

# Aniket Das

PRE-DOCTORAL RESEARCHER, GOOGLE RESEARCH INDIA

EDUCATION	<b>Indian Institute of Technology Kanpur</b> <i>BTech in <b>Electrical Engineering</b> and BS in <b>Mathematics</b> (Double Major)</i> <b>GPA : Overall 9.3/10 Mathematics 9.8/10</b>	<i>Aug' 17 - May' 22</i> <i>8 Semesters</i>
	<b>Aalto University, Finland</b> <i>Year-long Academic Exchange in Aalto University School of Science</i> <b>GPA : 4.8/5.0</b>	<i>Jan' 20 - Jan' 21</i> <i>2 Semesters</i>

INTERESTS	Sampling Algorithms, Markov Chains, Stochastic Optimization, Statistical Learning Theory Optimal Transport, Applied Probability
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PUBLICATIONS	<b><i>Provably Fast Finite-Particle Variants of SVGD via Virtual Particle Stochastic Approximation</i></b> <b>Aniket Das, Dheeraj Nagaraj (<math>\alpha\beta</math>)</b> <i>Neural Information Processing Systems (NeurIPS) 2023 [Spotlight] [Paper]</i>
	<b><i>Utilising the CLT Structure in Stochastic Gradient based Sampling : Improved Analysis and Faster Algorithms</i></b> <b>Aniket Das, Dheeraj Nagaraj, Anant Raj (<math>\alpha\beta</math>)</b> <i>Conference On Learning Theory (COLT) 2023 [Paper]</i>
	<b><i>Near-Optimal Heteroscedastic Regression with Symbiotic Learning</i></b> <b>Dheeraj Baby, Aniket Das, Dheeraj Nagaraj, Praneeth Netrapalli (<math>\alpha\beta</math>)</b> <i>Conference On Learning Theory (COLT) 2023 [Paper]</i>
	<b><i>Sampling without Replacement Leads to Faster Rates in Finite-Sum Minimax Optimization</i></b> <b>Aniket Das, Bernhard Schölkopf, Michael Muehlebach</b> <i>Neural Information Processing Systems (NeurIPS) 2022 [Paper]</i>
	<b><i>NeurInt - Learning Interpolation by Neural ODEs</i></b> <b>Avinandan Bose*, Aniket Das*, Yatin Dandi, Piyush Rai</b> <i>Workshop on Deep Learning and Differential Equations @ NeurIPS 2021 [Spotlight] [Paper]</i>
	<b><i>Jointly Trained Image and Video Generation using Residual Vectors</i></b> <b>Yatin Dandi, Aniket Das, Soumye Singhal, Vinay P. Namboodiri, Piyush Rai</b> <i>IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2020 [Paper]</i>
	<b><i>TorchGAN: A Flexible Framework for GAN Training and Evaluation</i></b> <b>Avik Pal*, Aniket Das*</b> <i>Journal of Open Source Software (JOSS) [Paper]</i>
	$(\alpha\beta)$ : indicates alphabetical ordering      * : indicates equal contribution

EXPERIENCE	<b>Google Research India</b> <i>Pre-Doctoral Researcher, Machine Learning and Optimization (MLO)</i>	<i>July '22 - Present</i>
	<ul style="list-style-type: none"> <li>- Working on sampling, spin systems, high dimensional statistics and stochastic optimization</li> <li>- 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.</li> </ul>	

## 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

<b>Computer Science</b>	Introduction to Programming, Data Structures and Algorithms, Advanced Algorithms, Toolkit for Theoretical Computer Science <sup>II</sup> ,
<b>Probability Statistics &amp; ML</b>	Optimization in ML, Kernel Methods and Learning Theory, Advanced Probability Theory <sup>II</sup> , Markov Chains and Mixing Times <sup>II</sup> , Probabilistic ML, State Space Models
<b>Mathematics</b>	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

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

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### 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

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### SERVICE

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