Benjamin D. **Killeen**

Department of Computer Science, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD 21218

+1 (314) 651-6809 | killeen@jhu.edu | benjamindkilleen.com | benjamindkilleen | benjamindkilleen | Benjamin D. Killeen

Summary

A PhD Student at Johns Hopkins University, I am a member of the Advanced Robotics and Interests Computationally Augmented Environments (ARCADE) research group and the Computational Interaction and Robotics Laboratory (CIRL). My research interests include *computer vision*, *machine learning*, and *domain generalization*, focusing on applications in *robotic manipulation*, *medical imaging*, and *surgical robotics*.

Education

Johns Hopkins University

Baltimore, Maryland

PhD in Computer Science — *Aug 2019 - Present*

- *Primary Advisor:* Mathias Unberath, Gregory D. Hager.
- *Secondary Advisor:* Russel H. Taylor.
- *Funding:* LCSR Fellowhip for outstanding incoming PhD students.

University of Chicago

Chicago, Illinois

BA in Computer Science with Honors, Minor in Physics — *Sep 2015 - Jun 2019*

GPA: 3.806

- *Advisor:* Gordon Kindlmann.
- *Honors Thesis:* "Starting from Scratch: Deep Learning for Novel Scientific Image Analysis."

Research Experience

Johns Hopkins University

Baltimore, Maryland

Graduate Research Assistant — *Aug 2019 - Present*

- Collected county level demographic and infection data to model the spread of COVID-19 with machine learning, with Mathias Unberath, Jie Ying Wu, and others.
- Developing novel computer vision algorithm for "Patch-normalized Convolution: A Simple Technique for Improving Robustness to Noise in Deep Neural Networks."
- Investigating practical use-case for patch-normalized convolution in "Improved Generalization of Pelvis X-ray Landmark Detection," with Cong Gao.
- Developed deep reinforcement learning (DRL) algorithms for multi-stage robotic manipulation tasks, such as constructing blocks in stacks or rows, with Andrew Hundt.

University of Chicago

Chicago, Illinois

Undergraduate Research Assistant — *Mar. 2018 - Aug. 2019*

- Investigated general object detection in novel experiments for condensed matter physics, with Gordon Kindlmann and William Irvine.

Professional Experience

Intuitive Surgical

Sunnyvale, California

Incoming Research Intern — *Jun. 2019 - Sep. 2019*

- *Supervisor:* Omid Mohareri.

Epic Systems

Madison, Wisconsin

Software Development Intern — *Jun. 2018 - Aug. 2018*

- Developed custom machine learning functionality for SlicerDicer, a web-based tool empowering clinicians to investigate demographic statistics.
- Demonstrated proof of concept Aug. 29, 2018.

IBM Research - Almaden

San Jose, California

Research Intern — *Jun. 2017 - Aug. 2017*

- *Advisor:* Geoffrey Burr.
- Developed an algorithm (patent pending, see [1]) for accelerating convolutional neural networks on neuromorphic architectures, a type of analog processing unit for efficient evaluation and training.

Teaching

University of Chicago *Chicago, Illinois*

Teaching Assistant *Jan. 2019 - Aug. 2019*

- *Graduate-level TA:* "Machine Learning and Large Scale Data Ansalysis," with Yali Amit, Spring 2019.
  Wrote supplementary course material (available here) and taught weekly lab sessions on ML theory and practice.
  Anonymous student reviews available here.
- *Grader:* Scientific Visualization, Introduction to Computer Science I & II.

Publications and Patents

Publications

[6] C. Gao, X. Liu, W. Gu, **B. Killeen**, M. Armand, R. Taylor, and M. Unberath, "Generalizing Spatial Transformers to Projective Geometry with Applications to 2D/3D Registration," *arXiv:2003.10987 [cs]*, Mar. 2020. arXiv: 2003.10987 [cs].

[5] A. Hundt, **B. Killeen**, N. Greene, H. Wu, H. Kwon, C. Paxton, and G. D. Hager, ""Good Robot!": Efficient Reinforcement Learning for Multi-Step Visual Tasks with Sim to Real Transfer," *submitted to IEEE Robotics and Automation Letters*, Feb. 2020. arXiv: 1909.11730.

[4] **B. Killeen**, J. Y. Wu, K. Shah, A. Zapaishchykova, P. Nikutta, A. Tamhane, S. Chakraborty, J. Wei, T. Gao, M. Thies, and M. Unberath, "A County-level Dataset for Informing the United States' Response to COVID-19," *arXiv:2004.00756 [physics, q-bio]*, Apr. 2020. arXiv: 2004.00756 [physics, q-bio].

[3] X. Liu, Y. Zheng, **B. Killeen**, M. Ishii, G. D. Hager, R. H. Taylor, and M. Unberath, "Extremely Dense Point Correspondences using a Learned Feature Descriptor," *IEEE Conference on Computer Vision and Pattern Recognition*, Jun. 2020. arXiv: 2003.00619.

[2] J. Y. Wu, B. D. Killeen, P. Nikutta, M. Thies, A. Zapaishchykova, S. Chakraborty, and M. Unberath, "Changes in Reproductive Rate of SARS-CoV-2 Due to Non-pharmaceutical Interventions in 1,417 U.S. Counties," en, *medRxiv*, p. 2020.05.31.20118687, Jun. 2020. DOI: 10.1101/2020.05.31.20118687.

[1] S. Ambrogio, P. Narayanan, H. Tsai, R. M. Shelby, I. Boybat, C. di Nolfo, S. Sidler, M. Giordano, M. Bodini, N. C. P. Farinha, **B. Killeen**, C. Cheng, Y. Jaoudi, and G. W. Burr, "Equivalent-accuracy accelerated neural-network training using analogue memory," en, *Nature*, vol. 558, no. 7708, p. 60, Jun. 2018, ISSN: 1476-4687. DOI: 10.1038/s41586-018-0180-5.

Patents

[7] G. W. Burr and **B. Killeen**, "Efficient Processing Convolutional Neural Network Layers using Analog-Memory-Based Hardware," P201804196US02.

Selected Coursework

Graduate-level

Nonlinear Optimization II · Computer Integrated Surgery I & II · Deep Learning · Unsupervised Learning

Undergraduate

Machine Learning and Large Scale Data Analysis · Computer Vision · Operating Systems · Networks and Distributed Systems · Scientific Visualization · Programming Languages · Honors Combinatorics · Computer Systems · Honors Introduction to Computer Science I & II · Honors Algorithms · Honors Discrete Mathematics · Honors Calculus (with Spivak) · Multivariable Calculus · Statistical Models · Quantum Mechanics I & II · Classical Mechanics · Electricity and Magnetism · Waves and Optics · Honors Intro to Physics I & II Electronics

Honors & Awards

Mar. 2020 **COVID-19 Dataset Award (1st place, $1000)**
Online Kaggle Competition

Dec. 2019 **Intuitive Surgical Best Project Award (1st place, $600)** *Baltimore, MD*
"Deep Learning" Course, Group Project, Johns Hopkins University

Jun. 2019 **General Honors for Academic Achievement** *Chicago, IL*
University of Chicago

Skills

Machine Learning Image Classification, Object Detection, Image Segmentation, Pose Estimation, Depth Estimation
Domain Adaptation/Generalization, Deep Reinforcement Learning, Unsupervised/Self-supervised Learning

Programming Python, Tensorflow/Keras, PyTorch, C/C++, Haskell, Scala, SML, Java, MATLAB, Bash, HTML, LaTeX, Emacs-lisp

Software MacOS, Linux, Windows, Git, Slurm, Emacs