

# 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,** *Patna, India*  
*Bachelor of Technology, Computer Science and Engineering,* *Jul' 13 - Jul' 17*

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## RESEARCH INTERESTS

Machine Learning, Resource Efficient Machine Learning, Machine Learning on Devices (Embedded Devices, IoT Devices, Autonomous Systems), Machine Perception

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## PUBLICATIONS

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

**GesturePod: Programmable Gesture Recognition for Augmenting Assistive Devices**  
Shishir P, Don Kurian Dennis, Chirag P, Harsha Simhadri, Manik Varma, Prateek Jain  
In submission at *ACM Conference on Human Factors in Computing Systems (CHI)*, 2019. [\[Link\]](#)

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## WORKSHOP PRESENTATIONS

**Fast and Accurate Keyword Spotting with 5kB 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, A Priyam, Sukhpreet Virk, Sajal Agrawal, Tanuj S, Arijit Mondal, KC Ray  
*International Symposium on Embedded Computing and System Design (ISED), 2017.*

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## RESEARCH PROJECTS

**Faster Recurrent Networks: Feed-forward Approximations & Rolling Predictions**  
*Supervisors: Dr. Prateek Jain* *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**  
*Supervisors: 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 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 to 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 review, 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). (*Demo part of NIPS '18*).

## Nagging Naagin: The Q-Learning Snake

Supervisor: Prof. Arijit Mondal

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

Feb - April '17, IIT Patna

Taught an agent to play the classic *Snake* game 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: Prof. Arijit Mondal & Prof. 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: Prof. 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

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: Prof. 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*)

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## OPEN SOURCE & ACADEMIC PROJECTS

### EdgeML: Machine Learning for Edge and End-Point Devices [\[GitHub\]](#)

Open Source

Microsoft Research

Core developer of EdgeML, Micorosoft 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

## The CTF Framework

[GitHub]

## Open Source

IIT Patna

Developed a Django based framework for capture the flag competitions. Was deployed for the CTF competition that was part of IIT Patna's annual techno-cultural festival, Anwesha 2015.

## Sentiment Analysis on Twitter

*Academic*

IIT Patna

Implemented various models published at SemEval '16 for sentiment analysis on Tweets. Model implemented include simple algorithms such as Naive Bayes and more sophisticated LSTM based approaches.

## Network Simulator: CHORD, IRC and NS2

*Academic*

IIT Patna

Implemented a NS2 style discrete event network simulator with a fully functional transport and network layer. Implemented the P2P distributed hash table CHORD and an Internet Relay Chat Service on top of the simulator.

## AWARDS & ACHIEVEMENTS

2016 Runner up, **Grand Challenge**, ISED 2016

2016	Awarded Certificate of Leadership, <b>National Entrepreneurs Network</b> , India
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2015      Broze Medalist, **CodeStorm 2015** - Competitive Programming

2013 All-India-Rank 42 in **CUSAT** entrance exam amongst 40,000 candidates

2013 Was in top 0.3 Percentile in JEE Advanced 2013 amongst 150,000 candidates

## POSITIONS OF RESPONSIBILITY

2015-16      Coordinator, NJACK, Computer Science Club

IIT Patna

2015-16      Coordinator, Entrepreneurship Club

IIT Patna

2014-15 Sub-coordinator, Anwesh 15, IIT Patna's Annual Techno-cultural Fest

IIT Patna