# Ganga Meghanath

Data & Applied Scientist, Microsoft Bengaluru

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## Education

**Indian Institute of Technology Madras**
*Bachelor of Technology in Electrical Engineering*
*Minor: Data Analytics*
**GPA: 8.79/10** (9/10 in Data Science Courses)

## Interests

Reinforcement Learning, Deep Learning, Game Theory, Computer Vision and Robotics.

## Preprint

Ran Xu, Jinkyu Koo, Rakesh Kumar, Peter Bai, Subrata Mitra, **Ganga Meghanath**, Saurabh Bagchi."ApproxNet: Content and Contention Aware Video Analytics System for the Edge".

## Professional Experience

**Microsoft - Data &Applied Scientist, Bengaluru**
*(Manager: Rahul Agrawal, AI and Research, Microsoft, India)* *Jun '19 - Present*

*Aim* : Detection, rejection and removal of adversarial attacks on multi-media advertising such as Product Ads displayed anywhere by Microsoft that violates editorial policies.

- Developed effective data-mining techniques for sampling data that constitutes ∼1 in $10^6$ of the total number of incoming ads, where within each rare class there exists highly skewed diverse categories.
- Built Image-Text classifiers over multi-label space, trained on in-house data with extensions to state of the art Deep Learning architectures such as MobileNet, EfficientNet, CDSSM, BERT, etc.
- Developed and shipped models that can scale to billions of ads, ensuring nearly 99.9999% coverage, and at present processes close to 100 million incoming ads per day.

**Purdue University - Summer Intern, Dependable Computing Systems Lab**
*(Guide: Prof. Saurabh Bhagchi, Department of ECE, Purdue University)* *May '18 - July '18*

*Aim :* To create an architecture that enables runtime approximation during analytics on live video, captured at the edge device, using a single Deep Neural Network model.

- Trained the local executor offline on AWS EC2 instance, a ResNet-34 model with 6 output ports and Spatial Pyramidal Pooling to handle inputs of variable sizes (down-sampled frames).
- Evaluated the model on the NVIDIA Jetson TX2 embedded board to classify frames (30 runtime approximation tuning depending on image complexity and accuracy/latency requirements.).
- Created videos to demonstrate how ApproxNet adapts to different resource contention at runtime (paper available on arXiv; videos available at approxnet.github.io).

**PhotoGurus - Summer Intern, Cochin**
*(Guide: Laurent Martin, Co-Founder and CTO, PhotoGurus)* *May '17 - Jul '17*

*Aim :* To develop an architecture for auto-tagging and auto-selection of photographs using face similarity metrics and aesthetic rankings.

- Integrated AWS Rekognition APIs into the company's Rest Framework using Boto3 SDK & Python.
- Processed over 3 lakh images through Rekognition and EyeEm vision API and analysed the stored results on mongodb using the rankings, image tags, face details and orientation corrections.
- Created and analysed montage visualisations of extracted faces from the images categorized based on attributes such as 'emotion', 'smile', etc (sample available here).
- Gave a presentation on future applications of AWS Rekognition in this domain (Slides).

## Technical Skills

**Programming Languages**: Python, C/C#/C++, Tensorflow, MATLAB, Assembly (ARM)
**Embedded Systems:** Arduino, FPGA, Raspberry Pi, Atmega8.
**Operating Systems:** Linux(Ubuntu), Microsoft Windows.
**Other**: Robot Operating System (ROS), OpenCV, Amazon Rekognition, MySQL, LaTeX.

## Related Projects

**Modeling Ecological Populations⋆ - Game Theory**
*(Guide: Prof. Puduru Viswanadha Reddy, Department of EE, IIT Madras) Mar '19 - Apr '19*

*Aim :* To study the population convergence of N-player Hawk-Dove game using learned strategies.

- Developed static N-player Hawk-Dove game with interaction dependent pay-offs at each stage.(Slides)
- Studied convergence of the population w.r.t to MSNE using different strategy models & interactions.
- Injected inherent cooperation through code-of-conduct giving higher population pay-off than MSNE.
- Future work involves quantifying rewards of cooperation & using Informed Reinforcement learners.

**Improving robustness of neural networks against adversarial attacks - IIT Madras**
*(Guide: Prof. Mitesh Khapra, Department of CS, IIT Madras) Oct '18 - Feb '19*

*Aim :* Study of Adversarial attacks and Defence techniques for Machine Learning models.

- Conducted an exhaustive literature survey on state-of-the-art adversarial sample generation techniques and defense methods for DNNs (Graphs available at 1.Attacks, 2.Defense, 3.Overview).
- Successfully developed *Non-targeted* adversarial attacks and formulated reactive and proactive defence techniques for improving the robustness of visual question answer model TGIF-QA.
- Future work involves developing an effective defense method with high success rate on most attacks.

**Memory based Multi-tasking A3C Agent⋆ - Topics in Reinforcement Learning**
*(Guide: Prof. Balaraman Ravindran, Department of CS, IIT Madras) Jul '18 - Dec '18*

*Aim :* To build a memory-incorporated RL framework that can learn to do Multiple tasks through active learning, and effectively reduce catastrophic forgetting on a set of Atari Games.

- Conducted a study on multi-tasking algorithms and existing techniques for incorporating a form of memory in RL agents (One page summary available here).
- Established empirically that query-retrieval based memory (adapted from RMQN) improves the performance of an agent on single and multiple tasks by implementing three different agents augmented with memory and comparing their performances with memory-less agents.
- Built a Multi-tasking architecture called *Modularised Recurrent Memory-A3C* (MRM-A3C) that has a better regret optimality, sampling efficiency and performance, compared to its A3C baselines.
- Future work involves evaluating MRM-A3C on different combinations of games to check for negative transfers & challenging domains requiring short term memory and context vectors.

**A Hierarchical Approach to Multi Tasking⋆ - Reinforcement Learning**
*(Guide: Prof. Balaraman Ravindran, Department of CS, IIT Madras) Feb '18 - May '18*

*Aim :* To study and evaluate the performance Hierarchical Reinforcement Learning frameworks in multi-tasking domains using active sampling.

- Evaluated the performance of dmakian implementation of *Feudal Network* architecture (to generate temporally extended sub-policies) on multiple Atari games using OpenAI Gym environment.
- Integrated multi-tasking algorithms: Adaptive Active Sampling, Doubling UCB and Doubling DQN for active selection of games during training into *Option Critic* architecture using ALE.
- Future work involves using prioritized experience replay for Doubling DQN and simultaneous assignment of CPU threads for all the games based on selection probabilities.

**Weather data summarizer using encoder-decoder networks⋆ - Deep Learning**
*(Guide: Prof. Mitesh Khapra, Department of CS, IIT Madras) Apr '18 - May '18*

- Implemented a table summarizer for structured weather data using an encoder-decoder model comprising of an attention layer over a hierarchical bidirectional LSTM based encoder and LSTM decoder.
- Compared its performance to a uni-directional LSTM encoder-decoder model using BLEU-4 score.

**Word embeddings for native languages⋆ - Deep Learning**
*(Guide: Prof. Mitesh Khapra, Department of CS, IIT Madras) Mar '18 - Apr '18*

- Scraped data from over 30 websites to successfully construct a corpus of ∼15 million words in the Indian native language Malayalam (Corpus available here).
- Performed a comparative study on the effectiveness of existing word2vec models on the corpus.
- Developed custom metrics and test cases in Malayalam for model evaluation.

**Team Anveshak, University Rover Challenge - Center For Innovation (IIT Madras)**
*(Guide: Prof. T Asokan, Department of Engineering Design, IIT Madras)* *Oct '16 - Jun '17*

*Aim :* To build a remote operated all-terrain rover, complete with a robotic manipulator and digger, with an in-built autonomous navigation module. (Website)

- One of the 3 teams from India to get selected for University Rover Challenge held by Mars Society in Utah, finishing 29th out of 70+ teams from across the world at URC 2017 in our debut attempt.
- Developed novel heuristics for path planning for autonomous 6 wheel drive systems.
- Developed ROS meta-packages in C++ and Python, interfacing the robotic manipulator and on-board drive systems for seamless control.
- Implemented Computer Vision algorithms for identification and estimation of object distance, and a custom built radar using ultrasonic sensors.

⋆ *Course Project*

## Related Coursework

**Data Science**

- CS7015: Deep Learning
- CS6700: Reinforcement Learning
- CS4011: Principles of Machine Learning
- CS7011: Topics in Reinforcement Learning
- ID7123 : Machine Intelligence and Brain Research

**Other Relevant Courses**

- EE6418: Game Theory
- EE3004: Control Engineering
- ID6040 : Introduction to Robotics
- BT6270: Computational Neuroscience
- EE4371: Data Structures and Algorithms

## Leadership Experience

**Class Representative - B.Tech Electrical Engineering, IIT Madras**

- Elected to represent a batch of 130 students in the Class Committee and Department meetings.
- Successfully coordinated an additional course on Probability after much deliberation with the Dean of Academic Courses and the Head of the Department of Electrical Engineering.

**National Service Scheme, India**

- Taught Science and Math to underprivileged school students by conducting classes.
- Produced live video recordings on the usage of internet services for housewives and school students.
- Actively participated in collection drives for food and clothes for the underprivileged.

**Academic Mentor - Saathi, IIT Madras**

- Coordinator for a team that endeavors to identify challenges faced by the student community.
- Mentored 4 freshman from the Department of EE during the course of their first academic year.

**Coordinator - Saarang'17, IIT Madras**

- Coordinator for Saarang, one of the largest, completely student run, non-profit college fests in India.
- Organized a series of 3 different workshops and a live demonstration with the winner of "Culinary Olympics", Chef Umashankar and competitions judged by celebrity chef Vicky Ratnani.

## Extra & Co-curricular Activities

- Trained Classical *Bharatnatyam dancer* under the tutelage of Kalamandalam Smitha.
- Runner up in the *Big Data Challenge* conducted by *American Express* during Shaastra 2018.
- Winners on public leader-board and runners up on private leader-board among ∼30 teams, for the *Kaggle contest* held as part of the Machine Learning coursework.
- *Head Volunteer* for the Hostel during *Tech-Soc* (the Inter-Hostel Technical Competitions of IIT Madras) with prominent events: Manual Robotics, Autonomous Robotics & Reverse Coding.
- Participated and successfully completed the *Terry Fox Run* to spread awareness about cancer.

## References

**Balaraman Ravindran**

- Professor, Computer Science and Engineering; Head, Robert Bosch Centre for Data Science & AI
- Indian Institute of Technology Madras, Chennai
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