ARCHAN RAY

github: archanray ⋄ website: people.cs.umass.edu/∼ray

(413) · 992 · 9222 ⋄ ray@cs.umass.edu, talk2archan@gmail.com

New York, NY 11372

RESEARCH INTEREST

Randomized Algorithms, Sublinear Algorithms, Kernel Methods, Statistical Analysis, 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
Percentage: 74.25%

Jalpaiguri Government Engineering College, West Bengal   *June 2013*
B.Tech. in Computer Science and Engineering
GPA: 8.5/10.0

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   May 2020 - August 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
· Develop an algorithm to detect and recognize texts in historical maps. Create a database of annotated historical maps (technical publication listed).
· *Area of Study*: Convolutional Neural Networks, Computer Vision and Word Spotting.

Applied Research Intern, Amazon Web Services, New York, NY   June 2019 - August 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   May 2014 - July 2014
· A new computation framework was developed and the interpretations are done on the basis of statistical differences between populations of normal and abnormal classes of face images.
· *Area of Study*: Computer Vision, Support Vector Machines, Markov Models, Topology and Modern Analysis, Active Shape Modeling.

Research Intern, Indian Space Research Organization (RRSC-E), Kolkata, India   June 2012 - August 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.

PROFESSIONAL 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 *)

Bhattacharjee R., Dexter, G., Musco, C., **Ray, A.** & Woodruff, D., "Approximating Eigenvalues and the Quadratic Form of PSD Matrices using Deterministic Algorithms"*

Bhattacharjee R., Dexter, G., Musco, C., Nguyen, T., **Ray, A.**, Swartworth, W., & Woodruff, D., "Approximating Eigenvalues of Indefinite Matrices using Matrix Vector Products"*

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

PUBLICATIONS

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

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

IEEE Transactions on Image Processing. Reviewer

NeurIPS 2019 Workshop Sets & Partitions. Reviewer

Indian Conference on Computer Vision, Graphics and Image Processing. Reviewer

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.