

CURRICULUM VITAE

October 24, 2018

Notarization. I have read the following and certify that this *curriculum vitae* is a current and accurate statement of my professional record.

Signature _____ Date_____

I Personal Information

UID, Last Name, First Name, Contact Information

UID: 100934397
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Univ. of Maryland
Dept of Computer Science
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Current Academic Appointment: Full Professor.

Other Academic and/or Administrative Appointments while at UMD

UMIACS 1985–2010

Employment Background

1. 1981-85 Teaching Assistant, Comp. Sci. Dept., Harvard Univ.
2. 1981-85 Research Assistant, Comp. Sci. Dept., Harvard Univ.
3. 1985-1991 Assistant Professor, Comp. Sci. Dept., Univ. of Maryland.
4. 1991- Associate Professor, Comp. Sci. Dept, Univ. of Maryland.
5. 1985-2010 Univ. of Maryland Institute for Adv. Comp. Studies (UMIACS).
6. 1988- Member of Applied Math Program.
7. 1991-1992 Sabbatical. Visited several Universities (list available).
8. 1998- Full Professor, Comp. Sci. Dept., Univ of Maryland.
9. 1998-1999 Sabbatical. Visited several Universities (list available).
10. Fall 2005 Sabbatical. Visited several Universities (list available).

11. Spring 2015- Math Affiliate.

Educational Background

1. BA in Math and Applied Math, SUNY at Stonybrook, Spring 1980.
2. MS in Applied Math, Harvard University, Spring 1982.
3. Ph.D in Computer Science, Harvard University, Spring 1985. Adviser: Harry Lewis. Title of Thesis: *Recursion-theoretic techniques in complexity theory and combinatorics*.

II Research, Scholarly and Creative Activities

Books

Books Authored

1. Bounded Queries in Recursion Theory (With Georgia Martin). Birkhauser. 1998. ISBN: 0917639667.
2. Problems in Algorithms (With Ian Parberry). 2002. A Web book, hence no ISBN Web address: <http://larc.unt.edu/ian/books/free/poa.pdf>

Book Chapters

1. Oracles: Three New Results. *Marcel Dekker Lecture Notes in Pure and Applied Mathematics Vol. 106*, Edited by D.W. Kueker, E.G.K. Lopez-Escobar, and C.H. Smith, 1987, pp. 219-252. ISBN: 0824777468.
2. Index Sets in Recursive Combinatorics (with G. Martin), *Logical Methods (In honor of Anil Nerode's Sixtieth Birthday)*. Edited by Crossley, Remmel, Shore, and Sweedler. 1993. Edited by Birkhauser, Boston. ISBN: 0817636900
3. The Complexity of Problems, *Advances in Computers Volume 43*. Edited by Marvin Zelkowitz. Published by Academic Press. Pages 215–241. 1996. ISBN: 978-0-12-012143-4
4. A Survey of Inductive Inference with an Emphasis on Learning via Queries (with C. Smith). *Complexity, Logic, and Recursion Theory*. Edited by A. Sorbi. Published by M. Dekker. Pages 225–260. Volume 187. 1997. ISBN: 08247-0026-0.
5. A Survey of Recursive Combinatorics. *Handbook of Recursive Mathematics Volume 2*. Edited by Ershov, Goncharov, Marek, Nerode, and Remmel. 1998. Pages 1041–1176. Published by Elsevier ISBN: 0444544249
6. A techniques-oriented survey of bounded queries. (with Frank Stephan). *Models and Computability (invited papers from Logic Colloquium '97)* (Lecture Note Series 259), Edited by Cooper and Truss. 117-156, 1999. London Mathematical Society Forschungsberichte Mathematische Logik 32 / 1998, Mathematisches Institut, Universitaet Heidelberg, Heidelberg, 1998. ISBN: 0521635500

7. Computability, *Handbook of Discrete and Combinatorial Mathematics*. Edited by Kenneth Rosen. Published by CRC Press (Boca Raton, Florida). 2000. pp. 1062-1066. ISBN: 8131219569
8. A Survey of Constant Time Parallel Sorting, for *Bulletin of the European Association for Theoretical Computer Science* (with Evan Golub and Clyde Kruskal), Vol 72, pages 84-102, October 2000, Computational Complexity Column.
9. Gems in the field of bounded queries. *Computability and Models* Edited by Cooper and Goncharov. 2003. ISBN: 03064700X
10. A Survey on Private Information Retrieval *Bulletin of the European Association for Theoretical Computer Science* Vol 82, February 2004, pages 72–107. Computational Complexity Column.
11. Classifying Problems Into Complexity Classes. *Advances in Computers Volume 95*. Edited by Atif Memon Published by Elsevier. Pages 239–292. 2014. ISBN 978-0-12-800160-8
12. Proving Programs Terminate using Well Orderings, Ramsey Theory, and Matrices. *Advances in Computers Volume 97*. Edited by Atif Memon. Published by Elsevier. Pages 147–200. 2015. ISBN 978-0-12-802133-0

Articles in Refereed Journals

1. Relativizations Comparing NP and Exponential Time (with S. Homer), *Information and Control*, Vol. 58, July 1983, pp. 88–100.
2. Oracles for Deterministic vs. Alternating Classes, *SIAM Journal of Computing*, Vol. 16, Aug 1987, pp. 613–627.
3. Polynomial Terse Sets (with A. Amir), *Information and Computation*, Vol. 77, No. 1, 1988, pp. 37–56. (Conference version appeared in *Conference on Structure in Complexity Theory*, 1987)
4. Nondeterministic Bounded Query Reducibilities (with R. Beigel, and J. Owings), *Annals of Pure and Applied Logic*, Vol. 41, 1989, pp. 107-118.
5. Training Sequences (with D. Angluin and C. Smith), *Theoretical Computer Science*, Vol. 66, 1989, pp. 255-272.
6. On the Complexity of Finding the Chromatic Number of a Recursive Graph I: The Bounded Case (with R. Beigel), *Annals of Pure and Applied Logic*, Vol. 45, 1989, pp. 1-38.
7. On the Complexity of Finding the Chromatic Number of a Recursive Graph II: The Unbounded Case (with R. Beigel), *Annals of Pure and Applied Logic*, Vol. 45, 1989, pp. 227-247.
8. Bounded Query Classes and the Difference Hierarchy (with R. Beigel and L. Hay), *Archive for Math. Logic*, Vol. 29, 1989, pp. 69-84.

9. The Mapmaker's Dilemma (with R. Beigel), *Discrete Applied Math (Special Issue on Theoretical Computer Science)*, Vol. 34, 1991, pp. 37-48. (Conference version in *Capital City Conference on Combinatorics and Theoretical Computer Science, 1989*)
10. On Selecting the k Largest with Restricted Quadratic Queries, *Information Processing Letters*, Vol. 38, 1991, pp. 193-195.
11. Learning via Queries to $[+,i]$ (with M. Pleszkoch and R. Solovay), *Journal of Symbolic Logic*, Vol. 57, 1992, pp. 53-81. (Conference version in *Computational Learning Theory (COLT)*, 1990)
12. Learning Programs with an Easy to Calculate Set of Errors (with Rameshkumar Sitarman, C. Smith, and Mahendran Velauthapillai), *Fundamentica Informaticae*, Vol. 16, No. 3-4, pp. 355-370, 1992. (Conference version in *Conference on Computational Learning Theory (COLT)* 1988.)
13. Learning via Queries (with C. Smith), *Journal of the Association of Computing Machinery*, Vol. 39, 1992, pp. 649-675. (Conference versions in *Foundations of Computer Science (FOCS) 1988* and *Conference on Computational Learning Theory (COLT)* 1988)
14. Selection Problems using m-ary queries (with K. Guimaraes and J. Purtilo), *Computational Complexity*, Vol. 2, 1992, pp. 256-276.
15. Terse, Superterse, and Verbose Sets (with R. Beigel, J. Gill, and J. Owings), *Information and Computation*, Vol. 103, 1993, pp. 68-85, 1993.
16. On Checking Versus Evaluation of Multiple Queries (with Lane Hemachandra and Albrecht Hoene), *Information and Computation*, Vol. 105, 1993, pp. 72-93. (Conference version in *Mathematical Foundations of Computer Science (MFCS) 1990*)
17. Extremes in the Degrees of Inferability (with L. Fortnow, S. Jain, E. Kinber, M. Kummer, S. Kurtz, M. Pleszkoch, T. Slaman, F. Stephan, R. Solovay), *Annals of Pure and Applied Logic*, Vol. 66, 1994, pp. 231-276. (Subsumes the conference papers *Learning via queries to an Oracle* and *Degrees of Inferability*).
18. On Honest Polynomial Reductions and $P=NP$ (with R. Downey, and M. Moses), *Annals of Pure and Applied Logic*, Vol. 70, 1994, pp. 1-27. (Conference version appeared in *Conference on Structure in Complexity Theory*, 1989.
19. Learning via Queries with Teams and Anomalies (with E. Kinber, M. Pleszkoch, C. Smith, and T. Zeugmann), *Fundamenta Informaticae*, Vol. 23, Number 1, May 1995, pp. 67-89.
20. Recursion theoretic models of learning: some results and intuitions, (with C. Smith) *Annals of Mathematics and Artificial Intelligence*, Vol. 15, II, 1995, pp. 155-166.
21. OptP-Completeness as the Normal Behavior of NP-Complete Problems (with M. Krentel and K. Rappoport), *Math Systems Theory*, Vol. 28, 1995, 487-514
22. Frequency Computation and Bounded Queries (with R. Beigel and E. Kinber) *Theoretical Computer Science*, Vol. 163, 1996, 177-192. (Conference version *Conferences on Computational Complexity Theory (CCC) 1995*)

23. Bounded Queries and Approximation (with R. Chang and C. Lund), *SIAM Journal of Computing*, Vol. 26, 1997, 188-209 (Conference version in *Foundations of Computer Science (FOCS)* 1993.)
24. Binary search and recursive graph problems (with K. Guimaraes) *Theoretical Computer Science* Vol 181, 1997, 119-139. Special issue for LATIN 95 conference. (Conference version in LATIN 1995).
25. Asking Questions Versus Verifiability (with M. Velauthapillai), *Fundamenta Informaticae* Vol. 30, 1-9, 1997 (Conference version in *Analogical and Inductive Inference (AII)* 1992)
26. Addition in $\log n + O(1)$ Steps on Average: A Simple Analysis (with R. Beigel, M. Li, L. Zhang), *Theoretical Computer Science*. Vol 191, 1998, 245–248.
27. Relative Sizes of Learnable Sets (with L. Fortnow, R. Freivalds, M. Kummer, S. Kurtz, C. Smith, and F. Stephan), *Theoretical Computer Science* Vol 197(1-2):139-156, 1998.
28. Recursion theory and Reverse Mathematics (with Jeffery Hirst). *Mathematical Logic Quarterly*. Vol. 44, 1998, 465-473.
29. On the Finiteness of the Recursive Chromatic Number (with A. Lee). *Annals of Pure and Applied Logic* Vol. 93, 73-81, 1998.
30. Classification via Information (with M. Plezskoch, M. Velauthapillai, and F. Stephan), *Annals of Mathematics and Artificial Intelligence*. Vol. 23, 147–168, 1998.
31. On the Number of Automorphisms of a Graph (with R. Beals, R. Chang and J. Toran), *Chicago Journal of Theoretical Computer Science* February 1999. (Conference version in *Tenth Annual Conferences on Structure in Complexity Theory*.)
32. When can one load a set of dice so that the sum is uniformly distributed? (with C. Kruskal) *Mathematics Magazine*. Vol. 72, No. 2, 1999, pp 133-138.
33. The Complexity of ODD_n^A (with R. Beigel, M. Kummer, G. Martin, T. McNichol, and F. Stephan) *Journal of Symbolic Logic*, Vol. 65, 1–18, 2000. (Subsumes the conference paper *The query complexity of sets* from *Mathematical Foundations of Computer Science (MFCS)* 1996.
34. The Communication Complexity of Enumeration, Elimination, and Selection (with Andris Ambainis, Harry Buhrman, Bala Kalyanasundaram, Leen Torenvliet) *Journal of Computer and Systems Science* (Special issue for *Conference on Computational Complexity* 2000). Vol 63, pages 148-185, 2001.
35. Automata Techniques for Query Inference Machines (with G. Hird), *Annals of Pure and Applied Logic* Vol. 117, 2002, pp 171-202.
36. Max and min limiters (with James Owings and Georgia Martin), *Archives of Mathematical Logic* Vol. 41, 2002, pp 483-495.
37. Constant Time Parallel Sorting: An Empirical View (with E. Golub and C. Kruskal) *Journal of Computer and Systems Science* Vol 67, 2003, pages 63-91.

38. When Does a Random Robin Hood Win? (with E. Golub and A. Srinivasan) *Theoretical Computer Science* Vol 304, 2003, pages 477–484.
39. Some connections between bounded query classes and non-uniform complexity (with A. Amir and R. Beigel), *Information and Computation* Vol 186, 2003, 104-139. (Conference version in *Conference on Computational Complexity (CCC)* 19)
40. A Nearly Tight Lower Bound for Restricted Private Information Retrieval Protocols (with Richard Beigel and Lance Fortnow), *Computational Complexity*. Vol 15, No 1, 2006, 82–91.
41. Inferring Answers from Questions (with Andrew Lee) *Journal of Computer and Systems Sciences*. Volume 74, No 4, 2008, 490-512. (Conference version in *Conference on Computational Learning theory COLT* 1997).
42. Finding Large 3-free sets I: The small n case. (with James Glenn and Clyde Kruskal), *Journal of Computer and Systems Science* Volume 74, No 4, 2008, 628-655.
43. The Complexity of Finding SUBSEQ(A). (with Steven Fenner and Brian Postow). *Theory of Computing Systems* Volume 45, No. 3, 2009, pages 577-612.
44. The Complexity of Learning SUBSEQ(A). (with Steven Fenner and Brian Postow). *Journal of Symbolic Logic* Volume 74, No 3, 2009, pages 939-975. (Conference version in *Algorithmic Learning Theorem (ALT) 2006*)
45. A Survey of Lower Bounds on the van der Waerden Numbers $W(k, 2)$: Randomized-Constructive and Deterministic-Constructive (With Bernhard Haeupler). *Electronic Journal of Combinatorics* Volume 18, No. P64, 2011.
46. Limits on the computational power of random strings (with E. Allender and L. Friedman). *Information and Computation* Special issue for ICALP 2011. Volume 222, 2013, Pages 80–92.
47. Lower bounds on the Deterministic and Quantum Communication Complexity of Hamming-Distance Problems (with Andris Ambainis, Aravind Srinivasan, Andrey Utis). *ACM Transactions of Complexity Theory*. Volume 7, No 3, July 2015, Article 10.
48. Distinct volume subsets (with David Conlon, Jacob Fox, David Harris, Douglas Ulrich, Samuel Zbarsky). at *SIAM Journal of Discrete Mathematics*. Vol. 29, No. 1, 472–480, 2015.
49. On the sizes of DPDAs, PDAs, and LBAs (with Richard Beigel). *Theoretical Computer Science*. Vol 638, No. 25, 2016, pages 63-75.
50. Hilbert’s proof of his Irreducibility Theorem (with Ken Regan and Mark Villarino) *American Mathematics Monthly* Vol 125, No. 6, 2018, pages 513–530.
51. The Coefficient-Choosing Game (with Larry Washington and Sam Zbarsky). *Journal of Combinatorial Number Theory* (To appear)
52. Distinct volume subsets: The Uncountable Case (with Douglas Ulrich). *Archives of Mathematical Logic* (To appear)

Submitted or In Progress

1. The Muffin Problem (with Guangiqi Cui, John Dickerson, Naveen Durvasula, Erik Metz, Naveen Raman, Sung Hyun Yoo).
2. Small NFA's for co-finite Unary Languages (with Eric Shen and Zan Xu).
3. Betting in Final Jeopardy (with Jessica Abramsom and Natalie Collina).

Profession/Extension Publications

Other Professional Publications.

1. Finding the i th largest of n for small i, n , (with W. Kelly and B. Pugh) *SIGACT NEWS*, Vol 27, No. 2, 1996.
2. Complexity Theory Newsflash (with L. Fortnow and S. Fenner), *SIGACT NEWS*, Vol 27, No. 3, 1996.
3. Squares in a Square: On-line questions. (with A. Ambainis) *Geocombinatorics*, Volume X, No. 1, 2000.
4. Problem 1659, December 2002, *Mathematics Magazine*.
5. A Survey of Constant Time Parallel Sorting, for *Bulletin of the European Association for Theoretical Computer Science* (with Evan Golub and Clyde Kruskal), Vol 72, pages 84-102, October 2000, *Computational Complexity Column*.
6. The $P=?NP$ Poll *Special Interest Group in Algorithms and Computing Theory (SIGACT)* Vol 33, 2002.
7. A Survey on Private Information Retrieval *Bulletin of the European Association for Theoretical Computer Science* Vol 82, February 2004, pages 72–107. *Computational Complexity Column*.
8. The $P=?NP$ Poll- 10 years later. *Special Interest Group in Algorithms and Computing Theory (SIGACT)* Vol 43, 2012.

Book Reviews, Notes, and Other Contributions

Book Reviews

Over 100. List available on request.

Conferences and Workshops: Talks, Abstracts, and Other Contributions

Refereed Presentation

1. Bounded Queries in Recursive Graph Theory and Complexity Theory. Association of Symbolic Logic Spring Meeting, March 1988, Michigan State Univ.

2. Some Open problems in Concrete Complexity, *Workshop on Structural Complexity*, Dagstuhl, Germany, Feb. 1992.
3. Frequency Computation and Bounded Queries, *Workshop on Structural Complexity*, Dagstuhl, Germany, Feb. 1994.
4. The Complexity of Finding the Obstruction Set *Association of Symbolic Logic*, Orlando Florida, Jan 1996.
5. Inductive Inference and Recursion Theory. European Meeting on Complexity, Logic, and Recursion theory. Barcelona, Spain. March 1996.
6. Bounded Queries in Recursion Theory: A Historical Survey. Association of Symbolic Logic. Leeds, England. 1997
7. Bounded queries in recursion theory, Learning via Queries, Concrete Complexity (9 lectures). University of Sienna (Italy). Oct 1998.
8. Gems of Bounded Queries. Computable Model Theory Conference. Germany, 2001.
9. What is an Explicit Construction?, October 2009 Dagstuhl Workshop on Complexity Theory
10. What is an Explicit Construction?, October 2009 Italian Workshop on Ramsey Theory and Logic.
11. Sane Bounds on Some Polynomial VDW numbers, DIMACS Workshop on Ramsey Theory, May 2009.
12. Grid Coloring, DIMACS workshop on Ramsey Theory, May 2009.
13. Sane Bounds on Some Polynomial VDW numbers, October 2009. Italian Workshop on Ramsey Theory and Logic, October 2009.
14. An NP-Complete problem in Grid Coloring Dagstuhl Workshop on Complexity Theory, October 2012.
15. Inserting Cryptography into Discrete Math Courses. August 2013. Intel Conference on Security Education.
16. NIM with Cash, Dagstuhl Workshop on Complexity Theory, October 2014.
17. A sane reduction from 3-COL to k -COL. Dagstuhl Workshop on Complexity Theory, October 2014.
18. On SAT Solvers and Ramsey-type Numbers (with Burcu Canakci, Hannah Christenson, Robert Fleishman, Nicole McNabb, Daniel Smolyak). AMS regional meeting in Rutgers, October 2015.
19. Three results on making change (an exposition) (with Naveen Raman) AMS regional meeting in Rutgers, October 2015.
20. Rectangle Free colorings of grids. Gathering for Gardner, May 2016.

21. Wagering in Final Jeopardy (with Jessica Abramson and Natalie Collina) Regional AMS conference in Buffalo, Fall 2017
22. The Muffin Problem (with Guang Cui, Naveen Durvasula, John Dickerson, Erik Metz, Jacob Prinz, Naveen Raman, Daniel Smolyak, Sunny Yoo). Invited talk at AMS regional conference in San Diego Winter 2018.
23. The Muffin Problem (see above for co-authors). Gathering for Gardner, April 2018.

Non-refereed Presentations

1. Clock versus Vacation Schedules (with Yoni Levy), *Operations Research Society of America* May 1985.
2. Recursive Categoricity of Highly Recursive Rooted Graphs (with D. Mount and D. Kueker) *Nineteenth Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Baton Rouge, February 1988 Also in *Congressus Numerantium*, Vol. 69, pp. 97-102, 1989.
3. Comparisons Between Complexity-Theoretic and Recursion-Theoretic Graph Theory (with R. Beigel and Mike Lockwood) *Third Carbondale Combinatorics Conference* October 1988.
4. The Mapmaker's Dilemma (with R. Beigel) *Capital City Conference on Combinatorics and Theoretical Computer Science*, George Washington Univ. (In Washington DC), May 1989.
5. Recursion Theoretic Models of Learning: Some Results and Intuitions, (with C. Smith) *International Symposium on Artificial Intelligence and Mathematics*, Ft. Lauderdale, Florida, January 1990.
6. Recursive Edge Colorings of Recursive Graphs (with Gary Benson and Terry Grant), *Twenty-First Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, February 1990
7. A Survey of Recursive Combinatorics, *A Symposium in Honor of Anil Nerode's Sixtieth Birthday*, Cornell, June 1992
8. Reverse mathematics and recursive graph theory, (with Jeff Hirst), *Annual meeting of the Association of Symbolic Logic*, March 1994.
9. Implementing Weak Second Order Theory of Natural Numbers via Finite Automata (with James Glenn), *Workshop on Implementing Automata*, August 1996.
10. Implementing WS1S via Finite Automata: Performance Issues. (with James Glenn), *Workshop on Implementing Automata*, September 1997.
11. On the order of Queries (with Richard Beigel, Richard Chang, Jacob Lurie, and Timothy McNicoll) *AMS meeting*, October 1997.

12. Finding the same number twice. (with Alexander Chan and Clyde Kruskal). *Thirtieth Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, February 1999
13. The search for an honest man. (with Adam Bargteil). *Thirtieth Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, February 1999
14. Nonconstructive is BETTER for sorting. (with Evan Golub and Clyde Kruskal). *Thirtieth Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, February 1999
15. Knights and Knormals (with Adam Bartgeil). *Thirty first Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, March 2000.
16. Constructive techniques in Ramsey Theory (with Kevin Kane). *Thirty first Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, March 2000.
17. Interesting Colorings of the Plane (with Clyde Kruskal). *Thirty first Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, March 2000.
18. Squares in a square: an online problem (with Andris Ambainis). *Thirty first Southeastern International Conference on Combinatorics, Graph Theory, and Computing* Boca Raton, Florida, March 2000.
19. Monochromatic rectangles in grid colorings (with Guang Cui, Kaan Dokmeci, Sung Yoo), *Fourty Eighth Southeastern International Conference on Combinatorics, Graph Theory, and Computing*. Boca Raton, Florida, March 2017.
20. To click, plick, point, card or survey in class? (with Evan Golub and Jason Filippou), *23rd Annual Innovations in Teaching and Learning Conference*. Poster Session, University of Maryland, College Park, May 2017

Refereed Conference Proceedings

1. On the inference of sequences of functions, *International Workshop on Analogical and Inductive Inference*, (with C. Smith), Wendisch–Rietz, DDR, October 1986. (Lecture Notes in Computer Science 265, pp. 23-41)
2. Polynomial Terse Sets (with A. Amir), *Second Annual Conference on Structure in Complexity Theory*, Cornell, June 1987. (Journal version in *Information and Computation*)
3. Learning Via Queries (with C. Smith) *Conference on Computational Learning Theory* August 1988.

4. Learning via Queries (with C. Smith) *29th Annual IEEE Symposium on the Foundations of Computer Science* October 1988. (Journal version in *Journal of the Association of Computing Machinery (JACM)*).
5. Learning Programs with an Easy to Calculate Set of Errors (with Rameshkumar Sitarman, C. Smith, and Mahendran Velauthapillai) *Conference on Computational Learning Theory, August 1988* (Also presented at *International Workshop on Analogical and Inductive Inference*. Journal version in *Fundamenta Informaticae*)
6. On Honest Polynomial Reductions, Relativizations, and $P=NP$ (with R. Downey, S. Homer, and M. Moses), *Fourth Annual Conference on Structure in Complexity Theory*, Univ. of Oregon, June 1989. (Journal version in *Annals of Pure and Applied Mathematics*)
7. Learning via Queries to an Oracle (with M. Pleszkoch), *Second Annual Conference on Computational Learning Theory* August 1989. (Subsumed in the journal paper *Extremes in the degrees of Inferability* which appeared in *Annals of Pure and applied Logic*.)
8. Some connections between bounded query classes and non-uniform complexity (with A. Amir and R. Beigel), *Fifth Annual Conference on Structure in Complexity Theory*, Barcelona, Spain, June 1990. (Journal version in *Information and Computation*)
9. On Checking Versus Evaluation of Multiple Queries (with Lane Hemachandra and Albrecht Hoene), *15th International Symposium on Mathematical Foundations of Computer Science (MFCS '90)*, Banska Bystrica, Czechoslovakia August 1990. (Journal version in *Information and Computation*)
10. Learning via Queries to $[+,i]$ (with M. Pleszkoch and R. Solovay), *Third Annual Conference on Computational Learning Theory* August 1990. (Journal version in *Journal of Symbolic Logic*)
11. Learning via Queries with Teams and Anomalies (with E. Kinber, M. Pleszkoch, C. Smith, and T. Zeugmann), *Third Annual Conference on Computational Learning Theory* August 1990.
12. A Survey of Bounded Queries in Recursion Theory, *Sixth Annual Conferences on Structure in Complexity Theory*, Chicago, June 1991.
13. On the number of components of a recursive graph (with K. Guimaraes), *First Latin American Symposium on Theoretical Informatics (LATIN 92)* April 1992. Lecture notes in Computer Science volume 583, 177-190. (Journal version in *Theoretical Computer Science* Special issue of the best papers from LATIN.)
 Degrees of Inferability (with P. Cholak, R. Downey, L. Fortnow, E. Kinber, M. Kummer, S. Kurtz, and T. Slaman), *Fifth Annual Conference on Computational Learning Theory* July 1992. (Subsumed in the journal paper *Extremes in the degrees of Inferability* which appeared in *Annals of Pure and applied Logic*.)
14. Asking Questions Versus Verifiability *International Workshop on Analogical and Inductive Inference (AII)*, (with M. Velauthapillai), October 1992. (Lecture notes in Artificial Intelligence 642, pp. 197-213)

15. Bounded Queries and Approximation (with R. Chang), *34th Annual IEEE Symposium on the Foundations of Computer Science* October 1993. (Journal version in *SIAM Journal of Computing*.)
16. Classification Using Information *Algorithmic Learning Theory* (with M. Pleszkoch and Mahendran Velauthapillai), Germany, October 1994. (Lecture notes in Artificial Intelligence 961, pp. 165-176)
17. Measure, Category, and Learning Theory *International Conference on Automata, Languages, and Programming (ICALP)*. July 1995. (with Fortnow, Freivalds, Kummer, Kurtz, Smith, and Stephan)
18. Frequency Computation and Bounded Queries (with R. Beigel and E. Kinber), *Tenth Annual Conferences on Structure in Complexity Theory*, June 1995. (Journal version in *Theoretical Computer Science*.)
19. On the Number of Automorphisms of a Graph, (with R. Chang and J. Toran), *Tenth Annual Conferences on Structure in Complexity Theory*, June 1995. (Journal version in *Chicago Journal of Theoretical Computer Science*)
20. Reductions in Learning Via Queries (with G. Hird) *Eighth Conference on Computational Learning Theory* July 1995. (Journal version, different title: Automata Techniques for Query Inference Machines in *Annals of Pure and Applied Logic* Vol. 117, 2002, pp 171-202.)
21. Unbounded search and recursive graphs (with K. Guimaraes), *Fourth annual Latin American Symposium on Theoretical INformatics (LATIN 95)* Lecture Notes in Computer Science, 911, pp. 323-331, 1995. (Journal version in *Theoretical Computer Science* Special issue for the best papers in LATIN 1995.)
22. On the query complexity of sets (with R. Beigel, M. Kummer, G. Martin, T. McNichol, and F. Stephan) *21st International Symposium on Mathematical Foundations of Computer Science (MFCS '96)*, Cracow, Poland August 1996. (Subsumed in Journal paper *The complexity of ODD_n^A* in *Journal of Symbolic Logic*.)
23. Inferring answers from data (with A. Lee) *Tenth Annual Conference on Computational Learning theory* July 1997. (Journal version in *Journal of Computer and Systems Sciences*).
24. FIN Teams and games *Algorithmic Learning Theory (ALT)* (A. Ambainis, K. Apsitis, R. Freivalds, W. Gasarch and C. Smith), *Eighth International Workshop on Algorithmic Learning Theory*, Sendai, Japan, October 1997, in *Springer Verlag Lecture Notes in Artificial Intelligence*, Vol. 1316, pp. 2-17.
25. The Communication Complexity of Enumeration, Elimination, and Selection (with Andris Ambainis, Harry Buhrman, Bala Kalyanasundaram, Leen Torenvliet) *Fifteenth Annual Conferences on Structure in Complexity Theory*, July 2000. (Journal version in *Journal of Computer and Systems Science*.)
26. AHA: An illuminating Perspective. (with Dan Garcia and David Ginat). *Thirty third annual SIGCSE Technical symposium on Computer Science Education*, Feb 2002.

27. The Multiparty Communication Complexity of Exact- T revisited. (with Richard Beigel and James Glenn). *Thirty First International Symposium on Mathematical Foundations of Computer Science (MFCS)* August 2006.
28. The Complexity of Learning SUBSEQ(A). (with Steven Fenner) *Seventeenth International Workshop on Algorithmic Learning Theory (ALT)*, September 2006. (Journal version in *Journal of Symbolic Logic*).
29. Lower bounds on the Deterministic and Quantum Communication Complexity of HAM_n^a . (with A. Ambainis, A. Srinivasan, A. Utis) *Proceedings of 17th International Symposium on Algorithms and Computation (ISAAC)* December 2006.
30. Limits on the computational power of random strings (with E. Allender and L. Friedman) *International Conference on Automata, Languages, and Programming (ICALP)*. July 2011. (Journal version in *Information and Computation* Special Issue for best papers in ICALP 2011.)
31. Applications of the Erdos-Rado Canonical Ramsey Theorem to Erdos-Type problems. (with Sam Zbarsky). Conference for Paul Erdos's 100th Birthday. (Appeared in *Electronic notes in discrete mathematics* Vol 43, Sept 2013, pages 305-310.)
32. A Muffin-Theoerm Generator. (with Guang Cui, Naveen Durvasula, John Dickerson, Erik Metz, Jacob Prinz, Naveen Raman, Daniel Smolyak, Sunny Yoo) FUN with Algorithms 2018.

Completed Creative Works

A play which got into a play-writing contest: *Sure he created the Universe, but would he get Tenure?* 2000.

Sponsored Research

Grants

1. 1988-1990 NSF Research Grant to study *Bounded Queries in Complexity Theory*, jointly with A. Amir. Grant number: CCR-880-3641. Amount: \$134,000.
2. 1990 NSF Research Experience for Undergraduates award jointly with A. Amir. To study decision tree complexity. Add to Grant CCR-880-3641, Amount: \$4000.
3. 1991-1993 NSF Research Grant to study *Inductive Inference and other topics in Foundations of Computing*. Jointly with C. Smith. Grant Number CCR 9020079. Amount: \$173,400.
4. 1991-1995 Capitol Area Theory Seminar, (with C. Smith) NSF \$6000. CCR 9112976.
5. 1994-1997 Learning, Complexity, and Testing, (with C. Smith) NSF \$211,260. 1994-1997. CCR 9301339.
6. 1994 NSF Supplement to Learning, Complexity, and Testing for undergrad research. \$5000.

7. 1994-1997 Capitol Area Theory Seminar, (with S. Khuller) NSF \$7500. CCR 9401842.
8. 1996 NSF Supplement to Learning, Complexity, and Testing for undergrad research. \$5000.
9. 1997 NSF Supplement to Learning, Complexity, and Testing for undergrad research. \$5000.
10. 1997-1999 The capabilities and Limitations of Automated Discovery (with C. Smith) NSF \$180,000.
11. 2001-2003 A Computational Theory of Discovery (with C. Smith) NSF 210,000. CCR-01-05413.
12. 2003 NSF Supplement to Computational Theory of Discovery, for undergrad research. \$5000.
13. 2005 Request by STAND (Science and Technology: Addressing the Need for Diversity) to Intel to Pilot CS SPIRAL(Summer Project in Research and Learning). Faculty Director. (with Clyde Kruskal, Larry Davis, Joelle Carter). \$40,000
14. 2013-2016 NSF Research Experience for Undergraduates (REU) Grant (PI is Samir Khuller, I am coPI). 3 years, \$300,000. CNS 1262805
15. 2013. Intel Grant for Security Education. 1 year. \$5000.00.
16. 2016-2019 NSF Research Experience for Undergraduates (REU) Grant (I am PI. Samir Khuller is coPI). 3 years, \$375,000. CNS 1560193

Work in Progress

Working Papers

1. The Multiparty Communication Complexity of Exact- T revisited. (with Richard Beigel and James Glenn).
2. Large 3-free sets: An Empirical Study. II (with James Glenn and Clyde Kruskal),
3. Sane bounds on some Polynomial VDW numbers (with Clyde Kruskal and Justin Kruskal).
4. Rectangle free Colorings of Grids. (with Stephen Fenner, Charles Glover, Semmy Purewal)
5. The Tug of War game (with Nick Sovitch and Paul Zimand).
6. New upper and lower bounds on the Rado numbers (with Russell Moriarity and Nithin Tamma)
7. Three proofs of the hypergraph Ramsey Theorem (with Parrish and Sinai)
8. An NP-complete problem in grid coloring (with Apon and Lawler)
9. Square-free differences of sets of size $\Omega(n^{0.7334\dots})$. (with Richard Beigel)
10. Can Matrix Codes be Broken by Cipher-text Only Attacks? (with Jon Katz)

11. Ramsey Games (with Kruskal, Lu, Weaver, Wilkerson)
12. NIM with Cash (with Purlito, Ulrich)
13. Van der Warden's theorem: Variants and Applications. (With Clyde Kruskal and Andy Parrish) Book.
14. Three Results on Making Change (An Exposition). (With Naveen Raman)

Manuscripts Under Review

1. Easy proofs about making change Under Review at *Mathematics Magazine*
2. A Sane Reduction from COL_k to COL_3 . Under Review at *Information Processing Letters*
3. Which unbounded protocols for envy free cake cutting is better? Under Review at *American Mathematics Monthly*.

III Teaching, Mentoring, and Advising

Courses Taught

1. Spring 2010: HONR 209, Fair Division: From Cake-cutting to dispute resolution, 16 students.
2. Spring 2010: CMSC 452, Theory of Computation, 16 students
3. Spring 2011: CMSC 250H, Discrete Math (Honors Section), 30 students.
4. Spring 2011: CMSC 452, Theory of Computation, 32 students
5. Spring 2012: HONR 209, Fair Division: From Cake-cutting to dispute resolution, 16 students.
6. Spring 2012: CMSC 452, Theory of Computation, 32 students
7. Winter 2013: CMSC 389T, Discrete Math Plus Plus. 16 students.
8. Spring 2013 CMSC 452: Theory of Computation, 40 students
9. Spring 2013: CMSC 858, Ramsey Theory and its "Applications" 16 students.
10. Summer 2013 (Young Scholars Program): CMSC 198B, Computer Science: A Hands Off Approach. 24 students.
11. Fall 2013: HONR 209, Fair Division: From Cake-cutting to dispute resolution, 19 students.
12. Winter 2014: CMSC 389T, Discrete Math Plus Plus. 35 students.
13. Spring 2014: CMSC 452, Theory of Computation.
14. Spring 2014: CMSC 652, Complexity Theory. 9 students.

15. Summer 2014 (Young Scholars Program): CMSC 198B, Computer Science: A Hands Off Approach. 24 students.
16. Fall 2014: CMSC 452, Theory of Computation. 20 students.
17. Winter 2015: CMSC 389T, Discrete Math Plus Plus. 33 students.
18. Spring 2015: CMSC 250H, Discrete Math Honors. 23 students.
19. Spring 2015: HONR 209, Fair Division: From Cake-cutting to dispute resolution, 13 students.
20. Summer 2015 (Young Scholars Program): CMSC 198B, Computer Science: A Hands Off Approach. 16 students.
21. Winter 2016: CMSC 389T, Discrete Math Plus plus. 26 students.
22. Summer 2016: CMSC 198B, Computer Science: A Hands Off Approach. 20 students.
23. Winter 2017: CMSC 389T, Discrete Math Plus Plus. 40 students.
24. Spring 2017: CMSC 250, Discrete Math. Two sections of 120 students each.
25. Spring 2017: CMSC 452, Theory of Computation. 48 students.
26. Winter 2018: CMSC 389T, Introduction to Cryptography. 60 students
27. Spring 2018: CMSC 452, Theory of Computation. 50 students.
28. Spring 2018: CMSC 858F: Ramsey Theory and its “Applications” 24 students.

Course or Curriculum Development

1. Developed and taught the course *HONR 209: Fair Division*. This is an interdisciplinary course for honors students that combines ideas from mathematics, politics, and economics. The basic theme is: *given a resource, how to divide it fairly*. The course was developed in Spring 2002 and taught for the first time in Fall 2002 but keeps getting refined and changed in response to current events and research.
2. Developed and taught the course *CMSC 389T: Discrete Math Plus Plus*. This is a 3-week 1-credit winter course. The prerequisite is CMSC 250 (Discrete Math) and takes advantage of that by being able to pursue advanced topics in Discrete Math. The course was developed in Summer 2013 and taught in Winter 2013. I’ve taught it twice and the syllabus is stable now.
3. Developed and taught the course *CMSC 858R: Ramsey Theory and its “Applications”*. This course was developed and taught in Spring 2013. Its been taught once. This course gathers together theorems in Ramsey Theory that apply to Computer Science. Many of the proofs presented were educationally better than those in the literature.

4. Developed and taught the course *CMSC 198B: Computer Science: A Hands Off Approach*. This is a 3-week 3-credit summer course taught in the Young Scholars Program to High School Students. The theme is the kind of math they will need in computer science, with an emphasis on Cryptography. The course was developed and taught (for the first time) in Summer 2013. I've taught it twice and the syllabus is stable now.

Advising: Research Direction

High School Students Research

1. Jacob Lurie. Surreal Analysis. Fall 1995- Spring 1996 (Westinghouse award, top prize) Went to Harvard.
2. Keenen Keeling. Empirical Studies in Computer Science. Fall 1996-Spring 1997.
3. Chris Sutton. Empirical Studies in Computer Science. Fall 1996-Spring 1997.
4. Brendan Connel. Taking probability seriously. Spring 1997-Spring 1998
5. James Lee. The Egg-Drop Game. Summer 2002. Went to UIUC.
6. Jefferson Pecht. Ramsey Theory. Summer 2006.
7. Joshua Yanovski. Complexity of Graph Isomorphism. Summer 2006. (Top 300 Intel Competition)
8. Paolo Casumbal. Partial Order Game. Summer 2006-Spring 2007.
9. Darnell Primus. Ramsey Theory. Fall 2006.
10. Simeon Andre. Cover times of Random Walks. Fall 2006.
11. Louis Wasserman. Monotone Circuits. Fall 2007, Spring 2008. (Top 20 Siemens Competition)
12. Aki Hogge. Ramsey Theory. Fall 2007, Spring 2008. Went to MIT.
13. Jourdan Walls. Cryptography. Fall 2007, Spring 2008.
14. Nicholas Ink, Cryptography, Spring 2008, Fall 2008, Spring 2009. Went to UMCP
15. Justin Kruskal, Ramsey Theory. Spring 2008. Went to UMCP
16. Rahul Rajagopalan. Summer 2008. Cryptography.
17. Nils Molina. Spring 2009. Ramsey Theory. Third in Yau Competition (On Team with Oza and Puttagunta). Went to MIT.
18. Anand Oza. Spring 2009. Ramsey Theory. Third in Yau Competition (On Team with Molina and Puttagunta). Went to MIT.

19. Rohan Puttagunta. Spring 2009. Ramsey Theory. Third in Yau Competition (On Team with Molina and Oza). Went to Stanford.
20. Scott Zimmerman. Spring 2009. Ramsey Games. Went to UMCP.
21. James Pinkerton. Spring 2011. Dup-Spoiler Games (Third in Siemens Competition, Joint with Rafael Setra) Semifinals in Yau Competition (team with Setra).
22. Rafael Setra. Spring 2011. Dup-Spoiler Games. (Third in Siemens Competition, Joint with James Pinkerton) Semifinals in Yau Competition (team with Pinkerton).
23. Daniel Farias. Spring 2011. Dup-Spoiler Games.
24. Alexander Briese. Spring 2011. Ramsey Games.
25. Thomas Zhang. Spring 2011. Ramsey Games. Went to MIT.
26. Samuel Zbarsky. Spring 2011. Ramsey Theory. Went to CMU.
27. John Purtle. Summer 2011. Nim Games. Went to UMCP.
28. Steve Cable. Summer 2011, Fall 2011. Nim Games. Went to UMCP.
29. Sandow Sinai. Spring 2011, Summer 2011, Fall 2011. Ramsey Theory. Went to Hood College.
30. Jessica Shi, Fall 2011, Spring 2012, Fall 2013, Ramsey Theory. Went to Princeton.
31. Tucker Bane, Fall 2011, Spring 2012, Fall 2013, Ramsey Games
32. Ryan Cho, Summer 2013, Fall 2013, Ramsey Games. Went to University of Maryland at College Park.
33. Jared Marx-Kuo, Fall 2011, Spring 2012, fall 2013, Factoring. Went to University of Chicago.
34. James Liam, Fall 2011, Spring 2012, fall 2013, Factoring
35. Josh Brule, Spring 2012, Probability.
36. Victor Baules, Fall 2013, Collatz conjecture. Went to Cal Tech.
37. Victoria Tsai, Spring 2014-Fall 2013, Cake cutting
38. Adam Busis, Spring 2014-Fall 2014, Cake Cutting. Went to Harvey Mudd University.
39. Soumya Pattanayak, Spring 2014-Fall 2014, Computational Number Theory. Went to University of Maryland at College Park.
40. Patrick Cable, Spring 2014-Fall 2014, The Change Problem. Went to Univ of MD at College Park.
41. Robert Fleishman, Blair, Summer 2015, SAT Solvers for Ramsey Numbers.
42. Daniel Smolyak, Blair, Summer 2015, SAT Solvers for Ramsey Numbers

43. Naveen Roman, Blair, Summer 2015, The Change Problem
44. Jason Choi, Richard Montgomery, Summer 2015, Constructive Pigeonhole Principle.
45. Guang Cui. Blair, Fall 2015-Spring 2016, Ramsey Theory.
46. Yash Somaiya. Blair. Summer 2016. Factoring.
47. Fausto Zurita. Blair. Coloring Grids. Summer 2016
48. Anish Senapati. Blair. Coloring Grids. Summer 2016
49. Siddharth Taneja. Blair. Coloring Grids. Summer 2016.
50. Sung Yoo. Bergenson Academia. Summer 2016-Fall 2016
51. James Gao, Blair, Summer 2017, Game Theory-Jeopardy
52. Dihlan Saigado, Blair, Summer 2017, Game Theory-Jeopardy
53. Zan Xu, Blair, Summer 2017, Automata Theory
54. Eric Shen, Summer 2017, Automata Theory
55. Chandran Murthy, Summer 2017, Boolean Formula Evaluation
56. Thomas Del Vecchio, Summer 2017, Boolean Formula Evaluation
57. Le Do Summer 2017, Boolean Formula Evaluation
58. Gabe Udell Summer 2017 Truth Tellers and Liars in a grid
59. Eyob Tsegaye Summer 2017 Truth Tellers and Liars in a grid
60. Dilhan Selgado Summer 2017 Sums of Reciprocals
61. Andrew Mao, Summer 2017, Factoring.
62. Zan Xu Summer 2017 and Fall 2017. Small NFA's for Unary Languages
63. Eric Shen Summer 2017 and Fall 2017. Small NFA's for Unary Languages
64. Naveen Raman, Spring 2017 and Summer 2017, The Muffin Problem.
65. Naveen Durvula, Spring 2017 and Summer 2017, The Muffin Problem.
66. Sunny Yoo, Spring 2017 and Summer 2017, The Muffin Problem.
67. Guang Cui, Spring 2017 and Summer 2017, The Muffin Problem.
68. Utas Santhosh, Fall 2017 and Spring 2018, Nim Games.
69. Patrick Wang, Spring 2018, Factoring and RSA.
70. Ipsa Mittra, Spring 2018, Factoring and RSA.

71. Joshua Liu, Spring 2018, Factoring and RSA.
72. Rafi Pedersen, Spring 2018, Factoring and RSA.
73. Eli Maynard, Spring 2018, Factoring and RSA.
74. William Bass, Spring 2018, Hat Problems.
75. Tyler Huang, Spring 2018, Hat Problems.
76. Reynald Oliveria, Spring 2018, Hat Problems.
77. Kevin Zhou, Spring 2018, Hat Problems.
78. Sofia Bzhilyanskaya, Spring 2018, The Muffin Problem.
79. Daniel Wei, Spring 2018, The Muffin Problem
80. Connor Nguyen, Spring 2018, Summer 2018 Randomized Constructions.
81. Gabriel Naval, Spring 2018, Summer 2018 Randomized Constructions.

Undergraduate Student Research

1. Recursive Algebra. Jon Siegal. 1984 At Harvard. Law School.
2. Recursive Graph Theory. Sharon Kantrowitz. 1985 At Harvard.
3. Van Der Waerden Numbers. Bruce Gaffney. 1985. At Harvard.
4. Scheduling Algorithms. Daniel Levine. 1991
5. Heapsort. Jason Ellis. 1995. PhD at Georgia Tech.
6. Heapsort. Chi Tran. 1995
7. Machine learning and Game theory. Gil Carmel. 1997. He founded 2D-boy, a computer game company.
8. Knights and Knormals. Adam Bartgeil. 2000. Univ of California at Berkeley Grad School in CS. Now a professor at the University of Utah.
9. Constructive Proofs in Ramsey Theory. Kevin Kane. Spring 2000. PhD Program Univ of Texas at Austin Grad School in CS.
10. RSA cracking. Eric Everstine. 2001 PhD Program Univ of Texas at Austin Grad School in CS.
11. Private Information Retrieval. Amy Castner. Spring 2002
12. Zero Knowledge. Chad Groft. Spring 2002 Univ of California at Berkeley Grad School in Math. Now a professor.

13. Perfect and PluPerfect Digital Invariants. Scott Moore. Spring 2003
14. Analysis of a New Shift Cipher Nikolai Yakovenko. 2004. (co-advised with Larry Washington)
15. Creating a pseudo-random number generator. Will Valencia. 2004
16. Graph Games. Dan Halperin. Summer 2003.
17. Ramsey Games. Jacob Burnim. Summer 2003.
18. Egg Game. Stuart Fletcher. Spring 2004.
19. Richman Games. Michael Fan. Spring 2004
20. Minesweeper. Patrick Armstrong. Fall 2005.
21. Purely Combinatorial Proof of Van Der Warden Type Theorems. Andy Parrish. Fall 2007. PhD Program at University of California at San Diego, in math.
22. Katrina LaCurts. Tug of War. Fall 2006, Spring 2007, Fall 2007. She finished a PhD at MIT in Computer science.
23. Brent Dorman. Secret Sharing with Cards. Spring 2007, Fall 2007
24. Lynn Reggia. Secret Sharing with Cards. Spring 2007, Fall 2007 Went to John Hopkins Applied Physics lab.
25. Tug of war. Nick Sovich. 2009.
26. Paul Zimand. Tug of War. 2009. PhD program in statistics at CMU.
27. Takako Nishimura. The Test Taking Problem. Summer 2012
28. Krishna Pai, Nim Games. Fall 2013
29. Ramsey Games Tucker Bane. 2013. Transferred to Digipen.
30. Michael Roberts. Lower bounds on Proofs of PHP. Fall 2013, Spring 2014
31. Xiaotian Zheng, Nim Games. Fall 2013, Spring 2014
32. Ramsey Games. Brendan Good. Grad school in Math at UMCP.
33. Cake Cutting. Andrew Lohr. 2013. PhD program Grad School in Math at Rutgers.
34. Vincent Zell, Nim Games, Fall 2014
35. Phong Dinh, Nim Games, Fall 2014
36. Nim with Cash. Doug Ulrich 2014. PhD Program in Math at UMCP.
37. Ramsey Games. Eric Weaver. 2014 (REU program).
38. Ramsey Games Natalie Wilkerson. 2014 (REU program)

39. Ramsey Games Annie Lu. 2014 (REU program)
40. Vincent Zell, Test Taking Problem , Spring 2015
41. Phong Dinh, Test Taking Problem, Spring 2015
42. Devin Gajewski. Test taking problem, Spring 2015.
43. Hannah Christenson. Using SAT solvers to find Ramsey Numbers. Summer 2015 (REU)
44. Burcu Canakci. Using SAT solvers to find Ramsey Numbers. Summer 2015 (REU)
45. Nichole McNabb. Using SAT solvers to find Ramsey Numbers. Summer 2015 (REU)
46. Albert Cheu. Van der Warden Games. Summer 2015 (REU).
47. Luciann Kiffer. Van der Warden Games. Summer 2015 (REU).
48. Miguel Berlanga. Loaded Dice. Summer 2016 (REU).
49. Peter Tian. Loaded Dice. Summer 2016 (REU).
50. Vince Cozzo. Sums of Reciprocals. Spring 2016
51. Natalie Collina. Game Theory. Summer 2017 (REU).
52. Jessica Abramson. Game Theory. Summer 2018 (REU).
53. Jacob Prinze. Muffins. Spring 2018.
54. Daniel Smolyak. Muffins. Spring 2018.
55. Erik Metz. Muffins. Spring 2018.
56. Sanchin Pandey. Muffins. Summer 2018.
57. Saddiq Shaik. Muffins. Summer 2018.

Masters Students

Adviser on Masters Thesis

1. Geometric algorithms. Lazarus Kikas. 1997.
2. Private Information Retrieval. Charles Lin. 2001.
3. Towers of Hanoi. Andrey Rukin. 2004
4. Bit Probe Data Structures. Ryan Blue. 2009.

Adviser on Masters Scholarly Papers

1. Matching in Recursive Graph Theory. Mike Lockwood. 1987

2. Functional NP-Complete Problems. Stuart Pearlman. 1988
3. Message Passing and Mutual Exclusion. Susan Flynn. 1988
4. Structure of the Turing Degrees. David Kamishlian. 1988
5. Recursive Edge Colorings. Gary Benson. 1989
6. Recursive Edge Colorings. Terry Grant. 1990
7. Truth Table Degrees. William Setzer. Spring 1990
8. Parallel Algorithms. Larry Herman. Summer 1990
9. Communication Complexity. Paul Timmel. Spring 1991
10. Recursive Vertex Colorings. Yeung Chung Lee. 1995
11. Concrete Complexity. Alex Chan. 1997
12. The Grid Coloring Problem. Charles Glover. 2006.
13. Better bounds on Rado Numbers. Russell Moriarty. 2010.

On Masters Thesis Committee

1. Primality Testing. Brian Sutton. 1988.
2. Number Theory. Mary Conrad. 1990.

Doctoral

Doctoral Adviser

1. Machine Learning with Queries and Oracles. Mark Pleszkoch. Spring 1990. Went to IBM.
2. On the quality of queries. Katia Guimaraes. Spring 1992. Went to University of Recife (Brazil).
3. On queries in computational learning theory and Combinatorial problems. Andrew Lee. Summer 1998. Went to State University of New York at Oneonta.
4. Implementing *WS1S* via Finite Automata. James Glenn. Fall 1998. Went to Loyola College.
5. Empirical studies in parallel sorting. Evan Golub. Spring 1999. Went to University of Maryland at College Park.
6. Finite Model Theory. Walid Gomma. Summer 2007. Went to Alexandria University (Egypt).
7. SAT Solvers. Carl Anderson. Spring 2007. Went to BBN.

On Doctoral Committee

1. Inductive Inference. Mahendran Velauthapillai. Spring 1986.
2. Step Logics. Jennifer Drapkin. Spring 1988.
3. Model Stability Theory. Phil Steitz. Spring 1990.
4. Programming Languages. Dominic Duggan. Spring 1990.
5. Model Theory. Pat Sime. Spring 1992.
6. Pattern Matching. James Helmreich. Spring 1992.
7. Pattern Matching. Gary Benson. Spring 1992.
8. Model Theory. Tony Greif. Spring 1993
9. Recursion Theory. Kevin Rappoport. Summer 1993
10. Neural Nets. Georgia Martin. Fall 1993
11. Root Numbers of Fibers. Gary Flake. Fall 1993
12. Algorithms in Ring Theory. Elisabeth Manduchi. Spring 1994
13. Artificial Intelligence. J. Lyn Miller. Spring 1994.
14. Artificial Intelligence. Subrata Ghosh. Spring 1994
15. Abstract Algebra. Cheng-Chieh Lee. Spring 1995.
16. Program Transformations. Elena Black. Spring 1995
17. Empirical Modeling. Wayne Kelly. Spring 1996
18. Parallelism. Bill Thomas. Spring 1997
19. Model Theory. Suleyman Sahinalp. Spring 1997
20. Model Theory. Amanda Lubell. Summer 1997.
21. Parallelism. Brian Tornaquist. Summer 1997
22. Number Theory. Lee Guan. Summer 1997
23. Number Theory. Kimberly King. Spring 1998.
24. Model Theory. Stephanie Cawthorne. Spring 1998
25. Scheduling. Phillip Korn. Summer 1998.
26. Scheduling. Randeep Bhatia. Summer 1998.
27. Logic Programming. Parke Godfrey. Spring 1999.
28. Number Theory. Mark Morgan. Spring 1999.

29. Number Theory. Mu-Ling Chang. Spring 2001.
30. Number Theory. William McGraw. Spring 2001.
31. Logic. Mee Kim Knystautas. Spring 2001
32. Natural Languages Processing. Habash Nizar. Spring 2003.
33. Number Theory. Mike Roberts. Summer 2003.
34. Number Theory. Ed Eikenberg. Spring 2004
35. Natural lang processing. Dave Zajic. Fall 2006
36. Number Theory. Kathryn Truman. Spring 2007
37. Number Theory. John Vogler. Spring 2007
38. Number Theory. Susan Schmoeyers. Summer 2007.
39. Number Theory and Crypto, Greg Bard, Summer 2007
40. Cryptography and Number Theory. Tsz Wo Sze. Fall 2007.
41. Cryptography. Chiu-Yuen Koo. Fall 2007.
42. Model Theory. Chris Shaw. Spring 2008
43. Model Theory. Greg Johnson. Spring 2008
44. Software engineering. Cyntrica Eaton. Spring 2008.
45. Cryptography. Tom Draper. Spring 2009.
46. Model Theory. Justin Brody. Spring 2009.
47. Number Theory. Eleni Agathocleous. Summer 2009.
48. Spring 2010. Punarbasu Purkayastha. Codes.
49. Software Engineering Sandro Fouche. Fall 2010.
50. Model Theory Vincent Gingona. Spring 2011.
51. Graph Theory and Social Networks. Tom DuBois. Spring 2011.
52. Unitary Transformations. Sean Rostami. Fall 2011.
53. Programming Languages. Martin Mah. Fall 2011.
54. Algorithms. Koyel Mukherjee. Fall 2013.
55. Artificial Intelligence. Robert Alford. Fall 2013.
56. Human Computer Interaction. Megan Monroe. Spring 2014.

57. Number Theory David Blagg. Spring 2014.
58. Number Theory Angela Hennessy. Spring 2014.
59. Physics. John Mictchell. Fall 2014.
60. Number Theory. Morgan Stern. Fall 2014
61. Hierarchial goal networks. Vikas Shivshankar. Spring 2015
62. David Harris. Prob algorithms Spring 2015
63. Richard Rast. The Borel Complexity of Isomorphism for some first-order theories. Spring 2016.
64. Ran Cui. The real-quaternionic indicator of irreducible self-conjugate representations of real reductive groups. Spring 2016.
65. item Manish Purohit. Data-Aware scheduling in datacenters.
66. Srimathy Srinivasan. Motivic Decomposition. Spring 2016
67. Melika Abolhasani. Allocation in Networks with Economic Applications. Spring 2016.
68. Omar Shehab. (UMBC) Quantum Computing Summer 2016.
69. Sean Kelly. Adeles of surfaces and the Riemann hypothesis for curves Fall 2016.
70. Marc Horn. Combinatorial formulas for test functions. Spring 2017.
71. Doug Ulrich. Applications of Set Theory to Model Theory. Spring 2018
72. Adam Lizzi. Computations for the Abelinized etale fundamental group of curves of genus one or two. Spring 2018
73. Rebecca Black. Motive Cohomology of groups of order p^3 . Spring 2018

Outside Reader for a Doctoral Defense

1. Arun Sharma, Univ. of NY at Buffalo, Inductive Inference 1990
2. Tim McNichol, GWU, Recursion Theory 1995
3. Tizra Hirst, Weizmann Institute, Infinite Recursive Structures 1992

Advising (Other than Research Directions)

Undergraduate

Below is a list of all undergraduates who I lead on a reading project. I omit those that also did research with me as they are listed elsewhere.

1. Kent Kimball. Nim Games. Fall 1989

2. Dan Wilkerson. Nim Games Fall 1990
3. David Baggett. Scheduling Algorithms Spring 1991 He went on to get a Masters degree from MIT and later powered ITA-Software which now powers Orbitz.
4. Vimarsh Bakaya. Nim Games. Fall 1994
5. David Zimmerman. Nim Games. Fall 1995
6. Ali Saqib. Nim. Games. Fall 1995
7. David Peng. Casino Game. Summer 1996, Fall 1996.
8. Anna Winkler. Heap Sort. Fall 1996
9. Ilya Burdman. Fast Fourier Transforms. Fall 2002
10. Jon Chapin. 3-free sets. Fall 2004
11. Jeff Markey. Bin Packing. Spring 2005
12. Yosif Berman, Erdos-Szekeres problem. Spring 2008
13. Lee Stephen Green, Extremal Combinatorics. Spring 2008
14. Gordon Sommers, Classical Crypto. Summer 2008.
15. Sean Wilner, Ramsey Theory. Summer 2008
16. Rohit Gopal, Ramsey Theory. Summer 2009
17. Zijiang Yang. Duel and Truel games. Fall 2008, Spring 2009.
18. Arseni Verner. Nim Games. Fall 2008, Spring 2009.
19. Jeff Jacobs. NP-completeness. Fall 2011. He got a Masters at Stanford in Computer Science.
20. Jeff Jacobs. Probability Spring 2012

Graduate

Below is a list of all graduate students who I lead on a reading project. I omit those that also did research with me as they are listed elsewhere.

1. Rameshkumar Sitarman. Inductive Inference. Fall 1987, Spring 1988
2. Sofoklis Efremidis. Hilbert's Tenth Problem. Spring 1988
3. Bill Regli. Complexity theory over the reals. Spring 1991
4. Gary Flake. Complexity theory over the reals. Spring 1991
5. Steven Smith. Complexity theory over the reals. Spring 1991

6. Daniel Eshner. Complexity Theory. Spring 1991
7. Arkady Yerukhimovich, Communication Complexity. Fall 2006-Fall 2007
8. Kin Ma, Randomized Computation. Fall 2006-Fall 2007

Faculty Mentorship

1. I mentored Jon Katz his first year, 2001.

IV Service and Outreach

Editorial Boards

1. 1992-2008 Managing Editor for *Information and Computation* (I+C).
2. 1994-1995 Guest Editor for *Journal of Computing and System Sciences* (JCSS). Special issue on Computational Learning Theory Conference 1995.
3. 1995-2008 Associate Editor for *Journal of Computing and System Sciences* (JCSS).
4. 1997-2015 Book Review Editor for *Special Interest Group- Algorithms and Computability Theory News* (SIGACT News).

Reviewing Activities for Journals and Presses

I have refereed many articles for the following journals except those where I note *one report*.

1. Information and Computation
2. Journal of Computers and Systems Science
3. Mathematical Systems Theory
4. Operations Research/Management Sciences
5. Journal of Mathematical Psychology (one report).
6. Theoretical Computer Science
7. Math Reviews
8. Journal of Symbolic Logic
9. Information Processing Letters
10. Notre Dame Journal of Logic
11. Annals of Math and AI (one report)
12. Journal of Parallel and Distributed Computing
13. SIAM Journal of Computing

14. SIAM journal of Discrete Math

Reviewing Activities for Agencies and Foundations

I have reviewed many grants for the following organizations except those where I write *one report*.

1. National Science Foundation Grants
2. National Academy of Sciences Grants
3. NDSEG Program Review Panel (Reviewing grants for Grad Students funded by Defense.)
4. SMART Scholarship Review Panel.
5. Israel NSF grant reviewer. (One report)
6. Saudi Arabian NSF. (One report)
7. Siemens Foundation. (One time)

V Professional Service

Membership

1. Member, Association of Computing Machinery (since 1989)
2. Member, American Math Society (on and off)
3. Member, Mathematics Associate of America (on and off)

Conferences- Local Arrangements

1. Conference on Computational Complexity, 2007

Conferences-Program Committee

1. 1991- Computational Complexity Conference. (CCC)
2. 1994- Computational Learning Theory. (COLT)
3. 1996- Computational Learning Theory. (COLT)
4. 1998- Computational Learning Theory. (COLT)
5. 2006- Algorithmic Learning Theory. (ALG)
6. 2010- North American Annual Meeting of the Associate on Symbolic Logic.
7. 2011-Theory and Models of Computation.
8. 2015-International conference on Knowledge Discovery and Information Retrieval. (KDIR)
9. 2016-International conference on Knowledge Discovery and Information Retrieval. (KDIR)

VI Campus Service

Departmental

1. 1985- Member, Theory Field Committee
2. 1985- Organizer, Theory of Computing Seminar (Maryland/Washington Local area. Commonly called the CATS seminar)
3. 1986-1987 Participated in Academically Talented Open House for High School Students.
4. 1986- Graduate Admissions Committee (except 1991,1992)
5. 1986 Chairman of Summer Theory Comprehensive Exam
6. 1986- Chairman, Department Honors Committee (except 1991)
7. 1986- New Faculty Orientation Committee (except 1991)
8. 1987- Grad Student Orientation (for Computer Science)
9. 1988- Grad Student Orientation (for Computer Science)
10. 1988- Speaker at High School Day (Spring)
11. 1989-Undergraduate affairs committee
12. 1988- Chairman of Summer Theory Comprehensive Exam
13. 1989- Speaker at High School Day (Spring)
14. 1989- Chairman of Summer Theory Comprehensive Exam (with Dave Mount)
15. 1989-present. Math Competition Committee (Math Department)
16. 1989 Supervised a high school student for UMIACS Summer High School program
17. 1990- Chairman of Winter Theory Comprehensive Exam
1990- Grad Student Orientation (for Computer Science)
18. 1990- Chairman of Summer Theory Comprehensive Exam
19. 1990- Committee to form syllabus for CMSC 280, Member
20. 1990 Participated in Academically Talented Open House (recruiting talented high school students)
21. 1992-1996 Honors Research Award Committee
22. 1992- Chairman of Summer Theory Comprehensive Exam
23. 1992-1993 Chairman of Theory Field Committee

24. 1992- Undergraduate Education Committee
25. 1993- Chairman, Teaching Evaluation Committee
26. 1994- Teaching Evaluation Committee for full time lecturers
27. 1994-1996 Distinguished Dissertation committee
28. 1994 Chairman of Summer Theory Comprehensive Exam
29. 1994- New Grad Student Orientation
30. 1994-1995 Faculty Recruiting Committee
31. 1995 Graduate Retention Fellowship Committee
32. 1995 Chairman of Summer Theory Comprehensive
33. 1995-1996 Chairman of Holiday Entertainment Committee
34. 1996 Chairman of Winter Theory Comprehensive
35. 1997 Chen Scholarship Committee
36. 1997 Senior Summer Scholars Selection Committee
37. 1998 Minority Recruitment committee.
38. 2000- New Faculty Orientation
39. 2000-2004 Undergraduate Co-chair.
40. 2000-2006 Participated in Academically Talented Open House (recruiting talented high school students)
41. 2001 Faculty Recruitment Committee.
42. 2001 Speaker at Workshop for Women in Academia.
43. 2003-2005 Theory Field Committee Chair
44. 2003- Minority Recruitment Chair
45. 2006-2008 Judge at Workshop for Women and Minority Grad Students
46. 2006-now Teaching Evaluation Committee.
47. 2008 Middle States Eval Committee for PhD. Chair.
48. 2011-2011 College APT committee
49. 2013 Middle State Eval Committee for PhD Defenses. Chair
50. 2013 Middle State Eval Committee for Theory Courses. Chair.

51. 2013 Middle State Eval Committee for intros to PhD's . Chair.
52. 2014 Tandy Warnow Full Prof Committee
53. 2014 Andrew Childs Tenure Committee
54. 2014 Scott Aaronson Full Prof Committee
55. 2014 Lectures Search Committee
56. 2014 Gemstone discussant
57. 2014 Banneker Key Greeter
58. 2014 Organized Theory Day
59. 2014 Holiday Entertainment
60. 2014 Fund raising: Obtained \$25,000 from Jacob Lurie for REU program.
61. 2015 Banneker-Key Scholarship Committee.
62. 2016 Gemstone discussant
63. 2016 High School Student Research Liason
64. 2016 Head of Middle States Eval Committee. Chair.
65. 2014 Fund raising: Obtained \$10,000 from Goldman Sacks- Marty Chaves.
66. 2017 Head of Middle States Eval Committee. Chair.

College

1. 1999-present. Member, The Mathematics Competition Committee. (Makes up and supervises *The University of Maryland Mathematics Competition.*)
2. 1989-1994, Member, CMPS Committee on Cognitive Studies
3. 1990-1994, Member, Calculus Reform Committee
4. 1992-1993 College APT committee
5. 1993-2004 Summer Orientation of Freshman
6. 1994 First Two Years Committee
7. 2000 Supervised Governors School Program for High School Students in Computer Science
8. 2010-2012 College APT committee.

VII Awards and Honors

Teaching Awards

1. 1993- Certificate of Teaching Excellence (In Recognition of Significant Influence and Contributions to the Education of Outstanding Graduating Senior Sergey Brin.)
2. 1994 Teaching Excellence Award (Honorable Mention), Department of Computer Science
3. 1995 Service award for *Outstanding Contribution to Seniors* (given by the office of the Vice President for Student Affairs and the Senior Council).
4. 1997 Teaching Excellence Award (Honorable Mention), Department of Computer Science
5. 1998 Teaching Excellence Award (Honorable Mention), Department of Computer Science
6. 2000 Teaching Excellence Award, Department of Computer Science 2002
7. 2004 Certificate of Teaching Excellence (In Recognition of Significant Influence and Contributions to the Education of Outstanding Graduating Senior Amy Castner.)
8. 2007 Certificate of Teaching Excellence (In Recognition of Significant Influence and Contributions to the Education of Outstanding Graduating Senior Katrina LaCurts.)
9. 2012 Teaching Excellence Award, Department of Computer Science