Aniket Das

PRE-DOCTORAL RESEARCHER, GOOGLE DEEPMIND

Education	Indian Institute of Technology KanpurJul' 17 - May' 22 (8 Semesters)BTech. in Electrical EngineeringSecond Major in Mathematics & Scientific ComputingOverall GPA : 9.3/10Mathematics GPA : 9.8/10			
	Aalto UniversityJan' 20 - Dec' 20 (2 Semesters)Academic Exchange in Aalto University School of ScienceGPA : 4.78/5			
INTERESTS	Markov Chains and Mixing Times, Applied Probability, High Dimensional Statistics, Dynamical Systems and Optimization			
Publications	1. Provably Fast Finite-Particle Variants of SVGD via Virtual Particle Stochastic Approximation Aniket Das, Dheeraj Nagaraj Spotlight at Neural Information Processing Systems 2023 Oral at Optimal Transport and Machine Learning Workshop, NeurIPS 2023			
	2. Utilising the CLT Structure in Stochastic Gradient based Sampling : Improved Analysis and Faster Algorithms Aniket Das, Dheeraj Nagaraj, Anant Raj Conference On Learning Theory 2023 $[\alpha\beta]$ [COLT'23]			
	3. Near Optimal Heteroscedastic Regression with Symbiotic Learning Dheeraj Baby, Aniket Das , Dheeraj Nagaraj, Praneeth Netrapalli $[\alpha\beta]$ [COLT'23]			
	 4. Sampling without Replacement Leads to Faster Rates in Finite-Sum Minimax Optimization Aniket Das, Bernhard Schölkopf, Michael Muehlebach Neural Information Processing Systems 2022 			
	 5. NeurInt - Learning Interpolation by Neural ODEs Avinandan Bose*, Aniket Das*, Yatin Dandi, Piyush Rai Spotlight at DL & Differential Equations Workshop, NeurIPS 2021 [DLDE'21] 			
	6. TorchGAN: A Flexible Framework for GAN Training and Evaluation Avik Pal*, Aniket Das* Journal of Open Source Software 2021 [JOSS'21]			
	 Jointly Trained Image and Video Generation using Residual Vectors Yatin Dandi, Aniket Das, Soumye Singhal, Vinay P. Namboodiri, Piyush Rai Winter Conference on Applications of Computer Vision 2020 [WACV'20] 			
	[lphaeta] : indicates alphabetical ordering $*$: indicates equal contribution			
Experience	Google DeepMind, Bangalore			

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

- \clubsuit Working on markov chains, 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
 [Remote]

 Internship Advisors : Michael Muehlebach and Bernhard Schölkopf
 July '21 - Dec '21

- \clubsuit 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, Mumbai

Internship Advisor : Sandeep Juneja

SELECTED

Projects

[Remote] Apr '21 - Jun '21

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

Rapid Convergence of Finite-Particle SVGD using Virtual Particles

Advisor : Dheeraj Nagaraj, Google DeepMind [NeurIPS'23 Spotlight + OTML'23 Oral]

- Developed computationally efficient variants of Stein Variational Gradient Descent (SVGD) with provably fast convergence in the finite-particle regime.
- Obtained the first known gradient oracle complexity for SVGD that exhibits polynomial scaling in dimension and error tolerance. Obtained a double exponential speedup over prior works.
- Developed a novel and highly general technique for designing stochastic approximations in the space of measures that admit an exact finite-particle implementation
- Applied techniques from Wasserstein Gradient Flows, Differential Geometry and Functional Analysis.
- Accepted as a Spotlight Paper at Neural Information Processing Systems (NeurIPS) 2023. Selected for Oral Presentation at Optimal Transport & Machine Learning Workshop, 2023.

CLT Analysis of Stochastic-Gradient Based Sampling Advisor : Dheeraj Nagaraj, Google DeepMind

[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 rates for Stochastic Gradient Langevin Dynamics (SGLD) under minimal isoperimetric conditions.
- Analyzed the Random Batch Method (RBM) for simulating Interacting Particle Dynamics and derived state of the art trajectory-level guarantees under minimal assumptions.
- Derived the first known convergence rates for the Covariance Correction heuristic, and proved that it enables faster convergence of SGLD and RBM without added computational complexity.
- \blacklozenge Applied techniques from Stochastic Calculus, Markov Chains and Optimal Transport Theory.
- ♦ Work is published at *Conference on Learning Theory (COLT)*, 2023.

Minimax Optimal Heteroscedastic Linear Regression

Advisors : Dheeraj Nagaraj and Praneeth Netrapalli, Google DeepMind [COLT'23 Paper]

- Developed a computationally efficient Alternating Minimization algorithm for heteroscedastic linear regression that exhibits minimax optimal sample complexity (modulo log factors).
- Designed statistically and computationally efficient algorithms for linear regression and phase retrieval under the multiplicative noise model.
- Utilized the spectral properties of rank-deficient Wishart matrices to design a novel adaptation of LeCam's method which is robust to infinite mutual information quantities.
- ✤ Applied 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 Gradient Descent Ascent and Proximal Point Method under without-replacement sampling for finite-sum strongly monotone variational inequalities.
- Combined alternating updates and without-replacement sampling to outperform sampling with replacement for nonconvex-nonconcave problems satisfying a two-sided PL inequality.

	 Rigorously demonstrated the effectiveness of data ordering attacks on finite-sum minimization and minimax optimization by deriving near-optimal rates under the Adversarial Shuffling model. Utilized techniques from Game Theory, Variational Inequalities and Nonconvex Optimization. Work is published at <i>Neural Information Processing Systems (NeurIPS), 2022.</i> 			
	 Linear Time Streaming Algorithms for Heavy Tailed Statistics Advisors : Dheeraj Nagaraj and Arun Sai Suggala, Google DeepMind [In Preparation] Analyzed fine-grained information-computation-memory tradeoffs for high-dimensional heavy tailed statistical estimation Developed linear time algorithms for heavy-tailed statistical estimation in the streaming setting which nearly attain the optimal statistical rate. Developed a novel PAC Bayesian iterative refinement technique for proving fine-grained concen- tration of vector-valued martingales. Utilized techniques from Stochastic Optimization, High Dimensional Statistics and Applied Proba- bility. 			
Relevant Coursework	Computer Science	Introduction to Programming, Data Structures a Advanced Algorithms, Toolkit for Theoretical Co	and Algorithms, omputer Science [†] ,	
	Probability Statistics & ML	Advanced Probability Theory [†] , Markov Chains a Optimization, Kernel Methods and Learning The Statistical Signal Processing, State Space Models Probabilistic Modelling & Inference, ML for Sign	and Mixing Times [†] , eory, s nal Processing	
	Mathematics	Real Analysis, Complex Analysis, Functional An Measure Theory, Differential Geometry, Dynami- Ordinary Differential Equations, Partial Differen Linear Algebra, Abstract Algebra, Numerical Me	alysis, Topology, cal Systems, tial Equations, ethods	
	† : Audited Remotely at Tata Institute of Fundamental Research (TIFR), Mumbai			
Talks	Sampling Through t MSR-IISc Theory Semin	he Lens of Optimization : Recent Advances nar 2023, EPFL FLAIR Seminar 2024	and Insights Slides] [Video]	
	Utilising the CLT Structure in Stochastic Gradient-Based Sampling Conference on Learning Theory 2023 [Slides]			
	Near-Optimal Heteroscedastic Regression with Symbiotic LearningConference on Learning Theory 2023[Slides]			
Service	Reviewer JI Co-ordinator Sp Project Mentor P	MLR, NeurIPS 2023, AISTATS 2022, NeurIPS 202 pecial Interest Group in Machine Learning, IIT Ka rogramming Club, IITK and Stamatics (Math Clu	21 DLDE Workshop anpur b), IITK	
Awards and Honors	Academic Excellence Award, IIT Kanpur KVPY Scholarship, Govt. of India			