Aniket Das

Google AI Research, RMZ Infinity
Bangalore, Karnataka, India
ketd@google.com | 1998.aniket.das@gmail.com
Webpage : https://aniket1998.github.io/
Scholar : https://scholar.google.com/citations?user=o8Dyas0AAAAJ

PRE-DOCTORAL RESEARCHER, GOOGLE RESEARCH INDIA

EDUCATION

Indian Institute of Technology Kanpur   *Aug' 17 - May' 22*
*BTech in **Electrical Engineering** and BS in **Mathematics** (Double Major)*
GPA :   *Overall* **9.3/10** *Mathematics* **9.8/10**   *8 Semesters*

Aalto University, Finland   *Jan' 20 - Jan' 21*
Year-long Academic Exchange in Aalto University School of Science
GPA : 4.8/5.0   *2 Semesters*

INTERESTS

Sampling Algorithms, Markov Chains, Stochastic Optimization, Statistical Learning Theory
Optimal Transport, Applied Probability

PUBLICATIONS

Provably Fast Finite-Particle Variants of SVGD via Virtual Particle Stochastic Approximation
Aniket Das, Dheeraj Nagaraj $(\alpha\beta)$
Neural Information Processing Systems (NeurIPS) 2023 [**Spotlight**] [Paper]

Utilising the CLT Structure in Stochastic Gradient based Sampling : Improved Analysis and Faster Algorithms
Aniket Das, Dheeraj Nagaraj, Anant Raj $(\alpha\beta)$
Conference On Learning Theory (COLT) 2023 [Paper]

Near-Optimal Heteroscedastic Regression with Symbiotic Learning
Dheeraj Baby, **Aniket Das**, Dheeraj Nagaraj, Praneeth Netrapalli $(\alpha\beta)$
Conference On Learning Theory (COLT) 2023 [Paper]

Sampling without Replacement Leads to Faster Rates in Finite-Sum Minimax Optimization
Aniket Das, Bernhard Schölkopf, Michael Muehlebach
Neural Information Processing Systems (NeurIPS) 2022 [Paper]

NeurInt - Learning Interpolation by Neural ODEs
Avinandan Bose*, **Aniket Das***, Yatin Dandi, Piyush Rai
Workshop on Deep Learning and Differential Equations @ NeurIPS 2021 [**Spotlight**] [Paper]

Jointly Trained Image and Video Generation using Residual Vectors
Yatin Dandi, **Aniket Das**, Soumye Singhal, Vinay P. Namboodiri, Piyush Rai
IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2020 [Paper]

TorchGAN: A Flexible Framework for GAN Training and Evaluation
Avik Pal*, **Aniket Das***
Journal of Open Source Software (JOSS) [Paper]

$(\alpha\beta)$: *indicates alphabetical ordering*   ∗ : *indicates equal contribution*

EXPERIENCE

Google Research India
Pre-Doctoral Researcher, Machine Learning and Optimization (MLO)   *July '22 - Present*

- Working on sampling, spin systems, high dimensional statistics and stochastic optimization
- Published two papers at COLT 2023 on SGLD and minimax optimal heteroscedastic regression, and one spotlight paper at NeurIPS 2023 on finite particle convergence of SVGD.

Max Planck Institute for Intelligent Systems, Tübingen
Advisors : Michael Muehlebach and Bernhard Schölkopf   *May '21 - Dec'21*

- Worked on stochastic minimax optimization and gradient flows for constrained optimization
- Paper on sampling without replacement for minimax optimization published at NeurIPS 2022

Tata Institute of Fundamental Research, Bombay
Advisor : Sandeep Juneja   *Apr '21 - Jul'21*

- Worked on instance-dependent lower bounds for PAC learning in Markov Decision Processes and structured stochastic bandits

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SELECTED
PROJECTS

Rapid Convergence of Finite-Particle SVGD using Virtual Particles
Advisor : Dheeraj Nagaraj, Google Research   *[NeurIPS'23 Spotlight Paper]*

- Developed computationally efficient variants of Stein Variational Gradient Descent with provably fast convergence in the finite-particle regime
- Obtained the first known polynomial gradient oracle complexity for any SVGD-type algorithm, that enjoys a double exponential improvement over prior state-of-the-art
- Applied techniques from Optimal Transport, Geometry, Dynamical systems and Functional Analysis.
- Accepted as a **Spotlight Paper** at *Neural Information Processing Systems (NeurIPS) 2023*

CLT Analysis of Stochastic-Gradient Based Sampling
Advisor : Dheeraj Nagaraj, Google Research   *[COLT'23 Paper]*

- Developed novel non-asymptotic Central Limit Theorems to analyze the interaction between the stochastic approximation noise and diffusion noise in stochastic-gradient based sampling algorithms
- Obtained state-of-the art convergence guarantees for Stochastic Gradient Langevin Dynamics (SGLD) and the Random Batch Method (RBM) for Interacting Particle Dynamics
- Designed the Covariance Correction procedure to enable provably faster convergence of SGLD and RBM without added computational complexity
- Applied techniques from Stochastic Calculus, Markov Diffusion Processes and Optimal Transport
- Work is published at *Conference on Learning Theory (COLT), 2023*

Minimax Optimal Heteroscedastic Regression
Advisors : Dheeraj Nagaraj and Praneeth Netrapalli, Google Research   *[COLT'23 Paper]*

- Established tight (modulo log factors) non-asymptotic upper and lower bounds for the sample complexity of heteroscedastic linear regression.
- Derived fast rates for linear regression and phase retrieval under the multiplicative noise (or noisy covariate) model
- Developed a novel adaptation of Assouad's Lemma for heavy-tailed settings which applies even when the mutual information between two problem instances is infinite
- Utilised techniques from High Dimensional Statistics, Random Matrices and Information Theory.
- Work is published at *Conference on Learning Theory (COLT), 2023*

Sampling without Replacement for Finite-Sum Minimax Optimization
Advisors : Michael Muehlebach and Bernhard Schölkopf, MPI-IS   *[NeurIPS'22 Paper]*

- Analyzed stochastic gradient minimax optimization algorithms that sample the data points without replacement and demonstrated that they lead to faster convergence than uniform sampling.
- Derived near-optimal rates for GDA and PPM with Random Reshuffling, Single Shuffling and Incremental Gradient for solving finite-sum strongly monotone variational inequalities
- Developed an algorithm which combines without-replacement sampling with alternating updates to converge faster than with-replacement sampling for nonconvex-nonconcave minimax optimization.
- Utilised techniques from Game Theory, Variational Inequalities and Stochastic Optimization
- Work is published at *Neural Information Processing Systems (NeurIPS),2022*

Near-Optimal Streaming Heavy Tailed Stochastic Optimization
Advisors : Dheeraj Nagaraj and Arun Suggala, Google Research

- Rigorously analyzed the popular clipped SGD heuristic for heavy-tailed Stochastic Convex Optimization (SCO) in the streaming setting
- Proved that clipped SGD nearly achieves the optimal sub-Gaussian statistical rate for heavy-tailed SCO under smoothness and strong convexity
- Applied techniques from Stochastic Optimization and Heavy-tailed Statistics
- Currently working on extending our analysis to problems without strong convexity

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RELEVANT COURSEWORK

Computer Science	Introduction to Programming, Data Structures and Algorithms, Advanced Algorithms, Toolkit for Theoretical Computer Science$^\Pi$,
Probability Statistics & ML	Optimization in ML, Kernel Methods and Learning Theory, Advanced Probability Theory$^\Pi$, Markov Chains and Mixing Times$^\Pi$, Probabilistic ML, State Space Models
Mathematics	Real Analysis, Complex Analysis, Functional Analysis, Topology, Measure Theory, Differential Geometry, Dynamical Systems, Ordinary Differential Equations, Partial Differential Equations, Linear Algebra, Abstract Algebra, Numerical Methods

Π : *Audited at Tata Institute of Fundamental Research (TIFR), Mumbai*

TALKS

Utilising the CLT Structure in Stochastic Gradient-Based Sampling
Conference on Learning Theory 2023

Near-Optimal Heteroscedastic Regression with Symbiotic Learning
Conference on Learning Theory 2023

SERVICE

2023	**Reviewer**	JMLR
2023	**Reviewer**	NeurIPS 2023
2021	**Reviewer**	AISTATS 2022
2021	**Reviewer**	NeurIPS 2021 DLDE Workshop
2019-20	**Co-ordinator**	Special Interest Group in Machine Learning, IIT Kanpur
2019-20	**Project Mentor**	Programming Club, IIT Kanpur
2021	**Project Mentor**	Stamatics (Math Club), IIT Kanpur