Saurabh Garg

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Education

Ph.D. in Machine Learning. **2019 – Present**
School of Computer Science, Carnegie Mellon University (CMU)
GPA: 4.19/4.33
Advisors: Prof. Zachary Lipton, Prof. Sivaraman Balakrishnan
Committee: Prof. Aditi Raghunathan, Prof. Zico Kolter, Prof. Ludwig Schmidt
Awards: Bloomberg PhD Fellowship, JP Morgan AI PhD Fellowship, Amazon Graduate Research Fellowship

Bachelors (with honors) in Computer Science and Engineering. **2014 – 2018**
Minor in Applied Statistics and Informatics
Indian Institute of Technology (IIT) Bombay
GPA: 9.51/10.0
Advisor: Prof. Preethi Jyothi
Awards: Excellence in Research Award (1 among 110 students), Institute Academic Award

Selected Publications

Overview: Published >20 papers (six competitive oral/spotlight) in venues such as NeurIPS, ICLR, ICML, ACL, EMNLP and MICCAI. Work in my main line of research includes:

TiC-CLIP: Continual Training of CLIP Models.
Saurabh Garg, Mehrdad Farajtabar, Hadi Pouransari, Raviteja Vemulapalli, Sachin Mehta, Oncel Tuzel, Vaishaal Shankar, Fartash Faghri.
Oral at Distribution Shift Workshop, NeurIPS 2023.

Complementary Benefits of Contrastive Learning and Self-Training Under Distribution Shift.
Saurabh Garg*, Amrith Setlur*, Zachary Lipton, Siva Balakrishnan, Virginia Smith, Aditi Raghunathan.
NeurIPS 2023.

RLSbench: Domain Adaptation under Relaxed Label Shift.
Saurabh Garg, Nick Erickson, James Sharpnack, Alex Smola, Sivaraman Balakrishnan, Zachary C. Lipton.
ICML 2023.

Leveraging Unlabeled data to Predict Out-of-Distribution Performance.
Saurabh Garg, Siva Balakrishnan, Zachary Lipton, Behnam Neyshabur, Hanie Sedghi.
ICLR 2022.

RATT: Leveraging Unlabeled Data to obtain Generalization Guarantees.
Saurabh Garg, Zico Kolter, Sivaraman Balakrishnan, Zachary Lipton.
Long Oral at ICML 2021.

Mixture Proportion Estimation and PU Learning: A Modern Approach.
Saurabh Garg, Yifan Wu, Alex Smola, Sivaraman Balakrishnan, Zachary Lipton.
Spotlight at NeurIPS 2021.

A Unified View of Label Shift Estimation.
Saurabh Garg, Yifan Wu, Sivaraman Balakrishnan, Zachary Lipton.
Oral at Uncertainty in Deep Learning Workshop, ICML 2020.
NeurIPS 2020.

Selected Awards & Honors

Bloomberg Data Science PhD Fellowship	2023–ongoing (upto 3 years)
JP Morgan PhD Research Fellowship	2022-23
Amazon Graduate Research Fellowship	2022-23

Two Sigma Fellowship Finalist (8 out of 190)	2022
Invited to attend Deep Learning Theory Summer School at Princeton (remote)	2021
Excellence in Research Award (1 among 110 students) from CSE dept, IIT Bombay	2018
Undergraduate Research Award, IIT Bombay	2018
Institute Academic Award, IIT Bombay (10 among 900 students)	2015
All India Rank 93 in JEE Main (out of 1.4 million)	2014
All India Rank 154 in JEE Advanced (out of 126k)	2014

Research Internships

Apple MLR **Seattle, Washington**
Hosts: Fartash Faghri, Vaishaal Shankar, Mehrdad Fajartabad, and Hadi Pouransari May '23 – Sept' 23
· Worked on Time-Continual (TiC) training of CLIP models (under submission, Oral at DistShift Workshop)

Amazon AWS **Santa Clara, CA (remote)**
Hosts: Alex Smola, Nick Erickson, and James Sharpnack May '22 – Dec' 22
· Worked on RLSbench, a large scale study of domain adaptation under relaxed label shift (ICML 2023)

Google Brain **Mountain View, CA (remote)**
Hosts: Hanie Sedghi and Behnam Neyshabur May '21 – Dec '21
· Worked on leveraging unlabeled data to predict out-of-distribution generalization (ICLR 2023)

Microsoft Research **Banglore, India**
Hosts: Sunayana Sitaram Dec '17
· Worked on studying code-mixed language models (EMNLP 2018)

Publications and Pre-Prints

Pre-print/Workshop

P3. **TiC-CLIP: Continual Training of CLIP Models**
Saurabh Garg, Mehrdad Farajtabar, Hadi Pouransari, Raviteja Vemulapalli, Sachin Mehta, Oncel Tuzel, Vaishaal Shankar, Fartash Faghri
Oral at Distribution Shift Workshop, NeurIPS 2023.

P2. **PRO: Pseudo-label Regularized Optimization on Unlabeled Test Data**
Tzu-Ching Yen, **Saurabh Garg**, Alex Smola, Zachary Lipton, Francesco Locatello

P1. **Generate to Discriminate: Expert Routing for Continual Learning**
Yewon Byun, Sanket Vaibhav Mehta, **Saurabh Garg**, Emma Strubell, Bryan Wilder, Zachary Lipton

Conference

C19. **Complementary Benefits of Contrastive Learning and Self-Training Under Distribution Shift**
Saurabh Garg*, Amrith Setlur*, Zachary Lipton, Sivaraman Balakrishnan, Virginia Smith, Aditi Raghunathan
Advances in Neural Information Processing (NeurIPS), 2023

C18. **(Almost) Provable Error Bounds Under Distribution Shift via Disagreement Discrepancy**
Elan Rosenfeld, **Saurabh Garg**
Advances in Neural Information Processing (NeurIPS), 2023

C17. **Online Label Shift: Optimal Dynamic Regret meets Practical Algorithms**
Dheeraj Baby*, **Saurabh Garg***, Thomson Yen*, Sivaraman Balakrishnan, Zachary Lipton, Yu-Xiang Wang
Spotlight at Advances in Neural Information Processing (NeurIPS), 2023

C16. **Downstream Datasets Make Surprisingly Good Upstream Corpora**
Kundan Krishna, **Saurabh Garg**, Jefferey Bigham, Zachary C. Lipton
Proceedings of the 61th Annual Meeting of the Association for Computational Linguistics (ACL), 2023

C15. **RLSbench: Domain Adaptation Under Relaxed Label Shift**
Saurabh Garg, Nick Erickson, James Sharpnack, Alex Smola, Sivaraman Balakrishnan, Zachary C. Lipton
Internation Conference of Machine Learning (ICML), 2023

C14. **CHiLS: Zero-shot Image Classification with Hierarchical Label Sets**
Zachary Novack, Zachary C. Lipton, **Saurabh Garg**
International Conference on Machine Learning (ICML), 2023

C13. **Disentangling the Mechanisms Behind Implicit Regularization in SGD**
Zachary Novack, Simran Kaur, Tanya Marwah, **Saurabh Garg**, Zachary Lipton
International Conference on Learning Representations (ICLR), 2023
Also a Spotlight at NeurIPS Workshop on Benefits of Higher-Order Optimization in Machine Learning, 2022

C12. **Deconstructing Distributions: A Pointwise Framework of Learning Performance**
Gal Kaplun*, Nikhil Ghosh*, **Saurabh Garg**, Boaz Barak, Preetum Nakkiran
International Conference on Learning Representations (ICLR), 2023

C11. **Domain Adaptation under Open Set Label Shift**
Saurabh Garg, Sivaraman Balakrishnan, Zachary Lipton
Advances in Neural Information Processing (NeurIPS), 2022

C10. **Unsupervised Learning under Latent Label Shift**
Manley Roberts*, Pranav Mani*, **Saurabh Garg**, Zachary C. Lipton
Advances in Neural Information Processing (NeurIPS), 2022

C9. **Characterizing Datapoints via Second-Split Forgetting**
Pratyush Maini, **Saurabh Garg**, Zachary Lipton, Zico Kolter
Advances in Neural Information Processing (NeurIPS), 2022
Also a Spotlight at ICML Workshop on Spurious Correlations, Invariance, and Stability (SCIS), 2022

C8. **Leveraging Unlabeled Data to Predict Out-of-Distribution Performance**
Saurabh Garg, Sivaraman Balakrishnan, Zachary Lipton, Behnam Neyshabur, Hanie Sedghi [Paper]
International Conference on Learning Representations (ICLR), 2022

C7. **Mixture Proportion Estimation and PU Learning: A Modern Approach**
Saurabh Garg, Yifan Wu, Alex Smola, Sivaraman Balakrishnan, Zachary Lipton [Paper]
Spotlight at Advances in Neural Information Processing (NeurIPS), 2021

C6. **RATT: Leveraging Unlabeled Data to obtain Generalization Guarantees**
Saurabh Garg, Zico Kolter, Sivaraman Balakrishnan, Zachary Lipton [Paper]
Long Talk at International Conference of Machine Learning (ICML), 2021

C5. **On Proximal Policy Optimization's Heavy-Tailed Gradients**
Saurabh Garg, Joshua Zhanson, Emilio Parisotto, Adarsh Prasad, Zico Kolter, Zachary Lipton, Sivaraman Balakrishnan, Ruslan Salakhutdinov, Pradeep Ravikumar [Paper]
International Conference of Machine Learning (ICML), 2021

C4. **A Unified View of Label Shift Estimation**
Saurabh Garg, Yifan Wu, Sivaraman Balakrishnan, Zachary Lipton [Paper]
Advances in Neural Information Processing Systems (NeurIPS) 2020
Also a Contributed Talk at ICML Workshop on Uncertainty & Robustness in Deep Learning (UDL), 2020

C3. **Code-Switched Language models using Dual RNNs and Same-Source Pretraining**
Saurabh Garg[*], Tanmay Parekh[*], Preethi Jyothi [Paper] ([*] joint first authors)
Empirical Methods in Natural Language Processing (EMNLP), 2018

C2. **Uncertainty Estimation in Segmentation with Perfect MCMC Sampling in Bayesian MRFs**
Saurabh Garg, Suyash Awate [Paper]
Medical Image Computing & Computer Assisted Intervention (MICCAI), 2018

C1. **Dual Language Models for Code Mixed Speech Recognition**

Saurabh Garg, Tanmay Parekh, Preethi Jyothi [Paper]
Interspeech 2018 (19th Annual Conference of ISCA)

Journal

J2. **Estimating Uncertainty in MRF-based Image Segmentation: An Exact-MCMC Approach**
Suyash Awate*, **Saurabh Garg***, Rohit Jena* [Paper] (*alphabetic ordering)
Medical Image Analysis (MedIA) Journal, 2019

J1. **Neural Architecture for Question Answering Using a Knowledge Graph and Web Corpus**
Uma Sawant, **Saurabh Garg**, Soumen Chakrabarti, Ganesh Ramakrishnan [Paper]
Information Retrieval Journal, 2019
Invited Oral Talk at European Conference on Information Retrieval (ECIR), 2020

Work Experience

Samsung Research HQ **Suwon, South Korea**
Research Engineer Sept. '18 – July '19
Research Engineering Internship May '17 – July '17

Invited Talks

TiC-CLIP: Continual training of CLIP models
· DistShift Workshop, NeurIPS Dec' 23
· Apple MLR Sept' 23

Complementary benefits of self-training and contrastive learning
· University of Washington Aug 23
· ML Collective June 23
· Apple MLR Sept' 23

RLSbench: Domain Adaptation under Relaxed Label Shift
· GaTech AI reading group April 23
· Talking Robotics March 23
· UIUC AI Seminar March 23
· CMU AI Seminar Feb' 23
· Amazon ML Reading Group Nov' 22

Domain Adaptation under Structural Distribution Shift
· Google Research India Dec' 22
· ML Theory seminar at Princeton May' 22
· ML Seminar at IIT Bombay July' 22

Leveraging Unlabeled Data to Predict Out-of-Distribution Performance
· Google Brain Deep Phenomena Group Nov '21
· Carnegie Mellon University Nov '21

RATT: Leveraging Unlabeled Data to obtain Generalization Guarantees
· IIT Bombay Oct '21
· International Conference on Machine Learning 2021 July '21
· Google Brain Deep Phenomena Group June '21
· Carnegie Mellon University (Andrej's Reading Group) June '21

Neural Architecture for Question Answering using KG and Corpus
· European Conference on Information Retrieval (ECIR) 2020 April '20

Code-Switched Language models
· IIT Bombay Seminar April '18
· Microsoft Research Labs, India Dec '17

Mentorship

Ph.D. in Machine Learning, CMU student: Emily Byun 2023 – ongoing
Leveraging Diffusion Models for Continual Learning Under Distribution Shift (under submission at ICLR 2023)

Master in Computational Data Science, CMU student: Leon Zamel 2023 – ongoing
Role of Normalization Layers in Modern Vision Models from the Perspective of Distribution Shift (ongoing)

Research Assistant at MLD, CMU: Rishabh Ranjan 2022 – ongoing
Learning from Non-Separable Data: Practitioners Perspective (ongoing)

Master in Machine Learning, CMU student: Thomson Yen 2022 – ongoing
Detecting Severity of Covariate and Label Shifts in the Wild (ongoing)
Theory and Practice of Test-time Training of Zero-Shot Models (under submission at ICLR 2023)
Online Label Shift: Optimal Dynamic Regret meets Practical Algorithms (NeurIPS 2023)

Bachelors in Computer Science, CMU student: Zachary Novack 2021 – ongoing
CHiLS: Zero-shot Image Classification with Hierarchical Label Sets *(Accepted at ICML 2023)*
Understanding properties of stochastic gradient noise in deep learning *(Accepted at ICLR 2023)*

MS in Machine Learning, CMU, Students: Pranav Mani and Manley Roberts 2022 – ongoing
Unsupervised Learning under Latent Label Shift *(Accepted at NeurIPS 2022)*

Ph.D. in Machine Learning, CMU, Student: Pratyush Maini 2021–2022
Characterizing Datapoints via Second-Split Forgetting *(Accepted at NeurIPS 2022)*

Academic Service

Workshop Organizer
- R0-FoMo: Robustness of Few-shot and Zero-shot Learning in Foundation Models, NeurIPS 2023.
- Principles of Distribution Shift (PODS) Workshop at ICML 2022.

Reviewer. NeurIPS (2021, 2022, 2023), ICML (2021, 2022, 2023), ICLR (2022, 2023), EMNLP (2019, 2020), ACL (2020, 2021), NACL (2021), TMLR (2022).

Ph.D. Admission's Committee. Machine Learning Department, CMU, 2021-23

Teaching

Graduate Teaching Assistant, Carnegie Mellon University
- Advanced Introduction to Machine Learning, Prof. Nihar Shah — Fall 2021
- Theory of Machine Learning, Prof. Pradeep Ravikumar — Spring 2022

Undergraduate Teaching Assistant, IIT Bombay
- Introduction to Machine Learning, Prof. Preethi Jyothi — Spring 2018
- Data Analysis and Interpretation, Prof. Suyash Awate — Autumn 2017
- Computer Programming and Utilisation, Prof. Sunita Sarawagi — Spring 2017
- Computer Programming and Utilisation, Prof. Benard Menezes — Autumn 2016

Selected Coursework

Carnegie Mellon University: Advanced Introduction to Machine Learning (A+), Intermediate Statistics (A+), Advanced Statistical Theory 1 (A+), Convex Opt. (A+), Advanced Machine Learning Theory (A)

IIT Bombay: Web Search and Mining (AA), Organization of Web Information (AA), Optimization (AA), Artificial Intelligence (AA), Automatic Speech Recognition (AA), Linear Algebra (AA), Numerical Analysis (AA), Operating Systems (AA), Compilers (AP), Automata theory and logic (AA)