Harish Rajagopal

Fourth Year Undergraduate

Computer Science and Engineering · Indian Institute of Technology Kanpur

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Educational Qualifications

Degree	Year	Institution/Board	CGPA/%
B. Tech	2016 - Present	IIT Kanpur	9.7/10.0
Sr. Secondary	2016	Maharashtra H.S.C	90.46%
Secondary	2014	Maharashtra S.S.C	93.6%

Academic Achievements

- Secured 7 **A⋆** grades in 6 semesters.
- Awarded **Academic Achievement Awards** for performance in 1st and 2nd years.
- Secured All India Rank of **185** in **JEE (Advanced) 2016** given by about 200 thousand students.
- Secured All India Rank of **205** in **JEE (Mains) 2016** given by about 1.4 million students.

Internships

- **Research Intern, NYU Tandon**   May '19 - Present
  Prof. Paweł Korus, Prof. Nasir Memon

  - Project on building a robust image hash that is immune to typical image transformations, while being sensitive to malicious image edits such as face swaps, deep fakes, object addition/deletion.
  - Constructed a binary hash, given an image, which would give lower *Hamming distances* for hashes of similar images while giving more considerable distances for dissimilar images.
  - Tested various novel network architectures on different loss functions, notably the triplet loss, along with *mining* of examples for improved training by targeting semi-hard examples, similar to *FaceNet*.
  - Tested the networks against adversarial attack methods such as *FGSM*, *Projected Gradient Descent*.

- **Research Intern (Remote), NYU Tandon**   May '18 - July '18
  Prof. Yao Wang   https://github.com/rharish101/Plasticity-Networks

  - Used *differentiable plasticity* for *domain transfer* using CNNs.
  - Tested three architectures on the *Street View House Numbers (SVHN)* dataset: standard ResNet, ResNet with plasticity on the fully-connected layer and ResNet with plasticity on all layers, using 20 and 56 layer variants.
  - Modified the standard temporal update rule for the *Hebbian matrix* (plastic weights) for convolutional layers by using transpose convolution for an efficient method of obtaining the plasticity update.
  - Used models trained on the SVHN dataset for the MNIST dataset by keeping the convolutional layers as feature extractors, with notable improvement in classification accuracy for the 20 layer models due to full plasticity.

- **Intern, Machine Learning Team, New York Office of IIT Kanpur**   May '17 - July '18
  Prof. Manindra Agrawal

  - Created an online document vectorisation model based on the *Distributed Memory paragraph vectors* model.
  - Created an online clustering model using a fully-online modification of *DBSCAN* optimised for discrete data.
  - Created and trained a *Word2Vec* model to compare scraped articles using *Word Mover's Distance*.
  - Trained a character recognition CNN with sliding windows for English Optical Character Recognition (OCR).

Projects

- **Improving GANs through Test-Time Constraints**   Jan '19 - Present
  Prof. Vinay Namboodiri and Prof. Chetan Arora   https://cse.iitk.ac.in/users/rharish/ugp2

  - Pre-trained *Generative Adversarial Networks* (GANs) are fine-tuned using *interactive user input*, inspired by the iGAN paper and the paper Exploiting Test Time Evidence to Improve Predictions of Deep Neural Networks.

- The user provides sketches of edges on a single output of the generator, and a *difference-of-Gaussians* based loss is backpropagated through the generator to fine-tune the generator's weights.
  - A regularisation term in the loss prevents the weights from deviating away from the weights learned initially.

- **Multi-Agent GANs for Image Super-Resolution** — Aug '18 - Dec '18
  Prof. Vinay Namboodiri — https://cse.iitk.ac.in/users/rharish/ugp1
  - A *Multi-agent generalisation* of SRGAN inspired by MADGANs for image super-resolution in *TensorFlow*.
  - Four generators (with shared lower layers) get the four corner sections of the input (with a slight overlap), and their outputs are joined (negating the overlap) to get the final high-resolution image.
  - Each generator pairs with a discriminator, while a global discriminator acts on the final output.

- **Higher-Order Optimisation in Deep Learning** — Sep '18 - Nov '18
  Prof. Piyush Rai, CS771A Course Project — https://github.com/rharish101/CS771-Project
  - A survey on the use of *quasi-Newton methods* in deep learning as part of a course.
  - Surveyed *Hessian-Free optimisation*, *AdaQN*, and *Sum of Functions Optimiser (SFO)*.
  - Hessian-Free optimisation was tested on an MLP against the *Adam* and SGD optimisers in *TensorFlow* on Python.

- **7th Inter-IIT Tech Meet (Silver Medal)** — Dec '18
  IIT Kanpur Contingent — https://github.com/rharish101/eye-in-the-sky
  - The Eye in the Sky: Semantic segmentation of satellite images using a dataset of only 14 images.
  - Won *2nd place* using the *P-Net* architecture, trained on an augmented dataset generated by slicing each image into multiple images and using rotations.
  - Tuned model hyperparameters using the *Tree of Parzen Estimators* method from the *Hyperopt* library.

- **Compiler for Golang in Python** — Jan '19 - April '19
  Prof. Amey Karkare, CS335A Course Project — https://github.com/rharish101/CS335A
  - A compiler for translating Golang to MIPS written in Python as part of a course.
  - Implemented basic C-like features like data types, variables, expressions, control statements (if-else, switch, loops), arrays, functions, pointers, structs, library imports, and I/O.
  - Implemented advanced features like composite literals, struct embeddings, typedefs/aliases, operator overloading, multiple value returns, multiple parallel assignments, short declarations, and short-circuit evaluation.

- **No-Frills Cab Locator - Android App** — Sep '18 - Nov '18
  Prof. Nisheeth Srivastava, CS252A Course Project — https://nfcl.pythonanywhere.com

- **6th Inter-IIT Tech Meet** — Dec '17 - Jan '18
  IIT Kanpur Contingent — https://cse.iitk.ac.in/users/rharish/sixth-tech-meet

- **Reinforcement Learning in Atari Games** — Jan '17 - Jul '17
  Association of Computing Activities, IIT Kanpur — https://github.com/rharish101/ACA-Project

- **Depression Therapy Chatbot** — May '17 - Jul '17
  Programming Club, IIT Kanpur — https://github.com/rharish101/PClub-Project

- **Visual Attention in Image Captioning (Mentored)** — May '18 - Jul '18
  Programming Club, IIT Kanpur — https://github.com/DEVANSH99/Image_cptning2018

Technical Skills

- **Programming Languages:** Python, Bash, C, C++, LaTeX, PHP, HTML+CSS, MySQL, Typescript
- **Software and Utilities:** TensorFlow, PyTorch, Keras, Numpy, Git, OpenCV, Hyperopt, Gensim, Ionic, AutoCAD

Relevant Courses

Visual Recognition	Introduction to Machine Learning	Computational Cognitive Science
Probability and Statistics	Discrete Mathematics	Introduction to Linear Algebra (A$\star$)
Algorithms II	Data Structures and Algorithms	Fundamentals of Computing (A$\star$)

Positions of Responsibility

- **Secretary**, Programming Club, IIT Kanpur — Aug '17 - April '18
- **Academic Mentor**, Counselling Service, IIT Kanpur — March '17 - Feb '18