

Kaustubh Ponkshe

Efficient ML & Fine-Tuning · AI Safety & Security · Distributed Learning

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Education

- 2023 - 2024 **Indian Institute of Technology Bombay**
M. Tech. in Artificial Intelligence & Data Science 9.57 / 10
Advisor: Prof. Ganesh Ramakrishnan
- 2019 - 2023 **Indian Institute of Technology Bombay**
B. Tech. in Electrical Engineering
Minor: Computer Science & Engineering

Research Experience

- 2024–2025 **Researcher, MIT & MBZUAI**, Advisor: Prof. Praneeth Vepakomma
- 2023–2024 **Research Intern, MIT Media Lab**, Advisor: Prof. Ramesh Raskar
- 2024–2025 **Research Collaborator, UC San Diego**, with Prof. Babak Salimi
- 2023–2024 **Masters Thesis Researcher, IIT Bombay**, Advisor: Prof. Ganesh Ramakrishnan
- 2021–2022 **Undergraduate Researcher, IIT Bombay**, Advisor: Prof. Ganesh Ramakrishnan
- 2022 **AI Research Intern, AVL Inc., Japan**, Advisor: Alok Bishoyi
- 2021 **Research Intern, TCS Research**, Advisor: Arijit Ukil

Publications

Published/Accepted Peer-reviewed Papers

- [1] Raghav Singhal*, **Kaustubh Ponkshe***, Praneeth Vepakomma. FedEx-LoRA: Exact Aggregation for Federated and Efficient Fine-Tuning of Foundation Models. In *Proceedings of ACL*, 2025.
- [2] **Kaustubh Ponkshe***, Raghav Singhal, Eduard Gorbunov, Alexey Tumanov, Samuel Horvath, Praneeth Vepakomma. Initialization Using Update Approximation Is a Silver Bullet for Extremely Efficient Low-Rank Fine-Tuning. In *SCOPE Workshop, ICLR*, 2025.
- [3] **Kaustubh Ponkshe***, Praneeth Vepakomma. Power Learning: Differentially Private Embeddings for Collaborative Learning with Tabular Data. In *Trustworthy ML Workshop, CIKM*, 2024. (Oral)
- [4] **Kaustubh Ponkshe**, Venkatapathy Subramanian, Ganesh Ramakrishnan, Natwar Modani. StructFormer: Document Structure-Based Masked Attention and Its Impact on LLM Pre-Training. In *DocUI Workshop, AAAI*, 2025.
- [5] Raghav Singhal*, **Kaustubh Ponkshe***, Rohit Vartak, Praneeth Vepakomma. ABBA: Highly Expressive Hadamard-Product Adaptation for Large Language Models. In *ES-FoMo Workshop, ICML*, 2025.
- [6] Raghav Singhal*, **Kaustubh Ponkshe***, Rohit Vartak, Praneeth Vepakomma. Fed-SB: Extreme Communication Efficiency for Private Federated LoRA Fine-Tuning. In *ES-FoMo Workshop, ICML*, 2025.
- [7] Priya Mishra*, Suraj Racha*, **Kaustubh Ponkshe**, Adit Akarsh, Ganesh Ramakrishnan. GUIDEQ: Guided Questioning for Progressive Information Collection and Classification. In *Findings of NAACL*, 2025.
- [8] Parjanya Prashant, **Kaustubh Ponkshe**, Chirag Garg, Ishan Pendse, Prathamesh Muley. Crop Yield Prediction of Indian Districts Using Deep Learning. In *ICIIP*, 2021.

Preprint/Under Review

- [1] **Kaustubh Ponshe***, Shaan Shah*, Raghav Singhal*, Praneeth Vepakomma. Safety Subspaces Are Not Distinct: A Fine-Tuning Case Study. arXiv preprint, 2025.
- [2] Parjanya Prashant*, **Kaustubh Ponshe***, Babak Salimi. TokenSwap: A Lightweight Method to Disrupt Memorized Sequences in LLMs. arXiv preprint, 2025.

Selected Projects

Efficient ML and Fine-Tuning

- **LoRA-SB: Simulating Full Finetuning via Low-Rank Approximation** [\[Pdf\]](#)[\[Page\]](#)[\[Code\]](#)
 - Designed a low-rank initialization that bridges the gap to full finetuning with $27\text{-}90\times$ fewer parameters.
- **ABBA: Hadamard-Product Reparameterization for Expressive PEFT** [\[Pdf\]](#)[\[Code\]](#)
 - Reparameterized high-rank updates as Hadamard products of two learnable low-rank matrices

AI Safety and Security

- **Safety Subspaces: Geometric Limitations of Alignment Preservation** [\[Pdf\]](#)[\[Code\]](#)
 - Showed empirically that safe and unsafe behaviours co-activate overlapping subspaces, challenging subspace-isolation assumptions in alignment.
- **Power-Learning: Differentially Private Embeddings for Distributed Learning** [\[Pdf\]](#)[\[Page\]](#)[\[Code\]](#)
 - Generated privacy-preserving embeddings via normalizing flows, enabling model-agnostic training with formal privacy guarantees.
- **TokenSwap: Mitigating Verbatim Memorization in Deployed LLMs** [\[Pdf\]](#)
 - Swapped token probabilities at inference, reducing verbatim leakage up to $10\times$ while preserving fluency.

Distributed Learning

- **FedEx-LoRA: Exact Aggregation for Federated LoRA Finetuning** [\[Pdf\]](#)[\[Page\]](#)[\[Code\]](#)
 - Proposed a provably exact aggregation scheme, achieving full baseline fidelity with negligible overhead.
- **Fed-SB: Efficient & Private Federated Finetuning via Subspace Alignment** [\[Pdf\]](#)[\[Page\]](#)[\[Code\]](#)
 - Averaged square LoRA-SB matrices, yielding $230\times$ communication savings under fixed noise budgets.

Robotics and Control

- **IITB Racing: Autonomous Stack for Electric Racecar**
 - Led perception, planning, and control stack for FSSIM; deployed full autonomous system at FSUK 2023.

Scholastic Achievements

- **Undergraduate Research Award (URA 02)** for one of the best bachelors theses at IIT Bombay.
- Graduated with **3rd rank** in the M.Tech. Artificial Intelligence & Data Science programme at IIT Bombay.
- Qualified for National Mathematics Olympiad (**State rank 3**); precursor to the International Math Olympiad.
- Secured All-India Rank **846** in JEE (Advanced) and Rank **993** in JEE (Main) among **1.5 million** candidates.
- **PRISM 2020 Finalist** KAIST competition on Crop-Yield Prediction (Top 20 international projects).