Tyler Chen

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https://research.chen.pw

Positions

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

University of Washington 2017-2022

Ph.D. in Applied Mathematics

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

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

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

The Lanczos algorithm for matrix functions: a handbook for scientists
Tyler Chen. 2024. [arXiv]

Papers (in progress)

A simple analysis of a quantum-inspired algorithm for solving low-rank linear systems
Tyler Chen, Junhyung Lyle Kim, Archan Ray, Shouvanik Chakrabarti, Dylan Herman, and Niraj Kumar. 2025. [arXiv]

Does block size matter in randomized block Krylov low-rank approximation?
Tyler Chen, Ethan N. Epperly, Raphael A. Meyer, Christopher Musco, and Akash Rao. 2025. [arXiv]

Query Efficient Structured Matrix Learning
Noah Amsel, Pratyush Avi, Tyler Chen, Feyza Duman Keles, Chinmay Hegde, Cameron Musco, Christopher Musco, and David Persson. 2025. [arXiv]

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)

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. [jour-

nal] [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$^{\text{th}}$ Copper Mountain Conference on Iterative Methods

Student Mentoring

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

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

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 qudrature
2022. Presentation at Courant Numerical Analysis and Scientific Computing Seminar. [pdf]

GMRES, pseudospectra, and Crouzeix's conjecture for shifted and scaled Ginbre 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 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

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 chalkbaord 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

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

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