David G. Anderson

GitHub: daveanderson4

EDUCATION

UNIVERSITY OF CALIFORNIA, BERKELEY, CA — 2010 – 2016
Department of Mathematics, PhD candidate in Applied Mathematics
Advisor: Ming Gu

UNIVERSITY OF PENNSYLVANIA, Philadelphia, PA — 2003 – 2007
The Graduate School of Arts and Sciences, Masters of Arts in Mathematics
The Wharton School, Bachelor of Science in Economics
The College of Arts and Sciences, Bachelor of Arts in Mathematics

AREAS OF SPECIALIZATION

Low-rank data approximation, data compression, pattern recognition, PCA, numeric linear algebra, machine learning, randomized algorithms, communication-avoiding algorithms, online algorithms, sparse PCA, numeric solutions to PDEs

FELLOWSHIPS

Graduate Student Researcher Fellowship, Summer 2015, Fall 2015, Spring 2016 — Berkeley, CA
Dept. of Energy, Graduate Student Researcher, LBNL, Mathematics Group, Summer 2014 — Berkeley, CA
Graduate Student Researcher Fellowship, Spring 2013 — Berkeley, CA
Berkeley Graduate Fellowship, Fall 2010 — Berkeley, CA

AWARDS AND HONORS

Magna Cum Laude, May 2007 — Philadelphia, PA
Benjamin Franklin Scholar, 2003 – 2007 — Philadelphia, PA
Dean's List, 2005 – 2006, 2003 – 2004 — Philadelphia, PA
Winner of Class of 1880 Prize Exam (Penn math competition), 2004 — Philadelphia, PA

PAPERS

An Efficient, Sparsity-Preserving, Online Algorithm for Data Approximation, David Anderson and Ming Gu, Submitted to NIPS 2016. Prepreint available at http://arxiv.org/abs/1602.05950. 2016

This work introduces a fast low-rank approximation algorithm based on a truncated randomized LU decomposition. This algorithm is as fast as any known low-rank approximation algorithm for general data matrices, with accuracy provably close to the truncated SVD. Additionally, this algorithm preserves sparsity and is an "online algorithm", i.e. the approximation can be efficiently updated with new data.

Optimizing GMRES for Stiff Finite Element PDE Problems, David Anderson and Per-Olof Persson, In Progress, 2016

Currently in progress, this research will introduce a new variation of the Generalized Minimal Residual Method (GMRES) for finite element simulation of stiff PDE problems. Completion is expected in late spring/early summer.

Spectral Gap Error Bounds for Improving CUR Matrix Decomposition and the Nyström Method, David Anderson, Simon Du, Ming Gu, Michael Mahoney, Christopher Melgaard, and Kunming Wu, *Proceedings of the International Conference on Artificial Intelligence and Statistics* (AISTATS), http://jmlr.org/proceedings/papers/v38/anderson15.pdf, 2015

This paper is the first known work to prove that data approximation algorithms converge faster on data matrices with strong data trends than on data matrices with weak trends. A deterministic algorithm adapted from *An Efficient Algorithm for Unweighted Spectral Graph Sparsification* is introduced, and is shown to produce more accurate results than other current algorithms on machine learning problems involving kernel methods.

An Efficient Algorithm for Unweighted Spectral Graph Sparsification, David Anderson, Ming Gu, and Christopher Melgaard, Submitted: *SIAM Journal on Computing*, http://arxiv.org/abs/1410.4273, 2015

This work is the first to prove that a general unweighted graph can be spectrally approximated by a sparse unweighted graph, and a deterministic graph sparsification algorithm is introduced. This algorithm is shown to be an accurate low-rank approximation method in its own right, with provably better worst-case error than other current algorithms. Applications include CX and CUR decompositions, which in turn correspond to applications in machine learning.

Improved Algorithms for Column-Based Matrix Reconstruction, David Anderson, Simon Du, Ming Gu, Christopher Melgaard, and Kunming Wu, 2014

In this work, deterministic and randomized algorithms are introduced to provide accurate low-rank matrix approximations via column selection. Numeric experiments show that this method can accurately identify a subset of data attributes that accurately represent the whole dataset.

TALKS

A Randomized Algorithm for Computing a Spectrum-Revealing LU Decomposition, Matrix Computations and Scientific Computing Seminar, University of California, Berkeley April 29th, 2015

An Efficient Algorithm for Unweighted Spectral Graph Sparsification, Matrix Computations and Scientific Computing Seminar, University of California, Berkeley October 29th, 2014

EXPERIENCE

DEPARTMENT OF ENERGY, Berkeley, CA 2013 – 2015
Lawrence Berkeley National Laboratory Affiliate Researcher
Mathematics Group

UC BERKELEY, Berkeley, CA 2011 – 2015
Graduate Student Instructor
1 semester of graduate level numerical PDEs
1 semester of upper division numerical PDEs
4 semesters of various calculus classes

HUDSON ADVISORS, New York, NY 2008 – 2009
Analyst, Portfolio Management Group
Assessed the performance and risks of distressed debt assets
Created various portfolio analytics tools

BANK OF AMERICA, New York, NY 2007 – 2008
Analyst, Structured Securities Group
Various analyses for origination of structured securities
Performed stress tests and risk assessments for structured securities

POLICY STUDIES INC., Denver, CO Summer 2006
Leading provider of outsourced social service programs in U.S. 2,000+ employees
Business Strategy Intern
Built various project valuation models

PROGRAMMING EXPERIENCE

Low Level: C++
High Level: Matlab, Python, R
Other: LaTeX, MPI, LAPACK, previous experience with a variety of languages

ACTIVITIES

Cartoonist for the *Daily Pennsylvanian*, the University of Pennsylvania newspaper 2003 – 2007
Artist of the Year, 2005
Skier
Junior Ski Patroller, Winter Park, CO 2000 - 2003