

**Mark Tygert**  
tygert@aya.yale.edu  
http://tygert.com

Facebook, 1 Facebook Way, Menlo Park, CA 94025  
786 Coleman Ave., Apt. N, Menlo Park, CA 94025  
Date of birth: November 19, 1979

## Education

B.A., MATHEMATICS, PRINCETON  
September 1997 – June 2001

PH.D., APPLIED MATHEMATICS, YALE  
September 2001 – June 2004

## Employment

POSTDOCTORAL RESEARCHER  
Yale University, Math Dept.  
July 2004 – June 2008

VISITING ASSISTANT PROFESSOR  
UCLA, Math Dept.  
July 2008 – June 2009

ASSISTANT PROFESSOR  
NYU Courant Institute, Math Dept.  
September 2009 – August 2013

DIRECTOR  
M.S. in Scientific Computing  
NYU Courant Institute  
September 2011 – August 2013

RESEARCH SCIENTIST  
Yale University, Math Dept.  
September 2013 – June 2014

RESEARCH SCIENTIST  
Facebook, Yann LeCun’s AI group  
July 2014 –

## Honors

DARPA Young Faculty Award for “Computer-enabled metrics of statistical significance”  
The 2010 U.S. National Academy of Sciences Award for Initiatives in Research  
Sloan Research Fellowship  
U.S. National Defense Science and Engineering Graduate Fellowship  
Barry Goldwater, Robert Byrd, and National Merit Scholarships  
Brown and Covington Prizes, the top awards to a junior and to a senior majoring in math at Princeton  
Graduated summa cum laude and “with highest honors” from Princeton  
2 Princeton President’s Awards for Academic Achievement  
Valedictorian of the Schalmont High School class of 1997

## Current research interests

Machine learning, statistics, and computational science and engineering, particularly numerical analysis

## Publications

21. ACCURATE LOW-RANK APPROXIMATIONS VIA A FEW ITERATIONS OF ALTERNATING LEAST SQUARES, *SIAM Journal on Matrix Analysis and Applications*, 38 (2): 425–433, 2017 (with Arthur Szlam and Andrew Tulloch).
20. SCALE-INVARIANT LEARNING AND CONVOLUTIONAL NETWORKS, *Applied and Computational Harmonic Analysis*, 42 (1): 154–166, 2017 (with Soumith Chintala, Marc’Aurelio Ranzato, Arthur Szlam, Yuandong Tian, and Wojciech Zaremba).
19. ALGORITHM 971: AN IMPLEMENTATION OF A RANDOMIZED ALGORITHM FOR PRINCIPAL COMPONENT ANALYSIS, *ACM Transactions on Mathematical Software*, 43 (3): 28:1–28:14, 2016 (with Huamin Li, George Linderman, Arthur Szlam, Kelly Stanton, and Yuval Kluger).
18. A MATHEMATICAL MOTIVATION FOR COMPLEX-VALUED CONVOLUTIONAL NETWORKS, *Neural Computation*, 28 (5): 815–825, 2016 (with Joan Bruna, Soumith Chintala, Yann LeCun, Serkan Piantino, and Arthur Szlam).
17. SOME DEFICIENCIES OF  $\chi^2$  AND CLASSICAL EXACT TESTS OF SIGNIFICANCE, *Applied and Computational Harmonic Analysis*, 36 (3): 361–386, 2014 (with William Perkins and Rachel Ward).

16. AN ALGORITHM FOR THE PRINCIPAL COMPONENT ANALYSIS OF LARGE DATA SETS, *SIAM Journal on Scientific Computing*, 33 (5): 2580–2594, 2011 (with Nathan Halko, Per-Gunnar Martinsson, and Yoel Shkolnisky).
15. COMPUTING THE CONFIDENCE LEVELS FOR A ROOT-MEAN-SQUARE TEST OF GOODNESS-OF-FIT, *Applied Mathematics and Computation*, 217 (22): 9072–9084, 2011 (with William Perkins and Rachel Ward).
14. A FAST RANDOMIZED ALGORITHM FOR ORTHOGONAL PROJECTION, *SIAM Journal on Scientific Computing*, 33 (2): 849–868, 2011 (with Edouard Coakley and Vladimir Rokhlin).
13. A RANDOMIZED ALGORITHM FOR THE DECOMPOSITION OF MATRICES, *Applied and Computational Harmonic Analysis*, 30 (1): 47–68, 2011 (with Per-Gunnar Martinsson and Vladimir Rokhlin).
12. STATISTICAL TESTS FOR WHETHER A GIVEN SET OF INDEPENDENT, IDENTICALLY DISTRIBUTED DRAWS COMES FROM A SPECIFIED PROBABILITY DENSITY, *Proceedings of the National Academy of Sciences (USA)*, 107 (38): 16471–16476, 2010.
11. FAST ALGORITHMS FOR SPHERICAL HARMONIC EXPANSIONS, III, *Journal of Computational Physics*, 229 (18): 6181–6192, 2010.
10. RECURRENCE RELATIONS AND FAST ALGORITHMS, *Applied and Computational Harmonic Analysis*, 28 (1): 121–128, 2010.
9. A RANDOMIZED ALGORITHM FOR PRINCIPAL COMPONENT ANALYSIS, *SIAM Journal on Matrix Analysis and Applications*, 31 (3): 1100–1124, 2009 (with Vladimir Rokhlin and Arthur Szlam).
8. FAST ALGORITHMS FOR SPHERICAL HARMONIC EXPANSIONS, II, *Journal of Computational Physics*, 227 (8): 4260–4279, 2008.
7. A FAST RANDOMIZED ALGORITHM FOR OVERDETERMINED LINEAR LEAST-SQUARES REGRESSION, *Proceedings of the National Academy of Sciences (USA)*, 105 (36): 13212–13217, 2008 (with Vladimir Rokhlin).
6. A FAST RANDOMIZED ALGORITHM FOR THE APPROXIMATION OF MATRICES, *Applied and Computational Harmonic Analysis*, 25 (3): 335–366, 2008 (with Franco Woolfe, Edo Liberty, and Vladimir Rokhlin).
5. RANDOMIZED ALGORITHMS FOR THE LOW-RANK APPROXIMATION OF MATRICES, *Proceedings of the National Academy of Sciences (USA)*, 104 (51): 20167–20172, 2007 (with Edo Liberty, Franco Woolfe, Per-Gunnar Martinsson, and Vladimir Rokhlin).
4. APPROXIMATION OF BANDLIMITED FUNCTIONS, *Applied and Computational Harmonic Analysis*, 21 (3): 413–420, 2006 (with Yoel Shkolnisky and Vladimir Rokhlin).
3. ON INTERPOLATION AND INTEGRATION IN FINITE-DIMENSIONAL SPACES OF BOUNDED FUNCTIONS, *Communications in Applied Mathematics and Computational Science*, 1: 133–142, 2006 (with Per-Gunnar Martinsson and Vladimir Rokhlin).
2. FAST ALGORITHMS FOR SPHERICAL HARMONIC EXPANSIONS, *SIAM Journal on Scientific Computing*, 27 (6): 1903–1928, 2006 (with Vladimir Rokhlin).
1. A FAST ALGORITHM FOR THE INVERSION OF GENERAL TOEPLITZ MATRICES, *Computers and Mathematics with Applications*, 50 (5–6): 741–752, 2005 (with Per-Gunnar Martinsson and Vladimir Rokhlin).

## Preprints

10. HIERARCHICAL LOSS FOR CLASSIFICATION, *arXiv*, 1709.01062 (with Cinna Wu and Yann LeCun).
9. RANDOMIZED ALGORITHMS FOR DISTRIBUTED COMPUTATION OF PRINCIPAL COMPONENT ANALYSIS AND SINGULAR VALUE DECOMPOSITION, *arXiv*, 1612.08709 (with Huamin Li and Yuval Kluger).
8. POOR STARTING POINTS IN MACHINE LEARNING, *arXiv*, 1602.02823.
7. COMPUTER-ENABLED METRICS OF STATISTICAL SIGNIFICANCE FOR DISCRETE DATA, a 157-page monograph, available at <http://tygert.com/mono.pdf>, 2014 (with William Perkins and Rachel Ward).
6. TESTING GOODNESS-OF-FIT FOR LOGISTIC REGRESSION, *arXiv*, 1306.0959 (with Rachel Ward).
5. SIGNIFICANCE TESTING WITHOUT TRUTH, *arXiv*, 1301.1208 (with William Perkins and Rachel Ward).
4. A COMPARISON OF THE DISCRETE KOLMOGOROV-SMIRNOV STATISTIC AND THE EUCLIDEAN DISTANCE, *arXiv*, 1206.6367 (with Jacob Carruth and Rachel Ward).
3. COMPUTING THE ASYMPTOTIC POWER OF A EUCLIDEAN-DISTANCE TEST FOR GOODNESS-OF-FIT, *arXiv*, 1206.6378 (with William Perkins and Gary Simon).
2. TESTING THE SIGNIFICANCE OF ASSUMING HOMOGENEITY IN CONTINGENCY-TABLES/CROSS-TABS, *arXiv*, 1201.1421.
1. COMPUTING THE CONFIDENCE LEVELS FOR A ROOT-MEAN-SQUARE TEST OF GOODNESS-OF-FIT, II, *arXiv*, 1009.2260 (with William Perkins and Rachel Ward).

## Courses taught

|  |   |
|--|---|
| BASIC ANALYSIS IN FUNCTION SPACES<br>Yale undergraduate MATH 260b<br>Spring 2005       | NUMERICAL METHODS WITH PROBABILITY<br>NYU graduate MATH-GA-2012/CSCI-GA-2945<br>Spring 2010 |
| MULTILEVEL COMPRESSION OF LINEAR OPERATORS<br>Yale graduate AMTH 510a<br>Fall 2005     | REAL VARIABLES<br>NYU graduate MATH-GA-2430<br>Fall 2010                                    |
| DIFFERENTIAL CALCULUS<br>Yale undergraduate MATH 112a<br>Fall 2006                     | MATHEMATICAL STATISTICS<br>NYU undergraduate MATH-UA-0234<br>Spring 2011                    |
| MULTILEVEL COMPRESSION OF LINEAR OPERATORS<br>Yale graduate AMTH 510a<br>Fall 2006     | FAST MULTIPOLE METHODS<br>NYU graduate MATH-GA-2011/CSCI-GA-2945<br>Fall 2011               |
| INTRO. TO FUNCTIONS OF SEVERAL VARIABLES<br>Yale undergraduate MATH 118a<br>Fall 2007  | MATHEMATICAL STATISTICS<br>NYU undergraduate MATH-UA-0234<br>Spring 2012                    |
| EFFICIENT MATRIX COMPUTATIONS<br>Yale graduate AMTH/CPSC 951a<br>Fall 2007             | MATHEMATICAL STATISTICS<br>NYU graduate MATH-GA-2962<br>Spring 2012                         |
| OPTIMIZATION<br>UCLA undergraduate MATH 164<br>Winter 2009                             | PROBABILITY THEORY<br>NYU undergraduate MATH-UA-0233<br>Fall 2012                           |
| COMPUTATIONAL LINEAR ALGEBRA<br>UCLA graduate MATH 270C<br>Spring 2009                 | NUMERICAL COMPUTATION I<br>NYU graduate MATH-GA-2010/CSCI-GA-2420<br>Fall 2012              |
| COMPRESSION OF LINEAR OPERATORS<br>NYU graduate MATH-GA-2011/CSCI-GA-2945<br>Fall 2009 | MATHEMATICAL STATISTICS<br>NYU graduate MATH-GA-2962<br>Spring 2013                         |