

Robert Underwood

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Education

Clemson University

PhD Candidate in Computer Science, GPA 3.92/4.0

Passed Qualifying Exam: May 2018

Co-Advisers: Dr. Amy Apon, Dr. Jon Calhoun, and Dr. Franck Cappello

Clemson, SC

December 2021, expected

Clemson University

Master of Science in Computer Science, GPA 4.0/4.0

Concentration: Systems and Implementation

Clemson, SC

August 2018

Clemson University, Calhoun Honors College

Bachelor of Science, Summa Cum Laude in Computer Science, GPA 4.0/4.0

Honors Thesis: Automation in the Classroom, Adviser: Dr. Jacob Sorber

Clemson, SC

December 2016

Peer Reviewed Publications

- [1] Dakota Fulp et al. "ARC: An Automated Approach to Resiliency for Lossy Compressed Data via Error Correcting Codes". In: *Proceedings of 30th International ACM Symposium on High-Performance Parallel and Distributed Computing*. Co-Author. ACM. June 2021.
- [2] Jiannan Tian et al. "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*. Co-Author. ACM. Atlanta, Georgia (virtual), Oct. 2020.
- [3] Robert Underwood et al. "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*. Presented virtually at IPDPS 2020. IEEE. New Orleans, Louisiana (virtual), May 2020, pp. 1–11.
- [4] Robert Underwood, Jason Anderson, and Amy Apon. "Measuring Network Latency Variation Impacts to High Performance Computing Application Performance". In: *Proceedings of the 9th International Conference on Performance Engineering*. presented at ICPE 2018. ACM/SPEC. Berlin, Germany, Apr. 2018, pp. 1–12.

Academic Poster Presentations

Approachable Error Bounded Lossy Compression

Supercomputing 2021

Robert Underwood

Virtual

November 2021

Predicting Optimal E.B.L.C. Configuration for Sampled Data

S.I.A.M. Conference on Computer Science and Engineering

Robert Underwood, Jon Calhoun, and Amy Apon

Spokane, WA

February 2019

Research Experience

Clemson University

Clemson Data Intensive Computing Environments

Clemson, SC

2016-2021

- Applications and modeling of reliability and performance of error-bounded lossy compression
- Designed experiments to analyze performance of high performance computing systems
- Build models to improve reliability computer infrastructure.

Argonne National Laboratory

Under Dr. Franck Cappello

Lemont, IL

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

Clemson University

Clemson PERSIST Lab

Clemson, SC

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.

Significant Software

LibPressio

<https://github.com/robertu94/libpressio>

2019-present

- High-performance generic abstraction for compression of dense tensors
- Supports 45+ of plugins for compressors and analysis in collaboration with 6 institutions

Teaching Experience

Clemson University

CPSC/ECE 3220: Operating Systems

Clemson, SC

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 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 knowledgeable about computer science in general. This course felt overwhelming at times, but I definitely learned a lot through it.”

Relevant Coursework

Clemson University

EES 883: Resilient Infrastructure Systems

Clemson, SC

Spring 2018

- Constructed and quantified uncertainty in a queuing theory and population based model of Infrastructure systems
- Designed experiments for statistical model validation
- Prepared a NSF grant proposal submitted by my adviser to NSF and funded by NSF

Clemson University

Clemson, SC

CPSC 820: Parallel Architecture

Fall 2016

- Researched and presented on the design and implementation of Linux Bridge, OpenVSwitch, DPDK, SRIOV, and MACVLAN
- Designed and conducted experiment to quantify latency variation in RDMA using InfiniBand layers 1, 2, and 4

Clemson University

Clemson, SC

CPSC 840: Design and Analysis of Algorithms

Spring 2016

- Analyzed and designed amortized, randomized, and approximation algorithms to solve problems.
- Designed time and space efficient data structures

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, Postgresql, HTML, CSS, and JavaScript

Extracurricular Activities

Clemson University

Clemson, SC

Clemson School of Computing Graduate Student Organization, Secretary

2017-2019

- Keep minutes and assist with program and logistics
- Coordinate with other student organizations and School of Computing staff

Clemson University

Clemson, SC

Clemson University Cyber Security Team

2015-2018

- Primary developer for the Cyber Security reference material, 2016
- Competed in Collegiate Cyber Defense Competition 2015-2016 and Palmetto Cyber Defense Competition, 2015
- Designed and developed scripts to aid in auditing and administration of contest environments, 2016
- Lead training on Mitigating Exploitable patterns in software design and Observability tools

Clemson University

Clemson, SC

Clemson Association for Computing Machinery Vice President

2014-2016

- Planned and help found the Clemson Association for Computing Machinery Technology Seminar, Fall 2016
- Prepared and presented 4 seminars per semester on Git, Linux, Vim, Firewalls, Unix tools, and other topics, 2014-2016
- Coordinated with President to set up professional development and social events, 2014-2016

Clemson University

Clemson, SC

Clemson Association for Computing Machinery Programming Team

2013-2016

- Competed in competitions to design efficient algorithms to solve problems
- Team placed 1st at the Mercer Spring Programming Competition in 2014 and 2015
- Team placed 3rd at Association for Computing Machinery Southeast Regional Competition 2015
- Invited to participate in the National Invitational Programming Competition 2015, 2016
- Primary developer for the Clemson Hackpack algorithms reference
- Student apprentice judge at Mercer Programming Competition February 2016.

Professional Presentations

LibPressio

Virtual

Part of a session entitled "Lossy Data Reduction for ECP Applications"
Exascale Computing Project Annual Meeting

April 2021

Approachable Error Bounded Lossy Compression

Virtual

An Interface, Automated Tuning, and analysis for lossy compression
Super Computing 2020, Doctoral Showcase

November 2020

Lossy Compression for AI

Virtual

An overview of how to use lossy compression to reduce storage needs for AI
Joint Laboratory for Extreme Scale Computing

September 2020

FRaZ

Virtual

A Generic High Fidelity Fixed Ratio Lossy Compression Framework
for Floating Point Scientific Data; IPDPS 2020

May 2020

LibPressio: A Generic Abstraction for Compression

Huston, TX

Part of a 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
Argonne National Laboratory Mathematics and Computer Science Division Seminar

December 2019

Predicting Optimal Error-Bounded-Lossy-Compression Configuration

Huston, TX

Techniques for predicting error bounded lossy compression ratios
Supercomputing 18 Student Volunteer Talks

November 2018

Systemd Tools

Overview of useful, but lesser known systemd features
CU Cyber

Clemson, SC
November 2017

C++ Templates: Staring into the Abyss

Advanced talk on C++11-17 templates and uses
Clemson ACM Technology Seminar, Guest talk

Clemson, SC
April 2017

Dockerize all the Things!

Introduction to container technology and uses
Clemson ACM Technology Seminar, Guest talk

Clemson, SC
February 2017

Exploitable III: Reverse Engineering

Overview of binary analysis, user and kernel level tracers, and debuggers
CU Cyber and Clemson ACM Crossover Seminar

Clemson, SC
September 2016

Automation in the Classroom

Motivation and demonstration of classroom automation
School of Computing Seminar, Spring 2016 Seminar Series

Clemson, SC
April 2016

Python: A Parser Tongue Primer

Introduction to idiomatic Python programming
Clemson ACM Seminar

Clemson, SC
April 2016

Exploitable II: Application Design

Overview of writing secure software
CU Cyber and Clemson ACM Crossover Seminar

Clemson, SC
March 2016

Provisioning At the Speed of Thought

Evaluation and Uses of Ansible, Salt and Puppet
Clemson ACM Technology Seminar

Clemson, SC
October 2016

Writing Semantic Code

Using refactoring and design patterns for better code
Clemson ACM Technology Seminar

Clemson, SC
August 2016

Think Different

Introduction to approaching computer science projects
Clemson ACM Various Venues, Also titled "Perfecting Your Projects"

Clemson, SC
February 2016, et al

Linux is Scary

Introduction to Linux for new computer science students
Clemson ACM Seminar

Clemson, SC
February 2016, et al

Thou Shall Not Pass

Introduction to open source firewalls
Clemson ACM Seminar

Clemson, SC
February 2016

Exploitable: Ethical Hacking

Introduction to ethical software penetration testing
CU Cyber and Clemson ACM Crossover Seminar

Clemson, SC
October 2015

Git Well Soon

Introduction to the Git distributed version control system
Clemson ACM Various Venues, Also titled "Git Thee to a Version Control System"

Clemson, SC
September 2015, et al

Intermediate Vim

Advanced seminar on using the Vim text editor

Clemson, SC
February 2015

Clemson ACM Seminar
N Unix Tools in $O(N)$ Minutes
Overview of scripting tools for POSIX platforms
Clemson ACM Seminar
NMAP
Overview of network mapping with NMAP
CU Cyber

Clemson, SC
March 2015

Clemson, SC
October 2015

Computer Skills

Advanced: Bash, Bourne Shell, C, C++, Docker, Linux Kernel and Userspace, Python, Vim
Intermediate: Ansible, Git, Hadoop, JAVA, JavaScript, L^AT_EX, SaltStack, Systemd, SQL
Basic: ARM assembly, C#, FreeBSD, MPI, PHP, Perl, Puppet, SNMP, SVN, Apache Spark
Rust, Julia

Professional Affiliations

Association for Computing Machinery: Student Member 2014-2020

Professional Service

Reviewer: ICPE 2017, ICCCN 2017, PABS 2017, SC17, IEEE CLOUD 2018, IEEE TSE 2018, IPDPS 2018, IPDPS 2019, IEEE CLUSTER 2020

Honors

- 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