JULIA B. NAKHLEH

jnakhleh@wisc.edu | julianakhleh.github.io

EDUCATION

University of Wisconsin-Madison *September 2021 - present*
Ph.D. in Computer Sciences (in progress)

- Advisor: Robert D. Nowak

University of Wisconsin-Madison *September 2022 - May 2024*
M.A. in Mathematics (Foundations for Research)

- Coursework in Fourier/harmonic and complex analysis, nonlinear optimization, randomized numerical linear algebra, differentiable manifolds

Arizona State University *August 2015 - May 2019*
B.S. in Computer Science, B.A. in Spanish (Summa Cum Laude, GPA 4.0)

RESEARCH INTERESTS

Mathematical properties of neural networks trained with weight-based regularization schemes; connections with applied computational and harmonic analysis, nonparametric regression/function estimation, and compressed sensing.

PUBLICATIONS AND PREPRINTS

[1] (in preparation) **Deep Banach Spaces and the Complexity of Deep Neural Networks**
Julia B. Nakhleh, Robert D. Nowak

[2] **Global Minimizers of ℓ^p-Regularized Objectives Yield the Sparsest ReLU Networks**
Julia B. Nakhleh, Robert D. Nowak
NeurIPS 2025 (accepted) [arXiv]

[3] **A New Neural Kernel Regime: The Inductive Bias of Multi-Task Learning**
Julia B. Nakhleh, Joseph Shenouda, Robert D. Nowak
NeurIPS 2024 [proceedings] [arXiv]

[4] **Training OOD Detectors in their Natural Habitats**
Julian J. Katz-Samuels*, **Julia B. Nakhleh***, Robert D. Nowak, Yixuan Li (*equal contribution)
ICML 2022 [proceedings] [arXiv]

[5] **Identifying Entangled Physics Relationships through Sparse Matrix Decomposition to Inform Plasma Fusion Design**
M. Giselle Fernández-Godino, Michael J. Grosskopf, **Julia B. Nakhleh**, Brandon M. Wilson, John L. Kline, Gowri Srinivasan
IEEE Transactions on Plasma Science 2021 [IEEExplore] [arXiv]

[6] **Exploring Sensitivity of ICF Outputs to Design Parameters in Experiments using Machine Learning**
Julia B. Nakhleh, M. Giselle Fernández-Godino, Michael J. Grosskopf, Brandon M. Wilson, John L. Kline, Gowri Srinivasan
IEEE Transactions on Plasma Science 2021 [IEEExplore] [arXiv]

RESEARCH EXPERIENCE

Graduate student researcher, University of Wisconsin-Madison *September 2021 - present*
Advised by Robert Nowak

- Proved that single-hidden-layer ReLU neural networks trained to interpolation with an ℓ^p norm-type regularization ($0 < p < 1$) are the *sparsest* neural network interpolants of the given dataset, providing the first sparse recovery guarantee for neural networks trained with arbitrary data [2].

- Proved that single-hidden-layer, multi-output (multi-task) ReLU neural networks trained with weight decay coincide with minimum-norm solutions in data-dependent reproducing kernel Hilbert space, revealing a novel connection between multi-task learning in neural networks and kernel methods [3].
- Assisted in the conception, design and implementation of a novel, state-of-the-art OOD detection framework (WOODS) based on an augmented Lagrangian method for constrained optimization [4].

Post-baccalaureate researcher, Los Alamos National Laboratory *November 2019 - August 2021*
Applied Computer Science (CCS-7) and Verification & Analysis (XCP-8) groups

- Applied random forest regression and sparse principal component analysis to analyze data and quantify uncertainties in inertial confinement fusion (ICF) experiments, and performed sensitivity analyses using feature importance techniques (ALE, MDI, SHAP) to analyze experimental relationships [5] [6].

Undergraduate researcher, Arizona State University *August 2018 - May 2019*
Advised by Siddharth Srivastava, Autonomous Agents and Intelligent Robots (AAIR) lab

- Showed that neural networks are capable of predicting optimal actions from "generalized" problem states in classical planning domains, generating generalized plans capable of solving multiple problem instances.

Undergraduate researcher, Los Alamos National Laboratory *May 2016 - August 2017*
Information Sciences (CCS-3) group

- Applied neural-based sparse coding algorithms to identify a dictionary of base waveforms in noisy EEG data, indicating a potential new method of EEG analysis for cognitive research and diagnosis.

SELECTED TALKS

- **Global Minimizers of ℓ^p Regularized Objectives Yield the Sparsest ReLU Networks**
  UW Madison MLOPT minisymposium (2025).
- **Sparsest ReLU Neural Networks via ℓ^p Regularization for $0 < p \leq 1$**
  IFDS Workshop on Theoretical Foundations of Applied AI, Seattle, Washington (2025) [watch here].
- **Sparsest ReLU Neural Networks via ℓ^p Regularization for $0 < p \leq 1$**
  UW Madison IFDS Ideas forum (2025).
- **Sparsest ReLU Neural Networks via ℓ^p Regularization for $0 < p \leq 1$**
  UW Madison summer SILO (Systems, Information, Learning, and Optimization) seminar (2025).
- **A New Neural Kernel Regime: the Inductive Bias of Multi-Task Learning**
  ONR MURI review (2025).
- **The Effects of Multi-Task Learning on ReLU Neural Network Functions**
  UW Madison MLOPT Ideas seminar (2024).

TEACHING AND GRADING EXPERIENCE

TA for ECE/CS 532 (Matrix Methods in Machine Learning), UW Madison	*Spring 2026*
Grader for CS/ECE/STAT 861 (Theoretical Foundations of Machine Learning), UW Madison	*Fall 2025*
TA for MATH/STAT/ECE 888 (Nonparametric Methods in Data Science), UW Madison	*Spring 2025*
Grader for MATH 718 (Randomized Numerical Linear Algebra), UW Madison	*Fall 2024*
Undergraduate TA for CSE 310 (Data Structures & Algorithms), ASU	*Fall 2018*
Undergraduate TA for CSE 100 (Intro to C++), ASU	*Spring 2018*
Math tutor (calculus I-III, linear algebra, discrete math, statistics), ASU	*Fall 2016*

ACADEMIC SERVICE

Reviewer: JMLR (2025), NeurIPS (2025), IEEE Transactions on Information Theory (2025)

AWARDS & SCHOLARSHIPS

NSF Graduate Research Fellowship Program (GRFP), Honorable Mention	*2021*
ASME Student Presentation Award Winner, 2^{nd} place	*2020*
Phi Beta Kappa Honor Society	*2019*
Fulbright Scholarship (Spain - Study/Research), Semi-Finalist	*2019*
Marshall Scholarship, Finalist	*2018*
National Merit Scholar	*2015 - 2019*
New American University Scholar, Arizona State University	*2015 - 2019*

SKILLS

Programming Languages: Python, C, C++, MATLAB, Java, SQL
Machine Learning Toolboxes: TensorFlow, PyTorch, Keras, Scikit-learn
Languages: English (native), Spanish (fluent - C1 DELE diploma), Portuguese (advanced)