Pulkit Katdare

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Education

- **University of Illinois at Urbana-Champaign** Aug 2018 - Aug 2024 (Expected)
  Ph.D in Electrical and Computer Engineering
  Leadership: Head Teaching Assistant
- **Indian Institute of Technology, Bombay** Aug 2013 - July 2018
  Bachelors and Masters in Mechanical Engineering
  Leadership: Operations Lead, IITB Mars Rover Team

Publications

- P.Katdare, S.Liu *&* K.Driggs-Campbell, *Off Environment Evaluation using Convex Risk Minimization*, Accepted International Conference on Robotics and Automation (ICRA), 2022
- P.Katdare, N.Jiang *&* K.Driggs-Campbell, *Marginalized Importance Sampling for Off-Environment Policy Evaluation* , Accepted Conference on Robot Learning (CoRL), 2022
- P.Katdare, S. Basu, P. Sattigeri, V.Chenthamarakshan, K.Driggs-Campbell, P. Das *&* L.Varshney, *Equivariant Few-Shot Learning from Pretrained Models*, Accepted to Conference on Neural Information Processing Systems (Neurips), 2023
- P.Katdare, *&* K.Driggs-Campbell, *Towards Provable Log Density Policy Gradient*, To be submitted to Annual Learning for Dynamics and Control Conference (L4DC), 2024
- P.Katdare, Shourya Basu, K.Driggs-Campbell *&* L.Varshney *Gauge Equivariant Deep Q-Learning on Discrete Manifolds*, Accepted to ICLR Workshop on Geometrical and Topological Representation Learning
- P.Katdare, S.Kadam, K.Joshi, N.Gupta *&* R.Banavar, *Trajectory Tracking Using Motion Primitives for the Purcell's Swimmer*, Proc. International Conference on Intelligent Robots and Systems (IROS), 2017

Professional Experience

- **Incorporating Knowledge in Visual Question Answering**, Amazon Inc. May 2022 - Aug 2022
  - Designed a transformer based language model capable of performing both information retrieval as well as knowledge based question answering using cross-attention evaluated on the WebQA dataset
  - Developed a model parallelisation methodology that allows for training a **4x-8x** larger language model by horizontally splitting them across multiple GPUs
  - Demonstrated an improvement of **2%** over the previous baseline on the retrieval task and a competitive performance on the question answering task
- **Mixture of Experts Model for Trajectory Prediction**, Motional Inc. (formerly Aptiv) Jun 2019 - Aug 2019
  - Designed a novel Mixture of Expert (MoE) model that incorporates both learning and physics based prediction model to create a common model for a different types of agents
  - Mitigated mode collapse in the classical MoE model by initially learning an expert model before estimating mode probabilities, allowing for seamless integration of pre-trained models
  - Achieved a **66%** enhancement in computational efficiency, concurrently boosting accuracy by **15%**

Key Projects

- **Equivariant Few-Shot Learning from Pretrained Models** Oct 2022 - May 2023
  Accepted to Neurips 2023
  - Co-designed Equizero, a generalizable algorithm that can utilize any prior pre-trained models like CLIP to generalize across a group equivariant task with zero fine tuning
  - Developed λ-*equitune*, a refined EquiZero variant for equivariant tasks with minimal fine-tuning
  - Achieved a **10%** improvement over the nearest baseline across a diverse range of tasks, including reinforcement learning, classification, natural language processing, and compositional generalization
- **Off Environment Evaluation using Convex Risk Minimization** Aug 2019 - Aug 2021
  Accepted to ICRA 2022 (Code)
  - Developed a convex risk minimization algorithm to assess robot performance by quantifying the Sim2Real gap between simulation and real-world data, utilizing both simulator and offline real-world data
  - Established a sample complexity bound on algorithm performance, showcasing a polynomial rate of convergence, a critical milestone that underscores the robustness and efficiency of our algorithm
  - Improved evaluation accuracy by **30%** across Sim2Sim tasks like GridWorld, Taxi, Cartpole and Reacher Environment as well as Sim2Real tasks like Kinova Gen3 Robot

- **Marginalized Importance Sampling for Off-Environment Policy Evaluation** Aug 2021 - Present
  Accepted to CoRL 2023 (Code)
  - Developed a novel min-max optimization procedure that utilizes simulator data along with real world offline data to allow validation of robot policies in an offline manner without the need for deployment
  - Proved that the error propagation due to the min-max optimization procedure decreases of the order of $O(n^{-1/2})$ with n being the sample size thus validating the effectiveness of our algorithm
  - Improved upon the state-of-the-art accuracy by **60%** for both Sim2Sim scenarios like Cartpole, and Halfcheetah; and Sim2Real sceanrio like the KinovGen3 robotic arm
- **Log Density Gradient for Offline Reinforcement Learning** Jan 2022 - Ongoing
  Submitted to Neurips 2023
  - Developed an algorithm to approximate the policy gradient of the Reinforcement Learning using state-action discounted distribution formulation by approximating the gradient of log density
  - Demonstrated the sample complexity to be of the order of $n^{-1/2}$ with n being the sample size
- **Simulator Enabled Offline Reinforcement Learning** November 2021 - Ongoing
  To be submitted to ICLR 2024
  - Developed an algorithm to learn optimal robot policy that uses limited offline data along with the simulator to provide reliable robot performance

Professional Services

- **Teaching Assistant**
  - Served as a Head Teaching Assistant overseeing a team of 10 teaching assistants, 16 course assistants and supervising 500 students
  - Nominated for the Harold Olsen best teaching award in the introduction to electronics course
  - Teaching experience spanning 12 semesters and across variety of domains like Control Systems, Introduction to Physics, Numerical Analysis, Introduction to Electronics, Probability for Engineering Applications
- **Computing Connections Fellowships** (CCF) January 2023-Present
  - Treasurer of Computing Connections Fellowship (CCF), aiding Ph.D. students facing adversity, including advisor conflicts and discrimination, to foster a healthier academic environment
  - Collaborating closely with Prof. Talia Ringer to secure grants and sustain CCF's mission
- **CSL Student Conference** August 2021-April 2022
  - Managed publicity for the in-house student conference at the Coordinated Science Laboratory
  - Secured the participation of 400 attendees in the inaugural virtual conference during the pandemic
- **ENVISION** August 2019-May 2020
  - Logistics Co-ordinator for ENVISION which promotes STEM education among school students

Miscellaneous

- **Operations Lead, Mars Society India, IITB** August 2016 - August 2018
  - In charge of streamlining operations for the design and deployment of a mars rover as part of an international competition, University Rover Challenge (URC) competing against 104 teams from 15 countries
  - Design and Development of the rover includes budget management of $20k without any cost over-runs
- **Research Intern, University of Maryland, College Town, USA** May 2016 - July 2016
  - Research intern collaborating with the CALCE lab in understanding failures in modern electronics chips
  - Assessed the impact of frequent electronic failures in laptops from the coastal region and attributed to high composition of potassium in these regions

Technical Skills

- C, C++, Python, Matlab, MySQL, Pytorch, Tensorflow, Github, ROS, Github, LaTeX, Powerpoint, Docker

Personal

- A dedicated fitness enthusiast who recently conquered a challenging 10k race, showcasing both my commitment to fitness and determination
- I maintain a semi-regular blog focused on policy as an amateur writer. You can follow it here
- A passionate reader primarily focused on history, economics, foreign policy, occasionally delving into fiction