

# Fin Amin

Github: [www.github.com/FinAminToastCrunch](https://www.github.com/FinAminToastCrunch)

Google Scholar

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US Citizen (Security Clearance in Progress)

## RESEARCH INSTITUTIONS

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- **Massachusetts Institute of Technology Lincoln Laboratory** Lincoln, MA  
*Graduate Research Scientist (CO-OP) in Human Health and Performance Systems* Feb 2024 - Ongoing
  - Developing SOTA AI algorithms for brain mapping based on MRI data.
  - Working on the next generation of AI Guide, an AI-guided emergency surgical tool.
  - Investigating elastic and sheer mapping for soft tissue analysis.
  - Giving clinics to neuroscientists at Massachusetts General Hospital on using AI for axon centerline detection.
  - Investigating how to reduce energy consumption in mobile AI systems.
- **North Carolina State University** Raleigh, NC  
*PhD Student in Electrical Engineering advised by Prof. Paul D. Franzon* Aug 2021 - Ongoing
  - Dissertation Topic: Autoregressive Reinforcement Learning Agents for 3D Floorplanning in Elec. Design Automation
  - Research Interests: Neural Network Model Calibration, Unsupervised Domain Adaptation, Graph Neural Networks, Tomography, Medical Imaging, LLM Adaptation.<sup>1</sup>
  - GPA: 3.85/4.00
  - Junior advisor to four Ph.D students.
  - Funded the research of three other Ph.D students.
- **The University of Texas at Austin** Austin, TX  
*Bachelor of Science in Electrical Engineering* Aug 2016-May 2021
  - Primary Interest: Data Science, Digital Image/Video Processing, Digital Signal Processing
  - Received Computational Science and Engineering Certificate
  - Terry Foundation Scholar (full tuition and housing)

## EARNED RESEARCH FUNDING: \$313,900

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- **CISCO Research** 08/16/2024  
*\$75,000 Rapid 3DIC Thermal Modeling*
  - Proposed a novel machine learning approach for thermal modeling in 3DICs, focusing on addressing the challenges of heat dissipation across multiple stacked layers.
  - Introduced the concept of using a diffusion model to transform power maps into high-resolution heat maps, aiming to improve accuracy and efficiency over traditional methods.
  - Second author, written with Prof. Franzon and a labmate.
- **LAD Student Travel Grant** 06/28/2024  
*\$900 to present research at LLM-Aided Design*
  - Presented research on a novel LLM adaptation technique to over 200 researchers, industry members and tech startups.
  - Released a benchmark for LLM adaptation on microelectronic reasoning.
- **CAEML Research Award** 04/28/2024  
*\$70,000 for the development of Natural Language Optimization Models for PCBs and Analog ICs*
  - Motivated the development of LLMs for a query-based optimizer focused on packaging and on-chip interconnect problems.
  - Proposed support for multimodal inputs and outputs, including eye diagrams, waveform figures, and actual layouts.
  - Demonstrated proof of concept via retrieval augmented generation demo.
  - Co-first author with Prof. Franzon.
- **Qualcomm Innovation Fellow** 05/03/2023  
*\$100,000 for the development of Reinforcement Learning Agents for 3D Floorplanning in EDA*
  - Proposed and developed proof of concepts of novel RL algorithms for floorplanning.
  - Motivated research by identifying critical drawbacks in the SOTA.
  - Presented and defended research over 3 rounds of interviews.
  - Co-first author with a lab mate. Supervised by Prof. Franzon and Prof. Xiaorui Liu.
- **CAEML Research Award** 04/11/2023  
*\$68,000 for the development of Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection*
  - Proposed and developed a novel SGNN architecture to address the circuit graph isomorphism detection problem.
  - Demonstrated proof of feasibility and scalability for large graphs.
  - First author, supervised by Prof. Franzon.

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<sup>1</sup>In spring 2024, I was initially nominated for the NCSU Graduate Researcher of the Year Award. Due to moving to MIT-LL, I was considered ineligible. As for the research funding: I have worked on other successful grants but did not list them unless I had significant technical contribution.

## PUBLICATIONS

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- **Real-Time Vessel Segmentation for Ultra-Sound Guided Surgery** Feb 2024 - Ongoing  
*Published as second author in High Performance Extreme Computing (HPEC '24). Supervised by MIT-LL*
  - Investigated various pruning/quantization techniques for real-time image segmentation of human vessels.
  - Contributed to writing a custom application for evaluating performance on a mobile AI system.
  - Motivated the processing of tomographic segmentation algorithms from a discrete computer to a mobile AI system in the next generation of AI Guide.
- **Large Reasoning Models for 3D Floorplanning in EDA** Aug 2023 - Ongoing  
*Under review, submitted as **first author**. Supervised by Qualcomm Fellowship and Prof. Franzon*
  - Developed Dreamweaver, an auto-regressive decision-making model to optimize 3D IC floorplanning, significantly improving computational efficiency and scalability.
  - Implemented an architecture that integrates sequence-to-sequence reinforcement learning algorithms, enhancing the model's ability to reason over large discrete action spaces.
  - Achieved notable improvements in sample efficiency and floorplan quality by training the model using non-expert trajectories and implementing a novel reinforcement framework.
  - Evaluated the model against the SOTA, demonstrating superior performance in reducing wirelength and understanding complex multi-objective optimization tasks.
- **The Over-Certainty Phenomenon** Sept 2022 – Ongoing  
*Under review, submitted as **first author**, supervised by Prof. Jung-Eun Kim*
  - Introduced a novel memory-efficient unsupervised domain adaptation algorithm (UDA) which improves calibration.
  - Identified key issues in state-of-the-art UDA algorithms which harm model calibration.
  - Retained comparable accuracy to SOTA.
- **Can Low-Rank Knowledge Distillation be Useful for Microelectronic Reasoning?** March 2024 - May 2024  
*Published as **co-first author**, LLM-Aided Design (LAD '24)*
  - Presented empirical results on the feasibility of using offline LLMs in EDA.
  - Evaluated Llama-2-7B's performance as a microelectronics Q&A expert, focusing on its reasoning and problem-solving abilities.
  - Introduced a novel LLM adaptation technique, low-rank knowledge distillation (LoRA-KD).
  - Released an evaluation benchmark to support future research.
- **Optimal Brain Dissection** May 2022 – Aug 2023  
*Published as **first author** in BioInspired Processing (BIP '23), supervised by Sozzani Lab and USDA*
  - **Won Best Paper award.**
  - Introduced a SOTA technique for feature-importance determination.
  - Developed the dense autoencoder, a new autoencoder architecture for reducing reconstruction error in -omics data.
  - Outperformed the *de facto* gene regulatory network with respect to explaining gene expressions.<sup>2</sup>
- **DepthGraphNet** Oct 2022 – July 2023  
*Published as **first author** in Machine Learning for Computer Aided Design (MLCAD '23)*
  - Investigated the use of siamese-graph neural networks for circuit graph isomorphism (CGI) detection.
  - Showed logarithmic run-time complexity with respect to graph size.
  - Outperformed all other classical and neural methods in CGI detection accuracy.
  - Introduced theorems for the optimal architecture of GNNs for CGI detection.
- **Network Inference Approach for Phosphoproteomics** May 2022 – Nov 2022  
*Published as **co-first author** in Methods in Molecular Biology (MIMB vol. 2690), supervised by Sozzani Lab*
  - Described methods to statistically analyze label-free phosphoproteomic data and infer post-transcriptional regulatory networks over time.
  - Used the Bayesian Dirichlet Equivalent Uniform to inference underlying latent relationships between variables.

## RESEARCH TALKS AND CLINICS

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- MLCAD talk on *Large Reasoning Models for 3D Hard Macro Placement*. 09/11/2024
- Qualcomm Innovation Fellowship invited talk on *Large Reasoning Models for 3D Floorplanning*. 07/30/2024
- LLM-Aided Design talk on *Low-Rank Knowledge Distillation for LLMs*. 06/29/2024
- MIT-LL clinic on *Axon centerline detection using 3D-UNets*. 05/18/2024
- BioInspired Processing talk on *Optimal Brain Dissection*. 11/29/2023
- MLCAD talk on *Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection*. 09/12/2023

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<sup>2</sup>During my time at NC State, I wanted to enrich my knowledge beyond what I was learning in class and within Prof. Franzon's lab. To do this, I joined two additional labs: the low-resource computing lab under Prof. Jung-Eun Kim in the CS department and Sozzani lab under Prof. Ross Sozzani in the Microbial Biology department. I **concurrently** produced research for all three labs while balancing my responsibilities as a student, junior advisor, teaching assistant, and research/grant proposal writer. **I have manuscripts being prepared; contact me for details.**

## TEACHING EXPERIENCE

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- **ECE 220 Analytical Foundations of ECE** Raleigh, NC  
*Teaching Assistant for North Carolina State University* *Aug 2022 - May 2023*
  - Taught a sophomore-level course on circuit theory, control, differential equations and communication systems.
  - Supervised weekly labs which introduced students to MATLAB.
  - Graded homework and exams.
  - Gave career advice to aspiring engineers.
- **ECE 301 Linear Systems and Signals** Raleigh, NC  
*Teaching Assistant for North Carolina State University* *Aug 2021 - May 2022*
  - Taught a junior level course on linear systems and signals.
  - Wrote exams and lead recitation twice a week.
  - Taught students introductory machine learning in MATLAB.
  - Graded homework and exams.
  - **Received outstanding feedback from my students.**
- **Signal Processing and Data Science Tutor** Austin, TX  
*Varsity Tutors* *Feb 2021 - July 2021*
  - Tutored undergraduates in data science, linear systems and signals
  - Taught introductory classes in Java and Python
  - 4.9/5.0 stars (top 10% of all tutors on platform)

## TECHNICAL SKILLS

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- Extremely experienced with PyTorch and TensorFlow machine learning frameworks.
- Expert in Python. Skilled with Java, MATLAB, C, and L<sup>A</sup>T<sub>E</sub>X.
- Highly familiar with libraries such as OpenCV, PIL, sci-kit-image, and Gym.
- Skilled at digital {tomography, image, video, voxel} processing. Also skilled with pattern recognition, detection and estimation theory. Strong background in reinforcement learning and Bayesian optimization.

## PROFESSIONAL SERVICE

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- Director of NC State Community Affairs for ECE Graduate Students Association (2021-2022).
- Organized NC State ECE Research Symposium January 28, 2022.
- Organized NC State TEDx Talk with Analog Devices, March 7, 2022.
- Member of UT Austin IEEE Robotics and Automation Society
- Director of Student Affairs for UT Austin Planet Longhorn (International Students Org)

## UNDERGRADUATE PROJECTS

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- **Deep Framerate Upscaling**  
*Undergraduate Computational Science and Engineering Research Certificate Project, under Prof. Al Bovik*
  - Created a deep learning architecture to interpolate frames in videos to increase framerate.
  - Modified a Pix2Pix Conditional Generative Adversarial Network to predict a frame which would be present between two given frames.
  - Researched methods to reduce the smearing/ghosting artifacts traditionally associated with framerate upscaling.
  - Utilized extensive signal processing theory on the spatial and temporal attributes of videos to (unsuccessfully) create a better loss function.
- **Parallel Neural Networks in OpenMP and MPI**  
*Parallel Compute Final Project*
  - Worked in a team of two to create a deep neural network to train on the MNIST handwritten digits dataset from scratch in C++ for serial execution for baseline performance metric.
  - Re-implemented the same network in Open Multi-Processing and Message Passing Interface to show speed up with various network sizes.
  - Won Best Project Award.
- **EmotionNet: Autonomous Body Language Assessment**  
*Project manager for Honors Senior Design supervised by Prof. Al Bovik*
  - Created computer vision/image processing algorithms for dataset feature extraction such as blurry image detector, predominant face identifier, Haar Cascade Classifier, and MTCNN hyperparameter optimizer.
  - Created a deep network based on VGG16 for facial emotion classification and encoding.
  - Utilized ResNet18 to classify and encode body-posture and pose.
  - Created a recurrent neural network decoder using LSTM to establish spatio-temporal relationships between facial emotions, pose, and posture with human body language.

## EMPLOYMENT

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- **Smith and Nephew** Austin, TX  
*CO-OP: Real-Time FootSwitch Demultiplexer* *May 2019 - Dec 2019*
  - Created a surgical device to demultiplex signals from a universal footswitch to numerous soft tissue ablation and coagulation systems.
  - All signals (analog, digital, RS-485) sent and received are galvanically isolated to meet medical safety requirements.