

**Positions & Education**

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| <b>Harvard University</b><br>Michael O. Rabin Postdoctoral Fellow, Theory of Computing Group   | <b>2019-present</b> |
| <b>Massachusetts Institute of Technology</b><br>Ph.D. in Computer Science<br>Advisors: Ryan Williams and Virginia Vassilevska Williams<br>Thesis: Linear Algebraic Techniques in Algorithms and Complexity | <b>2017-2019</b>    |
| <b>Stanford University</b><br>M.S. in Computer Science<br>Advisors: Ryan Williams and Virginia Vassilevska Williams  | <b>2014-2016</b>    |
| <b>Massachusetts Institute of Technology</b><br>B.S. in Mathematics  | <b>2010-2014</b>    |

**Selected Honors**

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- Machtey Award for Best Student Paper at FOCS 2019
- Best Student Paper Award at CCC 2019
- European Association of TCS Distinguished Dissertation Award, 2019
- George M. Sprowls Award for outstanding Ph.D. theses in Computer Science at MIT, 2019
- Michael Cohen Award for Best MIT Theory of Computation Student Paper, 2017
- Special Issue Papers at FOCS 2019, CCC 2019, and FOCS 2018
- NSF Graduate Research Fellowship, 2014-2017
- Student Travel Awards, sponsored by NSF and ACM for FOCS 2016, 2018, STOC 2016, 2017, 2018
- Represented Stanford at the ACM International Collegiate Programming Contest World Finals, 2016
- Top 25 at the Putnam Math Competition, 2012
- Member of Phi Beta Kappa Honor Society since 2014

**Publications**

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Copies of all my publications can be found at [joshalman.com/publications](http://joshalman.com/publications)

**A Refined Laser Method and Faster Matrix Multiplication**

with Virginia Vassilevska Williams

*To appear in 32nd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2021)*

**Algorithms and Hardness for Linear Algebra on Geometric Graphs**

with Timothy Chu, Aaron Schild, Zhao Song

*To appear in 61st Annual IEEE Symposium on Foundations of Computer Science (FOCS 2020)*

**OV Graphs are (Probably) Hard Instances**

with Virginia Vassilevska Williams

*In 11th Innovations in Theoretical Computer Science Conference (ITCS 2020)*

**Faster Update Time for Turnstile Streaming Algorithms**

with Huacheng Yu

*In 31st Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2020)*

**Faster Deterministic and Las Vegas Algorithms for Offline Approximate Nearest Neighbors in High Dimensions**

with Timothy M. Chan, Ryan Williams

*In 31st Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2020)*

**Predicate Encryption from Bilinear Maps and One-Sided Probabilistic Rank**

with Robin Hui

*In 17th Theory of Cryptography Conference (TCC 2019)*

**Efficient Construction of Rigid Matrices Using an NP Oracle**

with Lijie Chen

*In 60th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2019)*

*Machtey Award for Best Student Paper at FOCS 2019*

*Invited to special issue of SIAM Journal on Computing for FOCS*

**Limits on the Universal Method for Matrix Multiplication**

*In 34<sup>th</sup> Computational Complexity Conference (CCC 2019)*

*Best Student Paper Award at CCC 2019*

*Invited to special issue of ToC for CCC*

**An Illuminating Algorithm for the Light Bulb Problem**

*In 2<sup>nd</sup> Symposium on Simplicity in Algorithms (SOSA 2019)*

**Limits on All Known (and Some Unknown) Approaches to Matrix Multiplication**

with Virginia Vassilevska Williams

*In 59th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2018)*

*Invited to special issue of SIAM Journal on Computing for FOCS*

**Cell-Probe Lower Bounds from Online Communication Complexity**

with Joshua Wang, Huacheng Yu

*In 50th Annual ACM Symposium on the Theory of Computing (STOC 2018)*

**Further Limitations of the Known Approaches for Matrix Multiplication**

with Virginia Vassilevska Williams

*In 9th Innovations in Theoretical Computer Science Conference (ITCS 2018)*

**Dynamic Parameterized Problems and Algorithms**

with Matthias Mnich, Virginia Vassilevska Williams

*In 44<sup>th</sup> International Colloquium on Automata, Languages, and Programming (ICALP 2017)*

**Probabilistic Rank and Matrix Rigidity**

with Ryan Williams

*In 49<sup>th</sup> Annual ACM Symposium on the Theory of Computing (STOC 2017)*

*Michael Cohen Award for Best MIT Theory of Computation Student Paper*

### **Theoretical Foundations of Team Matchmaking**

with Dylan McKay

*In 16<sup>th</sup> International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2017)*

### **Polynomial Representations of Threshold Functions and Algorithmic Applications**

with Timothy M. Chan, Ryan Williams

*In 57<sup>th</sup> Annual IEEE Symposium on Foundations of Computer Science (FOCS 2016)*

### **Probabilistic Polynomials and Hamming Nearest Neighbors**

with Ryan Williams

*In 56<sup>th</sup> Annual IEEE Symposium on Foundations of Computer Science (FOCS 2015)*

### **Laurent Phenomenon Sequences**

with Cesar Cuenca, Jiaoyang Huang

*Journal of Algebraic Combinatorics 43, 589-633 (2016)*

### **Circular Planar Electrical Networks: Posets and Positivity**

with Carl Lian, Brandon Tran

*Journal of Combinatorial Theory, Ser. A 132, 58-101 (2015).*

## **Invited Talks**

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### **Tutorial on Matrix Rigidity Upper Bounds**

- FSTTCS Workshop on Matrix Rigidity, Dec 2020

### **Faster Update Time for Turnstile Streaming Algorithms**

- Stanford Theory Seminar, Jan 2020
- Google Mountain View Theory Seminar, Jan 2020

### **Limits on the Universal Method for Matrix Multiplication**

- AMS Sectional Meeting at the University of Virginia, session on Tensors and Complexity, Mar 2020
- Northeastern Theory Seminar, Dec 2019
- University of Chicago Combinatorics and Theoretical Computer Science Seminar, Oct 2019
- MIT Combinatorics Seminar, Sept 2019

### **Efficient Construction of Rigid Matrices Using an NP Oracle**

- BIRS Workshop on Algebraic Techniques in Computational Complexity, July 2019

### **Limits on All Known (and Some Unknown) Approaches to Matrix Multiplication**

- Highlights of Algorithms Invited Speaker, June 2019
- MIT Algorithms and Complexity Seminar, Oct 2018
- Schloss Dagstuhl Seminar on Algebraic Methods in Computational Complexity, Sept 2018
- China Theory Week at Tsinghua University, Sept 2018
- Oxford/Clay Mathematics Institute Workshop on Complexity Theory, July 2018

### **Dynamic Parameterized Problems and Algorithms**

- SIAM DM Conference, Minisymposium on Modification Problems to Discrete Structures, June 2018

### **Cell-Probe Lower Bounds from Online Communication Complexity**

- MIT Algorithms and Complexity Seminar, May 2017

### **Probabilistic Rank and Matrix Rigidity**

- TCS+ Online Seminar, Mar 2017

### **Polynomial Representations of Threshold Functions with Algorithmic Applications**

- IT University of Copenhagen Theory Seminar, Aug 2016

### **Probabilistic Polynomials and Hamming Nearest Neighbors**

- SODA Workshop on Multi-dimensional Proximity Problems, Jan 2016
- Simons Institute Workshop on Connections between Algorithm Design and Complexity Theory, Oct 2015

### **Positivity Phenomena in Circular Planar Electrical Networks**

- University of Michigan Combinatorics Seminar, Feb 2014

## **Research Internships**

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### **IBM Research – Almaden Research Center**

**Summer 2017**

Worked in the Principles and Methodologies group

## **Service and Outreach**

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### **Leadership Activities:**

- Co-Organizer of STOC Workshop on MCSP and Hardness Magnification, July 2020
- Organizer of Harvard Theory Seminar, 2020-21 academic year

**Conference Reviewing:** STOC, FOCS, SODA, CCC, SoCG, SOSA, ICALP, ITCS, ESA, FSTTCS, STACS, SPAA, CSR, SWAT, MFCS, FUN, WADS, COCOON, *etc.*

**Journal Reviewing:** ACM Transactions on Algorithms, Journal of Computational Geometry, Computational Complexity, Theory of Computing, Electronic Journal of Combinatorics, Random Structures & Algorithms, Theoretical Computer Science, SIAM Journal on Computing, SIAM Journal on Discrete Mathematics, *etc.*

### **Volunteering:**

- Coach and Assistant to the Team Leader for Ghana at the 2020 International Math Olympiad
- Taught over 50 Computer Science and Math classes for Middle and High School students through the Educational Studies Programs at MIT and Stanford
- 75+ hours volunteering at the MIT Museum, including designing puzzles for new museum activities

## **References**

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### **Alexander Razborov**

Andrew MacLeish Distinguished Service Professor – University of Chicago Computer Science and Math  
[razborov@math.uchicago.edu](mailto:razborov@math.uchicago.edu)

### **Leslie Valiant**

T. Jefferson Coolidge Professor of Computer Science and Applied Mathematics – Harvard SEAS  
[valiant@seas.harvard.edu](mailto:valiant@seas.harvard.edu)

### **Ryan Williams**

Professor of Electrical Engineering and Computer Science – MIT CSAIL and EECS  
[rrw@mit.edu](mailto:rrw@mit.edu)

### **Virginia Vassilevska Williams**

Steven and Renee Finn Career Development Associate Professor – MIT CSAIL and EECS  
[virgi@mit.edu](mailto:virgi@mit.edu)