# Vatsal Sharan

**Appointments**

**University of Southern California**
*Assistant Professor,*
*Department of Computer Science* **Fall 2021 – present**

**Massachusetts Institute of Technology**
*Norbert Weiner Postdoctoral Associate,*
*Institute for Data, Systems & Society* **2020 – 2021**

**Education**

**Stanford University**
*Ph.D. in Electrical Engineering* **2014 – 2020**
*Advisor: Gregory Valiant, Dept. of Computer Science*

**Indian Institute of Technology Kanpur**
*B.Tech. in Electrical Engineering* **2010 – 2014**

**Distinctions**

- Okawa Foundation Research Grant 2025
- Google Research Scholar Award 2025
- Amazon Research Award 2024
- NSF CAREER Award 2023
- Amazon Research Award 2022
- Best Paper Award at 35th Conference on Learning Theory (COLT) 2022
- Norbert Wiener Postdoctoral Fellowship, MIT 2020
- Outstanding reviewer at ICML'19, NeurIPS'21
- Invited to China Theory Week, Tsinghua University 2018
- Director's Gold Medal for best all-round performance and leadership in graduating class, IIT Kanpur 2014
- Best Final Year Project in Electrical Engineering, IIT Kanpur 2014
- Honda Young Engineer and Scientist Award 2013

**Selected Publications**

(most papers in theory venues have alphabetical author ordering)

1. **Transformers Learn Low Sensitivity Functions: Investigations & Implications**
   Bhavya Vasudeva, Deqing Fu, Tianyi Zhou, Elliott Kau, Youqi Huang, Vatsal Sharan
   *International Conference on Learning Representations (ICLR) 2025*

2. **Proper Learnability and the Role of Unlabeled Data**
   Julian Asilis, Siddartha Devic, Shaddin Dughmi, Vatsal Sharan, Shang-Hua Teng
   *Algorithmic Learning Theory (ALT) 2025*

3. **On the Inherent Privacy of Two Point Zeroth Order Projected Gradient Descent**
   Devansh Gupta, Meisam Razaviyayn, Vatsal Sharan
   *Artificial Intelligence & Statistics (AISTATS) 2025*

4. **Transformers Learn Higher-Order Optimization Methods for In-Context Learning: A Study with Linear Models**
   Deqing Fu, Tian-Qi Chen, Robin Jia, Vatsal Sharan
   *Neural Information Processing Systems (NeurIPS) 2024*
   ***Best Paper Award at SoCal NLP Symposium 2023***

5. **Pre-trained Large Language Models Use Fourier Features to Compute Addition**
   Tianyi Zhou, Deqing Fu, Vatsal Sharan, Robin Jia
   *Neural Information Processing Systems (NeurIPS) 2024*

6. **When is Multicalibration Post-Processing Necessary?**
   Dutch Hansen, Siddartha Devic, Preetum Nakkiran, Vatsal Sharan
   *Neural Information Processing Systems (NeurIPS) 2024*

7. **Optimal Multiclass U-Calibration Error and Beyond**
   Haipeng Luo, Spandan Senapati, Vatsal Sharan
   *Neural Information Processing Systems (NeurIPS) 2024*

8. **Transductive Sample Complexities Are Compact**
   Julian Asilis, Siddartha Devic, Shaddin Dughmi, Vatsal Sharan, Shang-Hua Teng
   *Neural Information Processing Systems (NeurIPS) 2024*

9. **On the Statistical Complexity of Sample Amplification**
   Brian Axelrod, Shivam Garg, Yanjun Han, Vatsal Sharan, Gregory Valiant
   *Annals of Statistics, 2024*

10. **Regularization and Optimal Multiclass Learning**
    Julian Asilis, Siddartha Devic, Shaddin Dughmi, Vatsal Sharan, Shang-Hua Teng
    *Conference on Learning Theory (COLT) 2024*

11. **Stability and Group Fairness in Ranking with Uncertain Predictions**
    Siddartha Devic, Aleksandra Korolova, David Kempe, Vatsal Sharan
    *International Conference on Machine Learning (ICML) 2024*
    *Non-archival at Symposium on Foundations of Responsible Computing (FORC 2024)*

12. **Mitigating Simplicity Bias in Deep Learning for Improved OOD Generalization and Robustness**
    Bhavya Vasudeva, Kameron Shahabi, Vatsal Sharan
    *Transactions on Machine Learning Research (TMLR) 2024*

13. **Fairness in Matching under Uncertainty**
    Siddartha Devic, David Kempe, Vatsal Sharan, Aleksandra Korolova
    *International Conference on Machine Learning (ICML) 2023*
    *ACM Conference on Equity & Access in Algorithms, Mechanisms, & Optimization (EAAMO'23)*

14. **NeuroSketch: A Neural Network Method for Fast and Approximate Evaluation of Range Aggregate Queries**
    Sepanta Zeighami, Vatsal Sharan, Cyrus Shahabi
    *ACM Special Interest Group on Management of Data Conference (SIGMOD) 2023*

15. **Efficient Convex Optimization Requires Superlinear Memory**
    Annie Marsden, Vatsal Sharan, Aaron Sidford, Gregory Valiant
    *Conference on Learning Theory (COLT), 2022* ***(Best Paper Award)***
    ***Invited to IJCAI 2023 Sister Conference Notable Paper Track***
    *Journal of the ACM (JACM), 2024*

16. **Efficient Gradient Methods for Objectives with Multiple Scales**
    Jon Kelner, Annie Marsden, Vatsal Sharan, Aaron Sidford, Gregory Valiant, Honglin Yuan
    *Conference on Learning Theory (COLT) 2022*

17. **Multicalibrated Partitions for Importance Weights**
    Parikshit Gopalan, Omer Reingold, Vatsal Sharan, Udi Wieder
    *Algorithmic Learning Theory (ALT) 2022*

18. **Omnipredictors**
    Parikshit Gopalan, Adam Tauman Kalai, Omer Reingold, Vatsal Sharan, Udi Wieder
    *Innovations in Theoretical Computer Science (ITCS) 2022*

19. **Modular versus Monolithic Task Formulations in Neural Networks Learning**
    Atish Agarwala, Abhimanyu Das, Brendan Juba, Rina Panigrahy, Vatsal Sharan, Xin Wang, Qiuyi Zhang
    *International Conference on Learning Representations (ICLR) 2021*

20. **Sample Amplification: Increasing Dataset Size even when Learning is Impossible**
Brian Axelrod, Shivam Garg, Vatsal Sharan, Gregory Valiant
*International Conference on Machine Learning (ICML) 2020*

21. **PIDForest: Anomaly detection via Partial Identification**
Parikshit Gopalan, Vatsal Sharan, Udi Wieder
*Neural Information Processing Systems (NeurIPS) 2019* ***(Spotlight presentation)***

22. **Fast and Accurate Low-Rank Factorization of Compressively-Sensed Data**
Vatsal Sharan, Kai Sheng Tai, Peter Bailis, Gregory Valiant
*International Conference on Machine Learning (ICML) 2019*

23. **Memory-sample Tradeoffs for Linear Regression with Small Error**
Vatsal Sharan, Aaron Sidford, Gregory Valiant
*Symposium on the Theory of Computing (STOC) 2019*

24. **Recovery Guarantees for Quadratic Tensors with Limited Observations**
Hongyang Zhang, Vatsal Sharan, Moses Charikar and Yingyu Liang
*Artificial Intelligence & Statistics (AISTATS) 2019*

25. **A Spectral View of Adversarially Robust Features**
Shivam Garg, Vatsal Sharan, Brian Zhang, Gregory Valiant
*Neural Information Processing Systems (NeurIPS) 2018* ***(Spotlight presentation)***

26. **Efficient Anomaly Detection via Matrix Sketching**
Vatsal Sharan, Parikshit Gopalan, Udi Wieder
*Neural Information Processing Systems (NeurIPS) 2018*

27. **Prediction with a Short Memory**
Vatsal Sharan, Sham Kakade, Percy Liang, Gregory Valiant
*Symposium on the Theory of Computing (STOC) 2018*

28. **Sketching Linear Classifiers over Data Streams**
Kai Sheng Tai, Vatsal Sharan, Peter Bailis, Gregory Valiant
*ACM SIGMOD Conference on Management of Data (SIGMOD) 2018*

29. **Moment-Based Quantile Sketches for Efficient High Cardinality Aggregation Queries**
Edward Gan, Jialin Ding, Kai Sheng Tai, Vatsal Sharan, Peter Bailis
*Conference on Very Large Data Bases (VLDB) 2018*

30. **Learning Overcomplete HMMs**
Vatsal Sharan, Sham Kakade, Percy Liang, Gregory Valiant
*Neural Information Processing Systems (NeurIPS) 2017*

31. **Orthogonalized Alternating Least Squares: A Theoretically Principled Tensor Factorization Algorithm for Practical Use**
Vatsal Sharan, Gregory Valiant
*International Conference on Machine Learning (ICML) 2017*

## Teaching at USC

**Theory of Machine Learning:** Fall'21, Fall'23
**Machine Learning:** Fall'22, Spring'24
**Computational Perspectives on the Frontiers of Learning:** Spring'23

## Students

### PhD students

Bhavya Vasudeva (started Fall'21)
Siddartha Devic (started Fall'21, co-advised with Aleksandra Korolova)
Julian Asilis (started Fall'22)
Deqing Fu (started Fall'22, co-advised with Robin Jia)
Devansh Gupta (started Fall'23, co-advised with Meisam Razaviyayn)
Spandan Senapati (started Fall'23, co-advised with Haipeng Luo)
Tianyi Zhou (started Fall'23, co-advised with Robin Jia)

**Undergraduate and Masters students**
Kuan Liu
Nathan Derhake
Woody Gan
Anish Jayant
Jung Whan Lee
You Qi Huang
Dutch Hansen (graduated in Fall'25, will start as Ph.D. student at the University of Washington)
Natalie Abreu (graduated in Fall'23, now Ph.D. student at Harvard)
Aditya Prased (graduated in Fall'24, now Ph.D. student at the University of Chicago)
Kameron Shahabi (graduated in Fall'24, now Ph.D. student at the University of Washington)
Qilin Ye (graduated in Fall'24, now M.S. student at Duke)
Devin Martin (SURE program intern in Summer'22, mentored by Bhavya Vasudeva)

## Professional Activities

**Reviewing for Grants**
National Science Foundation (NSF) Panelist, 2022, 2023
Swiss National Science Foundation Reviewer, 2024

**Reviewing for Journals**
IEEE BITS "Special Issue on Generative Models" 2025 *(co-editor)*
IEEE Transactions on Information Theory, 2023
Journal of Machine Learning Research (JMLR), 2021, 2022
SIAM Journal of Computing, 2020, 2021

**Conference Program Committee/Reviewing**
Foundations of Responsible Computing (FORC), 2025 *(PC member)*
Conference on Learning Theory (COLT), 2019-2024, 2025 (area chair)
Algorithmic Learning Theory (ALT), 2022-2023, 2024-2026 *(area chair)*
International Conference on Learning Representations (ICLR), 2021-2023, 2025 *(area chair)*
International Conference on Machine Learning (ICML), 2019-2023, 2025 *(area chair)*
Neural Information Processing Systems (NeurIPS), 2019-2021, 2023, 2025 *(area chair)*
International Conference on Artificial Intelligence and Statistics (AISTATS), 2021
AAAI Conference on Aritificial Intelligence (AAAI), 2020
Symposium on Theory of Computing (STOC), 2020-2022, 2024, 2025
Foundations of Computer Science (FOCS), 2020, 2023, 2024, 2025 *(PC member)*
Symposium on Discrete Algorithms (SODA), 2019, 2022, 2024, 2025
Innovations in Theoretical Computer Science (ITCS), 2020, 2023

## Outreach

**Learning Theory Alliance (LeT-All), Workshop Committee**
- Organized a social and mentorship event at Neurips 2024 on "Learning Theory Research in the Era of LLMs", attended by around 100 participants.
- Organized day-long virtual mentoring workshop on "Day-to-day life of an ML/theory researcher" on June 4 2024, attended by around 300 students.
- Organized day-long virtual mentoring workshop on "Communicating your research" on October 26 2023, attended by around 200 students.

**High-school students hosted in the summer (in collaboration with USC Viterbi K-12 Center)**
Janna Audrey Doratan (Summer'24, mentored by Devansh Gupta)
Angela Zhuang (Summer'23, mentored by Julian Asilis)
Jayron Martinez (Summer'22, mentored by Siddartha Devic)
Luke Pratt (Summer'22, mentored by Bhavya Vasudeva)

**Talks for high-school students**

*Fair & Robust Artificial Intelligence*
- As part of USC SHINE program for high-schoolers, June 2022
- Los Angeles County Office of Education (LACOE) CS speaker series, February 2023

## Invited Talks & Seminars

*Using Algorithms to Understand Transformers (and Using Transformers to Understand Algorithms)*
- Workshop on Theoretical Perspectives on LLMs, UCSD, March 2025
- Cornell Artificial Intelligence Seminar, February 2025
- Simons Institute Workshop on Transformers as a Computational Model, September 2024
- Google Research Mountain View, November 2024
- University of British Columbia CAIDA Seminar, December 2024

*Discovering Data Structures: Nearest Neighbor Search and Beyond*
- Information Theory and Applications, San Diego, February 2025

*Transformers Learn Higher-Order Optimization Methods for In-Context Learning*
- USC Symposium on Frontiers of Generative AI in Science and Society, March 2024
- Information Theory and Applications, San Diego, February 2024

*Memory as a Lens to Understand Efficient Learning and Optimization*
- UC Berkeley Theory Seminar, October 2024
- Workshop on Computational/Statistical Gaps in Learning & Optimization, UCLA, February 2024
- Indian Institute of Technology, Delhi, December 2023
- University of Maryland, College Park, September 2023
- Microsoft Research, NYC, September 2023

*A multigroup perspective to go beyond loss minimization in ML*
- BIRS Workshop on New Directions in Machine Learning Theory, Banff, October 2024

*From Anomaly Detection to Robust ML: Multicalibration as an Algorithmic Paradigm*
- Amazon Research, Palo Alto, July 2023

*Fairness in Matching under Uncertainty*
- Information Theory and Applications, San Diego, February 2023

*Sample Amplification: Increasing Dataset Size even when Learning is Impossible*
- IISA Annual Meeting, December 2024
- Simons Institute Seminar, September 2024
- USC Probability Seminar, October 2023
- Learning Theory Alliance Mentoring Workshop, February 2021
- Simons Institute, Learning in High Dimensions Program, September 2020
- Neurips Machine Learning with Guarantees Workshop, December 2019

*Memory-sample Tradeoffs for Continuous Optimization and Learning*
- MIT Theory Lunch, October 2020
- NYU Theory Seminar, November 2019
- EPFL Theory Seminar, November 2019
- Northwestern Junior Theorists Workshop, November 2019
- University of Washington Theory Lunch, October 2019
- Cornell ORIE Young Researchers Workshop, October 2019
- Google Research, Mountain View, August 2019

*Prediction with a Short Memory*
- ETH Zurich Institute for Theoretical Studies, November 2019
- China Theory Week, Tsinghua University, September 2018
- Google Mountain View Algorithms TechTalk, March 2018

*Orthogonalized ALS: Theoretically Principled Tensor Factorization for Practical Use*
- SIAM Annual Meeting, Portland, July 2018