# Pranav Kulkarni

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## EDUCATION

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| 2018 – 2022 | University of Maryland, College Park, MD | BS in Computer Science; BS in Mathematics (*Dual Degree*) |

## PROFESSIONAL EXPERIENCE

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| Apr 2024 – | Bioinformatics Software Engineer I | University of Maryland Institute for Health Computing (UM-IHC), University of Maryland School of Medicine | • Involved in effort to build an inter-disciplinary medical imaging AI group.<br>• Developing tools for biomedical data analysis and visualization. |
| Aug 2022 – Apr 2024 | Bioinformatics Software Engineer I | University of Maryland Medical Intelligent Imaging (UM2ii) Center, University of Maryland School of Medicine | **Mentors:** Drs. Vishwa Parekh, Paul Yi<br>• Developed novel techniques for medical image analysis in federated learning, data curation, and adversarial bias attacks. |
| Aug 2021 – Dec 2021 | Undergraduate Student Researcher | Capstone Research in Machine Learning, Department of Computer Science, University of Maryland | **Mentor:** Dr. Tom Goldstein<br>• Explored adversarial attacks on Grover, a language model for detecting AI-generated fake news, using uninformed and informed perturbations. |
| Jan 2021 – May 2022 | Head Teaching Assistant | Department of Computer Science, University of Maryland | **Mentor:** Dr. Anwar Mamat<br>• Restructured course material for a hybrid classroom and managed TAs.<br>• Held weekly recitations, exam reviews, and office hours |
| Sep 2019 – Mar 2020 | MATLAB Tutor | Department of Mathematics, University of Maryland | • Provided one-on-one tutoring to students in MATLAB programming, tailored to their course and proficiency. |
| Aug 2018 – Dec 2019 | Undergraduate Student Researcher | The First-Year Innovation and Research Experience (FIRE), University of Maryland | **Mentor:** Dr. Müge Karagöz<br>• Explored unsupervised probabilistic models to reconstruct path of particles splitting into their constituents. |

## RELEVANT COURSEWORK AND SKILLS

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| **Computational Coursework** | Geometric Computer Vision (*Graduate-Level*), Computer Vision, Deep Learning, Machine Learning, Artificial Intelligence, Algorithms, Data Structures, Data Science, Functional Programming, Object-Oriented Programming |
| **Mathematics Coursework** | Linear Algebra, Multivariate Calculus, Advanced Calculus, Differential Equations, Partial Differential Equations, Fourier Transforms, Statistical Analysis |
| **Technical Skills** | Python, TensorFlow, PyTorch, Git, Linux, C/C++, C#, Java, MATLAB, SQL |
| **Other Skills** | Data Visualization, Data Analysis, Scientific Writing, Public Speaking |

## RESEARCH INTERESTS

My current research focuses on the domain-specific challenges in ML for medical image analysis, with the goal of advancing fundamental ML research in computer vision and improving healthcare outcomes. Specifically, I am interested in three distinct areas: (1) Developing **federated continual learning** methods that integrate new data and tasks (e.g., detecting COVID-19) to tackle domain shift over time in a privacy-preserving way. (2) Using **data-centric ML** techniques to intelligently select training data (e.g., using coresets) to reduce the burden of manual annotation and enable few-shot learning. (3) Building **trustworthy and explainable AI** models to defend against adversarial bias attacks, mitigate algorithmic bias, and alleviate healthcare disparities in underserved patient populations. Beyond my primary research interests, I have ongoing collaborations with clinicians in translational AI research on topics such as fairness and bias.

## PUBLICATIONS AND CONFERENCE PROCEEDINGS

I have (first/co-) authored 7-(1/6) journal publications, 4-(2/2) conference proceedings, and 21-(7/14) conference abstracts and short papers. My work has been featured in reputable conferences (e.g., MIDL, ML4H, and CVPR) and journals (e.g., Radiology).

***First/Co-first author. # Corresponding author**

### Peer-Reviewed Journal Publications

1. Kavandi, H.*, **Kulkarni, P.**, Garin, S. P., Bachina, P., Parekh, V. S., & Yi, P. H.# (2024). Radiomics-Based Prediction of Demographics on Chest Radiographs: Looking Beyond Deep Learning for Risk of Bias. *American Journal of Roentgenology*. doi: 10.2214/AJR.24.31963  
Online first — Paper

2. Kamel, P.*#, Khalid, M., Steger, R., Kanhere, A., **Kulkarni, P.**, Parekh, V. S., Yi, P. H., Bodanapally, U., & Gandhi, D. (2024). Dual Energy CT for Deep Learning-Based Segmentation and Volumetric Estimation of Early Ischemic Infarcts. *Journal of Imaging Informatics in Medicine*. doi: 10.1007/s10278-024-01294-5  
Online first — Paper

3. Chatterjee, D.*, Kanhere, A.*, Doo, F. X., Zhao, J., Chan, A., Welsh, A., **Kulkarni, P.**, Trang, A., Parekh, V. S., & Yi, P. H.# (2024) Children Are Not Small Adults: Addressing Limited Generalizability of an Adult Deep Learning Organ Segmentation Model to the Pediatric Population. *Journal of Imaging Informatics in Medicine*. doi: 10.1007/s10278-024-01273-w  
Online first — Paper • Code

4. Kamel, P.*#, Kanhere, A., **Kulkarni, P.**, Kahlid, M., Steger, R., Bodanapally, U., Gandhi, D., Parekh, V. S., & Yi, P. H. (2024). Optimizing Acute Stroke Segmentation on MRI using Deep Learning: Self-configuring Neural Networks Provide High Performance using only DWI Sequences. *Journal of Imaging Informatics in Medicine*. doi: 10.1007/s10278-024-00994-2  
Online first — Paper

5. **Kulkarni, P.***, Kanhere, A., Siegel, E., Yi, P. H., & Parekh, V. S.# (2024). ISLE: An Intelligent Streaming Framework for High-Throughput AI Inference in Medical Imaging. *Journal of Imaging Informatics in Medicine*. doi: 10.1007/s10278-024-01173-z  
Online first — Paper • Code

6. Doo, F. X.*#, **Kulkarni, P.**, Siegel, E., Toland, M., Yi, P. H., Carlos, R. C., & Parekh, V. S. (2024). Economic and environmental costs of cloud for medical imaging and radiology artificial intelligence. *Journal of the American College of Radiology, 21*(2), 248-256. doi: 10.1016/j.jacr.2023.11.011  
Paper

7. Bachina, P.*, Garin, S. P., **Kulkarni, P.**, Kanhere, A., Sulam, J., Parekh, V. S., & Yi, P. H.# (2023). Coarse Race and Ethnicity Labels Mask Granular Underdiagnosis Disparities in Deep Learning Models for Chest Radiograph Diagnosis. *Radiology, 309*(2), e231693. doi: 10.1148/radiol.231693  
Paper

### Peer-Reviewed Conference Proceedings

1. **Kulkarni, P.***, Kanhere, A., Yi, P. H., & Parekh, V. S.# (2024). From Isolation to Collaboration: Federated Class-Heterogeneous Learning for Chest X-Ray Classification. In *Proceedings of the 4th Machine Learning for Health Symposium* (In Press). PMLR.  
Paper • Code

2. Chan, S.*, **Kulkarni, P.**, Yi, P. H., & Parekh, V. S.# (2024). Expanding the Horizon: Enabling Hybrid Quantum Transfer Learning for Long-Tailed Chest X-Ray Classification. In *Proceedings of the 2024 IEEE International Conference on Quantum Computing and Engineering (QCE)*. IEEE (In Press).  
Spotlight Talk — Paper • Code

3. **Kulkarni, P.***, Chan, A., Navarathna, N., Chan, S., Yi, P. H., & Parekh, V. S.# (2024). Hidden in Plain Sight: Undetectable Adversarial Bias Attacks on Vulnerable Patient Populations. In *Medical Imaging with Deep Learning* (pp. 785-813). PMLR.  
Spotlight Talk — Paper • Code

4. Kanhere, A.*, **Kulkarni, P.**, Yi, P. H., & Parekh, V. S.# (2024). Privacy-Preserving Collaboration for Multi-Organ Segmentation via Federated Learning from Sites with Partial Labels. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops* (pp. 2380-2387). doi: 10.1109/CVPRW63382.2024.00244  
Paper • Code
   o Winner of **Best Poster Award**, DCA-in-MI Workshop, CVPR'24

### Book Chapters

1. Parekh, V. S.*#, **Kulkarni, P.**, Kanhere, A., & Jacobs, M. A. (2024). Expanding the Federated Horizon: Cross-Domain Techniques for Collective Intelligence. *In Federated Learning for Medical Imaging: Principles, Algorithms and Applications* (In Press). The MICCAI Society Book Series, Elsevier.

### Review Articles

1. Yi, P. H.*#, Bachina, P., Bharti, B., Garin, S. P., Kanhere, A., **Kulkarni, P.**, Li, D., Parekh, V. S., Santomartino, S. M., Moy, L., & Sulam, J. (2024). Pitfalls and Best Practices in Evaluation of Algorithmic Biases in Radiology. *Radiology* (In Press).

## Preprints

1. **Kulkarni, P.\***, Kanhere, A., Yi, P. H., & Parekh, V. S.[#] (2023). Text2Cohort: Facilitating Intuitive Access to Biomedical Data with Natural Language Cohort Discovery. *arXiv preprint arXiv:2305.07637*.
2. **Kulkarni, P.**, Kanhere, A., Siegel, E., Yi, P. H., & Parekh, V. S. (2023). One Copy Is All You Need: Resource-Efficient Streaming of Medical Imaging Data at Scale. *arXiv preprint arXiv:2307.00438*.
3. **Kulkarni, P.**, Kanhere, A., Yi, P. H., & Parekh, V. S. (2023). Optimizing Federated Learning for Medical Image Classification on Distributed Non-IID Datasets with Partial Labels. *arXiv preprint arXiv:2303.06180*.
4. Ji, Z., **Kulkarni, P.**, Neskovic, M., Nolan, K., & Xu, Y., (2022). Exploring Semantic Perturbations on Grover. arXiv preprint arXiv:2302.00509.

## INVENTIONS, PATENTS, AND COPYRIGHTS

1. Parekh, V. S., **Kulkarni, P.**, Kanhere, A., Yi, P. H., & Siegel, E. Systems and Methods for High-Throughput Analysis for Graphical Data. International Patent Application No. WO/2024/233969 – Published November 14, 2024.

## PRESENTATIONS, ABSTRACTS, AND SHORT PAPERS

*\* Presenting author*

1. **Kulkarni, P.\***, Kanhere, A., Kukreja, H., Zhang, V., Yi, P. H., & Parekh, V. S. (2024). Improving Multi-Center Generalizability of GAN-Based Fat Suppression using Federated Learning. *Medical Imaging with Deep Learning*. — Short Paper
2. **Kulkarni, P.\***, Kanhere, A., Savani, D., Chan, A., Chatterjee, D., Yi, P. H., & Parekh, V. S. (2024). Anytime, Anywhere, Anyone: Investigating the Feasibility of Segment Anything Model for Crowd-Sourcing Medical Image Annotations. *Medical Imaging with Deep Learning*. — Short Paper
3. Zhao, J.\*, Kanhere, A., **Kulkarni, P.**, Chatterjee, D., Parekh, V. S., & Yi, P. H. (2024). Using Deep Learning to Predict Knee Osteoarthritis. *Undergraduate Research Day 2024*, University of Maryland.
4. Kamel, P.\*, Khalid, M., Steger, R., Kanhere, A., **Kulkarni, P.**, Parekh, V. S., Yi, P. H, Bodanapally, U., & Gandhi, D. (2024). Is Dual-Energy CT Better for Deep Learning-Based Detection and Segmentation of Early Ischemic Infarcts on CT? *2024 American Society of Neuroradiology Annual Meeting*.
5. Kamel, P.\*, Kanhere, A., **Kulkarni, P.**, Khalid, M., Steger, R., Bodanapally, U., Gandhi, D., Parekh, V. S., & Yi, P. H. (2024). Assessing the Generalizability of Acute Stroke Segmentation using a Self-Configuring Neural Network Trained on Public Data. *2024 American Society of Neuroradiology Annual Meeting*. — Spotlight Talk
6. Kamel, P.\*, Khalid, M., Steger, R., Kanhere, A., **Kulkarni, P.**, Parekh, V. S., Yi, P. H., Bodanapally, U., & Gandhi, D. (2024). Cross-Modality Stroke Segmentation using Deep Convolutional Neural Networks for Detection of Acute Ischemic Infarcts on Non-Contrast Head CT. *2024 American Society of Neuroradiology Annual Meeting*.
7. **Kulkarni, P.\***, Hafey, C., Siegel, E., Yi, P. H., & Parekh, V. S. (2024). Medical Images On-Demand: Intelligent Streaming of Medical Images for High-Throughput AI Inference. *2024 Society for Imaging Informatics in Medicine Annual Meeting*. — Spotlight Talk, Abstract
8. Chan, A.\*, **Kulkarni P.**, Garin, S., Parekh, V. S., & Yi, P. H. (2024). More pixels, more bias? Comparing fairness of chest x-ray deep learning models trained with image vs. pixel-level annotations. *2024 Society for Imaging Informatics in Medicine Annual Meeting*. — Spotlight Talk, Abstract
9. Navarathna, N.\*, Chatterjee, D., Chan, A., **Kulkarni, P.**, Kanhere, A., Parekh, V. S., & Yi, P. H. (2024). From Download to ML: Challenges in Directly Using the MIDRC Dataset for Machine Learning and Enhancing its Usability. *2024 Society for Imaging Informatics in Medicine Annual Meeting*. — Spotlight Talk, Abstract
10. Chan, S.\*, **Kulkarni, P.**, Navarathna, N., Murphy, Z., Venkatesh, K., Sulam, J., Parekh, V. S., & Yi, P. H. (2024). Vision Transformers are More Robust to Real-World Medical Image Variations than Convolutional Neural Networks. *2024 Society for Imaging Informatics in Medicine Annual Meeting*. — Abstract
11. Kim, J.\*, **Kulkarni, P.**, Welsh, A., Garin, S., Chatterjee, D., Kanhere, A., Parekh, V. S, & Yi, P. H. (2023). Sex Bias in Pediatric Deep Learning Chest Radiograph Classifier Model. *Medical Student Research Day 2023*, University of Maryland School of Medicine. — Spotlight Talk
12. Kavandi, H.\*, **Kulkarni, P.**, Garin, S., Bachina, P., Parekh, V. S., & Yi, P. H. (2023). Risk of Bias in Chest X-Ray Radiomics Models: Looking Beyond Neural Networks. *Radiological Society of North America 109th Scientific Assembly and Annual Meeting*. — Spotlight Talk
13. Kamel, P.\*, Kanhere, A., **Kulkarni, P.**, Khalid, M., Steger, R., Bodanapally, U., Gandhi, D., Parekh, V. S., & Yi, P. H. (2023). Quantifying the Technical Challenges and DICOM Metadata Variability in Stroke Machine Learning Data Curation. *Radiological Society of North America 109th Scientific Assembly and Annual Meeting*. — Spotlight Talk

14. **Kulkarni, P.\***, Kanhere, A., Yi, P. H., & Parekh, V. S. (2023). From Isolation to Collaboration: Harmonizing Heterogeneous Medical Imaging Datasets with Partial Annotations. *2023 Conference on Machine Intelligence in Medical Imaging*.  Spotlight Talk [Abstract]

15. Bachina, P.\*, Garin, S., **Kulkarni, P.**, Kanhere, A., Sulam, J., Parekh, V. S., & Yi, P. H. (2023). Coarse Race and Ethnicity Labels Mask Granular Underdiagnosis Disparities in Deep Learning Models for Chest Radiograph Diagnosis. *2023 Conference on Machine Intelligence in Medical Imaging*.  Spotlight Talk [Abstract]

16. **Kulkarni, P.\***, Kanhere, A., Siegel, E., Yi, P. H., & Parekh, V. S. (2023). One Copy Is All You Need: Resource-Efficient Streaming of Medical Imaging Data at Scale. *2023 Conference on Machine Intelligence in Medical Imaging*.  [Abstract]

17. **Kulkarni, P.\***, Kanhere, A., Yi, P. H., & Parekh, V. S. (2023). Text2Cohort: Democratizing the NCI Imaging Data Commons with Natural Language Cohort Discovery.*2023 Conference on Machine Intelligence in Medical Imaging*.

18. Kanhere, A.\*, **Kulkarni, P.**, Yi, P. H., & Parekh, V. S. (2023). SegViz: A Federated Learning Framework to Train Multi-task Segmentation Models from Partially Annotated and Distributed Datasets. *Conference on Machine Intelligence in Medical Imaging*.

19. Bachina, P.\*, Garin, S., **Kulkarni, P.**, Kanhere, A., Kargilis, D., Parekh, V. S., & Yi, P. H. (2023). Not So Black and White: Confounders Mediate AI Prediction of Race on Chest X-Rays. *Machine Learning for Healthcare 2023*.

20. Kamel, P.\*, Kanhere, A., **Kulkarni, P.**, Parekh, V. S., & Yi, P. H. (2023). Optimizing Acute Stroke Segmentation: Do Additional Sequences Matter for Deep Learning Algorithms? *2023 Society for Imaging Informatics in Medicine Annual Meeting*.

21. **Kulkarni, P.\***, Kanhere, A., Yi, P. H., & Parekh, V. S. (2022). From Competition to Collaboration: Making Toy Datasets on Kaggle Clinically Useful for Chest X-Ray Diagnosis Using Federated Learning. *Medical Imaging meets NeurIPS Workshop, NeurIPS 2022*.  [Short Paper]

## GRANTS

### Active Grants

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| Jul 2024 – Jun 2027 | **(Key Personnel, 20%)** Subcontract PI: Vishwa S. Parekh<br>"Enabling Intuitive Access to Biomedical Data with Natural Language Queries"<br>ARPA-H Biomedical Data Fabric Toolbox<br>Total Direct Costs: $384,140 |

### Completed Grants

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| Apr 2023 – Dec 2023 | **(Key Personnel)** PIs: Vishwa S. Parekh, Paul H. Yi<br>"Amazon Experimental Credits"<br>Total Direct Costs: $9,998 (AWS Credits) |
| Oct 2022 – Sep 2023 | **(Key Personnel)** PI: Vishwa S. Parekh<br>"CheXViz: A collaborative learning medical imaging platform for chest x-ray diagnosis"<br>Total Direct Costs: $5,000 (GCP Credits) |

## MENTORING AND TEACHING

Throughout the ups and downs of my journey, mentorship has been just as important as research in getting me to this point. It was my mentors' guidance that inspired me to pursue a career in research and laid the foundation for my goal of becoming a professor. Recognizing the impact that mentorship had on my journey, I am committed to supporting others in the same way as an educator and mentor. My goal is to further equitable access to resources in STEM to set up every student for success and inspire the next generation of researchers.

### Teaching

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| 2021 – 2022 | Head Teaching Assistant | **Courses:** CMSC330 (Programming Language Paradigms); CMSC132 (Object-oriented Programming)<br>• Held weekly recitations for >200 students, exam review sessions for >2000 students, and one-on-one office hours with students. | Department of Computer Science, University of Maryland |

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| 2019 – 2020 | MATLAB Tutor | • Planned and restructured course materials for a hybrid classroom and managed >50 TAs.<br>• Provided one-on-one tutoring to students in MATLAB programming in linear algebra, multivariate calculus, and differential equations, tailored to their course and proficiency. | | Department of Mathematics, University of Maryland |

## Mentoring

### *Staff*

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| 2023 – 2024 | Andrew Chan | Research Assistant | Research and project mentor. His contributed to multiple studies on AI fairness and bias presented at conferences. | University of Maryland School of Medicine |
| 2023 – 2024 | Nithya Navarathna | Research Program Coordinator | Research and project mentor. Her work in imaging informatics resulted in a spotlight talk at *2024 SIIM Annual Meeting*. | University of Maryland School of Medicine |
| 2023 – 2024 | Skylar Chan | Research Assistant | Research and project mentor. His work resulted in a first-author publication and spotlight talk on quantum ML for medical imaging at *IEEE QCE 2024*. | University of Maryland School of Medicine |

### *MD Students*

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| 2023 – 2024 | Devina Chatterjee | Research and statistical mentor. Her work resulted in a first-author publication in *Journal of Imaging Informatics in Medicine* on generalizability of adult medical image segmentation models to pediatric patients. | University of Maryland School of Medicine |
| 2023 – 2024 | Jake Kim | Research and project mentor for his work on AI fairness and bias in pediatric patients. | University of Maryland School of Medicine |
| 2023 – 2024 | Annie Trang | Statistical mentor for her work on AI fairness and bias in FDA-approved tools. | University of Maryland School of Medicine |
| 2023 | Alexander Welsh | Research mentor for his work on AI interpretability and explainability using saliency maps. | University of Maryland School of Medicine |
| 2023 | Niket Patel | Research and project mentor on his work on the impact of medical image compression on AI. | Drexel University |
| 2023 | Sam Santomartino | Research mentor for her work on AI fairness and bias. | Drexel University |
| 2022 – 2023 | Daniel Kargilis | Research and project mentor for his work on AI interpretability and explainability using saliency maps. | Johns Hopkins University |

### *Undergraduate Students*

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| 2023 | Jerry Zhao | Research mentor for his work on using DL to predict knee osteoarthritis. | University of Maryland |
| 2023 | Noam Fox | Research mentor for her work on DL segmentation of knee bone and cartilage. | University of Maryland |
| 2021 – 2022 | Aasritha Sanikommu | Peer mentor as part of Iribe Initiative for Inclusion and Diversity in Computing (I4C). | University of Maryland |

## RECOGNITION

## Awards and Honors

| 2024 | Best Poster Award (Co-Author) | DCA-in-MI Workshop, CVPR'24 |
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| 2021 – 2022 | OMSE Academic Excellence Award | Office of Multi-Ethnic Student Education, University of Maryland |
| 2019 | FIRE Summer Fellowship | The First-Year Innovation and Research Experience Program, University of Maryland |
| 2019 | 125 Mile E-Bike Challenge Preliminary Design Competition Award | A. James Clark School of Engineering, University of Maryland |
| 2018 – 2022 | Semester Academic Honors (Dean's List) | Department of Computer Science, University of Maryland |

## LEADERSHIP AND ORGANIZATIONAL ACTIVITIES

### Leadership Activities

| 2019 – 2022 | President | CompuTerps | Student Organization |
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| 2019 | Committee Member | Student (Under)graduate Directing Organization | Student Organization |

### Journal Peer-Review Activities

| 2023 | Invited Reviewer, *Frontiers in Medicine (1)* |
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