SUZANNA PARKINSON

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EDUCATION

University of Chicago, **Chicago, IL**
Ph.D., Computational and Applied Mathematics June 2026
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 August 2020

RESEARCH INTERESTS

Deep learning, neural networks, generalization, optimization, inductive bias, depth separation, single- and multi-index models, bottleneck rank, gradient descent, machine learning, data science.

RESEARCH EXPERIENCE

University of Chicago Physical Sciences Division, Chicago, IL
Graduate Researcher under Professor Rebecca Willett October 2022 – Present
- Proved that more functions can be learned with polynomial sample complexity using three-layer ReLU networks than with two-layer ReLU networks
- Showed 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
- Analyzed how linear neural networks adapt to low-dimensional structure in data when trained via gradient descent with standard hyperparameter settings

Graduate Researcher under Professor Matthew Stephens June 2021 – December 2022
- Developed algorithms to identify branching structure in data using matrix factorizations

Brigham Young University, Provo, UT
Research Assistant under Professor Tyler Jarvis March 2018 – August 2020
- Analyzed algorithms for finding zeros of nonlinear systems of equations

Research Assistant under Professor Gus Hart May 2018 – August 2018
- Derived formulas and wrote Python code for density functional theory calculations

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

PUBLICATIONS

In Preparation

6. **S. Parkinson**, G. Ongie, R. Willett. "Removing ReLU Activations from Middle Neural Network Layers Preserves the Benefit of Depth," 2025.

In Submission

5. H. Laus, **S. Parkinson**, V. Charisopoulos, F. Krahmer, and R. Willett, "Solving Inverse Problems with Deep Linear Neural Networks: Global Convergence Guarantees for Gradient Descent with Weight Decay," May 2025, *arXiv*: arXiv:2502.15522. doi: 10.48550/arXiv.2502.15522.

Peer-Reviewed Publications

4. **S. Parkinson**, G. Ongie, and R. Willett, "ReLU Neural Networks with Linear Layers Are Biased towards Single- and Multi-index Models," *SIAM Journal on Mathematics of Data Science*, vol. 7, no. 3, pp. 1021–1052, Sep. 2025, doi: 10.1137/24M1672158.

3. J. Blanc, M. Steiner, L. Blake, E. Gibbons, M. Ianni-Ravn, R. Morgan, **S. Parkinson**, C. Porras, and E. Zhong, "Ten simple rules for success as a trainee-led outreach organization in computational biology education," *PLOS Computational Biology*, vol. 21, no. 7, pp. 1–12, Jul. 2025, doi: 10.1371/journal.pcbi.1013281.

2. **S. Parkinson**, G. Ongie, R. Willett, O. Shamir, and N. Srebro, "Depth Separation in Norm-Bounded Infinite-Width Neural Networks," in *Proceedings of Thirty Seventh Conference on Learning Theory*, S. Agrawal and A. Roth, Eds., in Proceedings of Machine Learning Research, vol. 247. PMLR, Jul. 2024, pp. 4082–4114. [Online]. Available: https://proceedings.mlr.press/v247/parkinson24a.html

1. **S. Parkinson**, H. Ringer, K. Wall, E. Parkinson, L. Erekson, D. Christensen, T. Jarvis, "Analysis of normal-form algorithms for solving systems of polynomial equations," *Journal of Computational and Applied Mathematics*, vol. 411, p. 114235, Sep. 2022, doi: 10.1016/j.cam.2022.114235.

HONORS & AWARDS

American Dissertation Fellowship, American Association of University Women	2025-2026
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 Fellowship for Women in Science, 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

PRESENTATIONS

Seminars & Invited Talks

15. **S. Parkinson** (2025). *On The Role of Depth in Deep Learning,* John Reinitz Memorial Lecture, University of Chicago Computational & Applied Mathematics, Chicago, IL

14. **S. Parkinson** (2025). *Neural Networks Can Automatically Adapt to Low-Dimensional Structure in Inverse Problems,* Brigham Young University Applied Analysis Seminar, Provo, UT

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

Conferences & Workshops

12. **S. Parkinson** (2025). *Depth Separation in Learning via Representation Costs,* IFDS Workshop on Theoretical Foundations of Applied AI, Seattle, Washington

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

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

9. **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

8. 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

7. **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

6. **S. Parkinson** (2025). *Depth Separation in Learning via Representation Costs,* IFDS Workshop on Theoretical Foundations of Applied AI, Seattle, Washington

5. **S. Parkinson** (2025). *Depth Separation in Learning via Representation Costs,* Midwest Machine Learning Symposium, Chicago, IL

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

3. **S. Parkinson** (2024). *Depth Separation in Learning via Representation Costs,* University of Chicago Statistics Department Student Poster Day, Chicago, IL

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

1. **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, Data Science Institute September 2025

- Developed and presented hands-on coding notebooks to illustrate concepts and introduce technical tools
- AI + Science Deep Dive for Postdoctoral Researchers (4-day intensive)

Scientific Content Committee Chair, Computational Biology Outreach Group 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 7 events (workshops/science fair booths); presented at 6

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
- Scientific Computing with Python (2 quarters) & Machine Learning (1 quarter)

University of Washington, Seattle, WA

Teaching Assistant, Department of Biostatistics July 2022

- Helped students implement computational solutions in Zoom breakout rooms during virtual course
- Monte Carlo Markov Chains for Genetics (1-week bootcamp)

PROFESSIONAL ACTIVITIES

Technical Paper Reviewer

Neural Information Processing Systems (NeurIPS) 2025
SIAM Journal on Mathematics of Data Science (SIMODS) 2025

Conference Special Session Organizer

"Learning Functions with Low-Dimensional Structure using Neural Networks." SIAM Conference on Mathematics of Data Science, 2024. Co-organized with R. Willett and G. Ongie.