SUZANNA PARKINSON

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EDUCATION

University of Chicago, **Chicago, IL**
Ph.D., Computational and Applied Mathematics, Expected June 2025
Thesis: "The Role of Depth in Neural Networks: A Representation Cost Perspective"
Advisor: Rebecca Willett, Ph.D.

Brigham Young University, Provo, UT
B.S., Mathematics, April 2020

RESEARCH EXPERIENCE

University of Chicago, Chicago, IL
Graduate Researcher, Physical Sciences Division under Professor Rebecca Willett, October 2022 – Present
- Proved a separation in the sample complexity needed to learn functions with two vs. three layer ReLU neural networks— more functions can be learned with polynomial sample complexity using deeper networks
- Proved that the size of weights needed to represent functions using neural networks with many linear layers is related to how close the function is to being a multi-index model

Graduate Researcher, Physical Sciences Division under Professor Matthew Stephens, June 2021 – December 2022
- Developed algorithms to identify branching structure in data using matrix factorizations
- Established results related to the existence and uniqueness of decompositions
- Proved correctness and temporal complexity of relevant algorithms

Brigham Young University, Provo, UT
Mathematics Research Assistant, Professor Tyler Jarvis, March 2018 – August 2020
- Analyzed algorithms for finding zeros of non-linear systems of equations
- Proved that applying the algorithms to a pathological example involves an ill-conditioned eigenvalue problem
- Demonstrated numerically that in practice such numerical issues are rare

Physics Research Assistant, Professor Gus Hart, May 2018 – August 2018
- Derived formulas for the area of intersection between a hyperbola and a parallelogram in all 27 possible cases
- Wrote, edited, and tested Python code to use aforementioned formulas in density functional theory calculations

National Security Agency, Fort G. Meade, MD
Intern, Director's Summer Program, May 2019 – August 2019
- Conducted statistical analysis on an implementation of a popular post-quantum cryptographic algorithm
- Worked in the Mathematics Research Group on a team project of mission importance
- Submitted detailed findings in an internal refereed technical paper

PAPERS & PUBLICATIONS

S. Parkinson, G. Ongie, R. Willett, O. Shamir, N. Srebro (2024). *Depth Separation in Norm-Bounded Infinite-Width Neural Networks*, Conference on Learning Theory, Edmonton, Canada.

S. Parkinson, G. Ongie, R. Willett (2024). *ReLU Neural Networks with Linear Layers are Biased Towards Single- and Multi-Index Models*, arXiv:2305.15598.

S. Parkinson, H. Ringer, K. Wall, E. Parkinson, L. Erekson, D. Christensen, T. Jarvis (2022). *Analysis of normal-form algorithms for solving systems of polynomial equations*, Journal of Computational and Applied Mathematics.

TALKS

S. Parkinson (2024). *Linear Layers in ReLU Networks Promote Learning Single-/Multiple-Index Models,* SIAM Conference on Mathematics of Data Science, Atlanta, GA

S. Parkinson (2024). *Depth Separation in Learning via Representation Costs,* Computational Harmonic Analysis in Data Science and Machine Learning, Oaxaca, Mexico

S. Parkinson (2024). *Depth Separation in Learning via Representation Costs,* Brigham Young University Applied Math Seminar, Provo, UT

S. Parkinson, S. (2023). *Finding Low-Rank Functions Using Linear Layers in Neural Networks*, University of Chicago Computational and Applied Mathematics Student Seminar, Chicago, IL

L. Erekson, **S. Parkinson**, D. Christensen, N. Larsen, T. Jarvis (2020). *A Hybrid Multivariate Root-finding Method For Smooth Functions*, Joint Mathematics Meetings, Denver, CO

S. Parkinson, N. Larsen, E. Parkinson, H. Ringer, T. Moncur, T. Jarvis (2019). *Fast, stable multivariate numerical rootfinding in a compact region.*, Joint Mathematics Meetings, Baltimore, MD

POSTERS

S. Parkinson (2024). *Depth Separation in Learning via Representation Costs,* Conference on Learning Theory, Edmonton, Canada.

S. Parkinson, S. (2023). *Linear Layers Promote Learning Single-/Multiple-Index Models*, Midwest Machine Learning Symposium, Chicago, IL

S. Parkinson, N. Larsen, E. Parkinson, H. Ringer, T. Moncur, T. Jarvis (2019). *Numerical rootfinding on a compact region.*, Joint Mathematics Meetings, Baltimore, MD

TEACHING EXPERIENCE

University of Chicago, Chicago, IL
Teaching Assistant, Committee on Computational and Applied Mathematics, September 2021 – May 2022

- Graded assignments; Answered student questions during office hours and in online discussion groups
- CAAM 37830: Scientific Computing with Python
- CAAM 37710: Machine Learning

SERVICE & LEADERSHIP

University of Chicago Computational Biology Outreach Group, Chicago, IL
Chair, Scientific Content Committee, October 2022 – January 2024

- Led a committee of 2-6 trainees to develop materials for teaching computational biology to K-12 students
- Prepared teaching materials for seven events (workshops/science fair booths); Presented at six

HONORS & AWARDS

Graduate Research Fellowship, National Science Foundation, 2020-2025
Student Travel Award: MDS2024, Society for Industrial and Applied Mathematics, 2024
Outstanding Poster Award, University of Chicago Statistics Department Student Poster Day, 2024
Outstanding Teaching Assistant Award, University of Chicago Computational and Applied Mathematics, 2022
Elaine K. Bernstein Women in Science Award, University of Chicago, 2020
Junior of the Year, Brigham Young University Mathematics Department, 2019
Outstanding Poster Award, Joint Mathematics Meetings, 2019
Presidential Scholarship (1.5x Tuition), Brigham Young University 2015-2020

SKILLS & INTERESTS

- Research Interests: Deep learning, neural networks, numerical analysis, analysis of algorithms for data science.
- Programming languages: Advanced in Python (NumPy, SciPy, SKLearn, Jupyter, etc.); intermediate in R, Bash, Git, LaTeX, SageMath, & CI/CD; some experience in Julia, C/C++
- Fluent in Spanish (reading, writing, speaking, listening)