

# Amit Chakrabarti

*Curriculum Vitae*  
July 2009

Associate Professor  
Department of Computer Science  
Dartmouth College  
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## Research Interests

- **Complexity theory**, with an emphasis on **lower bounds** in non-uniform models of computation.
- **Algorithms**, especially handling **massive data** under space restrictions via **streaming**, and coping with computational hardness via **approximation**.

## Education

- **Ph.D.** in Computer Science, Princeton University, Nov 2002  
Thesis Title: Limitations of Non-Uniform Computational Models  
Advisor: Bernard Chazelle
- **M.A.** in Computer Science, Princeton University, Jun 1999
- **B.Tech.** in Computer Science & Engineering, Indian Institute of Technology (IIT), Bombay, Aug 1997

## Professional Experience

**2009–present:** Associate Professor, Department of Computer Science, Dartmouth College, Hanover, NH.

**2003–2009:** Assistant Professor, Department of Computer Science, Dartmouth College, Hanover, NH.

**Feb 2008:** Visiting Assistant Professor, Department of Computer Science, University of Texas, Austin, TX.

**August 2007:** Visiting Researcher, AT&T Labs – Research, Florham Park, NJ.

**July 2007:** Visiting Researcher, DIMACS (Rutgers University) and Google Labs, New York, NY.

**May 2007–Jun 2007:** Visiting Researcher, IBM Almaden Research Center, San Jose, CA.

**Jan 2007–May 2007:** Visiting Assistant Professor, Department of Computer Science and Engineering, University of Washington, Seattle, WA.

**August 2006:** Visiting Researcher, IBM Almaden Research Center, San Jose, CA.

**June–July 2005:** Visiting Assistant Professor, Department of Computer Science and Software Engineering, University of Melbourne, Australia.

**August 2004:** Visiting Researcher, IBM Almaden Research Center, San Jose, CA.

**2002–2003:** Postdoctoral Fellow, School of Mathematics, Institute for Advanced Study, Princeton, NJ.

**1999–2002:** Research Assistant, Princeton University, Princeton, NJ.

**Summer 2001:** Summer intern at Bell Laboratories, Murray Hill, NJ. Worked in the Computing Sciences Research Center.

**Summer 2000:** Summer manager at AT&T Labs – Research, Florham Park, NJ. Worked in the Algorithms and Optimization Department.

**1997–2000:** Teaching Assistant, Princeton University, Princeton, NJ. Work spanned five undergraduate courses.

**Summer 1996:** Summer intern at IBM India Limited (formerly TISL), Bangalore, India. Worked in the PowerPC architecture group.

**Fall 1995:** Teaching Assistant, IIT Bombay, Mumbai, India.

## Awards and Honors

- McLane Family Fellowship, 2009–2010.
- Karen E. Wetterhahn Memorial Award for Distinguished Creative or Scholarly Achievement, 2009.
- Dartmouth College Junior Faculty Fellowship, Spring 2007.
- National Science Foundation CAREER Award, 2005.
- Postdoctoral Fellow, School of Mathematics, Institute for Advanced Study, 2002–2003.
- DIMACS Summer Research Fellow, 1998.
- President of India Gold Medalist of IIT Bombay’s Class of 1997.
- Silver Medalist at the International Mathematical Olympiad, 1993.
- National Talent Search Scholar, 1991–1997.

## Research Support

- National Science Foundation, “Data Streaming through a Complexity-Theoretic Lens,” \$336,456. Aug 2009 – Jul 2012.
- McLane Family Fellowship, \$1,500. Jul 2009 – Jun 2010.
- National Science Foundation CAREER Award, “Information Theoretic Methods in Communication and Computational Complexity,” \$400,000. Jul 2005 – Jun 2010.
- Dartmouth College Junior Faculty Fellowship, \$700. Apr–Jun 2007.
- Dartmouth College Burke Award, \$20,000. Aug 2003 – Jun 2009.
- Dartmouth College Startup Award, \$130,000. Aug 2003 – Jun 2010.

## Publications

### A. In International Journals

- [J1] An Optimal Randomised Cell Probe Lower Bound for Approximate Nearest Neighbour Searching,” (with O. Regev), *SIAM Journal on Computing*, accepted for publication, 2009.
- [J2] “A Near-Optimal Algorithm for Estimating the Entropy of a Stream,” (with G. Cormode, A. McGregor), *ACM Transactions on Algorithms*, accepted for publication, 2009.

- [J3] “Improved Lower Bounds on the Randomized Complexity of Graph Properties,” (with S. Khot), *Random Structures and Algorithms*, **30**(3), 2007, pp. 427–440.
- [J4] “Approximation Algorithms for the Unsplittable Flow Problem,” (with C. Chekuri, A. Gupta, A. Kumar), *Algorithmica*, **47**(1), 2007, pp. 53–78.
- [J5] “Estimating Entropy and Entropy Norm on Data Streams,” (with K. Do Ba, S. Muthukrishnan), *Internet Mathematics*, **3**(1), 2006, pp. 63–78.
- [J6] “A Lower Bound on the Complexity of Approximate Nearest Neighbor Searching on the Hamming Cube,” (with B. Chazelle, B. Gum, A. Lvov), *Discrete and Computational Geometry: The Goodman-Pollack Festschrift*, Springer-Verlag, 2003, pp. 313–328.
- [J7] “Evasiveness of Subgraph Containment and Related Properties,” (with S. Khot, Y. Shi), *SIAM Journal on Computing*, **31**(3), 2002, pp. 866–875.

## B. In Proceedings of Refereed International Conferences

- [C1] “A Multi-Round Communication Lower Bound for Gap Hamming and Some Consequences,” (with Joshua Brody), *CCC 2009, the 24th Annual IEEE Conference on Computational Complexity*, 2009, pp. 358–368.
- [C2] “Annotations in Data Streams,” (with G. Cormode and A. McGregor), *ICALP 2009, the 36th International Colloquium on Automata, Languages and Programming*, Lecture Notes in Computer Science **5555**, Springer-Verlag, 2009, pp. 222–234.
- [C3] “Functional Monitoring Without Monotonicity,” (with C. J. Arackaparambil and J. Brody), *ICALP 2009, the 36th International Colloquium on Automata, Languages and Programming*, Lecture Notes in Computer Science **5555**, Springer-Verlag, 2009, pp. 95–106.
- [C4] “Embeddings, Cuts, and Flows in Topological Graphs: Lossy Invariants, Linearization, and 2-Sums,” (with A. Jaffe, J. R. Lee and J. Vincent), *FOCS 2008, the 49th Annual Symposium on Foundations of Computer Science*, 2008, pp. 761–770.
- [C5] “Robust Lower Bounds for Communication and Stream Computation,” (with G. Cormode and A. McGregor), *STOC 2008, the 40th Annual ACM Symposium on Theory of Computing*, pp. 641–649.
- [C6] “Sublinear Communication Protocols for Multi-Party Pointer Jumping and a Related Lower Bound,” (with J. Brody), *STACS 2008, the 25th Annual Symposium on Theoretical Aspects of Computer Science*, 2008, pp. 145–156.
- [C7] “Tight Lower Bounds for Selection in Randomly Ordered Streams,” (with T. S. Jayram and M. Pătraşcu), *SODA 2008, the 19th Annual ACM-SIAM Symposium on Discrete Algorithms*, 2008, pp. 720–729. Invited to SODA 2008 special issue by *ACM Transactions on Algorithms*.
- [C8] “Nearly Private Information Retrieval,” (with A. Shubina), *MFCS 2007, the 32nd International Symposium on Mathematical Foundations of Computer Science*, Lecture Notes in Computer Science **4708**, Springer-Verlag, 2008, pp. 383–393.
- [C9] “Lower Bounds for Multi-Player Pointer Jumping,” (sole author), *CCC 2007, the 22nd Annual IEEE Conference on Computational Complexity*, 2007, pp. 33–45.
- [C10] “A Near-Optimal Algorithm for Computing the Entropy of a Stream,” (with G. Cormode, A. McGregor), *SODA 2007, the 18th Annual ACM-SIAM Symposium on Discrete Algorithms*, 2007, pp. 328–335.
- [C11] “Attack Detection in Time Series for Recommendation Systems,” (with S. Zhang, J. Ford, F. Makedon), in *Proceedings of the 12th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 2006, pp. 809–814.
- [C12] “A Quasi-PTAS for Unsplittable Flow on Line Graphs,” (with N. Bansal, A. Epstein, B. Schieber), *STOC 2006, the 38th Annual ACM Symposium on Theory of Computing*, 2006, 721–729.
- [C13] “Estimating Entropy and Entropy Norm on Data Streams,” (with K. Do Ba, S. Muthukrishnan), *STACS 2006, the 23rd Annual Symposium on Theoretical Aspects of Computer Science*, Lecture Notes in Computer Science **3884**, Springer-Verlag, 2006, pp. 196–205.

- [C14] “An Optimal Randomised Cell Probe Lower Bound for Approximate Nearest Neighbour Searching,” (with O. Regev), *FOCS 2004, the 45th Annual Symposium on Foundations of Computer Science*, 2004, pp. 473–482. Invited to FOCS 2004 special issue by *SIAM Journal on Computing*.
- [C15] “ $R^*$ -Histograms: Efficient Representation of Spatial Relations between Objects of Arbitrary Topology,” (with Y. Wang, F. Makedon), in *Proceedings of the 12th Annual ACM International Conference on Multimedia*, 2004, pp. 356–359.
- [C16] “Near-Optimal Lower Bounds on the Multi-Party Communication Complexity of Set Disjointness,” (with S. Khot, X. Sun), *CCC 2003, the 18th Annual IEEE Conference on Computational Complexity*, 2003, pp. 97–107.
- [C17] “Approximation Algorithms for the Unsplittable Flow Problem,” (with C. Chekuri, A. Gupta, A. Kumar), *APPROX 2002, the 5th International Workshop on Approximation Algorithms for Combinatorial Optimization*, Lecture Notes in Computer Science **2462**, Springer-Verlag, 2002, pp. 51–66.
- [C18] “Improved Approximation Algorithms for Resource Allocation,” (with G. Calinescu, H. Karloff, Y. Rabani), *IPCO 2002, the 9th Conference on Integer Programming and Combinatorial Optimization*, Lecture Notes in Computer Science **2337**, Springer-Verlag, 2002, pp. 401–414.
- [C19] “Informational Complexity and the Direct Sum Problem for Simultaneous Message Complexity,” (with Y. Shi, A. Wirth, A. C.-C. Yao), *FOCS 2001, the 42nd Annual Symposium on Foundations of Computer Science*, 2001, pp. 270–278.
- [C20] “Improved Lower Bounds on the Randomized Complexity of Graph Properties,” (with S. Khot), *ICALP 2001, the 28th International Colloquium on Automata, Languages and Programming*, Lecture Notes in Computer Science **2076**, Springer-Verlag, 2001, pp. 285–296.
- [C21] “Evasiveness of Subgraph Containment and Related Properties,” (with S. Khot, Y. Shi), *STACS 2001, the 18th Annual Symposium on Theoretical Aspects of Computer Science*, Lecture Notes in Computer Science **2010**, Springer-Verlag, 2001, pp. 110–120.
- [C22] “A Lower Bound on the Complexity of Approximate Nearest Neighbor Searching on the Hamming Cube,” (with B. Chazelle, B. Gum, A. Lvov), *STOC 1999, the 31st Annual ACM Symposium on Theory of Computing*, 1999, pp. 305–311.

### C. Technical Reports and Other Writings

- [O1] “Approximability of the Unsplittable Flow Problem on Trees,” (with C. J. Arackaparambil and C.-C. Huang), Technical Report TR2009-642, Computer Science, Dartmouth College, 2009. Also submitted for publication, 2008.
- [O2] “A Multi-Round Communication Lower Bound for Gap Hamming and Some Consequences,” (with Joshua Brody), *Electronic Colloquium on Computational Complexity*, TR09-015, 2009.
- [O3] “Lower Bounds for Multi-Player Pointer Jumping,” (sole author), *Electronic Colloquium on Computational Complexity*, TR07-014, 2007.
- [O4] “A Quasi-PTAS for Unsplittable Flow on Line Graphs,” (with N. Bansal, A. Epstein, B. Schieber), Technical Report TR2005-561, Computer Science, Dartmouth College, 2005.
- [O5] “Combinatorial Theorems about Embedding Trees on the Real Line,” (with S. Khot), Technical Report TR2005-560, Computer Science, Dartmouth College, 2005. Revised and improved version submitted for publication, 2006.
- [O6] “An Optimal Randomised Cell Probe Lower Bound for Approximate Nearest Neighbour Searching,” (with O. Regev), *Electronic Colloquium on Computational Complexity*, TR03-070, 2003.
- [O7] “Randomized Graph Partitioning Algorithms,” Senior Thesis, IIT Bombay, 1997.
- [O8] “Algorithms in Invariant Theory,” Junior Thesis, IIT Bombay, 1996.

## D. Articles in Preparation

- [P1] “The Power of a Single Bit: Communication Complexity of the SUM-INDEX Problem,” (with M. Adelfio), in preparation, 2009.
- [P2] “The Information Complexity Paradigm: A Survey,” (with T. S. Jayram), in preparation, 2009.

## Invited Talks

- Jul 2009 “*Multi-pass Data Stream Lower Bounds via Round Elimination*,” CS Seminar at Technische Universität Dortmund, Germany
- May 2009 “*Multi-pass Data Stream Lower Bounds via Round Elimination*,” Colloquium at Microsoft Research New England, Cambridge, MA
- Mar 2009 “*Lower Bounds for Gap-Hamming-Distance and Consequences for Data Stream Algorithms*,” DIMACS/DyDAN Workshop on Streaming, Coding, and Compressive Sensing, Rutgers University, Piscataway, NJ
- Feb 2009 “*Functional Monitoring Without Monotonicity*,” 4th International Workshop on Information Theory and Applications (ITA 2009), San Diego, CA
- Jan 2009 “*Cell Probe Lower Bounds for Approximate Nearest Neighbour Searching*,” BIRS Workshop on Mathematics of String Spaces and Algorithmic Applications, Banff, Canada
- Oct 2008 “*Functional Monitoring Without Monotonicity*,” Microsoft Research Silicon Valley, Mountain View, CA
- Aug 2008 “*Robust Communication Complexity and Random-Order Data Streams*,” Workshop on Sublinear Algorithms, Schloss Dagstuhl, Germany
- Feb 2008 “*Robust Communication Complexity and Applications*,” Theory Seminar, University of Texas, Austin, TX
- Sep 2007 “*The Information Complexity Paradigm*,” Dartmouth CS Research Symposium, Dartmouth College, Hanover, NH
- Jul 2007 “*Multi-Player Pointer Jumping: Lower Bounds and Why They Matter*,” AT&T Labs Research, Florham Park, NJ
- Jun 2007 “*Multi-Player Pointer Jumping: Lower Bounds and Why They Matter*,” TOC-Talk, IBM Almaden Research Center, San Jose, CA
- Apr 2007 “*The Information Complexity Paradigm*,” Intel Research Lab, Seattle, WA
- Mar 2007 “*Lower Bounds for Multi-Player Pointer Jumping*,” Theory Seminar, Department of Computing Science, Simon Fraser University, Vancouver, Canada
- Jan 2007 “*Estimating Entropy (and its Friends) on Data Streams*,” Theory Seminar, Department of Computer Science and Engineering, University of Washington, Seattle, WA
- Dec 2006 “*Estimating Entropy (and its Friends) on Data Streams*,” Workshop on Algorithms for Data Streams, IIT Kanpur, India
- Nov 2006 “*Estimating Entropy (and its Friends) on Data Streams*,” Theory of Computation Seminar, School of Computer Science, McGill University, Montréal, Canada
- Oct 2006 “*Estimating Entropy (and its Friends) on Data Streams*,” Theory of Computation Seminar, IBM T. J. Watson Research Center, Yorktown Heights, NY
- Aug 2006 “*Unsplittable Flows in Line and Ring Networks*,” 19th International Symposium on Mathematical Programming, Rio de Janeiro, Brazil
- Jun 2006 “*Estimating Entropy and Entropy Norm on Data Streams*,” Workshop on Space-Conscious Algorithms, University of Bologna Residential Center, Bertinoro, Italy
- May 2006 “*Estimating Entropy and Entropy Norm on Data Streams*,” Theory of Computation Seminar, Toyota Technological Institute, Chicago, IL
- Jul 2005 “*A Surprising Upper Bound for High-Dimensional Approximate Nearest Neighbour Search*,” Theory of Computation Seminar, IBM T. J. Watson Research Center, Yorktown Heights, NY

- Jun 2005 *“Lower Bounds via Information Theory and an Application to the Approximate Nearest Neighbour Search Problem,”* School of Computer Science and Software Engineering Seminar Series, Monash University, Australia
- Jun 2005 *“A Surprising Upper Bound for High-Dimensional Approximate Nearest Neighbour Search,”* Computer Science & Software Engineering Seminar, The University of Melbourne, Australia
- May 2005 *“Information Theory and Complexity,”* Faculty Presentation to Graduate Students, Department of Computer Science, Dartmouth College, Hanover, NH
- Dec 2004 *“Two Applications of Topology to Impossibility Results in Computer Science,”* Mathematics Department Colloquium, Indian Institute of Science, Bangalore, India
- Oct 2004 *“Quantum Computation: A Biased Guided Tour,”* Quantum Information Science Workshop, Department of Physics, Dartmouth College, Hanover, NH
- Aug 2004 *“Tight Bounds for Approximate Nearest Neighbour Search,”* TOC-Talk, IBM Almaden Research Center, San Jose, CA
- Mar 2004 *“Tight Bounds for Approximate Nearest Neighbour Search,”* DIMACS Theory Seminar, Rutgers University, Piscataway, NJ
- Dec 2003 *“Tight Bounds for Approximate Nearest Neighbour Search,”* U. C. Berkeley Theory Seminar, Berkeley, CA
- Nov 2003 *“Tight Bounds for Approximate Nearest Neighbour Search,”* University of Michigan Theory Seminar, Ann Arbor, MI
- Nov 2003 *“Tight Bounds for Approximate Nearest Neighbour Search,”* Princeton Seminars in Theoretical Computer Science, Princeton, NJ
- Mar 2003 *“Lower Bounds for Multi-Party Set Disjointness,”* IAS Combinatorics and Complexity Theory Seminar, Princeton, NJ
- Feb 2003 *“Informational complexity and lower bounds in communication complexity,”* CUNY Graduate Center Combinatorics Seminar, New York, NY
- Nov 2002 *“A Lower Bound for Approximate Nearest Neighbor Searching,”* IAS Combinatorics and Complexity Theory Seminar, Princeton, NJ
- Nov 2002 *“Informational Complexity and Lower Bounds in Communication Complexity,”* DIMACS, Rutgers University, Piscataway, NJ
- Apr 2002 *“Minor-closed Graph Properties are Evasive,”* CUNY Graduate Center Combinatorics Seminar, New York, NY
- Nov 2001 *“Informational Complexity and the Direct Sum Problem for Simultaneous Message Complexity,”* Institute for Advanced Study (IAS), Princeton, NJ
- Jan 2001 *“Evasiveness of Subgraph Containment and Related Properties,”* Indian Institute of Science, Bangalore, India
- Aug 2000 *“Improved Approximation Algorithms for Bandwidth Allocation,”* AT&T Labs Research, Florham Park, NJ

## Advising

### A. Theses Supervised as Primary Advisor

- Anna Shubina, Ph.D., Nov 2007
- Marco Adelfio '05, Senior Honors thesis
- David Blinn '06, Senior Honors thesis

### B. Non-Thesis Undergraduate Research Supervised

- Khanh Do Ba '06, summer research student
- Owen Worley '09, Presidential scholar

### C. Advisory Committee Membership not as Primary Advisor

- Member on Ph.D. thesis committee of Yuhang Wang, David Wagner, Sheng Zhang, Heng Huang, Zhifeng Wang and Chien-Chung Huang.
- Member on M.S. thesis committee of John J. Thomas (as co-advisor) and Anne Loomis.

### D. Current Students

- Joshua Brody, Ph.D. student
- Chrisil Arackaparambil, Ph.D. student
- Ranganath Kondapally, Ph.D. student
- William Henderson-Frost '08, Senior Honors thesis student

## Teaching

### A. Dartmouth College

- Instructor, CS109 (Theory of Computation, Graduate Level), Spring 2009.
- Instructor, CS33 (Information Systems), Spring 2009.
- Instructor, CS39 (Theory of Computation), Winter 2009.
- Instructor, CS85/185 (Lower Bounds in Computer Science), Spring 2008.
- Instructor, CS109 (Theory of Computation, Graduate Level), Spring 2008.
- Instructor, CS39 (Theory of Computation), Fall 2007.
- Instructor, CS39 (Theory of Computation), Fall 2006.
- Instructor, CS85/185 (Information, Communication & Complexity Theory), Winter 2006.
- Instructor, CS19 (Discrete Mathematics in Computer Science), Winter 2006.
- Instructor, CS39 (Theory of Computation), Fall 2005.
- Instructor, CS105 (Algorithms and Data Structures), Winter 2005.
- Instructor, CS39 (Theory of Computation), Winter 2005.
- Instructor, CS39 (Theory of Computation), Fall 2004.
- Instructor, CS21 (Discrete Mathematics in Computer Science), Winter 2004.
- Instructor, CS85/185 (Lower Bounds in Computer Science), Fall 2003.

### B. Princeton University

- Preceptor, COS226 (Algorithms and Data Structures), Spring 2000.
- Teaching Assistant, COS423 (Theory of Algorithms), Spring 1999.
- Teaching Assistant, COS423 (Theory of Algorithms), Spring 1998.
- Teaching Assistant, COS487 (Theory of Computation), Fall 1997.
- Teaching Assistant, COS341 (Discrete Mathematics), Fall 1997.

## C. IIT Bombay

- Teaching Assistant, CS101 (Computer Programming and Utilization), Fall 1995.

## Professional Service

- Program Committee member, 50th IEEE Symposium on Foundations of Computer Science (FOCS), 2009.
- Program Committee member, 23rd IEEE Conference on Computational Complexity (CCC), 2008.
- Co-Editor of *Computational Complexity*, special issue for CCC 2008.
- NSF panelist and reviewer of research proposals in the field of Theory of Computing, 2005, 2006, 2007.
- Reviewer of research proposal for W. M. Keck Foundation, 2006.
- Referee for the following journals, some on multiple occasions: *ACM Transactions on Algorithms*, *ACM Transactions on Computation Theory*, *Algorithmica*, *Combinatorica*, *Computational Complexity*, *IEEE Transactions on Information Theory*, *Information Processing Letters*, *Integration – the VLSI Journal*, *Journal of Computer and System Sciences*, *Journal of Parallel and Distributed Computing*, *Machine Learning*, *SIAM Journal on Computing*.
- Referee for the following conferences (primarily in theoretical computer science) over several years: FOCS, STOC, SODA, CCC, STACS, ICALP, ISIT, ESA, SPAA.
- Member of ACM SIGACT and MPS.

## University Activities

Dartmouth College.

- Committee on Instruction (Arts & Sciences faculty) (Winter 2006)

Dartmouth College, Computer Science Department.

- Founder and organizer, Dartmouth Computer Science Theory Seminar Series (2004–07, 2008–09)
- Ph.D. Admissions Chair (Winter and Spring 2008)
- Ph.D. Admissions Committee (2003–04, 2004–05)
- Colloquium Chair (2004–05, 2005–06, Fall 2006)
- Curriculum Committee (2003–04, 2004–05 (chair), 2005–06 (chair), 2008–09, 2009–10 (chair))
- Kemeny Prize Committee (2003–04)
- Library Representative (2003–04, 2007–10)

Princeton University, Computer Science Department.

- Founder and organizer, Let's Talk Theory student seminar series (1999–2000)