac on how to design and implementation of statistical measures to estimate lossy compress-ability without compressors. He is now a Postdoc at Argonne National Laboratory.

Clemson University   **Clemson, SC**
Mentoring   *Summer 2021*

○ Mentored one female and one male, undergraduate student on projects that led to two ACM student research poster submissions and later journal submission.
○ Provided training on git, python, C++, lossy compression, and scientific experiment design

Clemson University   **Clemson, SC**
CPSC/ECE 3220: Operating Systems   *Fall 2018*

○ Graduate Teacher of Record, produced all lectures and most materials
○ Junior/Senior level course - 50 Students enrolled, Completed (78%), Course GPA (2.42)
○ Course materials `https://robertu94.github.io/cpsc3220-f18/`
○ Anonymous Student Assessment Responses:
  - Response Rate (92.3%), Would Recommend (72.2%)
  - Median Results: Effective Instructor (4/5), Helpful Feedback (4/5), Relative Difficulty (5/5)
  - Selected Student Comments:
    · "Definitely. One of the best professors I've had at Clemson."
    · "Yes. He is very knowledgeable [sic] and works very hard to impart that knowledge to others."
    · "Yes, it is obvious that Mr. Underwood is passionate about operating systems and is extensively knowledgable about computer science in general. This course felt overwhelming at times, but I definitely learned a lot through it."

Work Experience

The Boeing Company   **Charleston, SC**
Information Technology Intern   *Summer 2016, 2017*

○ Developed improvements for a web based portal system in HTML, Python, and JavaScript
○ Developed the user interface for a materials database using HTML and JavaScript
○ Designed, developed, and led development on a resource management tool using C#, HTML, and JavaScript.
○ Worked on the Network Automation, Tooling, and Standards Integration Team

Unitrends, Inc   **Columbia, SC**
Software Development Intern   *2014-2016*

○ Developed GPU offloading for AES encryption using Nvidia CUDA.
○ Designed and developed automated configuration scripts for testing environments using Ansible.
○ Designed and developed new cloud infrastructure using LVM, Linux, and Docker
○ Designed and developed a Dynamic Alert System in Python
○ Worked on the Alerts System in PHP, BASH, C, PERL, SQL
○ Worked on the internal Customer Incident Analysis web portal using Django, Postgreql, HTML, CSS, and JavaScript

Academic Presentations

Presentations associated with peer reviewed (co-)authored papers omitted

Preparing Data at Scale: The Data Pipeline for AuroraGPT   **Virtual**
National Cancer Institute   *January, 2025*

Parsing and Duplicating Scientific Text at Scale for AuroraGPT | **Virtual**
International Council of Scientific and Technical Information Forum | *November, 2024*

Scientific Data At Scale | **Lemont, Illinois**
Mathematics and Computer Science Division Seminar | *August, 2024*

Preparing Data at Scale for AuroraGPT | **Virtual**
Mathematics and Computer Science Division Seminar | *June, 2024*

Compression for Light Sources | **Baltimore, Maryland**
Johns Hopkins University | *August, 2024*

CereSZ: Enabling and Scaling Error -bounded Lossy Compression on Cerebras CS-2 | **Pisa, Italy**
International Symposium High-Performance Parallel and Distributed Computing
for Shihui Song | *June, 2024*

Project Talk on Compression for Instruments | **Kobe, Japan**
16th JLESC Workshop | *April, 2024*

Compression for Light Sources | **Fairfax, Virginia**
George Mason University | *March, 2024*

Project Talk on Compression for Instruments | **Bordeaux, France**
15th JLESC Workshop | *March 2023*

LibPressio | **Bordeaux, France**
15th JLESC Workshop | *March 2023*

The Benefits of JLESC: An Early Career Prospective | **Bordeaux, France**
JLESC Evaluation Meeting | *March 2023*

Coping with Large Scientific Training Datasets in Deep and Machine Learning Using Lossy Compression | **Chicago, Illinois**
AI+Science Summer School at the University of Chicago Data Science Institute | *August 2022*

LibPressio | **Lemont, Illinois**
Argonne Postdoctoral Symposium | *October 2022*

Project Talk on Compression for Instruments | **Urbanna, Illinois**
14th JLESC Workshop | *September 2022*

LibPressio | **Urbanna, Illinois**
14th JLESC Workshop | *September 2022*

Hands on With Lossy Compression | **Dallas, Texas**
Tutorial entitled "Compression for Scientific & Engineering Data" at Super Computing | *November 2022*

Hands on With Lossy Compression | **Hamburg, Germany**
Tutorial entitled "Compression for Scientific & Engineering Data" at ISC High Performance | *May 2022*

LibPressio | **Virtual**
Session entitled "Compression for Scientific Data and ECP Applications" | *May 2022*
Exascale Computing Project Annual Meeting

Understanding the Effects of Modern Lossless and Lossy Compressors on the Community Earth Science Model	**Virtual**
Session entitled " Meeting Exascale Computing Challenges with Compression and Pangeo"	*May 2022*
European Geospatial Union General Assembly	
Improving Lossy Compression for Climate Datasets with SZ3	**Virtual**
Session entitled " Meeting Exascale Computing Challenges with Compression and Pangeo"	*May 2022*
European Geospatial Union General Assembly	
Exploring Lossy Compressibility through Statistical Correlations of Geophysical Datasets	**Virtual**
Session entitled " Meeting Exascale Computing Challenges with Compression and Pangeo"	*May 2022*
European Geospatial Union General Assembly	
LibPressio	**Virtual**
Session entitled "Lossy Data Reduction for ECP Applications"	*April 2021*
Exascale Computing Project Annual Meeting	
Approachable Error Bounded Lossy Compression	**Virtual**
An Interface, Automated Tuning, and analysis for lossy compression	*November 2020*
Super Computing 2020, Doctoral Showcase	
Lossy Compression for AI	**Virtual**
An overview of how to use lossy compression to reduce storage needs for AI	*September 2020*
Joint Laboratory for Extreme Scale Computing	
FRaZ	**Virtual**
A Generic High Fidelity Fixed Ratio Lossy Compression Framework	*May 2020*
for Floating Point Scientific Data; IPDPS 2020	
LibPressio: A Generic Abstraction for Compression	**Huston, TX**
Session entitled "Lossy Data Reduction/Compression for ECP Applications"	*February 2020*
Exascale Computing Project Annual Meeting	
Approachable Error Bounded Lossy Compression	**Lemont, IL**
Overview of tools and techniques for using error bounded lossy compression	*December 2019*
Argonne National Laboratory Mathematics and Computer Science Devision Seminar	
Predicting Optimal Error-Bounded-Lossy-Compression Configuration	**Huston, TX**
Techniques for predicting error bounded lossy compression ratios	*November 2018*
Supercomputing 18 Student Volunteer Talks	

Computer Skills

Advanced: Bash, Bourne Shell, C, C++, Linux Containers (podman, docker, ...), Linux Kernel and Userspace, Python, Vim

Intermediate: Ansible, Cuda, Git, Hadoop, JAVA, JavaScript, Keras, HDF5, Julia, LaTeX, Linux Profiling (perf), LLVM-libtooling, MPI, OpenCL, OpenMP, SQL, Salt-Stack, SciKit Learn, Spack, Systemd, Tensorflow 2.x, SWIG, TypeScript, vLLM, Py-Torch

Basic: Apache Spark, ARM assembly, CSS3 C#, Haskell, HTML5, Perl, Puppet, RCpp/RInside, Rust, SNMP, SVN, FreeBSD, PHP

Professional Affiliations

Association for Computing Machinery (ACM): Professional Member 2022-Present

Institute of Electrical and Electronics Engineers (IEEE): Professional Member 2023-Present

Joint Laboratory for Extreme Scale Computing (JLESC): 2018-Present

Association for Computing Machinery (ACM): Student Member 2014-2021

Professional Service

JLESC Early Career Ambassador for Argonne National Laboratory: 2023-present

Program Chair: HPAI4S 2025

Session Chair: JLESC 2022-2024

Reviewer: ICPE 2017, ICCCN 2017, PABS 2017, SC17, IEEE CLOUD 2018, IEEE TSE 2018, IPDPS 2018, IPDPS 2019, IEEE CLUSTER 2020, Sustainable Computing 2021, IEEE Big Data 2021, PacificVis 2022, HPDC 2023, IEEE TC 2023, SC23-Posters 2023, FGCS 2024, ATPETSC 2024, ATPETSC 2025, ISC 2025, ACM ICS 2025, IEEE Cluster 2025

Volunteer: SC2018, SC21

Conference/Workshop/Tutorial/BoF Organization

Workshops: Joint Labratory for Extreme Scale Computing (JLESC) Breakout Session Organizer on AI '24, Trillion Parameter Consortium Hands-on Hackathon (Oct'24), Program Chair High Performance AI for Science (HPAI4S) (Jun'25)

Tutorials: Supercomputing (SC) Data Reduction Tutorial Presenter, (Nov'22-'24)

Events: Argonne AI Evaluation Hackathons (Jan'24, July'24, Aug'24), Postdoctoral Research and Career Symposium – Program Committee Member (Nov 2023), 1000 Scientist JAM – Data Collection (Feb'25)

Honors

o Outstanding Postdoctoral Performance Award in Basic Science, Argonne National Laboratory 2024

o Best Paper, Data Reduction for Big Scientific Data Workshop (ACM SC-W, DRBSD) 2024

o Best Paper, The International ACM Symposium on High-Performance Parallel and Distributed Computing (ACM HPDC), 2024

- Best Poster, ACM Student Research Competition at Supercomputing (ACM SC), 2022
- Best Paper, Data Reduction for Big Scientific Data Workshop (ACM SC-W, DRBSD) 2022
- Clemson Outstanding Ph.D. in Computer Science Award, 2021
- Graduate Student Research Lighting Talk Competition Faculty Award, 2020
- Department of Energy Office of Science Graduate Student Research Award, 2019
- Fellowship, National Research Traineeship: Resilient Infrastructure Systems 2017-2020
- National Science Foundation Graduate Research Fellowship Honorable Mention 2017
- Faculty Scholarship Award, Clemson University 2016
- Benefitfocus Scholarship 2015-2016
- McAlister Scholarship 2015-2016
- Palmetto Fellows Recipient 2013-2016
- President's List at Clemson University 2013-2016
- Outstanding Sophomore in Computer Science at Clemson University 2015
- Order of the Arrow, Vigil Honor 2013
- Eagle Scout 2010