




# Ameya Prabhu

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## Research Interests

- > Continual Learning
- > Unsupervised Learning
- > Active Learning
- > Learning Theory
- > Network Compression
- > AI Alignment

## Past Interests —

- > Submodular Optimization
- > Language Modelling
- > Analysis of Codemixed Data
- > Information Extraction  
in Knowledge Graphs
- > Multimodal Representation  
Learning

## Selected Courses

- > Project: Modeling Deep  
Networks as Graphs
- > Project: Privacy in  
Computer Vision Datasets
- > Machine Learning
- > Computer Vision
- > Natural Language  
Processing
- > Artificial Intelligence
- > Digital Image Processing
- > Distributed Systems
- > Advanced Cryptography
- > Functional Programming
- > Advanced Data Structures
- > Advanced Algorithms

## Education

### D. Phil. in Engineering Science (Machine Learning)

Torr Vision Group, University of Oxford

Oct '20 - Present

CGPA: Nil

### B. Tech. (Honors) and MS by Research in Computer Science

Center for Visual Information Technology (CVIT), IIIT-H, India.

Aug '14 - Aug '19

CGPA: 8.94/10 (Top 10%)

## Thesis

**DPhil: Large-Scale Continual Learning** Advisors: Philip Torr, Puneet Dokania, Varun Kanade

The aim of my thesis is enable neural networks to continually align classification models with feedback and new data encountered after deployment in the real world. Our focus is on learning efficiency as repeated training becomes expensive very quickly with large-scale datasets. Parts of this project will get adopted by Facebook AI.

**Masters: Network Compression by Pruning and Quantization** Advisor: Anoop Namboodiri

I explored simple but effective methods to reduce overparameterization in networks using pruning and quantization allowing deployment of more compact, cheap CNNs. I asked the question "where to binarize" which gave a surprising performance improvements with little tradeoff in computational costs and demonstrated the power of random pruning with expander graphs beating state-of-the-art pruning methods. Parts of this project got adopted by Texas Instruments.

## Selected Publications

*Shyamgopal Karthik, Ameya Prabhu, Puneet Dokania and Vineet Gandhi. No Cost Likelihood Manipulation at Test Time for Making Better Mistakes in Deep Networks. ICLR 2021.*

This paper introduces a no-cost capability to amend mistakes using class heirarchies at inference time on pretrained networks, yet consistently yields large performance improvements on top-k heirarchical error compared to recent methods which train heirarchy-aware classifiers.

*Ameya Prabhu, Philip Torr and Puneet Dokania. GDumb: A Simple Approach that Questions Our Progress in Continual Learning. ECCV 2020 (Oral).*

We introduce a simple baseline GDumb which is not designed for CL problems, but obtains state-of-the-art accuracies in diverse benchmarks compared to a multitude of complex CL algorithms tuned for those benchmarks. This demonstrates that the current settings are oversimplified to an surprising extent, raising concerns regarding our progress in CL.

*Aurobindo Munagala, Ameya Prabhu and Anoop Namboodiri. STQ-Nets: Unifying Network Binarization and Structured Pruning. BMVC 2020.*

We show that these two paradigms are complementary, their combination obtaining high compression rates with little accuracy loss across several benchmarks. Intuitively, weights/activations closer to zero have higher binarization error making them good pruning candidates.

*Ameya Prabhu\*, Charles Dognin\* and Maneesh Singh. Sampling Bias in Deep Active Classification: An Empirical Study. EMNLP 2019.*

We show that simple uncertainty sampling with deep models exhibits negligible class, feature bias questioning recent trends towards diversity sampling. Also, samples collected actively correlate with supports of a SVM, effectively generate compact surrogate datasets (5x-40x compression).

*Ameya Prabhu\*, Girish Varma\* and Anoop Namboodiri. Deep Expander Networks: Efficient Deep Networks from Graph Theory. ECCV 2018 (Oral).*

We introduce a capability of pruning networks at intialization without using data by using intelligent inductive biases. We leverage Expander Graphs from TCS to develop sparse but highly connected networks. This property allows randomly pruned networks to beat several state-of-the-art pruning methods, discover better connectivity structures and allow training of larger sparse networks.

*Ameya Prabhu, Vishal Batchu, Rohit Gajawada, Aurobindo Munagala and Anoop Namboodiri. Hybrid Binary Networks: Optimizing for Accuracy, Efficiency and Memory. WACV 2018 (Oral).*

We investigate the question of *where* to binarize inputs and show that binarizing the right areas in the network could contribute significantly to speed-ups, without damaging the overall accuracy as compared to end-to-end binarized networks.

## ML Frameworks –

- > Deep Learning: PyTorch, Keras & Tensorflow
- > Parallel Computing: MPI, OpenMP & CUDA (Basic)
- > Small Experiments: OpenCV, SciPy, & Scikit-Learn
- > Languages: Python, C++ Java (Basic), Bash & Lua

## Peer Reviewing –

CVPR 2021  
ECCV 2020\*  
CVPR 2020\*  
ICCV 2019  
CVPR 2019\*  
\* Outstanding Reviewer

## Activities —

**Overall Coordinator**  
The Economics Club  
IIIT-H

**Captain**  
Table Tennis Mens Team  
IIIT-H

**Member**  
Student Constitution  
Drafting Committee  
IIIT-H

**Organizer**  
Kings of Machine Learning  
*Felicity '17*

**Writer**  
Eye to the Future  
Tech & Society Column, Ping!  
*Newsletter , IIIT-H*

**Ameya Prabhu, Vishal Batchu, Aurobindo Munagala, Rohit Gajawada and Anoop Namboodiri.** *Distribution-Aware Binarization of Neural Networks. WACV 2018 (Oral).*

We provide theoretical evidence that binary networks might potentially be as accurate as infinite-precision networks and present a distribution-aware approach to binarizing deep networks that allows us to better leverage expressiveness of a binary representations.

**Ameya Prabhu\*, Aditya Joshi\*, Manish Shrivastava, Vasudeva Varma.** *Towards Sub-Word Level Compositions for Sentiment Analysis of Hindi-English Code Mixed Data. COLING 2016.*

We introduce a capability to directly perform application-level tasks such as sentiment analysis, skipping the traditional CL annotation pipelines which become unscalable given with diversity in codemixed data. Subword-LSTMs incorporate nice linguistic priors in networks and automatically learn information like sentiment value of important morphemes.

**Koustav Ghosal, Ameya Prabhu, Riddhiman Dasgupta and Anoop Namboodiri.** *Learning Clustered Subspaces for Sketch Based Image Retrieval. ACPR 2015 (Oral).*

We show that assuming sketches and images belong to different modalities and establishing a cross-modal correspondence with Cluster-CCA allows for far better semantic (classwise) sketch-based image retrieval compared to traditional SBIR methods.

## Work Experience

**Machine Learning Intern, Verisk Analytics, Aug '18 - Jan '20**

Working on Uncertainty Estimation for Bayesian Deep Networks, Calibration of Neural Networks and Active Learning. Published in EMNLP '19 on the same.

**Machine Learning Intern, IBM-Research, India, May '18 - Aug '18**

Worked on performing trainless neural architecture search efficiently with limited computational resources, learning unsupervised representations for neural networks for IBM Watson, accepted in NeurIPS-W '19. Awarded best intern poster for outstanding research.

**Undergraduate Research Assistant - CVIT, IIIT-H, From Jan '16 - Aug '18**

Worked on developing compressed representations for limited resourced systems, starting off with neural network compression for CNNs in the domain of Computer Vision. Published two oral papers in WACV 2018 on Binary Networks as a part of the assistantship.

**Undergraduate Research Assistant - LTRC, IIIT-H, Jan '15 - Jan '16**

Worked on developing resources for enabling systems to work on low-resource Hindi-English Code-mixed data, along with contributing machine learning algorithms for the same. Published a paper in COLING on Sub-word LSTMs as a part of the assistantship.

## Teaching Assistantships 2015-2018

I contributed by teaching in tutorial sessions, setting and grading assignments, supervising course projects in the following courses:

- **Computer Vision (Spring '18):** The graduate-level introductory machine learning course (Instructor: Prof. Anoop Namboodiri, CVIT)
- **Foundations of AI and ML (Spring '18):** Introduction to machine learning in an educational initiative by IIIT-H for professionals. (Instructor: Prof. C.V. Jawahar, CVIT)
- **Statistical Methods in AI (Monsoon '17):** The graduate-level introductory machine learning course (Instructor: Prof. Vineet Gandhi, CVIT)
- **Digital Signal Analysis and App. (Spring '17):** The introductory undergraduate signal processing course (Instructor: Prof. Vineet Gandhi, CVIT)
- **Computer Programming (Monsoon '16):** The introductory undergraduate programming course (Instructor: Prof. Anoop Namboodiri, CVIT)
- **Electronics Workshop-1 (Spring '16):** The undergraduate freshman year course primarily designing analog circuits with a hands-on component involving handling lab equipment. (Instructor: Prof. Madhava Krishna, RRC)
- **Digital Logic and Processor Design (Monsoon '15):** The undergraduate digital processor design course consisting of boolean logic to sequential logic, ALU designs, and programming basic 8085-like processor (Instructor: Prof. Vijay Prakash, RRC)

## ML Projects

### **Neural Algorithm for Artistic Style in Sketches**, Spring'17

Implemented the style transfer paper to transfer color between two images experimenting with different loss functions for the content and style loss and extending it to color sketches, obtaining an automatic colorization method for sparse domains

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### **Unsupervised semantic sentence retrieval for use in Chatbot Systems**, Spring'16

Developed a system to semantically rank relevant domain-related sentences using KNN and Skip-thought vectors to the current sentences fine tuned on a scraped Reddit dataset and showed that it is better than using TF-IDF based inverted index.

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### **POS Tagging using Seq-Seq LSTMs posing it as SMT task**, Monsoon'16

Implemented a sequence to sequence system for POS Tagging by modeling it as a statistical machine translation task, aimed at capturing dependencies from all over the entire sentence, instead of a specific window of words. It failed to beat standard tagging methods.

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### **Structured Tensors for Large Scale SBIR**, Monsoon'15

Implemented a Sketch based Image Retrieval (SBIR) system using Structure Tensors & Sketch Tokens. This allows fast online addition of new images to the database and efficient querying them by new and old Sketches.

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### **NLIDB System for processing Natural Language Queries**, IASNLP Summer School '15

Developed a simple baseline Natural Language Interface to Database (NLIDB) system to convert a Natural Language (NL) query into a Structured Query Language (SQL) and then use the SQL query to retrieve information from databases.

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### **Programming Projects**, 2015-Present

- Implemented a distributed banking system, and cryptographic protocols using Diffie-Hellman Key Exchange Protocol using Java RMI.
  - Implemented various parallel algorithms like sorting, computing MSTs and the games like Game of Life in MPI.
  - Implemented a compiler for a subset of the C language using Flex and Bison for parsing, followed by generating ASTs and conversion to LLVM intermediate representations.
  - Implemented graph and string processing algorithms along Data Structures like Seg-Trees, AVL-trees, Hash-Maps for Data Structure and Algorithms courses.
  - Developed a mobile app security framework with a pipeline consisting of automatic decompilation from .apk to .java code, with static and dynamic code flow analysis along with various signature detection algorithms.
  - Developed a bash shell in C++.
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### **Past Achievements and Awards**,

- Dean's Merit List holder for outstanding performance in Academics.
  - Dean's Undergraduate Research Award holder for outstanding publications.
  - Best intern poster awardee, IBM-Research for research performed during internship.
  - Selected among the top 40 in India for International Chemistry Olympiad Training Camp (IChOTC)
  - Selected in KVPY programme by Indian Institute of Sciences (IISc) in top 100 in India
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### **Workshops, Conferences and Schools Attended**, 2015-2018

- Attended NeurIPS 2018 in Montreal, Canada and CVPR 2019, Long Beach to get more exposure to current research problems.
  - Completed the 1-week Undergraduate Summer School on Computer Science CSA, IISc Bangalore (CSAUSS 2016)
  - Completed the 2-week IIIT-H Advanced Summer School on NLP (IASNLP-2015)
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