

Matthew Gwilliam



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English, Spanish

Statement of Research

“Analyzing and Improving Self-supervised Learning”

I built a toolkit for benchmarking and comparing the representations learned by different unsupervised algorithms for image representation learning. The manuscript was published at CVPR 2022. I also completely exploratory work demonstrating the classification capabilities of out-of-the-box state-of-the-art diffusion models, writing one manuscript as an initial pre-print. I proposed ideas for fusing diffusion features for better performance, as well as a more thorough benchmark, in an article currently under review. I also proposed using large language models to analyze self-supervised vision-language models, in an article currently under review.

“Implicit Neural Video Representation”

I am working on implicit neural representation (INR) methods for video, both in the traditional internal learning paradigm as well as by using hypernetworks. I have collaborated on papers (which appeared at BMVC and CVPR) that propose hybrid representations for video, with good data compression performance and other promising emergent properties as well. I am also investigating emergent properties of implicit representation for recognition tasks, including classification and segmentation. I mentored another PhD student, and we proposed a framework for analyzing a variety of different types of INR networks. The manuscript was published at CVPR 2024. I am the main organizer for INRV, a workshop at CVPR 2024.

Education

Doctor of Philosophy in Computer Science Aug. 2020 – May 2026
University of Maryland, College Park, Maryland
Advisor Abhinav Shrivastava

Bachelor of Science in Computer Science Sep. 2014 – Dec. 2019
Brigham Young University, Provo, Utah

Selected Awards

Dean’s Fellowship 2020, 2021
University of Maryland
Awarded to new graduate students who have demonstrated superior academic achievement

GRFP Honorable Mention 2020
National Science Foundation
Awarded to meritorious applicants who do not receive financial rewards

Service

Workshop Organizer {2024} INRV @ CVPR 2024
<https://inrv.github.io>

Conference Reviewer ECCV 2022, 2024; CVPR {2022-2024}; ICCV 2023; WACV 2024

Journal Reviewer International Journal of Computer Vision

Peer Mentor UMD Graduate Student Council Mentorship Program, 2023-2024

Graduate Admissions {2021-2024} admission cycles

Experience & Appointments

Research Assistant June 2021 – Present
University of Maryland Institute for Advanced Computer Studies
Working with my advisor, Dr. Abhinav Shrivastava, I have authored multiple papers, which have appeared at CVPR [2, 3, 9] and BMVC [7], with another currently under review [6]. I am continuing my work on learning to represent data, operating at the intersection of image recognition, generation, and implicit representation, as I work on finding universal visual data representation.

Teaching Assistant Aug. 2020 – Present
Computer Science Department, University of Maryland (College Park)
I have participated in grading, running help sessions, substituting for lectures, holding office hours, and developing coursework. In addition to taking sole responsibility for approving, guiding, and grading the final project, my coursework responsibilities included developing several different assignments for the university’s Introduction to Deep Learning course (CMSC 472) and graduate-level computer vision course (CMSC 8281).

Computer Vision Research Intern May 2023 – Dec. 2023
SRI International
I developed data and methods for better long-form video understanding for retrieval, question answering, and summarization. I submitted the manuscript [4] to CVPR.

Online Course Instructor Jan. 2023 – May 2023
UpGrad and Robert H. Smith School of Business, University of Maryland (College Park)
I developed, prepared, and recorded 4 weeks of course material for a deep learning course offered by the School of Business. In total, I delivered 7.5 hours of lecture material and a major assignment. I also host a quarterly live review session.

Applied Science Research Intern May 2022 – Aug. 2022
Amazon Music
I adapted state-of-the-art computer vision and natural language processing techniques for music recommendations. I gained experience working with data in a different modality (music, rather than images or text), as well as using Apache Spark, AWS, pandas, and PyTorch for manipulating and filtering large amounts of data for model training.

Software Engineer Sep. 2018 – Aug. 2020
Qualtrics
This role started as a part-time position while I was still a student. I designed, built, and deployed custom automations solutions. For one major project, I built a solution using Python that scraped data from hundreds of dashboards, with dozens of unique widgets. After graduation, I transitioned to fulltime work, where I helped maintain a text analysis pipeline and user interface.

Research Assistant Jan. 2019 – Dec. 2019
Brigham Young University
As an undergraduate, I worked on fine-grained visual categorization (FGVC) under Dr. Ryan Farrell. I completed projects exploring interactions between algorithms and data for FGVC [14, 11, 13, 1]. I learned the basics of deep learning research: pre-requisite mathematical understanding, working with PyTorch, NumPy, GPUs, etc.

Publications and Preprints

- [1] Connor Anderson, **Matt Gwilliam**, Evelyn Gaskin, and Ryan Farrell. “Elusive Images: Beyond Coarse Analysis for Fine-Grained Recognition”. In: WACV. 2024. url: https://openaccess.thecvf.com/content/WACV2024/html/Anderson_Elusive_Images_Beyond_Coarse_Analysis_for_Fine-Grained_Recognition_WACV_2024_paper.html.
- [2] Namitha Padmanabhan*, **Matthew Gwilliam***, Pulkit Kumar, Shishira R Maiya, Max Ehrlich, and Abhinav Shrivastava. *Explaining the Implicit Neural Canvas: Connecting Pixels to Neurons by Tracing their Contributions*. 2024. arXiv: 2401.10217 [cs.CV].
- [3] Hao Chen, **Matthew Gwilliam**, Ser-Nam Lim, and Abhinav Shrivastava. “HNeRV: A Hybrid Neural Representation for Videos”. In: CVPR. 2023. arXiv: 2304.02633 [cs.CV].
- [4] **Matthew Gwilliam**, Michael Cogswell, Meng Ye, Karan Sikka, Abhinav Shrivastava, and Ajay Divakaran. *A Video is Worth 10,000 Words: Training and Benchmarking with Diverse Captions for Better Long Video Retrieval*. 2023. arXiv: 2312.00115 [cs.CV].
- [5] **Matthew Gwilliam***, Soumik Mukhopadhyay*, Vatsal Agarwal, Namitha Padmanabhan, Archana Swaminathan, Srinidhi Hegde, Tianyi Zhou, and Abhinav Shrivastava. *Diffusion Models Beat GANs on Image Classification*. 2023. arXiv: 2307.08702 [cs.CV].
- [6] **Matthew Gwilliam***, Soumik Mukhopadhyay*, Yosuke Yamaguchi**, Vatsal Agarwal**, Namitha Padmanabhan, Archana Swaminathan, Tianyi Zhou, and Abhinav Shrivastava. *Do text-free diffusion models learn discriminative visual representations?* 2023. arXiv: 2311.17921 [cs.CV].
- [7] Hao Chen, **Matt Gwilliam**, Bo He, Ser-Nam Lim, and Abhinav Shrivastava. *CNeRV: Content-adaptive Neural Representation for Visual Data*. 2022. arXiv: 2211.10421 [cs.CV].
- [8] Kaitlyn DeValk, **Matthew Gwilliam**, Thomas Hanson, Michael Harrity, and Michelle Mazurek. “Industry Perspectives on Offensive Security Tooling”. In: *SOUPS WSIW*. 2022.
- [9] **Matthew Gwilliam** and Abhinav Shrivastava. “Beyond Supervised vs. Unsupervised: Representative Benchmarking and Analysis of Image Representation Learning”. In: CVPR. 2022. arXiv: 2206.08347 [cs.CV].
- [10] **Matthew Gwilliam**, Srinidhi Hegde, Lade Tinubu, and Alex Hanson. “Rethinking Common Assumptions To Mitigate Racial Bias in Face Recognition Datasets”. In: *ICCV Workshop*. 2021. arXiv: 2109.03229 [cs.CV].
- [11] **Matthew Gwilliam**, Adam Teuscher, Connor Anderson, and Ryan Farrell. “Fair Comparison: Quantifying Variance in Results for Fine-Grained Visual Categorization”. In: WACV. 2021. url: <http://dx.doi.org/10.1109/WACV48630.2021.00335>.
- [12] Eva Vanmassenhove, Dimitar Shterionov, and **Matthew Gwilliam**. “Machine Translationese: Effects of Algorithmic Bias on Linguistic Complexity in Machine Translation”. In: *EACL*. 2021. arXiv: 2102.00287 [cs.CL].
- [13] Connor Anderson, **Matt Gwilliam**, Adam Teuscher, Andrew Merrill, and Ryan Farrell. *Facing the Hard Problems in FGVC*. 2020. arXiv: 2006.13190 [cs.CV].
- [14] **Matthew Gwilliam** and Ryan Farrell. “Intelligent Image Collection: Building the Optimal Dataset”. In: WACV. 2020. url: https://openaccess.thecvf.com/content_WACV_2020/html/Gwilliam_Intelligent_Image_Collection_Building_the_Optimal_Dataset_WACV_2020_paper.html.