Lijie Chen

Curriculum Vitae

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Position

2022–Now **Miller Institute for Basic Research in Science**, *University of California, Berkeley*.
Miller Postdoctoral Fellow, hosted by Avishay Tal and Umesh Vazirani

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Education

2017–2022 **EECS**, *Massachusetts Institute of Technology*, Cambridge.
S. M. and Ph.D. in Electrical Engineering and Computer Science, advised by Ryan Williams
S. M. thesis: *Fine-Grained Complexity Meets Communication Complexity*
Ph.D. thesis: *Better Hardness via Algorithms, and New Forms of Hardness versus Randomness*

2013–2017 **Institute for Interdisciplinary Information Sciences**, *Tsinghua University*, Beijing.
Bachelor of Engineering in Computer Science and Technology

Research Interests

○ Computational Complexity   ○ Pseudorandomness   ○ Fine-Grained Complexity
○ Quantum Computing/Complexity   ○ Algorithm Design   ○ Cryptography

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Visiting and Internship

2024 Spring **Simons Institute for the Theory of Computing**, *Berkeley*.
Vising Scientist. Quantum Algorithms, Complexity, and Fault Tolerance.

2023 Spring **Simons Institute for the Theory of Computing**, *Berkeley*.
Research Fellow. Meta-Complexity.

2021 Summer **IBM T. J. Watson Research Center**, *New York (remote)*.
PhD Quantum Research Summer Intern hosted by Ramis Movassagh.

2020 Summer **Google Inc.**, *Mountain View (remote)*.
Research Intern hosted by Ravi Kumar.

2020 Winter **Weizmann Institute of Science**, *Rehovot*.
(Jan - Feb) Visiting Student of Guy Rothblum.

2018 Fall **Simons Institute for the Theory of Computing**, *Berkeley*.
Visiting Graduate Student. Lower Bounds in Computational Complexity.

2016 Spring **EECS**, *Massachusetts Institute of Technology*, Cambridge.
Visiting Student, advised by Scott Aaronson.

Selected Awards and Scholarships

2023   MIT George M. Sprowls PhD Thesis in Computer Science Award
2022   EATCS Distinguished Dissertation Award 2022
2022   Miller Research Fellowship
2020   IBM Fellowship
2019   **FOCS 2019 Best Student Paper**
2019   **STOC 2019 Best Student Paper**
2017   MIT Akamai Presidential Graduate Fellowship
2017   International Collegiate Programming Contest, World Final, **6th place**
2013   International Olympiad in Informatics, Gold model, **1st place**

Special Issue Invitations

Invited journal articles considered to be among the top 5-10 papers in a given conference:
FOCS 2024, FOCS 2021, STOC 2021, STOC 2020, FOCS 2019, FOCS 2019, CCC 2018, FOCS 2017, CCC 2017

Professional Activities and Service

Program Committee
ITCS 2022, **FOCS 2022**, **CCC 2023**, **RANDOM 2024**, **ITCS 2025**, **FOCS 2025**

Conference Reviewing
FOCS, **STOC**, **SODA**, **CCC**, **ITCS**, **ICALP**, **QIP**, **TCC**, **IPEC**, **COLT**, **RANDOM**, **ISAAC**

Journal Reviewing
Journal of the ACM, **Theory of Computing**, **Quantum**, **Algorithmica**, **Izvestiya: Mathematics**, **Journal of Privacy and Confidentiality**

Leadership Activities
Co-Organizer of FOCS Workshop on New Directions in Derandomization, 2022
Co-Editor of the SICOMP special issue of FOCS 2022
Co-Organizer of the Meta-Complexity Program Weekly Seminar at Simons Institute, 2023
Co-Organizer of FOCS Workshop on Recent Developments in Explicit Constructions, 2023

Teaching Experiences

2019 Fall
Advanced Complexity Theory
Teaching Asistant, Massachusetts Institute of Technology

2017 Spring
Introduction to Computational Complexity
Teaching Asistant, Tsinghua University

Selected Invited Academic Talks

2022 - Oct
Background, and the new paradigm of non-black-box derandomization
New Directions in Derandomization, FOCS 2022 Workshop

2022 - Apr
New Directions in Derandomization: Overview Non-black-box Techs., Superfast Algorithms.
DIMACS Workshop on Meta-Complexity, Barriers, and Derandomization, Rutgers University

2022 - Feb
Derandomization and its connections throughout complexity theory, Part II
Theoretical Computer Science and Discrete Math Seminars, Institute for Advanced Study

2020 - Feb
Strong Average-Case Circuit Lower Bounds from Non-trivial Derandomization
Theoretical Computer Science and Discrete Math Seminars, Institute for Advanced Study

Full Academic Talks

2023 - Nov
The Iterative Win-Win Paradigm (Part 2): New Circuit Lower Bounds via Solving Range Avoidance
Recent Developments in Explicit Constructions, **FOCS 2023** workshop

2023 - Nov
Derandomization vs Refutation: A Unified Framework for Characterizing Derandomization
FOCS 2023

2023 - Oct
Derandomization vs Refutation: A Unified Framework for Characterizing Derandomization
Oxford-Warwick Complexity Meetings, Online

2023
2023 - May
2023 - Sept
2023 - Sept
2023 - Oct
Polynomial-Time Pseudodeterministic Construction of Primes
Cornell Junior Theorists' Workshop, Cornell University
Berkeley Theory Lunch, UC Berkeley
ARC Colloquium, Georgia Institute of Technology
Theory Seminar, UT Austin

2023 - June
When Arthur Has Neither Random Coins Nor Time to Spare: Superfast Derandomization of Proof Systems
STOC 2023

2023 - May
From Derandomization to Fiat-Shamir
Minimal Complexity Assumptions for Cryptography workshop, Simons Institute

2023 - Feb	New Lower Bounds and Derandomization for ACC, and a Derandomization-centric View on the Algorithmic Method Lower Bounds, Learning, and Average-Case Complexity workshop, Simons Institute
2023 - Jan	New Lower Bounds and Derandomization for ACC, and a Derandomization-centric View on the Algorithmic Method Innovations in Theoretical Computer Science (**ITCS 2023**), MIT
2022 - Nov	Truly Low-Space Element Distinctness and Subset Sum via Pseudorandom Hash Functions Algorithms & Complexity Seminar, MIT
2022 - Oct	Background, and the new paradigm of non-black-box derandomization New Directions in Derandomization, **FOCS 2022** workshop
2022 - Sept	Better Hardness via Algorithms, and New Forms of Hardness versus Randomness. Berkeley Theory Lunch, UC Berkeley
2022 - July	Extremely Efficient Constructions of Hash Functions, with Applications to Hardness Magnification and PRFs. Computational Complexity Conference (**CCC 2022**), University of Pennsylvania
2022 - Apr	New Directions in Derandomization: Overview Non-black-box Techs., Superfast Algorithms. DIMACS Workshop on Meta-Complexity, Barriers, and Derandomization, Rutgers University
2022 - Feb	Hardness vs Randomness, Revised: Uniform, Non-Black-Box, and Instance-Wise. **FOCS 2021**, Online
2022 - Feb	Derandomization and its connections throughout complexity theory, Part II IAS, Computer Science/Discrete Mathematics Seminar II
2022 - Jan	Quantum Merkle Trees. UC Berkeley Theory CS Seminar, Online
2021 - Dec	Hardness vs Randomness, Revised: Uniform, Non-Black-Box, and Instance-Wise. CMU Theory Seminar, Online
2021 - Nov	Hardness vs Randomness, Revised: Uniform, Non-Black-Box, and Instance-Wise. University of Washington Theory Seminar, Online
2021 - July	The quest for superfast derandomization. ICPCU Alumni Lecture Series, Online
2021 - June	Inverse-Exponential Correlation Bounds and Extremely Rigid Matrices from a New Derandomized XOR Lemma. **STOC 2021**, Online
2021 - June	Simple and Fast Derandomization from Very Hard Functions: Eliminating Randomness at Almost No Cost. **STOC 2021**, Online
2021 - June	Hardness vs Randomness, Revised: Uniform, Non-Black-Box, and Instance-Wise. Oxford-Warwick Complexity Meetings, Online
2021 - Feb	On Distributed Differential Privacy and Counting Distinct Elements. Boston Area Differential Privacy Seminar Series, Online
2021 - Jan	On Distributed Differential Privacy and Counting Distinct Elements. **ITCS 2021**, Online
2020 - Nov	Almost Everywhere Circuit Lower Bounds from Non-Trivial Derandomization. **FOCS 2020**, Online
2020 - Sep	Simple and fast derandomization from very hard functions: Eliminating randomness at almost no cost. SIGMA ICT CAS, Online
2020 - July	Sharp Threshold Results for Computational Complexity. Oxford-Warwick Complexity Meetings, Online
2020 - June	Strong Average-Case Lower Bounds from Non-trivial Derandomization. **STOC 2020**, Online
2020 - June	Sharp threshold results for computational complexity. **STOC 2020**, Online

2019 - 2020	Strong Average-Case Circuit Lower Bounds from Non-trivial Derandomization Theory Seminar, University of Chicago Lower Bounds in Computational Complexity Reunion, Simons Institute Theory Seminar, Weizmann Institute of Science Theory Seminar, Hebrew University of Jerusalem Theory Seminar, Technion - Israel Institute of Technology Theoretical Computer Science and Discrete Math Seminars, Institute for Advanced Study DIMAP Seminar, University of Warwick
2019	Efficient Construction of Rigid Matrices Using an NP Oracle **FOCS 2019**
2019	Non-deterministic Quasi-Polynomial Time is Average-case Hard for ACC Circuits **FOCS 2019**
2019	On Algebraic and Number Theoretical Methods in Fine-Grained Complexity Nanjing University
2019	Recent Developments on the Algorithmic Approach Towards Circuit Lower Bounds Tsinghua University
2019	Recent Developments in Fine-Grained Complexity via Communication Complexity Tsinghua University
2019	Stronger Connections Between Circuit Analysis and Circuit Lower Bounds, via PCPs of Proximity **CCC 2019**
2019	Bootstrapping Results for Threshold Circuits "Just Beyond" Known Lower Bounds **STOC 2019**
2019	Non-deterministic Quasi-Polynomial Time is Average-case Hard for ACC Circuits Theory Seminar of UT Austin Harvard TGINF CMU Theory Lunch
2019	Classical Algorithms from Quantum and Arthur-Merlin Communication Protocols **ITCS 2019**
2019	An Equivalence Class for Orthogonal Vectors **SODA 2019**
2018	Recent Structure Lemmas for Depth-Two Threshold Circuits Simons Institute for the Theory of Computing
2018	On The Hardness of Approximate and Exact (Bichromatic) Maximum Inner Product **CCC 2018** Algorithms & Complexity Seminar, MIT
2017	On The Power of Statistical Zero Knowledge **FOCS 2017** Algorithms & Complexity Seminar, MIT
2017	Complexity-Theoretic Foundations of Quantum Supremacy Experiments **CCC 2017**
2016	Adaptivity vs Postselection **ISAAC 2016**
2016	Pure Exploration of Multi-armed Bandit Under Matroid Constraints **COLT 2016**

Journal Publications

10	Quantum merkle trees. **Lijie Chen**, Ramis Movassagh **Quantum**, 2024.
9	Non-deterministic Quasi-Polynomial Time is Average-case Hard for ACC Circuits. **Lijie Chen**. **SIAM Journal on Computing**, 2024.

8   Constructive Separations and Their Consequences.
Lijie Chen, Ce Jin, Rahul Santhanam, Ryan Williams.
TheoretiCS, 2024

7   On Exponential-Time Hypotheses, Derandomization, and Circuit Lower Bounds.
Lijie Chen, Ron Rothblum, Roei Tell, Eylon Yogev.
Journal of the ACM, 2023.

6   Improved Merlin–Arthur Protocols for Central Problems in Fine-Grained Complexity.
Shyan Akmal, **Lijie Chen**, Ce Jin, Malvika Raj, Ryan Williams.
Algorithmica, 2023.

5   Beyond Natural Proofs: Hardness Magnification and Locality.
Lijie Chen, Shuichi Hirahara, Igor Oliveira, Jan Pich, Ninad Rajgopal, Rahul Santhanam.
Journal of the ACM, 2022.

4   Efficient Construction of Rigid Matrices Using an NP Oracle.
Josh Alman, **Lijie Chen**.
SIAM Journal on Computing, 2022.

3   Strong average-case circuit lower bounds from nontrivial derandomization.
Lijie Chen, Hanlin Ren.
SIAM Journal on Computing, 2021.

2   On The Hardness of Approximate and Exact (Bichromatic) Maximum Inner Product.
Lijie Chen.
Theory of Computing, 2020.

1   On The Power of Statistical Zero Knowledge.
Adam Bouland, **Lijie Chen**, Dhiraj Holden, Justin Thaler, Prashant Nalini Vasudevan.
SIAM Journal on Computing, 2020.

Conference Publications

50   Reverse mathematics of complexity lower bounds.
Lijie Chen, Jiatu Li, Igor C. Oliveira
FOCS 2024. (**Invited to the SICOMP Special Issue for FOCS 2024**)

49   Symmetric Exponential Time Requires Near-Maximum Circuit Size.
Lijie Chen, Shuichi Hirahara, Hanlin Ren
STOC 2024.

48   Polynomial-Time Pseudodeterministic Construction of Primes.
Lijie Chen, Zhenjian Lu, Igor C. Oliveira, Hanlin Ren, Rahul Santhanam
FOCS 2023.

47   Derandomization vs Refutation: A Unified Framework for Characterizing Derandomization.
Lijie Chen, Roei Tell, Ryan Williams
FOCS 2023.

46   Weighted Pseudorandom Generators via Inverse Analysis of Random Walks and Shortcutting.
Lijie Chen, William Hoza, Xin Lyu, Avishay Tal and Hongxun Wu
FOCS 2023.

45   New PRGs for Unbounded-width/Adaptive-order Read-once Branching Programs.
Lijie Chen, Xin Lyu, Avishay Tal, Hongxun Wu
ICALP 2023.

44   When Arthur has Neither Random Coins nor Time to Spare: Superfast Derandomization of Proof Systems.
Lijie Chen, Roei Tell
STOC 2023.

43   New Lower Bounds and Derandomization for ACC, and a Derandomization-centric View on the Algorithmic Method.
Lijie Chen
ITCS 2023.

42   Black-box Constructive Proofs are Unavoidable.
Lijie Chen, Ryan Williams, Tianqi Yang
ITCS 2023.

41   Towards Multi-Pass Streaming Lower Bounds for Optimal Approximation of Max-Cut.
Lijie Chen, Gillat Kol, Dmitry Paramonov, Raghuvansh Saxena, Zhao Song, Huacheng Yu
SODA 2023.

40   Unstructured Hardness to Average-Case Randomness.
Lijie Chen, Ron D. Rothblum, Roei Tell
FOCS 2022.

39   Extremely Efficient Constructions of Hash Functions, with Applications to Hardness Magnification and PRFs.
Lijie Chen, Jiatu Li, Tianqi Yang
CCC 2022.

38   Improved Merlin-Arthur Protocols for Central Problems in Fine-Grained Complexity.
Shyan Akmal, **Lijie Chen**, Ce Jin, Malvika Raj, Ryan Williams
ITCS 2022.

37   Average-case Hardness of NP and PH from Worst-case Fine-grained Assumptions.
Lijie Chen, Shuichi Hirahara, Neekon Vafa.
ITCS 2022.

36   Truly Low-Space Element Distinctness and Subset Sum via Pseudorandom Hash Functions.
Lijie Chen, Ce Jin, Ryan Williams, Hongxun Wu.
SODA 2022.

35   Constructive Separations and Their Consequences.
Lijie Chen, Ce Jin, Rahul Santhanam, Ryan Williams.
FOCS 2021.

34   Hardness vs Randomness, Revised: Uniform, Non-Black-Box, and Instance-Wise.
Lijie Chen, Roei Tell.
FOCS 2021.

33   Majority vs. Approximate Linear Sum and average-case complexity below NC1.
Lijie Chen, Zhenjian Lu, Xin Lyu, Igor Oliveira.
ICALP 2021.

32   Near-Optimal Two-Pass Streaming Algorithm for Sampling Random Walks over Directed Graphs.
Lijie Chen, Gillat Kol, Dmitry Paramonov, Raghuvansh Saxena, Zhao Song, Huacheng Yu.
ICALP 2021.

31   Almost Optimal Super-Constant-Pass Streaming Lower Bounds for Reachability.
Lijie Chen, Gillat Kol, Dmitry Paramonov, Raghuvansh Saxena, Zhao Song, Huacheng Yu.
STOC 2021. (**Invited to the SICOMP Special Issue for STOC 2021**)

30   Inverse-Exponential Correlation Bounds and Extremely Rigid Matrices from a New Derandomized XOR Lemma.
Lijie Chen, Xin Lyu.
STOC 2021.

29   Simple and fast derandomization from very hard functions: Eliminating randomness at almost no cost.
Lijie Chen, Roei Tell.
STOC 2021.

28   On Distributed Differential Privacy and Counting Distinct Elements.
Lijie Chen, Badih Ghazi, Ravi Kumar, Pasin Manurangsi.
ITCS 2021.

27   Almost Everywhere Circuit Lower Bounds from Non-Trivial Derandomization.
Lijie Chen, Xin Lyu, Ryan Williams.
FOCS 2020.

26   On Exponential-Time Hypotheses, Derandomization, and Circuit Lower Bounds.
Lijie Chen, Ron Rothblum, Roei Tell, Eylon Yogev.
FOCS 2020.

25   Sharp Threshold Results for Computational Complexity.
Lijie Chen, Ce Jin, Ryan Williams.
STOC 2020.

24   Strong Average-Case Circuit Lower Bounds from Non-trivial Derandomization.
Lijie Chen, Hanlin Ren.
STOC 2020. (**Invited to the SICOMP Special Issue for STOC 2020**)

23   Beyond Natural Proofs: Hardness Magnification and Locality.
Lijie Chen, Shuichi Hirahara, Igor Oliveira, Jan Pich, Ninad Rajgopal, Rahul Santhanam.
ITCS 2020.

22   Hardness Magnification for all Sparse NP Languages.
Lijie Chen, Ce Jin, Ryan Williams.
FOCS 2019.

21   Efficient Construction of Rigid Matrices Using an NP Oracle.
Josh Alman, **Lijie Chen**.
FOCS 2019. (**Machtey Award (Best Student Paper)**)
(**Invited to the SICOMP Special Issue for FOCS 2019**)

20   Non-deterministic Quasi-Polynomial Time is Average-case Hard for ACC Circuits.
Lijie Chen.
FOCS 2019. (**Invited to the SICOMP Special Issue for FOCS 2019**)

19   Broadcast Congested Clique: Planted Cliques and Pseudorandom Generators.
Lijie Chen, Ofer Grossman.
PODC 2019.

18   Relations and Equivalences Between Circuit Lower Bounds and Karp-Lipton Theorems.
Lijie Chen, Dylan McKay, Cody Murray, Ryan Williams.
CCC 2019.

17   Stronger Connections Between Circuit Analysis and Circuit Lower Bounds, via PCPs of Proximity.
Lijie Chen, Ryan Williams.
CCC 2019.

16   Bootstrapping Results for Threshold Circuits "Just Beyond" Known Lower Bounds.
Lijie Chen, Roei Tell.
STOC 2019. (**Danny Lewin Best Student Paper Award**)

15   Classical Algorithms from Quantum and Arthur-Merlin Communication Protocols.
Lijie Chen, Ruosong Wang.
ITCS 2019.

14   An Equivalence Class for Orthogonal Vectors.
Lijie Chen, Ryan Williams.
SODA 2019.

13   Fine-grained Complexity Meets IP = PSPACE.
Lijie Chen, Shafi Goldwasser, Kaifeng Lyu, Guy N. Rothblum, Aviad Rubinstein.
SODA 2019.

12   Nearly Optimal Separation Between Partially And Fully Retroactive Data Structures.
Lijie Chen, Erik D. Demaine, Yuzhou Gu, Virginia Vassilevska Williams, Yinzhan Xu, Yuancheng Yu.
SWAT 2018.

11   An Improved Algorithm for Incremental DFS Tree in Undirected Graphs.
Lijie Chen, Ran Duan, Ruosong Wang, Hanrui Zhang, Tianyi Zhang.
SWAT 2018.

10   On The Hardness of Approximate and Exact (Bichromatic) Maximum Inner Product.
Lijie Chen.
CCC 2018. (**Invited to the Toc Special Issue for CCC 2018**)

9   On The Power of Statistical Zero Knowledge.
   Adam Bouland, **Lijie Chen**, Dhiraj Holden, Justin Thaler, Prashant Nalini Vasudevan.
   FOCS 2017. (**Invited to the SICOMP Special Issue for FOCS 2017**)

8   Nearly Optimal Sampling Algorithms for Combinatorial Pure Exploration.
   Lijie Chen, Anupam Gupta, Jian Li, Mingda Qiao and Ruosong Wang.
   COLT 2017.

7   Towards Instance Optimal Bounds for Best Arm Identification.
   Lijie Chen, Jian Li, Mingda Qiao.
   COLT 2017.

6   Complexity-Theoretic Foundations of Quantum Supremacy Experiments.
   Scott Aaronson, **Lijie Chen**.
   CCC 2017. (**Invited to the Toc Special Issue for CCC 2017**).

5   Nearly Instance Optimal Sample Complexity Bounds for Top-k Arm Selection.
   Lijie Chen, Jian Li, Mingda Qiao.
   AISTATS 2017.

4   K-Memory Strategies in Repeated Games.
   Lijie Chen, Fangzhen Lin, Pingzhong Tang, Kangning Wang, Ruosong Wang, Shiheng Wang.
   AAMAS 2017 (extended abstract).

3   Bounded rationality of restricted Turing machines.
   Lijie Chen, Pingzhong Tang, Ruosong Wang.
   AAAI 2017.

2   Adaptivity vs Postselection, and Hardness Amplification in Polynomial Approximation.
   Lijie Chen.
   ISAAC 2016 (**Best Student Paper**).

1   Pure Exploration of Multi-armed Bandit Under Matroid Constraints.
   Lijie Chen, Anupum Gupta, Jian Li.
   COLT 2016.

Languages

- Chinese (Native)
- English (Fluent)
- Japanese (N2)