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Shashanka Ubaru

Research Interests

Machine learning, numerical linear algebra, coding theory applications, approximation theory and algorithms, eigenvalue problems, and material informatics.

Current Position

Aug. 2018 **IBM T.J. Watson Research Center**, *Yorktown Heights*, NY, USA.
Goldstine Postdoctoral Fellow

Education

2012-18 **University of Minnesota**, *Minneapolis*, MN, USA.
Ph.D. Computer Science May 2018
Advisor: Yousef Saad
Thesis: *Algorithmic advances in learning from large dimensional matrices and scientific data*

M.S. Computer Science October 2015
M.S. Electrical Engineering November 2014
Advisors: Yousef Saad and Arya Mazumdar
Thesis: *Randomized techniques for matrix decomposition and estimating the approximate rank of a matrix*

2008-12 **M.S. Ramaiah Institute of Technology**, *Bangalore*, India.
B.Eng. Electronics and Communication

Publications

Journal articles

2019 *Sampling and multilevel coarsening algorithms for fast matrix approximations*.
S. Ubaru and Y. Saad
Numerical Linear Algebra with Applications, In press.

2017 *Fast estimation of* $\mathtt{tr}(f(A))$ *via Stochastic Lanczos Quadrature*.
S. Ubaru, J. Chen, and Y. Saad
SIAM Journal on Matrix Analysis and Applications (SIMAX), 38(4), 1075–1099.

2017 *Low rank approximation and decomposition of large matrices using error correcting codes*.
S. Ubaru, A. Mazumdar, and Y. Saad
IEEE Transactions on Information Theory, 63(9), 5544–5558.

2017 *Formation enthalpies for transition metal alloys using machine learning*.
S. Ubaru, A. Miedlar, Y. Saad, and J R. Chelikowsky
Physical Review B, (Vol.95, No.21).

2017 *Fast estimation of approximate matrix ranks using spectral densities*.
S. Ubaru, Y. Saad, and A.-K. Seghouane
Neural Computation, 29(5):1317–1351.

2017 *Improving the Incoherence of a Learned Dictionary via Rank Shrinkage*.
S. Ubaru, A.-K. Seghouane, and Y. Saad
Neural Computation, 29(1):263–285.

2012 *Displaying gray scales by cross pairing select and data voltages in multi-line addressed LCD*.
S. Ubaru and T.N. Ruckmongathan
IEEE Journal of Display Technology, 8(11), 669–677.

Conference proceedings

2019 *Spectrum-Adapted Polynomial Approximation for Matrix Functions*.
L. Fan, D. Shuman, **S. Ubaru**, and Y. Saad
International Conference on Acoustics, Speech, and Signal Processing (ICASSP).

2019 *Find the dimension that counts: Fast dimension estimation and Krylov PCA*.
S. Ubaru, A.-K. Seghouane, and Y. Saad
SIAM International Conference on Data Mining (SDM).

2018 *Spectral Sums Beyond Fast Matrix Multiplication: Algorithms and Hardness*.
C. Musco, P. Netrapalli, A. Sifford, **S. Ubaru**, and D. P. Woodruff
Innovations in Theoretical Computer Science (ITCS).

2017 $UoI\text{-}NMF_{cluster}$*: A Robust Nonnegative Matrix Factorization Algorithm for Improved Parts-Based Decomposition and Reconstruction of Noisy Data*.
S. Ubaru, K. Wu, and K. E. Bouchard
IEEE International Conference on Machine Learning and Applications (ICMLA).
Best Paper Award.

2017 *Union of Intersections (UoI) for Interpretable Data Driven Discovery and Prediction*.
K. E. Bouchard, A. F. Bujan, F. Roosta-Khorasani, **S. Ubaru**, Prabhat, A. M. Snijders, J.-H. Mao, E. F. Chang, M. W. Mahoney, and S. Bhattacharyya
Neural Information Processing Systems (NIPS).

2017 *Multilabel Classification with Group Testing and Codes*.
S. Ubaru and A. Mazumdar
International Conference on Machine Learning (ICML).

2016 *Fast methods for estimating the Numerical rank of large matrices*.
S. Ubaru and Y. Saad
International Conference on Machine Learning (ICML).

2016 *Group testing schemes from low-weight codewords of BCH codes*.
S. Ubaru, A. Mazumdar, and A. Barg
IEEE International Symposium on Information Theory (ISIT).

2015 *Low rank approximation using error correcting coding matrices*.
S. Ubaru, A. Mazumdar, and Y. Saad
International Conference on Machine Learning (ICML).

Book chapter

2018 *Applications of trace estimation techniques*.
S. Ubaru and Y. Saad
High Performance Computing in Science and Engineering, LNCS book series, vol. 11087, ch. 2, pp 19–33.

Submissions

2018 *Run Procrustes, Run! On the convergence of accelerated Procrustes flow*.
A. Krylidis, **S. Ubaru**, G. Kollias, and K. E. Bouchard.

Presentations and Visits

2019 *Error Correcting Codes for Machine Learning.*
- CSA Seminar, Indian Institute of Science (IISc), Bengaluru, India.

2018 *Error Correcting Codes for Machine Learning.*
- Theory Seminar, University of Massachusetts, Amherst, MA.
- IP Seminar, IBM T.J. Watson Research Center, NY.

Lawrence Berkeley National Laboratory, CA (Two weeks visit in June).

2017 $UoI\text{-}NMF_{cluster}$*: A Robust Nonnegative Matrix Factorization Algorithm for Noisy Data*
- International Conference on Machine Learning and Applications (ICMLA), Cancun, Mexico.

Multilabel Classification with Group Testing and Codes
- Neural Systems and Engineering Labs, Lawrence Berkeley National Laboratory, CA.
- International Conference on Machine Learning (ICML), Sydney, Australia.

Error Correcting Codes for Machine Learning.
- The University of Melbourne, Melbourne, Australia (Two weeks visit in August).

UoI-NMFcluster and UoI-CUR: Union of Intersections methods for matrix approximations
- Neural Systems and Engineering Labs, Lawrence Berkeley National Laboratory,CA.

Microsoft Research, Bangalore, India (Two days visit in May).

2016 *Error correcting codes for low rank approximation and group testing*
- BLISS Seminar, University of California, Berkeley, CA.

Fast methods for estimating the Numerical rank of large matrices
- International Conference on Machine Learning (ICML), New York, NY.

2015 *Low rank approximation using error correcting coding matrices.*
- International Conference on Machine Learning (ICML), Lille, France.

Awards

2018-20 ***Herman Goldstine Fellowship***, IBM Research.

2017 ***Best Paper Award***, International Conference on Machine Learning and Applications (ICMLA).

2015,16,17 *ICML Travel Scholarship*.

2015 *CS Department Travel Award*.

2011 *Visiting Research Student Program*, Raman Research Institute.

Experience

2013-18 **University of Minnesota**, *Minneapolis*, MN, USA.
Research Assistant, Department of Computer Science.

Jun-Aug. 17 **Lawrence Berkeley National Laboratory**, *Berkeley*, CA, USA.
May-Aug. 16 *Research Intern*, Scientific Data Management group.

May-Aug. 13 **Seagate Technology**, *Shakopee*, MN, USA.
Signal Processing Intern.

2011-12 **Raman Research Institute**, *Bangalore*, India.
Visiting Research Student Program.

Teaching

University of Minnesota

Spring 2018 CSci 2033, Elementary Computational Linear Algebra, *Recitation Instructor*.

Fall 2017 CSci 5304, Computational Aspects of Matrix Theory, *Teaching Assistant*.

Spring 2017 CSci 8314, Sparse Matrix Computations, *Temporary Instructor*.

Service

Reviewer: ICML 2019, ICMLA 2018, ISIT 2017, NIPS 2016, PLOS One, SIAM Journal on Matrix Analysis and Applications, Signal Processing Letters, IEEE Transactions on Information Theory, Acta Materialia, Electronic Transactions on Numerical Analysis, IEEE Transactions on Signal and Information Processing over Networks, Journal of Mathematics and Applications, Mathematical Modelling and Analysis.

Organizer: ICMLA Challenge 2018 - Parts based decomposition of noisy data.
MSRIT ROBONXG-2012, a week long robotics festival.

Graduate courses

Random matrices and high dimensional statistics, Sparse matrix computations, Optimization theory, Machine learning, Methods of applied mathematics, Computational aspects of matrix theory, Advanced algorithms and data-structures, Pattern recognition, Data compression, Adaptive digital signal processing, Detection and estimation theory, Digital communications, Probability and stochastic processes.

References

Yousef Saad
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Computer Science and Engineering,
University of Minnesota- Twin Cities, MN, USA.
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Arya Mazumdar
Assistant Professor,
College of Information and Computer Sciences,
University of Massachusetts at Amherst, MA, USA.
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Neural Systems and Engineering
Lawrence Berkeley National Laboratory, CA, USA.
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