Shelby Lockhart

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Education

Aug 2016 – Apr 2023 (Expected)	**University of Illinois at Urbana-Champaign**, Urbana-Champaign, IL, USA *Doctor of Philosophy (PhD) in Computer Science* Advisor: Luke N. Olson Thesis Title: Reducing Communication Bottlenecks in Iterative Solvers Research Areas: Scientific Computing and High Performance Computing Current GPA: 3.71/4.00
Aug 2012 – May 2016	**Wake Forest University**, Winston-Salem, NC, USA *Bachelor of Science (BS) in Mathematics* Double majored in Computer Science Cumulative GPA: 3.72 / 4.00, Magna Cum Laude

Research Experience

Scientific Computing Group, Dept. of CS, University of Illinois at Urbana-Champaign
Graduate Research Assistant

Jan 2021 - Current	Advisor: Luke N. Olson Project: PSAAP Grant - Center for Exascale-enabled Scramjet Design • Designed models for communication on heterogeneous architectures culminating in a publication. • Designing optimal point-to-point communication for the unstructured-mesh boundary exchanges on heterogeneous architectures for use within the *MIRGE-Com* framework.
Aug 2017 - May 2020	Advisor: Luke N. Olson Project: ExxonMobil Research Grant • Performed a performance analysis of Enlarged Krylov methods at scale. • Developed optimal node-aware communication and implemented within the RAPtor solver framework culminating in a publication.

Scientific Computing Group, Computation, CASC, Lawrence Livermore National Laboratory
Predictive Science Academic Alliance Program III Student Intern

May 2021 - Aug 2021	Advisor: Carol S. Woodward Co-Advisor: David J. Gardner • Implemented low synchronization orthogonalization methods within the SUNDIALS codebase for use within Anderson Acceleration. • Analyzed the parallel performance of low synchronization orthogonalization methods outside of and within the context of Anderson Acceleration, culminating in a publication.

Scientific Computing Group, Computation, CASC, Lawrence Livermore National Laboratory
Computation Scholar Program Graduate Intern

Jun 2020 - Aug 2020	Advisor: Carol S. Woodward Co-Advisor: David J. Gardner • Researched low synchronization orthogonalization methods and their potential use within Anderson Acceleration.
Jun 2018 - Aug 2018	Advisor: Carol S. Woodward Co-Advisor: David J. Gardner • Implemented an OpenMP 4.5 N_Vector within the SUNDIALS codebase for offloading computation to GPUs.

Computational and Applied Mathematics Group, Oak Ridge National Laboratory
Department of Energy HERE Graduate Intern

Jun 2017 - Aug 2017	Advisor: Clayton Webster
	Project: Study Reduced Order Modeling for Finite Element Methods

Scientific Computing Group, Dept. of CS, University of Illinois at Urbana-Champaign
Independent Study Research

Aug 2016 - May 2017	Advisor: Michael Heath
	Project: Analysis of the Universal Number Format

Dept. of Mathematics, Wake Forest University
Undergraduate Thesis Research

Aug 2015 - May 2016	Advisor: Jennifer Erway
	Project: Limited-Memory Trust-Region Methods for Sparse Relaxation

Cyber and Information Security Research Group, Oak Ridge National Laboratory
Department of Energy SULI Intern

Jun 2015 - Aug 2015	Advisor: Robert Bridges
	Project: STUCCO (Situation and Threat Understanding by Correlating Contextual Observations)

Teaching Experience

Dept. of CS at University of Illinois at Urbana-Champaign, Urbana-Champaign, IL, USA
Graduate Teaching Assistant

Aug 2020 - Dec 2020	Course: Numerical Analysis, CS 450 Supervising Professor: Luke N. Olson
	Duties: Aid with instruction, hold office hours, and create course content
Jan 2019 - May 2019	Course: Numerical Methods for Partial Differential Equations, CS 555
	Supervising Professor: Paul Fischer
	Duties: Hold office hours, create course content, and grading
Jan 2017 - May 2017	Course: Numerical Analysis, CS 450 Supervising Professor: Paul Fischer
	Duties: Hold office hours, create course content
Aug 2016 - Dec 2016	Course: Numerical Methods, CS 357 Supervising Professor: Andreas Kloeckner
	Duties: Hold office hours, create course content, and manage grading

Dept. of CS at Wake Forest University, Winston-Salem, NC, USA
Teaching Assistant

Aug 2015 - May 2016	Course: Computer Organization (using MIPS assembly) Supervising Professor: Pete Santago
	Duties: Aid with instruction, hold office hours, create course content, and grading
Jan 2015 - May 2015	Course: Introduction to Computer Science (using Python) Supervising Professor: Pete Santago
	Duties: Hold office hours, create course content, and grading

Awards

Mar 2023	**Selected to attend Rising Stars in Computational and Data Sciences**
Oct 2022	**ACM/IEEE CS George Michael Memorial HPC Fellowship**, *Honorable Mention*
Aug 2018	**Lawrence Livermore National Laboratory** *Awarded Outstanding Poster Presentation*, Summer Student Poster Symposium
Aug 2016	**University of Illinois at Urbana-Champaign** *Awarded Saburo Muroga Endowed Fellowship*
May 2016	**Wake Forest University** *Awarded John W. Sawyer Prize in Computer Science*

Publications

2023

1. **Lockhart, S.**, Bienz, A., Gropp, W. & Olson, L. Performance Analysis and Optimal Node-Aware Communication for Enlarged Conjugate Gradient Methods. *ACM Trans. Parallel Comput.,* Just Accepted (Jan. 2023).

2022

2. **Lockhart, S.**, Bienz, A., Gropp, W. & Olson, L. *Characterizing the Performance of Node-Aware Strategies for Irregular Point-to-Point Communication on Heterogeneous Architectures* in (arXiv, 2022), in submission to *Parallel Computing*.

3. **Lockhart, S.**, Gardner, D. J., Woodward, C. S., Thomas, S. & Olson, L. N. *Performance of Low Synchronization Orthogonalization Methods in Anderson Accelerated Fixed Point Solvers* in *Proceedings of the 2022 SIAM Conference on Parallel Processing for Scientific Computing* (2022), 49–59.

2021

4. Bienz, A., Olson, L. N., Gropp, W. D. & **Lockhart, S.** *Modeling Data Movement Performance on Heterogeneous Architectures* in *2021 IEEE High Performance Extreme Computing Conference (HPEC)* (2021), 1–7.

2019

5. Karlin, I., Park, Y., de Supinski, B. R. & et al. (including Shelby Lockhart). *Preparation and Optimization of a Diverse Workload for a Large-Scale Heterogeneous System* in *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis* (Association for Computing Machinery, Denver, Colorado, 2019).

2017

6. Adhikari, L., DeGuchy, O., Erway, J. B., **Lockhart, S.** & Marcia, R. F. *Limited-memory trust-region methods for sparse relaxation* in *Wavelets and Sparsity XVII* (eds Lu, Y. M., Ville, D. V. D. & Papadakis, M.) **10394** (SPIE, 2017), 95–102.

Presentations

Feb 2023	**SIAM Conference on Computational Science and Engineering (CSE23)**, Amsterdam, Netherlands *Anderson Acceleration on Emerging Architectures*
Apr 2022	**17th Copper Mountain Conference on Iterative Methods**, Virtual *Reducing Communication Costs in ECG with Optimal Node Aware Communication*
Feb 2022	**SIAM Conference on Parallel Processing for Scientific Computing Conference Proceedings**, Virtual *Performance of Low Synchronization Orthogonalization Methods in Anderson Accelerated Fixed Point Solvers*
May 2021	**ASC PI Meeting 2021**, Virtual *Modeling Data Movement on Heterogeneous Architectures*
Feb 2020	**SIAM Conference on Parallel Processing for Scientific Computing Poster Session**, Seattle, WA *Multi-Step Communication in Enlarged Krylov Subspace Solvers*
Apr 2019	**9th JLESC Workshop**, Knoxville, TN *Designing Scalable Solvers for Enlarged Krylov Subspace Methods*
Aug 2018	**LLNL Summer Student Poster Symposium**, Livermore, CA *Increasing the Portability of SUNDIALS with OpenMP 4.5*

Codebase Contributions

RAPtor: parallel algebraic multigrid solver	Contributed the implementation of block vector operations, *enlarged* Krylov methods, and *Split* optimal node-aware communication.
SUNDIALS	Contributed the implementation of an OpenMP 4.5 N_Vector for increased portability of the SUNDIALS software stack, as well as, low synchronization orthgonalization routines for use within Anderson acceleration in the KINSOL package.

Other Work Experience

Aug 2014 - May 2016	**Dept. of Mathematics at Wake Forest University**, Winston-Salem, NC, USA *Math Center Tutor* Tutored in 9 undergraduate mathematics courses Supervising Professor: Jules Connolly Duties: Aid students in understanding mathematical concepts and coursework
Aug 2012 - Dec 2014	**Best Choice Center**, Winston-Salem, NC, USA *Middle School Tutor* Tutored in an after-school program for low-income families Supervisor: Mildred Houser Duties: Tutor and aid students with their homework

Service

2019 - 2020	**SIAM Student Chapter President**, University of Illinois at Urbana-Champaign, IL, USA
2017 - 2018	**SIAM Student Chapter Officer**, University of Illinois at Urbana-Champaign, IL, USA

Memberships

Society for Industrial and Applied Mathematics (SIAM)
Association for Computing Machinery (ACM)
Institute of Electrical and Electronics Engineers (IEEE)
Women in High Performance Computing (WHPC)
Association for Women in Mathematics (AWM)

Professional References

Luke N. Olson, University of Illinois at Urbana-Champaign
- Email: lukeo@illinois.edu
- Website: https://lukeo.cs.illinois.edu

Carol S. Woodward, Lawrence Livermore National Laboratory
- Email: woodward6@llnl.gov
- Website: https://people.llnl.gov/woodward6

Amanda Bienz, University of New Mexico
- Email: bienz@unm.edu
- Website: https://www.amandabienz.com

William D. Gropp, University of Illinois at Urbana-Champaign
- Email: wgropp@illinois.edu
- Website: https://wgropp.cs.illinois.edu/