

ARNAB BHATTACHARYYA

Tenure-Track Assistant Professor

Computer Science, School of Computing, National University of Singapore

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AREAS OF INTEREST

Theoretical Computer Science & Foundations of Data Science; more specifically: high-dimensional probability & statistics, property testing, learning theory, causality, complexity theory, coding theory.

EDUCATION & TRAINING

Massachusetts Institute of Technology

Ph.D. in Computer Science (Advisor: Ronitt Rubinfeld) 2012, June

M.Eng. in Computer Science (Advisor: G.J. Sussman) 2006

S.B. in Computer Science and Physics, minor in Mathematics 2005

CCI Postdoctoral fellow at Princeton University (Mentor: B. Chazelle) 2011-12

DIMACS Postdoctoral associate at Rutgers University (Mentor: S. Muthukrishnan) 2012-13

RELATED EXPERIENCE

Long-term visitor at the Simons Institute for the Theory of Computing 2017, Spring

2022, Spring

Simons visitor at National Centre for Biological Sciences, India 2014 – 2016

Assistant Professor (with tenure)

Computer Science & Automation, Indian Institute of Science, Bangalore. 2013--2018

AWARDS

CACM Research Highlights 2022

ACM SIGMOD Research Highlights 2022

Best of PODS 2021

National Research Foundation Fellowship in AI 2020

Amazon Faculty Research Award 2019

Ramanujan Fellow 2014 – 2019

Krell Institute Computational Science Graduate Fellow 2006 – 2010

ADVISING

Yadati Naganand (Postdoc) 2022 – Present

Dimitrios Myrasiotis (Postdoc) 2022 – Present

Themistoklis Gouleakis (Postdoc) 2022 – Present

Sutanu Gayen (Postdoc → faculty @ IIT Kanpur) 2019 – 2022

Davin Choo (Ph.D.) 2021 – Present

Yuhao Wang (Ph.D.) 2021 – Present

Philips George John (Ph.D.) 2020 – Present

Vipul Arora (Ph.D.) 2019 – Present

Suprovat Ghoshal (Ph.D. → postdoc @ U. Michigan) 2015 – 2020

(co-advised with Prof. Siddharth Barman)

Palash Dey (Ph.D. → postdoc @ TIFR → faculty @ IIT Kharagpur) 2013 – 2017

(co-advised with Prof. Y. Narahari)

Indranil Bhattacharya (M.Sc. → Amazon) 2015 – 2017

Anurita Mathur (M.Sc. → Microsoft) 2015 – 2017

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Kirankumar Shiragur (M.Sc. → Ph.D. @ Stanford University)	2013 – 2015
Ameet Gadekar (M.Sc. → Citrix → Ph.D. @ Aalto University)	2013 – 2015
Chetan Gupta (M.Sc. → Samsung)	2013 – 2016

TEACHING EXPERIENCE

National University of Singapore Lecturer – Algorithms at Scale	Fall '20
National University of Singapore Lecturer – Randomized Algorithms	Spring '20, '21
National University of Singapore Lecturer – Property Testing	Fall '19
National University of Singapore Lecturer – Design and Analysis of Algorithms	Spring '19, Fall '21, '22
Indian Institute of Science Lecturer – Probability & Statistics in High Dimensions	Fall '17
Indian Institute of Science Lecturer – Randomized Algorithms	Spring '16
Indian Institute of Science Lecturer – Approximation Algorithms	Spring '15
Indian Institute of Science Lecturer – Design and Analysis of Algorithms	Fall '13-17
Indian Institute of Science Lecturer – Expander Graphs and Applications	Spring '14
Massachusetts Institute of Technology Teaching Assistant for various undergraduate and graduate classes	2005-2010

FUNDING OBTAINED

- NRF Fellowship in AI (Principal PI, 2020 – present)
- MOE Tier II Grant (Principal PI, 2020 – present)
- Amazon Faculty Award (Principal PI, 2019 – present)
- NUS Startup Grant ACF Tier I (Principal PI, 2018 – present)
- Indo-US Joint Centre for Research on Pseudorandomness in Computer Science (Principal PI, 2017-19)
- DRDO-IISc Programme to Advance the Frontiers of Communications, Control, Signal Processing and Computation (co-PI, 2016-18)
- Robert Bosch Centre for Cyberphysical Systems, “Autonomous Coordinated Navigation of Drones” (co-PI, 2016-17)
- Ramanujan Fellowship (2015-19)

PROFESSIONAL ACTIVITIES

- Local organizing co-chair for ALT '23.
- Editor for Special Issue of ACM Transactions on Algorithms, 2016.
- Steering committee member of the NMI Thematic Program on Complexity and Cryptography (2016-17)
- Organizer for FSTTCS 2015 workshop, “FOURIER”
- Co-organizer for the Indo-US Symposium on Learning, Algorithms and Complexity, 2015
- Co-organizer for FOCS 2014 workshop, “Higher-order Fourier Analysis”

- Program Committee member: *XRCI Open '15, FSTTCS '13, SODA '16, KDD '16, AAMAS '17, RANDOM '17, FSTTCS '17, WINE '17, AAAI '19 (Senior PC), IJCAI '20, IJCAI '21 (Senior PC invitation declined), AISTATS '21, FOCS '21, NeurIPS '22 (Area chair), COLT '22, RANDOM '22, ICDE '23 (Area chair), AISTATS '23, ALT '23 (Senior PC), FOCS '23.*
- Reviewer for conferences and journals such as: *IEEE Foundations of Computer Science, ACM Symposium on Theory of Computing, SLAM Symposium on Discrete Algorithms, Conference on Computational Complexity, European Symposium on Algorithms, SLAM Journal on Computing, IEEE Transactions on Information Theory*, etc.
- Selected invited talks:
 - TEDxYouth@SunbeamBhagwanpur, "How to Count Fast" (Oct 1, 2022)
 - IISc-MSR Bangalore Theory Seminar, "Algorithms for learning and testing high-dimensional statistical and causal relations" (Jul 21, 2022)
 - Amazon Research, "Algorithms for learning and testing high-dimensional statistical and causal relations" (Jun 9, 2022)
 - UCLA CS Seminar, "Algorithms for learning and testing high-dimensional statistical and causal relations" (Apr 26, 2022)
 - UCSD Theory Seminar, "Algorithms for learning and testing statistical and causal relations" (Mar 28, 2022)
 - "Algorithmic Aspects of Causal Inference" workshop at Simons Institute for Theory of Computing, "Efficient Distance Estimation And Causal Inference For Discrete Models" (Mar 22, 2022)
 - Google Algorithms Seminar, "Algorithms for learning and testing statistical and causal relations" (Mar 17, 2022)
 - "Learning from Interventions" workshop at Simons Institute for Theory of Computing, "Learning and Testing Causal Models: A Property Testing Viewpoint" (Feb 15, 2022)
 - Facebook Research Seminar, "Model Counting meets F0 Estimation" (Feb 3, 2022)
 - NUS School of Computing Research Talk, "New algorithms for efficient statistical inference" (Aug 26, 2020)
 - "Workshop on Analysis of Boolean functions" at Indian Statistical Institute, "New approaches for proving lower bounds on the length of locally decodable codes" (Feb 21, 2020)
 - Guest lecture at Tanglin Trust School Hackathon (Mar 16, 2019)
 - NUS Center for Quantum Technology CS Talk, "Hardness of Even Set" (Sep 26, 2018)
 - NUS School of Computing Seminar, "Algorithms and hardness for finding concise data representations" (Mar 19, 2018)
 - MIT LIDS Special Seminar, "Learning and Testing Causal Models with Interventions" (May 29, 2018)
 - "Statistical Physics Methods in Machine Learning" workshop at International Centre for Theoretical Sciences, "Testing Sparsity over Known and Unknown Bases" (Dec 29, 2017)
 - "Evolution and Computing" workshop at Schloss Dagstuhl, "Natural Algorithms and Opinion Dynamics" (Jan 7, 2016)
 - Charles University Noon lectures, "Higher-order Fourier Analysis and Applications" (Sep. 11, 2014)
 - Special ASU Seminar at Indian Statistical Institute, "Higher-order Fourier analysis and its applications" (May 09, 2014)
 - Big Data lecture at Indian Institute of Science, "Spectral Graph Theory and Graph Partitioning" (Apr 18, 2014)
 - Electrical Sciences Symposium at Indian Institute of Science, "On the convergence of the Hegselmann-Krause system" (Feb. 21, 2014)
 - Indo-Swiss Pre-Workshop School on Algorithms & Complexity, "Higher-order Fourier Analysis and its Applications" (Feb. 10, 2014)
 - Microsoft Research Seminar, "A computer scientist's viewpoint on evolutionary innovation" (Jan. 28, 2014)
 - National Centre for Biological Sciences Theory semina: "A computer scientist's viewpoint on robustness and evolution" (Jan. 24, 2014)
 - International Centre for Theoretical Sciences Seminar, "A computer scientist's viewpoint on biological robustness and evolution" (Jan. 16, 2014)
 - MIT Algorithms & Complexity Seminar, "Algorithmic Regularity for Polynomials and Applications" (Dec. 13, 2013)

- “Neoclassical Methods in Discrete Analysis” workshop at Simons Institute for Theory of Computing, "Algorithmic Regularity for Polynomials and Applications" (Dec. 3, 2013)
- Applied Statistics Unit of Indian Statistical Institute, "Every locally characterized affine-invariant property is testable" (Aug. 6, 2013)
- MIT Algorithms & Complexity Seminar, "Every locally characterized affine-invariant property is testable" (Apr. 17, 2013)
- ACO Seminar (CMU math), "Every locally characterized affine-invariant property is testable" (Apr. 4, 2013)
- University of Michigan EECS Theory Seminar, "Every locally characterized affine-invariant property is testable" (Mar. 22, 2013)
- Stanford CS Theory seminar, "Every locally characterized affine-invariant property is testable" (Mar. 14, 2013)
- Dartmouth College Theory Seminar, "Every locally characterized affine-invariant property is testable" (Jan. 18, 2013)
- Center for Exploring Limits of Computation (ELC), Tokyo, "Every locally characterized affine-invariant property is testable" (Nov. 30, 2012)

INDUSTRIAL COLLABORATION

- Consultant for the Computational Materials Science team at Shell Technology Center, 2015—2018.

JOURNAL PUBLICATIONS¹

Model Counting meets FO Estimation (with A Pavan, NV Vinodchandran and KS Meel)

Invited to ACM Transactions of Database Systems, 2022 (as “Best of PODS 21” paper)

ACM SIGMOD Record, 2022 (as “ACM SIGMOD Research Highlight” paper)

Invited to CACM Research Highlights, 2022.

Predicting winner and estimating margin of victory in elections using sampling (with P. Dey)

Artificial Intelligence, 2021.

Parameterized Intractability of Even Set and Shortest Vector Problem (with É. Bonnet, L. Egri, **S. Ghoshal**, Karthik C. S., B. Lin, P. Manurangsi, and D. Marx)

Journal of the ACM, 2021.

Machine Learning Constrained with Dimensional Analysis and Scaling Laws: Simple, Transferable, and Interpretable Models of Materials from Small Datasets (with N. Kumar, P. Rajagopalan, P. Pankajakshan, S. Sanyal, J. Balachandran)

Chemistry of Materials, 2019.

Discovering vesicle traffic network constraints by model checking (with A. Shukla, L. Kuppusamy, M. Srivas, and M. Thattai)

PLOS ONE, 2017.

Machine Learning and Statistical Analysis for Materials Science: Stability and Transferability of Fingerprint Descriptors and Chemical Insights (with P. Pankajakshan, S. Sanyal, O.E. de Noord, **I. Bhattacharya** and U. Waghmare)

Chemistry of Materials, 2017.

Tight lower bounds for linear 2-query locally correctable codes over finite fields (with Z. Dvir, S. Saraf, A. Shpilka)

Combinatorica, 2016.

Optimal algorithms for heavy hitters in insertion streams and related problems (with **P. Dey** and D. Woodruff)

ACM Transactions on Algorithms, 2019.

Lower bounds for constant query affine-invariant LCC's and LTC's (with S. Gopi)

ACM Transactions on Computation Theory, 2017.

On Testing Affine-Invariant Properties

Invited column on ACM SIGACT News, vol. 44, no. 4, 2013.

¹ Names in blue were students/interns under my supervision during co-authorship period.

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A bipartite graph with non-unimodal independent set sequence (with J. Kahn)

Electronic Journal of Combinatorics, vol. 20, no. 4, 2013.

Testing Odd-Cycle Freeness in Boolean Functions (with E. Grigorescu, P. Raghavendra, A. Shapira)

Combinatorics, Probability & Computing, 2012.

Approximation algorithms for spanner problems and directed Steiner forest (with P. Berman, K. Makarychev, S. Raskhodnikova, G. Yaroslavtsev)

Invited to special issue of Information and Computation, 2013.

Every locally characterized affine-invariant property is testable (with E. Fischer, H. Hatami, P. Hatami, S. Lovett)

Submitted to SIAM Journal of Computing.

Steiner transitive-closure spanners for low-dimensional posets (with P. Berman, E. Grigorescu, S. Raskhodnikova, D. Woodruff, G. Yaroslavtsev)

Combinatorica, 2014.

A Unified Framework for Testing Linear-Invariant Properties (with E. Grigorescu, A. Shapira)

Random Structures & Algorithms, 2012.

Lower Bounds for Monotonicity Reconstruction from Transitive-Closure Spanners (with E. Grigorescu, M. Jha, K. Jung, S. Raskhodnikova, D. Woodruff)

SIAM Journal of Discrete Mathematics, 2012.

Testing Linear-Invariant Non-linear Properties (with V. Chen, M. Sudan, N. Xie)

Theory of Computing, 2011.

Transitive Closure Spanners (with E. Grigorescu, K. Jung, S. Raskhodnikova, D. Woodruff)

SIAM Journal of Computing, 2012.

CONFERENCE PUBLICATIONS¹

An Adaptive Kernel Approach to Federated Learning of Heterogeneous Causal Effects (with Thanh V.V., Lee Y., Leong T.Y.)
Proc. Conference on Neural Information Processing Systems, 2022.

Independence Testing for Bounded Degree Bayesian Network (with C. Canonne and [Joy Qiping Y.](#))

Proc. Conference on Neural Information Processing Systems, 2022.

Verification and Search Algorithms for Causal DAGs (with [D. Choo](#) and K. Shiragur)

Proc. Conference on Neural Information Processing Systems, 2022.

Universal 1-Bit Compressive Sensing for Bounded Dynamic Range Signals (with [S. Bansal](#), A. Chaturvedi, and J.M. Scarlett)
Proc. IEEE Symposium on Information Theory, 2022.

Efficient Inference of interventional distributions (with S. Gayen, S. Kandasamy, [V. Raval](#), NV Vinodchandran)

Proc. International Conference on Artificial Intelligence and Statistics, 2022.

Learning Sparse Fixed-Structure Gaussian Bayesian Networks (with [D. Choo](#), R. Gajjala, S. Gayen, and [Y. Wang](#))

Proc. International Conference on Artificial Intelligence and Statistics, 2022.

Identifiability of AMP chain graphs (with [Y. Wang](#))

Proc. Association of Artificial Intelligence, 2022.

Model Counting meets F0 Estimation (with A Pavan, NV Vinodchandran and KS Meel)

Proc. ACM Principles of Database Systems, 2021.

Near-optimal learning of tree-structured distributions by Chow-Liu (with S Gayen, E Price, NV Vinodchandran)

Proc. ACM SIGACT Symposium on Theory of Computing, 2021.

Testing Product Distributions: A Closer Look (with S Gayen, S Kandasamy, NV Vinodchandran)

Proc. Algorithmic Learning Theory, 2021.

Efficient Statistics for Sparse Graphical Models from Truncated Samples (with [R Desai](#), SG Nagarajan, I Panageas)

Proc. International Conference on Artificial Intelligence and Statistics, 2021.

Efficient distance approximation for structured high-dimensional distributions via learning (with S Gayen, KS Meel, NV Vinodchandran)

Proc. Conference on Neural Information Processing Systems, 2020.

Efficiently Learning and Sampling Interventional Distributions from Observations (with S Gayen, S Kandasamy, A Maran, NV Vinodchandran)

Proc. International Conference on Machine Learning, 2020.

Combinatorial Lower Bounds for 3-query LDC's (with **S. Ghoshal** and S. Chandran)

Proc. Innovations in Theoretical Computer Science, 2020.

Minimum Intervention Cover of a Causal Graph (with **S. Kandasamy** and V. Honavar)

Proc. Association of Artificial Intelligence, 2019.

Parameterized Intractability of Even Set and Shortest Vector Problem from Gap-ETH (with **S. Ghoshal**, Karthik C.S, and P. Manurangsi)

Proc. International Colloquium on Automata, Languages and Programming, 2018.

Learning and Testing Causal Models with Interventions (with J. Acharya, C. Daskalakis, and **S. Kandasamy**)

Proc. Conference on Neural Information Processing Systems, 2018.

Hardness of learning noisy halfspaces using polynomial thresholds (with **S. Ghoshal** and R. Saket)

Proc. Conference on Learning Theory, 2018.

Improved bounds for universal one-bit compressed sensing (with J. Acharya and P. Kamath)

Proc. IEEE International Symposium on Information Theory, 2017.

On the gap between outcomes of voting rules (with **A. Mathur**). Extended abstract.

Proc. Conference on Autonomous Agents & Multiagent Systems, 2017.

Lower bounds for 2-query LCCs over large alphabet (with Sivakanth Gopi and Avishay Tal)

Proc. International Workshop on Randomization and Computation, 2017.

Higher-order Fourier Analysis over non-prime fields (with A. Bhowmick and **C. Gupta**)

Proc. International Workshop on Randomization and Computation, 2016.

On the hardness of learning sparse parities (with A. Gadekar, **S. Ghoshal** and R. Saket)

Proc. European Symposium on Algorithms, 2016.

Lower bounds for constant query affine-invariant LCC's and LTC's (with S. Gopi)

Proc. Computational Complexity Conference, 2016.

Optimal algorithms for heavy hitters in insertion streams and related problems (with **P. Dey** and D. Woodruff)

Proc. Principles of Database Systems, 2016.

How friends and non-determinism affect opinion dynamics (with **K. Shiragur**)

Proc. Conference on Decision and Control, 2015.

Sample Complexity for Winner Prediction in Elections (with **P. Dey**)

Proc. Conference on Autonomous Agents & Multiagent Systems, 2015.

Algorithmic Regularity for Polynomials and Applications (with P. Hatami and M. Tulsiani)

Proc. Symposium on Discrete Algorithms, 2015.

Polynomial decompositions in polynomial time

Proc. European Symposium on Algorithms, 2014.

Every locally characterized affine-invariant property is testable (with E. Fischer, H. Hatami, P. Hatami, S. Lovett)

Proc. ACM Symposium on Theory of Computing, 2013.

On the convergence of the Hegselmann-Krause system (with M. Braverman, B. Chazelle, H. Nguyen)

Proc. Innovations in Theoretical Computer Science, 2013.

An Algebraic Characterization of Testable CSPs (with Y. Yoshida)

Proc. International Colloquium on Automata, Languages and Programming, 2013.

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- Testing Low Complexity Affine-Invariant Properties* (with E. Fischer, S. Lovett)
Proc. SIAM Symposium on Discrete Algorithms, 2013.
- Testing Permanent Oracles – Revisited* (with S. Arora, R. Manokaran, S. Sachdeva)
Proc. Intl. Workshop on Randomization and Computation, 2012.
- Testing Odd-Cycle Freeness in Boolean Functions* (with E. Grigorescu, P. Raghavendra, A. Shapira)
Proc. SIAM Symposium on Discrete Algorithms, 2012.
- Tight lower bounds for linear 2-query locally correctable codes over finite fields* (with Z. Dvir, S. Saraf, A. Shpilka)
Proc. IEEE Foundations of Computer Science, 2011.
- Approximation algorithms for spanner problems and directed Steiner forest* (with P. Berman, K. Makarychev, S. Raskhodnikova, G. Yaroslavtsev)
Proc. Intl. Colloquium on Automata, Languages and Programming, 2011.
- Steiner transitive-closure spanners for low-dimensional posets* (with P. Berman, E. Grigorescu, S. Raskhodnikova, D. Woodruff, G. Yaroslavtsev)
Proc. Intl. Colloquium on Automata, Languages and Programming, 2011.
- The Complexity of Linear Dependence Problems in Vector Spaces* (with P. Indyk, D. Woodruff, N. Xie)
Proc. Innovations in Computer Science, 2011.
- Testing Monotonicity of distributions over general partial orders* (with E. Fischer, R. Rubinfeld, P. Valiant)
Proc. Innovations in Computer Science, 2011.
- A Unified Framework for Testing Linear-Invariant Properties* (with E. Grigorescu, A. Shapira)
Proc. Foundations of Computer Science, 2010.
- Optimal Testing of Reed-Muller Codes* (with S. Kopparty, G. Schoenebeck, M. Sudan, D. Zuckerman)
Proc. Foundations of Computer Science, 2010.
- Lower Bounds for Monotonicity Reconstruction from Transitive-Closure Spanners* (with E. Grigorescu, M. Jha, K. Jung, S. Raskhodnikova, D. Woodruff)
Proc. Intl. Workshop on Randomization and Computation, 2010.
- Lower Bounds for Testing Triangle-freeness in Boolean Functions* (with N. Xie)
Proc. SIAM Symposium on Discrete Algorithms, 2010.
- Testing Linear-Invariant Non-linear Properties* (with V. Chen, M. Sudan, N. Xie)
Proc. Symposium on Theoretical Aspects of Computer Science, 2009.
- Transitive Closure Spanners* (with E. Grigorescu, K. Jung, S. Raskhodnikova, D. Woodruff)
Proc. SIAM Symposium on Discrete Algorithms, 2009.
SIAM Journal of Computing, vol. 41, no. 6, 2012.

BOOKS

- Property Testing* (with Y. Yoshida)
Springer, Singapore 2022.