# Ishu Dharmendra Garg | CS13B060

**Indian Institute of Technology Madras**

Many entities in resume have hidden hyperlinks, for more detail refer to underlying link
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## Education

**Indian Institute of Technology, Madras** **Aug 2013 - May 2018**[e]
***Dual Degree (B.Tech. and M.Tech.) in Computer Science and Engineering*; CGPA: 9.39/10** *Chennai, India*

- Major: **Computer Science and Engineering**; Minor: **Industrial Engineering**
- Key Courses:
  - **Artificial Intelligence**: Deep Learning[*](A), Natural Language Processing[*](A), Machine Learning[*](S), Kernel Methods[*](S).
  - **Math**: **Theory** - Convex Optimization[*](A), Number Theory[*](A), Linear Algebra(S), Probability(S), Graph Theory(A), Calculus I and II(S and B). **Application** - Economics(S), Operation Research(S), Industrial Engineering(S), Computer Simulations(A).
  - **Key Undergraduate Courses**: **Theory** - Data Structures and Algorithms[+], Distributed Network Algorithms[*], Topics in Complexity Theory[*], Language Machines and Computation. **Hardware** - Computer System Design[+], Computer Organization[+], Switching Theory and Digital Design[+]. **System** - Software Engineering[+], Operating Systems[+], Computer Networks[+], Introduction to Database Systems, Compiler Design[+], Principles of Communication.

[Grading Policy: S = 10, A = 9, B = 8 (out of 10); * : post-graduate level course; + : course with additional Lab course]

## Scholastic Achievements

- Selected as a **"Star Teaching Assistant"** by my department for making a significant difference to the course in a positive manner.
- Among fifty awardees selected for **S.N. Bose Scholarship** in India to be sponsored by the **Department of Science and Technology, Govt. of India** to undertake a research internship in the United States for the summer of 2017.
- Secured **16th rank** in **YouTube-8M Video Understanding Challenge**[!] 2017 hosted by **Google**.
- Secured **211st rank** in India under SX program in **Kishore Vaigyanik Protsahan Yojna** 2013 organised by **IISC**.
- Secured **1st rank** in machine learning contest conducted as a part of Machine Learning Course 2015 at IIT Madras [github link], [PDF].
- Placed under **national top 1%** students in India in **National Standard Examination in Physics** 2013 and represented my state in **Indian National Physics Olympiad** organised by **HBCSE TIFR**.
- Placed **under top 20** students in **Regional Mathematical Olympiad** 2011 in Chhattisgarh state and represented my state in **Indian National Mathematical Olympiad** 2012 organised by **HBCSE TIFR**.
- Institute topper in first semester and got a branch change to CSE Department based on academic excellence.
- Secured **rank 1053/1.4 million** in JEE Mains 2013 and **rank 899/150 thousand** in JEE Advance 2013 in India.

## Extra-Curricular Activities and Position of Responsibility

- Currently working with Ramakrishna Mission in Narainpur District, helping underrepresented high school students from Abujhmadh (Bastar, Chhattisgarh) to appear and qualify competitive exams like JEE, AIPMT etc.
- Currently working for child nutrition and education with an NGO called Childline India in Rajnandgaon, Chhattisgarh.
- Teaching Assistant for Computer System Design Course, where I plan logistics of course; design and evaluate assignments and coordinate with other fellow Teaching Assistants and the Professor.
- As a Saathi coordinator, mentored five freshmen for a year and helped them with any difficulties they might have faced.
- Taught English to visually challenged in a blind school at Chennai, India under NSS.
- Helped cheer up children suffering from cancer in children cancer hospital under NSS.
- Worked on beaches, protecting eggs of endangered turtle species under Students Sea Turtle Conservation with NSS.

## Professional Experience (Research)

**1. Machine Learning Department, Carnegie Mellon University** **May-July 2017**
*Learning of Structure and Motion from Video* *Prof. Katerina Fragkiadaki*

- Worked on 3-D geometry aware deep neural networks that decomposes frame-to-frame pixel motion in terms of camera motion, object depth, rotation and translation; predicts meaningful depth maps from the single monocular 2-d image, estimates motion and segments moving objects even though such supervision is never provided [github link].

**2. IBM Research Lab** **May-July 2016**
*Cognitive Dictionary Building and Sentence Template Matching for Unstructured Data* *Salil Joshi*

- Worked on unsupervised text mining, where we developed a ML pipeline model for mining sentences, events and entities from raw unstructured text in any natural language. achieving precision and recall of $0.76$ and $0.65$ on AP news Corpus.
  Code:[github link], Report:[PDF], Poster:[PDF]

## Key Projects (Research and Development)

**1. Visual Dialogue System** **December 2017-May 2018[e]**

*Dual Degree Project; Advisor: Prof. Mitesh Khapra*

- Developing intelligent multimodal visual dialogue systems using deep neural networks on Guess What?! dataset.

**2. Kaggle YouTube-8M Video Understanding Challenge[!] hosted by Google** **January - May 2017**

*Deep Learning Course Semester Project; Advisor: Prof. Mitesh Khapra*

- Multilabelled video classification on large dataset (1.7TB) and 4716 classes (3.4 labels/video); Rank: 16 of 655 teams, Team Name: IITM Utubers [leaderboard link].

**3. Polysemy Resolution in Word Embeddings** **August - December 2016**

*NLP Course Semester Project, Advisor - Prof. Sutanu Chakraborti* *IIT Madras*

- Suggested sense embedding to tackle polysemy in word2vec; outperforming word2vec on word similarity & relatedness. Problem Statement:[PDF], Report:[PDF], PPT:[PDF]

**4. Context Sensitive Spell Check** **July - August 2016**

*NLP Course Project, Advisor - Prof. Sutanu Chakraborti* *IIT Madras*

- Context sensitive Spell-checker utility based on the noisy channel model & word-cooccurence counts [PDF].

**5. Custom Linux Shell** **October - November 2016**

*Operating Systems Course Project, Advisor - Prof. Chester Rebeiro* *IIT Madras*

- Custom Linux shell that supports standard commands & operations like piping, forking, redirection etc in C.

**6. Algorithm Theatre** **April 2015**

*Advanced Programing lab Course Semester Project* *IIT Madras*

- Interactive Java API with 4K+ lines of code; gives animation of working of various data structures and algorithms with customized real time input given by the user. [github link], [YouTube link]

## Other Projects and Key Assignments

- **Development**

1. **Tic Tac Toe Game** - Implemented GUI based N×N Tic-Tac-Toe game in C where N is a user input.
2. **Sudoku Solver** - Implemented fast Sudoku solver in C.
3. **Big Int And Complex Number Library** - Implemented mathematical operations like addition, multiplication and division for Big-Int and Complex number in C.
4. **Library for DSA including Graph algorithms** - Coded a simple C library for many different graph algorithms and other complex data structures and algorithms.
5. **Functional Programming in Haskell** - Implemented several algorithms including graph algorithms in Haskell.
6. **Vehicle Counter** - Laser and sensor based intelligent and scalable working model which counts number of vehicles crossing campus gate without counting pedestrians which also calculates average speed and length of the vehicle [YouTube link].
7. **Computer Simulation Systems** - Designed and coded several Computer Simulation Systems such as Random Number generator, queues, stocks and inventory etc [github link].

- **Systems**

1. **JOS Operating System** - Modules for booting, memory management and preemptive multitasking in JOS Operating System [github link].
2. **Out-Of-Order Super-Scalar Processor Simulator** - Designed and coded processor simulator in C consisting of register-renaming, centralized reservation station, re-order buffer, operand forwarding, load forwarding features etc [github link].
3. **Associativity Experiments** - Coded a method to find out the Cache Address Translation Scheme and Replacement Strategy in Intel Processors [github link].
4. **'Ghost' Processor** - CPU model in Verilog with sixteen basic hardware operation like ADD, SHIFT etc under resource and time constraints using basic logic gates.
5. **Assembly Programming** - Basic programs including matrix multiplication and operating system primitives like segmentation, paging and task switching in x86 assembly language.
6. **Compression Codec** - Codec based on Huffman code. Simulated a small network to send large compressed files between two machines.
7. **Human Friendly Graph Language** - Defined a human friendly graph language; designed and implemented efficient compiler for the same.
8. **Language Translators** - Designed and coded language translators translating high level language to assembly language.

- **Artificial Intelligence**

1. **Spam Filter** - A ML model for classifying spam emails.
2. **Machine Learning & Pattern Analysis:** Bandit Problems [PDF], Extensive ML experiments on classification using C-SVM and $\nu$-SVM each with different kernels, Decision Trees, Deep Convolutional Neural Networks, Restricted Boltzmann Machine, Random Forests etc [PDF1] [PDF2] [PDF3] [PDF4]
   Dimensionality reduction techniques using PCA, autoencoders and stacked autoencoders etc; regression using Deep Neural Networks, Gaussian Mixture Models, C-SVM, $\nu$-SVM, Random Forests etc; novelty detection using K-Means, Kernel K-Means etc; clustering using K-Means, Kernel K-Means, DB Scan, Hierarchchal etc; unsupervised learning [PDF1] [PDF2] [PDF3]
3. **Neural Networks with Back Propagation from Scratch** - Implemented Neural Networks and Back Propagation algorithm from scratch in Matlab for multi-class classification.
4. **Bounds on LSTM gradients** - Proved and demonstrated how LSTMs solves the vanishing gradient problem [PDF].

## Professional Skills

- ***Languages***: Proficient in C and comfortable with Python, Java, C++, Matlab, Haskell, X86 Assembly Language, SQL
- ***Tools and Libraries***: TensorFlow, Scikit-Learn, Numpy, Gensim, NLTK, Latex, Eclipse, Sublime-Text, Weka

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e : expected date; ! : no coding contribution;