

Allen Tu

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EDUCATION

University of Maryland, College Park

Ph.D. in Computer Science

College Park, MD

January 2025 – May 2027 (Expected)

- Advised by Prof. Tom Goldstein

University of Maryland, College Park

M.S. in Computer Science

College Park, MD

August 2023 – December 2024

University of Maryland, College Park

B.S. in Computer Science, Minor in Statistics

College Park, MD

August 2019 – December 2022

- National Merit Scholarship Winner
- President's Scholarship Recipient

RESEARCH EXPERIENCE

Graduate Research Assistant

University of Maryland Institute of Advanced Computer Studies

College Park, MD

January 2024 – Present

- Researching novel view synthesis for IARPA Walkthrough Rendering of Images from Varying Altitude (WRIVA) under Prof. Tom Goldstein, Prof. Matthias Zwicker, Prof. Abhinav Shrivastava, and Prof. Rama Chellappa
- Published methods for compressing 3D Gaussian Splatting (3D-GS) scenes by $10\times$ while retaining visual fidelity [2] and accelerating inference speed by over $6\times$ through pruning the model and optimizing rendering [1]
- Developing parametric uncertainty quantification and appearance-based error estimation techniques and datasets for 3D-GS and Neural Radiance Field (NeRF) models
- Investigating diffusion model and Generative Adversarial Network (GAN) priors for 3D-GS to improve 3D scene reconstruction quality in few-shot, noisy, and underconstrained scenarios
- Implemented Structure-from-Motion (SfM), appearance, and transform-based camera clustering algorithms to improve point cloud initialization for training 3D-GS models of large environments

Graduate Researcher

University of Maryland Department of Computer Science

College Park, MD

September 2023 – Present

- Enabled stable real-time rendering of large 3D-GS scenes with millions of primitives on edge devices like the Meta Quest 3 VR headset by pruning 90% of primitives via a novel compression technique [2]
- Probed the information efficiency of Large Language Models (LLMs) by using memorization as a proxy
- Trained detection and segmentation heads for a Mixture of Experts (MoE) large vision backbone

Computer Vision Research Intern

Systems & Technology Research

Arlington, VA

May 2024 – August 2024

- Researched face recognition for IARPA Biometric Recognition and Identification at Altitude and Range (BRIAR) under Dr. Jennifer Xu, Dr. Nathan Shnidman, Prof. Vishal Patel, and Prof. Rama Chellappa
- Created a face chip quality estimator that achieved 0.8534 correlation with probe-to-gallery feature cosine similarities in early experiments by distilling a SWIN vision transformer
- Prototyped a network that clusters and aggregates video frame features to improve the performance of the state-of-the-art face recognition system by an empirical upper bound of 11.54%
- Implemented detection quality filtering and loss functions for face encoder training and evaluation

Computer Vision Research Co-op

Systems & Technology Research

Arlington, VA

January 2023 – August 2023

- Researched face recognition and multimodal fusion for IARPA BRIAR under Noam Eshed, Dr. Nathan Shnidman, Prof. Vishal Patel, and Prof. Rama Chellappa
- Created a mixed voting model ensembling approach that boosted open search performance by 24.24% for face recognition, 39.18% for body recognition, and 49.10% for multimodal fusion
- Developed a self-supervised Barlow Twins network for training face recognition models to be invariant to operating conditions and raised rank-1 accuracy by over 52.10%
- Improved system performance by training face encoders with hard examples, implementing pose-aware feature template compilation algorithms, and filtering detections with no-reference image quality estimation

Peer Research Mentor (Capital One Machine Learning)

First Year Innovation and Research Experience

College Park, MD

January 2021 – December 2022

- Researched realistic talking head synthesis with Dr. Raymond Tu (no relation)
- Implemented a GAN that synthesizes a video of a talking head given a single face frame and a speech audio clip
- Presented posters at the 2021 FIRE Summit and Undergraduate Research Day 2022

Undergraduate Researcher

University of Maryland Department of Computer Science

College Park, MD

January 2021 – December 2022

- Conducted research on image generation metrics with Prof. Tom Goldstein (Capstone for Machine Learning) and visualization recommendation with Prof. Dave Levin and Prof. Leilani Battle (Undergraduate Honors Seminar)
- Designed a human study to rank metrics for evaluating generative models by their alignment with human judgment of image quality and implemented an Amazon MechanicalTurk website
- Built a framework that manipulates the weights of any image GAN to control the Fréchet Inception Distance (FID) of the generated synthetic image distributions by up to 100 points
- Identified behavioral trends of data analysts through a statistical analysis of 2.3 million dataset-visualization pairs in the Plotly Community Feed [arXiv:2203.04937]

Computer Vision Research Intern

Systems & Technology Research

Woburn, MA

June 2022 – August 2022

- Researched body recognition for IARPA BRIAR under Matt Meyn, Dr. Mark Keck, and Prof. Rama Chellappa
- Created a 3D reclothing approach that trains whole-body recognition models to be invariant to clothing changes by realistically transferring garments between multiple subjects in the training data
- Fused dense human pose estimation, GAN-based novel view synthesis, semantic segmentation, and inpainting to produce reclothed image distributions that achieve an FID of 12.93 while preserving identity biometrics

PUBLICATIONS

Google Scholar: scholar.google.com/citations?user=sqPGyG4AAAAJ

1. A. Hanson, **Allen Tu**, Lin Geng, V. Singla, M. Zwicker, and T. Goldstein, ‘Speedy-Splat: Fast 3D Gaussian Splatting with Sparse Pixels and Sparse Primitives’, arXiv, 2024.
2. A. Hanson*, **Allen Tu***, V. Singla, M. Jayawardhana, M. Zwicker, and T. Goldstein, ‘PUP 3D-GS: Principled Uncertainty Pruning for 3D Gaussian Splatting’, arXiv, 2024.

* denotes equal contribution

TEACHING EXPERIENCE

Peer Research Mentor (Capital One Machine Learning)

College Park, MD

First Year Innovation and Research Experience

January 2021 – December 2022

- Mentored 2 cohorts of 80 students in a 3-semester introduction to machine learning research experience that is accessible to freshmen from all backgrounds
- Produced project-based coursework, created code tutorials, tutored students during office hours, graded assignments, and taught classes on peer-reviewed machine learning publications
- Guided scrum teams of 3-6 students to choose a research problem, conduct a literature review, design and implement a machine learning network, and then release their project with pretrained weights on GitHub
- Presented posters for machine learning text-to-audio generation, image super-resolution, and face attribute classification at the 2021 and 2022 FIRE Summits

RELATED EXPERIENCE

Software Engineering Intern

Wilmington, NC

nCino, Inc.

June 2021 – August 2021

- Fulfilled bug and feature tickets across 3 nCino Cloud Bank Operating System data integration packages using Java, JavaScript, and SQL
- Securely integrated the Salesforce platform with 5 partner credit, loan, and insurance services using Informatica, REST, and SOAP
- Implemented regression testing suites with 100% coverage for 9 packages

TECHNICAL SKILLS

Languages: Python, CUDA, C/C#/C++, Shell, Java, SQL, MATLAB, SAS, R, OCaml, Ruby, JavaScript, HTML

Libraries: PyTorch, TensorFlow, NumPy, SciPy, scikit-learn, Matplotlib, OpenCV, pandas, NerfStudio, Unity, OpenGL

Selected Graduate Coursework: Advanced Computer Graphics, Advances in XR, Computational Geometry, Foundations of Deep Learning, Physically-based Modeling, Simulation and Animation, Natural Language Processing, Interactive Technologies in Human-Computer Interaction, How to Conduct Great Research

Selected Undergraduate Coursework: Advanced Data Structures, Applications of Linear Algebra, Applied Probability and Statistics, Capstone in Machine Learning, Computer Vision, Database Design, Design and Analysis of Algorithms, Introduction to Data Science, Introduction to Machine Learning, Introduction to Parallel Computing, Introduction to Probability Theory, Introduction to Statistical Computation, Programming Language Technologies and Paradigms, Programming Handheld Systems