Vikash Sehwag

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Research Interests

My vision is to develop the next generation of Generative Artificial Intelligence (AI) systems safely and responsibly. I'm interested in demonstrating the significant potential of modern generative models in enhancing existing AI systems, particularly by distilling knowledge embedded in modern generative models. I also aim to thoroughly investigate the safety risks posed by generative models, including the leaking of private information and amplification of biases in training data, which are further exacerbated by their widespread usage[1]. Overall, my goal is to enhance the potential of generative models while simultaneously limiting their pitfalls.

Key Topics: Generative AI, AI safety, Diffusion models, Knowledge distillation from generative models, AI safety risks with generative models, Memorization and privacy leakage, Bias & Fairness, Adversarial robustness, Trustworthy machine learning

Phd thesis: Promises and Pitfalls of Generative AI: An AI-Safety Centric Approach

Education

Program	Institution	Years
Ph.D., Electrical and Computer Engineering *Advisors – Prateek Mittal, Mung Chiang*	Princeton University NJ, USA	2017 - 2023
M.A., Electrical Engineering	Princeton University NJ, USA	2017 - 2019
B.Tech., Electronics and Electrical Communication Engg.	Indian Institute of Technology (IIT) Kharagpur, INDIA	2013 - 2017

Honors and Awards

- Graduate student award for excellence in service (ECE department, Princeton University) 2022
- Charlotte Elizabeth Proctor Honorific Fellowship, one of the highest honors at Princeton University 2022
- Best paper honorable mention award at ICLR workshop on Security and Safety in ML Systems 2021
- Winner of Qualcomm Innovation Fellowship, North America Region 2019
- Received best undergraduate thesis award (1 from 72 students) at IIT Kharagpur 2017
- IEEE student award from IEEE student branch of IIT Kharagpur 2016
- Awarded the WISE scholarship from German Academic Exchange Service (DAAD), Germany 2016
- Received Merit-cum-Means Scholarship from MHRD, Government of India 2013-17

Work Experience

- Research Internship – *Facebook AI*, USA Summer 2021
  Advisors – Caner Hazirbas, Cristian Canton Ferrer (AI Red Team)
  Project: Generating novel hard instances from low-density regions using generative models.
- Research Internship – *Microsoft Research*, Redmond (USA) Summer 2019
  Advisors – Jay Stokes, Cha Zhang
  Project: Adversarial attacks and defenses beyond ℓ_p norms
- Research Assistant – *IIT Kharagpur*, India Fall 2016
  Advisors – Indrajit Chakrabarti, Santanu Chattopadhyay
  Project: Implementing physical unclonable functions with Network-on-chip routers

[1] More than 10 million users have used Stable Diffusion.

- Research Internship – *Technische Universität Darmstadt*, Germany Summer 2016
  Advisor – Heinz Koeppl
  Project: A study of stochastic SIS disease spreading on random graphs

Publications

Preprints and papers under review

- Extracting Training Data from Diffusion Models
  Nicholas Carlini, Jamie Hayes, Milad Nasr, Matthew Jagielski, **Vikash Sehwag**, Florian Tramèr, Borja Balle, Daphne Ippolito, Eric Wallace
  Arxiv 2023, Under review
- DP-RAFT: A Differentially Private Recipe for Accelerated Fine-Tuning
  Ashwinee Panda, Xinyu Tang, **Vikash Sehwag**, Saeed Mahloujifar, Prateek Mittal
  Arxiv 2023, Under review

Conference and Journal Publications

- Uncovering Adversarial Risks of Test-Time Adaptation
  Tong Wu, Feiran Jia, Xiangyu Qi, Jiachen T. Wang, **Vikash Sehwag**, Saeed Mahloujifar, Prateek Mittal
  *International Conference on Machine Learning (**ICML**), 2023*
- MultiRobustBench: Benchmarking Robustness Against Multiple Attacks
  Sihui Dai, Saeed Mahloujifar, Chong Xiang, **Vikash Sehwag**, Pin-Yu Chen, Prateek Mittal
  *International Conference on Machine Learning (**ICML**), 2023*
- A Light Recipe to Train Robust Vision Transformers
  Edoardo Debenedetti, **Vikash Sehwag**, Prateek Mittal
  *IEEE Conference on Secure and Trustworthy Machine Learning (**SaTML**), 2023*
- Generating High Fidelity Data from Low-density Regions using Diffusion Models
  Vikash Sehwag, Caner Hazirbas, Albert Gordo, Firat Ozgenel, Cristian Canton Ferrer
  *Conference on Computer Vision and Pattern Recognition (**CVPR**), 2022*
- Robust Learning Meets Generative Models: Can Proxy Distributions Improve Adversarial Robustness?
  Vikash Sehwag, Saeed Mahloujifar, Tinashe Handina, Sihui Dai, Chong Xiang, Mung Chiang, Prateek Mittal
  *International Conference on Learning Representations (**ICLR**), 2022*
- Understanding Robust Learning through the Lens of Representation Similarities
  Christian Cianfarani*, Arjun Nitin Bhagoji*, **Vikash Sehwag***, Ben Zhao, Prateek Mittal, Haitao Zheng
  *Neural Information Processing Systems (**NeurIPS**), 2022*
- RobustBench: a standardized adversarial robustness benchmark
  Francesco Croce*, Maksym Andriushchenko*, **Vikash Sehwag***, Edoardo Debenedetti*, Nicolas Flammarion, Mung Chiang, Prateek Mittal, Matthias Hein
  *Neural Information Processing Systems (**NeurIPS**), 2021 - Datasets and Benchmarks Track*
  *Won **best paper honorable mention prize** at ICLR 2021 workshop on Security and Safety in Machine Learning Systems.*
- Lower Bounds on Cross-Entropy Loss in the Presence of Test-time Adversaries
  Arjun Nitin Bhagoji, Daniel Cullina, **Vikash Sehwag**, Prateek Mittal
  *International Conference on Machine Learning (**ICML**), 2021*
- SSD: A Unified Framework for Self-Supervised Outlier Detection
  Vikash Sehwag, Mung Chiang, Prateek Mittal
  *International Conference on Learning Representations (**ICLR**), 2021*
  Short version accepted at NeurIPS 2020 Workshop on Self-Supervised Learning - Theory and Practice
- Beyond ℓ_p Norms: Delving Deeper into Robustness to Physical Image Transformations
  Vikash Sehwag, Jay Stokes, Cha Zhang
  IEEE Military Communications Conference (MILCOM), 2021

* refers to equal contribution.

- PatchGuard: Provable Defense against Adversarial Patches Using Masks on Small Receptive Fields
  Chong Xiang, Arjun Nitin Bhagoji, **Vikash Sehwag**, Prateek Mittal
  ***USENIX Security Symposium**, 2021*
- HYDRA: Pruning Adversarially Robust Neural Networks
  Vikash Sehwag, Shiqi Wang, Prateek Mittal, Suman Jana
  *Neural Information Processing Systems (**NeurIPS**), 2020*
- Fast-Convergent Federated Learning
  Hung T. Nguyen, **Vikash Sehwag**, Seyyedali Hosseinalipour, Christopher G. Brinton, Mung Chiang, H. Vincent Poor
  *IEEE Journal on Selected Areas in Communications (**J-SAC**) - Series on Machine Learning for Communications and Networks, 2020*

Peer-reviewed Workshop Publications

- Just Rotate it: Deploying Backdoor Attacks via Rotation Transformation
  Tong Wu, Tianhao Wang, **Vikash Sehwag**, Saeed Mahloujifar, Prateek Mittal
  *In Proceedings of the 12th ACM Workshop on Artificial Intelligence and Security (**AISec**), 2022*
- Robustness from Perception
  Saeed Mahloujifar, Chong Xiang, **Vikash Sehwag**, Sihui Dai, Prateek Mittal
  ICLR workshop on Security and Safety in Machine Learning Systems, 2021
- Time for a Background Check! Uncovering the impact of Background Features on Deep Neural Networks
  Vikash Sehwag, Rajvardhan Oak, Mung Chiang, Prateek Mittal
  ICML workshop on Object-Oriented Learning, 2020
- On separability of self-supervised representations
  Vikash Sehwag, Mung Chiang, Prateek Mittal
  ICML workshop on Uncertainty & Robustness in Deep Learning, 2020
- On Pruning Adversarially Robust Neural Networks
  Vikash Sehwag, Shiqi Wang, Prateek Mittal, Suman Jana
  ICLR workshop on Towards Trustworthy ML, 2020
- Analyzing the robustness of open-world machine learning
  Vikash Sehwag*, Arjun Nitin Bhagoji*, Liwei Song*, Chawin Sitawarin, Daniel Cullina, Mung Chiang, Prateek Mittal
  *In Proceedings of the 12th ACM Workshop on Artificial Intelligence and Security (**AISec**), 2019*
- Not All Pixels are Born Equal: An Analysis of Evasion Attacks under Locality Constraints
  Vikash Sehwag, Chawin Sitawarin, Arjun Nitin Bhagoji, Arsalan Mosenia, Mung Chiang, Prateek Mittal
  Poster at ACM SIGSAC Conference on Computer and Communications Security (CCS), 2018.

Academic services

Teaching

- Lecture on basics of adversarial machine learning at Princeton-Intel REU Seminar 2021
- Teaching assistant for ECE 574: Security & Privacy Fall 2021
- Taught a mini-course on adversarial attacks & defenses in Wintersession at Princeton University 2020
- Teaching assistant for ECE 535: Machine Learning and Pattern Recognition Fall 2019

Mentoring

I continue to mentor the next generation of researchers.

- *Christian Cianfarani* - Graduate student at University of Chicago. 2021-now
- *Edoardo Debenedetti* - Master's student at École polytechnique fédérale de Lausanne (EPFL) 2021-2022
- *Rajvardhan Oak* - Master's student at University of California, Berkeley Summer 2020
- *Tinashe Handina* (B.S.E., Electrical Engineering 2021) - now a graduate student at Caltech.
- *Matteo Russo* (B.S.E., Computer Science 2020) - now a masters student at ETH Zurich.

Peer reviewing IEEE Conference on Secure and Trustworthy Machine Learning (SaTML) - *2023*; Transactions on Machine Learning Research (TMLR) - *2022*; International Conference on Machine Learning (ICML) - *2022*; International Conference on Learning Representations (ICLR) - *2022*; International Conference on Learning Representations (ICLR) - *2022*; Conference on Computer Vision and Pattern Recognition (CVPR) - *2022*; International Conference on Computer Vision (ICCV) - *2022*; Conference on Neural Information Processing Systems (NeurIPS) - *2021, 2022*; Privacy Enhancing Technologies Symposium (PETS) - *2021*, *2022*; Conference on Information Sciences and Systems (CISS) - *2020*, *2022*; PLOS Computational Biology - *2020*; ACM Transactions on Privacy and Security (TOPS) - *2019*; USENIX Security Symposium - *2018*, *2019*

Other Services

- Program committe member for IEEE Conference on Secure and Trustworthy Machine Learning 2023
- Organized more than 20 talks on security & privacy in machine learning (SPML seminar series) 2022
- Part of core maintaining team of Adversarial Robustness Benchmark (robustbench.github.io) 2020-now
- Volunteered for beta-testing of OpenReview submission pipeline for upcoming TMLR journal 2022
- Volunteered as junior mentor at Princeton-OLCF-NVIDIA GPU Hackathon 2020

Invited Talks

- Promises and pitfalls of modern generative models: An AI safety based perspective Feb 2023
  NEC Laboratories, Princeton
- Enhancing machine learning using synthetic data distilled from generative models Jan 2023
  Microsoft Research, Cambridge
- Role of synthetic data in trustworthy machine learning May 2022
  University of Chicago; University of California, Berkeley
- A generative approach to robust machine learning Mar 2022
  Annual Conference on Information Sciences and Systems (CISS)
- A generative approach to robust machine learning (link) Jan 2022
  RIKEN-AIP TrustML Young Scientist Seminar, Japan
- Generating novel hard-instances form low-density regions using generative models Aug 2021
  Facebook AI, USA
- A primer on adversarial machine learning July 2021
  Princeton-Intel REU Seminar
- Embedding data distribution to make machine learning more reliable March 2021
  Adversarial robustness seminar, École polytechnique fédérale de Lausanne (EPFL)
- Private Deep Learning Made Practical Oct 2019
  Qualcomm, San Diego