Amir Reza ASADI

Leverhulme Early Career Fellow
Isaac Newton Trust Fellow

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Research Interests

- Machine Learning

- Information Theory

- Differential Privacy

- Statistics

- High-Dimensional Probability

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 and Computer 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. *arXiv preprint arXiv:2502.01203 (Submitted)*

○ 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 Error 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 Transaction on Information Theory.*

○ **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*, 233, p.106181.

○ **A. R. Asadi** & P. Loh (2023) On the Gibbs Exponential Mechanism and Private Data Generation. *IEEE International Symposium on Information Theory (ISIT) 2023.*

○ 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 the Iranian 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
2025	Co-organizer, 8th London Symposium on Information Theory
2024	Co-organizer, 2nd Cambridge Information Theory Colloquium
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 (JSAIT)
- 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.
Master's level course.

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***, *Program in Applied and Computational Mathematics, Princeton University*, Princeton, New Jersey, United States.
Devised and graded problem sets, midterm and final exams in collaboration with Prof. Emmanuel Abbe.

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
Probability Theory	Ovidiu Calin	A
Theory of Detection and Estimation	Paul Cuff	A

Course Title	Instructor(s)	Grade
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