

# Don Kurian Dennis

PhD Student, Machine Learning Department  
Carnegie Mellon University  
Advisor: *Prof. Virginia Smith*

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## RESEARCH INTERESTS

**Primary:** Theoretical and Applied Aspects of Machine Learning, Optimization, Statistical Learning  
**Secondary:** Systems for ML, Resource Efficient Inference and Training

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## EDUCATION

**Carnegie Mellon University**  
PhD, Machine Learning Department  
Courses: Optimization, Measure Theoretic Probability, High-Dim Stats, Advanced ML, Modern Algorithms.

August '19 -

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

July '13 - May '17

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## PUBLICATIONS

### Heteroginity For the Win: Communication Efficient Federated Clustering

Don Dennis, Virginia Smith

*Advances in Neural Information Processing Systems (NeurIPS), 2020 (SpicyFL Workshop).*

### Shallow RNN: Accurate Time-series Classification on Resource Constrained Devices

Don Dennis, Durmus Alp Emre Acar, Venkatesh Saligrama, Prateek Jain

*Advances in Neural Information Processing Systems (NeurIPS), 2019.* [\[Link\]](#)

### Multiple Instance Learning for Sequential Data Classification on Resource Constrained Devices

Don Dennis, Chirag Pabbaraju, Harsha Simhadri, Prateek Jain

*Advances in Neural Information Processing Systems (NeurIPS), 2018.* [\[Link\]](#)

### EdgeML: Edge of Machine Learning - Demonstration of Low resource Keyword Spotting

Don Dennis, Harsha Simhadri, Prateek Jain

*Advances in Neural Information Processing Systems (NeurIPS), 2018 (MLPCD2 Workshop).*

### GesturePod: Programmable Gesture Recognition for Augmenting Assistive Devices

Shishir Patil, Don Dennis, Chirag Pabbaraju, Harsha Simhadri, Manik Varma, Prateek Jain

*ACM Symposium on User Interface Software and Technology (UIST), 2019.* [\[Link\]](#)

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## WORK EXPERIENCE

### Microsoft Research Lab India

Advisor: Dr. Prateek Jain & Dr. Harsha Simhadri

July '17 - July '19, Research Fellowship

Working on bringing machine learning to severely resource constrained edge and end-point devices (IoT devices, embedded systems, etc). Research involved designing new and novel theoretical frameworks and algorithmic tools for such settings as well as implementing these algorithms on user-facing real-world systems.

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

[\[Report\]](#)

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

Summer Internship '16

Research involved building and analysing various ontologies for a protocol agnostic universal IoT Gateway.

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

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

Advisor: Prof. Debajyoti Bera

Summer Internship '15

Explored a new Breadth First Search algorithm with multi-point initialization for throughput efficiency on the distributed map-reduce framework. Also worked on developing 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. Simulator was built using extremely scarce schematics inferred from recently declassified documents.

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## RESEARCH EXPERIENCE

### Improving Parallelizability and Compute Reuse in RNNs

Advisors: Dr. Prateek Jain & Prof. Venkatesh Saligrama

Oct '18 - May '19, *Microsoft Research*

Building on top of recent works that theoretically justify replacing RNNs with feed forward networks, a middle ground is explored — infusing a shallow recurrence in the RNN model. This can capture long dependencies while still admitting parallelization or computation reuse for streaming data. Further, we also extend existing analysis with fairly weak assumptions that are verified experimentally.

★ Accepted to NeurIPS '19

### 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 exploits structure in data for faster classification. Showed linear convergence to global optimum in the number of non-noise samples in a non-homogeneous setting while improving inference speeds by up to 72x on real-world data.

★ Accepted at NeurIPS '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 NeurIPS '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 for *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.

★ Accepted to UIST '19 & Microsoft's demonstration at NeurIPS '18

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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.

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## REFERENCES

#### Virginia Smith

Assistant Professor,  
Machine Learning Department, CMU  
[smithv@cmu.edu](mailto:smithv@cmu.edu)

#### Prateek Jain

Sr. Principal Researcher  
Microsoft Research  
[prajain@microsoft.com](mailto:prajain@microsoft.com)

#### Harsha Vardhan Simhadri

Senior Researcher  
Microsoft Research  
[harshasi@microsoft.com](mailto:harshasi@microsoft.com)