Kimathi Kaai

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Education

Ph.D., Systems Design Engineering - University of Waterloo, ON, Canada — Sep. 2024 - Aug. 2028
Focus: Machine Learning (ML) and ML System Design | Advisors: Prof. Alexander Wong, Prof. Sirisha Rambhatla

M.A.Sc., Systems Design Engineering - University of Waterloo, ON, Canada — Sep. 2022 - Aug. 2024
Focus: Machine Learning (ML) and ML System Design | Advisors: Prof. Alexander Wong, Prof. Sirisha Rambhatla
Thesis: *Addressing Data Scarcity in Domain Generalization for Computer Vision Applications in Image Classification*

Awards and Honors

IBET Momentum Fellowship Award — Sep. 2024
4th Year Design Project I-Beam Award — Feb. 2022
Presidents Scholarship of Distinction — Sep. 2017

Skills

Programming: Python, C++, JavaScript
Tools: PyTorch, TensorFlow, MLflow, Tensorboard, Docker, Git, Slurm, Linux, and **i eat, breath and sleep vim**

Research Experience

Graduate Researcher - University of Waterloo, Waterloo, ON — Sep. 2022 - Present
- Advanced domain generalization computer vision techniques, demonstrating expertise in reducing dependency on labeled datasets with both empirical and theoretical approaches; presented early stages of this work at NeurIPS 2023 [3].
- Co-designed data-efficient ego-centric 3D human pose estimation models in collaboration with Nissan, enhancing factory worker training tools, culminating in the KDD 2023 published methodology Ego-STAN [2, 4].
- Addressed challenges of data scarcity in AI systems for visual defect segmentation through self-supervised learning, reducing dependency on annotated datasets by 20% in collaboration with Apple.

Work Experience

Deep Learning Developer Intern - Applied Brain Research, Waterloo, ON — Apr. 2021 - Sep. 2021
- Developed and optimized recurrent neural networks for wearable and computer vision applications, improving activity recognition accuracy by $\sim 2\%$ using ECG signals.

Computer Vision Software Engineering Intern - Cepton Technologies, Ottawa, ON — Jun. 2020 - Apr. 2021
- Optimized 3D point-cloud surface descriptors for LiDAR-based object recognition, achieving a $\sim 19\%$ boost in computational efficiency and a $\sim 5\%$ increase in vehicle detection accuracy.
- Developed a multimodal camera-LiDAR network integrating CNNs (UNet, DeepLabV3) for 3D point-cloud object recognition, reducing manual data annotation costs by $\geq 90\%$.

Hardware Design Intern - Evertz Microsystems, Markham, ON — Sep. 2019 - Dec. 2019
- Developed and debugged FPGA-based audiovisual broadcasting systems for Amazon and ESPN streaming services, leveraging C/C++ for high-performance functionality.
- Wrote data corruption detection modules for video IP packets with Python, reducing transmission error rates by 15%.

Software Engineering Intern - Vena Solutions, Toronto, ON — Jan. 2019 - Apr. 2019
- Built navigation wizards for financial platform integration using React and Redux, improving user onboarding efficiency.
- Diagnosed backend issues in Java 8 applications, resolving MongoDB and SQL Server transaction bottlenecks.

Research Papers

[1] **K. Kaai**, J. Kurien, M. Singh, C. Thomas, R. Vemulapalli, K. Lai, S. Rambhatla, A Wong. DiCoH: Towards Self-Supervised Pretraining for Semantic Segmentation in Scarce Homogenous Medical Domains. *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2024. **[Under Review]**

[2] J. Park, **K. Kaai**, S. Hossain, N. Sumi, S. Rambhatla, P. Fieguth. Domain-Guided Spatio-Temporal Self-Attention for Egocentric 3D Pose Estimation. *International Conference on Knowledge Discovery & Data Mining (KDD)*, 2023.

[3] **K. Kaai**, S. Hossain, S. Rambhatla. Are all classes created equal? Domain Generalization for Domain-Linked Classes. *Workshop on Distribution Shifts, Advances in Neural Information Processing Systems (NeurIPS)*, 2023.

[4] J. Park, **K. Kaai**, S. Hossain, N. Sumi, S. Rambhatla, P. Fieguth. Building Spatio-temporal Transformers for Egocentric 3D Pose Estimation. *Joint International Workshop on Egocentric Perception, Interaction and Computing (EPIC) and Ego4D, IEEE/CVF Computer Vision and Pattern Recognition Conference (CVPR)*, 2022.