J. Travis Johnston

Research Scientist in Artificial Intelligence
for High Performance Computing

CONTACT

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EDUCATION

- **University of South Carolina**, Columbia SC

  Ph.D. Mathematics, May 2014.

  Advisor: Linyuan (Lincoln) Lu

- **University of Nebraska-Lincoln**, Lincoln NE

  B.S. Mathematics, May 2009.

  Concurrent Minors in Physics and French

  University Honors Program, Received degree with Highest Distinction

POSITIONS HELD

- **Research Scientist**, Oak Ridge National Lab, June 2018-Present.

  I am a staff scientist in the Computational Data Analytics (CDA) group, Nature Inspired Machine Learning (NIML) team. My research revolves around leveraging supercomputers to push the boundaries of what is possible with machine learning and AI. I was a Gordon Bell Finalist (2018) for work using the Summit supercomputer to build novel neural network architectures with the ultimate goal of building a self-driving electron microscope capable of building materials atom-by-atom.

- **Postdoctoral Researcher**, Oak Ridge National Lab, July 2016-May 2018.

  Advisor: Robert Patton

  Worked on designing Neural Nets (convolutional feed forward nets and fully convolutional neural networks) for a variety of tasks including object recognition, image segmentation applied to remotely sensed data as well as scientific datasets. Designed and implemented a software tool (RAvENNA) to optimize neural network topologies in Apache-Spark and scaled it to all of Titan (using 18,000 GPUs). The 18,000 node Spark cluster I created is the largest in the world (2nd largest instance Tencent in China with 8,000 nodes). The code based achieved peak performance of 20 PetaFLOPs (single precision) and was featured in an ORNL press release.

- **Postdoctoral Researcher**, University of Delaware, September 2014-July 2016.

  Advisor: Michela Taufer

  Designed algorithms for extreme scale, scientific computing on big data sets with applications to numerical reproducibility, protein folding and prediction, and performance modeling. Used wide range of statistical machine learning techniques including surrogate modeling, support vector machines, and clustering algorithms. Collaborated with and mentored undergraduate and graduate student researchers.

- **Graduate Teaching Assistant**, University of South Carolina, August 2009-May 2014.

  Instructor of several classes including Precalculus, College Algebra, Finite Mathematics, Calculus I/II, and Business Calculus. Gave lectures, recitations, and Maple labs, held office hours, review sessions, wrote, proctored, and graded exams and quizzes, designed activities for Maple labs.

- **Mathematics Summer Intern**, National Security Agency, May 2008-August 2008.

  Studied graphics editing techniques. Developed algorithms to detect editing techniques and effects, and implemented these algorithms into image processing software.

- **Teaching Assistant**, University of Nebraska-Lincoln, August 2007-May 2009.

  Taught recitations, held office hours, review sessions, proctored exams and quizzes, graded exams, quizzes and homework.

HONORS AND AWARDS

- **Gordon Bell Finalist (2018)**, The Gordon Bell Prize is awarded each year (by the ACM) to recognize outstanding achievement in high-performance computing. The purpose of the award is to track the progress over time of parallel computing, with particular emphasis on rewarding innovation in applying high-performance computing to applications in science, engineering, and large-scale data analytics.

  I was the technical lead on the project for which our team were finalists. I led the effort to both scale the computation and accurately benchmark performance.

- **Director's Discretionary Allocation on Titan**, 3.5M Core-hours allocation on Titan to study surrogate-based modelling as a technique for hyper-parameter optimization of neural networks. As part of this allocation, I built Apache-Spark on Titan and ran it (using Spark+GPUs) on 18k nodes to tune hyper-parameters for a cloud detection network.

- **Best Solution**, Smoky Mountains Conference on Computational Science and Engineering Data Challenge (2017). `https://smc-datachallenge.ornl.gov/`

- **2014 Breakthrough Graduate Scholar**

  "The Breakthrough Graduate Scholars program honors USC graduate students who demonstrate excellence in the classroom, and make considerable contributions to research and scholarly activities in their field."

- **Dean's Dissertation Fellowship**

  $25,000 award from the College of Arts and Sciences. Designed to give graduating students more opportunity to travel and conduct research.

- **SIAM Service Award**

  An award from SIAM for "outstanding efforts and accomplishments on behalf of the SIAM chapter."

- **3rd Place 2009 Cryptanalytic Literature Competition**

  Sponsored by the Kryptos Society; paper written while a summer intern at the National Security Agency (NSA). This was the first time student work was ever considered in the competition.

- **Chair's Prize for Outstanding Undergraduate in Mathematics**

  University of Nebraska-Lincoln, Department of Mathematics prize awarded to one graduating math major.

PAPERS

(*) indicates that the co-author was a **graduate** student which I mentored.
(+) indicates that the co-author was an **undergraduate** student which I mentored.

Journals

1. R. Searles(*), S. Herbein(*), **Travis Johnston**, M. Taufer, and S. Chandrasekaran. A Portable, High-Level Graph Analytics Framework Targeting Distributed, Heterogeneous Systems, International Journal of High Performance Computing and Networking, IJHPCN 2017, vol 10.

2. S.M. Cioabă, W.H. Haemers, M. McGinnis(*), and **Travis Johnston**. Cospectral Mates for the Union of some Classes in the Johnson Association Scheme, *Linear Algebra and its Applications* (LAA), volume 539, 219-228 (2018).

3. **Travis Johnston** and L. Lu. Strong Jumps and Lagrangians of Non-Uniform Hypergraphs. (Submitted, Journal of Combinatorial Theory)

   Available on arXiv at: https://arxiv.org/abs/1403.1220

4. **Travis Johnston**, B. Zhang(*), A. Liwo, S. Crivelli, and M. Taufer. In-Situ Data Analytics and Indexing of Protein Trajectories, *J. Comput. Chem.* 2017.

5. É. Czabarka, A. Dutle, **Travis Johnston**, and L. Székely. Abelian groups yield many large families for the diamond problem, *European Journal of Mathematics* 1 (2), 320-328 (2015).

6. **Travis Johnston**, L. Lu, and K. Milans. Boolean Algebras and the Lubell Function, *Journal of Combinatorial Theory Series A (JCTA)* 136, 174-183 (2015).

7. **Travis Johnston** and L. Lu. Turán Problems on Non-uniform Hypergraphs, *Elec. Journal of Combinatorics*, volume 21, issue 4, (2014).

8. (See Honor's and Awards) Internally published paper at National Security Agency (while working as summer intern). Won award for the paper–this was the first time a student paper was ever considered in the competition.

9. S. M. Nakhmanson, R. Korlacki, **Travis Johnston**, S. Ducharme, Z. Ge. Vibrational properties of ferroelectric β-vinylidene fluoride polymers and oligomers, *Physical Review B* **81**, 174120 (2010).

10. R.Korlacki, **Travis Johnston**, et al. Oligo (Vinylidene Fluoride) Langmuir Blodgett films studies by spectroscopic ellipsometry and the density functional theory, *Journal of Chemical Physics* (2008).

Peer Reviewed Conferences

1. R. M. Patton, **Travis Johnston**, S. R. Young, C. D. Schuman, T. E. Potok, D. C. Rose, S.-H. Lim, J. Chae, L. Hou, S. Abousamra, D. Samaras, and J. Saltz. 2019. Exascale Deep Learning to Accelerate Cancer Research.

   Sumbitted as Gordon Bell 2019 nomination.

2. M. Dimovska(*) and **Travis Johnston**. 2019. A Novel Pruning Method for Convolutional Neural Networks Based off Identifying Critical Filters. *In Proceedings of Practice and Experience in Advanced Research Computing (PEARC19)*. IEEE Press, (Accepted).

3. R. M. Patton, **Travis Johnston**, S. R. Young, C. D. Schuman, D. D. March, T. E. Potok, D. C. Rose, S.-H. Lim, T. P. Karnowski, M. A. Ziatdinov, and S. V. Kalinin. 2018. 167-PFlops deep learning for electron microscopy: from learning physics to atomic manipulation. *In Proceedings of the International Conference for High Performance Computing, Networking, Storage, and Analysis (SC '18)*. IEEE Press, Article 50, 11 pages.

   Gordon Bell Finalist (2018)

4. **Travis Johnston**, S. Young, D. Hughes, R. Patton, and D. White. 2017. Optimizing Convolutional Neural Networks for Cloud Detection. *In Proceedings of the Machine Learning on HPC Environments (MLHPC'17)*. ACM, New York, NY, USA, Article 4, 9 pages.

5. Steven Young, D. Rose, **Travis Johnston**, W. Heller, T. Karnowski, T. Potok, R. Patton, G. Perdue, and J. Miller. 2017. Evolving Deep Networks Using HPC. *In Proceedings of the Machine Learning on HPC Environments (MLHPC'17)*. ACM, New York, NY, USA, Article 7, 7 pages.

6. **Travis Johnston**, C. Zanin(+), and M. Taufer. HYPPO: A Hybrid, Piecewise Polynomial Modeling Technique for Non-Smooth Surfaces, *In Proceedings of the 28th IEEE Symposium on Computer Architecture and High Performance Computing* (SBAC-PAD), 1-8 (2016).

   Acceptance Rate: $27/77 \sim 35\%$, one of four best paper finalists

7. M. R. Wyatt II(*), **Travis Johnston**, M. Papas, and M. Taufer. A Scalable Method for Creating Food Groups Using the NHANES Dataset and MapReduce, *ACM Bioinformatics and Computational Biology Conference* (ACM-BCB), 1-10 (2016).

   Acceptance rate: $47/112 \sim 42\%$

8. D. Chapp(*), **Travis Johnston**, and M. Taufer. On the Need Reproducible Numerical Accuracy through Intelligent Runtime Selection of Reduction Algorithms at the Extreme Scale, *In Proceedings of the IEEE Cluster Conference*, 166-175 (2015).

   Acceptance rate: 38/157 $\sim 24\%$

9. **Travis Johnston**, M. Alsulmi(*), P. Cicotti, and M. Taufer. Performance Tuning of MapReduce Jobs Using Surrogate-based Modeling, *Procedia Computer Science (International Conference on Computational Science, ICCS)*, volume 51, 49-59 (2015).

   Acceptance rate: 79/304 $\sim 26\%$

Notes on authorship:

For mathematics journals it is typical to list authors in alphabetical order; this convention is followed in the above mathematical papers. In other disciplines the order of authorship varies. Typically the first author is the individual primarily concerned with the collection and analysis of data and has the primary responsibility of writing the paper. The co-authors are collaborators who contribute to the research and potentially mentor the (first) author.

Notes on publication venue:

A number of my publications are in proceedings of Computer Science Conferences. Conferences are the preferred venue for publication and presentation of research results in computer science. Conference papers are rigorously peer-reviewed comparable to journal papers in other disciplines. When a paper is selected for publication the work is presented at the conference, assuring a fast research contribution turnaround. The fast turnaround is essential in a rapidly evolving environment such as Computer Science.

SERVICE

Academic/Professional

- Served on Program Committee for SC19 (Supercomputing), Machine Learning Track

- Served on Program Committees for IEEE Cluster 2017-2018, Applications Track

- Served as ORPA Secretary (Oak Ridge Postgraduate Association) FY 2017.

- Served on the Applications track program committee for SBAC-PAD 2016.

  This involved reviewing a half dozen submissions to the conference and assisting with the final selection of papers for the Applications track.

- Reviewed a number of papers for journals including: Order, Discrete Applied Mathematics, and the Journal of Parallel and Distributed Computing (JPDC).

Community

- Spent 3 days in Louisiana (near Baton Rouge) assisting with flood recovery as a part of Mormon Helping Hands, Sept 2016.

- Church Organist, Sept 2009 - Sept 2013, Oct 2014-Present.

- Assistant Scoutmaster, Sept 2009 - Sept 2013.

- Served Full-time mission for The Church of Jesus Christ of Latter Day Saints, France Paris Mission (French speaking), Mar 2003 - Mar 2005

COURSES TAUGHT

- High Performance Computing and Data Analytics (co-taught w/UD faculty), Fall 2015

- High Performance Computing and Data Analytics (co-taught w/UD faculty), Fall 2014

  Assisted with the preparation of course materials. Gave lectures on machine learning techniques and graph algorithms using MapReduce.