Matthew Gwilliam
Curriculum Vitae

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RESEARCH PROJECTS

Analyzing and Improving Robustness of 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.

Implicit Neural Video Representation

I am working on implicit neural representation 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. More recently, I am working on generating videos in weight space (as implicit representations) using GANs and hypernetworks. I am also investigating emergent properties of implicit representation for recognition tasks, including classification and segmentation. I mentored a more junior student, writing a paper where we propose a framework for analyzing a variety of different types of INR networks.

Exploring Relationships Between Algorithms, Data, and Performance for Fine-grained Visual Categorization

During my undergraduate experience, I worked to identify the interplay between many factors for fine-grained visual categorization (FGVC) deep learning models. In my first work, *a first author paper at the Winter Conference on Applications of Computer Vision (WACV) in 2020*, I explored the way dataset composition affected performance. In a subsequent work, I demonstrated the extent of variance, at multiple levels, in results for FGVC methods, and, *as first author, I presented my findings at WACV 2021*. I later collaborated with other members in the lab to explore the complimentary nature of FGVC methods, and diagnose the source of their collective strengths and weaknesses, with one submission currently under review.

WORK EXPERIENCE

JUN 2021 – CURRENT

University of Maryland
Research Assistant

Working with my advisor, Dr. Abhinav Shrivastava, I have authored multiple papers, which have appeared at CVPR and BMVC, with more currently under review. 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.

SEP 2020 – CURRENT, RECURRING

University of Maryland
Teaching Assistant

EDUCATION

2020 – 2026	**Doctor of Philosophy**
	3.75 GPA
	Computer Science
	University of Maryland, College Park
2014 – 2019	**Bachelor of Science**
	MAGNA CUM LAUDE, 3.97 GPA
	Computer Science
	Brigham Young University

AWARDS

2020, 2021	**Dean's Fellowship**
	University of Maryland
2020	**GRFP Honorable Mention**
	National Science Foundation

SKILLS

TOOLS	Python, PyTorch, NumPy, SciPy, SQL, Javascript, HTML, CSS
LANGUAGES	English, Spanish

PUBLICATIONS

Gwilliam, M.*, Mukhopadhyay, S.*, Yamaguchi, Y.**, Agarwal, V.**, Padmanabhan, N., Swaminathan, A., Zhou, T., Shrivastava, A. (2023). Do text-free diffusion models learn discriminative visual representations? *Submission under review.*

Padmanabhan, N., **Gwilliam, M.**, Kumar, P., Maiya, S., Shrivastava, A. (2023). Explaining the Implicit Neural Canvas: Connecting Pixels to Neurons by Tracing their Contributions. *Submission under review.*

Gwilliam, M., Cogswell, M., Ye, M., Sikka, K., Shrivastava, A., Divakaran, A. (2023). A Video is Worth 10,000 Words: Training and Benchmarking with Diverse Captions for Better Long Video Retrieval. *Submission under review.*

Gwilliam, M.*, Mukhopadhyay, S.*, Agarwal, V., Padmanabhan, N., Swaminathan, A., Hegde, S., Zhou, T., Shrivastava, A. (2023). Diffusion Models Beat GANs on Image Classification. *preprint.*

Gwilliam, M., Shrivastava, A. (2022). Beyond Supervised vs. Unsupervised: Representative Benchmarking and Analysis of Image Representation Learning. CVPR 2022.

Chen, H., **Gwilliam, M.**, Lim, Ser-Nam, Shrivastava, A. (2022). HNeRV: A Hybrid Neural Representation for Videos. CVPR 2023.

Chen, H., **Gwilliam, M.**, He, B., Lim, Ser-Nam, Shrivastava, A. (2022). Beyond Supervised vs. Unsupervised: Rep-

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).

MAY 2023 – DEC 2023

SRI Intenational
Computer Vision Research Intern

I developed data and methods for better long-form video understanding for retrieval, question answering, and summarization. I prepared a manuscript for submission to CVPR.

JAN 2023 – MAY 2023

University of Maryland
Online Course Instructor

In partnership with UpGrad, 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.

MAY 2022 – AUG 2022

Amazon Music
Applied Science Research Intern

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 and AWS for manipulating and filtering large amounts of data for model training.

SEP 2018 – AUG 2020

Qualtrics
Software Engineer

This role started as a part-time position while I was still a student. During this time, 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.

JAN 2019 – DEC 2019

Brigham Young University
Research Assistant

As an undergraduate, I worked on fine-grained visual categorization (FGVC) under Dr. Ryan Farrell. I completed a project exploring interactions between algorithms and data for FGVC, described in greater detail in "Research Projects." As part of this work, I learned the basics of deep learning research: pre-requisite mathematical understanding, working with PyTorch, NumPy, GPUs, etc.

resentative Benchmarking and Analysis of Image Representation Learning. **Oral**, BMVC 2022.

Gwilliam, M., Hegde, S., Tinubu, L., Hanson, A. (2021). Rethinking Common Assumptions to Mitigate Racial Bias in Face Recognition Datasets. **Best paper runner-up**, ICCV 2021 Workshop.

Gwilliam, M., Teuscher, A., Anderson, C., Farrell, R. (2021). Fair Comparison: Quantifying Variance in Results for Fine-grained Visual Categorization. WACV 2021.

Anderson, C., **Gwilliam, M.**, Teuscher, A., Merrill, A., Farrell, R. (2020). Facing the Hard Problems in FGVC. *preprint only*.

Gwilliam, M., Farrell, R. (2020). Intelligent image collection: Building the optimal dataset. WACV 2020.

Vanmassenhove, E., Shterionov, D., **Gwilliam, M.**. (2021). Machine Translationese: Effects of Algorithmic Bias on Linguistic Complexity in Machine Translation. EACL 2022.

DeValk, K., **Gwilliam, M.**, Hanson, T., Harrity, M., Mazurek, M. (2022). Industry Perspectives on Offensive Security Tooling. USENIX Symposium on Usable Privacy and Security (SOUPS) 2022.

REFERENCES

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Dr. Ryan Farrell

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