

## Jin-Yi Cai

Curriculum Vitae

Computer Sciences Department  
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### Positions Held

- 2000—            Computer Sciences Department, University of Wisconsin at Madison.  
                  Professor
- 2003—            Mathematics Department, University of Wisconsin at Madison.  
                  Professor (courtesy appointment)
- 2007—2008       Radcliffe Institute, Harvard University.  
                  Radcliffe Fellow
- 2010—2013       Peking University.  
                  Changjiang Chair Professor (visiting appointment)
- 2003—2006       Tsinghua University.  
                  Visiting Chair Professor (visiting appointment)
- 1999             Department of Computer Science, University of Toronto.  
                  Guggenheim Fellow & Visiting Professor
- 1996—2000       Department of Computer Science, State University of New York at Buffalo.  
                  Professor
- 1995—2001       Department of Computer Science, Fudan University, Shanghai, China.  
                  Guest Professor
- 1993—1996       Department of Computer Science, State University of New York at Buffalo.  
                  Associate Professor
- 1989—1993       Department of Computer Science, Princeton University.  
                  Assistant Professor
- 1986—1989       Department of Computer Science, Yale University.  
                  Assistant Professor
- Summer 1986     Department of Computer Science, Cornell University.  
                  Lecturer

### Research Interests

My research area is in computational complexity theory, and in its applications to all aspects of computer science. I am particularly interested in the global structures and relationships among complexity classes of LOGSPACE, P, NP, the polynomial-time hierarchy PH, and PSPACE, and connections of average case and worst case complexity. Currently my work has focused on holographic algorithms and complexity dichotomy theorems for counting problems.

## Education

<b>Ph.D.</b>	Computer Science, Cornell University, 1986.
<b>Ph.D. Dissertation</b>	<i>On Some Most Probable Separations of Complexity Classes.</i>
<b>M.S.</b>	Computer Science, Cornell University, 1985.
<b>M.A.</b>	Mathematics, Temple University, 1983.
<b>Certificate</b>	Mathematics, Fudan University, 1981.

## Professional Association

The American Association for the Advancement of Science.

The Association for Computing Machinery, Special Interest Group in Algorithms and Computing Theory.

## Awards and Honors

- Vilas Associate Award, UW Madison. 2008.
- Fellow of The American Association for the Advancement of Science. 2007.
- Radcliffe Fellowship, Harvard University. 2007.
- Morningside Silver Medal in Mathematics. 2004.
- ACM Fellow. 2001.
- Carolyn Rosner Excellent Educator Award, CS Dept. UW Madison. 2001 and 2005.
- Humboldt Research Award for Senior U. S. Scientists. 1999.
- John Simon Guggenheim Fellowship. 1998.
- Hao Wang Prize, 1997.
- Alfred P. Sloan Fellowship. 1994.
- Presidential Young Investigator Award, 1990.

## Grants

- National Science Foundation research grant "Counting Problems and Dichotomy Theorems" \$397,326. Sept 1, 2009—Aug 31, 2012.

- National Science Foundation, SCREMS: Scientific Computing Research Environments for the Mathematical Sciences. \$99,330. With Amir Assadi et al. August 15, 2009 — August 14, 2011. Co-PI.
- National Science Foundation research grant “Holographic Algorithms and Reductions” NSF CCF-0830488. Amount \$99,999. August 1, 2008 — July 31, 2011.
- National Science Foundation research grant “Some Problems in Complexity Theory”, NSF CCR-0511679. Amount \$200,000. July 1, 2005– June 30, 2008.
- National Science Foundation research grant “Some Problems in Structural and Lattice Complexity”, NSF CCR-0208013. Amount \$294,103. September 1, 2002– August 31, 2005.
- National Science Foundation research grant “Worst-case versus Average-Case Complexity and Applications to Secure Cryptography”, CCR9820806. Amount \$220,004. August 1, 2000 – July 31, 2003.
- National Science Foundation research grant “Realistic Uncheatable Benchmarks”, CCR-9634665. Amount \$242,237. Sept. 1996 – August 1999. co-PI: Min-You Wu.
- National Science Foundation SBE-INT Japan Program “US-Japan Cooperative Research: Complexity Theory for Strategic Goals”, Amount \$30,950. April 1, 1998 – March 31, 2001. co-PIs: Ken Regan, Alan Selman, Mitsunori Ogihara.
- Alfred P. Sloan Foundation Fellowship. \$30,000. 1994–1996.
- Presidential Young Investigator Award “A study of computational complexity theory”, CCR-9057486, Sept. 1990 – July. 1995. This award provides a five year grant of up to \$500,000 with matching funds.
- National Science Foundation research grant “Uncheatable Benchmarks”, CCR-9319393. Amount \$134,242. Sept. 1993 – Sept. 1996.
- National Science Foundation REU Grant for supervising research by undergraduate students. Amount \$6,500. 1991–1992.
- National Science Foundation research grant “Complexity Bounds in Parallel Computation”, CCR-8709818, Amount \$78,000. 1987–1989. co-PI: Michael J. Fischer and Merrick L. Furst.
- Matching Grant from General Motors Corporation. Amount \$15,000. February 1991.
- Matching Grant from MITL. Amount \$22,500. March 1991.
- Matching Grant from Sun Corporation. Amount \$7990. June 1994.

## Some Biographical Listings

- Listed in *Who's Who in America*, (2003) 57th edition.
- Listed in *Who's Who in Science and Engineering*, Premier Edition.
- Listed in *Who's Who in Science and Engineering*, (1996-1997) 3rd edition.
- Listed in *American Men and Women of Science*, 19th Edition.
- Listed in *Who's Who in the Media and Communications*, First Edition. (1998-1999)
- Listed in *Who's Who Among Asian Americans*, First Edition.
- Listed in *International Who's Who of Information Technology*, 1999 Edition.

## Publications

### BOOK EDITED

- *Advances in Computational Complexity Theory*.  
Jin-Yi Cai, Editor. DIMACS Series Discrete Mathematics and Theoretical Computer Science, Volume 13. Published by the American Mathematical Society, 1993.

### ARTICLES

1. Jin-Yi Cai, Michael Kowalczyk: Spin Systems on Graphs with Complex Edge Functions and Specified Degree Regularities. *Annual International Computing and Combinatorics Conference (COCOON)* 2011: 146-157.
2. Jin-Yi Cai, Michael Kowalczyk, Tyson Williams: Gadgets and Anti-gadgets Leading to a Complexity Dichotomy CoRR abs/1108.3383: (2011).
3. Jin-Yi Cai: Progress in Complexity of Counting Problems. FAW-AAIM 2011: 1-3
4. Jin-Yi Cai, Xi Chen, Pinyan Lu: Non-negatively Weighted #CSP: An Effective Complexity Dichotomy. *IEEE Conference on Computational Complexity* 2011: 45-54
5. Jin-Yi Cai, Pinyan Lu, Mingji Xia: Dichotomy for Holant\* Problems of Boolean Domain. *ACM-SIAM Symposium on Discrete Algorithms (SODA)* 2011: 1714-1728.
6. Jin-Yi Cai, Pinyan Lu, Mingji Xia: Holographic Algorithms with Matchgates Capture Precisely Tractable Planar #CSP. *Annual Symposium on Foundations of Computer Science (FOCS)* 2010: 427-436.

7. Jin-Yi Cai, Xi Chen: A Decidable Dichotomy Theorem on Directed Graph Homomorphisms with Non-negative Weights. *Annual Symposium on Foundations of Computer Science (FOCS)* 2010: 437-446.
8. Jin-Yi Cai and Michael Kowalczyk, A Dichotomy for  $k$ -Regular Graphs with  $\{0, 1\}$ -Vertex Assignments and Real Edge Functions. *Theory and Applications of Models of Computation (TAMC)* 2010: 328-339.
9. Jin-yi Cai, Sangxia Huang, Pinyan Lu: From Holant to  $\#$ CSP and Back: Dichotomy for Holantc Problems. *Annual International Symposium on Algorithms and Computation (ISAAC)* 2010: 253-265.
10. Michael Kowalczyk, Jin-Yi Cai: Holant Problems for Regular Graphs with Complex Edge Functions CoRR abs/1001.0464: (2010) *International Symposium on Theoretical Aspects of Computer Science (STACS)* 2010: 525-536
11. Jin-Yi Cai, Xi Chen and Pinyan Lu. Graph Homomorphisms with Complex Values: A Dichotomy Theorem. Preliminary version in *International Colloquium on Automata, Languages and Programming (ICALP)* (1) 2010: 275-286.  
Full version (121 pages) in journal submission. Available at  
<http://pages.cs.wisc.edu/~jyc/papers/Graph-Homo-Dichotomy.pdf>
12. Jin-yi Cai, Xi Chen, Richard J. Lipton, Pinyan Lu: On Tractable Exponential Sums. CoRR abs/1005.2632: (2010). In Proceedings of FAW 2010: 148-159. Best paper award.
13. Jin-Yi Cai, Pinyan Lu, Mingji Xia: Computational Complexity of Holant Problems. *SIAM J. Comput.* 40(4): 1101-1132 (2011)
14. Jin-Yi Cai, Pinyan Lu and Mingji Xia. The Complexity of Complex Weighted Boolean  $\#$  CSP. In journal submission.
15. Jin-Yi Cai, Pinyan Lu, Mingji Xia: Holant problems and counting CSP. *ACM Symposium on the Theory of Computing (STOC)* 2009: 715-724.
16. Jin-Yi Cai, Pinyan Lu, Mingji Xia. Holographic Reduction, Interpolation and Hardness. In journal submission.
17. Jin-Yi Cai, Pinyan Lu, Mingji Xia: Holographic algorithms by Fibonacci gates. *Linear Algebra and its Applications* doi:10.1016/j.laa.2011.02.032
18. Jin-Yi Cai, Pinyan Lu, Mingji Xia: Holographic Algorithms by Fibonacci Gates and Holographic Reductions for Hardness. *IEEE Symposium on Foundations of Computer Science (FOCS)* 2008: 644-653.

19. Jin-Yi Cai, Pinyan Lu, Mingji Xia: A Computational Proof of Complexity of Some Restricted Counting Problems. *Theory and Applications of Models of Computation (TAMC) 2009*: 138-149. *Theor. Comput. Sci.* 412(23): 2468-2485 (2011).
20. Peng Zhang, Jin-Yi Cai, Linqing Tang, Wenbo Zhao: Approximation and Hardness Results for Label Cut and Related Problems. *Theory and Applications of Models of Computation (TAMC) 2009*: 460-469. *Journal of Combinatorial Optimization* 21(2): 192-208 (2011).
21. Jin-Yi Cai, Xi Chen and Dong Li. A quadratic lower bound for the permanent and determinant problem over any characteristic  $\neq 2$ . *The 40th Annual ACM Symposium on the Theory of Computing (STOC) 2008*. 491-498. Quadratic Lower Bound for Permanent Vs. Determinant in any Characteristic. *Computational Complexity* 19(1): 37-56 (2010).
22. Jin-Yi Cai, Pinyan Lu, Mingji Xia: A Family of Counter Examples to an Approach to Graph Isomorphism. CoRR abs/0801.1766: (2008)
23. Jin-Yi Cai and Pinyan Lu. Signature Theory in Holographic Algorithms. The 19th International Symposium on Algorithms and Computation (ISAAC 2008), 568-579. Submitted for journal special issue of *Algorithmica*, selected as top papers from ISAAC 2008.
24. Jin-Yi Cai and Pinyan Lu. Holographic Algorithms With Unsymmetric Signatures. In proceedings of ACM-SIAM Symposium on Discrete Algorithms (SODA), 2008. 54-63.
25. Jin-Yi Cai. Matchgate Computations and Holographic Algorithms. In the Proceedings of ICCM 2007.
26. Jin-Yi Cai. Holographic Algorithms. In *Current Developments in Mathematics (2007)*, pp. 111-150. Edited by S. T. Yau. International Press.
27. Jin-Yi Cai and Pinyan Lu. On Block-wise Symmetric Signatures for Matchgates. *Fundamentals of Computation Theory, 16th International Symposium (FCT)*, Budapest, Hungary, 2007. *Lecture Notes in Computer Science* 4639, pp 187-198. Springer 2007. Special issue of *Theoretical Computer Science*, selected among best papers from FCT. 411(4-5): 739-750 (2010).
28. Jin-Yi Cai and Pinyan Lu. Holographic Algorithms: The Power of Dimensionality Resolved. The 34th International Colloquium on Automata, Languages and Programming (ICALP), Wroclaw, Poland, 2007. *Lecture Notes in Computer Science* 4596, pp. 631-642. Winner of the Best Paper Award. *Theor. Comput. Sci.* 410(18): 1618-1628 (2009).
29. Jin-Yi Cai, Pinyan Lu. Basis Collapse in Holographic Algorithms. *IEEE Conference on Computational Complexity (CCC) 2007*, pp 292–304. *Computational Complexity* 17(2): 254-281 (2008).

30. Jin-Yi Cai and Pinyan Lu. Holographic Algorithms: From Art to Science. *The 39th Annual ACM Symposium on the Theory of Computing (STOC) 2007*, 401–410. *J. Comput. Syst. Sci.* 77(1): 41-61 (2011).
31. Jin-Yi Cai and Pinyan Lu. On Symmetric Signatures in Holographic Algorithms. *The 24th Annual Symposium on Theoretical Aspects of Computer Science (STACS), 2007*, 429–440. Available at Electronic Colloquium on Computational Complexity (ECCC) TR06-135. *Theor. Comput. Sci.* 411(4-5): 739-750 (2010).
32. Byron J. Gao, Martin Ester, Jin-Yi Cai, Oliver Schulte and Hui Xiong: The minimum consistent subset cover problem and its applications in data mining. *Proceedings of the 13th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD) 2007*: 310-319.
33. Vinod Yegneswaran, Chris Alfeld, Paul Barford and Jin-Yi Cai. Camouflaging Honeynets. In *Proceedings of IEEE Global Internet Symposium 2007*, Anchorage, AK, May, 2007.
34. Jin-Yi Cai and Osamu Watanabe. Stringent Relativization—A New Approach for Studying Complexity Classes. *SIGACT News Complexity Theory*, volume 37 number 4, December 2006, pp 47–55.
35. Jin-Yi Cai, Vinay Choudhary and Pinyan Lu. On the Theory of Matchgate Computations. *IEEE Conference on Computational Complexity (CCC) 2007*, 305–318. Available at Electronic Colloquium on Computational Complexity (ECCC)(018): (2006). *Theory of Computing Systems* 45(1): 108-132 (2009).
36. Jin-Yi Cai, Vinay Choudhary. Some Results on Matchgates and Holographic Algorithms. In *Proceedings of ICALP 2006, Part I. Lecture Notes in Computer Science* vol. 4051. pp 703-714. Springer. *International Journal of Software and Informatics*. p. 3-36. Volume 1, No.1, Dec. 2007.
37. Jin-Yi Cai, Vinay Choudhary. Valiant’s Holant Theorem and Matchgate Tensors. In *Proceedings of TAMC 2006. Lecture Notes in Computer Science* vol. 3959. pp 248-261. *Theoretical Computer Science* 384(1): 22-32 (2007).
38. Jin-Yi Cai, Vinod Yegneswaran, Chris Alfeld and Paul Barford. An Attacker-Defender Game for Honeynets. *COCOON 2009*: 7-16.
39. Eric Bach and Jin-Yi Cai. A Novel Information Transmission Problem and its Optimal Solution. *Fundamentals of Computation Theory, 16th International Symposium (FCT), Budapest, Hungary, 2007. Lecture Notes in Computer Science* 4639, pp 64-75. Springer 2007.
40. Jin-Yi Cai and Hong Zhu. Progress in Computational Complexity Theory. *Journal of Computer Science and Technology*. Vol. 20, No. 6, Nov 2005, 735–750.

41. Jin-Yi Cai and Venkatesan T. Chakaravarthy. A Note on Zero Error Algorithms Having Oracle Access to One NP Query. In Proceedings of COCOON 2005. Lecture Notes in Computer Science vol. 3595. pp 339-348.
42. Pinyan Lu, Jialin Zhang, Chung Keung Poon and Jin-Yi Cai. Simulating Undirected st-Connectivity Algorithms on Uniform JAGs and NNJAGs. In Proceedings of ISAAC 2005. Lecture Notes in Computer Science vol. 3827. pp 767-776.
43. Jin-Yi Cai and Robert Threlfall. A Note on Quadratic Residuosity and UP. *Information Processing Letters* 92(3): 127-131 (2004).
44. Zheng Huang, Lei Chen III, Jin-Yi Cai, Deborah S. Gross, David R. Musicant, Raghu Ramakrishnan, James J. Schauer and Stephen J. Wright. Mass Spectrum Labeling: Theory and Practice. ICDM 2004: 122-129.
45. Jin-Yi Cai and Osamu Watanabe. Random Access to Advice Strings and Collapsing Results. *The 15th International Symposium on Algorithms and Computation, (ISAAC) 2004*. Lecture Notes in Computer Science 3341, pp 209-220.
46. Jin-Yi Cai and Osamu Watanabe. On Proving Circuit Lower Bounds Against the Polynomial-Time Hierarchy. *SIAM J. Comput.* 33(4): 984-1009 (2004) A preliminary version: On Proving Circuit Lower Bounds Against the Polynomial-Time Hierarchy: Positive and Negative Results. Appeared in the *Proc. of COCOON 2003*, Springer-Verlag Lecture Notes in Computer Science, 2697. pp. 202-211.
47. Jin-Yi Cai and Osamu Watanabe. Relativized collapsing between BPP and PH under stringent oracle access. *Information Processing Letters* 90(3): 147-154 (2004)
48. Jin-Yi Cai, Venkat Chakaravarthy and Dieter van Melkebeek. Time-Space Tradeoff In Derandomizing Probabilistic Logspace. In *The 21st Annual Symposium on Theoretical Aspects of Computer Science (STACS)*. Springer-Verlag Lecture Notes in Computer Science, Vol. 2996 (2004) 571–583. *Theory of Computing Systems* 39(1): 189-208 (2006).
49. Jin-Yi Cai and Osamu Watanabe. Stringent Relativization. Plenary invited talk. FSTTCS 2003: Foundations of Software Technology and Theoretical Computer Science, 23rd Conference, Mumbai, India, December 15-17, 2003. Proceedings, Lecture Notes in Computer Science 2914, pp. 408-419.
50. M. Adler, Jin-Yi Cai, J. K. Shapiro and D. Towsley. Estimation of Congestion Price Using Probabilistic Packet Marking. In Proceedings of INFOCOM 2003, vol 3, Apr. 2003, pp 2068-2078. Full version in

UMass Technical Report UM-CS-2002-023.  
ftp://ftp.cs.umass.edu/pub/techrept/techreport/2002/

51. Jin-Yi Cai. On the Impossibility of Certain Ranking Functions. *International Mathematical Journal*, **3**, No. 2, 119–128, (2003).
52. Jin-Yi Cai, Venkat Chakaravarthy, Lane Hemaspaandra, Mitsunori Ogihara. Competing Provers Yield Improved Karp-Lipton Collapse Results. In the *Proc. of STACS 2003*, Springer-Verlag Lecture Notes in Computer Science. 535-546. *Information and Computation*, 198(1): 1-23 (2005)
53. Jin-Yi Cai and Hong Zhu. Progress in Computational Complexity Theory. *J. Comput. Sci. Technol.* 20(6): 735-750 (2005).
54. Yuan Wang, David DeWitt and Jin-Yi Cai. X-Diff: An Effective Change Detection Algorithm for XML Documents. 19th International Conference on Data Engineering (ICDE 2003), March 5 - March 8, 2003 - Bangalore, India.
55. Jin-Yi Cai and Osamu Watanabe. Relativized Collapsing Results under Stringent Oracle Access. In Proc. 1st Forum on Information Technology (FIT2002), Sept. 25 - 28, 2002.
56. Jin-Yi Cai, Denis Charles, A. Pavan, Samik Sengupta. On Higher Arthur-Merlin Classes. *Int. J. Found. Comput. Sci.* 15(1): 3-19 (2004). A preliminary version appeared in the *Proc. of COCOON 2002*, Springer-Verlag Lecture Notes in Computer Science. pp. 18-27.
57. Jin-Yi Cai. On the Minimum Volume of a Perturbed Unit Cube. In the *Proc. of ISAAC 2002*, Springer-Verlag Lecture Notes in Computer Science Volume 2518. pp. 67-78.
58. Jin-Yi Cai.  $S_2^p \subseteq ZPP^{NP}$ . In *Proc. 42nd IEEE Symposium on Foundations of Computer Science (FOCS)*, 2001, 620–628. *J. Comput. Syst. Sci.* 73(1): 25-35 (2007).
59. Jin-Yi Cai. On the Average-Case Hardness of CVP. In *Proc. 42nd IEEE Symposium on Foundations of Computer Science (FOCS)*, 2001, 308–317.
60. Jin-Yi Cai and Eric Bach. On Testing for Zero Polynomials by a Set of Points with Bounded Precision. In the Proceedings of COCOON 2001, Springer-Verlag Lecture Notes in Computer Science, Jie Wang (Ed.) Vol **2108** (2001) 473–482. *Theoretical Computer Science*, 296 (1): 15-25, 2003.

61. Jin-Yi Cai, Venkatesan T. Chakaravarthy, Raghav Kaushik and Jeffrey F. Naughton. On the Complexity of Join Predicates. In the Proceedings of the Symposium on Principles of Database Systems (PODS) 2001, 207–214.
62. Jin-Yi Cai. Essentially Every Unimodular Matrix Defines an Expander. *The 11th International Symposium on Algorithm and Computation (ISAAC) 2000*, Taipei, Taiwan. Plenary Talk. Springer-Verlag Lecture Notes in Computer Science, D. T. Lee and Shang-Hua Teng (Eds.) Vol **1969** (2000) 2–22. *Theory of Computing Systems* Vol. **36**, 105–135 (2003).
63. Jin-Yi Cai. The Complexity of Some Lattice Problems. *The 4th Algorithmic Number Theory Symposium (ANTS IV)* , Leiden, the Netherlands. Plenary Talk. Springer-Verlag Lecture Notes in Computer Science, Wieb Bosma (Ed.) Vol. **1838** (2000) 1–32.
64. Jin-Yi Cai, Richard J. Lipton, Yechezkel Zalcstein. The Complexity of the A B C Problem. *SIAM J. Comput.* 29(6): 1878-1888 (2000).
65. V. Kabanets and J. Cai. Circuit Minimization Problem. In the Proceedings of *The 32nd Annual ACM Symposium on the Theory of Computing (STOC)*, 2000, pp 73-79.
66. Jin-Yi Cai and Ajay Nerurkar. A note on the non-NP-hardness of approximate lattice problems under general Cook reductions. *Information Processing Letters*, 76(1-2): 61-66 (2000).
67. Jin-Yi Cai. A new transference theorem in the geometry of numbers and applications to Ajtai’s connection factor. *Discrete Applied Mathematics* 126(1): 9-31 (2003).
68. Jin-Yi Cai. A New Transference Theorem in the Geometry of Numbers. *Fifth Annual International Computing and Combinatorics Conference (COCOON)*. Springer-Verlag Lecture Notes in Computer Science, T. Asano et. al.(Ed.) Vol. **1627** (1999) 113–122.
69. J.-Y. Cai, G. Havas, B. Mans, A. Nerurkar, J.-P. Seifert and I. Shparlinski. On Routing in Circulant Graphs. *Fifth Annual International Computing and Combinatorics Conference (COCOON)*. Springer-Verlag Lecture Notes in Computer Science, T. Asano et. al.(Ed.) Vol. **1627** (1999) 360–369.
70. Jin-Yi Cai, Ajay Nerurkar and D. Sivakumar. Hardness and Hierarchy Theorems for Probabilistic Quasi-polynomial Time. In the Proceedings of *The 31st Annual ACM Symposium on the Theory of Computing (STOC)*, 726–735, 1999.

71. Jin-Yi Cai. Applications of a New Transference Theorem to Ajtai's Connection Factor.  
In the Proceedings of *The 14th Annual IEEE Conference on Computational Complexity*, 205–214, 1999.
72. Jin-Yi Cai. Some Recent Progress on the Complexity of Lattice Problems.  
Plenary Talk. In the Proceedings of *The 14th Annual IEEE Conference on Computational Complexity*, 158–177, 1999.
73. J-Y. Cai, A. Pavan and D. Sivakumar. On the Hardness of Permanent.  
In the Proceedings of *The 16th Annual Symposium on Theoretical Aspects of Computer Science* (STACS). Springer-Verlag Lecture Notes in Computer Science, Ch. Meinel and S. Tison (Ed.), Vol. **1563** (1999) 90–99.
74. Jin-Yi Cai and Ajay Nerurkar. Algorithm Theory.  
In *Encyclopedia of Electrical and Electronics Engineering*. Published by John Wiley and Sons (John G. Webster, Editor), 1999. pp 415–426.
75. Jin-Yi Cai. A Classification of Probabilistic Polynomial Time Hierarchy under Fault Tolerant Access to Oracle Classes.  
*Information Processing Letters*, Vol. **69** (1999) 167–174.
76. J-Y. Cai and A. Nerurkar. Approximating the SVP to Within a Factor  $\left(1 + \frac{1}{\dim^\epsilon}\right)$  is NP-hard under Randomized Reductions.  
In *Proc. of the 13th Annual IEEE Conference on Computational Complexity*, 1998, 46–55. Available from ECCC, *Electronic Colloquium on Computational Complexity* TR97-059, at <http://www.eccc.uni-trier.de/eccc/>. Special issue of *The Journal of Computer and System Sciences*, 59(2): 221-239 (1999).
77. Jin-Yi Cai and Tom Cusick. A Lattice-Based Public-Key Cryptosystem.  
*Information and Computation*, Vol. **151**, (1999) 17–31.
78. Jin-Yi Cai, Ajay Nerurkar and Min-You Wu. The Design of Uncheatable Benchmarks using Complexity Theory.  
In the Proceedings of *IEEE International Computer Performance and Dependability Symposium* (IPDS) 1998, 216–225.
79. Yumei Song, Min-You Wu and Jin-Yi Cai. Real-time Implementation of Uncheatable Benchmark Using Web Server.  
In the Proceedings of *Parallel and Distributed Computing and Systems* (PDCS) 1998, 687–690.
80. Jin-Yi Cai and Lane Hemaspaandra and Gerd Wechsung. Robust Reductions.  
*Theory of Computing Systems* (formally *Mathematical Systems Theory*), **32**, 625–647, (1999). A preliminary version appeared in the *Fourth Annual International Computing and Combinatorics Conference* (COCOON). Springer-Verlag Lecture Notes in

- Computer Science, Wen-Lian Hsu and Ming-Yang Kao (Ed.) Vol. **1449** (1998) 174–183.
81. J-Y. Cai and A. Nerurkar. An Improved Worst-Case to Average-Case Connection for Lattice Problems.  
In *Proc. 38th IEEE Symposium on Foundations of Computer Science (FOCS)*, 1997, 468–477.
  82. Jin-Yi Cai, D. Sivakumar and Martin Strauss. Constant Depth Circuits and the Lutz Hypothesis.  
In *Proc. 38th IEEE Symposium on Foundations of Computer Science (FOCS)*, 1997, 595–604.
  83. Jin-Yi Cai. A Relation of Primal-Dual Lattices and the Complexity of Shortest Lattice Vector Problem.  
*Theoretical Computer Science* (207), 1998, pp 105–116.
  84. Jin-Yi Cai and D. Sivakumar. Resolution of Hartmanis’s Conjecture for NL-hard sparse sets.  
*Third Annual International Computing and Combinatorics Conference (COCOON)*, Springer-Verlag Lecture Notes in Computer Science, Tao Jiang and D. T. Lee (Ed.) Vol. **1276** (1997) 62–71. Winner of the Hao Wang Prize. *Theoretical Computer Science* (240), 2000, pp 257–269.
  85. Pu Cai and Jin-Yi Cai. On the 100% Rule of Sensitivity Analysis in Linear Programming.  
In the Proceedings of the *Third Annual International Computing and Combinatorics Conference (COCOON)*. Springer-Verlag Lecture Notes in Computer Science, Tao Jiang and D. T. Lee (Ed.) Vol. **1276** (1997) 460–469.
  86. Jin-Yi Cai and D. Sivakumar. Sparse Hard sets for P: Resolution of a Conjecture of Hartmanis.  
*The Journal of Computer and System Sciences*, (special issue), Vol. **58**, 280–296 (1999). A preliminary version appeared as  
The Resolution of a Hartmanis Conjecture.  
*The 36th Annual Symposium on Foundations of Computer Science (FOCS)*, 362–371. Milwaukee, WI, 1995.
  87. Jin-Yi Cai and Mitsunori Ogihara. Sparse Sets versus Complexity Classes.  
*Complexity Theory Retrospective II*, edited by Lane A. Hemaspaandra and Alan L. Selman, 1997. Published by Springer.
  88. Jin-Yi Cai, Pu Cai and Yixin Zhu. On a Scheduling Problem of Time Deteriorating Jobs.  
*Journal of Complexity*, Vol. **14** No. 2 (1998) 190-209.

89. L. Babai, R. Beals, J-Y. Cai, G. Ivanyos and E. Luks. Multiplicative Equations over Commuting Matrices.  
In the proceedings of *The Seventh Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA), January 1996. pp. 498–507.
90. Jin-Yi Cai and Alan L. Selman. Fine Separation of Average Time Complexity Classes.  
In the proceedings of *The 13th Annual Symposium on Theoretical Aspects of Computer Science* (STACS), 1996, 331–343. *SIAM Journal on Computing*, 1310–1325, (1999).
91. Jin-Yi Cai and Ashish V. Naik and D. Sivakumar. On the Existence of Hard Sparse Sets under Weak Reductions.  
In the proceedings of *The 13th Annual Symposium on Theoretical Aspects of Computer Science* (STACS), 1996, 307–318.
92. Jin-Yi Cai. Frobenius’s degree formula and Toda’s polynomials.  
*Theory of Computing Systems* (formally *Mathematical Systems Theory*), **31**, 67–75, (1998).
93. K. W. Regan, D. Sivakumar and Jin-Yi Cai. Pseudorandom Generators, Measure Theory, and Natural Proofs.  
In the proceedings of *The 36th Annual Symposium on Foundations of Computer Science* (FOCS), Milwaukee, WI, 1995, 26–35.
94. Jin-Yi Cai, W. H. J. Fuchs, Dexter Kozen and Zicheng Liu. Efficient Average-Case Algorithms for the Modular Group.  
In the Proceedings of *The 35th Annual Symposium on Foundations of Computer Science* (FOCS), (1994) 143–152.
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*The 35th Annual Symposium on Foundations of Computer Science* (FOCS), (1994) 135–142.
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98. Jin-Yi Cai, Pu Cai and Yixin Zhu. A Fully Polynomial Time Approximation Scheme in Scheduling Deteriorating Jobs.

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99. Jin-Yi Cai and Suresh Chari. On the Impossibility of Amplifying the Independence of Random Variables.  
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  100. Sigal Ar and Jin-Yi Cai. Reliable Benchmarks Using Numerical Instability.  
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In the Proceedings of *The 12th Annual Symposium on Theoretical Aspects of Computer Science* (STACS), Springer-Verlag Lecture Notes in Computer Science, Ernst W. Mayr and Claude Puech (Ed.), Vol. **900** (1995) 38–49.
  103. Jin-Yi Cai, Richard J. Lipton, Robert Sedgewick and Andrew Chi-Chih Yao. Towards Uncheatable Benchmarks.  
In the Proceedings of *The Structure in Complexity Theory Conference*, (1993) 2–11.
  104. Pu Cai, Jin-Yi Cai and A. Naik. Efficient Algorithms for a Scheduling Problem and Its Applications to Illicit Drug Market Crackdowns.  
*Journal of Combinatorial Optimizations*, **1**, 367-376 (1998). A preliminary version appeared in *International Symposium on Operations Research with Applications in Engineering, Technology, and Management*, pp. 123-132, World Scientific Publishing Co. August 1995, in Beijing, China.
  105. Jin-Yi Cai. Parallel Computation Over Hyperbolic Groups.  
In the Proceedings of *The 24th Annual ACM Symposium on the Theory of Computing* (STOC), (1992) 106–115.
  106. Jin-Yi Cai, Frederic Green and Thomas Thierauf. On the Correlation of Symmetric Functions.  
*Mathematical Systems Theory*, **29**, 245–258 (1996). Published by Springer-Verlag.
  107. Jin-Yi Cai, Anne Condon and Richard Lipton. PSPACE is Provable by Two Provers in One Round.

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108. Jin-Yi Cai, Anne Condon and Richard Lipton. On Bounded Round Multi-Prover Interactive Proof Systems.  
In the Proceedings of *The Structure in Complexity Theory Conference*, (1990) 45–54.
109. Jin-Yi Cai, Anne Condon and Richard Lipton. PSPACE is Provable by Two Provers in One Round.  
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110. Jin-Yi Cai, Anne Condon and Richard Lipton. On Games of Incomplete Information. *Theoretical Computer Science Part A*, Vol. **103** (1992) 25–38. Published by Elsevier Science Publishers, B.V. A preliminary version appeared in *The 7th Annual Symposium on Theoretical Aspects of Computer Science*, Springer-Verlag Lecture Notes in Computer Science, C. Choffrut and T. Lengauer (Ed.), Vol. **415** (1990) 58–69.
111. Jin-Yi Cai and Lane Hemachandra. A Note on Enumerative Counting. *Information Processing Letters* Vol. **38** (1991) 215–219. Published by North-Holland.
112. Jin-Yi Cai and Richard Lipton. Subquadratic Simulations of Balanced Formulae by Branching Programs.  
*SIAM Journal on Computing*, June 1994, Vol. **23**, no. 4. 563–572. Published by SIAM. A preliminary version appeared in *The 30th Annual Symposium on Foundations of Computer Science (FOCS)*, (1989) 568–573.
113. S. N. Bhatt and Jin-Yi Cai. Take Random Walks to Grow Trees in Hypercubes. *The Journal of ACM* Vol. **40**, No. 3, (1993) 741–764. Published by The Association for Computing Machinery.
114. Jin-Yi Cai, Lane Hemachandra and Jozef Vyskoč. Promise Problems and Guarded Access to Unambiguous Computation.  
Appeared in *Complexity Theory—Current Research*, 101–146, edited by Klaus Ambos-Spies, Steve Homer and Uwe Schöning, Cambridge University Press, 1993. A preliminary version appeared in *The 17th Symposium on Mathematical Foundations of Computer Science* (1992), 162–171. Springer-Verlag *Lecture Notes in Computer Science* Vol. **629**.
115. Jin-Yi Cai. Computations Over Infinite Groups.  
An *Invited Lecture* in the Proceedings of *The 8th International Conference on Fundamentals of Computation Theory*. Springer-Verlag Lecture Notes in Computer Science, L. Budach (Ed.), Vol. **529** (1991) 22–32.

116. Jin-Yi Cai. Lower Bounds for Constant Depth Circuits in the Presence of Help Bits. *Information Processing Letters* Vol. **36** (1990) 79–83. Published by North-Holland. A preliminary version appeared in *The 30th Annual Symposium on Foundations of Computer Science (FOCS)*, (1989) 532–537.
117. Jin-Yi Cai and Juris Hartmanis. On Hausdorff and Topological Dimensions of the Kolmogorov Complexity of the Real Line. *The Journal of Computer and System Sciences*, 1994, December, Vol. **49**, no. 3, 605–619. Published by Academic Press.
118. Jin-Yi Cai, Martin Fürer and Neil Immerman. An Optimal Lower Bound on the Number of Variables for Graph Identification. *Combinatorica* **12** (4) (1992), 389–410. Published by Akadémiai Kiadó—Springer-Verlag. A preliminary version appeared in *The 30th Annual Symposium on Foundations of Computer Science*, (FOCS), (1989) 612–617.
119. Jin-Yi Cai. A Note on the Determinant and Permanent Problem. *Information and Computation*, Vol. **84**, No. 1, (1990) 119–127. Published by Academic Press.
120. Jin-Yi Cai and Juris Hartmanis. The Complexity of the Real Line is a Fractal, In the Proceedings of *The Structure in Complexity Theory Conference*, (1989) 138–146.
121. Jin-Yi Cai and Lane Hemachandra. Enumerative Counting is Hard. *Information and Computation*, Vol. **82**, No. 1, (1989) 34–44. Published by Academic Press. A preliminary version appeared in *The Structure in Complexity Theory Conference* (1988) 194–203.
122. Jin-Yi Cai and Lane Hemachandra. On the Power of Parity Polynomial Time. *Mathematical Systems Theory* Vol. **23** (1990) 95–106. Published by Springer-Verlag. A preliminary version appeared in *The 6th Annual Symposium on Theoretical Aspects of Computer Science (STACS)*, Springer-Verlag Lecture Notes in Computer Science, B. Monien and R. Cori (Ed.), Vol. **349**, (1989) 229–239.
123. S. N. Bhatt and Jin-Yi Cai. Take a Walk, Grow a Tree. In the Proceedings of *The 29th Annual Symposium on Foundations of Computer Science (FOCS)*, (1988) 469–478.
124. Jin-Yi Cai and Merrick Furst. PSPACE Survives Three-Bit Bottlenecks. *International Journal of Foundations of Computer Science* Vol. **2**, No. 1, (1991) 67–76. Published by World Scientific Publishing Co. A preliminary version appeared in *The Structure in Complexity Theory Conference*, (1987) 94–102.
125. Jin-Yi Cai. With Probability One, a Random Oracle Separates PSPACE from the Polynomial-time Hierarchy.

- Special issue of *The Journal of Computer and System Sciences*, Vol. **38**, No. 1, (1989) 68–85. Published by Academic Press. A preliminary version appeared in *The 18th ACM Symposium on the Theory of Computing (STOC)*, (1986) 21–29.
126. Jin-Yi Cai, T. Gundermann, J. Hartmanis, L. Hemachandra, V. Sewelson, K. Wagner, and G. Wechsung. The Boolean Hierarchy I: Structural Properties. *SIAM Journal on Computing*, Vol. **17** No. 6 (1988) 1232-1252. Published by SIAM.
  127. Jin-Yi Cai, T. Gundermann, J. Hartmanis, L. Hemachandra, V. Sewelson, K. Wagner, and G. Wechsung. The Boolean Hierarchy II: Applications. *SIAM Journal on Computing*, Vol. **18** No. 1 (1989) 95-111. Published by SIAM.
  128. Jin-Yi Cai. Probability One Separation of the Boolean Hierarchy. In the Proceedings of *The 4th Annual Symposium on Theoretical Aspects of Computer Science*, Springer-Verlag Lecture Notes in Computer Science, F. J. Brandenburg, G. Vidal-Naquet and M. Wirsing (Ed.), Vol. **247**, (1987)148-158.
  129. Jin-Yi Cai and Lane Hemachandra. The Boolean Hierarchy: Hardware over NP, In the Proceedings of *The Structure in Complexity Theory Conference*, (1986) 105–124.
  130. Jin-Yi Cai and Gabriele Meyer. Graph Minimal Uncolorability is  $D^P$ -complete. *SIAM Journal on Computing*, Vol. **16** No. 2 (1987) 259–277. Published by SIAM. A preliminary version appeared as:  
On the Complexity of Graph Critical Uncolorability.  
In the Proceedings of *The 14th International Colloquium on Automata, Languages and Programming (ICALP)*, Springer-Verlag Lecture Notes in Computer Science, Thomas Ottmann (Ed.) Vol. **267** (1987) 394–403.
  131. Jin-Yi Cai and Tom Coleman. The Cyclic Coloring Problem and Estimation of Sparse Hessian Matrices. *SIAM Journal on Discrete and Algebraic Methods*, Vol. **7** No. 2 (1986) 221-235. Published by SIAM.

## Professional Activities

- Editor of JOURNAL OF COMPUTER AND SYSTEMS SCIENCES.
- Editor of INTERNATIONAL JOURNAL OF FOUNDATIONS OF COMPUTER SCIENCE.
- Associate Editor of JOURNAL OF COMPLEXITY.
- Associate Editor of JOURNAL OF COMPUTATIONAL COMPLEXITY.
- Area Editor of INTERNATIONAL JOURNAL OF SOFTWARE AND INFORMATICS (IJSI).

- Member of the Editorial Board of THE CHICAGO JOURNAL OF THEORETICAL COMPUTER SCIENCE.
- Former Member of the Scientific Board for ELECTRONIC COLLOQUIUM ON COMPUTATIONAL COMPLEXITY.
- Former Associate Editor of JOURNAL OF COMPUTER SCIENCE AND TECHNOLOGY.
- Special issue editor for THE JOURNAL OF COMPUTER AND SYSTEM SCIENCES.
- Special issue editor for ALGORITHMICA.
- Program committee member for *The Structure in Complexity Theory Conference*, 1993, San Diego, California.
- Chair of the program committee for *The Annual Conference on Computational Complexity* (Formerly *The Structure in Complexity Theory Conference*), 1996, Philadelphia, Pennsylvania.
- Co-chair of the program committee for *The Annual International Computing and Combinatorics Conference*, 1996, Hong Kong.
- Program committee member for *The 28th Annual ACM Symposium on Theory of Computing* (STOC), 1996.
- Program committee member for *The 18th International Conference on Foundations of Software Technology & Theoretical Computer Science* (FST&TCS), 1998, Chennai, India.
- Program committee member for *International Workshop on Cryptographic Techniques and E-Commerce* (CrypTEC '99), 1999, Hong Kong, China.
- Program committee member for *The Tenth Annual International Computing and Combinatorics Conference*, 2004.
- Program committee member for *The Second Annual Conference on Computation and Logic*, 2005.
- Program committee member for *The 37th Annual ACM Symposium on Theory of Computing* (STOC), 2005.
- Conference co-organizer for the Third International Conference of Theory and Applications of Models of Computation (TAMC), 2006.
- Program Committee Chair for the Fourth International Conference of Theory and Applications of Models of Computation (TAMC), 2007.
- Program Committee member for Algorithms and Computation, 16th International Symposium, ISAAC 2007.

- Conference committee member for *The Annual Conference on Computational Complexity*, 1996–2001.
- Organizer for DIMACS workshops in the complexity special year 1990–91.
- Panel member for various NSF review panels, starting with NSF Research Initiation Award in 1993–1994.
- Referee for the National Science Foundation grant proposals.
- Referee for various professional journals and publishers: *Journal of ACM*, *SIAM Journal of Computing*, *Journal of Computer and Systems Science*, *International Journal of Foundations of Computer Science*, *Theoretical Computer Science*, *Mathematical Systems Theory*, *Information and Computation* and formerly *Information and Control*, *Journal of Complexity*, Princeton University Press, *Information Processing Letters*, *The IEEE Transactions on Computers*, and *Journal of Parallel and Distributed Computing*, etc.
- Referee for various conferences: *The IEEE Annual Symposium on Foundations of Computer Science* (FOCS), *The ACM Annual Symposium on the Theory of Computing* (STOC), *The Structure in Complexity Theory Conference*, *The Annual International Computing and Combinatorics Conference* (Cocoon), etc.

### Invited, Plenary Speaker at Major Conferences or Named Lectures

- Robert Stewart Distinguished Lecture, 2008, Iowa State University.
- Distinguished Lecture, 2008, Temple University.
- Distinguished Lecture, 2007, Texas A&M University.
- *The 11th International Symposium on Algorithm and Computation* (ISAAC) 2000, Taipei, Taiwan.
- *Algorithmic Number Theory*, the 4th International Symposium, (ANTS-IV) 2000, Leiden, The Netherlands.
- *IEEE Annual Conference on Computational Complexity* 1999 at FCRC, Atlanta, GA.
- *Fundamentals of Computation Theory (FCT)* 1991, Berlin, Germany.

### Courses Taught

- Discrete Mathematics

- Introduction to Theoretical Computer Science
- Data Structures
- Data Structures and Algorithms
- Design and Analysis of Algorithms
- Topics in Complexity Theory
- Mathematical Foundations of Computer Science
- Introduction to the Theory of Computation
- Concrete Mathematics
- Automata Theory

### **Departmental and University Committees**

- Physical Science Divisional Committee (2011–)
- Graduate School Research Committee (2010-2011)
- Award Committee Chair (2008–2009)
- Award Committee (2006–2007)
- Recruiting Committee (2004-2005)
- Award Committee Chair (2004-2005)
- Recruiting Committee (2003-2004)
- Award Committee Chair (2003-2004)
- Rosser Lecture Chair (2002-2004)
- Colloquium Committee Chair (2002-2003)
- Recruiting Committee (2000–2001)
- Ad Hoc Committee Chair for Tenure of Cluster Hiring Candidate (2000)
- College of Arts and Sciences Tenure and Promotion Committee (1998–2000)
- Faculty of Natural Science and Math Tenure and Promotion Committee (1997–1998)
- Director of Graduate Studies (1996–1998)

- Faculty Senator (1996–1997)
- Departmental Tenure and Personnel Committee (1993–2000)
- Internship Chair (1994–96)
- Recruitment Committee (1994–96)
- Graduate Studies Committee (1993–1994)
- Colloquium Committee Chair (1993–1994)
- Ad Hoc Infrastructure Committee (1993–1994)
- Advisory Council for FNSM Science Alumni Association (1995–1998)
- Graduate Admissions Affairs (1989–1993)
- Graduate Qualifying Exam Affairs (1989–1993)
- United Way Campaign Coordinator (1991–1992 and 1992–1993)

## Student Supervision

- Thesis Advisor for Sigal Ar. Ph. D. from Princeton University, 1993. Thesis title: “Trustworthy Computations”.
- Thesis Advisor for Ajay Nerurkar. Ph. D. from SUNY Buffalo, 1999. Thesis title: “Average-Case versus Worst-Case Complexity of Computation”.
- Thesis Advisor for Venkatesan Chakaravarthy. Ph. D. from University of Wisconsin, Madison, 2004. Thesis title: “On Some Computational Problems in Randomization, Interaction and Inapproximability”.
- Co-Advisor for Pinyan Lu, Ph. D. from Tsinghua University, Beijing, 2008.
- Thesis Advisor for Michael Kowalczyk. Ph. D. from University of Wisconsin, Madison, 2010. Thesis title: “Dichotomy Theorems for Holant Problems”.
- Currently supervising Ph. D. students: Tyson Williams (3rd year), Heng Guo (2nd year) and Aaron Gorenstein (1st year).
- Post-doc supervisor for Mingji Xia.
- Post-doc supervisor for Gabor Ivanyos.
- Served on the Ph. D. Committee for D. Sivakumar.

- Served on the Ph. D. Committee for Pavan Aduri.
- Served on the Ph. D. Committee for Samik Sengupta.
- Served on the Ph. D. Committee for Charles Denis.
- Project advisor for Tibor Beke at Princeton University, funded by an NSF REU grant.
- Project advisor for Mike Rubinstein at Princeton University, funded by an NSF REU grant.