Caleb Hallinan

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EDUCATION

PhD in Biomedical Engineering *August 2023 – Present*
Johns Hopkins University, Baltimore, MD

Bachelor of Arts in Statistics and Biology *August 2017 – May 2021*
University of Virginia, Charlottesville, VA

RESEARCH EXPERIENCE

Biomedical Engineering PhD Candidate *August 2023 – Present*
Johns Hopkins University
Advisor: Jean Fan, PhD

- Utilize deep learning to predict spatial gene expression using features learned from histology images

Research Assistant II *September 2021 – June 2023*
Boston Children's Hospital & Harvard Medical School
Advisor: Kwonmoo Lee, PhD

- Developed a feature selection algorithm to discover novel subtypes in gene, protein, and image data
- Investigated live cell images from breast cancer stem cells using machine learning and image analysis techniques
- Employed deep-learning algorithms for cell segmentation and feature extraction
- Managed Linux servers, order materials, and present recent research papers to fellow lab members

Undergraduate Research Assistant *May 2020 – August 2021*
Focused Ultrasound Foundation & University of Virginia
Advisors: Frederic Padilla, PhD & Tianxi Li, PhD

- Performed statistical analysis on flow cytometry data to deduce the effect of focused ultrasound on mice tumors
- Transformed, analyzed, and visualized brain tumor data to distinguish normal brain matter from tumor tissue
- Transferred R-version of the package 'randnet' to Python

TEACHING EXPERIENCES

Course Instructor, Deep Learning for Spatial Transcriptomics *August 2025 – November 2025*
Biomedical Engineering Department, Johns Hopkins University

- Designed and taught an original course on deep learning for spatial transcriptomics, blending conceptual lectures with hands-on coding tutorials in PyTorch to support student learning

Teaching Assistant, Genomic Data Visualization *January 2025 – March 2025*
Biomedical Engineering Department, Johns Hopkins University

- Supported student learning by attending classes, answering questions, and providing individualized guidance during office hours
- Evaluated student progress by grading assignments and offering constructive feedback to enhance their understanding of genomic data visualization techniques

Teaching Assistant, Data Science for Public Health I/II *January 2024 – May 2024*
Biostatistics Department, Johns Hopkins Bloomberg School of Public Health

- Facilitated student understanding of data science concepts by holding office hours and grading assignments

Teaching Assistant, Computational Analysis of Heterogeneity in Cellular Images Nano Course *January 2023*
Harvard Medical School Curriculum Fellows Program, Harvard Medical School

- Guided 20 participants in understanding basic algorithms of segmentation, edge detection, and tracking of cells
- Worked with participants in a hands-on experience of analyzing live-cell image datasets

Teaching Assistant, Regression Analysis *January 2020 – May 2021*
Statistics Department, University of Virginia

- Oversaw 80 students while aiding in their understanding of regression in a SAS, project-based course
- Held office hours, graded assignments, and answered specific questions during class

Teaching Assistant, Introduction to Chemistry Lab *September 2019 – December 2019*
Chemistry Department, University of Virginia

- Supervised 24 students in weekly labs, designed presentations, graded assignments, and held office hours

PUBLICATIONS

Journal Papers:

J6. C. Hallinan, H.J. Ji, S.L. Salzberg, J. Fan. "Evidence of off-target probe binding in the 10x Genomics Xenium v1 Human Breast Gene Expression Panel compromises accuracy of spatial transcriptomic profiling." *eLife, 2025.*
J5. H. Zhou, P. Panwar, B. Guo, **C. Hallinan**, S. Ghazanfar, SC. Hicks. "Spatial mutual nearest neighbors for spatial transcriptomics data." *Bioinformatics, 2025.*
J4. A. Abul-Basher*****, **C. Hallinan***, and K. Lee. "Heterogeneity-Preserving Feature Selection for Subtype Discovery." *Nature Communications, 2025.*
J3. S. Busatto, T. Song, HJ. Kim, **C. Hallinan**, …, K. Lee, M. Moses. "Breast Cancer-Derived Extracellular Vesicles Modulate the Cytoplasmic and Cytoskeletal Dynamics of Blood-Brain Barrier Endothelial Cells." *Journal of Extracellular Vesicles, 2025.*
J2. J. Jang, Y. Kim, B. Westgate, Y. Zong, **C. Hallinan**, A. Akalin, and K. Lee. "Screening Adequacy of Unstained Fine Needle Aspiration Samples Using a Deep Learning-based Classifier." *Scientific Reports, 2023.*
J1. J. Jang, **C. Hallinan**, and K. Lee. "Protocol for live cell image segmentation to profile cellular morphodynamics using MARS-Net." *STAR Protocols, 2022.*

Papers Under Review:

P1. C. Hallinan, CHG. Lucas, J. Fan. "Impact of Data Quality on Deep Learning Prediction of Spatial Transcriptomics from Histology Images." *2025.*

*Equal Contributors

INVITED TALKS AND PRESENTATIONS

Poster Presentations:

P3. "Impact of Data Quality on Deep Learning Prediction of Spatial Transcriptomics from Histology Images," AI in Molecular Biology Keystone Symposia, Eldorado Hotel & Spa, Santa Fe, NM, 2025.
P2. "Phenotyping of Heterogenous Live Cell Motility and Morphology," Dr. M. Judah Folkman Research Day, Boston Children's Hospital & Harvard Medical School, Boston, MA, 2023.
P1. "Deep-Hetero: A Deep Metric Learning with UMAP-based Clustering Approach for Identifying Heterogeneity in Cells," Dr. M. Judah Folkman Research Day, Boston Children's Hospital & Harvard Medical School, Boston, MA, 2022.

Oral Presentations:

O3. "Deconvolution of Cellular Heterogeneity for Sub-Type Discovery by Analyzing Feature Variation," Vascular Biology Program Work in Progress, Boston Children's Hospital & Harvard Medical School, Boston, MA, 2022.
O2. "Machine Learning Approaches Applied to the Prediction of Covid-19 Spread and Cell Motility Phenotyping," Vascular Biology Program Work in Progress, Boston Children's Hospital & Harvard Medical School, Boston, MA, 2022.

O1. "Ultrasound Microbubble Tumor Analysis," Focused Ultrasound Foundation Summer Intern Presentations, Focused Ultrasound Foundation, Charlottesville, VA, 2021.

VOLUNTEERING AND OUTREACH

Hopkins Biomedical Engineering Application Assistance Program (BMEAAP) *November 2023 - Present*
Biomedical Engineering Department, Johns Hopkins University

- Mentor underrepresented JHU BME PhD applicants by providing CV/personal-statement feedback and mock interview coaching

Johns Hopkins Biomedical Engineering Student Council *September 2023 - Present*
Biomedical Engineering Department, Johns Hopkins University

- Serving as co-President, representing over 200+ doctoral students across Johns Hopkins University
- Coordinate council meetings, spearhead initiatives to enhance the student experience, and serve as a liaison between students, faculty, and administration

Statistics Alumni Panel & Biostatistics Symposium *October 2022*
Statistics Department, University of Virginia

- Talked about experiences at UVA Statistics Department to 250+ college students
- Engaged with audience regarding questions post graduating and current research work

Lee Lab Diversity Outreach Video *March 2022*
Boston Children's Hospital & Harvard Medical School

- Designed and produced a five-minute multimedia overview combining lab footage, graphics, and AI-narration to introduce the Lee Lab research to a diverse local high school

Volunteer Leader *March 2018 – May 2021*
Young Life, University of Virginia

- Lead a collaborative, volunteer leadership team providing guidance to students at The Covenant School
- Coordinated and executed events by creating a safe and encouraging environment for more than 100 students

HONORS AND AWARDS

- Graduated with Distinction – Highest Honors Possible *May 2021*
- Dean's List – 4/5 Possible Semesters *January 2018 – December 2019*

SKILLS

- Proficient in: Python, R, R Markdown, TensorFlow, Pytorch, Shell Script, Word, Excel, ImageJ and PowerPoint
- Experience with: SQL, Git, MATLAB, SAS, Mathematica, LaTeX, HTML, CSS, and C
- Machine Learning, Deep Learning, AI, Statistical Analysis, Data Science, Cell Biology, Omics Analysis

REFERENCES

References available upon request.