Lijie Chen

Curriculum Vitae

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Education

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

2017–2022 **EECS**, *Massachusetts Institute of Technology*, Cambridge.
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
- Algorithm Design
- Fine-Grained Complexity
- Quantum Computing/Complexity

Visiting and Internship

2021 Summer **IBM**, *New York (remote)*.
Research Intern hosted by Ramis Movassagh.

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

2020 Winter (Jan - Feb) **Weizmann Institute of Science**, *Rehovot*.
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

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**
2016 Tsinghua Top-Grade Scholarship (**10 best undergraduate students** a year)
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 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**

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**

Selected Publications

Derandomization

FOCS 2021 Hardness vs Randomness, Revised: Uniform, Non-Black-Box, and Instance-Wise.
Lijie Chen, Roei Tell. **Invited to the SICOMP Special Issue for FOCS 2021**

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

Circuit Lower Bounds from Algorithms

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

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

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

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

Hardness Magnification

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

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

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

Other topics

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

CCC 2018 Fine-grained complexity — On The Hardness of Approximate and Exact (Bichromatic) Maximum Inner Product.
Lijie Chen.
Invited to the Toc Special Issue for CCC 2018

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

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

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

Teaching Experiences

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

2017 Spring — Introduction to Computational Complexity
Teaching Asistant, Tsinghua University

Academic Talks

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 - 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

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

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)