

HARISH RAJAGOPAL

Fourth Year Undergraduate

Computer Science and Engineering · Indian Institute of Technology Kanpur

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EDUCATIONAL QUALIFICATIONS

Degree	Year	Institution/Board	Marks
B. Tech	2016 - Present	IIT Kanpur	9.7/10.0 CPI
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.
- 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. Pawel Korus, Prof. Nasir Memon
 - Project on building a robust image hash that is immune to common image transformations, while being sensitive to malicious image edits like face swaps, deep fakes, object addition/deletion, etc.
 - A binary hash is constructed given an image, which would give lower *Hamming distances* for hashes of similar images, while giving larger distances for dissimilar images.
 - Various novel network architectures are tested on different loss functions, notably the triplet loss, along with *mining* of examples for improved training by targeting semi-hard examples, similar to *FaceNet*.
 - The network is also tested against adversarial attack methods such as *Fast Gradient Sign Method*, *Basic Iterative Method*, *Projected Gradient Descent*, etc.
- **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.
 - Three architectures with two variants tested 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.
 - Models trained on the SVHN dataset were used 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 vectorization 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 GANs are fine-tuned during test time 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 originally learned weights.

• 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) are fed 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 has its own discriminator, along with a global discriminator for the final output.

• Higher Order Optimization 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.
- *Hessian-Free optimization*, *AdaQN*, and *Sum of Functions Optimizer (SFO)* were surveyed.
- Hessian-Free optimization was tested on an MLP against the *Adam* and *SGD* optimizers 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.
- Model hyperparameters were tuned 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.
- Basic C-like features like datatypes, 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 also implemented.

• 6th Inter IIT - Tech Meet

Dec '17 - Jan '18

IIT Kanpur Contingent

- Fiducial Localisation in Medical Images (<https://github.com/rharish101/Fiducial>): Used *Shi-Tomasi* algorithm to identify corners of fiducials after canny-edge detection, followed by *Hough transform* to capture circular faces.
- Exoplanet Detection (<https://github.com/rharish101/Exoplanet>): Implemented LSTMs combined with anomaly detection by fitting a beta distribution for a skewed dataset of sequences of light intensities of planets.

• Reinforcement Learning in Atari Games

Jan '17 - Jul '17

Association of Computing Activities, IIT Kanpur

<https://github.com/rharish101/ACA-Project>

- Used *Dynamic Programming* techniques for policy iteration and value iteration to solve a Model-based Markov Decision Process(MDP) in Python using OpenAI Gym environments.
- Implemented on-policy and off-policy *Monte Carlo* control, *SARSA*, *Q-Learning* Temporal Difference control and *DQNs* to solve Model-free MDPs.
- Wrote programs to learn playing Atari Pong using both Policy Gradients (using experience replay and fixed targets with an actor-critic using TD learning) and DQNs separately.

• Depression Therapy Chatbot

May '17 - Jul '17

Programming Club, IIT Kanpur

<https://github.com/rharish101/PClub-Project>

- Used a *Word2Vec* model to create a *Sentiment Analysis* model in Python using a Dual LSTM encoder in Keras.
- Implemented a chatbot using manually-created responses dependent on sentiment classification.
- Used the Heroku platform to host the bot and integrated it with Facebook Messenger in Python.

• Visual Attention in Image Captioning (Mentored)

May '18 - Jul '18

Programming Club, IIT Kanpur

https://github.com/DEVANSH99/Image_cptning2018

- *Mentored* a team of 3 students in creating an image-captioning framework based on *Visual Attention*.
- Soft-attention is used along with an LSTM decoder on features obtained through a VGG16 encoder.

- **Generalisation of Deep Learning Networks**

<https://github.com/rharish101/DLGeneralization>

- Self project to recreate the results of the paper Understanding Deep Learning Requires Rethinking Generalization.
- Implemented mini Inception, mini Alexnet and two different MLPs to classify images on CIFAR10, with and without regularisation, and with random labels.

TECHNICAL SKILLS

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

RELEVANT COURSES

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

POSITIONS OF RESPONSIBILITIES

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