RAIYYAN SIDDIQUI

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EDUCATION

The University of Texas at Austin (UT) May 2024
B.S. in Neuroscience with High Honors
GPA: 3.96/4.0
Related courses: Neural Computation, Programming and Data Analysis for Modern Neuroscience, Modeling and Theory in Neuroscience, Mathematical Modeling in Biology

RESEARCH EXPERIENCE

Section on Critical Brain Dynamics (Plenz Lab) Jul 2024 - Present
Postbaccalaureate Research Fellow National Institutes of Health

- Assessed decoding of optogenetic stimulations using SHapley Additive exPlanations (SHAP) to identify informative neurons.
- Performed feature-dropping and additional model interpretability analyses to reveal nonlinear scaling in network recruitment from perturbations of single cells to multi-cell ensembles.
- Initiated collaboration with NIMH Machine Learning Core to study representation of task-related variables in a learning/decision-making task using SVM-derived decision values and linear mixed-effects modeling.

Mauk Lab Aug 2022 - Jun 2024
Undergraduate Research Assistant UT Center for Computational and Theoretical Neuroscience

- Investigated information processing and learning in the cerebellum using large-scale computer simulations.
- Evaluated a cerebellar network model's ability to perform basic eyelid conditioning and generalize to more advanced Pavlovian tasks.
- Assessed the effect of mossy fiber collaterals onto deep cerebellar nuclei in shaping learning in a cerebellar network model.

Neuroscience Undergraduate Research Program (NURP) Sep 2023 - May 2024
Undergraduate Mentee UT Institute for Neuroscience (INS)

- Spring 2024: Studied clinical applications of brain criticality; developed network models of criticality; presented results at NURP Symposium
- Fall 2023: Investigated applications of chaos theory in epileptic seizure detection; implemented algorithms to estimate Lyapunov exponents from time series; presented findings at NURP Symposium

PUBLICATIONS

[1] T. L. Ribeiro, A. Vakili, B. Gifford, **Siddiqui, Raiyyan**, V. Sinfuego, S. Pajevic, and D. Plenz, "Critical scaling of novelty in the cortex," *bioRxiv*, 2024, Under review at Nature Communications. DOI: 10.1101/2024.12.23.630084.

PRESENTATIONS

Machine learning models reveal scaling of cortical networks to holographic perturbation Upcoming Nov 2025
Poster Presentation Society for Neuroscience

Recurrent neural networks with diverse intrinsic timescales Upcoming Sep 2025
Poster Presentation National Institute of Mental Health Training Day

Multi-region prediction of motor cortex spike trains in mice Jul 2025
Oral Presentation Neuromatch Academy: Deep Learning

Interpretable machine learning models reveal scaling of cortical network responses to optogenetic perturbations May 2025
Poster Presentation NIH Postbac Poster Day

Feature selection methods for analyzing optogenetic perturbations in cortex Feb 2025
Oral Presentation NIMH Fellows Afternoon Neuroscience Seminar

Machine learning approaches for analysis of optogenetic stimulation recordings Oct 2024
Poster Presentation Society for Neuroscience

The Critical Brain Hypothesis: Background and Clinical Relevance Apr 2024
Oral Presentation NURP Symposium

Epilepsy as a Dynamical Disease: Analysis and Applications Nov 2023
Oral Presentation NURP Symposium

INDEPENDENT PROJECTS

Recurrent neural networks with diverse intrinsic timescales Aug 2025 - Present

- Implemented RNN architectures in Pytorch with units exhibiting diverse intrinsic timescales.
- Evaluated training efficiency and performance on sequence-based working memory tasks.
- Analyzed how timescale heterogeneity affected training and dynamics of the trained network.

Multi-region prediction of motor cortex spike trains in mice Jul 2025

- Developed an RNN to predict motor cortex spike trains in mice using the Steinmetz et al. (2019) dataset, which contains high-density Neuropixel recordings from multiple brain regions simultaneously during a visual decision-making task.
- Applied ablation analyses and computed exact Shapley values to assess the contribution of individual brain regions to model predictions.
- Led a team at Neuromatch Academy: selected the project idea, chose appropriate model architectures, and guided the code implementation and overall analysis workflow.

Investigating eigenspectrum patterns in pathological networks Apr 2024 - May 2024

- Independently selected and designed this project as the final course project for Mathematical Modeling in Biology, choosing the research question and methodology.
- Investigated how deviations from the zero-row-sum constraint in random matrices with elements sampled from two normal distributions affect alternations from stable to unstable long-term dynamics in linear rate network models.

TEACHING EXPERIENCE

Neural Systems I Jan 2024 - May 2024
Teaching Assistant College of Natural Sciences, UT

- Provided additional mentoring and regular check-ins for a designated student cohort
- Planned and led supplemental review sessions outside of scheduled class time
- Held office hours and assisted with grading, offering detailed feedback on assignments and exams

Neural Systems II Aug 2023 - Dec 2023
Teaching Assistant College of Natural Sciences, UT

- Developed practice problems and review materials to reinforce lecture and discussion content
- Led review sessions and held office hours to support student learning
- Assisted with grading and provided constructive feedback on assignments and exams

Perry-Castañeda Library STEM Study Center Jan 2022 - May 2024
Lead Peer Tutor College of Natural Sciences, UT

- Led one-on-one and group tutoring sessions for undergraduate students in STEM courses
- Coordinated tutoring schedules and trained new tutors, improving overall tutoring program efficiency

College Readiness Program May 2022 - Aug 2022, May 2023 - Aug 2023
College Readiness Mentor College of Natural Sciences, UT

- Oversaw a team of mentors and managed weekly newsletters for a cohort of 1000+ incoming students
- Handled email communications, provided guidance, and coordinated activities to support student success

ACHIEVEMENTS

Certificate of Completion, Deep Learning Interactive Track, Neuromatch Academy *Jul 2025*
Intramural Research Training Award, National Institutes of Health *Jul 2024*
College Scholars Program, UT Austin — Junior and Senior Years *2022–2024*
University Honors, UT Austin — every semester *2020–2024*

SKILLS

Programming Languages Python, Bash, R, MATLAB, C++
Machine Learning Tools Pytorch, Sklearn, Pandas, Numpy