Ian Lumsden

Curriculum Vitae

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Research Interests

- High-Performance Computing
- Workflow Scheduling, Orchestration, and Data Movement
- Performance Analysis
- Software Engineering
- Data Analysis
- GPU Computing
- Machine Learning/AI

Education



University of Tennessee, Knoxville, TN Concentration in High-Performance Computing

PhD Computer Science, Tickle College of Engineering,

B.S. Computer Science, *Tickle College of Engineering*, University of Tennessee, Knoxville, TN Major in Computer Science (Honors Concentration) and Part of Chancellor's Honors Program and Cook Grand Challenge Engineering Honors Program

2019

Professional/Research Experience

Graduate (formerly Undergraduate) Research Assistant,

Global Computing Laboratory, University of Tennessee, Knoxville, TN

Advisor Dr. Michela Taufer

- **Projects** Developing novel techniques and tools based on Flux to assist in data movement for scientific workflows
 - Developing novel techniques to identify causes of interesting performance phenomena in High-Performance Computing applications using Hatchet
 - Examining the performance and implications of in-situ and in-transit data analysis of molecular dynamics simulations through the Analytics4MD project (https://analytics4md.org/)

²⁰²² Summer Graduate Computing Student Intern, Lawrence Livermore National Laboratory, Livermore, CA

Mentors Dr. Jae-Seung Yeom

- **Projects** Augmented the workflow framework from the Analytics4MD project to make use of LLNL's Dynamic and Asynchronous Data Streamliner (DYAD)
 - Created a test suite for DYAD based on workflows from the Analytics4MD project
 - Examined the performance of DYAD using our test suite and using the performance data collection tool PerfFlow Aspect
 - Summer Graduate Computing Student Intern, Center for Advanced Scientific Computing, Lawrence Livermore National Laboratory, Livermore, CA
- Mentors Dr. Olga Pearce, Dr. Stephanie Brink
- **Projects** Developed a data analysis workflow that uses profiles of LLNL's MARBL multi-physics simulation tool to predict what compiler MARBL should be built with to get the best performance for a particular simulation workload



2021

Summer Undergraduate Computing Student Intern, Lawrence Livermore National Laboratory, Livermore, CA

- Mentors Dr. Stephanie Brink, Dr. Abhinav Bhatele, Dr. Olga Pearce, Dr. Todd Gamblin
- **Projects** Designed a new graph-based filtering query language for the Hatchet data analysis tool to enable relationship-based analysis of profiling data
 - Implemented the query language and integrated it into Hatchet's data analysis capabilities
 - Used the query language to perform novel analysis of the performance of different MPI calls in HPC benchmark applications
 - Presented the work associated with this internship at the ACM Student Research Competition at the annual Supercomputing (SC) conference, where it won the 1st place award in the Undergraduate category
 - Presented an expanded version of this work at the ACM Student Research Competition Grand Finals

2017 2018		HERE Intern , <i>Neutron Scattering Division</i> , Oak Ridge National Laboratory, Oak Ridge, TN
N	Nentors	Dr. Jiao Lin and Dr. Garrett Granroth
Ρ	Projects	 Developing GUIs using Python and JavaScript for user data analysis (https://github.com/scikit-beam/ipywe) Updating code to support both Python 2.7 and 3 (https://github.com/mcvine)
		 Developing a Python package to convert XML representations of construc- tive solid geometry into OpenSCAD code for visualization and 3D-printing purposes (https://github.com/mcvine/SCADGen)

 Parallelizing a Monte-Carlo neutron ray-tracing software package with CUDA (https://github.com/mcvine/McVineGPU)



Math, Science, and Computer Science Thesis Student, Oak Ridge High School, Oak Ridge, TN

- Mentor Dr. Len Gray
- **Projects** Developing a boundary integral method approach to nonlinear fracture mechanics

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	Honors and Scholarships
202:	² NSF Travel Scholarship , to attend the IEEE International Conference on <i>e-Science</i>
	SC20 ACM Student Research Competition: 1st Place (Undergradu- ate Category) , <i>ACM/IEEE International Conference for High Performance</i> <i>Computing, Networking, Storage, and Analysis (SC)</i> , Virtual (originally Atlanta, GA)
2020	Tennessee Fellowship for Graduate Excellence , <i>University of Tennessee</i> , Knoxville, TN
2016 2020	Member of Chancellor's Honors Program , University of Tennessee, Knoxville, TN
2016 2020	Member of Cook Grand Challenge Engineering Honors Program , University of Tennessee, Knoxville, TN
2016 2020	Volunteer Scholarship (Highest Level) , <i>University of Tennessee</i> , Knoxville, TN
2016	Hope Scholarship, State of Tennessee
2016	Herbert and Lillian Duggan Engineering Scholarship , <i>University of Tennessee</i> , Knoxville, TN
2017 2020	Carol and Malcom Bayless Merit Scholarship , <i>University of Tennessee</i> , Knoxville, TN
2018	Charles Weaver Memorial Scholarship , <i>University of Tennessee</i> , Knoxville, TN

Publications

- I. Lumsden, J. Luettgau, V. Lama, C. Scully-Allison, S. Brink, K. Isaacs, O. Pearce, and M. Taufer, "Enabling call path querying in hatchet to identify performance bottlenecks in scientific applications," in 2022 IEEE 18th International Conference on eScience (eScience), 2022.
- [2] S. Brink, I. Lumsden, C. Scully-Allison, K. Williams, O. Pearce, T. Gamblin, M. Taufer, K. Isaacs, and A. Bhatele, "Usability and performance improvements in hatchet," in 2020 IEEE/ACM International

Workshop on HPC User Support Tools (HUST) and Workshop on Programming and Performance Visualization Tools (ProTools), 2020, pp. 49–58.

- [3] J. Bilheux, H. Bilheux, J. Lin, I. Lumsden, and Y. Zhang, "Neutron imaging analysis using jupyter python notebook," *Journal of Physics Communications*, vol. 3, no. 8, 2019.
- [4] J. Lin, F. Islam, G. Sala, I. Lumsden, H. Smith, M. Doucet, M. B. Stone, D. L. Abernathy, G. Ehlers, J. F. Ankner, and G. E. Granroth, "Recent developments of mcvine and its applications at sns," *Journal of Physics Communications*, vol. 3, no. 8, 2019.
- [5] I. Lumsden, L. Gray, and W. Ye, "Grid-based volume integration for elasticity: Traction boundary integral equation," *Engineering Fracture Mechanics*, vol. 176, pp. 74–82, 2017.

Professional Services

- ²⁰²² Lead Student Volunteer, ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), Dallas, TX
- 2021

2019

2019

2020

- **Lead Student Volunteer (SCALEr)**, *ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC)*, St. Louis, MO
- **Student Volunteer**, ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), Virtual (originally Atlanta, GA)
- **Student Volunteer**, *ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC)*, Denver, CO
 - **Volunteer**, *FIRST Robotics Smokey Mountain Regional Competition*, Knoxville, TN

Skills

Programming Languages	C, C++, Python, Rust, JavaScript, TypeScript, Kotlin, Java
Parallelism Libraries	MPI, OpenMP, CUDA, Argobots, PThreads
Data Analysis Tools	Hatchet, NumPy, SciPy, Matplotlib, Pandas, Jupyter, ipywidgets, Apache Spark, Scikit-Learn, Tensorflow
Build Systems and Packaging Tools	CMake, Autotools, Spack, Cargo, Meson
Testing and Continuous Integration Tools	PyTest, Googletest, Travis CI, GitHub Actions
Shells	Bash, Bourne, minimal experience in Zsh
Other	Flux, LaTeX, SQL, Graph Databases, LLVM, HTML, CSS

Languages

English Native

French Good Understanding

6 years of study in Middle and High School

Professional Memberships

- IEEE Student Member since April 2017
- ACM Student Member since August 2019