

# Christopher Musco

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## Education

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### Massachusetts Institute of Technology

*Ph.D. Candidate, Computer Science – Theory of Computation*

Advisor: Jonathan Kelner

Masters Thesis: “Dimensionality Reduction for Sparse and Structured Matrices (Spring 2015)”

Cambridge, MA

2013 – present

### Yale University

*B.S. Applied Mathematics, B.S. Computer Science*

Applied Mathematics Thesis: Fast Discrete Laplace Transforms (with Vladimir Rokhlin)

Computer Science Thesis: Graph Constructions for Machine Learning (with Daniel Spielman)

New Haven, CT

2008 – 2012

## Research Areas

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foundations of data science • scalable machine learning • randomized linear algebra • theory of algorithms  
dimensionality reduction • sketching and streaming • algorithmic graph theory • iterative matrix algorithms

## Publications

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*Authors appear in alphabetical order, in the tradition of mathematics and theoretical computer science.*

[Minimizing Polarization and Disagreement in Social Networks](#). Cameron Musco, Christopher Musco and Charalampos Tsourakakis. *The Web Conference (WWW)* 2018.

[Stability of the Lanczos Method for Matrix Function Approximation](#). Cameron Musco, Christopher Musco, Aaron Sidford. *ACM-SIAM Symposium on Discrete Algorithms (SODA)* 2018.

[Recursive Sampling for the Nyström Method](#). Cameron Musco, Christopher Musco. *Conference on Neural Information Processing Systems (NIPS)* 2017.

[Random Fourier Features for Kernel Ridge Regression: Approximation Bounds and Statistical Guarantees](#). Haim Avron, Michael Kapralov, Cameron Musco, Christopher Musco, Ameya Velingker, Amir Zandieh. *International Conference on Machine Learning (ICML) 2017*.

[Input Sparsity Time Low-Rank Approximation via Ridge Leverage Score Sampling](#). Michael B. Cohen, Cameron Musco, Christopher Musco. *ACM-SIAM Symposium on Discrete Algorithms (SODA)* 2017.

[Determining Tournament Payout Structures for Daily Fantasy Sports](#). Christopher Musco, Maxim Sviridenko, Justin Thaler. *SIAM Algorithm Engineering and Experiments (ALENEX)* 2017.

[Principal Component Projection Without Principal Component Analysis](#). Roy Frostig, Cameron Musco, Christopher Musco, Aaron Sidford. *International Conference on Machine Learning (ICML)* 2016.

[Randomized Block Krylov Methods for Stronger and Faster Approximate Singular Value Decomposition](#). Cameron Musco, Christopher Musco. *Conference on Neural Information Processing Systems (NIPS)* 2015. Invited for full oral presentation (1 of 15 out of 403 accepted papers). Also presented at the 2016 Copper Mountain Conference on Iterative Methods

[Dimensionality Reduction for K-Means Clustering and Low Rank Approximation](#). Michael B. Cohen, Samuel Elder, Cameron Musco, Christopher Musco, Madalina Persu. *ACM Symposium on Theory of Computing (STOC)* 2015.

**Principled Sampling for Anomaly Detection.** Brendan Juba, Fan Long, Christopher Musco, Stelios Sidiropoulos-Douskos, Martin Rinard. *Network and Distributed System Security Symposium (NDSS)* 2015.

**Uniform Sampling for Matrix Approximation.** Michael B. Cohen, Yin Tat Lee, Cameron Musco, Christopher Musco, Richard Peng, Aaron Sidford. *Innovations in Theoretical Computer Science (ITCS)* 2015.

**Single Pass Spectral Sparsification in Dynamic Streams.** Michael Kapralov, Yin Tat Lee, Cameron Musco, Christopher Musco, Aaron Sidford. *IEEE Symposium on Foundations of Computer Science (FOCS)* 2014, Special Issue SIAM Journal on Computing 2017.

Other.....

**Learning Networks from Random Walk-Based Node Similarities.** Jeremy Hoskins, Cameron Musco, Christopher Musco, Charalampos Tsourakakis. *In submission.* 2017.

## Teaching

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### **Advanced Algorithms (MIT 6.854/18.415)**

*Teaching Assistant* 2016

Held office hours, wrote problem sets, and compiled notes and resources for an updated version of this challenging graduate algorithms course. Wrote guide on topics and expectations for student projects. Prepared and delivered a lecture on linear programming relaxations.

### **Technical Communication Skills for Graduate Students (MIT 6.S977)**

*Workshop Leader* 2016

Lead weekly workshops that supplemented lecture material with hands-on writing and presentation exercises. Met with students one-on-one outside of class to offer individual support and coaching in technical communication.

### **Introduction to Computer Science (Yale CPSC-201)**

*Teaching Assistant* 2012

Held weekly office hours and provided support for students online, covering boolean logic, functional programming, formal language theory, and basic complexity theory.

### **Introduction to Programming (Yale CPSC-112)**

*Teaching Assistant* 2011

Led weekly section for 15-25 students covering basic Java programming. Tutored 6 students individually.

### **Introductory Calculus (Yale MATH-112 & MATH-115)**

*Grader* 2009 – 2010

Scored problem sets and provided explanations and solutions for students, as well as feedback to the professor.

## Mentorship and Outreach

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### **MIT Graduate Communication Lab**

*Communication Advisor* 2015 – present

Helped to establish an EECS Communication Lab to provide over 700 graduate students with support in academic writing, oral presentation, job applications, and generally, in communicating effectively. Offer feedback, guidance, and coaching to individual students during weekly office hours (100+ individual appointments to date).

### **CSAIL Algorithms Office Hours**

*Member* 2016 – present

Advise researchers, generally in applied fields, on framing and solving algorithmic problems in their research.

### **Research Science Institute at MIT**

*Summer Research Advisor* 2014

Primary supervisor for Christopher Wang, a high school student participating in the prestigious RSI summer program. Chris's project, "Relaxation of a Concurrent Disjoint-Set", was selected as one of 10 program finalists.

## Industry Research

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### **Yahoo Labs**

**New York, NY**

*Research Intern, Scalable Machine Learning Group*

*Summer 2015*

Mentors: Justin Thaler, Maxim Srividenko, Edo Liberty

Worked on streaming matrix sampling problems and on algorithms for managing Yahoo's Fantasy Sports platform.

## Talks and Presentations

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### **The Lanczos Method in Data Science: Challenges and Opportunities**

Georgetown University, CS Seminar

*Feb. 2018*

Symposium on Discrete Algorithms (SODA)

*Jan. 2018*

### **Unifying Random Fourier Features and Leverage Scores for Kernel Matrix Approximation**

Harvard University, guest lecture in "Sketching Algorithms for Big Data"

*Nov. 2017*

Microsoft Research, Redmond

*Sept. 2017*

### **Sketching and Sampling Methods for Large Scale Linear Algebra**

Twitter, Cambridge

*July 2017*

### **Recursive Sampling for the Nyström Method**

Neural Information Processing Systems (NIPS) poster session

*Dec. 2017*

New England Machine Learning Day poster session

*May 2017*

### **Algorithms for Determining Tournament Payout Structures**

Meeting on Algorithm Engineering and Experiments (ALENEX)

*Jan. 2017*

### **Introduction to Linear Sketching**

MIT, Theory Retreat

*Sept. 2016*

### **Principal Component Projection without Principal Component Analysis**

International Conference on Machine Learning (ICML)

*June 2016*

### **Ridge Leverage Score Sampling**

National Institute of Informatics, Shonan Meeting

*July 2016*

MIT, Algorithms & Complexity Seminar

*July 2016*

University of Utah, Data Group Meeting

*Jan. 2016*

### **Randomized Block Krylov Methods**

Neural Information Processing Systems (NIPS) poster session

*Dec. 2015*

### **Large Scale Column Subset Selection**

Yahoo Labs, Science Week poster session

*July 2015*

### **Dimensionality Reduction for k-Means Clustering**

IBM T.J. Watson, Mathematical Sciences research seminar

*Aug. 2015*

Symposium on Theory of Computing (STOC)

*June 2015*

MIT, Theory Lunch

*June 2014*

### **Principled Sampling for Anomaly Detection**

MIT, Defense Advanced Research Projects Agency site visit

*Mar. 2015*

Network and Distributed System Security Symposium (NDSS)

*Feb. 2015*

### **Uniform Sampling for Matrix Approximation**

Yahoo Labs, Scalable Machine Learning research seminar

*June 2015*

## Single Pass Spectral Sparsification in Dynamic Streams

MIT, Annual Sublinear Algorithms Day poster session

Apr. 2015

Harvard University, Theory Seminar

Nov. 2014

Foundations of Computer Science (FOCS)

Oct. 2014

## Service

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### Conference Reviewer.....

COLT (2016), ESA (2015, 2017), FOCS (2015), ICALP (2015, 2017), ITCS (2018), NIPS (2015, 2016, 2017), NDSS (2015), RANDOM (2017), STACS (2018), SODA (2016, 2017, 2018), WALCOM (2018)

### Journal Reviewer.....

IEEE Transactions on Knowledge and Data Engineering (2017), IEEE Transactions on Signal Processing (2016, 2017, 2018), SIAM Journal on Matrix Analysis and Applications (2016, 2017), Mathematical Programming (2018)

## Other Research Experience

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### Japan National Institute of Informatics

*Invited participant*

2016

Shonan meeting on Recent Advances in Randomized Numerical Linear Algebra.

## Honors and Awards

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### National Science Foundation

2014-2017

*Graduate Research Fellowship, recipient.*

### Yale University

2012

*Cum Laude, Distinction in Both Majors.*

## Professional Experience

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### Redfin

Seattle, WA

*Software Engineer, Data Team*

2012 – 2014

Developed backend Java infrastructure for internet-powered real estate startup. Incorporated large-scale machine learning algorithms into production code. Managed three interns and onboarded four new-hires.

### Elysium Digital

Cambridge, MA

*Summer Consultant*

Summer 2011

Provided technical expertise in software patent cases at leading litigation consulting company.

### Amicus

New Haven, CT

*Software Developer*

2010 – 2011

Built applications for political campaign management and social fundraising at an early-stage startup that went on to raise nearly 4 million dollars in seed funding.