Anirudh Sridhar

Researcher in Applied Probability, Statistics and Networked Systems

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Employment

Massachusetts Institute of Technology — *Cambridge, MA*

Postdoctoral Researcher, Department of Mathematics — *Aug 1 – Current*

- Mentor: Prof. Elchanan Mossel

Education

Princeton University — *Princeton, NJ*

PhD in Electrical and Computer Engineering — *Sep. 2018 - May 2023*

- Dissertation topic: *Inference of Cascades and Correlated Networks*, advised by Prof. Miklós Rácz and Prof. H. Vincent Poor

Carnegie Mellon University — *Pittsburgh, PA*

Bachelor of Science in Electrical and Computer Engineering — *Aug. 2014 - May 2018*

- Honors Research topic: *Deterministic approximation of stochastic games*, advised by Prof. Soummya Kar

Selected Honors & Awards

2023 **Finalist for Best Graduating Student Talk**, Information Theory and Applications Workshop

2022 **Yan Huo *94 Graduate Fellowship in Electrical Engineering**, Princeton University

2021 **Spotlight presentation**, 35th Conference on Neural Information Processing Systems (NeurIPS)

2021 **Interdisciplinary Fellowship**, Department of Electrical & Computer Engineering, Princeton University

2020 **Finalist**, INFORMS-APS Best Student Paper Award (for *Correlated Randomly Growing Graphs*)

Publications

Note: $[\alpha/\beta]$ indicates that authors are listed in alphabetical order of last name.

Submitted preprints (available on arXiv)

1. Average-case and Smoothed Analysis of Graph Isomorphism.
   $[\alpha/\beta]$ J. Gaudio, M. Z. Rácz, A. Sridhar
   Submitted to *The Annals of Applied Probability*

Publications

10. Mean-field Approximations for Stochastic Population Processes with Heterogeneous Interactions.
    A. Sridhar, S. Kar
    To appear in the *SIAM Journal on Control and Optimization (SICON)*, 2023+
9. The Role of Masks in Mitigating Viral Spread on Networks.
   Y. Tian, A. Sridhar, C. W. Wu, S. A. Levin, K.M. Carley, H. V. Poor, O. Yağan
   Physical Review E, July 2023.
8. Spreading Processes with Mutations over Multi-Layer Networks.
   M. Sood, A. Sridhar, R. Eletreby, C. W. Wu, S. A. Levin, H. V. Poor, O. Yağan
   Proceedings of the National Academy of Sciences (PNAS), June 2023.
7. Quickest Inference of Network Cascades with Noisy Information.
   A. Sridhar, H. V. Poor
   IEEE Transactions on Information Theory, April 2023.
6. Recovering the Graph Underlying Networked Dynamical Systems under Partial Observability: A Deep Learning Approach.
   S. Machado, A. Sridhar, P. Gil, J. Henriques, J.M.F. Moura, A. Santos
   AAAI Conference on Artificial Intelligence 2023
5. Exact Community Recovery in Correlated Stochastic Block Models.
   $[\alpha/\beta]$ J. Gaudio, M. Z. Rácz, A. Sridhar
   Conference on Learning Theory (COLT) 2022
4. Correlated Randomly Growing Graphs.
   $[\alpha/\beta]$ M. Z. Rácz, A. Sridhar
   The Annals of Applied Probability, May 2022.
   Finalist for the *INFORMS-APS Best Student Paper Award*, 2020.

3. Correlated Stochastic Block Models: Exact Graph Matching with Applications to Recovering Communities.
   [α/β] M. Z. Rácz, A. Sridhar
   Conference on Neural Information Processing Systems (NeurIPS) 2021
   Selected for a spotlight presentation (top 3% of submissions).
2. Modeling and Analysis of the Spread of COVID-19 under a Multiple-Strain Model with Mutations.
   O. Yağan, A. Sridhar, R. Eletreby, S. A. Levin, J. B. Plotkin, H. V. Poor
   Harvard Data Science Review, April 2021.
   Part of a *Special Issue on COVID-19*.
1. Client-CASH: Protecting Master Passwords Against Offline Attacks.
   J. Blocki, A. Sridhar
   ACM Asia Conference on Computer and Communications Security (ASIACCS) 2016

Short conference papers

7. Quickest Inference of Suceptible-Infected Cascades in Sparse Networks.
   A. Sridhar, T. Routtenberg, H. V. Poor
   IEEE International Symposium on Information Theory (ISIT) 2023
6. Matching Correlated Inhomogeneous Random Graphs using the k-core Estimator.
   [α/β] M. Z. Rácz, A. Sridhar
   IEEE International Symposium on Information Theory (ISIT) 2023
5. Leveraging a Multiple-Strain Model with Mutations in Analyzing the Spread of COVID-19.
   A. Sridhar, O. Yağan, R. Eletreby, S. A. Levin, J. B. Plotkin, H. V. Poor
   IEEE Conference on Acoustics, Speech and Signal Processing (ICASSP) 2021
4. Bayes-Optimal Methods for Finding the Source of a Cascade.
   A. Sridhar, H. V. Poor
   IEEE Conference on Acoustics, Speech and Signal Processing (ICASSP) 2021
3. Analysis of the Impact of Mask-wearing in Viral Spread: Implications for COVID-19.
   Y. Tian, A. Sridhar, O. Yağan, H. V. Poor
   American Control Conference (ACC) 2021
2. Sequential Estimation of Network Cascades.
   A. Sridhar, H. V. Poor
   Asilomar Conference in Signals and Systems 2020
1. On Distributed Stochastic Gradient Algorithms for Global Optimization.
   B. Swenson, A. Sridhar, H. V. Poor
   IEEE Conference on Acoustics, Speech and Signal Processing (ICASSP) 2020

Selected Talks

Correlated Stochastic Block Models: Graph Matching and Community Recovery

- *INFORMS Annual Meeting*, Oct 2023. (Phoenix, AZ)
- *Statistical Foundations of Data Science and their Applications*, May 2023. (Princeton, NJ)
- *INFORMS Annual Meeting*, Oct 2022. (Indianapolis, IN)
- *COLT*, July 2022. (Virtual)
- *Stochastic Networks Conference*, June 2022. (Ithaca, NY)
- *NeurIPS*, Dec 2021. (Virtual)
- 20^{th} *Northeast Probability Seminar*, Nov 2021. (Virtual)

Quickest Inference of Network Cascades

- *IEEE International Symposium on Information Theory*, June 2023 (Taipei, Taiwan)
- *Information Theory and Applications Workshop*, Feb 2023 (San Diego, CA)
- *North American School of Information Theory*, Aug 2022. (Los Angeles, CA)
- *ICASSP*, June 2021. (Virtual)
- *Asilomar Conference on Signals, Systems, and Computers*, Nov 2020. (Virtual)

Nature vs. Nurture in Randomly Growing Graphs

- *RandNET Workshop*, Aug 2022. (Eindhoven, The Netherlands)

Matching Correlated Inhomogeneous Random Graphs using the k-core Estimator

- *IEEE International Symposium on Information Theory*, June 2023. (Taipei, Taiwan)

Understanding the Impact of Mutations and Mask-wearing in Viral Spread on Networks

- *Networks*, July 2021. (Virtual)
- *ICASSP*, June 2021. (Virtual)

Correlated Randomly Growing Graphs

- *INFORMS Annual Meeting*, Nov 2020. (Virtual)
- *IMS-Bernoulli One World Symposium*, Aug. 2020. (Virtual)
- *MIFODS Workshop: Learning Under Complex Structure*, Jan. 2020. (Boston, MA)

Mean-field Approximation for Stochastic Population Processes on Networks

- *49th Probability Summer School*, July 2019. (Saint-Flour, France)
- *Meeting of the Minds (Senior Honors Thesis), Carnegie Mellon University*, May 2018 (Pittsburgh, PA)

Teaching

ELE 201: Information Signals (Princeton University)

Princeton, NJ

Head Graduate Teaching Assistant — *Spring 2020, Fall 2020, Fall 2022*

- Designed and taught content for a first undergraduate course in signal processing.
- Created innovative content for online teaching settings.
- Graded assignments and supervised other TAs.
- Updated and redesigned labs for the course

ORF 526: Probability Theory (Princeton University)

Princeton, NJ

Teaching Assistant — *Fall 2021*

- An introductory course in graduate probability which includes the central limit theorem, martingales and Brownian motion.
- Held office hours, graded homework and taught a few lectures.

Accelerated Natural Language Processing course (Machine Learning University, Amazon)

Virtual

Instructor — *July 2021*

- Taught over 180 students the fundamentals of Natural Language Processing in a three day course.
- Topics included introductory machine learning, neural networks, RNNs, LSTMs and Transformers.
- Students also completed a final project involving Amazon product reviews.
- Student body included interns, software developers, and managers at Amazon.

Probabilistic Machine Learning course (Machine Learning University, Amazon)

Virtual

Instructor — *June – Aug 2021*

- Worked in a team of 5 people to design a 2-week course on probabilistic machine learning for Amazon applied scientists.
- Topics include Bayesian inference, Markov Chain Monte Carlo, and Bayesian neural networks (e.g., variational auto-encoders)
- Designed lectures, created supporting JuPyter notebooks, and designed a final project where students applied methods from the course to retail data
- Course has been taught at Amazon's Machine Learning University since 2021.

21-127 Concepts of Mathematics (Carnegie Mellon University)

Pittsburgh, PA

EXCEL Leader — *Sep 2015 - May 2018*

- Designed and taught course content for Concepts of Mathematics, a proof-based mathematics course for first-year undergraduates.
- Focused on improving student study skills and building student work ethic in a collaborative learning environment.
- Planned weekly review sessions for 25 students each semester.
- Team lead for the 6 other EXCEL leaders for the course.

Carnegie Mellon Academic Development

Pittsburgh, PA

EXCEL and SI Head Supervisor — *Jan. 2017 - May 2018*

- Hired, trained and supervised about 50 student EXCEL and Supplemental Instruction (SI) leaders who taught a variety of courses in engineering, mathematics and the sciences.
- Handled various administrative tasks for the SI and EXCEL programs, such as enrollment logistics and evaluating employees.
- Instructor for 99-251 Fundamentals of Supplemental Instruction.
- Received a ***Senior Leadership Award*** for my work as an EXCEL Head Supervisor.

Further Professional Experience

Amazon Web Services (AWS), Machine Learning University

Virtual

Applied Science Intern (manager: Dr. Brent Werness) — *June 2021 - Aug. 2021*

- Designed a 2-week course on probabilistic machine learning for Amazon applied scientists.
- Topics included Bayesian inference, Markov Chain Monte Carlo, and Bayesian neural networks.
- Course has been taught at Amazon since 2021.
- Taught a 3-day accelerated course in Natural Language Processing; topics included introductory machine learning, neural networks, RNNs, LSTMs, and Transformers. Course had over 180 students, including interns, software developers, and managers.

École Polytechnique Fédérale de Lausanne (EPFL), Department of Information and Computer Sciences

Lausanne, Switzerland

Research Assistant (supervisor: Prof. Elisa Celis) *June 2018 - Aug. 2018*

- Studied the influence of individual attributes on link formation in social networks and used the findings to improve models of network formation.
- Analysis done on the AddHealth dataset, which has tracked the physical health, mental health and social connections of a set of individuals for over 20 years.

Argonne National Laboratory, Advanced Photon Source

Lemont, IL

Summer Undergraduate Laboratory Intern (supervisor: Ned Arnold) *June 2016 - Aug 2016*

- Designed an optimized embedded controller to correct the Advanced Photon Source synchotron beam.
- Implemented the controller on a digital signal processing chip and evaluated its performance.

Service

Graduate Student Committee, Electrical & Computer Engineering Department

Princeton, NJ

Committee member *Nov. 2021 - May 2023*

- Served as a liason between the graduate student body and the director of graduate studies
- Organized social and professional events in the department

Academic service

- Journal reviewer for *IEEE Transactions on Information Theory, The Journal of Communications and Networks, Physica A: Statistical Mechanics and Applications, Springer Nature Applied Network Science, IEEE/ACM Transactions on Networking, Transactions on Signal Processing, Bernoulli, SIAM Journal on Discrete Mathematics*
- Conference reviewer for *The American Control Conference (ACC), Conference on Information Systems and Sciences (CISS), NeurIPS*
- Served as an assistant in *CISS 2022*. I helped facilitate 2 sessions and helped solve technical issues that arose.
- Organized a session on *Advances in Community Recovery from Networks* in the *2023 Informs Annual Meeting*.

References

Professor Elchanan Mossel

Professor, Department of Mathematics, Massachusetts Institute of Technology

- Email: elmos@mit.edu

Professor Miklós Z. Rácz

Assistant Professor, Department of Statistics and Data Science, Department of Computer Science, Northwestern University

- Email: miklos.racz@northwestern.edu

Professor H. Vincent Poor

Michael Henry Strater University Professor of Electrical Engineering, Princeton University

- Email: poor@princeton.edu

Professor Soummya Kar

Professor, Department of Electrical and Computer Engineering, Carnegie Mellon University

- Email: soummyak@andrew.cmu.edu

Professor Yuxin Chen

Associate Professor, Department of Statistics & Data Science, Department of Electrical & Systems Engineering, University of Pennsylvania

- Email: yuxinc@wharton.upenn.edu