Ajinkya K. **Mulay**

Machine Learning Engineer · Privacy Researcher

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Research Interests

Privacy, Federated Learning & AutoML: My primary focus is learning, designing, and building privacy-preserving federated and automated learning systems. In my Ph.D. thesis, I study ways to minimize the expected risk of differentially private and federated algorithms for finite samples, and high dimensional models. My past research interests include Wireless Communications (3G and 4G), IoT, and Computational Social Sciences.

Education

Purdue University — *W. Lafayette, IN*

PhD in Electrical and Computer Engineering — *Aug. 2018 - Dec. 2023*

- Advised by *Prof. Xiaojun Lin*
- GPA: 3.6/4.0
- **Thesis:** Designing Optimal Locally Differentially Private and Federated Algorithms

Indian Institute of Technology, Hyderabad — *Hyderabad, India*

B.Tech (with Honors) in Electrical Engineering — *Aug. 2014 - May 2018*

- Advised by *Prof. Bheemarjuna Reddy*
- GPA: 8.88/10
- **Thesis:** Inference aware game-theoretic framework for unlicensed LTE and Wi-Fi Bands

Skills

Research Topics:	Differential Privacy, Federated Learning, Synthetic datasets, Document AI, Computational Social Sciences
Machine Learning	PyTorch, Tensorflow, Keras, Scikit-Learn, PySyft, Pandas, Numpy, Matplotlib
Programming	Python, C++, R, Go, AWS

Honors & Awards

2020	**Graduate Research Assistantship**, SuperPower Group, Psychological Sciences, Purdue	*Indiana, USA*
2017	**Two-Year Graduate Teaching Assistantship**, Electrical and Computer Engineering Department, Purdue	*Indiana, U.S.A*
2018	**Winner and World Finalist for Emergensor Startup**, Microsoft Imagine Cup, Japan National Final	*Tokyo, Japan*
2018	**Winner**, Third Business Plan Competition, University of Tokyo	*Tokyo, Japan*
2017	**India-Japan Engineering Program Research Scholarship**, University of Tokyo	*Tokyo, Japan*
2016	**Undergraduate Teaching Assistantship**, IIT Hyderabad	*India*
2016	**Special Recognition & 8th Rank for Young Team**, IEEE Signal Processing Cup	*India*
2014	**Academic Excellence Award**, IIT Hyderabad	*India*
2010	**Recipient of the prestigious National Talent Search Examination (N.T.S.E)**, Govt. of India	*India*

Workshop Publications

Ajinkya Mulay, Sean Lane, Erin Hennes "Private Hypothesis Testing for Social Sciences" — *SuperPower Lab, Purdue*

Theory and Practice of Differential Privacy, ICML 2022

Ajinkya Mulay, Sean Lane, Erin Hennes "PowerGraph: Using neural networks and principal components to multivariate statistical power trade-offs" — *SuperPower Lab, Purdue*

AI for Science, ICML 2022

Rakshit Naidu, Harshita Diddee, Ajinkya Mulay, Aleti Vardhan, Krithika Ramesh, Ahmed Zamzam, "Towards Quantifying the Carbon Emissions of Differentially Private Machine Learning" — *OpenMined*

Socially Responsible Machine Learning, ICML 2021

Ajinkya Mulay, Tushar Semwal, Ayush Agrawal, "FedPerf: A Practitioners' Guide to Performance of Federated Learning Algorithms" — *OpenMined*

NeurIPS 2020 Pre-Registration Experiment Workshop

Journal Publications

Ajinkya Mulay, Anand Basawade, Bheemarjuna Tamma, Anthony Franklin, "DFC: Dynamic UL-DL Frame Configuration for Improving Channel Access in eLAA" *NeWS Lab, IIT Hyderabad*

IEEE Networking Letters

Invited Talks

2023 **Privacy of Noisy SGD**, ML Theory, Cohere for AI

2022 **How to promote open science under privacy**, Psychological Sciences Department, Purdue University

2022 **PowerGraph: Using neural networks and principal components to multivariate statistical power trade-offs**, IMPS

2021 **Graphing multivariate statistical power manifolds with Machine Learning**, MCP Colloquium, Purdue University

2020 **FedPerf: A Practitioners' Guide to Performance of Federated Learning Algorithms**, NeurIPS Pre-Registration Workshop

Experience

Meta (Facebook) *Menlo Park, CA*

Ph.D. Software Engineering Intern *May 2022 - Aug 2022*

- Designed and deployed a modular and fully configurable **end-to-end production stack** for **Federated Semi-Supervised Learning (FSSL) vision** tasks to increase prototyping speed by 50%.
- Identified and benchmarked high computational overhead due to **certain PyTorch matrix** operators (75% of the total cost).
- Replicated performance benchmarks with popular SSL algorithms **FixMatch** and **SimCLR** on real devices.
- Enabled fast privacy research exploration to explore differential privacy, NoPeek, and NLP tasks with the deployed production environment.
- **Technology Stack:** C++, Torchscript, Python, PyTorch.

Meta (Facebook) *Menlo Park, CA*

Ph.D. Software Engineering Intern *May 2021 - Aug 2021*

- Developed a fast, highly scalable private machine learning algorithm using **PCA with differential privacy** that outperforms the state-of-the-art models by **15%** (test accuracy).
- Improved performance to privacy trade-off by more than 35% by enabling varying tree restarts for the private algorithm **DP-FTRL**.
- Implemented novel visualizations to understand gradient flow and noise relationships while enabling better ML debugging.
- **Technology Stack:** Python, PyTorch, Differential Privacy, Federated Learning.

SuperPower Research, Psychological Sciences, Purdue University *West Lafayette, IN, USA*

Machine Learning Team Lead *Aug. 2020 - Present*

- Developed a novel AI engine that assists psychology researchers in **identifying the ideal sample size** for hypothesis testing (NIH-funded).
- The AI engine examines the effects of **parameter uncertainty on statistical power** and identifies regions of robustness/reactivity in specified parameter values over extremely high-dimensional parameter space.
- Computational cost slashed by 90% of the baseline while maintaining an error rate of less than 5%.
- **Generating synthetic private tabular datasets** with **diffusion models** to promote empirical reproducibility in social sciences
- Developed theoretical results for increased sample size requirement due to the addition of differential privacy for hypothesis testing.
- **Technology Stack:** PyTorch, R, Hypothesis Testing, Bayesian Learning, Git, Differential Privacy, Federated Learning, Computational Social Science.

OpenMined (Open-Source) *West Lafayette, IN, USA*

Research Scientist *Mar. 2020 - Present*

- Collaborating with researchers worldwide to quantify the impact of Differential Privacy and Federated Learning on real-world systems-Link.
- Provided a detailed quantification of the impact of differential privacy on carbon emissions for benchmark NLP (Bert) and vision tasks.
- Suggested a new metric for benchmarking the performance of popular Federated Algorithms.
- **Technology Stack:** PyTorch, PySyft, Git.

Teaching and Mentoring

Mentoring Students for Anvil *Jan 2022 - May 2022*

Mentoring Undergraduate Students for the Anvil's Co-Founder AI Matching Platform Development

Graduate Teaching Assistant for ECE 27000 *Aug 2019 - May 2020*

Teaching assistant for *Introduction to Digital Design*

Graduate Teaching Assistant for ECE 20002 *Aug 2018 - May 2019*

Teaching assistant for *Electrical Engineering Fundamentals II*

Other Services

2022- **Open Source**, OpenMined, Gradio by Hugging Face

2023- **Meta-Reviewer**, AAAI-Representation learning for Responsible Human-Centric AI Workshop (2023)

2022- **Reviewer**, Neurips (2023), ICML-Tiny Papers Track (2023), FAccT (2023), ISIT (2023), IJCAI-Demo Track (2023), AAAI-Privacy-Preserving AI Workshop (2023), CHIL (2022-2023)

2022- **Active Member**, Cohere for AI, OpenMined

2022- **Professional Grant Reviewer**, Grant Review Allocation Committee

2022- **Volunteer**, ICLR (2022), ICML (2022)