Pratik Worah

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Employment

July 2015 - current

Senior Research scientist at Google Research.
Research Area: Neural networks and their limitations.

May 2014 - July 2015

Quantitative researcher at the Pacific Investment Management Company.
Research Area: Mathematical models for bond and derivative investment strategies.

July 2013 - May 2014

Post Doctoral researcher at the Courant Institute of Mathematical Sciences.
Research Area: Theoretical Computer Science and Mathematics.

May 2008–Sept. 2009

Software Engineer at Google inc.; Mountain view, California.
Designed and implemented algorithms for ranking web-pages for web-search.

Other Notable Positions

April 2018 - current

Visiting academic at the Courant Institute of Mathematical Sciences.
Research Area: Probability theory.

Education

June 2013

University of Chicago
Ph.D. in Theoretical Computer Science.

May 2008

University of Illinois at Urbana-Champaign
M.S. in Applied Mathematics.

May 2006
Indian Institute of Technology, Kharagpur.
B.Tech. and M.Tech. (Dual degree)
Dept.: Computer Science & Engineering.

Awards & Honors

2021   The president's volunteer service award for service during Covid (Americorps).

2006   Saburo Muroga fellowship at University of Illinois at Urbana-Champaign.

2006   Best thesis award by the Computer Science Dept. at IIT Kharagpur.

2002   J.C. Bose National Science scholarship.

2000   Selected among 30 students in the state of West Bengal for appearing in the Indian National Mathematics Olympiad.

Programming Languages: C/C++, Python, Mathematica.

Publications and Posters[1]

[1] **Papers with application to medicine**

   (i) *Learning rate schedules in the presence of distribution shift.* Joint with M.Fahrbach, A.Javanmard, V.Mirrokni, Proceedings of Machine Learning Research (ICML), 2023.

  (ii) *Designing optimal tests for slow converging Markov chains.* Joint with C.Stein, IMLH (ICML), 2023.

 (iii) *Enhancing small molecule selectivity using Wasserstein distance based reweighing.* Recomb 2024.

 (iv) *Recovering approximate single cell distribution from aggregate measurements.** Recomb-seq, 2024.

  (v) *Approximating a linear dynamical system from non-sequential data.* Joint with C.Stein. Recomb-genetics, 2024.

[2] **Neural networks**

   (i) *The Landscape of Nonconvex-Nonconcave Minimax Optimization.* Joint with Benjamin Grimmer, Haihao Lu, and Vahab Mirrokni, Math. Prog. (Springer Nature), 2022.

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[1]All papers, except the ones marked *, are peer reviewed and published. The ones marked * have been presented as posters and their full versions are under submission.

(ii) *Limiting Behaviors of Nonconvex-Nonconcave Minimax Optimization via Continuous-Time Systems*. Joint with Benjamin Grimmer, Haihao Lu, and Vahab Mirrokni, Algorithmic Learning Theory, 2022

(iii) *The spectrum of the Fisher Information matrix of a single hidden layer neural network*. Joint with J. Pennington, Neural Information and Processing Systems, 2018.

(iv) *Nonlinear random matrix theory for deep learning*. Joint with J. Pennington, Neural Information and Processing Systems, 2017.

[3] **Economics and pricing theory**

(i) *Description Complexity of Regular Distributions*. Joint with R.P.Leme, B.Sivan, Y.Teng, P.Worah, ACM conference on Electronic Commerce, 2023.

(ii) *Pricing Query Complexity of Revenue Maximization*. Joint with R.P.Leme, B.Sivan, Y.Teng, P.Worah, SIAM symposium on discrete algorithms, 2023.

(iii) *Learning to Price Against a Moving Target*. Joint with R.P.Leme, B.Sivan, Y.Teng, P.Worah, International Conference on Machine Learning, 2021.

(iv) **Spectral methods and pricing options on private equity*. Joint with P. Carr, under submission to Jounral of Derivatives.

(v) *Optimal rates from eigenvalues*. Joint with P. Carr, Finance Research Letters, 2016.

[4] **Complexity Theory and Lower Bounds**

(i) *A characterization of Strong Approximation Resistance*. Joint with S. Khot and M. Tulsiani. ACM Symposium on Theory of Computing, 2014.

(ii) **A short excursion into semi-algebraic hierarchies*. ECCC TR13-007, 2012. (A short survey).

(iii) *The complexity of Somewhat Approximation Resistant predicates*. Joint with S. Khot and M. Tulsiani. International Colloqium on Automata, Languages and Programming, 2014.

(iv) *LS_+ Bounds from pairwise independence*. Joint with M. Tulsiani. 28th IEEE Conference on Computational Complexity, 2013.

(v) *Rank Bounds for a Hierarchy of Lovász and Schrijver*. Journal of Combinatorial Optimization, 2013.

[5] **Algorithms and Combinatorics**

(i) *A control version of the Freidlin-Wentzell Theorem*. American Control Conference, 2018.

(ii) *Total acquisition in graphs*. Joint with T. LeSaulinier, N. Prince, P. Wenger, and D. West. SIAM Journal on Discrete Mathematics, 2013.

(iii) *Computing the shortest Essential Cycle*. Joint with J. Erickson. Discrete and Computational Geometry, 2010.

(iv) *Testing contractibility in planar Rips complexes*. Joint with E. Chambers and J. Erickson. 24th *Symposium on Computational Geometry*, 2008.

(v) *A linear time deterministic algorithm to find a small subset that approximates the centroid*. Joint with Sandeep Sen. Information Processing Letters, 2007.

(vi) *A temporal logic characterization of observational determinism*. Joint with M.Huisman, K.Sunesen, IEEE Computer Security Foundations Workshop, 2006.