

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

Machine Learning, Resource Efficient Machine Learning, Machine Learning on Devices (Embedded Devices, IoT Devices, Autonomous 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. [\[Link\]](#)

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 *Ongoing, Microsoft Research*
Supervisors: Dr. Prateek Jain

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 *Ongoing, Microsoft Research*
Supervisors: Dr. Prateek Jain & Prof. Venkatesh Saligrama

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 unsuitable for resource constrained devices.

Multiple Instance Learning For Fast and Accurate Sequential Data Classification [\[Preprint\]](#)
Supervisors: 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 results in smaller 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 [\[Preprint\]](#)

Supervisors: 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*).

Keyword Spotting in Low Resource Settings

Supervisors: 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*).

Nagging Naagin: The Q-Learning Snake

Supervisor: Dr. Arijit Mondal

[\[Demo, GitHub & Report\]](#)

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 and adversary who places food). Implemented and analyzed various RL algorithms - reflex agents, min-max tress, expectimax trees, Q-learning and approximate Q-learning.

Talk-Bot: Federated Human Detection for Collaborative Multi-angle Videography [\[Prototype\]](#)

Supervisors: Dr. Arijit Mondal & Dr. Jimson Mathew

Oct - Dec '17, **IIT Patna**

Developed a cluster of Raspberry Pi3s with a computer vision stack that collaborates 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*)

Universal IoT Gateway with Disaster Resilient Communication Pathways [\[Report\]](#)

Supervisors: 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 [\[GitHub & Report\]](#)

Supervisors: 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 [\[GitHub\]](#)

Supervisors: 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 little details of its working that had survived and was declassified recently. (*Helped win £50,000 funding.*)

RISC-V Micro-architecture Processor for Embedded Devices [\[GitHub & Publication\]](#)

Supervisors: Dr. Arijit Mondal

Thesis project, **IIT Patna**

Developed a RISC-V based single cycle micro architecture processor optimized for low-cost embedded devices, its 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*)

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.