Katherine Keegan

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Education

Mary Baldwin University, *Staunton, VA, USA* *Aug. 2018 - May 2022*

- **Degree:** Bachelor of Science in Applied Mathematics, Honors
- **GPA:** 4.00/4.00 (Honors List 2018-Present); **Minors:** Physics, Asian Studies
- **Honor Societies:** Sigma Pi Sigma National Physics Honors Society, Omicron Delta Kappa National Leadership Honors Society, Alpha Lambda Delta National First Year Honors Society, Iota Sigma Pi National Women in Chemistry Honor Society, will meet requirements for Phi Beta Kappa by May 2022
- Became full-time residential undergraduate student at age 14 through the Program for the Exceptionally Gifted; will graduate college at age 18

Kansai Gaidai University, *Osaka, Japan* *Fall 2021*

- Participating in virtual study abroad program involving remote cross-cultural activities with students from around the world; completing virtual KGU-taught course on "Japan and Globalization: A Cultural Approach"

Research Experience

Honors Thesis Research Student, *Mary Baldwin University* *Fall 2021 - Present*

- Undergraduate honors senior research project; advisor: Dr. Joseph Johnson; topic: "Color Normalization and SVD-based Approaches for Stereo Matching on Mars Analog Data"
- Focusing on two approaches for computing depth estimation maps from stereo image pairs: color consistency/normalization methods and SVD-based stereo matching
- Developing software for applying stereo matching methods to Mars analog dataset with goal of contributing to autonomous image-based exploration of remote locations (e.g. Mars rovers)
- Received funding from MBU Advisory Board of Visitors Capstone Fellowship; was the only math major selected in 2021

Undergraduate Research Fellow, *Emory University* *Summer 2021*

- Summer research at "Computational Mathematics for Data Science" REU with 2021 theme of "Learning from Images" at Emory University; advisor: Dr. Elizabeth Newman; topic: "Tensor-based Approaches to fMRI Classification"
- Studied mathematical techniques for representing and analyzing higher-dimensional data using tensors
- Applied a tensor analogue of the singular value decomposition to five-dimensional fMRI data to determine if tensor-based methods could be used to determine whether the human subject was reading a sentence or viewing a picture based only on the brain data
- Explored how taking advantage of knowledge about anatomically-defined regions of interest within the brain and incorporating this knowledge into classification process could affect performance

Visiting Research Student, *University of Virginia* *Spring 2021 - Present*

- Visiting research student project at University of Virginia; advisor: Dr. Miaomiao Zhang; topic: "Interpretable Deep Learning for COVID-19 Image Segmentation"
- Developing random forest, support vector machine, and U-net models for COVID-19 segmentation in 2D CT scan image data with radiologist annotations
- Applying Grad-CAM interpretability technique in order to ensure that U-net results are explainable

Undergraduate Research Fellow, *Brown University* *Summer 2020*

- Summer research at "Fast Learning Algorithms for Numerical Computation and Data Analysis" REU at Institute for Computational and Experimental Research in Mathematics (ICERM); advisor: Dr. Minah Oh; topic: "Applications of the Singular Value Decomposition"
- Applied principal component analysis (PCA) to COVID-19 dataset, analyzing trends among states and creating 3-D interactive visualizations of principal components to illustrate results
- Assisted with development of modified SVD-based watermarking scheme and constructed plots to illustrate improved efficiency and extraction accuracy of scheme in images, video, and audio

Publications

K. Keegan, D. Melendez, and J. Zheng, *Media Processing and a Modified Watermarking Scheme Based on the Singular Value Decomposition,* SIAM Undergraduate Research Online, 14, 446-467, 2021.

K. Keegan, T. Vishwanath, and Y. Xu. *A Tensor SVD-Based Classification Algorithm Applied to fMRI Data*, arXiV preprint arXiv:2111.00587 [cs.LG], 2021.

Presentations

"A Tensor SVD-based Classification Algorithm Applied to fMRI Data." American Mathematical Society-Pi Mu Epsilon Student Poster Session at the Joint Mathematics Meetings, January 2022. [Poster]

"A Tensor SVD-based Classification Algorithm Applied to fMRI Data." Shenandoah Undergraduate Mathematics and Statistics conference, James Madison University, December 2021. [Talk]

"A Tensor SVD-based Classification Algorithm Applied to fMRI Data." Undergraduate Mathematics Symposium, University of Illinois Chicago, November 2021. [Poster]

"Tensor-based Approaches to fMRI Classification." University of Connecticut Mathematics Continued Conference, October 2021. [Poster]

"Tensor-based Approaches to fMRI Classification." Council on Undergraduate Research REU Symposium, October 2021. [Talk]

"Applications of the Singular Value Decompositionin Media Processing and Watermarking Schemes." SIAM Annual Meeting Undergraduate Presentation Session, July 2021. [Talk]

"SVD and its Applications." Shenandoah Undergraduate Mathematics and Statistics conference, James Madison University, December 2020. [Talk]

Work Experience

MBU Academic Resource Center Tutor *Jan. 2020 - Present*

- Providing individual instruction and guidance with physics, Japanese, French, mathematics, and writing

MBU Teaching Assistant *Sep. 2019 - Dec. 2020*

- Assisted with teaching and grading of Precalculus in Fall 2019 and Calculus I in Fall 2020

Extracurricular Activities

Single-Engine Airplane Piloting Student *Sep. 2019 - Present*

- With funding provided from Mary Baldwin University's Experiential Learning Grant, began flying lessons with goal of obtaining a private pilot certificate; completed first solo flight in Sep. 2020 at age 16

MBU Math Club President (previously Secretary) *Sep. 2019 - Present*

- Working on expanding scope of club to assist those struggling in math classes across the campus community
- Led workshops on GRE preparation and introductory Python coding
- Maintained communications and compiled event announcements as club secretary from 2019-2021

MBU Baldwin Honors Scholars President (previously Secretary) *Sep. 2020 - Present*

- Working with other student leaders with coordination of activities for students in the honors program at Mary Baldwin University; held vice president position from 2020-2021

Student Marshal *Feb. 2020 - Present*

- Student with highest GPA in class of 2022, assisting with Commencement

Girls Who Code elementary school volunteer *Fall 2019*

- Assisted with elementary school teachers in hosting after school program introducing girls to programming concepts

Selected Honors and Awards

- Google Computer Science Research Mentorship Program Scholar (2021)
- Barry Goldwater Scholarship Nominee (2021)

- MBU First Year Calculus Award (awarded annually to freshman with highest average in Calculus I & II sequence) (2019)
- MBU Experiential Learning Grant (2018)
- MBU Presidential Scholarship (highest merit scholarship offered to incoming students based on prior academic achievement) (2018)

Additional Courses and Certificates

- STRIVE for MORE 2021
- Machine Learning Summer School 2021 Taipei (general program participant)
- EdX IBM Deep Learning with Keras online course (certification, 2021)

Skills

- Technical: Python, LaTeX, GitHub, Google Cloud Platform, Linux, introductory Matlab
- Other: Fluent in English and Japanese