

# Shirley Xiaoqi Liu

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My research develops statistical and information-theoretic foundations for machine learning, with a focus on learning under data heterogeneity. I characterise fundamental limits for learning problems, develop principled algorithms for sequential decision-making and high-dimensional inference, and analyse learning dynamics with provable guarantees.

## RESEARCH

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### Postdoctoral Researcher, University of Oxford

Oct 2024 – present

Host: Prof. Patrick Rebeschini

- Characterising training dynamics of canonical statistical models including shallow neural networks, with a focus on early stopping, benign overfitting, and feature learning
- Designing algorithms with rigorous guarantees for sequential decision-making problems, including bandits and adaptive inference
- Uncertainty quantification using distribution-free and assumption-lean methods, including e-values, conformal prediction, and prediction-powered inference

### PhD, University of Cambridge

Oct 2019 – Jun 2024

Advisor: Prof. Ramji Venkataramanan | Thesis: Message passing algorithms for high-dimensional statistical estimation

- Change-point detection in heterogeneous data (e.g., genomics, financial data)
- Sketching sparse, low-rank matrices (e.g., adjacency matrices of large social networks)
- Reliable, efficient communications (encoding and decoding) for large user networks

## SELECTED PREPRINTS & PUBLICATIONS

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- [1] J. Allison, ..., **X. Liu**, ... (alphabetical order), “Laser writing in glass for dense, fast and efficient archival data storage”, *Nature*, 2026.
- [2] **X. Liu**, D. Baudry, J. Zimmert, P. Rebeschini, A. Akhavan, “Non-stationary Bandit Convex Optimization: A Comprehensive Study”, *Annual Conference on Neural Information Processing Systems*, 2025.
- [3] **X. Liu**, P. Pascual Cobo, R. Venkataramanan, “Many-user multiple access with random user activity: achievability bounds and efficient schemes”, *IEEE Transactions on Information Theory*, 2025.
- [4] G. Arpino, **X. Liu**, J. Gontarek, R. Venkataramanan, “Inferring Change Points in High-Dimensional Regression via Approximate Message Passing”, *Journal of Machine Learning Research*, 2025.
- [5] **X. Liu**, K. Hsieh, R. Venkataramanan, “Coded many-user multiple access via Approximate Message Passing”, *Information Theory, Probability and Statistical Learning: A Festschrift in Honor of Andrew Barron*, 2025.
- [6] G. Arpino, **X. Liu**, R. Venkataramanan, “Inferring change points in high-dimensional linear regression via AMP”, *International Conference on Machine Learning*, 2024.
- [7] **X. Liu**, R. Venkataramanan, “Sketching Sparse Low-Rank Matrices With Near-Optimal Sample- and Time-Complexity Using Message Passing”, *IEEE Transactions on Information Theory*, 2023.

## EDUCATION

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### BA and MEng, University of Cambridge

Oct 2015 – Jun 2019

Information and Computer Engineering (Honours with Distinction): ranked top 3–7% each year in a cohort of 300+

### Overseas Family School, Singapore

Aug 2013 – Jun 2015

IB Diploma (Bilingual): 45/45, top 0.3% globally

## SCHOLARSHIPS & AWARDS

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- Cambridge Trust International PhD Scholar (£49,000/year)
- 2020 British Education Award (Nov 2019)
- Best Thesis Presentation Award (Jun 2019)
- Scholar of Newnham College, Cambridge (2016–2019)

## ACADEMIC SERVICE & OUTREACH

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- **Reviewer:** NeurIPS (top reviewer 2024), ICLR, TMLR, ISIT
- **Lecturer & speaker,** Oxford Algorithmic Statistics CDT module (Nov 2025): lecture on uncertainty quantification via e-values and e-processes; research talk on non-stationary bandit optimisation
- **Research project supervision** (2022–present): UNIQplus project on sequential uncertainty quantification; MSc projects on in-context learning in transformers under adversarial attacks; MEng projects on high-dimensional statistical estimation for heterogeneous data
- **Organiser & speaker,** Cambridge Information Engineering Divisional Conference (Mar 2022)
- **Teaching:** Supervisor for Information Theory & Coding and Data Transmission (2019–2024), and Cambridge AI+ Programme (2022, 2023)

## WORK EXPERIENCE

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**Research Intern, Microsoft Research, Cambridge** Apr – Jun 2023

- Designed novel error correction scheme for Project Silica (glass-based cloud storage), increasing transmission rate by 5–10%; contributed to a *Nature* publication
- Clarified key information-theoretic performance metric and proposed a unifying evaluation framework
- Enhanced image classification decoder in PyTorch

**Software Development Intern, MediaTek Inc, Cambourne** Jun – Sep 2017

## REFEREES

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**Prof. Patrick Rebeschini**  
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**Prof. Ramji Venkataramanan**  
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Department of Engineering, Cambridge

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Mathematical Statistics, Cambridge