# ABDUL-MALIK ZEKRI

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## EDUCATION

**University of South Florida**                                                                                 Tampa, Fl
Bachelor of Science in Computer Engineering                                                   Expected May 2026
Bachelor of Arts in Mathematics, with Applied/Computational Mathematics Concentration
Minor in Biology
Judy Genshaft Honors College
*GPA: 4.00*
**Select Awards:** Barry Goldwater Scholar, Dean's List 2022 – Present

## RESEARCH EXPERIENCE

**Cold Spring Harbor Laboratory Undergraduate Research Program**                       Laurel Hollow NY
*Principal Investigator:* Dr. Tony Zador                                                            June 2025 – August 2025
*Description:*                                                          *Skills:*

- Contributed to project developing a generalized model of neuromodulation based on weight manifolds in artificial neural networks for efficient generalization to related tasks.
- Applied weight manifold approach to reinforcement learning (RL) control tasks.
- Engineered custom wrappers and environment interfaces to integrate lab weight manifold code with Brax/Flax backend using Proximal Policy Optimization (PPO) for training.
- Created intuitive visualizations of novel manifold optimization approach to communicate complex mathematical concepts using Manim.

- **Programming:** Python, Bash | **Tools:** JAX, Flax, Brax, MuJoCo, MJX, Manims
- **Reinforcement Learning (RL):** Proximal Policy Optimization (PPO) training using Brax; multi-agent environment vectorization for continuous control tasks
- **Scientific Computing:** Functional programming with JAX (jit, vmap, scan); transformation-safe architecture for weight-manifold policies
- **High-Performance Computing (HPC):** SLURM-based job scheduling, parallelized simulation, and resource-efficient training on compute cluster

**Auditory Development and Connectomics Laboratory (ADCL)**                                     Tampa, FL
*Principal Investigator:* Dr. George Spirou | *Role:* Undergraduate Researcher          September 2021 – Present
*Description:*                                                          *Skills:*

- Applied deep learning, machine learning, and image processing techniques for organelle and cell segmentation in electron microscopy (EM) image volumes for 3D reconstruction.
- Developed a semi-automated proofreading workflow to improve accuracy and efficiency of mitochondria segmentation.
- Created user-friendly data systems and tools to load, visualize, and facilitate interaction with large image volumes and streamline access and analysis of lab datasets. Engineered code to translate segmentation data for use across research tools.
- Implemented high-performance computing (HPC) workflows using SLURM to run large-scale segmentation and deep learning models.

- **Programming:** Python, Bash | **Data Tools:** Scikit-Learn, Pandas, Dask, SciPy, Scikit-Image, PyQt5, Matplotlib
- **High-Performance Computing (HPC):** SLURM job scheduling on cluster, multiprocessing, efficient resource allocation
- **Machine Learning:** Deep learning for semantic segmentation (CDeep3M), training/testing ML classifiers, parallelized preprocessing for large datasets
- **Image Processing:** Morphological manipulations for augmented EM data, visualization of segmented structures
- **Version Control:** Git (repository creation, version tracking, GitLab repo maintenance)
- **Tool Development:** Lab-specific app/tool creation for streamlined data access and segmentation workflows

**Trustworthy Knowledge-Driven Artificial Intelligence (TKAI) Lab**                               Tampa, FL
*Principal Investigator:* Dr. Ankur Mali                                                            August 2024 – Present
*Description:*                                                          *Skills:*

- Conducted an independent study on evolutionary optimization of mechanistic input-output models of neural circuits in the auditory pathway
- Utilized CNModel to generate synthetic input-output spike train data from the cochlear nucleus.
- Utilized evolutionary meta-heuristic algorithms to optimize a biologically inspired mechanistic input-output spiking neural network (SNN) models of neural circuits.
- Contributed to paper establishing the theoretical foundation linking predictive coding to MDL, with formal generalization and convergence guarantees.

- **Programming:** Python
- **Synthetic Data Generation:** Cochlear nucleus spike train data generation using CNModel package
- **Neural Circuit Modeling:** Recurrent SNN simulation and implementation of STDP local learning rules using Brian2
- **Evolutionary Algorithms:** Multiprocessing to distribute SNN simulation and evolutionary optimization across compute cluster

**GPU-Accelerated Parallel Algorithms for HNSW Search**                    Tampa, FL
*Principal Investigator:* Dr. Yicheng Tu | *Role*: Undergraduate Researcher                    November 2024 – Present

*Description:*

*Skills:*

- Designed and implemented GPU-accelerated parallelized search for Hierarchical Navigable Small World (HNSW) graphs to optimize search efficiency for large-scale nearest neighbor search problems such as rapid alignment of DNA sequence reads to reference databases.

- Analyzed computational performance, achieving significant speedup compared to CPU-only implementations.

- **Programming:** C, C++, CUDA
- **High-Performance Computing (HPC):** Profiling and optimizing GPU-accelerated applications.
- **Parallel Graph Algorithm Design:** Developed and optimized traversal algorithms for efficient, parallel nearest neighbor searches in large-scale HNSW graphs.

**Center for Assistive, Rehabilitation and Robotics Technologies**                    Tampa, FL
*Principal Investigator:* Dr. Stephanie Carey | *Role:* Collaborator                    March 2022
*Description:* Devised novel network-based representation of user performance in a driving simulator. Designed and implemented Center-Based Frequency Clustering algorithm in Python for dynamic generation of scenario-specific testing environments, adjusted based on network outcomes.

**Independent Research (Epistemic Applications of Mathematical Concepts)**                    Tampa FL
*Supervising Faculty:* Dr. Simon Dutton                    September 2021 – February 2022
*Description:*

- Studied topics in logic and mathematics including formal systems, model theory, and first-order (predicate) logic.
- Studied Kurt Gödel's first and second incompleteness theorems as well as Alan Turing's halting problem.
- Studied the nature of natural laws, proposed a formal system of natural law, and applied the mathematical concepts above to the system, analyzing and reporting the resulting epistemological implications.

## ADDITIONAL SKILLS

**Programming Languages:** Python, C, C++, CUDA, Bash, LaTeX, RISC-V
**Frameworks and Libraries:** PyTorch, JAX, Flax, Brax, MuJoCo, MJX, Brian2, Scikit-Learn, Dask, Pandas, SciPy, Scikit-Image, OpenCV, PyQt5, Flask, Matplotlib, Seaborn, Plotly, NetworkX, PostgreSQL, Manim
**Software:** Unity (ray-based object detection, VR game mechanics, physics-based character animation), Blender
**Embedded Systems:** MSP430 (assembly and C programming for microcontrollers, peripheral interfacing)

## LEADERSHIP

Founder and President of STEM Collaboration and Research Initiative                    November 2024 – Present
President of Bioinformatics Club                    November 2024 – Present
PAMSA Tutoring Officer                    August 2024 – Present
Research Officer of Bioinformatics Club                    May 2024 – November 2024
Treasurer of USF Pickleball Club                    August 2024 – January 2025
Vice President of USF Pickleball Club                    August 2023 – August 2024
Mayor's Youth Leadership Council                    January 2021 – August 2021

## ADDITIONAL EXPERIENCE

**Judy Genshaft Honors College Peer Mentor**   Tampa, FL
*Contact:* Dr. Kevin Lee                    May 2025 – December 2025

- Mentored first-year honors students by sharing experiences, resources, and strategies for academic and personal success.
- Designed lesson plans in accordance with course learning objectives for a semester long course for first-year honors students
- Instructed and facilitated weekly sessions of the Honors Foundations course.

**Cancer Biology Learning Assistant**                    Tampa, FL
*Contact:* Dr. Sandy Westerheide                    January 2025 – May 2025

- Graded homework, exams, etc. Conducted review sessions and was a first point of contact for students
- Facilitated discussions on course content and supported students in developing and delivering a presentation.

**Infinite Edge Learning Center**                    Tampa, FL
*Role:* Math Tutor                    August 2021 – September 2022

- Designed learning plans for high school students studying for the SAT
- Organized student files and kept track of individual student progression and needs

## PUBLICATIONS

A.-M. Zekri, E. Amick, G. Spirou, T. J. Fawcett, "Semi-Automated Human-in-the-Loop Proofreading Workflow for the Instance Segmentation of Mitochondria in SBEM Image Volumes," In progress.

A. Benjamin, K. Daruwalla, C. Pehle, A.-M. Zekri, and A. M. Zador, "Walking the Weight Manifold: a Topological Approach to Conditioning Inspired by Neuromodulation," *arXiv preprint arXiv:2505.14635*, 2025

B. Prada, S. Matsumoto, A.-M. Zekri, and A. Mali, "Bridging Predictive Coding and MDL: A Two-Part Code Framework for Deep Learning," *arXiv preprint arXiv:2505.22994*, 2025

## ORAL PRESENTATIONS

A.-M. Zekri, A. Benjamin, A. M. Zador, "Neuromodulation-Inspired Conditioning for Reinforcement Learning Tasks," *Gulf Coast Undergraduate Research Symposium*, Houston, TX, October 2025.

A.-M. Zekri, A. Benjamin, A. M. Zador, "Neuromodulation-Inspired Conditioning for Reinforcement Learning Tasks," *CSHL Undergraduate Research Symposium*, Cold Spring Harbor, NY, August 2025.

## POSTER PRESENTATIONS

A.-M. Zekri, A. Mali, "Evolutionary Optimization of Biologically Inspired Mechanistic Input-Output Neural Circuit Models in the Auditory Pathway," *OneUSF Undergraduate Research Conference,* University of South Florida, Tampa, FL, April 2025.

A.-M. Zekri, A. Mali, "Evolutionary Optimization of Biologically Inspired Mechanistic Input-Output Neural Circuit Models in the Auditory Pathway," *National Conference on Undergraduate Research*, Pittsburgh, PA, April 2025.

A.-M. Zekri, A. Mali, "Evolutionary Optimization of Biologically Inspired Mechanistic Input-Output Neural Circuit Models in the Auditory Pathway," *Florida Undergraduate Research Conference*, University of South Florida, Tampa, FL, February 2025.

A.-M. Zekri, A. Mali, "Evolutionary Optimization of Biologically Inspired Mechanistic Input-Output Neural Circuit Models in the Auditory Pathway," *National Collegiate Research Conference*, Harvard University, Cambridge, MA, January 2025, Abstract Accepted.

A.-M. Zekri, E. Amick, G. Spirou, T. J. Fawcett, "Automated Proofreading Workflow for the Instance Segmentation of Mitochondria in Serial Section Electron Microscopy Image Volumes via Machine Learning," *10th Annual BRAIN Initiative Conference*, Rockville, MD, June 2024.

T. J. Fawcett, A.-M. Zekri, E. Amick, G. Spirou, "Proofreading Workflow for the Semantic Segmentation of Mitochondria in Serial Section Electron Microscopy Image Volumes," *2023 ARO MidWinter Meeting*, Orlando, FL, February 2023.

A.-H. Zekri, A.-M. Zekri, R. Turner, S. Carey, "A Model for Procedurally Generated Environments in a Dynamic Driving Simulator to Train Persons with Autism Spectrum Disorder," *USF Tampa Undergraduate Research Conference*, University of South Florida, Tampa, FL, April 2022.

A.-M. Zekri, "On the Epistemological Application of the Mathematical Concepts of Completeness, Consistency, and Decidability to Systems of Natural Law," *Florida Undergraduate Research Conference*, University of Central Florida, Orlando, FL, February 2022.

## HONORS & AWARDS

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| Yakov Gluzman Fellowship | August 2025 |
| Katya H. Davey Fellowship | August 2025 |
| Undergraduate Research – General Disciplinary Student Award | April 2025 |
| Barry Goldwater Scholar | March 2025 |
| Break Through Tech AI Fellow | March 2025 – Present |
| Sigma Xi Member | April 2024 – Present |
| Pi Mu Epsilon Members | April 2024 – Present |
| Tau Beta Pi Member | November 2022 – Present |
| Florida Bright Futures Academic Scholarship | August 2021 – Present |
| Kantner Foundation Scholarship | July 2021 |
| Jesse Maali Scholarship | Aug 2021 |
| Judy Genshaft Honors College | August 2021 – Present |
| USF Presidential Award | August 2021 – Present |
| USF College of Engineering Dean's List | January 2022 – Present |