
Research Interests

Large Language Models, Recommender Systems, Deep Learning, and Optimization.

Education

2017 – 2023 Ph.D., Computer Sciences (Minor in Mathematics), UW-Madison. GPA: 3.925/4
Runner-Up for the Best Ph.D. Thesis Award

2011 – 2015 B.Tech. (Hons.), Computer Science and Engineering, IIT Kharagpur. GPA: 9.09/10

Experience

Sep 2023 – **Research Scientist**, *MosaicML team, Databricks*.
Working on the pretraining of Large Language Models.

Summer 2023 **Postdoctoral Research Fellow**, *IFML, UT Austin*.
Worked on Parameter Efficient Fine-Tuning of Large Generative Models with Prof. Alex Dimakis.

Summer 2022 **Research Scientist Intern**, *Google Brain, with Dr. Maheswaran Sathiamoorthy and Dr. Raghunandan Keshavan*.
Built the first Semantic IDs based Generative Retrieval framework for Recommender Systems. We achieve SOTA accuracy on multiple datasets with this framework. (Paper accepted to NeurIPS 2023. TLDR Newsletter also covered our paper.)

Summer 2021 **Academic Research Intern**, *MIT, with Prof. Suvrit Sra*.
Analyzed the convergence rates for local and minibatch Random Reshuffling in Federated Learning, and developed a new technique to speed up convergence under heterogeneity. (Paper published at ICLR 2022.)

2016 – 2017 **Applied Scientist**, *Bing Related Searches, Microsoft India*.
Developed a model to generate suggestions for low frequency queries using mined patterns and entity types. Clustered queries based on user's intent over dynamic query stream to create a graph of related queries.

2015 – 2016 **Software Engineer**, *Bing Autosuggest, Microsoft India*.

Summer 2014 **Summer Intern**, *Samsung R&D Institute India*.

Summer 2013 **Research Intern**, *POSL Research Group, Kyushu University, Japan*.

Services and Selected Awards

- Outstanding Graduate Research Honorable Mention, 2023. University of Wisconsin - Madison, Department of Computer Sciences. (*Runner-Up for the Best Ph.D. Thesis*)
- Google Ph.D. Fellowship, 2022.
- Institute for Foundations of Machine Learning (IFML) Postdoctoral Fellowship, University of Texas - Austin.
- Institute for Foundations of Data Science (IFDS) Research Assistant, University of Wisconsin - Madison. 2020 and 2021.
- Graduation Day Award, Information Theory and Applications (ITA) Workshop 2023.
- NeurIPS 2021 Outstanding Reviewer Award.
- Student Travel Award, NeurIPS 2019.
- Reviewer for NeurIPS, ICML, ICLR, AISTATS, TMLR, JMLR, ALT, and KDD.
- Innovation Award, Microsoft Bing India Hackathon 2016.
- Ranked in top 0.1% in the IIT-JEE 2011 exam among about 500,000 candidates.

Research in News

Mar 2023 **TLDR Newsletter** covered our paper *Recommender Systems with Generative Retrieval* ([Link](#)).

- Feb 2023 **TheGradient** covered our paper *Looped Transformers as Programmable Computers* ([Link](#)).
- Sep 2022 **UW-Madison Graduate School Newsletter** covered my *Google Ph.D. Fellowship* ([Link](#)).

Invited Talks and Panel Discussions

- Jul 2023 **Recommender Systems with Generative Retrieval.** *Amazon.*
- Jun 2023 **Recommender Systems with Generative Retrieval.** *Apple.*
- May 2023 **Looped Transformers as Programmable Computers.** *Nvidia.*
- May 2023 **Minibatch vs Local SGD With Shuffling.** *Comm. efficient fed. opt. at SIAM Opt.*
- Mar 2023 **Expressive Power of Modern Neural Architectures.** *D. E. Shaw.*
- Oct 2022 **Efficient Optimization Techniques in Modern Machine Learning.** *Google.*
- Jul 2021 **Sparsity in Neural Networks Workshop (SparseNN)** (Panelist).

Publications

(* indicates joint first authorship)

- NeurIPS 2023 **Recommender Systems with Generative Retrieval**
Shashank Rajput*, Nikhil Mehta*, Anima Singh, Raghunandan H. Keshavan, Trung Vu, Lukasz Heldt, Lichan Hong, Yi Tay, Vinh Q. Tran, Jonah Samost, Maciej Kula, Ed H. Chi, and Maheswaran Sathiamoorthy.
Neural Information Processing Systems (To Appear).
- ICML 2023 **Looped Transformers as Programmable Computers**
Shashank Rajput*, Angeliki Giannou*, Jy-yong Sohn, Kangwook Lee, Jason D. Lee, and Dimitris Papailiopoulos.
International Conference on Machine Learning.
- COLT 2023 **The Expressive Power of Tuning Only the Norm Layers**
Shashank Rajput*, Angeliki Giannou*, and Dimitris Papailiopoulos.
Conference on Learning Theory.
- ICLR 2022 **Permutation-Based SGD: Is Random Optimal?**
Shashank Rajput, Kangwook Lee, and Dimitris Papailiopoulos.
International Conference on Learning Representations.
- ICLR 2022 **Minibatch vs Local SGD with Shuffling: Tight Convergence Bounds and Beyond**
Chulhee Yun, **Shashank Rajput**, and Suvrit Sra.
International Conference on Learning Representations - Oral Presentation.
- NeurIPS 2022 **LIFT: Language-Interfaced FineTuning for Non-language Machine Learning Tasks**
Tuan Dinh, Yuchen Zeng, Ruisu Zhang, Ziqian Lin, Michael Gira, **Shashank Rajput**, Jy-yong Sohn, Dimitris Papailiopoulos, and Kangwook Lee
Neural Information Processing Systems.
- EMNLP 2022 **Utilizing Language-Image Pretraining for Efficient and Robust Bilingual Word Alignment**
Tuan Dinh, Jy-yong Sohn, **Shashank Rajput**, Timothy Ossowski, Yifei Ming, Junjie Hu, Dimitris Papailiopoulos, and Kangwook Lee.
Conference on Empirical Methods in Natural Language Processing (Findings).
- AISTATS 2022 **Finding Everything within Random Binary Networks**
Kartik Sreenivasan, **Shashank Rajput**, Jy-yong Sohn, and Dimitris Papailiopoulos.
International Conference on Artificial Intelligence and Statistics.
- UpML 2022 **Super Seeds: Extreme Model Compression by Trading off Storage With Compute**
Shashank Rajput*, Nayoung Lee*, Jy-yong Sohn, Hongyi Wang, Eric Xing, Kangwook Lee, and Dimitris Papailiopoulos.
ICML Workshop on Updatable Machine Learning - Spotlight Talk.

- NeurIPS 2021 **An Exponential Improvement on the Memorization Capacity of Deep Threshold Networks**
Shashank Rajput, Kartik Sreenivasan, Dimitris Papailiopoulos, and Amin Karbasi.
Neural Information Processing Systems.
- NeurIPS 2020 **Optimal Lottery Tickets via SubsetSum: Logarithmic over-parameterization is sufficient**
Shashank Rajput*, Ankit Pensia*, Alliot Nagle, Harit Vishwakarma, and Dimitris Papailiopoulos.
Neural Information Processing Systems - Spotlight paper.
- ICML 2020 **Closing the Convergence Gap of SGD Without Replacement**
Shashank Rajput, Anant Gupta, and Dimitris Papailiopoulos.
International Conference on Machine Learning.
- NeurIPS 2020 **Attack of the tails: Yes, you really can backdoor Federated Learning**
Hongyi Wang, Kartik Sreenivasan, **Shashank Rajput**, Harit Vishwakarma, Saurabh Agarwal, Jy-yong Sohn, Kangwook Lee, and Dimitris Papailiopoulos.
Neural Information Processing Systems.
- NeurIPS 2019 **DETOX: A Redundancy-based Framework for Faster and More Robust Gradient Aggregation**
Shashank Rajput*, Hongyi Wang*, Zachary Charles, and Dimitris Papailiopoulos.
Neural Information Processing Systems.
- ICML 2019 **Does Data Augmentation Lead to Positive Margin?**
Shashank Rajput*, Zhili Feng*, Zachary Charles, Po-Ling Loh, and Dimitris Papailiopoulos.
International Conference on Machine Learning.

Preprints

Convergence and margin of adversarial training on separable data
Zachary Charles, **Shashank Rajput**, Stephen Wright, and Dimitris Papailiopoulos.
arXiv preprint arXiv:1905.09209, 2019.

Technical Skills

Languages Python, Java, C++, C, C#, R, Matlab.
Frameworks PyTorch, Tensorflow, JAX, Flax.

Relevant Courses Taken

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| Graduate | <ul style="list-style-type: none"> ○ Mathematical foundations of machine learning ○ Theoretical foundations of machine learning ○ Advanced learning theory ○ Nonparametric methods in machine learning ○ Nonlinear optimization (I and II) ○ Convex analysis ○ Advanced algorithms | <ul style="list-style-type: none"> ○ Information theory ○ Modern discrete probability ○ Robustness theory ○ Optimal transport ○ Program verification and synthesis ○ Probability theory ○ Real analysis |
| Undergraduate | <ul style="list-style-type: none"> ○ Analysis 2 ○ Intro. to stochastic processes ○ Intro. to artificial intelligence | <ul style="list-style-type: none"> ○ Distributed systems ○ Natural language processing ○ Complex networks |
| Reading Groups | <ul style="list-style-type: none"> ○ Algorithmic Game Theory <p>Other topics can be found here - https://mfsd-reading.github.io/mfsd-reading/</p> | <ul style="list-style-type: none"> ○ Deep Learning Theory |