TRISTAN PEAT

tpeat@gatech.edu • (919) 601-3991 • tpeat.github.io • US Citizen • Secret Clearance

EDUCATION

GEORGIA INSTITUTE OF TECHNOLOGY, College of Computing **Atlanta, Georgia**
Master of Science in Computer Science, Machine Learning GPA: 4.0 *Expected May 2025*
Bachelor of Science in Computer Science *May 2024*
- Concentrations: Machine Learning and Distributed Systems GPA: 3.84

RESEARCH EXPERIENCE

GEORGIA TECH RESEARCH INSTITUTE, Performance Optimization Team (PERF) **Atlanta, Georgia**
The Performance and Optimization team specializes in developing advanced algorithms and simulation systems for military survivability applications, focusing on electro-optical (EO) and infrared (IR) countermeasure optimization. Working closely with all branches of the military and major defense contractors, PERF leverages high-performance computing to model, analyze, and enhance mission-critical defense systems that protect warfighters across air, space, and naval domains.

Graduate Machine Learning Research Assistant (Secret Clearance) *August 2024 – Present*
- Lead ML scientist for a $1M budget Air and Space Force Project tracking unresolved targets in noisy infrared (IR) data
- Built a real-time in-the-loop object detection pipeline for multiple unresolved targets in a low-variability feature space
- Architected an image-generation pipeline that generates novel engagement sequences by injecting energy onto raw infrared frames without an object and integrated the pipeline into an existing codebase
- The image generation pipeline efficiently scales processing across GPUs while flexibly supporting the injection of clutter, changing object trajectory, forced occlusions, and distractions from non-target moving objects
- Designed an algorithm for object detection built on statistical clutter suppression techniques that consider the expected noise properties of the physical sensor recording the raw data
- Advisor: Dr. Jason Zutty

Undergraduate Machine Learning Research Assistant – Tracking Airborne Targets *August 2023 – May 2024*
- Optimized a >1B parameter ViT based on "Associating Objects with Transformers" (Yang et al., 2021) for an object tracking objective on the Amazon Object Tracking dataset
- Conducted a full literature review on fundamental and state-of-the-art object tracking techniques, personally selecting a modular training methodology to easily swap backbones, latent space operations, and bounding box prediction heads
- Led the design of a data loader that pulls over 1TB of videos from S3 and automatically creates masks for dense prediction annotations using the Segment Anything model from Meta
- Improved the efficiency of the Vision Transformer (ViT) by over 15FPS by adding a lightweight feature encoder, FlashAttention, and token merging capabilities to the codebase
- Advisors: Dr. Jason Zutty and Clint Morris

Undergraduate Machine Learning Research Assistant – Deep Monocular Depth Estimation *January 2023 – May 2023*
- Implemented a 400M-parameter monocular depth estimation ViT based on "Depth Estimation with Simplified Transformer" (Yang et al., 2022) achieving less than 5% Mean Absolute Error (MAE) up to 1000m on the KITTI dataset
- Designed a novel InceptionNet-based token reduction method to map query tokens to a smaller subspace in a learnable manner, improving computational complexity
- Designed an evaluation script to bin model error (MAE) by each pixel's depth range to separate depth-wise error from holistic error, allowing the team to select the best model at a higher granularity
- **Research Impact:** Work published in *Synthetic Data for Artificial Intelligence and Machine Learning: Tools, Techniques, and Applications II* (Vol. 13035), received $100,000 IRAD funding, and selected for presentation at two DoD conferences
- Advisors: Dr. Jason Zutty, Clint Morris and Jacob Brechbuhl

GEORGIA INSTITUTE OF TECHNOLOGY, Vertically Integrated Project **Atlanta, Georgia**
Automated Algorithm Design, Stocks & Neural Architecture Search (NAS) Team *August 2022 – May 2023*
- Implemented a Deep Reinforcement Learning (DRL) model for Portfolio Optimization with a custom loss function based on the Sharpe Ratio
- Contributed to the NAS branch of the open-source Evolutionary Multi-objective Algorithm Design Engine (EMADE) codebase to build support for DRL data loading and unsupervised optimization
- Implemented the coordination of evolvable InceptionNet-style modules that allow for branching and recombination of inputs to sub-networks while maintaining the auto-gradient flow
- Trained hundreds of small (~100k-parameter) models on over 5,000 experiences in the DRL simulation

- Directly mentored three students in deep learning concepts, all of whom later led their respective project sub-teams, and two of whom joined Georgia Tech Research Institute as machine learning research student assistants
- **Invited Talk**: "Evolutionary Neural Architecture Search", College of Computing, Georgia Tech, December 2023
- Advisors: Dr. Jason Zutty, Dr. Greg Rohling, and Aaron McDaniel

INDUSTRY EXPERIENCE

AMAZON WEB SERVICES, IAM APIAuth Team **Denver, Colorado**

The IAM API Authentication team forms the security backbone of AWS, protecting critical infrastructure by managing authentication and authorization for all AWS API calls - processing over 1 billion requests per second across 700,000 data centers worldwide.

Software Development Engineer Intern *May 2024 – August 2024*

- Architected an operational metrics analyzer to statistically detect anomalies, retrieve related deployments, tickets, and system logs, and publish a report to an internal Wiki page
- Developed, tested, and deployed a new Python package within a CICD pipeline that is triggered on a cron schedule using a AWS CloudWatch event to call an AWS Lambda
- Designed and conducted experiments evaluating the root cause analysis capabilities of LLMs given time series data snapshots and related deployments, tickets, and logs as context
- Performed feature selection and compared AD algorithms, such as Holts Winter and RandomCutForest, in Sagemaker
- Advisor: Adam Marrapode

ZILLOW GROUP, Artificial Intelligence Division **Remote**

Software Development Engineer Intern *May 2023 – August 2023*

- Designed and implemented a data pipeline in Python and SQL to report digital traffic to Wall Street stakeholders
- Calibrated user traffic using hypothesis testing to migrate from Google Analytics API to an internal cookie software
- Transformed petabytes of data from raw input to a presentable format using parallel spark jobs executed on AWS
- Performed statistical analysis on data source migration and summarized findings in discussions with stakeholders
- Advisor: Dr. Tianlong Song

DELTA AIR LINES, Simulator Support Team **Atlanta, Georgia**

Simulator Engineer Co-Op *May 2022 – August 2022*

- Programmed C scripts for automatic flight simulator software updates to reduce man–hour cost by 15%
- Debugged C and FORTRAN programs implemented using real-time simulation on Unix-based platforms

HALO COLLAR **Remote**

Data Science Intern (part–time) *May 2022 – August 2022*

- Collected, labeled, and transformed raw data into a model input vector using noise filters and PCA feature selection
- Tuned and trained a multi-class ML activity classifier with 83% accuracy using Python's scikit-learn
- Converted sliding window time-series preprocessing code and classifier to C for embedding on the microcontroller
- Deployed C code to the microcontroller and live beta-tested the classifier on real dogs in real-time

PROJECTS

GEORGIA INSTITUTE OF TECHNOLOGY **Atlanta, Georgia**

Clustering in Transformers Exploration (Personal Project) *August 2024 - Present*

- Performed a literature review on the clustering phenomenon in Transformers, investigating rank collapse, neural collapse, and mathematical frameworks on attention by synthesizing perspectives from over 40 research papers
- Trained a custom Transformer on French to English machine translation and CIFAR10 classification past zero loss to observe the neural collapse phenomenon and make claims for mitigation strategies
- Formulated self-attention dynamics as an optimal transport problem, modeling queries as interacting particles within a Wasserstein gradient flow framework
- Tracked query vector trajectories in cross-attention layers, demonstrating their convergence to effective cluster centroids

Counting to Detection Vision-Language Model (VLM) *August 2024 - Present*

- Developed a novel fine-tuning approach to CLIP (ViT-B/32) using a counting contrastive loss and teacher-student forcing to enhance fine-grained vision-language understanding
- Created a synthetic COCO dataset with controlled object placement to training counting-aware visual representations
- Achieved 7x improvement on CountBench and 80% improvements in grid counting in the VLM's Are Blind benchmark
- Employed AdamSPD and teacher-student forcing to maintain CLIP generalization robustness under finetuning

- **Invited Talk**: "CountDetectVLM: Fine grained CLIP alignment", College of Computing, Georgia Tech, November 2024

MessiAnything Consistency Diffusion Model (Machine Learning) *March 2024 - May 2024*

- Managed a team of five in developing "MessiAnything", a deep learning project focused on segmenting and removing humans from input images, followed by in-painting the negative space with generated images of Lionel Messi
- Architected the custom segmentation model built with a Hiera backbone and a simple feature pyramid network head
- Trained the segmentation model for 50k steps on the MSCOCO dataset filtered for human objects across multiple GPUs
- Finetuned a Consistency (score-based) model for 100k iterations distributed across 4 GPUs using the consistency distillation objective on an ImageNet base on a custom dataset of Messi images

ZILLOW GROUP, Hackathon 2nd Place Winner **Seattle, Washington**

Internal Resource LLM SlackBot *July 2023*

- Productionized a question-answering (QA) LLM SlackBot with RAG on embeddings of Zillow's internal documentation, Gitlab repositories, and Slack threads for Zillow internal employees in a one-week timeframe
- Built an evaluation dataset of select examples of "typical" user queries and expected answers for evaluating our team's QA LLM pipeline
- Conducted experiments on base model type, history summarization schema, prompt engineering, and RAG retrieval mechanism in a scientific manner over our custom evaluation dataset
- Awarded 2nd place in the annual Zillow Hackathon

OUTREACH & LEADERSHIP

GEORGIA INSTITUTE OF TECHNOLOGY, GOALS Soccer **Atlanta, Georgia**

Equipment Manager and Volunteer Coach *August 2023 – Present*

- Volunteered every Sunday to enrich the lives of Atlanta's youth with special needs through the sport of soccer in partnership with Georgia Outreach for Advancing the Lives of Special Needs
- Managed and organized practice equipment to ensure prompt start times and safety for all the children

GEORGIA INSTITUTE OF TECHNOLOGY, Men's Club Soccer **Atlanta, Georgia**

Team Event Coordinator, Safety Officer, and Forward *January 2020 – May 2024*

- Planned and organized team bonding events to boost morale under the constraint of a $100 semesterly budget
- Improved the team tryout process by designing a criteria-based player ranking system for fair evaluation
- Took initiative to serve as the team's safety officer to ensure care in the case of emergency by enrolling in CPR and First-Aid courses, despite no previous medical background
- Led the team to a 5th place finish at 2023 NIRSA National Championship held in Austin, TX

GEORGIA INSTITUTE OF TECHNOLOGY, College of Computing **Atlanta, Georgia**

Head Undergraduate Teaching Assistant (part–time) *May 2021 – May 2022*

- Managed seven undergraduate teaching assistants for an introductory Python course
- Taught two full-class lectures, programmed biweekly homework assignments, and wrote exams for multiple sections of the course with over 200 total students enrolled
- Programmed a homework auto grader script in Python to score and report hundreds of student homework submissions
- Engaged with GT faculty to align curriculum goals to engage a diverse (~30% female, 67% minority) student population

Undergraduate Teaching Assistant (part–time) *January 2021 – May 2021*

- Independently led weekly supplementary review sessions with over 30 students, preparing custom PowerPoint slides, handouts, knowledge quizzes, and engagement activities to maximize student success
- Held 1-1 office hours to provide personalized support, answer homework questions, and address re-grade requests

SKILLS

- **Programming Languages:** Python – expert, Numpy, Pandas, Java, C, SQL, Apache Spark
- **ML Frameworks:** PyTorch, Huggingface, Tensorflow
- **Computer Vision:** Vision Transformers (ViT), Segment Anything, CNN-UNet, InceptionNet, YOLO, DINO, AOT
- **Natural Language Processing:** CLIP, BERT, AlBERT, T5
- **Classical:** Random Forests, Linear/Logistic Regression, HoltsWinter
- **Cloud Services:** AWS Bedrock, AWS Sagemaker, AWS S3, AWS Lambda, Azure
- **Distributed Computing:** Slurm cluster, ZeroMQ, Protobuf, TCP
- **Development Tools:** Git, Jupyter, Docker