

Joseph Shenouda

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Research Interests

Deep Learning Theory, Machine Learning, Signal Processing

Education

University of Wisconsin-Madison	2021-2026
Ph.D. Electrical and Computer Engineering (In Progress)	
Advisors: Kangwook Lee & Robert D. Nowak	
Rutgers University	2017-2021
B.S. Electrical and Computer Engineering	
Summa Cum Laude	

Preprints

- **Vector-Valued Variation Spaces and Bounds on Neural Network Widths**
Joseph Shenouda, Rahul Parhi, Kangwook Lee, Robert Nowak
In Submission 2023

Publications

- **A Guide to Reproducible Research in Signal Processing and Machine Learning.**
Joseph Shenouda and Waheed U. Bajwa.
IEEE Signal Processing Magazine (2023).
- **A Better Way to Decay: Proximal Gradient Training Algorithms for Weight Decay**
Liu Yang, Jifan Zhang, **Joseph Shenouda**, Dimitris Papailiopoulos, Kangwook Lee, Robert Nowak.
Neural Information Processing Systems (NeurIPS) OPT-ML Workshop (2022)

Research Projects

Proximal Point Algorithms for Training Neural Networks with Weight Decay

- Developed computational experiments implementing a novel proximal point algorithm to accelerate weight decay regularization in neural network training.
- Provided empirical and theoretical evidence that our approach can learn neural networks that are more robust than those trained with standard weight decay. (Tools: PyTorch)

Vector-Valued Variation Spaces and Bounds on Neural Network Widths

- Characterized the kinds of functions learned by training with weight decay for multi-output (vector-valued) ReLU neural networks.
- Via a novel reduction of the weight decay solution to a convex optimization we derive new and tighter bounds on the sufficient width for any homogeneous layer of a deep neural network.

Experience

MIT Lincoln Laboratory: Summer Research Intern

Summer 2021

- Compared graphical and deep learning methods for segmenting RF spectrograms.
- Developed and implemented modified spectral clustering algorithms on both synthetic and real RF spectrograms.
- Presented our algorithm to the technical staff highlighting its advantages to the deep learning method.

Undergraduate Research Assistant (INSPIRE Lab)

Fall 2020-Spring 2021

- Senior thesis investigating hypergraph signal processing advised by Prof. Waheed Bajwa.

Los Alamos National Laboratory: Electrical Engineer Intern

Summer 2020

- Research and development of digital signal processing algorithms for X-Ray radiation detection in space, to replace current analog approaches.
- Optimized simulation scripts to decrease simulation time by 75%
- Conducted analysis to determine the best parameters for our filter to accurately measure the energy levels of the signals coming into the detector.

Undergraduate Research Assistant (INSPIRE Lab)

Fall 2019-Spring 2020

- Researched reproducibility of computational experiments in signal processing and machine learning under Prof. Waheed Bajwa.
- Read through recent publications of the lab to reproduce results of computational experiments; codebases can be found at <https://github.com/INSPIRE-Lab-US>.
- Created a set of standards and best practices for the lab to ensure that all computational experiments are readily reproducible by other researchers at the time of publication.

Lockheed Martin: Software Engineering Intern

Summer 2019

- Successfully implemented a new messaging interface in C++ for radar simulation software.
- Independently worked to incorporate this new protocol into an existing system while learning about new technologies such as C++, gdb and network programming.

Relevant Coursework

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|-----------------------------------|-----------------------------------------------------------|
| – High Dimensional Statistics | – Analysis |
| – Detection and Estimation Theory | – Mathematical Methods of Machine Learning |
| – Stochastic Signals and Systems | – Theoretical Foundations of Large Scale Machine Learning |
| – Convex Optimization | – Non-linear Optimization |
| – Error Control Coding | |
| – Linear Algebra | |

Service

- Organizer for Signal and Information Processing (SIP) Seminar at Rutgers University.
- Reviewer: Asilomar Conference 2021
- Organizer for Systems Information Learning Optimization (SILO) Seminar at University of Wisconsin-Madison
- Led reading group on High Dimensional Statistics Summer 2022

Awards and Memberships

ECE 2021 Wisconsin Distinguished Graduate Fellowship-Richardson

JJ Slade Scholar

Tau Beta Pi

Recipient of the Kuhl Memorial Engineering Scholarship