Amir Reza ASADI

Leverhulme Early Career Fellow
Isaac Newton Trust Fellow

Statistical Laboratory
Centre for Mathematical Sciences
University of Cambridge
Cambridge, CB3 1AE
United Kingdom
✉ *asadi@statslab.cam.ac.uk*
amirrezaasadi.com

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Research Interests

- Machine Learning
- Information Theory
- Differential Privacy
- High-Dimensional Probability and Statistics

Education

2017–2021 **Ph.D. in Electrical and Computer Engineering**, *Princeton University*, Princeton, New Jersey, United States.

Dissertation: *"Neural Network Learning: A Multiscale-Entropy and Self-Similarity Approach"*

Advisor: Prof. Emmanuel Abbe

2015–2017 **M.A. in Electrical Engineering**, *Princeton University*, Princeton, New Jersey, United States.

Advisors: Prof. Emmanuel Abbe and Prof. Sergio Verdú

2010–2015 **B.Sc. in Mathematics**, *Sharif University of Technology*, Tehran, Iran.

2010–2015 **B.Sc. in Electrical Engineering (Communications)**, *Sharif University of Technology*, Tehran, Iran.

Cumulative GPA: 18.48/20.00 (calculated across both Mathematics and Electrical Engineering degrees)

Project: Some Schemes for File Dissemination in Networks Employing Linear Network Coding

Project Advisor: Dr. Amin A. Gohari

Academic Positions

2023–Present **Leverhulme Early Career Fellow**, *Statistical Laboratory, Department of Pure Mathematics and Mathematical Statistics, University of Cambridge*, Cambridge, United Kingdom.

- Fellow of the Isaac Newton Trust, Cambridge, United Kingdom
- PI of the "Hierarchical Approaches to Statistical Learning and Private Data Generation" project

2021–2023 **Postdoctoral Research Associate**, *Statistical Laboratory, Department of Pure Mathematics and Mathematical Statistics, University of Cambridge*, Cambridge, United Kingdom.

Mentors: Prof. Po-Ling Loh and Prof. Varun Jog

Academic Affiliation

2022–Present **Postdoctoral Affiliate**, *Trinity College*, Cambridge, United Kingdom.

Publications

- **A. R. Asadi**, A. Davoodi, R. Javadi & F. Parvaresh. (2025) Exact Recovery in the Data Block Model. *(In Preparation)*
- **A. R. Asadi**. (2025) Hierarchical Maximum Entropy via the Renormalization Group. *(Submitted)*
- G. Aminian, **A. R. Asadi**, I. Shenfeld & Y. Mroueh. (2025) Theoretical Analysis of KL-regularized RLHF with Multiple Reference Models. *2nd Workshop on Models of Human Feedback for AI Alignment at the International Conference on Machine Learning (ICML) 2025.*
- G. Aminian, I. Shenfeld, **A. R. Asadi**, A. Beirami & Y. Mroueh. (2025) Best-of-N through the Smoothing Lens: KL Divergence and Regret Analysis. *Efficient Systems for Foundation Models Workshop at the International Conference on Machine Learning (ICML) 2025.*
- G. Aminian, **A. R. Asadi**, T. Li, A. Beirami, G. Reinert & S. N. Cohen (2025) Generalization and Robustness of the Tilted Empirical Risk. *International Conference on Machine Learning 2025.*
- A. Pensia, **A. R. Asadi**, V. Jog & P. Loh. (2024) Simple Binary Hypothesis Testing under Local Differential Privacy and Communication Constraints. *IEEE Transactions on Information Theory*. vol. 71, no. 1, pp. 592-617.
- **A. R. Asadi**. (2024) An Entropy-Based Model for Hierarchical Learning. *Journal of Machine Learning Research*, 25(187), pp. 1-45.
- **A. R. Asadi** & P. Loh (2024) Entropic Regularization of Neural Networks: Self-Similar Approximations. *Journal of Statistical Planning and Inference*, Vol. 233.
- **A. R. Asadi** & P. Loh (2023) On the Gibbs Exponential Mechanism and Private Data Generation. *IEEE International Symposium on Information Theory (ISIT) 2023.* pp. 2213-2218
- A. Pensia, **A. R. Asadi**, V. Jog & P. Loh. (2023) Simple Binary Hypothesis Testing under Local Differential Privacy and Communication Constraints. *Conference on Learning Theory (COLT).*
- **A. R. Asadi** & E. Abbe. (2022) Maximum Multiscale Entropy and Neural Network Regularization. *arXiv preprint arXiv:2006.14614*
- **A. R. Asadi** & E. Abbe. (2020) Chaining Meets Chain Rule: Multilevel Entropic Regularization and Training of Neural Networks. *Journal of Machine Learning Research*, 21(139), pp. 1-32.
- **A. R. Asadi**, E. Abbe, & S. Verdú. (2018) Chaining Mutual Information and Tightening Generalization Bounds. *Advances in Neural Information Processing Systems (NeurIPS)*, pp. 7245-7254.
- **A. R. Asadi**, E. Abbe, & S. Verdú, (2017) Compressing Data on Graphs with Clusters. *IEEE International Symposium on Information Theory (ISIT)*, pp. 1583-1587.
- M. Asadi, & **A. R. Asadi**. (2014) On the Failure Probability of Used Coherent Systems. *Communications in Statistics, Theory and Methods*, Vol. 43, pp. 2468-2475.
- **A. R. Asadi** (2013). Problem 96.J with solution, *The Mathematical Gazette*, Vol. 97, No. 539, pp. 345-346, United Kingdom. (Available at JSTOR.)

Invited Talks

June 2025 **"Differential Privacy: A Stability-Based Perspective"**, UK Crypto Day, University of Sheffield, Sheffield, United Kingdom

January 2025 **"Hierarchical Learning: An Entropy-Based Approach"**, Chennai Mathematical Institute, Chennai, India

May 2023 **"An Entropy-Based Model for Hierarchical Learning"**, Department of Mathematical Sciences, Durham University, Durham, United Kingdom

February 2023 **"An Entropy-Based Model for Hierarchical Learning"**, Statistical Laboratory, University of Cambridge, Cambridge, United Kingdom

February 2021 **"Neural Networks and Multiscale Entropies"**, Department of Computer Science, ETH Zürich, Zürich, Switzerland

December 2020 **"Neural Networks and Multiscale Entropies"**, Department of EECS, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States

December 2020 **"Neural Networks and Multiscale Entropies"**, NSF-Simons Collaboration on the Theoretical Foundations of Deep Learning

June 2020 **"Neural Networks and Multiscale Entropies"**, Center for Data Science, New York University, New York, United States

May 2020 **"Neural Networks and Multiscale Entropies"**, Laboratoire de Physique, École Normale Supérieure, Paris, France

April 2020 **"Neural Networks and Multiscale Entropies"**, Department of Statistical Sciences, University of Toronto, Toronto, Canada

March 2020 **"Neural Networks and Multiscale Entropies"**, Department of Engineering, University of Cambridge, Cambridge, United Kingdom

October 2019 **"Chaining Meets Chain Rule"**, Institute for Advanced Study, Princeton, New Jersey, United States. (Available at YouTube.)

September 2019 **"Chaining Meets Chain Rule"**, Microsoft Research AI, Redmond, Washington, United States

Awards and Honors

2023–present Leverhulme Early Career Fellowship, the Leverhulme Trust and the Isaac Newton Trust

2019 Teaching Assistant Award, Department of Electrical and Computer Engineering, Princeton University

2016 Anthony Ephremides Fellowship, Princeton University

2009 Bronze Medal, Iranian Mathematical Olympiad

2009 Diploma of Mathematics, Tournament of Towns Contest, Russian Academy of Sciences

2009–present Member of Iran's National Elite Foundation

Research Visits

September 2019 **Visiting Ph.D. Student**, *Microsoft Research AI*, Redmond, Washington, United States, **Host:** Prof. Sebastien Bubeck.

Summer 2014 **Research Intern**, *Institute of Network Coding*, The Chinese University of Hong Kong, Hong Kong, **Host:** Prof. Raymond Yeung.
Working on linear network coding

Professional Services

2024–present Co-organizer of the Information Theory Seminar, University of Cambridge

14–16 May 2025 Co-organizer, 8th London Symposium on Information Theory

10 May 2024 Co-organizer, 2nd Cambridge Information Theory Colloquium

21 April 2023 Co-organizer, 1st Cambridge Information Theory Colloquium

Reviewer for:

- Journal of Machine Learning Research
- IEEE Transactions on Information Theory
- Journal of Statistical Planning and Inference
- Journal of Selected Areas on Information Theory
- Conference on Neural Information Processing Systems (NeurIPS)
- Conference on Learning Theory (COLT)
- International Symposium on Information Theory (ISIT)
- International Conference on Machine Learning (ICML)
- International Conference on Learning Representations (ICLR)
- Information Theory Workshop (ITW)
- Conference on Information Sciences and Systems (CISS)
- Notices of the American Mathematical Society
- Conference on Uncertainty in Artificial Intelligence (UAI)

Teaching Experience

2024–2025 **Supervisor for *Information Theory and Coding***, *Department of Engineering, University of Cambridge*, Cambridge, United Kingdom.
Supervised third year undergraduate students.

2023–2025 **Supervisor for *Probability***, *Department of Pure Mathematics and Mathematical Statistics, University of Cambridge*, Cambridge, United Kingdom.
Supervised first year undergraduate students.

2023–2025 **Supervisor for *Principles of Statistics***, *Department of Pure Mathematics and Mathematical Statistics, University of Cambridge*, Cambridge, United Kingdom.
Supervised third year undergraduate students.

2022 **Examples Class Instructor for *Information Theory***, *Department of Pure Mathematics and Mathematical Statistics, University of Cambridge*, Cambridge, United Kingdom.
Instructed Master's students.

2018–2019 **Teaching Assistant for *Probability in High Dimension***, *Program in Applied and Computational Mathematics, Princeton University*, Princeton, New Jersey, United States.
Graded problem sets for Prof. Ramon van Handel's course.

2017–2018 **Teaching Assistant for *Transmission and Compression of Information***, *Department of Electrical and Computer Engineering, Princeton University*, Princeton, New Jersey, United States.
Devised and graded problem sets, midterm and final exams in collaboration with Prof. Emmanuel Abbe.
Recipient of the Department of Electrical and Computer Engineering Teaching Assistant Award.

Coursework (Princeton University)

Course Title	Instructor(s)	Grade
Information Theory	Sergio Verdú	A^+
Lossless Data Compression	Sergio Verdú	A^+
Coding Theory and Random Graphs	Emmanuel Abbe	A^+
Theoretical Machine Learning	Elad Hazan	A
Probability in High Dimension	Ramon van Handel	A

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Course Title	**Instructor(s)**	**Grade**
Probability Theory	Ovidiu Calin	A
Theory of Detection and Estimation	Paul Cuff	A
Random Graphs and Networks	Emmanuel Abbe	A
Sparsity, Structure and Inference	Yuxin Chen	A
Theory of Algorithms	Robert Tarjan	A
Random Processes in Information Systems	Sergio Verdú	A$^-$
New Directions in Theoretical Machine Learning	Sanjeev Arora	AUD
The Probabilistic Method	Noga Alon	AUD
Theory of Detection and Estimation	Sergio Verdú	AUD
Introduction to Statistical Mechanics	Salvatore Torquato & Roberto Car	AUD

Programming Languages

- MATLAB
- Python
- C++