

Quanquan Catherine Liu

☎ 857-285-3279

✉ quanquan@northwestern.edu

🌐 www.quanquanliu.com/

Research Interests

Theory and practice of algorithms for large data; dynamic, distributed, and parallel graph algorithms; algorithms and data structures; parallel and high performance computing; differential privacy and Byzantine-resilient algorithms

Education

- 2016–2021 **PhD in Computer Science**, *MIT CSAIL*, Cambridge, *4.9/5.0*.
Advisors: Erik D. Demaine and Julian Shun
- 2015–2016 **Master of Engineering in Computer Science**, *MIT*, Cambridge, *5.0/5.0*.
Advisor: Erik D. Demaine
- 2011–2015 **S.B. in Computer Science and Math**, *MIT*, Cambridge, *5.0/5.0*.

Professional Positions

- 2022–Present **Postdoctoral Scholar**, *Northwestern University*, Evanston.
Mentor: Samir Khuller
- 2021–2022 **Postdoctoral Scholar**, *MIT CSAIL*, Cambridge.
Mentor: Julian Shun
- 2020 **Student Researcher/Research Intern**, *Google Research*, Mountain View.
Mentor: Joshua Wang
- Summer 2019 **Research Summer Intern**, *MIT Digital Currency Initiative*, Cambridge.
Mentors: Neha Narula and Thaddeus Dryja
- 2012–2015 **Undergraduate Research Assistant**, *MIT*, Cambridge.
2014 **Associate Product Manager Intern**, *Google*, Mountain View.
- 2012, 2013 **Software Engineering Intern**, *Google*, New York and Mountain View.

Selected Awards and Honors

- 2022 **Best Paper Award at SPAA 2022** ([News](#))
- 2021 **Rising Stars in EECS**
- 2015 **NSF Graduate Research Fellowship**
- 2015 **P.D. Soros Fellowship Finalist**
- 2015 **Phi Beta Kappa**
- 2013 **Actifio Undergraduate Research and Innovation Scholar**
- 2013 **James E. Cunningham (1957) Memorial Scholarship (EECS)**
Awarded each year to a selected female student in MIT EECS.

Refereed Conference Publications

Following the convention in theoretical computer science, authors are listed in alphabetical order unless indicated by a *.

- [1] Laxman Dhulipala, Quanquan C. Liu, Sofya Raskhodnikova, Jessica Shi, Julian Shun, Shangdi Yu: **Differential Privacy from Locally Adjustable Graph Algorithms: k -Core Decomposition, Low Out-Degree Ordering, and Densest Subgraphs.** *IEEE Symposium on Foundations of Computer Science (FOCS 2022)*.
- [2] Amartya Shankha Biswas, Talya Eden, Quanquan C. Liu, Slobodan Mitrović, Ronitt Rubinfeld: **Massively Parallel Algorithms for Small Subgraph Counting.** *International Conference on Approximation Algorithms for Combinatorial Optimization Problems (APPROX 2022)*.
- [3*] Quanquan C. Liu, Jessica Shi, Shangdi Yu, Laxman Dhulipala, Julian Shun: **Parallel Batch-Dynamic Algorithms for k -Core Decomposition and Related Graph Problems.** *Symposium on Parallelism in Algorithms and Architectures (SPAA 2022)*. **Best Paper Award**
- [4] Quanquan C. Liu, Manish Purohit, Zoya Svitkina, Erik Vee, Joshua R. Wang: **Scheduling with Communication Delay in Near-Linear Time.** *Symposium on Theoretical Aspects of Computer Science (STACS 2022)*. **Invited to Special Issue**
- [5] Shiri Antaki, Quanquan C. Liu, Shay Solomon: **Near-Optimal Distributed Implementations of Dynamic Algorithms for Symmetry-Breaking Problems.** *Innovations in Theoretical Computer Science (ITCS 2022)*.
- [6] Laxman Dhulipala, Quanquan C. Liu, Julian Shun, Shangdi Yu: **Parallel Batch-Dynamic k -Clique Counting.** *Symposium on Algorithmic Principles of Computer Systems (APOCS 2021)*.
- [7*] Lili Su, Quanquan C. Liu, and Neha Narula: **The Power of Random Symmetry-Breaking in Nakamoto Consensus.** *International Symposium on Distributed Computing (DISC 2021)*.
- [8] Michael A. Bender, Rezaul Alam Chowdhury, Rathish Das, Rob Johnson, William Kuszmaul, Andrea Lincoln, Quanquan C. Liu, Jayson Lynch, Helen Xu: **Closing the Gap Between Cache-oblivious and Cache-adaptive Analysis.** *Symposium on Parallelism in Algorithms and Architectures (SPAA 2020)*.
- [9] Aviv Adler, Jeffrey Bosboom, Erik D. Demaine, Martin L. Demaine, Quanquan C. Liu, Jayson Lynch: **Tatamibari is NP-Complete.** *Conference on Fun with Algorithms (FUN 2020)*.
- [10] Erik D. Demaine, Timothy D. Goodrich, Kyle Kloster, Brian Lavalley, Quanquan C. Liu, Blair D. Sullivan, Ali Vakilian, Andrew van der Poel: **Structural Rounding: Approximation Algorithms for Graphs Near an Algorithmically Tractable Class.** *European Symposium on Algorithms (ESA 2019)*.
- [11] Thaddeus Dryja, Quanquan C. Liu, Sunoo Park: **Static-Memory-Hard Functions and Modeling the Cost of Space vs. Time.** *Theory of Cryptography Conference (TCC 2018)*.
- [12] Andrea Lincoln, Quanquan C. Liu, Jayson Lynch, Helen Xu: **Cache-Adaptive Exploration: Experimental Results and Scan-Hiding for Adaptivity.** *Symposium on Parallelism in Algorithms and Architectures (SPAA 2018)*.
- [13] Erik D. Demaine, Quanquan C. Liu: **Red-Blue Pebble Game: Complexity of Computing the Trade-Off between Cache Size and Memory Transfers.** *Symposium on Parallelism in Algorithms and Architectures (SPAA 2018)*.

- [14] Erik D. Demaine, Andrea Lincoln, Quanquan C. Liu, Jayson Lynch, and Virginia Vassilevska Williams: **Fine-grained I/O Complexity via Reductions: New Lower Bounds, Faster Algorithms, and a Time Hierarchy**. *Innovations in Theoretical Computer Science (ITCS 2018)*.
- [15] Erik D. Demaine, Quanquan C. Liu: **Inapproximability of the Standard Pebble Game and Hard to Pebble Graphs**. *Algorithms and Data Structures Symposium (WADS 2017)*.
- [16] Hugo A. Akitaya, Erik D. Demaine, Adam Hesterberg, Quanquan C. Liu: **Upward Partitioned Book Embeddings**. *Graph Drawing (GD 2017)*.
- [17] Erik D. Demaine, Tim Kaler, Quanquan C. Liu, Aaron Sidford, Adam Yedidia: **Polylogarithmic Fully Retroactive Priority Queues via Hierarchical Checkpointing**. *Algorithms and Data Structures Symposium (WADS 2015)*.
- [18*] Quanquan C. Liu, David R. Karger: **Kibitz: End-to-End Recommendation System Builder**. *ACM Conference Series on Recommender Systems (RecSys 2015)*.

Journal Publications and Book Chapters

- [19] Quanquan C. Liu: **A Note on Improved Results for One Round Distributed Clique Listing**. *Information Processing Letters (IPL 2023)*.
- [20] Sayan Bhattacharya, Fabrizio Grandoni, Janardhan Kulkarni, Quanquan C. Liu, Shay Solomon: **Fully Dynamic $(\Delta + 1)$ -Coloring in Constant Update Time**. *ACM Transactions on Algorithms (TALG 2022)*.
- [21] Erik D. Demaine, Quanquan C. Liu: **Chess Equilibrium Puzzles**. *To appear in Mathematics Magazine (2022)*.
- [22] Erik D. Demaine, Martin L. Demaine, Adam Hesterberg, Quanquan C. Liu, Ron Taylor, Ryuhei Uehara: **Tangled Tangles**. in *The Best Writing on Mathematics 2018*, Princeton University Press, 2018.
- [23] Erik D. Demaine, Varun Ganesan, Vladislav Kontsevoi, Qipeng Liu, Quanquan C. Liu, Fermi Ma, Ofir Nachum, Aaron Sidford, Erik Waingarten, Daniel Ziegler: **Arboreal Satisfaction: Recognition and LP Approximation**. *Information Processing Letters (IPL) 127* (2017).
- [24] Aviv Adler, Erik D. Demaine, Adam Hesterberg, Quanquan C. Liu, Mikhail Rudoy: **Clickomania is Hard Even With Two Colors and Columns**. in *The Mathematics of Various Entertaining Subjects (MOVES 2015)*: vol 2: 325-363, Princeton University Press, 2017.
- [25] Erik D. Demaine, Martin L. Demaine, Adam Hesterberg, Quanquan C. Liu, Ron Taylor, Ryuhei Uehara: **Tangled Tangles**. in *The Mathematics of Various Entertaining Subjects (MOVES 2015)*: vol 2: 141-152, Princeton University Press, 2017.

Manuscripts

- [26] Talya Eden, Quanquan C. Liu, Sofya Raskhodnikova, Adam Smith: **Triangle Counting with Local Edge Differential Privacy**. 2022.
- [27*] Quanquan C. Liu, Yiduo Ke, Samir Khuller: **Auction Algorithms for Maximum Weight Bipartite Matching and Maximum Cardinality Bipartite b -Matching**. 2022.

- [28*] [Quanquan C. Liu](#), Aruzhan Amanbayeva, Julian Shun: **Streaming Triangle Counting: Breaking the Curse of Small Sample Size**. 2022.
- [29] Erik D. Demaine, Jingwei Li, [Quanquan C. Liu](#): **Byzantine-Resilient Distributed Graph Algorithms**. 2022.
- [30] Thaddeus Dryja, [Quanquan C. Liu](#), Neha Narula: **A Lower Bound for Byzantine Agreement and Consensus for Adaptive Adversaries using VDFs**. 2020.

Conference and Workshop Presentations

- 2022 **FOCS** Differential Privacy from Locally Adjustable Graph Algorithms: k -Core Decomposition, Low Out-Degree Ordering, and Densest Subgraphs
- 2022 **FODSI Workshop on Sublinear Algorithms** Massively Parallel Algorithms for Small Subgraph Counting
- 2022 **SPAA** Parallel Batch-Dynamic Algorithms for k -Core Decomposition and Related Graph Problems
- 2022 **ITCS** Dynamic Distributed MIS with Improved Bounds
- 2022 **STACS** Scheduling with Communication Delay in Near-Linear Time
- 2021 **Dagstuhl Seminar: Scalable Data Structures** Parallel Batch-Dynamic Triangle Counting
- 2020 **WOLA** Massively Parallel Algorithms for Small Subgraph Counting
- 2019 **ESA** Structural Rounding: Approximation Algorithms for Graphs Near an Algorithmically Tractable Class
- 2018 **TCC** Static-Memory-Hard Functions and Modeling the Cost of Space vs. Time
- 2018 **SPAA** Red-Blue Pebble Game: Complexity of Computing the Trade-Off between Cache Size and Memory Transfers
- 2017 **GD** Upward Partitioned Book Embeddings
- 2017 **WADS** Inapproximability of the Standard Pebble Game and Hard to Pebble Graphs
- 2015 **RecSys** Kibitz: End-to-End Recommendation System Builder
- 2015 **WADS** Polylogarithmic Fully Retroactive Priority Queues via Hierarchical Checkpointing

Invited Talks

- 2022 **IDEAL Institute** Differential Privacy from Locally Adjustable Graph Algorithms: k -Core Decomposition, Low Out-Degree Ordering, and Densest Subgraphs
- 2022 **Purdue CS Colloquium** Scalable and Private k -Core Decomposition
- 2022 **Harvard CMSA Colloquium** Scalable Dynamic Graph Algorithms
- 2022 **Tufts Computer Science Colloquium** Scalable Dynamic Graph Algorithms
- 2022 **Northwestern Theory Seminar** Dynamic Distributed MIS with Improved Bounds
- 2022 **MIT Parallel Algorithms Group** Scheduling with Communication Delay in Near-Linear Time
- 2021 **Future of Computing Architectures** Fast and Scalable Parallel Batch-Dynamic k -Core Decomposition
- 2021 **UMass Amherst** Scheduling with Communication Delay in Near-Linear Time
- 2021 **Georgia Tech (ARC) Seminar** Parallel Algorithms for Graph Computations
- 2021 **Northwestern Seminar** Parallel Algorithms for Triangle Counting and k -Core Decompositions
- 2021 **Google Tech Talk** Parallel Algorithms for Triangle Counting
- 2021 **ADA Liaison Meeting** Fast and Scalable Parallel Batch-Dynamic k -Core Decomposition

2021	MIT Local Algorithms Group	Structural Rounding: Approximation Algorithms for Graphs Near an Algorithmically Tractable Class
2020	Columbia Theory Seminars	Parallel Algorithms for Triangle Counting
2020	CESC	A Lower Bound for Byzantine Agreement and Consensus for Adaptive Adversaries using VDFs
2020	MIT Bitcoin Expo	A Lower Bound for Byzantine Agreement and Consensus for Adaptive Adversaries using VDFs
2020	MIT Local Algorithms Group	Fully Dynamic $(\Delta + 1)$ -Coloring in Constant Update Time
2020	Google Research Intern Talks	Massively Parallel Algorithms for Small Subgraph Counting
2019	Simon's Institute	A Lower Bound for Byzantine Agreement and Consensus for Adaptive Adversaries using VDFs
2019	MIT TDS Seminar	A Lower Bound for Byzantine Agreement and Consensus for Adaptive Adversaries using VDFs
2019	NYC Crypto Day	Static-Memory-Hard Functions and Modeling the Cost of Space vs. Time

Invited Research Visits

2023	Dagstuhl Seminar: Scalable Data Structures	<i>Schloss Dagstuhl, Wadern, Germany</i>
2021	Dagstuhl Seminar: Scalable Data Structures	<i>Schloss Dagstuhl, Wadern, Germany</i>
2020	Large-Scale Consensus and Blockchains	<i>Simon's Institute, UC Berkeley, Berkeley, CA</i>
2018	Women in Theory	<i>Harvard University, Cambridge, MA</i>
2017	32nd Bellairs Winter Workshop on Computational Geometry	<i>Barbados</i>
2016	31st Bellairs Winter Workshop on Computational Geometry	<i>Barbados</i>

Teaching and Coaching Experience

2022–Present	Coach for the Northwestern ICPC Team	
2017–Present	USACO Coach and Problem Writer	
2022–Present	Coach for USA EGOI Team	
2021–Present	Trainer for North America Programming Camp (NAPC)	
Spring 2021	SuperUROP Undergraduate Research Course (6.UAR)	<i>TA, 6.9/7.0 rating</i>
Spring 2021	Algorithm Engineering (6.886)	<i>Guest Lecturer</i>
Fall 2020	SuperUROP Undergraduate Research Course (6.UAR)	<i>TA, 7.0/7.0 rating</i>
Fall 2019	SuperUROP Undergraduate Research Course (6.UAR)	<i>TA, 7.0/7.0 rating</i>
Spring 2016	Introduction to Algorithms (6.006)	<i>Head TA, 7.0/7.0 rating</i>
Fall 2015	Introduction to Algorithms (6.006)	<i>Head TA, 6.5/7.0 rating</i>
Sum. 2015	Women's Technology Program	<i>Discrete Math Tutor</i>
Fall 2013	Introduction to Algorithms (6.006)	<i>TA, 6.0/7.0 rating</i>

Service and Outreach

2022 **Organizer of IDEAL Theory-in-Practice Workshop**, ([News](#)).

Organized workshop on the intersection between theory and practice. Invited 8 outside speakers from various institutions. Topics included high performance computing, large-scale graph algorithms, and parallel algorithms and data structures.

2019–2021 **Organizer of MIT Algorithms and Complexity Seminar**.

Organized weekly CS theory seminar featuring talks from faculty/student researchers from different institutions.

2022–Present **Program Committee Member.**

SPAA 2023, ALENEX 2023

2016–Present **Reviewer.**

PODC 2017, ICALP 2018, ISAAC 2018, SODA 2019, PODC 2019, FOCS 2019, AFT 2019, ISAAC 2019, SODA 2020, SPAA 2020, STACS 2020, SWAT 2020, ICALP 2020, FOCS 2020, TCC 2020, SOSA 2021, SPAA 2021, ACDA 2021, ESA 2021, DISC 2021, Information and Computation Journal, ALENEX 2022, ITCS 2022, ICALP 2022, ESA 2022, SPAA 2022, SODA 2023, STOC 2023, Transactions on Parallel and Distributed Systems

Mentorship

2022–Present **Yiduo Ke**, *Northwestern Graduate Student.*

Working on fair course allocation and graph algorithms. Paper in submission.

2022–Present **Jingwei Li**, *Northwestern Undergraduate Research Student.*

Working on round-efficient algorithms for matching, maximal independent set, and coloring in the presence of Byzantine nodes. Paper in submission.

2021–2022 **Aruzhan Amanbayeva**, *MIT UROP Student.*

Worked on machine-learning triangle counting algorithms in the streaming model. Paper in submission.

2020–2021 **Shwetark Patel**, *MIT UROP Student.*

Worked on round-efficient distributed edge coloring in the presence of Byzantine nodes.

2020–2021 **Anne Ouyang**, *MIT UROP Student.*

Worked on simulating proofs-of-work consensus schemes given various randomized tie-breaking strategies. Produced Github code repository.

Other Skills and Hobbies

Computer: C++, Java, Python, Go, Django, Node.js, HTML/XML, CSS, PHP/MYSQL, JavaScript, MATLAB, Mathematica, Android Development Tools

Hobbies: board games (Dominion and bughouse), puzzles, tennis, running, drums