Austin Reilley Benson

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Academic Appointments

Assistant Professor, Cornell University Department of Computer Science 2018–Present
Postdoctoral Associate, Cornell University Department of Computer Science 2017–2018

Additional affiliations:

Field Member, Cornell University Center for Applied Mathematics 2018–Present

Education

Ph.D. Computational and Mathematical Engineering · Stanford University 2017
M.S. Computational and Mathematical Engineering · Stanford University 2017
B.S. Electrical Engineering and Computer Sciences · University of California, Berkeley 2012
B.A. Applied Mathematics · University of California, Berkeley 2012

Professional Experience

Research Intern, Google Inc. · Mountain View, CA Jul 2016–Dec 2016
Research Intern, Google Inc. · Mountain View, CA Jun 2015–Dec 2015
Research Intern, Sandia National Laboratories · Livermore, CA Summer 2014
Research Intern, HP Labs · Palo Alto, CA Summer 2013
Software Engineering Intern, Google Inc. · Mountain View, CA Summer 2012
Software Engineering Intern, Google Inc. · Mountain View, CA Summer 2011

Preprints

3. Modeling and Analysis of Tagging Networks in Stack Exchange Communities.
   Xiang Fu*, and Shangdi Yu*, and Austin R. Benson (*equal contribution)
   arXiv, 2019.
   Software available at **https://github.com/yushangdi/stack-exchange-cotagging**.
   Data available at **https://www.cs.cornell.edu/~arb/data/index.html#sxtags**.
2. Random Walks on Simplicial Complexes and the normalized Hodge Laplacian.
   Michael T. Schaub, Austin R. Benson, Paul Horn, Gabor Lippner, Ali Jadbabaie.
   arXiv:1807.05044, 2018.
1. Computing tensor Z-eigenvectors with dynamical systems.
   Austin R. Benson and David F. Gleich.
   arXiv:1805.00903, 2018.
   Software available at **https://github.com/arbenson/TZE-dynsys**.

Accepted and Published Peer-reviewed Publications

27. Three hypergraph eigenvector centralities.
    Austin R. Benson.
    To appear in *SIAM Journal on Mathematics of Data Science (SIMODS)*, 2019.
    Software available at **https://github.com/arbenson/Hyper-Evec-Centrality**.

26. Link Prediction in Networks with Core-Fringe Data.
Austin R. Benson and Jon Kleinberg.
To appear in *Proceedings of the Web Conference (WWW)*, 2019.
Software available at **https://github.com/arbenson/cflp**.

25. Choosing to grow a graph: Modeling network formation as discrete choice.
Jan Overgoor, Austin R. Benson, and Johan Ugander.
To appear in *Proceedings of the Web Conference (WWW)*, 2019.
Software available at **https://github.com/janovergoor/choose2grow**.

24. Random Spatial Network Models with Core-Periphery Structure.
Junteng Jia and Austin R. Benson.
Proceedings of the ACM International Conference on Web Search and Data Mining (WSDM), 2019.
Software available at **https://github.com/000Justin000/spatial_core_periphery**.
Data available at **https://www.cs.cornell.edu/~arb/data/index.html#spatial**.

23. Sampling Methods for Counting Temporal Motifs.
Paul Liu, Austin R. Benson, and Moses Charikar.
Proceedings of the ACM International Conference on Web Search and Data Mining (WSDM), 2019.
Software available at **https://gitlab.com/paul.liu.ubc/sampling-temporal-motifs**.
Data available at **http://www.cs.cornell.edu/~arb/data/index.html#tempnets**.

22. The Local Closure Coefficient: A New Perspective On Network Clustering.
Hao Yin, Austin R. Benson, and Jure Leskovec.
Proceedings of the ACM International Conference on Web Search and Data Mining (WSDM), 2019.

21. Simplicial closure and higher-order link prediction.
Austin R. Benson, Rediet Abebe, Michael T. Schaub, Ali Jadbabaie, and Jon Kleinberg.
Proceedings of the National Academy of Sciences (PNAS), 2018.
Software available at **https://github.com/arbenson/ScHoLP-Tutorial**.
Data available at **https://www.cs.cornell.edu/~arb/data/index.html#hon**.

20. Found Graph Data and Planted Vertex Covers.
Austin R. Benson and Jon Kleinberg.
Advances in Neural Information Processing Systems (NeurIPS), 2018.
Software available at **https://github.com/arbenson/FGDnPVC**.
Data available at **http://www.cs.cornell.edu/~arb/data/index.html#pvc**.

19. Sequences of Sets.
Austin R. Benson, Ravi Kumar, and Andrew Tomkins.
Proceedings of the International Conference on Knowledge Discovery and Data Mining (KDD), 2018.
Software available at **https://github.com/arbenson/Sequences-of-Sets**.
Data available at **https://www.cs.cornell.edu/~arb/data/index.html#sos**.

18. Higher-order clustering in networks.
Hao Yin, Austin R. Benson, and Jure Leskovec.
Physical Review E, 2018.
Software available at **https://github.com/arbenson/HigherOrderClustering.jl**.

17. A discrete choice model for subset selection.
Austin R. Benson, Ravi Kumar, and Andrew Tomkins.
Proceedings of the International Conference on Web Search and Data Mining (WSDM), 2018.
Software available at **https://github.com/arbenson/discrete-subset-choice**.
Data available at **https://www.cs.cornell.edu/~arb/data/index.html#subset-choice**.

16. Local higher-order graph clustering.
Hao Yin, Austin R. Benson, Jure Leskovec, and David F. Gleich.
Proceedings of the International Conference on Knowledge Discovery and Data Mining (KDD), 2017.
Code and data available at **http://snap.stanford.edu/mappr**.

15. Motifs in temporal networks.
    Ashwin Paranjape, Austin R. Benson, and Jure Leskovec.
    Proceedings of the International Conference on Web Search and Data Mining (WSDM), 2017.
    Code and data available at **https://snap.stanford.edu/temporal-motifs**.

14. The spacey random walk: a stochastic process for higher-order data.
    Austin R. Benson, David F. Gleich, and Lek-Heng Lim.
    SIAM Review, 2017.
    Software available at **https://github.com/arbenson/spacey-random-walks**.
    Data available at **https://www.cs.cornell.edu/~arb/data/index.html#taxi**.

13. Higher-order organization of complex networks.
    Austin R. Benson, David F. Gleich, and Jure Leskovec.
    Science, 2016.
    Code and data available at **https://snap.stanford.edu/higher-order**.

12. General tensor spectral co-clustering for higher-order data.
    Tao Wu, Austin R. Benson, and David F. Gleich.
    Advances in Neural Information Processing Systems (NeurIPS), 2016.
    Software available at **https://github.com/wutao27/GtensorSC**.

11. Modeling user consumption sequences.
    Austin R. Benson, Ravi Kumar, and Andrew Tomkins.
    Proceedings of the International World Wide Web Conference (WWW), 2016.

10. On the relevance of irrelevant alternatives.
    Austin R. Benson, Ravi Kumar, and Andrew Tomkins.
    Proceedings of the International World Wide Web Conference (WWW), 2016.

9. Improving the numerical stability of fast matrix multiplication.
    Grey Ballard, Austin R. Benson, Alex Druinksy, Benjamin Lipshitz, and Oded Schwartz.
    SIAM Journal on Matrix Analysis and Applications (SIMAX), 2016.
    Software available at **https://github.com/arbenson/fast-matmul**.

8. Tensor spectral clustering for partitioning higher-order network structures.
    Austin R. Benson, David F. Gleich, and Jure Leskovec.
    Proceedings of the SIAM International Conference on Data Mining (SDM), 2015.
    Software available at **https://github.com/arbenson/tensor-sc**.

7. A framework for practical parallel fast matrix multiplication.
    Austin R. Benson and Grey Ballard.
    Proceedings of the Symposium on Principles and Practice of Parallel Programming (PPoPP), 2015.
    Software available at **https://github.com/arbenson/fast-matmul**.

6. Scalable methods for nonnegative matrix factorizations of near-separable tall-and-skinny matrices.
    Austin R. Benson, Jason D. Lee, Bartek Rajwa, and David F. Gleich.
    Advances in Neural Information Processing Systems (NeurIPS), 2014.
    Selected for spotlight presentation.
    Software available at **https://github.com/arbenson/mrnmf**.
    Data available at **https://www.cs.cornell.edu/~arb/data/index.html#fc**.

5. Learning multifractal structure in large networks.
    Austin R. Benson, Carlos Riquelme, and Sven Schmit.
    Proceedings of the International Conference on Knowledge Discovery and Data Mining (KDD), 2014.

4. A parallel directional Fast Multipole Method.
    Austin R. Benson, Jack Poulson, Kenneth Tran, Björn Engquist, and Lexing Ying.
    SIAM Journal on Scientific Computing (SISC) 2014.
    Software available at **https://github.com/arbenson/ddfmm**.

3. Silent error detection in numerical time-stepping schemes.
    Austin R. Benson, Sven Schmit, and Robert Schreiber.

International Journal of High Performance Computing Applications (IJHPCA), 2014.
Software available at **https://www.cs.cornell.edu/~arb/silent.html**.

2. Direct QR factorizations for tall-and-skinny matrices in MapReduce architectures.
Austin R. Benson, David F. Gleich, and James Demmel.
Proceedings of the IEEE International Conference on Big Data (BigData), 2013.
Software available at **https://github.com/arbenson/mrtsqr**.

1. The Gamma-Ray Imaging Framework.
Austin R. Benson, Mark S. Bandstra, Daniel H. Chivers, Timothy Aucott, Ben Augarten, Cameron Bates, Adam Midvidy, Ryan Pavlovsky, James Siegrist, Kai Vetter, and Ben Yee.
IEEE Transactions on Nuclear Science, 2013.
Software available at **https://github.com/bearing/grif**.

Teaching Experience

Instructor, Cornell University

CS 6241: Numerical Methods for Data Science	Spring 2019
CS 2850/INFO 2040/ECON 2040/SOC 2090: Networks (615 students)	Fall 2018

Instructor, Stanford University

CME 193: Introduction to Scientific Python	Spring 2013
CME 193: Introduction to Scientific Python (created course)	Winter 2013

Advising

Ph.D. students

Junteng Jia · Computer Science	Spring 2018–Present
Ilya Amburg · Applied Mathematics	Fall 2018–Present

M.Eng. students

Lillyan Pan · Computer Science	Fall 2018
Multimodal Graph Embeddings	

Undergraduate students

Jakob Kaminsky · Computer Science	Spring 2019–Present
Leah Ajmani · Computer Science & Philosophy	Fall 2018–Present
Scott Dickson · Computer Science	Fall 2018–Present
Shangdi Yu · Computer Science & Operations Research	Spring 2018–Present
Xiang (Felix) Fu · Computer Science & Operations Research	Spring 2018–Present

Invited talks

Conference of the International Linear Algebra Society · Rio de Janeiro, Brazil	Jul 2019
Higher-order Models NetSci Satellite · Burlington, VT	May 2019
Statistical Inference for Network Models NetSci Satellite · Burlington, VT	May 2019
GraphEx 2019 · Boston, MA	Apr 2019
Syracuse University Computer Science Seminar · Syracuse, NY	Apr 2019
Clarkson Center for Complex Systems Science Seminar · Potsdam, NY	Feb 2019
University at Buffalo Applied Mathematics Seminar · Buffalo, NY	Oct 2018
Cornell Scientific Computing and Numerics Seminar · Ithaca, NY	Sep 2018
SIAM Annual · Portland, OR	Jul 2018
Higher-order Models NetSci Satellite · Paris, France	Jun 2018
Statistical Learning and Data Science · New York, NY	Jun 2018
Stanford Linear Algebra/Optimization Seminar · Stanford, CA	Apr 2018
CMStatistics Conference · London, England	Dec 2017

Cornell Center for Applied Math Colloquium · Ithaca, NY — Oct 2017
Data Institute SF Annual Conference · San Francisco, CA — Oct 2017
Purdue Center for Science of Information Seminar · West Lafayette, IN — Oct 2017
Cornell Scientific Computing and Numerics Seminar · Ithaca, NY — Sep 2017
AMS Spring Western Sectional Meeting · Pullman, WA — Apr 2017
University of Chicago Scientific Computing Seminar · Chicago, IL — Jan 2017
Lawrence Livermore National Laboratory Seminar · Livermore, CA — Jun 2016
MX16 Multi-dimensional Networks Symposium · Davis, CA — May 2016
Purdue Center for Science of Information Seminar · West Lafayette, IN — May 2016
Copper Mountain Conference on Iterative Methods · Copper Mountain, CO — Mar 2016
Stanford Linear Algebra/Optimization Seminar · Stanford, CA — Feb 2016
Santa Fe Institute Inference on Networks Workshop · Santa Fe, NM — Dec 2015
NeurIPS Multiresolution Methods Workshop · Montreal, Canada — Dec 2015
SIAM Applied Linear Algebra · Atlanta, GA — Oct 2015
UC-Berkeley DMML Workshop · Berkeley, CA — Oct 2015
Allerton Conference · Monticello, IL — Oct 2015
Lawrence Livermore National Laboratory Seminar · Livermore, CA — Sep 2015
Higher-order Models NetSci Satellite · Zaragoza, Spain — Jun 2015
Stanford ICME Colloquium · Stanford, CA — Oct 2014
UT-Austin BLIS Retreat · Austin, TX — Sep 2014
Purdue Machine Learning Seminar · West Lafayette, IN — Sep 2014

Awards

LAA Early Career Speaker, International Linear Algebra Society — 2019
Outstanding program committee member, WSDM '19 — 2019
Stanford Gene Golub Doctoral Dissertation Award — 2017
Teaching Fellow, ICME, Stanford University — 2016
Office of Technology Licensing Stanford Graduate Fellowship — 2012-2016

Service

Editorial roles

Associate Editor, *Science Advances* — 2019–Present
Guest Editor, *Applied Network Science: Machine Learning with Graphs Special issue* — 2019

Conference activities organized

Mining and Modeling Evolving and Higher-Order Complex Data and Networks
(with Francesco Tudisco, Christine Klymko, and Eisha Nathan)
Minisymposium, International Congress on Industrial and Applied Mathematics (ICIAM '19) in Valencia, Spain

Modeling and Mining Network Data
Minisymposium, SIAM Discrete Mathematics 2018 (DM '18) in Denver, CO
http://www.cs.cornell.edu/~arb/mmnd18/

Tensor Eigenvectors and Stochastic Processes (with David Gleich)
Minitutorial, SIAM Applied Linear Algebra 2018 (ALA '18) in Hong Kong
http://www.cs.cornell.edu/~arb/tesp/

Eigenvectors and Decompositions of Structured Tensors (with David Gleich)
Minisymposium, SIAM Computational Science and Engineering 2017 (CSE '17) in Atlanta, GA

Outreach

Mentor for hackathon sponsored by PLOS to promote accessible code and data in Network Science, NetSci 2019
https://opennetsci.github.io/

Panelist for the Paper Unwind, Society of Young Network Scientists event, NetSci 2019
https://www.networkscienceinstitute.org/syns

Conference program committees

KDD '16, '17, '18, '19
WWW '17, '18 '19
WSDM '17, '18, '19
SIAM Network Science '18
ICML '19
SDM '19
NeurIPS '17, '18; Area chair: '19

Panels and proposal reviewing

NSF CISE Review Panel 2018, 2019
Department of Energy
Army Research Office

Journal reviewing

ACM Transactions on Knowledge Discovery in Data (TKDD)
Annals of Statistics
IEEE Transactions on Network Science and Engineering (TNSE)
IEEE Transactions on Knowledge and Data Engineering (TKDE)
Journal of Complex Networks
Journal of Machine Learning Research (JMLR)
Nature Scientific Reports
Network Science
PLOS ONE
SIAM Journal on Applied Mathematics (SIAP)
SIAM Journal on Scientific Computing (SISC)
SIAM Journal on Matrix Analysis and Applications (SIMAX)
SIAM Review (SIREV)

Book reviewing

CRC Press
Morgan & Claypool Publishers

Press

Coverage of our *PNAS* article "Simplicial closure an higher-order link prediction":

Predicting future combos, from rap songs to pharmaceuticals (Cornell Chronicle)

Coverage of our *Science* article "Higher-order organization of complex networks":

Stanford-led effort creates a new way to analyze and control networks (Stanford News)
Mathematical framework offers a more detailed understanding of network relationships (Phys.org)
Mathematical Framework that Prioritizes Key Patterns in Networks Aims to Accelerate Scientific Discovery (DARPA)

Coverage of our work on fault-tolerant algorithms at HP Labs:

Summer 2013 interns at HP Labs (HP Blogs)