ARCHAN RAY

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RESEARCH INTEREST

Randomized Algorithms, Sublinear Algorithms, Kernel Methods, Machine Learning.

EDUCATION

University of Massachusetts, Amherst   September 2016 - *present*
Ph.D. in Computer Science, *advised by* Professor Cameron Musco

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*: Randomized Algorithms, 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 (RRSC-E), 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 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.

WORKING PAPERS

(author listing is alphabetical for papers marked with *)

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. (2022, November) "Sublinear Time Deterministic Algorithms for Spectral Approximation". *In submission**.

Bhattacharjee, R., Dexter, G., Drineas, P., Musco, C., & **Ray, A.** (2022, May) "Sublinear Time Eigenvalue Approximation via Random Sampling". *arXiv preprint arXiv:2109.07647**.

Ray, A., Monath, N., McCallum, A., & Musco, C. (2021, December) "Sublinear Time Approximation of Text Similarity Matrices". to appear in *AAAI Conference on Artificial Intelligence (AAAI) 2022*.

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*

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*.

Ray, A., Kumar, N., Shaw, A., & Mukherjee, D. P. (2018, September). "U-PC: Unsupervised Planogram Compliance". *In European Conference on Computer Vision (pp. 598-613). Springer, Cham*.

PATENTS

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

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 - *present*
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
Advisor: Dr. Kaushik Chakraborty — *QuTech, TU Delft*

· 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.

Online nearest neighbor clustering using levarage score sampling — October 2019 - December 2019
Course advisor: Prof. Cameron Musco and Prof. Andrew McCallum — *UMass Amherst*

· We present an efficient and online nearest neighbor search.
· A kernel function is used as a distance measure for two points in the cluster. The use of leverage scores allows for a faster implementation.
· *Area of Study*: Kernel Methods and Natural Language Processing.

Invariant methods and graph equivalence (IMAGE) — February 2017 - May 2017
Course advisor: Prof. Yuriy Brun — *UMass Amherst*

· 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.

Recommendation from citation databases — April 2017 - May 2017
Course advisor: Prof. Alexandra Meliou — *UMass Amherst*

· Investigate recommendations in the context of bibliographic networks. Design a recommendation framework that uses only the graph topology to estimate valid recommendations given a query node in the graph.
· Our experiments on Stanford citation networks and CiteULike datasets promises that the combination of our method and topic modeling result in competent recommender models.
· *Area of Study*: Statistical Learning, Graph Database and Recommender Framework.

Generating Harder CAPTCHAs using GAN — September 2016 - December 2016
Course advisor: Prof. Sridhar Mahadevan — *UMass Amherst*

· We propose the use of GANs to generate harder CAPTCHAs taking into account the intrinsic properties of the breaker CNNS.
· Our experiments showed a significant decrease in the recognition accuracy of the CNNs.
· *Area of Study*: Deep Learning, Generative Models and Adversarial Networks.

Canonicalizing Neural Networks — September 2016 - December 2016
Advisor: Prof. Erik Learned Miller — *UMass Amherst*

· 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

Sammon's Mapping Using a Revised Distance Strategy
September 2014 - August 2015
Advisor: Dr. Swagatam Das
ISI Kolkata
· Investigate Sammon's mapping using Bregman's divergence. Propose a different distance strategy to attain the reduction from non-linear dimension.
· *Area of Study*: Functional Analysis, and Measure Theory.

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

Frame Based Audio Signal Processing using DSK6713
August 2014 - October 2014
Advisor: Dr. Sarbani Palit
ISI Kolkata
· Investigate and develop an algorithm to remove noise and jitters while amplifying signals.
· *Area of Study*: Convolution Theorem, Micro-controllers and Microprocessor, DSK Toolkit.

Thread Library Implementation in Pintos
April 2014 - May 2014
Course advisor: Prof. Mandar Mitra
ISI Kolkata
· 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.

Minimum Enclosing Circle of a Set of Points and Two Mobile Points
November 2013 - February 2014
Advisor: Dr. Sandip Das
ISI Kolkata
· Study variations in the center and radius of the minimum enclosing circle (MEC) of a given set of points and two mobile points moving along straight lines.
· The basis of the changes is the farthest point Voronoi of the given set of points.
· *Area of Study*: Voronoi Diagram, Kinetic Data Structure, Co-Ordinate Geometry.

Facial Recognition using Fiducial Points and Graph Matching
Aug 2012 - May 2013
Advisor: Prof. Animesh Hazra
Jalpaiguri Govt. Engg. College
· Develop an algorithm to extract the facial features of the given image to help identify peoples faces from an already available database with increased efficiency and optimal time complexity.
· *Area of Study*: Image Processing, Graph Theory.