

Gaurav Sinha

Data and Applied Scientist
Bing Ads, Microsoft

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Work Experience

- **Microsoft Bing Ads** Sunnyvale, CA
Data and Applied Scientist - Ranking Allocation and Pricing - Core Algorithms Team 2016 - current
 - Formulated and designed a new **ad-ranking function** which targets only a selection of ads and minimally affects others. Proved hard bounds on the price impact. Implemented the mechanism for simulations and obtained expected revenue gains of 1.2% to 1.5%. Currently working with Infrastructure teams to implement the changes into Bing Ads' code and then analyze impact in terms of revenue and advertiser behaviour.
 - Created a new interpolation approach to **tuning auction parameters in Bing Ads** based on a research paper of mine. The current method uses grid points to simulate auctions and select optimal parameters for business goals. My approach improves running time by 3x and achieves better accuracy thereby improving efficiency. The work is being used by the team and has been quite impactful. It will be submitted to a machine learning/ data science conference.
 - Developed and trained machine learning models on auction data to understand advertiser behavior, address privacy questions and improve overall performance. Developed, implemented and tested a modification to the current auction mechanism for Product Ads. Designed a convex optimization approach to modelling advertiser profits. Investigating the applicability of the suggested model.

Education

- **CalTech** Pasadena, CA
Ph.D. Mathematics 2011 - 2016
 - Researcher in Algebraic Combinatorics with Prof. Eric Rains.
 - Teaching Assistant for Calculus, Analysis, Probability, Differential Equations.
- **Indian Institute of Technology** Kanpur, India
Integrated (5 yr) M.Sc. in Mathematics and Scientific Computing 2006 - 2011
 - Best M.Sc. Project Award (by IIT Kanpur), for best masters research project in mathematics.
 - Suman Gupta Gold Medal, for being topper in the outgoing mathematics class of 2011.
 - KVPY Fellowship (by Dept. of Science and Technology India) for undergraduate studies.

Publications

1. *Efficient exact learning of depth three circuits with top fan-in two over finite fields*, To be submitted.
2. *SparTun: Sparse Grid Parameter Tuning in Bing Ads*, To be Submitted.
3. *Reconstruction of $\Sigma\Pi\Sigma(2)$ circuits over \mathbb{R}* , *Conference on Computational Complexity (CCC) 2016*.
4. *Black-box reconstruction of depth three circuits with top fan-in two*, *PhD Thesis, CalTech 2015*.
5. *Multiple point evaluation on combined tensor product supports*, (with R.Hiptmair, G.Widmer) *Numerical Algorithms 2012, SAM Report 2011-63*.
6. *JSZap: Compressing JavaScript Code*, (with M. Burtcher, B. Livshits, B. Zorn) *USENIX WebApps, MSR-TR-2010-21, 2010*.
7. *Fast Evaluation on Adaptive Sparse Grids*, (with R. Hiptmair and G. Widmer). *SIAM Conference on Computational Science and Engineering (Undergraduate Research Experience) 2009*.

Patent

- **JSZap: Compressing JavaScript Code**, US Patent No : US 20110219357 A1

Olympiads, Programming Contests, Awards

1. Qualified Indian National Mathematics Olympiad(**INMO**) and selected for International Mathematical Olympiad(**IMO**) Training Camp in 2005 and 2006.
2. Qualified Indian National Olympiad in Informatics(**INOI**) and selected for International Olympiad in Informatics(**IOI**) Training Camp in 2006.
3. World Rank 2 in **International Online Programming contest** (by IIT Kanpur) successively for two years.
4. Prof. J N Kapur Prize (by Math Sciences Trust Society) for excellence in mathematics as an undergraduate.
5. Academic Excellence Award (by IIT Kanpur), for excellent academic performance in an academic year.

Relevant Research Experience

- **Exact learning of depth three polynomials over finite fields** '16-'17
Self
 - Solved an open problem from a recent paper on reconstruction of arithmetic circuits.
 - Running time of previous known algorithm was quasi-polynomial (with dependence on field size).
 - Using Enumerative Geometry, reduced complexity to polynomial time (and independent of field size).
- **Learning depth three polynomials over reals** Microsoft Research India
with Dr. Neeraj Kayal '11-'15
 - Solved an open problem on **Reconstructing Real $\Sigma\Pi\Sigma(2)$ polynomials**
 - Used techniques from Algebraic Geometry and recent results from Incidence Geometry.
 - First polynomial time exact **Learning Algorithm** for this class
- **Generalized Polynomial Association Schemes** CalTech
with Prof. Eric Rains '11 - '16
 - Generalized P-Polynomial Association Schemes to Multivariate Case.
 - Discovered many results and connections to Orthogonal Polynomial Theory.
- **JSZap: Compressing JavaScript Code** Microsoft Research Redmond
with Dr. Ben Zorn May '09 - July '09
 - Designed + Implemented a new strategy for **compressing JavaScript**.
 - Achieved **15 % better compression** than the existing techniques.
 - Implementation was carried out in C# and was around **8000 + lines of code**.
- **Fast Evaluation on Sparse Grids** ETH Zurich
with Prof. Ralf Hiptmair May '08 - July '08
 - Solved a challenging problem about interpolation in an Adaptive Sparse Grid.
 - Our algorithm **lowers the complexity** from $O(n^2)$ to $O(n \log^2 n)$.
 - **4000 + lines** of C++ code.

Technical Skills

Python, SQL, C, C++, C#, Java, L^AT_EX,