Ajinkya K. **Mulay**

MACHINE LEARNING ENGINEER · PRIVACY RESEARCHER

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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*

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

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

Ajinkya Mulay, Hideya Ochiai, Hiroshi Esaki, "IoT WebSocket Connection Management Algorithm for Early Warning Earthquake Alert Applications"   *Esaki Lab, University of Tokyo*
ACM/IEEE UCC, AUSTIN, TX, USA

Konkimalla Chandra Prakash, et. al., "A Novel Electric Network Frequency Classification Algorithm and an Electrical Power Signal Measurement Circuit"   *LFOVIA Group, IIT Hyderabad*
IEEE SIGNAL PROCESSING CUP, 2016

Invited Talks

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 Group, 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   *Remote, 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.

NeWS Lab at IIT Hyderabad   *Hyderabad, India*
Undergraduate Student Researcher   *Aug. 2017 - Apr. 2018*

- Designed and developed an algorithm to **reduce interference between eLAA-WiFi networks** by 40% using Game Theory techniques.
- **Technology Stack:** MATLAB, Python.

Emergensor (Startup), University of Tokyo   *Tokyo, Japan*
Chief Server Engineer   *Jul. 2017 - Dec. 2018*

- Built and maintained the back-end for a mobile application used to notify people of local emergencies.
- Reduced the map's refresh time by **60%** to improve user experience.
- **Technology Stack:** Azure, Java, Google Maps API, Android Studio, Go, Python.

Esaki Lab, University of Tokyo   *Tokyo, Japan*
Research Internship   *May 2017 - Jul. 2017*

- Slashed the packet drop rate over a 3G IoT-Cloud network by **99%** by designing a dynamic ping-pong connection management algorithm.
- **Technology Stack:** Go, Arduino, C.

LFOVIA Lab, IIT Hyderabad   *Hyderabad, India*
Undergraduate Student Researcher   *May 2015 - Jul. 2016*

- Developed a novel Neural Network-based classification algorithm to predict the location of an audio recording using the Electrical Network Frequency (ENF) signature embedded in the audio file; achieved an accuracy of over **85%**.
- **Technology Stack:** MATLAB, Python.

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*

Open Source

DIFFUSERS BY HUGGINGFACE **GITHUB LINK**   *Nov 2022 - Present*
Contributions to the Hugging Face Diffusers library for audio and speech models

GRADIO BY HUGGINGFACE **GITHUB LINK**   *Nov 2022 - Present*
Designing the backend infrastructure for building quick ML/data prototypes.

PIPELINEDP BY GOOGLE AND OPENMINED | **GITHUB LINK** | **WEBSITE**   *May 2022 - Present*
Developing the next generation of open-source tools for enterprise use

Other Services

2022- **Meta-Reviewer**, Representation learning for Responsible Human-Centric AI workshop at AAAI-2023

2022- **Reviewer**, Conference on Health, Inference, and Learning (CHIL-2022), Privacy-Preserving AI (PPAI) workshop at AAAI-2023

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

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

2022   **Volunteer**, ICLR

Extra-Curricular

2020-21 **Active Blogger**, Topics- Machine Learning, Differential Privacy, MS/PhD Applications

2018-21 **Active Member**, HKN (Eta Kappa Nau), Purdue University

2020-21 **Active Member**, Startup Purdue, Co-Founded Happyou, a mental health SaaS startup

2014-18 **Soccer Member, Varsity Team**, Inter & Intra-Collegiate Events, IIT Hyderabad

2015-17 **Head of Finance**, ELAN, IIT Hyderabad's Techno-Cultural Fest, managed budget in excess of $40K

2015-17 **Events and Workshop Manager**, Entrepreneurship Cell, IIT Hyderabad