

ARCHAN RAY

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RESEARCH INTEREST

Sublinear Algorithms, Machine Learning.

EDUCATION

University of Massachusetts, Amherst September 2016 - *present*
Ph.D. in Computer Science, *advised by* [Professor Cameron Musco](#)
Thesis: Sublinear Algorithms for Matrices: Theory and Applications

Indian Statistical Institute, Kolkata July 2015
M.Tech. in Computer Science, *advised by* [Professor Dipti Prasad Mukherjee](#)
Thesis: Estimation of image features representing facial emotions for emotion synthesis

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

RESEARCH EXPERIENCE

Graduate Research Assistant, University of Massachusetts, Amherst, MA August 2019 - *present*

- Approximate matrix properties and applications to real world datasets.
- *Area of Study*: Sublinear Algorithms.

Applied Research Intern, Amazon Web Services, New York, NY Summer 2020

- Develop an algorithm to perform pseudo semi-supervised learning for short texts.
- *Area of Study*: Unsupervised Learning, Natural Language Processing.

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

- Create a database of annotated historical maps. Detect and recognize texts in historical maps.
- *Area of Study*: Convolutional Neural Networks, Computer Vision.

Applied Research Intern, Amazon Web Services, New York, NY Summer 2019

- We develop an algorithm for visual question answering using transformer architecture.
- *Area of Study*: Computer Vision, Natural Language Processing.

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

- We developed an algorithm for detection and recognition of objects from planogram images.
- *Area of Study*: Computer Vision, Graph Theory.

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

- Develop a computation framework to identify between populations of normal and abnormal classes of face images.
- *Area of Study*: Computer Vision, Support Vector Machines, Topology, Active Shape Modeling.

Research Intern, Indian Space Research Organization (ISRO), Kolkata, India Summer 2012

- Develop 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.

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 Subhansu 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.

WORKING PAPERS

(author listing is alphabetical for papers marked with *)

Musco, C., **Ray, A.**, “Sublinear Time Matrix-Vector Algorithms for Eigenvalue Approximations: A Comparative Study”*.

Ray, A., Monath, N., Zaheer, M., “Generalizability with Localization: Algorithms for Learning Problems”.

PUBLICATIONS

Bhattacharjee, R., Dexter, G., Musco, C., **Ray, A.**, & Woodruff, D.P. (2023, February) “Universal Matrix Sparsifiers and Fast Deterministic Algorithms for Linear Algebra”. *In submission* [[arxiv](#)]*.

Bhattacharjee, R., Dexter, G., Drineas, P., Musco, C., & **Ray, A.** (2022, May) “Sublinear Time Eigenvalue Approximation via Random Sampling”. *In International Colloquium on Automata, Languages, and Programming (ICALP) 2023* [[arxiv](#)]*.

Ray, A., Monath, N., McCallum, A., & Musco, C. (2021, December) “Sublinear Time Approximation of Text Similarity Matrices”. *In AAAI Conference on Artificial Intelligence (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 European Conference on Computer Vision (ECCV) 2018*. [[PDF](#)].

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

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

AAAI-22 Student Scholarship, 36th AAAI Conference on Artificial Intelligence January 2022

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

TALKS AND POSTERS

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

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

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

RELEVANT COURSEWORKS

Deep Learning, Computer Vision, Machine Learning, Research Methods in Empirical CS, Automated Knowledge Based Construction, Advanced Algorithms, Software Analysis and Evaluation, Advanced Database Systems.

ACADEMIC ACTIVITIES

Reviewing. IEEE Transactions on Image Processing (TIP), NeurIPS 2019 Workshop Sets & Partitions, Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP).

MENTORSHIP AND OUTREACH

CARE PhD Application Support Program at UMass. Mentor.	2020 - <i>present</i>
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

OTHER RESEARCH AND CLASS PROJECTS

Efficient distributed routing in quantum networks	October 2019 - December 2019
<i>Advisor: Dr. Kaushik Chakraborty</i>	<i>QuTech, TU Delft</i>

- We present an efficient algorithm for routing in quantum networks.
- We improve upon the state of the art by using link prediction for dynamic routing of incoming datastreams.
- *Area of Study:* Quantum Networks and Link Prediction.

Invariant methods and graph equivalence (IMAGE)	February 2017 - May 2017
<i>Course advisor: Prof. Yuriy Brun</i>	<i>UMass Amherst</i>

- Inspect invariant methods with a view to identify code similarity using graph equivalence.
- Use graph kernels as a similarity measurement to quantify the similarities between code pieces.
- *Area of Study:* Kernel Methods, Software Analysis and Graph Kernels.

Canonicalizing Neural Networks	September 2016 - December 2016
<i>Advisor: Prof. Erik Learned Miller</i>	<i>UMass Amherst</i>

- Study the convergence of a fixed neural network to its many optima.
- Transform the trained network keeping its functional behaviour consistent and studied the existence of “equivalence classes” for a neural network.
- *Area of Study:* Neural Networks, and Functional Analysis

Estimation of Image Features for Emotion Synthesis (<i>best dissertation</i>)	February 2014 - July 2015
<i>Advisor: Prof. Dipti Prasad Mukherjee</i>	<i>ISI Kolkata</i>

- Develop a method to estimate emotion-specific features on human face which characterizes an emotion class.
- Develop an algorithm to estimate the change a person’s image from no emotion to a given emotion using these features.
- SNR of the synthesized images showed improvements as compared to state-of-the-art methods.
- *Area of Study:* Support Vector Machines, Statistical Inference, Computer Vision, Differential Geometry.

Thread Library Implementation in Pintos	April 2014 - May 2014
<i>Course advisor: Prof. Mandar Mitra</i>	<i>ISI Kolkata</i>

- Strengthen the thread library that supports the operating system. Implement an advanced scheduler.
- We removed busy waiting of the timer function. We further improved the timer interrupt service and added priority scheduling support for threads, including priority inversion and priority donation.
- *Area of Study:* Multilevel Feedback Queue Scheduling, Optimization Barriers, Priority Scheduling.