

# Don Kurian Dennis

Research Fellow, Machine Learning & Optimization Group  
Microsoft Research India

Advisors: *Dr. Prateek Jain & Dr. Harsha Simhadri*

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## RESEARCH INTERESTS

**Primary:** Theoretical and Applied Aspects of Resource/Systems Aware Machine Learning  
**Others:** Machine Learning on Devices (Embedded Devices, IoT Devices, Autonomous Systems),  
Interpretable and Robust ML, Machine Perception

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## EDUCATION

**Indian Institute of Technology Patna**  
Bachelor of Technology, Computer Science and Engineering

*India*  
*July '13 - May '17*

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## 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. [\[Link\]](#)

**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. [\[Link\]](#)

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## WORKSHOP PRESENTATIONS

**EdgeML: Edge of Machine Learning**

Demonstration of key-word spotting on 5kB RAM

**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.*

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## RESEARCH EXPERIENCE

**Faster Recurrent Networks and Convolutional Networks**

Advisors: *Dr. Prateek Jain & Prof. Venkatesh Saligrama*

*Ongoing, Microsoft Research*

Exploring feed-forward approximations and rolling predictions for efficient RNN inference. Working on adapting these and other techniques like *tree like RNNs* to computer vision techniques to enable object detection on resource constrained devices. Inspired by recent theoretical advances in feed-forward approximations for recurrent networks.

**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 model 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

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## WORK EXPERIENCE

### Microsoft Research Lab India

Advisor: Dr. Prateek Jain & Dr. Harsha Simhadri

**Research Fellowship**

Working on developing theoretically sound and practical machine learning solutions for resource constrained edge devices.

### Center for Smart Systems, SUTD/NUS Singapore

[Report]

Advisors: Dr. Vishram Mishra & Prof. Lim H Beng

**Summer Internship '16**

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.

★ Currently being commercialized by ST Engineering

### Indraprastha Institute of Information Technology (IIIT), Delhi

[GitHub & Report]

Advisor: Dr. Debajyoti Bera

**Summer Internship '15**

Explored a new Breadth First Search algorithm with multi-point initialization for efficiency on the distributed map-reduce framework. Worked on *ear-decomposition* algorithms on Map-Reduce.

### Google Summer of Code '15

[GitHub]

Advisors: David Anders & Tom King, Intel

**Summer Internship '15**

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.

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## 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.

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## 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.