

# Sean Kulinski

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## EDUCATION

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Aug. 2019 – May 2023

### PhD of Engineering in Computer Engineering

Purdue University, West Lafayette, Indiana

- *Area of Study:* Machine Learning and Artificial Intelligence
- *Some Foci:* Domain Generalization/Adaptation, Computer Vision, Generative Modeling

Aug. 2015 – May 2019

### Bachelor's of Science in Electrical Engineering

Purdue University, West Lafayette, Indiana

- *Area of Study:* Automatic Controls

## PUBLICATIONS

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Present

- **Sean Kulinski**, Musfiquir Rahman, Murat Kocaoglu, David Inouye, "Causal Discovery via Latent Factor Distribution Alignment Across Environments" [Under review](#)

Mar 2023

- **Sean Kulinski**, Nicholas Waytowich, James Zachary Hare, David Inouye, "StarCraftImage: A Dataset For Prototyping Spatial Reasoning Methods For Multi-Agent Environments" *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. (CVPR) 2023*

Feb 2023

- **Sean Kulinski**, David Inouye, "Towards Explaining Distribution Shifts" *Under Review (Preprint Available)*, 2023.

April 2022

- **Sean Kulinski**, Saurabh Bagchi, David Inouye, "Towards Explaining Image-Based Distribution Shifts", *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition VDU Workshop. (CVPR)*, 2022.

Dec 2020

- **Sean Kulinski**, Saurabh Bagchi, David Inouye, "Feature Shift Detection: Localizing Which Features Have Shifted Via Conditional Distribution Tests", *Neural Information Processing Systems (NeurIPS)*, Dec 2020.

## RESEARCH EXPERIENCE

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Aug. 2019 – Present

### Machine Learning Research Assistant

Advisor: Dr. David Inouye, West Lafayette, Indiana

- Creating approach for casual discovery via aligning the latent distributions of data gathered from heterogeneous domains (e.g., tissue samples from different hospitals).
- Derived method for interpretable optimal transport for the purposes of explaining image-based distribution shifts to a human operator which can be used for system monitoring or knowledge discovery .
- Constructed a new large-scale CV dataset based on human matches of StarCraft II that exhibits complex and shifting multi-agent behaviors yielding 1.8 million images with multiple data representations such as ones that can be used as a drop-in replacement for CIFAR10 and MNIST.
- Created a light-weight machine learning algorithm which uses deep density models to detect shifts in distributions as well as determine which feature(s) are causing the shift, allowing for online monitoring with little additional overhead .

May 2018 - Aug. 2019

### Lead Undergraduate Researcher for Prosthetic Haptic Interfaces Project

Advisor: Dr. Hong Tan, West Lafayette, Indiana

- Began international collaborative research project with Centro di Ricerca "E. Piaggio" Lab from University of Pisa, Italy.
- Lead experiment to test effects of proprioceptive feedback of prosthesis delivered via skin stretching for upper limb prostheses.
- Developed GUI for data collection for human subjects with automatic data parsing.
- Designed and manufactured wearable motorized device to encode the state of robotic hand.

## WORK EXPERIENCE

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May 2022 – Aug 2022

### Data Scientist, (Natural Language Processing; Search)

**Microsoft**, Seattle, Washington

- Worked in M365 Research to develop Natural Language Processing (NLP) models to allow for better search relevance across Microsoft365 applications.
- Designed an NLP model that detects if multiple enterprise search queries have the same intent, for the main purpose of measuring the semantic change of a query alteration.
- Identified and explored knowledge gap between web search methods (e.g., Google search or Bing search) and enterprise search methods (e.g., Outlook search or Teams search).

Oct 2021 – May 2022

### Machine Learning Scientist (Computer Vision)

**AbbVie**, Remote [San Francisco, California]

- Led the design and development of a novel computer vision model for processing histopathological images for the purpose of cancer detection and downstream diagnosis.
- Developed robust high-performance pipeline for continuous analysis of whole slide images for deployment to consumers.
- Assisted in building a consumer-facing custom viewer+annotator web-app for displaying mappings and meta-statistics generated by the model.

May 2020 – Aug 2020

### Machine Learning Scientist, (Computer Vision)

**Lawrence Livermore National Laboratory**, Livermore, California

- Research position for identifying issues in state-of-the-art computer vision frameworks for detection of COVID-19.
- Built computer vision models to conquer some of these issues, such as being robust to spatial distribution shifts. The models were trained using Livermore's Sierra HPC system.
- Used Natural Language Processing techniques on parsed Material Science publications to create an interpretable deep model to aid in the discovery of new nanostructures and nanomaterials.

Jan. 2019 – Aug. 2019

### Software and Embedded Electrical Engineer

**Indiana Microelectronics**, West Lafayette, Indiana

- Developed Genetic Algorithm to automate and optimize design of transmission zero filters for Lockheed Martin.
- Designed automated testing of temperature drift for a closed-loop linear piezoelectric motor.
- Oversaw testing, calibration, and reworks for a phased-array filter system.

Aug. 2019 – Dec. 2019

### Graduate Teaching Assistant for ECE Senior Design

**Purdue University**, West Lafayette, Indiana

- Directed a lab of 16 students through the process of bringing a hardware/software project from idea to product.
- Acted as a Senior Engineer and Manager to four different projects simultaneously.
- Held external workshops in various ECE skills such as Python, PCB design, and device testing.

May. 2017 – Aug. 2017

### Robotics R&D Testing Engineer

**Stryker Corp.**, Fort Lauderdale, Florida

- Created dynamic power consumption measuring tool for loads on an arm-assisted surgical robot.
- Designed, laid out, and printed circuit board for high frequency and large duration measurements.
- Created tool for automatic formatting and parsing of raw input data for the purpose of immediate analysis.

## TALKS AND LECTURES

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*Feb 2023* **Understanding Distribution Shifts and How We Can Learn from Them**

Invited talk to Laboratory of Data Science to discuss my research on Distribution Shifts covering:

- What is Distribution Shift and why is it significant?
- Whether distribution/domain shifts can be seen as “a feature rather than a bug”?
- How can we use distribution shift explanations to learn actionable environmental information?
- How can training on real-world distribution shifts lead to better generalizable machine learning models?

*Feb 2022 - Mar 2022* **Current Methods in Domain Generalization**

Led five lectures on the current approaches in Machine Learning for Domain Generalization covering:

- What is Domain Generalization, and its main thrusts?
- Why do we want domain invariance, how is IRM different than ERM, and what are people doing now?
- Showed how data augmentation can be seen as a tool for domain generalization, with an example using *Mixup*.
- Additional methods in domain generalization such as Meta-Learning, Domain disentanglement, etc.

*Nov 2020 - Dec 2020* **Primer on using Optimal Transport in Machine Learning**

Led introductory lectures on applying Optimal Transport in Machine Learning with four sessions:

1. What is Optimal Transport?
2. How can Optimal Transport be computed?
3. Walking through toy problems of exact computation of Wasserstein distances, visualization with McCann interpolations, and approximation using entropic regularization and Sinkhorn iterations.
4. Optimal Transport applications in Machine Learning such as WGAN and domain adaptation.

*Sep 2019* **ECE Design Skills Workshop**

- Walked through how to use Python for automation and control of simple motorized and visual systems using a Raspberry Pi, stepper motors, and LCD screen.
- Showed process of laying out a printed circuit board design using Altium and how to output GERBER files for fabrication.
- Walked through PCB assembly process and showed suggested debugging practices for both hardware and software.

**SKILLS**

**Programming Languages and Frameworks** Python, Pytorch, AzureML, C, LaTeX, Bash, Batch, Git, Numpy, Pandas, Scikit Learn, Keras, Scipy, PyOT, OpenCV, Excel, Linux, Jupyter

**More Skills** Leading and working within teams, strong mathematics background, statistics, data analysis, development using high-performance computing systems, Microsoft Office, product research and design

**LEADERSHIP AND ACTIVITIES**

2015 - Present Co-leader of Purdue's ML Reading Group (Present), Conference Reviewer (NeurIPS, ICML, AIS-TATS), Led lectures involving Python and Altium (2019), Elected Executive Board Member of Alpha Tau Omega Leadership Development Fraternity (2017), Volunteer at Natalie's Second Chance Dog Shelter (Present), Eagle Scout and Avid Backpacker (Present)

**REFERENCES**

To hear more about my experience and skills, please contact me or one of my references below.

David Inouye, Ph.D.

- *Ph.D. Research Advisor*
- *Assistant Professor in School of Electrical and Computer Engineering*
- *dinouye@purdue.edu*

Saurabh Bagchi, Ph.D.

- *Advising Collaborator during Feature Shift Detection Project*
- *Professor in School of Electrical and Computer Engineering and in Computer Science (by courtesy) at Purdue University and Assistant Director of CERIAS security center*
- *sbagchi@purdue.edu*

Hong Tan, Ph.D.

- *Prosthetic Haptic Interfaces Project Advisor (Undergraduate Research Advisor)*
- *Professor in School of Electrical and Computer Engineering at Purdue University and Mechanical Engineering (by courtesy) and head of HIRL lab*
- *hongtan@purdue.edu*

David Masica, Ph.D.

- *Manager during the development of production-level CV histomics pipeline*
- *Director of Convergence AI and Data Analytics, AbbVie*
- *david.masica@abbvie.com*