Adrian Rodriguez

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Education

The University of Texas at Dallas — Richardson, TX
Bachelor of Science in Computer Science — Expected May 2025
Specialization: Artificial Intelligence and Machine Learning
GPA 3.43/4.0
Courses: Machine Learning, Artificial Intelligence, Intelligent Systems Analysis, Computer Vision (Tentative)

Northeast Texas Community College — Mount Pleasant, TX
Associate of Science in Physics — December 2018
GPA 3.89/4.0
Honors: Magna Cum Laude

Research Experience

Integration of Topological Data Analysis in Vision Transformers 2024
Research Assistant and Second Author under Dr. Baris Coskunuzer

- Collaborated with a research group to enhance breast cancer detection using topological data analysis in convolutional neural networks and vision transformers.
- Developed a novel approach to integrate Betti vectors into a pre-trained SwinV2 vision transformer to improve generalization.
- Designed and implemented two custom transformer encoders for Betti vectors, introducing cross-attention mechanisms between the SwinV2 feature maps and Betti vector encodings.
- Achieved up to **10% improvement** in classification performance on a breast cancer dataset compared to baseline SwinV2 and **20% improvement** compared to baseline convolutional neural networks and topological convolutional neural networks.
- Solely responsible for coding the entire vision transformer pipeline in PyTorch, including data preprocessing, training, testing, k-fold cross validation, and models.

Development of a Sensitivity-Based Pruning Algorithm for Neural Networks 2024
Research Assistant and First Author under Dr. Richard Golden

- Partnered with Dr. Golden to create a novel pruning algorithm utilizing second-order statistics like the Hessian matrix, outer-product gradients, and covariance matrix, which utilized the Wald test for neuron significance.
- Implemented the algorithm from scratch using PyTorch, focusing on memory efficiency by computing second-order derivatives.
- Devised a pruning strategy that prunes neurons per layer, reducing computational overhead without compromising model integrity.
- Tested the algorithm on dense multi-layer perceptrons using MNIST/CIFAR datasets.
- Optimized memory usage by handling large matrices during the pruning process.

Enhancing Few-Shot Learning with Topological Data Analysis in Vision Transformers 2024
Research Assistant under Dr. Yunhui Guo and Dr. Baris Coskunzer

- Extended previous research to apply Betti vectors in cross-domain few-shot learning tasks.
- Developed a SwinV2-based vision transformer model incorporating Betti vector encoders with cross-attention.
- Engaged in iterative model design and discussions with Dr. Guo to refine the integration of TDA into the transformer architecture.

Human Identification in Videos Using Modified Vision Transformers 2024
Research Assistant under Dr. Alice O'Toole

- Contributed to improving generalization in human (face and body) identification from video sequences.
- Investigated modifications to the SwinV2 Vision Transformer to enhance performance over existing ViT models.
- Implemented model adjustments and collaborated with the research team to integrate and evaluate the modified transformer within the existing system.
- Aimed to achieve superior accuracy in human identification tasks.

Audio Visual Robustness Benchmarking 2024
Research Assistant under Dr. Yunhui Guo

- Collaborated in creating a new benchmark for audio-visual transformer models using existing datasets, such as AudioSet, Kinetics, and VGGSound.
- Tested audio-visual transformer models to get a base benchmark.
- I am currently working on creating a new architecture to excel at this benchmark.

Publications

Nuwagira, **Rodriguez**, Li, Coskunuzer. Topology Meets Deep Learning for Breast Cancer Detection (In Review). Submitted to *Conference on Computer Vision and Patter Recognition*, 2025.

Rodriguez and Golden. Statistical Pruning of Parameter Redundant Neural Networks (In Preparation). To be submitted to *The International Conference on Machine Learning*, 2025.

Research Interests

Pruning **Double Descent** **Superposition** **Few-Shot Learning**
Optimization **Transformers** **Computer Vision** **Statistical ML**
Topological ML **Multimodal**

Technical Skills

Programming Languages:	Python	C/C++	R	MATLAB
Deep Learning Frameworks:	PyTorch	Tensorflow	HuggingFace	Jax
Software Applications:	CUDA	Numpy	Colab	Simulink
Database Technologies:	Postgre SQL	MySQL	MariaDB	
Operating Systems:	Linux/Unix	MacOS	Windows 10/11	

Certifications

Machine Learning by Stanford University & DeepLearning.AI on Coursera, 2024

Deep Learning by Stanford University & DeepLearning.AI on Coursera, 2024

Teaching Experience

Private STEM Tutor 2018 - 2020
Tutored Family and Friends

- Helped students with any STEM topic through K-12 and college.
- Students saw an increase in up to two letter grades through my assistance.
- Guided students through the college application process.

Skills

2 years of experience in **academic projects/research** and **scientific research**.
2 years of experience in **deep learning research**.
2 years of experience in **team environments and team science**.
10 years of experience in **problem solving (academic)**.

Community Involvement

Society for Advancement of Chicanos/Hispanics and Native Americans in Science, **Mentor** 2021

- Mentoring Hispanic and Native American students in STEM fields, providing guidance on academic and research careers.
- Mentoring students in STEM-related coursework.

Languages

Written and oral fluency in Spanish

References

Dr. Richard Golden
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Dr. Baris Coskunuzer
Professor of Mathematics at UT Dallas
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Dr. Yunhui Guo
Professor of Computer Science at UT Dallas
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Dr. Alice O'Toole
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