

# Tyler Chen

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[tyler.chen@jpmchase.com](mailto:tyler.chen@jpmchase.com)  
<https://research.chen.pw>

## Positions

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**JPMorganChase** ..... (2025-present)

Vice President, Applied Research Lead

- Quantum-inspired and Randomized Algorithms team at Global Technology Applied Research, JPMorganChase

**New York University** ..... (2022-2025)

Assistant Professor / Courant Instructor

- Mathematics at Courant, Computer Science and Engineering at Tandon
- Sponsor: Christopher Musco

**University of Washington** ..... (2017-2021)

Academic Student Employee

- Instructor and Teaching Assistant (unionized with UAW Local 4121)

## Education

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**University of Washington** ..... 2017-2022

Ph.D. in Applied Mathematics

- Thesis: *Lanczos-based methods for matrix functions*
- Advisors: Anne Greenbaum, Thomas Trogon

**University of Washington** ..... 2017-2019

M.Sc. in Applied Mathematics

**Tufts University** ..... 2013-2017

B.S. Summa Cum Laude in Mathematics and Physics; Minor in Studio Art

## Research Interests

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I'm particularly interested in incorporating probabilistic techniques into classical algorithms to develop methods which are fast and reliable, both in theory and in practice. I hope that my work will help to bridge the gaps between numerical analysis, theoretical computer science, and applied computational sciences such as quantum physics with the ultimate goal of supporting the advancement of knowledge in the basic sciences.

## Monographs

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**The Lanczos algorithm for matrix functions: a handbook for scientists**

Tyler Chen. 2024. [\[arXiv\]](#)

## Papers (in progress)

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### **A Unified Framework for Provably Efficient Algorithms to Estimate Shapley Values**

Tyler Chen, Akshay Seshadri, Mattia J. Villani, Pradeep Niroula, Shouvanik Chakrabarti, Archan Ray, Pranav Deshpande, Romina Yalovetzky, Marco Pistoia, and Niraj Kumar. 2025. [\[arXiv\]](#)

### **GPU-Parallelizable Randomized Sketch-and-Precondition for Linear Regression using Sparse Sign Sketches**

Tyler Chen, Pradeep Niroula, Archan Ray, Pragna Subrahmanya, Marco Pistoia, and Niraj Kumar. 2025. [\[arXiv\]](#)

### **Quasi-optimal hierarchically semi-separable matrix approximation**

Noah Amsel, Tyler Chen, Feyza Duman Keles, Diana Halikias, Cameron Musco, Christopher Musco, and David Persson. 2025. [\[arXiv\]](#)

### **Provably faster randomized and quantum algorithms for $k$ -means clustering via uniform sampling**

Tyler Chen, Archan Ray, Akshay Seshadri, Dylan Herman, Bao Bach, Pranav Deshpande, Abhishek Som, Niraj Kumar, and Marco Pistoia. 2025. [\[arXiv\]](#)

### **Preconditioning without a preconditioner: faster ridge-regression and Gaussian sampling with randomized block Krylov subspace methods**

Tyler Chen, Caroline Huber, Ethan Lin, and Hajar Zaid. 2025. [\[arXiv\]](#)

### **Randomized block-Krylov subspace methods for low-rank approximation of matrix functions**

David Persson, Tyler Chen, and Christopher Musco. 2025. [\[arXiv\]](#)

### **Fixed-sparsity matrix approximation from matrix-vector products**

Noah Amsel, Tyler Chen, Feyza Duman Keles, Diana Halikias, Cameron Musco, and Christopher Musco. 2024. [\[arXiv\]](#)

## Papers (published)

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### **Optimal Polynomial Approximation to Rational Matrix Functions Using the Arnoldi Algorithm**

Tyler Chen, Anne Greenbaum, and Natalie Wellen. *Numerical Algorithms*. 2025. [\[journal\]](#) [\[arXiv\]](#)

### **Randomized Matrix-Free Quadrature: Unified and Uniform Bounds for Stochastic Lanczos Quadrature and the Kernel Polynomial Method**

Tyler Chen, Thomas Trogdon, and Shashanka Ubaru. *SIAM Journal on Scientific Computing*. 2025. [\[journal\]](#) [\[arXiv\]](#)

### **Near-optimal hierarchical matrix approximation from matrix-vector products**

Tyler Chen, Feyza Duman Keles, Diana Halikias, Cameron Musco, Christopher Musco, and David Persson. *Symposium on Discrete Algorithms (SODA)*. 2025. [\[journal\]](#) [\[arXiv\]](#)

### **Near-Optimal Approximation of Matrix Functions by the Lanczos Method**

Noah Amsel, Tyler Chen, Anne Greenbaum, Cameron Musco, and Christopher Musco. *Conference on Neural Information Processing (NeurIPS)*. 2024. [\[arXiv\]](#).

- invited for spotlight presentation.

#### **Faster Randomized Partial Trace Estimation**

Tyler Chen, Robert Chen, Kevin Li, Skai Nzeuton, Yilu Pan, and Yixin Wang. *SIAM Journal on Scientific Computing*. 2024. [\[journal\]](#)[\[arXiv\]](#)

#### **Near-optimal convergence of the full orthogonalization method**

Tyler Chen and Gérard Meurant. *ETNA - Electronic Transactions on Numerical Analysis*. 2024. [\[journal\]](#)[\[arXiv\]](#)

#### **On the fast convergence of minibatch heavy ball momentum**

Raghu Bollapragada, Tyler Chen, and Rachel Ward. *IMA Journal of Numerical Analysis*. 2024. [\[journal\]](#)[\[arXiv\]](#)

#### **GMRES, pseudospectra, and Crouzeix's conjecture for shifted and scaled Ginibre matrices**

Tyler Chen, Anne Greenbaum, and Thomas Trogdon. *Mathematics of Computation*. 2024. [\[journal\]](#)[\[arXiv\]](#)

#### **A posteriori error bounds for the block-Lanczos method for matrix function approximation**

Qichen Xu and Tyler Chen. *Numerical Algorithms*. 2024. [\[journal\]](#)[\[arXiv\]](#)

#### **Stability of the Lanczos algorithm on matrices with regular spectral distributions**

Tyler Chen and Thomas Trogdon. *Linear Algebra and its Applications*. 2024. [\[journal\]](#)[\[arXiv\]](#)

#### **A spectrum adaptive kernel polynomial method**

Tyler Chen. *The Journal of Chemical Physics*. 2023. [\[journal\]](#)[\[arXiv\]](#).

- This approach is implemented in the `spectral_density` package

#### **Krylov-Aware Stochastic Trace Estimation**

Tyler Chen and Eric Hallman. *SIAM Journal on Matrix Analysis and Applications*. 2023. [\[journal\]](#)[\[arXiv\]](#)

#### **Low-Memory Krylov Subspace Methods for Optimal Rational Matrix Function Approximation**

Tyler Chen, Anne Greenbaum, Cameron Musco, and Christopher Musco. *SIAM Journal on Matrix Analysis and Applications*. 2023. [\[journal\]](#)[\[arXiv\]](#)

#### **Numerical computation of the equilibrium-reduced density matrix for strongly coupled open quantum systems**

Tyler Chen and Yu-Chen Cheng. *The Journal of Chemical Physics*. 2022. [\[journal\]](#)[\[arXiv\]](#)

#### **Error Bounds for Lanczos-Based Matrix Function Approximation**

Tyler Chen, Anne Greenbaum, Cameron Musco, and Christopher Musco. *SIAM Journal on Matrix Analysis and Applications*. 2022. [\[journal\]](#)[\[arXiv\]](#)

#### **Analysis of stochastic Lanczos quadrature for spectrum approximation**

Tyler Chen, Thomas Trogdon, and Shashanka Ubaru. *International Conference on Machine Learning (ICML)*. 2021. [\[journal\]](#)[\[arXiv\]](#).

- invited for long presentation

#### **On the Convergence Rate of Variants of the Conjugate Gradient Algorithm in Finite Precision Arithmetic**

Anne Greenbaum, Hexuan Liu, and Tyler Chen. *SIAM Journal on Scientific Computing*. 2021. [journal] [arXiv]

**Non-asymptotic moment bounds for random variables rounded to non-uniformly spaced sets**  
Tyler Chen. *Stat.* 2021. [journal] [arXiv]

**Predict-and-recompute conjugate gradient variants**

Tyler Chen and Erin C. Carson. *SIAM Journal on Scientific Computing*. 2020. [journal] [arXiv].

- abridged version was Student Paper Competition winner at 16<sup>th</sup> Copper Mountain Conference on Iterative Methods

## Student Mentoring

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Robert Chen (NYU)	2023 - 2025
Caroline Huber (NYU)	2024 - 2025
Ethan Lin (NYU)	2024 - 2025
Devin Tang (NYU)	2024 - 2025
Hajar Zaid (Graduate Center CUNY)	2024 - 2025
Ginebra Ferreira (NYU)	summer 2024
Kevin Li (NYU)	2022 - 2024
Yixin Wang (NYU)	2023 - 2024
Yue Geng (NYU)	summer/fall 2023
Ismael Jimenez (NYU)	summer 2023
Skai Nzeuton (Stuyvesant High School)	2022 - 2023
Yilu Pan (NYU Shanghai)	2022 - 2023
Qichen Xu (UW)	2021 - 2023
Linda Zhao (NYU)	summer/fall 2023
Aeron Langford (UW)	autumn 2019

## Teaching

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### Instructor

Numerical Analysis (NYU MATH-UA 252)	fall 2024
Linear Algebra I (NYU MATH-GA 2110)	spring 2024
Numerical Analysis (NYU MATH-UA 252)	fall 2023
Numerical Analysis (NYU MATH-UA 252)	spring 2023
Mathematical Statistics (NYU MATH-UA 234)	fall 2022
Applied Linear Algebra and Numerical Analysis (UW AMATH 352)	spring 2021
Interdisciplinary Writing/Natural Science (UW ENGL 199)	winter 2021
Interdisciplinary Writing/Natural Science (UW ENGL 199)	autumn 2020

## TA or Grader

Probability and Statistics for Computational Finance, TA (UW CFRM 410).....	winter 2019
Calculus with Analytic Geometry I, TA (UW MATH 124) .....	autumn 2018
Calculus with Analytic Geometry II, TA (UW MATH 12).....	winter 2018
Calculus with Analytic Geometry II, TA (UW MATH 125) .....	autumn 2017
Electronics, TA (Tufts PHY 41).....	spring 2017
Electronics, TA (Tufts PHY 41) .....	spring 2016
Discrete Mathematics, Grader (Tufts MATH 61).....	spring 2016
Calculus III, Grader (Tufts MATH 42) .....	fall 2015
Differential Equations, Grader (Tufts MATH 51) .....	spring 2015
Calculus III, Grader (Tufts MATH 42) .....	fall 2014

## Talks and Posters

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### **Preconditioning without a preconditioner using randomized block KSMs**

2025. Presentation at Householder XXII. [\[pdf\]](#)

### **Near-optimal hierarchical matrix approximation from matrix-vector products**

2025. Presentation at Joint Math Meetings. [\[pdf\]](#)

### **Near-optimal hierarchical matrix approximation from matrix-vector products**

2024. Presentation at Mid-Atlantic Numerical Analysis Day. [\[pdf\]](#)

### **Near-optimal hierarchical matrix approximation from matrix-vector products**

2024. Presentation at NYU Theory Seminar. [\[pdf\]](#)

### **Near-optimal hierarchical matrix approximation from matrix-vector products**

2024. Presentation at Precond. [\[pdf\]](#)

### **Is the Lanczos-Method for Matrix Functions Nearly Optimal?**

2024. Presentation at SIAM Linear Algebra. [\[pdf\]](#)

### **Krylov Subspace Methods and Matrix Functions: new directions in design, analysis, and applications**

2024. Presentation at Georgia Tech. [\[pdf\]](#)

### **Randomized Numerical Linear Algebra and Iterative Methods**

2023. Presentation at NYU Math Modeling workshop

### **An introduction to (Randomized) Numerical Linear Algebra**

2023. Presentation at NYU Math Society meeting

### **Peering into the black box: Krylov-aware stochastic trace estimation**

2023. Presentation at SIAM New York, New Jersey, and Pennsylvania Annual Meeting. [\[pdf\]](#)

### **Lanczos-based typicality methods for Quantum Thermodynamics**

2023. Presentation at Universität Bielefeld. [\[pdf\]](#)

#### **Krylov subspace methods for matrix function trace approximation**

2023. Presentation at NYU Shanghai. [\[pdf\]](#)

#### **Krylov-aware low-rank approximation**

2023. Presentation at International Congress on Industrial and Applied Mathematics. [\[pdf\]](#)

#### **Randomized trace estimation**

2023. Presentation at Sampling Theory and Applications Conference. [\[pdf\]](#)

#### **Randomized matrix-free quadrature**

2023. Presentation at Foundations of Computational Mathematics. [\[pdf\]](#)

#### **Stochastic trace estimation and quantum typicality: a case study in interdisciplinary research**

2023. Presentation at Perspectives on Matrix Computations: Theoretical Computer Science Meets Numerical Analysis. [\[pdf\]](#)

#### **Randomized matrix-free quadrature**

2022. Presentation at Courant Numerical Analysis and Scientific Computing Seminar. [\[pdf\]](#)

#### **GMRES, pseudospectra, and Crouzeix's conjecture for shifted and scaled Ginibre matrices**

2022. Presentation at Conference on Random Matrix Theory and Numerical Linear Algebra. [\[pdf\]](#)

#### **Simple Algorithms for Spectral Sum and Spectrum Approximation**

2021. Poster at Workshop on Algorithms for Large Data (Online). [\[pdf\]](#)

#### **Analysis of stochastic Lanczos quadrature for spectrum approximation**

2021. Oral at International Conference on Machine Learning

#### **Concentration in the Lanczos Algorithm**

2021. Presentation at SIAM Linear Algebra 21. [\[pdf\]](#)

#### **Analysis of stochastic Lanczos quadrature for spectrum approximation**

2021. Presentation at Baidu Research. [\[pdf\]](#)

#### **Analyzing the Effects of Local Roundoff Error on Predict-and-Recompute Conjugate Gradient Variants**

2020. Poster at Householder Symposium (Cancelled)

#### **Predict-and-recompute conjugate gradient variants**

2020. Presentation at Copper Mountain Student Paper Award Session (Cancelled)

#### **Predict-and-recompute conjugate gradient variants**

2020. Presentation at SIAM Parallel Processing. [\[pdf\]](#)

#### **Symmetric Preconditioner Refinement Using Low Rank Approximations**

2019. Presentation at Baidu Research

### **Service and Outreach**

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**Proud to Be First Faculty Connect** ..... 2023-2024

Serve as mentor for Proud to Be First Faculty Connect, which pairs second-year, first-generation

students with faculty

**Math Modeling Workshop** ..... nov. 2023

Provide tutorial on randomized linear algebra for the math modeling club

**Math Society chalkboard talk** ..... nov. 2023

Guest lecture for NYU Math Society on randomized linear algebra

**NYU SIAM podcast** ..... oct. 2023

Discuss my path as a mathematician, and advice for students, etc.

**NYU SIAM Grad School Info Session** ..... oct. 2022

Panelist for Q/A session for students interested in grad school

**Minisymposium Organizer** ..... may 2021

Random matrices and numerical linear algebra (at SIAM Linear Algebra 21, co-organized with Thomas Trogdon) [\[program\]](#)

**Graduate Student Representative** ..... 2019 - 2020

Represent interests of graduate students to the department

**Minisymposium Organizer** ..... feb. 2020

High performance Krylov subspace methods: Theory, Implementation, and Application (at SIAM Parallel Processing 20) [\[program\]](#)

**Diversity Committee Departmental Climate Orientation** ..... oct. 2019

Panelist for event focused on building an inclusive department culture

**Numerical Analysis Research Club** ..... 2019 - 2020

Organize and plan weekly meetings for NARC

**SIAM UW Mental Health Conversation and Resources** ..... oct. 2018

Organize and facilitate a discussion about mental health in grad school

## Software

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**Research code** (<https://github.com/tchen-research>)

Repositories with code to generate figures and experiments from my papers.

**Spectral Density** (<https://pypi.org/project/spectral-density/>)

Develop `spectral_density` package to efficiently produce spectrum adaptive KPM approximations.

**PETSc** (<https://www.mcs.anl.gov/petsc/>)

Contribute `PIPEPRCG`. This method can be used by with the flag `-ksp_type pipeprcg`.

**mpmath** (<https://github.com/mpmath>)

Update matrix multiplication driver to significantly improve performance for sparse matrices.

## Awards & Honors

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Boeing Research Award (UW Department of Applied Mathematics) .....	2020
Student Paper Competition Winner (Copper Mountain Conference on Iterative Methods).....	2020
Graduate Research Fellowship (NSF) .....	2019
Top Scholars Fellowship (UW).....	2017
The Audrey Butvay Gruss Science Award (Tufts) .....	2017
Phi Beta Kappa (Tufts).....	2017
Sigma Pi Sigma Physics Honors Society (Tufts).....	2016
The Howard Sample Prize Scholarship in Physics (Tufts).....	2015