

2009 50th Annual IEEE Symposium on Foundations of Computer Science

(FOCS 2009)

**Atlanta, Georgia, USA
25 - 27 October 2009**



**IEEE Catalog Number: CFP09053-PRT
ISBN: 978-1-4244-5116-6**

Table of Contents

2009 50th Annual IEEE Symposium on Foundations of Computer Science

FOCS 2009

| | |
|---|-------------|
| Message from Program Chair | xi |
| Organizing Committee | xii |
| Reviewers | xiii |

Session 1A

| | |
|--|----|
| Approximation Algorithms for Multicommodity-Type Problems with Guarantees Independent of the Graph Size | 3 |
| <i>Ankur Moitra</i> | |
| Faster Generation of Random Spanning Trees | 13 |
| <i>Jonathan A. Kelner and Aleksander Madry</i> | |
| Local Graph Partitions for Approximation and Testing | 22 |
| <i>Avinatan Hassidim, Jonathan A. Kelner, Huy N. Nguyen, and Krzysztof Onak</i> | |
| Oblivious Routing for the Lp-norm..... | 32 |
| <i>Matthias Englert and Harald Räcke</i> | |

Session 1B

| | |
|--|----|
| Linear Systems over Composite Moduli | 43 |
| <i>Arkadev Chattopadhyay and Avi Wigderson</i> | |
| Multipart Communication Complexity and Threshold Circuit Size of AC^0 | 53 |
| <i>Paul Beame and Dang-Trinh Huynh-Ngoc</i> | |
| The Communication Complexity of Set-Disjointness with Small Sets and 0-1 Intersection..... | 63 |
| <i>Eyal Kushilevitz and Enav Weinreb</i> | |
| Polynomial Hierarchy, Betti Numbers and a Real Analogue of Toda's Theorem..... | 73 |
| <i>Saugata Basu and Thierry Zell</i> | |

Session 2A

| | |
|---|----|
| Randomized Self-Assembly for Exact Shapes | 85 |
| <i>David Doty</i> | |
| The Quantum and Classical Complexity of Translationally Invariant Tiling and Hamiltonian Problems | 95 |
| <i>Daniel Gottesman and Sandy Irani</i> | |

Session 2B

| | |
|---|-----|
| On Allocating Goods to Maximize Fairness..... | 107 |
| <i>Deeparnab Chakrabarty, Julia Chuzhoy, and Sanjeev Khanna</i> | |
| Online Stochastic Matching: Beating $1-1/e$ | 117 |
| <i>Jon Feldman, Aranyak Mehta, Vahab Mirrokni, and S. Muthukrishnan</i> | |

Session 3A

| | |
|---|-----|
| Instance-Optimal Geometric Algorithms..... | 129 |
| <i>Peyman Afshani, Jérémy Barbay, and Timothy M. Chan</i> | |
| Delaunay Triangulations in $O(\text{sort}(n))$ Time and More..... | 139 |
| <i>Kevin Buchin and Wolfgang Mulzer</i> | |
| Orthogonal Range Reporting in Three and Higher Dimensions..... | 149 |
| <i>Peyman Afshani, Lars Arge, and Kasper Dalgaard Larsen</i> | |
| Decomposing Coverings and the Planar Sensor Cover Problem..... | 159 |
| <i>Matt Gibson and Kasturi Varadarajan</i> | |

Session 3B

| | |
|---|-----|
| Bounded Independence Fools Halfspaces | 171 |
| <i>Ilias Diakonikolas, Parikshit Gopalan, Ragesh Jaiswal, Rocco A. Servedio, and Emanuele Viola</i> | |
| Extensions to the Method of Multiplicities, with Applications to Kakeya Sets and Mergers..... | 181 |
| <i>Zeev Dvir, Swastik Kopparty, Shubhangi Saraf, and Madhu Sudan</i> | |
| Constructing Small-Bias Sets from Algebraic-Geometric Codes..... | 191 |
| <i>Avraham Ben-Aroya and Amnon Ta-Shma</i> | |
| Blackbox Polynomial Identity Testing for Depth 3 Circuits | 198 |
| <i>Neeraj Kayal and Shubhangi Saraf</i> | |

Session 4A

| | |
|---|-----|
| A New Probability Inequality Using Typical Moments and Concentration Results | 211 |
| <i>Ravindran Kannan</i> | |
| A Probabilistic Inequality with Applications to Threshold Direct-Product Theorems | 221 |
| <i>Falk Unger</i> | |
| Choice-Memory Tradeoff in Allocations | 230 |
| <i>Noga Alon, Eyal Lubetzky, and Ori Gurel-Gurevich</i> | |

Session 4B

| | |
|---|-----|
| A Parallel Repetition Theorem for Any Interactive Argument..... | 241 |
| <i>Iftach Haitner</i> | |
| Resolving the Simultaneous Resettability Conjecture and a New Non-Black-Box Simulation Strategy | 251 |
| <i>Yi Deng, Vipul Goyal, and Amit Sahai</i> | |

| | |
|--|-----|
| Extracting Correlations | 261 |
| <i>Yuval Ishai, Eyal Kushilevitz, Rafail Ostrovsky, and Amit Sahai</i> | |

Session 5A

| | |
|---|-----|
| Settling the Complexity of Arrow-Debreu Equilibria in Markets with Additively Separable Utilities | 273 |
| <i>Xi Chen, Decheng Dai, Ye Du, and Shang-Hua Teng</i> | |
| Reducibility among Fractional Stability Problems | 283 |
| <i>Shiva Kintali, Laura J. Poplawski, Rajmohan Rajaraman, Ravi Sundaram, and Shang-Hua Teng</i> | |
| Convergence of Local Dynamics to Balanced Outcomes in Exchange Networks..... | 293 |
| <i>Yossi Azar, Benjamin Birnbaum, L. Elisa Celis, Nikhil R. Devanur, and Yuval Peres</i> | |
| Convergence to Equilibrium in Local Interaction Games | 303 |
| <i>Andrea Montanari and Amin Saberi</i> | |

Session 5B

| | |
|---|-----|
| Exact and Approximate Pattern Matching in the Streaming Model | 315 |
| <i>Benny Porat and Ely Porat</i> | |
| Efficient Sketches for Earth-Mover Distance, with Applications..... | 324 |
| <i>Alexandr Andoni, Khanh Do Ba, Piotr Indyk, and David Woodruff</i> | |
| Models for the Compressible Web | 331 |
| <i>Flavio Chierichetti, Ravi Kumar, Silvio Lattanzi, Alessandro Panconesi, and Prabhakar Raghavan</i> | |

Session 6

| | |
|--|-----|
| The Intersection of Two Halfspaces Has High Threshold Degree | 343 |
| <i>Alexander A. Sherstov</i> | |
| Breaking the Multicommodity Flow Barrier for $O(\sqrt{\log n})$ -Approximations to Sparsest Cut..... | 363 |
| <i>Jonah Sherman</i> | |

Session 7A

| | |
|---|-----|
| A Complete Characterization of Statistical Query Learning with Applications to Evolvability | 375 |
| <i>Vitaly Feldman</i> | |
| Agnostic Learning of Monomials by Halfspaces Is Hard..... | 385 |
| <i>Vitaly Feldman, Venkatesan Guruswami, Prasad Raghavendra, and Yi Wu</i> | |
| Learning and Smoothed Analysis | 395 |
| <i>Adam Tauman Kalai, Alex Samorodnitsky, and Shang-Hua Teng</i> | |
| k-Means Has Polynomial Smoothed Complexity..... | 405 |
| <i>David Arthur, Bodo Manthey, and Heiko Röglin</i> | |

Session 7B

| | |
|--|-----|
| Approximating Minimum Cost Connectivity Problems via Uncrossable Bifamilies and Spider-Cover Decompositions | 417 |
| <i>Zeev Nutov</i> | |
| Improved Approximation Algorithms for PRIZE-COLLECTING STEINER TREE and TSP..... | 427 |
| <i>Aaron Archer, Mohammad Hossein Bateni, Mohammad Taghi Hajiaghayi, and Howard Karloff</i> | |
| An $O(k^3 \log n)$ -Approximation Algorithm for Vertex-Connectivity Survivable Network Design..... | 437 |
| <i>Julia Chuzhoy and Sanjeev Khanna</i> | |
| An Oblivious $O(1)$ -Approximation for Single Source Buy-at-Bulk | 442 |
| <i>Ashish Goel and Ian Post</i> | |

Session 8A

| | |
|--|-----|
| Optimal Long Code Test with One Free Bit..... | 453 |
| <i>Nikhil Bansal and Subhash Khot</i> | |
| Combinatorial PCPs with Efficient Verifiers | 463 |
| <i>Or Meir</i> | |
| Composition of Low-Error 2-Query PCPs Using Decodable PCPs | 472 |
| <i>Irit Dinur and Prahladh Harsha</i> | |

Session 8B

| | |
|--|-----|
| The Complexity of Rationalizing Network Formation | 485 |
| <i>Shankar Kalyanaraman and Christopher Umans</i> | |
| Dynamic and Non-uniform Pricing Strategies for Revenue Maximization..... | 495 |
| <i>Tanmoy Chakraborty, Zhiyi Huang, and Sanjeev Khanna</i> | |
| On the Power of Randomization in Algorithmic Mechanism Design | 505 |
| <i>Shahar Dobzinski and Shaddin Dughmi</i> | |

Session 9A

| | |
|---|-----|
| Universal Blind Quantum Computation | 517 |
| <i>Anne Broadbent, Joseph Fitzsimons, and Elham Kashefi</i> | |
| Optimal Quantum Strong Coin Flipping | 527 |
| <i>André Chailloux and Iordanis Kerenidis</i> | |
| Two-Message Quantum Interactive Proofs Are in PSPACE..... | 534 |
| <i>Rahul Jain, Sarvagya Upadhyay, and John Watrous</i> | |
| Span Programs and Quantum Query Complexity: The General Adversary Bound Is Nearly Tight for Every Boolean Function | 544 |
| <i>Ben W. Reichardt</i> | |

Session 9B

| | |
|---|-----|
| A $(\log n)^{\Omega(1)}$ Integrality Gap for the Sparsest Cut SDP | 555 |
| <i>Jeff Cheeger, Bruce Kleiner, and Assaf Naor</i> | |
| SDP Integrality Gaps with Local ℓ_1 Embeddability | 565 |
| <i>Subhash Khot and Rishi Saket</i> | |
| Integrality Gaps for Strong SDP Relaxations of UNIQUE GAMES..... | 575 |
| <i>Prasad Raghavendra and David Steurer</i> | |
| How to Round Any CSP..... | 586 |
| <i>Prasad Raghavendra and David Steurer</i> | |
| Constraint Satisfaction Problems of Bounded Width | 595 |
| <i>Libor Barto and Marcin Kozik</i> | |

Session 10A

| | |
|---|-----|
| Bit Encryption Is Complete | 607 |
| <i>Steven Myers and Abhi Shelat</i> | |
| 2-Source Extractors under Computational Assumptions and Cryptography with Defective Randomness..... | 617 |
| <i>Yael Tauman Kalai, Xin Li, and Anup Rao</i> | |

Session 10B

| | |
|---|-----|
| (Meta) Kernelization..... | 629 |
| <i>Hans L. Bodlaender, Fedor V. Fomin, Daniel Lokshtanov, Eelko Penninx, Saket Saurabh, and Dimitrios M. Thilikos</i> | |
| Planarity Allowing Few Error Vertices in Linear Time | 639 |
| <i>Ken-ichi Kawarabayashi</i> | |

Session 11A

| | |
|--|-----|
| Symmetry and Approximability of Submodular Maximization Problems | 651 |
| <i>Jan Vondrák</i> | |
| Submodular Function Minimization under Covering Constraints | 671 |
| <i>Satoru Iwata and Kiyohito Nagano</i> | |
| Smoothed Analysis of Multiobjective Optimization | 681 |
| <i>Heiko Röglin and Shang-Hua Teng</i> | |

Session 11B

| | |
|--|-----|
| Fully Dynamic $(2 + \epsilon)$ Approximate All-Pairs Shortest Paths with Fast Query and Close to Linear Update Time .. | 693 |
| <i>Aaron Bernstein</i> | |
| Distance Oracles for Sparse Graphs | 703 |
| <i>Christian Sommer, Elad Verbin, and Wei Yu</i> | |

| | |
|---|-----|
| Space-Efficient Framework for Top-k String Retrieval Problems | 713 |
| <i>Wing-Kai Hon, Rahul Shah, and Jeffrey Scott Vitter</i> | |

Session 12

| | |
|--|-----|
| KKL, Kruskal-Katona, and Monotone Nets | 725 |
| <i>Ryan O'Donnell and Karl Wimmer</i> | |

| | |
|---|-----|
| Higher Eigenvalues of Graphs..... | 735 |
| <i>Jonathan A. Kelner, James R. Lee, Gregory N. Price, and Shang-Hua Teng</i> | |

| | |
|---|-----|
| Regularity Lemmas and Combinatorial Algorithms..... | 745 |
| <i>Nikhil Bansal and Ryan Williams</i> | |

| | |
|---|-----|
| Approximability of Combinatorial Problems with Multi-agent Submodular Cost Functions | 755 |
| <i>Gagan Goel, Chinmay Karande, Pushkar Tripathi, and Lei Wang</i> | |

| | |
|---|-----|
| The Data Stream Space Complexity of Cascaded Norms..... | 765 |
| <i>T.S. Jayram and David P. Woodruff</i> | |

| | |
|---------------------------|------------|
| Author Index | 775 |
|---------------------------|------------|