

# Kenneth Wingate Regan

*Curriculum vitae*

## Address for Correspondence

Department of Computer Science and Engineering  
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**Current Job Title:** Associate Professor

## Employment

*(Continuous service at UB from 8/1/89)*

*Associate Professor,* Department of Computer Science and Engineering, University at Buffalo. *Current,* from 7/1/98.

*Associate Professor,* Department of Computer Science, University at Buffalo, 8/1/95–6/30/98.

*Assistant Professor,* Department of Computer Science, University at Buffalo, 8/1/89–7/31/95.

*Postdoctoral Visitor,* Cornell Mathematical Sciences Institute, 10/1/86–12/31/87, 9/1/88–7/31/89.

*Junior Research Fellow,* Merton College, Oxford University 10/1/84–9/30/86, 1/1/88–8/31/88.

## Education

Oxford University, Doctor of Philosophy (Mathematics), September 1986.

Princeton University, B.A. *summa cum laude* (Mathematics), June 1981.

## Distinctions

1. *Honorary Member of the Golden Key National Honor Society*, elected by the University at Buffalo chapter 10/20/97, cited for Excellence in Teaching.
2. Elected a *Junior Fellow* of Merton College, Oxford, 11/83.
3. *Marshall Scholar*, for study in Mathematics at Oxford, 10/81–9/84.
4. Awarded permanent title of *International Chess Master* by the World Chess Federation (F.I.D.E.), 8/81.
5. *G.B. Cook Senior Prize in Mathematics* (shared), Princeton University, 6/81.

**Primary Research Field** Theoretical Computer Science.

## Research Support (all external)

1. *Previous:* National Science Foundation, CCR  
Project Title: “Complexity, Formal Systems, and Linear-Time Computation”  
Project Dates: July 1, 1990–February 28, 1993. (\$35,013)
2. *Previous:* National Science Foundation, CCR  
Project Title: “Linear-Time Computation and Low-Level Complexity”  
Project Dates: August 1, 1994–May 1, 1998. (\$152,022)
3. *Previous:* National Science Foundation, INT/Japan Program  
Project Title: “Complexity Theory For Strategic Goals”  
Co-PI’s: Jin-Yi Cai; Alan Selman; Mitsunori Ogihara (U. Rochester)  
Project Dates: April 1, 1998–March 31, 2002. (\$30,950, 1-yr. no-cost extension.)
4. *Previous:* National Science Foundation, CCR  
Project Title: “Low-Level Complexity and Hard Concepts”  
Project Dates: June 28, 1999–August 30, 2002. (\$178,529)

# Publications

It is the custom in Theoretical Computer Science to list authors alphabetically except for major differences in input.

## Journal Articles, In Print

- (1) K.W. Regan, “The topology of provability in complexity theory,” *Journal of Computer and Systems Sciences* **36**, No. 3 (June 1988) 384–432.
- (2) K. Regan, “Diagonalization, uniformity, and fixed-point theorems,” *Information and Computation* **98** (May 1992), 1–40.
- (3) K. Regan, “Minimum-complexity pairing functions,” *Journal of Computer and Systems Sciences* **45** (Dec. 1992), 385–395.
- (4) K. Regan and J. Royer, “On closure properties of bounded 2-sided error complexity classes,” *Mathematical Systems Theory* **28**, 1995, 229–243.
- (5) F. Green, J. Köbler, K. Regan, T. Schwentick, and J. Torán, “The power of the middle bit of a  $\#P$  function,” *Journal of Computer and Systems Sciences* **50** (1995) 456–467.
- (6) A. Naik, K. Regan, and D. Sivakumar, “On quasilinear time complexity theory,” *Theoretical Computer Science* **148** (1995) 325–349.
- (7) K. Regan, “Linear time and memory-efficient computation,” *SIAM Journal on Computing* **25** (1996) 133–168.
- (8) K. Regan, “Index sets and presentations of complexity classes,” *Theoretical Computer Science* **161**, July 1996, 263–287.
- (9) R. Downey, M. Fellows, and K. Regan, Descriptive Complexity and the W. Hierarchy, in P. Beame and S. Buss, eds., “Proof Complexity and Feasible Arithmetics: Proceedings of a DIMACS Workshop, April 1996,” volume 39 of the DIMACS Series on Discrete Mathematics and Theoretical Computer Science (Providence: AMS), 1997, pages 119–134. (This was fully refereed and counts as final publication.)
- (10) A. Jagota and K. Regan, “Performance of Neural-Net Heuristics for Maximum Clique on Diverse Highly-Compressible Graphs,” *Journal of Global Optimization* **10**, 1997, 439–465.
- (11) K. Regan and H. Vollmer, “Gap languages and log-time complexity classes,” *Theoretical Computer Science* **188**, 1998, 101–116.
- (12) R. Downey, M. Fellows, and K. Regan, “Parameterized Circuit Complexity and the W Hierarchy,” *Theoretical Computer Science* **191**, 1998, 97–115.
- (13) R. Downey, M. Fellows, and K. Regan, “Threshold dominating sets and an improved characterization of  $W[2]$ ,” *Theoretical Computer Science* **209**, 1998, 123–140.

- (14) A. Jagota, G. Narasimhan, and K. Regan, “Information capacity of binary weights associative memories,” *Neurocomputing* **19**, 1998, 35–58.
- (15) H. Buhrman, D. van Melkebeek, K. Regan, D. Sivakumar, and M. Strauss, “A generalization of resource bounded measure, with application to the BPP vs. EXP problem,” *SIAM Journal on Computing* **30**, 2001, 576–610.
- (16) B. Postow, K. Regan, and C. Smith, “UPSILON: Universal programming system with incomplete lazy object notation,” *Fundamenta Informaticae* **50**, 2002, 325–359.
- (17) S. Aida, M. Crasmaru, K. Regan, and O. Watanabe, “Games With Uniqueness Properties,” *Theory of Computer Systems* **37** (2004), 29–47. (STACS’02 Special Issue).
- (18) H. Liu and K. Regan, “Improved construction for universality of determinant and permanent,” *Information Processing Letters* **100** (Issue 6, 31 Dec. 2006), 233–237.
- (19) M. Jansen and K. Regan, “A Non-Linear Lower Bound for Constant Depth Arithmetical Circuits via the Discrete Uncertainty Principle,” *Theoretical Computer Science* **409** (Issue 3, 28 December 2008), 617–622.
- (20) S. Kalyanasundaram, R. Lipton, K. Regan, and F. Shokrieh, “Improved Simulation of Nondeterministic Turing Machines,” *Theoretical Computer Science* **417**, Feb. 2012, 66–73 (special issue for the MFCS 2010 conference).

### Journal Articles, Accepted

- (21) D.X. Charles and K. Regan, “On arithmetical formulas whose Jacobians are Gröbner bases,” accepted to the *Journal of Symbolic Computation*, subject to revisions.

### Book Chapters, Refereed

- (1) Polynomials and Combinatorial Definitions of Languages, in L. Hemaspaandra and A. Selman, eds., *Complexity Theory Retrospective II*, (Berlin and New York: Springer Verlag, 1997), pp 261-293.
- (2) E. Allender, M. Loui, and K. Regan, three chapters for the *CRC Handbook on Algorithms and Theory of Computation* (M.J. Atallah, ed.), (Boca Raton: CRC Press, 1998). “Chapter 27: Complexity Classes,” “Chapter 28: Reducibility and Completeness,” “Chapter 29: Other Complexity Classes and Measures.” *Revised* 2007–08 for the 2nd edition (2009), in which they will be numbered chapters 23–25.
- (5) T. Jiang, M. Li, B. Ravikumar, and K. Regan, two chapters for the above-cit. CRC volume: “Chapter 25: Formal Grammars and Languages,” “Chapter 26: Computability.”

### Book Chapter, Not Refereed

- (1) E. Allender, M. Loui, and K. Regan, “Complexity Theory,” in Allen B. Tucker, Jr., ed., *CRC Computer Science Handbook, Second Edition*, CRC Press, 2004, 5-1–5-30. A condensation, revision, and update of our three chapters for a different CRC Handbook. Revisions recently approved for 2012 update.

### Journal Articles, Non-Refereed

- (1) K. Regan, “Machine models and linear time complexity,” *SIGACT News* **24**, October 1993, pages 5–15. Guest Column for L. Hemaspaandra, ed., “Complexity Theory Column.”
- (2) K. Regan and J. Wang, “The Quasilinear Isomorphism Challenge,” *SIGACT News* **25**, September 1994, pages 106–113.
- (3) K. Regan, “Understanding the Mulmuley-Sohoni Approach to P vs. NP,” *Bulletin of the European Association for Theoretical Computer Science* **78**, October 2002, pp 86–97. Invited contribution to Lance Fortnow’s Computational Complexity Column.

### Conference Papers

(All were subject to selective acceptance and appear in published preceedings. All were refereed by committee with feedback except (2) and (15). Although the ethics of my field allow conference papers to be nothing more than “extended abstracts,” I have followed the standard of providing a full paper used in mathematics and other communities, except in paper (19) where stricter page limits led us to delete proofs from the conference version. *Jn* means that the material was subsequently included in journal article *n*.)

- (1) K. Regan, “On diagonalization methods and the structure of language classes,” in “Proceedings, Foundations of Computation Theory, Borgholm, Sweden, August 1983,” *Lecture Notes in Computer Science* **158**, Springer Verlag, Berlin, pp. 368–380. (Included in *J1*)
- (2) K. Regan, “Arithmetical degrees of index sets for complexity classes,” in “Proceedings, Logic and Machines, Münster, West Germany, May 1983,” *Lecture Notes in Computer Science* **171**, Springer Verlag, Berlin, 1984, pp. 118–130. (Included in *J8*)
- (3) K. Regan, “A topology of provability in complexity theory,” in “Proceedings, First Annual Conference on Structure in Complexity Theory, Berkeley, CA, June 1986,” *Lecture Notes in Computer Science* **223**, Springer Verlag, New York, 1986, pp. 291–310. (*J1*)
- (4) K. Regan, “A uniform reduction theorem, extending a result of J. Grollmann and A. Selman, in “Proceedings of the 14th ICALP, Rennes, France, July 1986,” *Lecture Notes in Computer Science* **226**, Springer Verlag, Berlin, 1986, pp. 324–333. (Included in *J2*)
- (5) K. Regan, “Unprovably intractable languages,” in “Proceedings, 2nd Annual IEEE Conference on Structure in Complexity Theory Ithaca, NY, June 1987,” IEEE Computer Science Press, Los Alamitos, CA, 1987, pp. 69–80.

- (6) K. Regan, "Finitary substructure languages," in "Proceedings, 4th Annual IEEE Conference on Structure in Complexity Theory, Eugene, OR, June 1989," IEEE Computer Science Press, Los Alamitos, CA, 1989, pp. 87–96.
- (7) K. Regan and T. Schwentick, "On the power of one bit of a  $\#P$  function," in "Proceedings, 4th Italian Conference on Theoretical Computer Science, L'Aquila, Italy, Oct. 1992," World Scientific Press, Singapore, 1982, pp 317–329. (Included in *J5*)
- (8) K. Regan, "On the difference between Turing machine time and random-access machine time," in "Proceedings, 5th International Conference on Computing and Information, Sudbury, Ontario, May 1993," pp 36–40. (Included in *J8*)
- (9) K. Regan, "A new parallel vector model, with exact characterizations of  $NC^k$ ," in "Proceedings, 11th Annual Symposium on Theoretical Aspects of Computation, Caen, France, February 1994." Lecture Notes in Computer Science **778**, Springer Verlag, 1994, pp 289–300.
- (10) A. Naik, K. Regan, and D. Sivakumar, "Quasilinear time complexity theory," in "Proceedings, 11th Annual Symposium on Theoretical Aspects of Computation, Caen, France, February 1994." Lecture Notes in Computer Science **778**, Springer Verlag, 1994, pp 97–108. (*J6*)
- (11) L. Li, M. Ogihara, and K. Regan, "On information from  $\#P$  functions," in "Proceedings, 6th Annual International Conference on Computers and Information, Peterborough, Ontario, May 1994." Proceedings appeared in: *Journal of Computers and Information* **1**, 1994, 280-295.
- (12) K. Regan, "Linear time algorithms in memory hierarchies," in "Proceedings, 13th IFIP World Computer Congress, Hamburg, Germany, Aug.-Sep. 1994, Volume 1: Technology and Foundations," B. Pehrson and I. Simon, eds., *IFIP Transactions*, Ser. A-51, North-Holland, 1994, pp 609–614.
- (13) K. Regan, "Linear speed-up, information vicinity, and finite-state machines," in "Proceedings, 13th IFIP World Computer Congress, Hamburg, Germany, Aug.-Sep. 1994, Volume 1: Technology and Foundations," B. Pehrson and I. Simon, eds., *IFIP Transactions*, Ser. A-51, North-Holland, 1994, pp 609–614.
- (14) J.-Y. Cai, R. Lipton, L. Longpré, M. Ogihara, K. Regan, and D. Sivakumar, "Communication complexity of key agreement on small ranges," in "Proceedings, 11th Annual Symposium on Theoretical Aspects of Computation, Munich, Germany, February 1995," Lecture Notes in Computer Science **900**, Springer-Verlag, Berlin, 1995, pp 38–49.
- (15) K. Regan, D. Sivakumar, and J.-Y. Cai, "Pseudorandom number generators, measure theory, and natural proofs," in "Proceedings, 36th Ann. IEEE Symposium on Foundations of Computer Science, Milwaukee, WI, October 1995," IEEE Computer Science Press, Los Alamitos, CA, 1995, pp 26–35.

- (16) A. Jagota and K. Regan, "Testing neural-net optimization algorithms on highly compressible problem instances." Invited paper, *in* "Proceedings, 1996 International Conference on Neural Information and Processing (ICONIP'96), Hong Kong, September 1996." (J10)
- (17) K. Regan, "Polynomial vicinity circuits and nonlinear lower bounds," *in* "Proceedings, 12th Annual IEEE Conference on Computational Complexity" Ulm, Germany, June 1997," IEEE Computer Science Press, Los Alamitos, CA, 1997, pp 61–68.
- (18) H. Buhrman, D. van Melkebeek, K. Regan, D. Sivakumar, and M. Strauss, "A Generalization of Resource-Bounded Measure, With an Application," *in* "Proceedings, 15th Annual Symposium on Theoretical Aspects of Computer Science, Paris, France, February 1998," Lecture Notes in Computer Science **1373**, Springer Verlag, Berlin, 1998, pp 161–171. (J14)
- (19) K. Regan and D. Sivakumar, "Probabilistic martingales and BPTIME classes," *in* "Proceedings of the 13th Annual IEEE Conference on Computational Complexity, Buffalo, NY, June 1998," IEEE Computer Science Press, Los Alamitos, CA, 1998, pp 186–200.
- (20) S. Aida, M. Crasmaru, K. Regan, and O. Watanabe, "On games with unique solutions," *in* "Proceedings, 15th Annual Symposium on Theoretical Aspects of Computer Science, Nice, France, March 2002," Springer LNCS **2285**, 2002, pp 396–407. (J17)
- (21) M. Crasmaru, C. Glasser, K. Regan, and S. Sengupta, "A Protocol for Serializing Unique Strategies," International Symposium on Mathematical Foundations of Computer Science (MFCS), Prague, Czech Republic, 2004. Lecture Notes in Computer Science 3153, pp 660–672, Springer-Verlag, 2004.
- (22) M. Jansen and K. Regan, "'Resistant' Polynomials and Stronger Lower Bounds for Depth-Three Arithmetical Formulas," in the proceedings of the 13th Annual International Computing and Combinatorics Conference (COCOON 2007), Banff, Canada, July 16–19, 2007, Springer LNCS **4598**, 2007, pp 470–481.
- (23) G. DiFatta, G. Haworth, and K. Regan, "Skill Rating by Bayesian Inference," in the proceedings of the 2009 IEEE Symposium on Computational Intelligence and Data Mining (CIDM'09), Nashville, TN, March 30–April 2, 2009, IEEE, pp 89–94.
- (24) G. Haworth, K. Regan, and G. DiFatta, "Performance and Prediction: Bayesian Modelling of Fallible Choice in Chess," in the proceedings of the 12th ICGA Conference on Advances in Computer Games, Pamplona, Spain, May 11–13, 2009, Final publication version (March 2010), Springer LNCS **6048**, 2010, pp 99–110.
- (25) S. Kalyanasundaram, R. Lipton, K. Regan, and F. Shokrieh, "Improved Simulation of Nondeterministic Turing Machines," in the proceedings of the 35th International Symposium on Mathematical Foundations of Computer Science, Brno, Czech Republic, August 23–27, 2010. Springer LNCS **6281**, Springer-Verlag, 2010, 453–464. (J20)

- (26) K. Regan and G. Haworth, “Intrinsic Chess Ratings,” Proceedings of AAAI 2011, San Francisco, Aug. 7–11, 2011.
- (27) R. Lipton, K. Regan, and A. Rudra, “Symmetric Functions Capture General Functions,” in the proceedings of the 36th International Symposium on Mathematical Foundations of Computer Science, Warsaw, Poland, Aug. 22–26, 2011. Springer LNCS **6907**, 2011, pp 436–447.
- (28) K. Regan and B. Maciejka and G. Haworth, “Understanding Distributions of Chess Performances,” Proceedings of the 13th ICGA *Advances in Computer Games* conference, Tilburg, Netherlands, November 2011. Proceedings to be published in the Springer-Verlag Lecture Notes in Computer Science series, final paper version approved in March 2012.

### Conference Paper—Non-Refereed

- (I) K. Regan, “On Super-Linear Lower Bounds in Complexity Theory” in “Proceedings, 1995 IEEE Conference on Structure in Complexity Theory, Minneapolis, MN, June 1995,” pp 50–64.
- (II) R. Lipton and K. Regan, “A Finite-Compactness Notion, and Property Testing,” Logic and Computational Complexity 2011, Toronto, June 25, 2011.

### Web Articles

I have authored 49 posts singly and innumerable ones jointly with Richard Lipton on the weblog *Gödel’s Lost Letter and  $P=NP$* , which he began in February 2009. I have been a full partner since January 2011. We are about to make post 400 on the blog; posts average 4–5 LaTeX source pages—each is a self-contained article not just a note or blurb. The following are among the most important and representative, all including research I have done or supervised.

- (i) K. Regan, “Can We Solve Chess One Day?” May 12, 2010 entry in Professor Richard J. Lipton’s weblog titled “Gödel’s Lost Letter and  $P=NP$ .” URL:  
<http://rjlipton.wordpress.com/2010/05/12/can-we-solve-chess-one-day/>
- (ii) K. Regan (preface by R. Lipton), “Projections Can Be Tricky,” August 19, 2010 entry in “Gödel’s Lost Letter and  $P=NP$ .” URL:  
<http://rjlipton.wordpress.com/2010/08/19/projections-can-be-tricky/>  
 (Basically a 7-page survey paper contrasting the main conceptual flaw in Vinay Deolalikar’s  $P \neq NP$  claim from August 2010 with a famous lower bound in computational complexity where such a strategy succeeded.)
- (iii) K. Regan, “Could Euler Have Solved This?”, April 20, 2011 entry in “Gödel’s Lost Letter and  $P=NP$ .” URL:  
<http://rjlipton.wordpress.com/2011/04/20/could-euler-have-solved-this/>

- (iv) K. Regan, “Succinct Constant Depth Arithmetic Circuits Are Weak,” April 28, 2011 entry in “Gödel’s Lost Letter and P=NP.” URL:  
<http://rjlipton.wordpress.com/2011/04/28/succinct-constant-depth-arithmetic-circuits-are-weak/>
- (v) K. Regan, “Empirical Humility,” October 12, 2011 entry, URL:  
<http://rjlipton.wordpress.com/2011/10/12/empirical-humility/>
- (vi) K. Regan, “More Quantum Chocolate Boxes,” November 14, 2011 entry, URL:  
<http://rjlipton.wordpress.com/2011/11/14/more-quantum-chocolate-boxes/>
- (vii) K. Regan, “The Higgs Confidence Game,” December 13, 2011 entry, URL:  
<http://rjlipton.wordpress.com/2011/12/13/the-higgs-confidence-game/>
- (viii) K. Regan, “When is a Law ‘Natural’?”, March 30, 2012 entry, URL:  
<http://rjlipton.wordpress.com/2012/03/30/when-is-a-law-natural/>
- (ix) K. Regan, “Digital Butterflies and PRGs,” May 4, 2012 entry, URL:  
<http://rjlipton.wordpress.com/2012/05/04/digital-butterflies-and-prgs/>
- (x) K. Regan, “Chess Knightmare and Turing’s Dream,” May 31, 2012 entry, URL:  
<http://rjlipton.wordpress.com/2012/05/31/chess-knightmare-and-turings-dream/>
- (xi) K. Regan, “Grilling Quantum Circuits,” July 8, 2012, URL:  
<http://rjlipton.wordpress.com/2012/07/08/grilling-quantum-circuits/>
- (xii) K. Regan and R. Lipton, various other posts in the same weblog during the August 8–19 timespan of the online review of Deolalikar’s paper. The first, fourth, and sixth items below were by Lipton (only edited by me), while I wrote most of the technical subsections in the other three, drawn from over 1000 comments made by researchers in this and other weblogs. URLs:

<http://rjlipton.wordpress.com/2010/08/08/a-proof-that-p-is-not-equal-to-np/>  
<http://rjlipton.wordpress.com/2010/08/10/update-on-deolalikars-proof-that-p%E2%89%A0np/>  
<http://rjlipton.wordpress.com/2010/08/11/deolalikar-responds-to-issues-about-his-p%E2%89%A0np-proof/>  
<http://rjlipton.wordpress.com/2010/08/12/fatal-flaws-in-deolalikars-proof/>  
<http://rjlipton.wordpress.com/2010/08/15/the-p%E2%89%A0np-proof-is-one-week-old/>  
<http://rjlipton.wordpress.com/2010/08/18/proofs-proofs-who-needs-proofs/>

## In Preparation or Revision

- M. Jansen and K. Regan “On determinants of random constrained Fourier minors.”
- J. Buss and K. Regan, “Simultaneous Bounds on Time and Space.”

- K. Regan and A. Chakrabarti, “Quantum Circuits, Polynomials, and Entanglement Measures”; featured in the “Grilling Quantum Circuits” post of July 8, 2012.
- K. Regan, P. McKenzie, and A. Tavenaux, “Cancellations in Arithmetical Complexity.”
- R. Lipton and K. Regan, “On the Power of Parity” (was submitted to MFCS’10).
- R. Lipton, K. Regan, and A. Rudra, “Two Theorems on Quantum Polynomial Time,” 2011.
- R. Lipton, K. Regan, and A. Rudra, “Simulating Special but Natural Quantum Circuits,” <http://arxiv.org/abs/1201.3306>, 2012. Revised under title “New Hard Problems Via Quantum Circuit Simulation,” was submitted to ITCS 2013.
- W. Gasarch and K. Regan, “The Very First Ramseyan Theorem and its Application,” 2012.
- K. Regan, “Intrinsic Ratings Compendium,”  
<http://www.cse.buffalo.edu/~regan/papers/pdf/Reg12IPRs.pdf>
- K. Regan, “Converting Utilities Into Probabilities,” 2012.

## Dissertation

*On the Separation of Complexity Classes*, Oxford University, September 1986. (D.J.A. Welsh, supervisor; A. Macintyre and U. Sch nung, examiners.)

## Other

- (1) K. Regan and J. Torán, “Proof Theory and Complexity,” chapter of lecture notes on “Lectures on Proof Theory” by Sam Buss, McGill-Montreal Invitational Workshop on Complexity Theory, Bellairs Inst., Barbados, March 1995; notes are McGill School of Computer Science TR No. SOCS-96.1, January 1996.

## Invited Presentations

1. K. Regan, “Scoping the Mind with Turing’s Chess Machine,” University of Bergen, Norway (series in honor of the Turing Centennial), 9/11/12.
2. K. Regan, “Converting Utilities Into Probabilities,” ARC Colloquium, Georgia Tech, February 7, 2012.
3. “Symmetric Functions Capture General Functions,” for the 4th Annual Eastern Great Lakes Theory Workshop (EaGL’11), 9/11/11.
4. “A Finite-Compactness Notion, and Property Testing,” *Logic in Computational Complexity*, workshop affiliated to LICS 2011, University of Toronto Fields Institute, June 25, 2011.

5. “Polynomial Translations of Quantum Circuits,” *ARC Colloquium*, Georgia Institute of Technology, Atlanta, GA, 11/15/2010.
6. “P, NP, and the Open-Source Model,” *Mathematics Department Seminar*, organized by Professor John Ringland (for undergraduates but attended by many faculty), 9/30/10.
7. “Complexity of Unique Alternation,” *ARC Colloquium*, Georgia Institute of Technology, Atlanta, GA, 4/8/10.
8. “High-Degree Polynomials and Arithmetical Lower Bounds,” *Association of Symbolic Logic Annual Meeting*, George Washington University, Washington, DC, 3/19/10.
9. “Polynomial Simulations of Quantum Circuits,” Theory Seminar, Department of IRO, Univ. of Montreal, 5/7/09.
10. “Concrete Open Problems,” Theory Seminar, Department of IRO, Univ. of Montreal, 4/11/09.
11. “Skill and Prediction and Cheating in Chess,” *Colloquium*, Department of Computer Science and Operations Research, University of Montreal, 1/29/09.
12. “From Super-Linear to Super-Polynomial Lower Bounds,” The Lipton Theory Symposium, in honor of Richard J. Lipton’s 60th birthday, Georgia Tech, Atlanta, 4/27/08. (I was invited to fill one of the two ‘contributed talk’ slots three weeks before the meeting.)
13. “Turning Quantum Computers Into Equations,” Department of Computer Science Seminar, Brooklyn College, 3/13/08.
14. “Extending the Degree Method in Complexity Theory,” 33rd EPIT (Spring School in Theoretical Computer Science, sponsored by the University of Lyon), Montagnac-les-Truffes, France, May 30–June 3, 2005. *Also* Theory Seminar, University of Montreal, 9/30/08.
15. “Extending the Degree Method in Complexity Theory,” Colloquium, Union College Department of Computer Science, Jan. 28, 2004.
16. “Extending the Degree Method in Complexity Theory,” *Invited workshop presentation*, Schloss Dagstuhl workshop on “Algebraic Methods in Complexity Theory,” Wadern, Germany, 10/02. [These three talks were substantially different despite re-use of the title.]
17. “Have All the Answers Already Been Computed? / Gröbner Bases and Complexity Lower Bounds”
  - *Colloquium*, Department of Computer Science, University of Rochester, October 18, 1999.
  - *Invited seminar presentation*, Department of Computer Science, Rutgers University, February 19, 1999.

18. “Polynomial Vicinity Circuits and Nonlinear Lower Bounds,”
  - *Theory Seminar*, Department of Computer Science, Princeton University, March 17, 1997.
  - *Theory Seminar*, Institut für Informatik, Technische Universität München, Munich Germany, June 23, 1997.
  - *Colloquium*, SUNY at Buffalo, 9/12/97.
  - *Theory Seminar*, Department of Computer Science, University of Maryland, November 17, 1997.
  - *Invited Workshop Presentation*, Fields Institute Workshop on “Complexity Lower Bounds,” University of Toronto, February 23–27, 1998.
19. “Structural Aspects of Parameterized Complexity,” *Invited workshop presentation*, workshop on “Parameterized Complexity” organized by M. Fellows and R. Downey at the 1998 SIAM–Discrete Math Joint Meetings at the University of Toronto, July 14–18, 1998.
20. “Descriptive Complexity and the  $W$  Hierarchy,” *Invited workshop presentation*, DIMACS Workshop on “Feasible Arithmetics and Lengths of Proofs,” organized by Drs. Paul Beame and Sam Buss, DIMACS at Rutgers University, April 21–23, 1996.
21. “Applications of Error-Correcting Codes in Complexity Theory,”
  - *Invited workshop presentation*, Southern Regional Meeting of the American Mathematical Society, organized by J. Wang, Greensboro, NC, Nov. 17–18, 1995.
  - *Invited workshop presentation*, workshop on complexity theory organized by D. Thérien at the 64th Congr s de L’Association Canadienne-Fran aise pour l’Avancement des Sciences, Montreal, Canada, May 1996 (gave talk in French).
22. “Pseudorandom Generators, Measure Theory, and Natural Proofs,”
  - *Invited lecture*, DIMACS “Theory Day,” Rutgers University, 2/17/95.
  - *Invited workshop presentation*, McGill-Montreal Theory Workshop (at the Bellairs Institute on Barbados), 3/5/95–3/11/95.
  - *Invited workshop presentation*, Schloss Dagstuhl workshop on “Algorithmic Information Theory and Randomness,” Wadern, Germany, July 1996.
23. “Improved Resource-Bounded Borel-Cantelli Lemmas and Stochasticity Theorems,” *Invited workshop presentation*, Schloss Dagstuhl workshop on “Algorithmic Information Theory and Randomness,” Wadern, Germany, July 1996.
24. “Quasilinear Time Complexity Theory,”
  - *Colloquium*, University of Rochester, 1/23/95.
  - *Theory Seminar*, University of North Carolina at Greensboro, 6/10/94.

25. “The Problem of Nonlinear Lower Bounds in Complexity Theory,”
  - *Theory Seminar*, University of Waterloo, 5/4/94.
  - *Theory Seminar*, Boston University, 4/8/94.
  - *Combinatorial Theory Seminar*, Mathematical Institute, Oxford University, 2/22/94. *Colloquium*, SUNY at Buffalo, 2/3/94.
26. “The Block Move Model and Circuit Complexity,” *Invited workshop presentation*, Special Workshop on “Structure in Complexity Theory,” Schloss Dagstuhl, Wadern, Germany, 2/94.
27. “Error Correcting Codes and Complexity Theory,”
  - *Colloquium*, Department of ECE, University of Illinois at Urbana-Champaign, 9/7/93.
  - *Invited workshop presentation*, Workshop on Complexity Theory, University of Southern Maine, 8/23/93.
28. “Practical Optics and Theoretical Computing,” *Colloquium* (titled “Graduate Seminar”), Department of Computer Science, University of Illinois at Urbana-Champaign, 9/8/93.
29. “Linear Time and Memory-Efficient Computation,” *Colloquium*, Department of Computer Science, University of Chicago, 6/25/93.
30. “Bounded Recursion for Linear-Time Computation,” *Invited workshop presentation*, Workshop on Feasible Mathematics, Mathematical Sciences Institute, Cornell University, 5/28/92.
31. “Parsimonious and Truly Linear-Time Computation,” *Invited workshop presentation*, Special Workshop on “Structure in Complexity Theory,” Schloss Dagstuhl, Wadern, Germany, 2/92.
32. “Computing with Partial Information,” *Colloquium*, Department of Computer Science, University of Delaware, 4/91.

## Articles About

1. Dylan McClain, “To Detect Cheating in Chess, a Professor Builds a Better Program,” *New York Times*, Science Tuesday section page D3, March 20, 2012. Picked up by many other sources.
2. Tyler Cowen, “Are chess players getting better over time?” for his weblog *Marginal Revolution* on 8/2/11, <http://marginalrevolution.com/marginalrevolution/2011/08/are-chess-players-getting-better-over-time.html>

3. Steven Levitt and Stephen Dubner, “Are We Actually Getting Better at Chess?” for their weblog *Freakonomics* on 8/4/11, <http://www.freakonomics.com/2011/08/04/are-we-actually-getting-better-at-chess/>

### **Ph.D. Students, Graduated**

- (1) Arun Jagota, “The Hopfield-Clique Network, Associative Memories, and Combinatorial Optimization,” 9/90–5/93, degree obtained May 1993.
- (2) D. Sivakumar, “Probabilistic Techniques in Structural Complexity Theory,” 9/93–8/96, degree obtained August 1996.
- (3) Maurice J. Jansen, “Lower Bound Frontiers in Arithmetical Circuit Complexity,” 9/99–8/06, degree obtained August 2006.
- (4) Qi Duan, “Graph Related Algorithms and Protocols in Wireless Security,” 9/03–8/08, degree obtained August 2008.

### **MS Students**

- (1) Anix Anbiah, Master’s Project entitled “A Study of Interior Gateway Routing Protocols and an Implementation of OSPF for ka9q,” 8/93–2/94, degree conferred 2/94.
- (2) Lijie Shi, Master’s Thesis entitled “Approximability of Satisfiability,” 8/96–12/96, defended 12/96.
- (3) Denis X. Charles, Master’s Thesis entitled “Sieve Methods,” defended 7/00.
- (4) Hong Liu, Master’s Project entitled “Improved Construction for Universality of Permanent and Determinant,” completed 5/12/04. (Published in 2006 as journal article (18).)
- (5) Akshay Wadia, Master’s Project on “Non-Interactive Zero Knowledge,” defended July 2006.

### **Ph.D. Dissertation Committees**

Internal:

1. Hing-Kai Hung (J. Zucker, chair), defended in May 1990.
2. Ramnath Sarnath (X. He, chair), defended in November 1993.
3. Robin Hill (W. Rapaport, chair), defended in December 1993.
4. Sivaprakasam Sunder (X. He, chair), defended in April 1994.
5. Devashis Jana (B. Jayaraman, chair), defended in August 1994.

6. Ashish V. Naik (A. Selman, chair), defended in December 1994.
7. Niloufer Mackey (P. Eberlein, chair), defended in January 1995.
8. Mauricio Osorio (B. Jayaraman, chair), defended in August 1995.
9. Kannan Govindarajan (B. Jayaraman, chair), defended in January 1997.
10. Ajay Nerurkar (J.-Y. Cai, chair), defended in September 2000.
11. Pavan Aduri (A. Selman, chair), defended in July 2001.
12. Phil Ventura, defended in September 2003.
13. Samik Sengupta, defended in August 2004.
14. Liyu Zhang, defended in July 2007.
15. Adrienne Decker, defended in May 2007.
16. S. Vidyaraman, defended in February 2008.
17. Yulai Xie, defended in May 2008.
18. Nathan Russell, current.
19. Andrew Hughes, current.

External:

1. Ioan Macarie (J. Seiferas, University of Rochester, chair), defended in August 1995.

## Courses Taught

- (1) “CS(E)305: Programming Languages,” Univ. at Buffalo, 1/95–5/95, 8/95–12/95, 1/97–5/97, 1/99–5/99, 8/05–12/05, 1/07–5/07, 8/07–12/07.
- (2) “CS(E)250: Data Structures and Algorithms,” Buffalo, 8/11–12/11, 8/10–12/10, 8/09–12/09, 1/00–5/00, 8/96–12/96.
- (3) “CSE191: Discrete Mathematics,” Buffalo, 1/11–5/11.
- (4) “CS192: Discrete Mathematics II,” Buffalo, 1/92–5/92.
- (5) “CS350: Advanced Data Structures,” Buffalo, 8/90–12/90.
- (6) “CS681: Formal Languages I,” Buffalo, 1/12–5/12, 1/10–5/10, 8/90–12/90.
- (7) “CS682: Formal Languages II,” Buffalo, 8/93–12/93.
- (8) “CS496/596: Theory of Computation,” Buffalo, 8/89–12/89, 8/91–12/91.

- (9) “CS396: Theory of Computation,” Buffalo, 1/10–5/10, 8/07–12/07, 8/03–12/03, 1/02–5/02, 8/01–12/01, 8/99–12/99, 8/97–12/97, 1/96–5/96, 8/94–12/94, 1/93–5/93.
- (10) “CS596: Theory of Computation,” 8/92–12/92, 1/94–5/94, 8/98–12/98, 1/01–5/01, 1/03–5/03, 8/04–12/04, 8/06–12/06, 8/08–12/08.
- (11) “CSE696: Complexity Theory,” 1/99–5/99.
- (12) “CS381: Theory of Computation,” Cornell University, 5/87–7/87 and 5/89–7/89.
- (13) “Communication Theory,” Oxford University, 1/86–3/86 (half of the lectures).
- (14) Yearly listed seminars with varying 7xx numbers on current topics in theoretical computer science.
- (15) Leader in graduate seminars related to Complexity Theory at Oxford (10/81–6/86), Cornell (9/86–12/87, 9/88–6/89), Buffalo (9/89–present).

## Professional Service

- (1) *Member of Editorial Board*, the *Journal of Universal Computer Science*, published by the Technical University of Graz, Austria.
- (2) *Public Website* <http://www.cse.buffalo.edu/~regan/chess/fidelity/> on scientific testing of allegations of cheating with computer chess programs at top-level human chess events. The site explains a basic statistical principle that (in my professional opinion) exonerates World Champion Vladimir Kramnik from allegations by Veselin Topalov that he cheated with the program Fritz 9 during their championship match 9/23/06–10/13/06 in Elista, Russia. Cases in some popular lower-level events, however, show evident statistical positives. Generally this site aims to enhance the public understanding of statistics and science.
- (3) *Program Committee*, International Conference on Theory and Applications of Models of Computation (TAMC’09), ChangSha, China, May 18–22, 2009. Service 2/1/09–3/10/09.
- (4) *Program Committee*, Mexican International Conference on Computer Science, Mexicali, Mexico, October 6–10, 2008. Service 6/1/08–7/15/08 (minor, large PC, only two papers).
- (5) *Program Committee*, International Workshop on Parameterized and Exact Computation (IWPEC’08), Victoria (BC), Canada, May 14–16, 2008. Service 1/8/08–2/15/08.
- (6) *Local Arrangements Chair* and *Finance Chair* of the 13th Annual IEEE Conference on Computational Complexity, being held on the UB North Campus, June 15–18, 1998. Duties included: organizing everything, preparing and revising budgets, building the conference Web Site and doing the CGI programming for on-line registration—we were the first ever at UB to take credit cards securely over the Internet.

- (7) *Program Committee* of the 10th Annual IEEE Conference on Structure in Complexity Theory, Minneapolis, June 1995. (E. Allender, chair; the others were K. Ambos-Spies, L. Fortnow, R. Impagliazzo, K. Ko, J. Kbler, and R. Lipton.)
- (8) *Referee* of many papers for many top journals, worth mentioning some less-usual ones for me: Journal of Parallel and Distributed Computation (1), Parallel Processing Letters (1), *The Monist* (philosophy/CS journal) (1), other formal logic (2).
- (9) *Referee* for the IEEE Conference on Computational Complexity (formerly “Structure in Complexity Theory”), and the STOC and STACS conferences, multiple times each. Referee for NSF panels and proposals (many), other countries’ proposals (2), and textbook manuscripts (3).
- (10) *External Ph.D. examiner*, University of Montreal, 8/91.
- (11) *Session chair*, Structure in Complexity Theory’95 and ICCI’94.
- (12) *Referee* for tenure cases, several, most recently in Nov. 2003.

## University Service

Department:

- 1. *Director of Graduate Studies*, August 2002–August 2006. Oversaw and helped design an on-line system called “GradVote” for on-line faculty participation in graduate recruiting. Developed policies and procedures for Master’s students doing independent projects lasting into a 4th semester, including those extending a summer co-op into the fall semester. Oversaw revisions in departmental policy and procedures for M.S. students applying to the Ph.D. program. Introduced uniform scoring system for graduate admissions. Began arranging for porting admissions-review software developed by Dr. Michalis Petropoulos for UCSD to UB. (The CSE Department split the job into separate Graduate Studies and Graduate Admissions directorates beginning in September 2006.)
- 2. *Undergraduate Curriculum Committee*, CSE, Buffalo, 1999–2000.
- 3. *Undergraduate Affairs Committee*, Computer Science, Buffalo, 1991-93, 1997–1998, 2000–2002.
- 4. *Recruiting Committee*, Computer Science, Buffalo, 1990-91; Computer Science and Engineering, 8/98–present.
- 5. *Lecturer Recruiting Committee*, CSE, Buffalo, Jan 2002—present.
- 6. *Graduate Studies/Affairs Committee*, Computer Science, Buffalo, 1989-90, 1993–1996, 2006–2008. (Chaired subcommittee to draft proposal for new MS program, 1993-94.)
- 7. *Graduate Admissions Committee*, CSE, Buffalo, 2007–2008. (This was split off from Graduate Studies/Affairs in 9/2006.)

8. CS596 Qualifying Examination Committee, chaired 1989-1996.
9. Departmental Brochures/Publications Committee, 1990-1997.
10. Library Committee, Buffalo, Aug. 2001—present

UB:

1. *Faculty Senate Representative* for Computer Science [and Engineering], 9/97–9/00.
2. *Alternate*, Faculty Senate Representative for Computer Science (9/94–8/97)
3. *Alternate*, SEAS Personnel Committee, from 5/01.

Other:

1. Computer Equipment Committees, Merton College, Oxford, and the Oxford Mathematical Institute, 1984-1986.

### **Other Activities**

1. *Consulting*, Stadheim and Gear Law Associates, Chicago, IL, relating to patents. Reported 29.5 hours since 3/11/10 on AY 2009-10 report, 5 more hours on AY 2010-11, and working currently.