ARCHAN RAY

github: archanray ◇ website: https://archanray.github.io
(413) · 992 · 9222 ◇ ray@cs.umass.edu, talk2archan@gmail.com
New York, NY 11372

RESEARCH INTEREST

Randomized Methods, Sublinear Algorithms, Machine Learning, Numerical Linear Algebra.

I develop computationally efficient algorithms using numerical linear algebra, with applications in machine learning. The body of my work can be thought of as a toolbox that can be used to perform various tasks within machine learning (including deep learning). The central focus of my work revolves around pushing the boundaries of sublinear time or query algorithms in the context of matrices and tensors, and their practical applications.

WORK EXPERIENCE

Applied Research Scientist, JPMorgan Chase, New York, NY September 2024 - *present*

· I design randomized methods with applications in quantum-inspired and machine learning algorithms.
· *Area of Study*: Randomized Algorithms, Numerical Linear Algebra, Quantum Algorithms.

Postdoctoral Research Scholar, Sloan Kettering Institute, New York, NY Summer 2024

· Developed algorithms for matrix approximation with applications in clinical data.
· *Area of Study*: Randomized Algorithms, Optimization, Numerical Linear Algebra.

Applied Research Intern, Amazon Web Services, New York, NY Summers 2019, 2020

· Developed an algorithm for visual question answering using transformer architecture.
· Developed an algorithm to perform pseudo semi-supervised learning for short texts.
· *Area of Study*: Computer Vision, Unsupervised Learning, Natural Language Processing.

Research Intern, TCS Innovation Labs, Gurgaon, India Summer 2014

· Developed a computational framework for classification of emotion classes of facial images.
· *Area of Study*: Computer Vision, Support Vector Machines, Topology, Active Shape Modeling.

Research Intern, Indian Space Research Organization (RRSC-E), Kolkata, India Summer 2012

· Developed an algorithm to identify distinct signals (spectral unmixing of endmembers) in a hyperspectral image.
· *Area of Study*: Game Theory, Digital Signal Processing, PCA & KPCA, Image Processing.

EDUCATION

University of Massachusetts, Amherst May 2024
Ph.D. in Computer Science, *advised by* Cameron Musco
Thesis: Sublinear Algorithms for Matrices: Theory and Applications
Committee: Cameron Musco, Andrew McCallum, Andrew McGregor, David P Woodruff

Indian Statistical Institute, Kolkata July 2015
M.Tech. in Computer Science, *advised by* Dipti Prasad Mukherjee
Thesis: Estimation of Facial Emotions for Emotion Synthesis

Jalpaiguri Government Engineering College, West Bengal June 2013
B.Tech. in Computer Science and Engineering

PUBLICATIONS

(author listing is alphabetical for papers marked with * and equally contributing authors are marked with †)

Chen, T.†, **Ray, A.**†, Seshadri, A.†, Herman, D., Bach, B., Deshpande, P., Som, A., Kumar, N., & Pistoia, M. (2025, April). "Provably faster randomized and quantum algorithms for k-means clustering via uniform sampling". In *submission at Quantum* [arxiv].

Ngo, D.D.†, **Ray, A.**†, Seshadri, A.†, Scott, D., Obitayo, S., Kumar, N., Potluru, V.K., Pistoia, M., & Veloso, M. (2025, May). "Adaptive and robust watermark for generative tabular data". In *UAI 2026* [arxiv].

Lopez-Piqueres, J., Deshpande, P., **Ray, A.**, Villani, M.J., Kumar, N., & Pistoia, M. (2025, June). "MetaTT: a global tensor-train adapter for parameter-efficient fine-tuning". In *TMLR 2026* [arxiv].

Chen, T., Niroula, P., **Ray, A.**, Subrahmanya, P., Pistoia, M., Kumar, N. "GPU-parallelizable randomized sketch-and-precondition for linear regression using sparse sign sketches". In *PDSEC 2026* [arxiv]* (**best paper**).

Chen T.†, Kim, J.L.†, **Ray, A.**†, Chakrabarti, S., Herman, D., Kumar, N. "A simple analysis of a quantum-inspired algorithm for solving low-rank linear systems". In *ArXiv* [arxiv].

Chen, T.†, Kumar, N.†, Seshadri, A.†, Villani, M.J.†, Niroula, P., Chakrabarti, S., Deshpande, P., Yalovetzky, R., **Ray, A.**, & Pistoia, M. (2025, June) "A unified framework for provably efficient algorithms to estimate Shapley values". In *NeurIPS 2025* [arxiv].

Bhattacharjee, B., Jayaram, R., Musco, C., Musco, C., & **Ray, A.** (2024, July) "Optimal Spectral Density Estimation via Explicit and Implicit Deflation". In *SODA 2025* [arxiv]*.

Bhattacharjee, R., Dexter, G., Musco, C., **Ray, A.**, Sachdeva, S., & Woodruff, D.P. (2023, February) "Universal Matrix Sparsifiers and Fast Deterministic Algorithms for Linear Algebra". In *ITCS 2024* [arxiv]*.

Bhattacharjee, R., Dexter, G., Drineas, P., Musco, C., & **Ray, A.** (2022, May) "Sublinear Time Eigenvalue Approximation via Random Sampling". Extended abstract in *ICALP 2023* and full paper in *Algorithmica 2024* [arxiv]*.

Ray, A., Monath, N., McCallum, A., & Musco, C. (2021, December) "Sublinear Time Approximation of Text Similarity Matrices". In *AAAI 2022* [arxiv].

Ray, A., Chowdhury, A. R., Fung, Y., Weinman, J., & Learned-Miller, E. (2019, December). "Tight Coupling of Character, Word, and Place Recognition for End-to-End Text Recognition in Maps". *Technical Report, College of Information and Computer Sciences, University of Massachusetts, Amherst, MA* [PDF].

Ray, A., Chen, Z., Gafford, B., Gifford, N., Jai Kumar, J., Lamsal, A., Niehus-Staab, L., Weinman, J., & Learned-Miller, E. (2018, October). "Historical Map Annotations for Text Detection and Recognition". *Technical Report, Grinnell College, Grinnell, IA 50112* [PDF].

Ray, A., Kumar, N., Shaw, A., & Mukherjee, D. P. (2018, September). "U-PC: Unsupervised Planogram Compliance". In *ECCV 2018.* [PDF].

RESEARCH EXPERIENCE

Graduate Research Assistant, University of Massachusetts, Amherst, MA August 2019 - June 2024

- Designed algorithms for approximate matrix properties, with applications to real world datasets.
- *Area of Study*: Sublinear Algorithms.

Graduate Research Assistant, University of Massachusetts, Amherst, MA May 2017 - May 2019

- Created a database of annotated historical maps, and designed algorithms to detect and recognize texts in them.
- *Area of Study*: Convolutional Neural Networks, Computer Vision.

Visiting Research Scholar, Indian Statistical Institute, Kolkata, India August 2015 - August 2016

- Developed an algorithm for detection and recognition of objects in images of shelves in superstores.
- *Area of Study*: Computer Vision, Graph Theory.

TEACHING EXPERIENCE

University of Massachusetts
Graduate Teaching Assistant *Amherst, MA*

- Representing, Storing, and Retrieving Information (CS145), *Spring '21*, with William T. Verts
- Algorithms for Data Science (CS514), *Spring '20*, with Cameron Musco.
- Graduate Computer Vision (CS670), *Fall '19*, with Subhransu Maji.
- Graduate Machine Learning (CS589), *Spring '19*, with Justin Domke.
- Graduate Machine Learning (CS589), *Spring '17*, with Benjamin Marlin.

· Introduction to Algorithms (CS311), *Fall '16*, with Andrew McGregor and Akshay Krishnamurthy.

PATENTS

Pranoy, H., Rao, S.Y., Ramakrishnan, R., Shaw, A.K., **Ray, A.**, Kumar, N. and Mukherjee, D.P., "System and method for object recognition based estimation of planogram compliance." U.S. Patent 10,748,030, issued August 18, 2020.

HONORS AND ACHIEVEMENTS

Best Paper Award, 27$^{\text{th}}$ IEEE International Workshop on Parallel and Distributed Scientific and Engineering Computing May 2026

Dissertation Writing Fellowship Award, Manning College of Information and Computer Sciences, University of Massachusetts Amherst Spring 2023

AAAI-22 Student Scholarship, 36$^{\text{th}}$ AAAI Conference on Artificial Intelligence January 2022

Best Dissertation in M.Tech. Computer Science, Indian Statistical Institute, Kolkata July 2015

TALKS AND POSTERS

Introduction to Neural Networks and its applications. *Guest lecture for Machine Learning in Public Health (MPH5003) at Icahn School of Medicine at Mount Sinai.* Talk. May 2026

GPU-parallelizable randomized sketch-and-precondition for linear regression using sparse sign sketches. *In PDSEC 2026.* Talk. May 2026

Scaling Machine Learning in Practice. *Guest lecture for Business Analytics and Machine Learning (BAML) course at ISI-Kolkata.* Talk. June 2025

Approximating Eigenvalues of Symmetric Matrices using Matrix-vector Query Algorithms. *In DIMACS Workshop on Modeling Randomness in Neural Network Training.* Poster. June 2024

Sublinear Time Eigenvalue Approximation via Random Sampling. *In ICALP.* Talk. August 2023

Sublinear Time Eigenvalue Approximation via Random Sampling. *In FODSI Sublinear Algorithms Workshop.* Poster. August 2022

Estimating Eigenvalues of Symmetric Matrices using Random Submatrices. *In Workshop for Algorithm for Large Data (Online) (WALDO).* Poster. August 2021

Efficient Kernel Learning in the Online and Sliding Window Models. *In Workshop on Local Algorithms (WOLA).* Poster. June 2021

Detection and Recognition of Texts in Cartographic Images. *In New England Computer Vision Workshop (NECV).* Poster. November 2018

ACADEMIC ACTIVITIES

Reviewing. FOCS 2026 (sub-reviewer), BIT Numerical Mathematics, ICLR 2026, NeurIPS 2025-*present*, AAAI 2025, AISTATS 2024-25, IEEE Transactions on Image Processing (TIP), NeurIPS 2019 Workshop Sets & Partitions, ICVGIP 2015-18.

MENTORSHIP AND OUTREACH

CARE PhD Application Support Program at UMass. Mentor. 2020 - 2024

Undergraduate Research Volunteers at UMass. Mentor. Winter 2021

Machine Learning and Friends Lunch at UMass. Co-organizer. Fall 2018 - Fall 2019

Computer Vision Lab at UMass. Mentor Masters students. Fall 2018

Graduate Employee Organisation at UMass. Steward. Fall 2017 - Fall 2018