Don Kurian Dennis

Research Fellow, Machine Learning & Optimization Group
Microsoft Research India
*Advisors: **Dr. Prateek Jain** & **Dr. Harsha Simhadri***

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Education

Indian Institute of Technology Patna — *India*
Bachelor of Technology, Computer Science and Engineering — *July '13 - May '17*

Research Interests

Primary: Theoritical and Applied Aspects of Resource/Systems Aware Machine Learning
Others: Machine Learning on Devices (Embedded Devices, IoT Devices, Autonomous Systems), ML Algorithms Co-designed with and for Efficient Devices and Systems, Machine Perception

Publications

Multiple Instance Learning for Sequential Data Classification on Resource Constrained Devices
Don Kurian Dennis, Chirag Pabbaraju, Harsha Simhadri, Prateek Jain
In *Advances in Neural Information Processing Systems (NIPS), 2018.* [Link]

GesturePod: Programmable Gesture Recognition for Augmenting Assistive Devices
Shishir Patil, **Don Kurian Dennis**, Chirag Pabbaraju, Harsha Simhadri, Manik Varma, Prateek Jain
In submission at *ACM Conference on Human Factors in Computing Systems (CHI)*, 2019.
Microsoft's demonstration at NIPS '18. [Link]

Workshop Presentations

Fast and Accurate Keyword Spotting with 5 kB Models
Don Kurian Dennis, Harsha Simhadri, Prateek Jain
Workshop on Machine Learning on the Phone and other Consumer Devices (MLPCD 2), NIPS 2018.

Talk-Bot: Federated Human Detection for Collaborative Multi-Angle Videography
Don Kurian Dennis, Harshit Singh, Karan Jakhar, Prashant Baghel
International Symposium on Embedded Computing and System Design (ISED), 2016.
***Runner-up**, ISED Grand Challenge.*

Single Cycle RISC-V Micro Architecture Processor and its FPGA Prototype
Don Kurian Dennis, Ayushi Priyam, Sukhpreet Virk, Sajal Agrawal, Tanuj, Arijit Mondal, Kailash Ray
International Symposium on Embedded Computing and System Design (ISED), 2017.

Research Experience

Faster Recurrent Networks: Feed-forward Approximations and Rolling Predictions
Advisors: Dr. Prateek Jain & Prof. Venkatesh Saligrama — *Ongoing,* ***Microsoft Research***

Exploring feed-forward approximations and rolling predictions for efficient RNN inference. Inspired by recent results that show that RNNs are well approximated by feed-forward networks in training and inference.

Object Detection for Resource Constrained Devices
Advisors: Dr. Prateek Jain & Prof. Venkatesh Saligrama — *Ongoing,* ***Microsoft Research***

Devising new computer vision techniques that can enable object detection on resource constrained devices. Current state of the art techniques have large working memory and compute requirements making them unsuitable for resource constrained devices.

Multiple Instance Learning For Fast and Accurate Sequential Data Classification [Preprint]
Advisors: Dr. Prateek Jain & Dr. Harsha Simhadri — *Jan - May '18,* ***Microsoft Research***

Developed a multiple-instance-learning based algorithm, EMI-RNN, that recovers the distinguishing signature of minimum length for each class in time series classification. Smaller signatures result in lower computational costs and effective use of classification model's capacity thereby improving performance while reducing compute by up to 72x. For nice data, showed linear convergence to global optimum in the number of non-noise samples in a non-homogeneous setting. ***(Accepted at NIPS '18)***

Machine Learning Based Gesture Recognition on Resource Constrained Devices [Preprint]
Advisors: Dr. Prateek Jain, Dr. Harsha Simhadri & Dr. Manik Varma *July - Dec, '17,* ***Microsoft Research***

Developed an efficient machine learning pipeline to enable *GesturePod*, a low resource microcontroller based device, to perform robust, low-latency gesture recognition. The ProtoNN algorithm powered prediction pipeline along with communication and storage stack works under 32kB RAM on a 48MHz processor.
(In submission, CHI '19 & Microsoft's demonstration at NIPS '18).

Keyword Spotting in Low Resource Settings
Advisors: Dr. Prateek Jain & Dr. Harsha Simhadri *Nov '17 - Sep '18,* ***Microsoft Research***

Developed a small, fast and accurate classifier based on LSTM and ProtoNN to enable real-time keyword spotting on Raspberry Pi3. Developed EMI-RNN to make it possible on even smaller devices (Raspberry Pi0, MXChip). ***(Demonstration part of NIPS '18).***

Talk-Bot: Federated Human Detection for Collaborative Multi-angle Videography [Prototype]
Advisors: Dr. Arijit Mondal & Dr. Jimson Mathew *Oct - Dec '17,* ***IIT Patna***

Developed a cluster of Raspberry Pi3s with a computer vision stack that collaborate with each other in real time to track a presenter so as to provide a multi-angle video stream to be used for cost efficient live streaming of talks. ***(Runner up at Grand Challenge, ISED '16)***

Nagging Naagin: The Q-Learning Snake [Demo, GitHub & Report]
Advisor: Dr. Arijit Mondal *Feb - April '17,* ***IIT Patna***

Taught an agent to play the classic game *Snake* through reinforcement learning. Created a custom version of the game to allow for a multi-bandit formulation (snake, adversarial food placement). Implemented and analyzed various search and RL algorithms — reflex agents, min-max and expectimax trees, Q-learning and approximate Q-learning with DQN.

RISC-V Micro-architecture Processor for Embedded Devices [GitHub & Publication]
Advisor: Dr. Arijit Mondal *Thesis project,* ***IIT Patna***

Developed a RISC-V based single cycle micro architecture processor optimized for low-cost embedded devices, a bare bones simulator and an FPGA prototype. Additionally wrote a custom assembler-linker-loader tool chain to run native programs on the prototype. ***(Published at ISED '17)***

Internship Experience

Universal IoT Gateway with Disaster Resilient Communication Pathways [Report]
Advisors: Dr. Vishram Mishra & Prof. Lim H Beng *Summer Internship '17,* ***CSI, SUTD/NUS, Singapore***

Developed a Universal IoT Gateway - a gateway that can interact with any IoT device, regardless of its manufacturer or communication protocol (BLE, Bluetooth, WiFi or ZigBee). Works on an ontology based kernel that understands device specific properties and communication atoms. Protocol agnostic communication allows the device to double as a disaster resilient communication pathway - a mesh network at the MAC layer.

Multi-node BFS for Map-Reduce on Hadoop [GitHub & Report]
Advisor: Dr. Debajyoti Bera *Summer Internship '16,* ***IIIT Delhi***

Explored a new Breadth First Search algorithm with multi-point initialization for efficiency on the distributed map-reduce framework

WITCH on A Board [GitHub]
Advisors: David Anders & Tom King, Intel ***Google Summer of Code***

Developed the first complete simulation of the Harwell WITCH, a dekatron based computer used at the Atomic Energy Research Establishment, Oxfordshire during early 1950s. Worked with the very few details of its working that had survived and was declassified recently. ***(Helped win £50,000 funding.)***

Open Source Contributions

EdgeML: Machine Learning for Edge and End-Point Devices [GitHub]
Open Source ***Microsoft Research***

Core developer of EdgeML, Microsoft Research India's machine learning library for edge and end-point devices. Developed ProtoNN and EMI-RNN for EdgeML's Tensorflow submodule. Maintainer of the python codebase.

Mixxx: Open Source DJ Mixing Software [GitHub]
Open Source

Contributor to the Mixxx project. Worked on improving its Auto-DJ feature.

Entrepreneurial Experience

ChironX [Web]

Early Stage Technical Consultant

Worked with ChironX in their early stages as a consultant for their deep learning based diagnostic retinopathy solutions.

Weave

Co-founder ,

Co-founded a start-up called Weave, that had a nice product on human body visualizations and virtual trial rooms for fashion e-commerce for marginalized weavers of India. Secured a few clients, and garnered interest from investors but could not crack product-market fit or unit economics. Realized that fundamental flaws in strategies were overlooked. We had made the classic mistake of running after products without going through customer development.

Entrepreneurship Club, IIT Patna [Web]

Coordinator

Was coordinator of IIT Patna's Entrepreneurship Club for the 2015-2016 term. As part of E-Club, was responsible for encouraging and supporting entrepreneurial spirit in campus, hosting well known entrepreneurs for talks and interaction sections, organizing workshops on various relevant topics like patent filing, attracting investors etc. Was awarded **Certificate of Leadership** by the National Entrepreneurs Network of India.