

# Malvika Raj Joshi

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**Research Interests:** Quantum computing, complexity theory, quantum-classical separations, cryptography, and secure systems.

## Education

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**University of California, Berkeley** 2021–Present

*Ph.D. in Computer Science*

Advisor: Umesh Vazirani. Research area: quantum complexity.

**Massachusetts Institute of Technology** 2020–2021

*M.Eng. in Electrical Engineering and Computer Science*

Advisor: Aram Harrow.

**Massachusetts Institute of Technology** 2016–2020

*B.S. in Physics and B.S. in Computer Science and Engineering; Minor in Mathematics. GPA: 5.0/5.0.*

## Publications

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1. **Malvika Raj Joshi**, Avishay Tal, Francisca Vasconcelos, and John Wright. *Improved Lower Bounds for  $\text{QAC}^0$* . In *Proceedings of the 58th Annual ACM Symposium on Theory of Computing (STOC)*, 2026.
2. **Malvika Raj Joshi** and Francisca Vasconcelos. *Constant-Depth Unitary Preparation of Dicke States*, 2026. arXiv:2601.10693
3. Lucas Gretta, Meghal Gupta, and **Malvika Raj Joshi**. *Parity  $\notin \text{QAC}^0 \iff \text{QAC}^0$  is Fourier-Concentrated*, 2026. arXiv:2604.02793
4. Lucas Gretta, Meghal Gupta, and **Malvika Raj Joshi**. *Super-Constant Dicke States in Constant Depth Without Fanout*, 2026. arXiv:2604.15298
5. Shyan Akmal, Lijie Chen, Ce Jin, **Malvika Raj**, and Ryan Williams. *Improved Merlin–Arthur Protocols for Central Problems in Fine-Grained Complexity*. In *Proceedings of the 13th Innovations in Theoretical Computer Science Conference (ITCS)*, 2022.

## Research and Industry Experience

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**University of California, Berkeley** 2021–Present

*Ph.D. Student in Computer Science (Advisor: Umesh Vazirani)*

Research in quantum complexity theory, focusing on the power and limitations of constant-depth quantum circuits and their relationship to classical circuit classes.

Work includes quantum circuit lower bounds, quantum–classical separations, and the complexity of preparing structured entangled states.

**Amazon, East Palo Alto** May–Aug. 2025

*Applied Scientist Intern*

Designed *Lexicure*, a leakage-free encrypted lexical search protocol, achieving improved tradeoffs between communication and presented new secure primitives for higher degree arithmetic. Evaluated on standard benchmarks (BEIR, TripClick), achieving accuracy competitive with BM25 while reducing bandwidth and client memory. *With:* Tal Wagner, Shai Halevi, Nina Mishra. Manuscript under submission.

**Massachusetts Institute of Technology** 2020–2021

*M.Eng. Thesis Researcher (Advisor: Aram Harrow)*

Developed a framework for IQP-based verification of quantumness and constructed classical forging attacks.

**Thesis:** *Pretending to be Quantum: A Study of IQP-Based Tests of Quantumness*. [Link](#).

### **Massachusetts Institute of Technology**

June–Aug. 2020

*Research Intern, CSAIL (Advisor: Dina Katabi)*

Processed large-scale video and RF data for sleep monitoring, reconstructing missing timestamps and improving data pipelines.

### **Massachusetts Institute of Technology**

2019–2020

*SuperUROP Researcher*

Studied nondeterministic algorithms for UNSAT and related problems with applications to fine-grained complexity.

### **Facebook, New York, NY**

May–Aug. 2019

*Open Source Software Development Intern (PyTorch)*

Designed and implemented a C++ API for PyTorch Autograd, introducing native C++ support for automatic differentiation using template metaprogramming. Improved reliability of the backend.

### **Facebook, Menlo Park, CA**

May–Aug. 2018

*Software Engineering Intern, News Feed Delivery Team*

Optimized the News Feed ranking pipeline by parallelizing components in C++.

### **WhatsApp, Menlo Park, CA**

Jun.–Sep. 2017

*Software Engineering Intern, Media Server Team*

Designed and implemented a caching mechanism for media downloads in backend infrastructure for end-to-end encrypted messaging; fixed bugs in Erlang-based servers.

### **Massachusetts Institute of Technology**

Oct.–Dec. 2016

*UROP Researcher (Advisor: Nancy Kanwisher)*

Developed components of an iOS application for calibrating eye-tracking experiments studying human visual attention.

## **Honors and Awards**

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- Three-time medalist at **International Olympiad in Informatics (IOI)**: Silver (2014: rank 28; 2015: rank 29); Bronze (2016).
- **Asia Pacific Informatics Olympiad (APIO)**: Silver (2014); Bronze (2015, 2016).
- Elected member of **Sigma Pi Sigma**.
- Microsoft Q# Coding Contest: Top 50 (2019).

## **Outreach and Professional Activities**

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### **INOI Training Initiative for Women**

2020–2021

*Founder and Volunteer*

Organized and taught algorithms and programming to female high school students preparing for the Indian National Olympiad in Informatics (INOI). Developed curriculum, delivered lectures, and provided mentorship.

### **Competitive Programming**

*Problem Setter*

Problem setter for programming contests including Indian IOI selection rounds (IOITC, ZIO/ZCO), ACM ICPC Chennai Regionals, and CodeChef Long Challenges.

## **Teaching Experience**

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**University of California, Berkeley**

*Graduate Student Instructor (CS70 Fall 2021, CS170 Fall 2023, CS270 Fall 2025)*

Led discussions, office hours, and graded coursework; additionally created homeworks and exams (CS170).

**Massachusetts Institute of Technology**

*Grader, 6.045: Automata, Computability, and Complexity Theory (Sp. 2018, 2020)*

Graded coursework and exams.

**Skills**

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Programming languages: C, C++, Python, Java, JavaScript, PHP, Bash, Octave, Assembly.