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## Education

Indian Institute of Technology, Madras

**Dual Degree (B.Tech. and M.Tech.) in Computer Science and Engineering; CGPA: 9.39/10**

Aug 2013 - May 2018<sup>e</sup>

Chennai, India

○ Major: **Computer Science and Engineering**; Minor: **Industrial Engineering**

○ Key Courses:

- **Artificial Intelligence**: Deep Learning<sup>\*</sup>(A), Natural Language Processing<sup>\*</sup>(A), Machine Learning<sup>\*</sup>(S), Kernel Methods<sup>\*</sup>(S).
- **Math: Theory** - Convex Optimization<sup>\*</sup>(A), Number Theory<sup>\*</sup>(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<sup>+</sup>, Distributed Network Algorithms<sup>\*</sup>, Topics in Complexity Theory<sup>\*</sup>, Language Machines and Computation. **Hardware** - Computer System Design<sup>+</sup>, Computer Organization<sup>+</sup>, Switching Theory and Digital Design<sup>+</sup>. **System** - Software Engineering<sup>+</sup>, Operating Systems<sup>+</sup>, Computer Networks<sup>+</sup>, Introduction to Database Systems, Compiler Design<sup>+</sup>, Principles of Communication.

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

## Professional Experience (Research)

1. **Machine Learning Department, Carnegie Mellon University**

*Learning of Structure and Motion from Video*

May-July 2017

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**

*Cognitive Dictionary Building and Sentence Template Matching for Unstructured Data*

May-July 2016

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**

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

December 2017-May 2018<sup>e</sup>

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

2. **Kaggle YouTube-8M Video Understanding Challenge<sup>1</sup> 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**

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

August - December 2016

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**

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

July - August 2016

IIT Madras

- Context sensitive Spell-checker utility based on the noisy channel model & word-cooccurrence counts [[PDF](#)].

5. **Custom Linux Shell**

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

October - November 2016

IIT Madras

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

6. **Algorithm Theatre**

*Advanced Programming lab Course Semester Project*

April 2015

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](#)]

e : expected date; ! : no coding contribution;

## Key Scholastic Achievements (in chronological order)

- Selected as a **"Star Teaching Assistant"** for being an active and efficacious Teaching Assistant for Computer System Design course where I helped plan logistics, designed and evaluated assignments and helped to make the solution manual of the course textbook.
- 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 **16<sup>th</sup> rank** in **YouTube-8M Video Understanding Challenge<sup>1</sup>** 2017 hosted by **Google**.
- Secured **1<sup>st</sup> rank** in machine learning contest conducted as a part of Machine Learning Course 2015 at IIT Madras [[github link](#)], [[PDF](#)].
- Institute topper in first semester and got my major changed to Compute Science and Engineering 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.
- Secured **211<sup>th</sup> rank** in India under SX program in **Kishore Vaigyanik Protsahan Yojna** 2013 organised by **Indian Institute of Science**.
- 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**.

## Other Important Projects and Assignments

### Development

- Tic Tac Toe Game** - Implemented GUI based N×N Tic-Tac-Toe game in C where N is a user input.
- Sudoku Solver** - Implemented fast Sudoku solver in C.
- Big Int And Complex Number Library** - Implemented mathematical operations like addition, multiplication and division for Big-Int and Complex number in C.
- Library for DSA including Graph algorithms** - Coded a simple C library for many different graph algorithms and other complex data structures and algorithms.
- Functional Programming in Haskell** - Implemented several algorithms including graph algorithms in Haskell.
- 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](#)].
- Computer Simulation Systems** - Designed and coded several Computer Simulation Systems such as Random Number generator, queues, stocks and inventory etc [[github link](#)].

### Systems

- JOS Operating System** - Modules for booting, memory management and preemptive multitasking in JOS Operating System [[github link](#)].
- 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](#)].
- Associativity Experiments** - Coded a method to find out the Cache Address Translation Scheme and Replacement Strategy in Intel Processors [[github link](#)].
- 'Ghost' Processor** - CPU model in Verilog with sixteen basic

hardware operation like ADD, SHIFT etc under resource and time constraints using basic logic gates.

- Assembly Programming** - Basic programs including matrix multiplication and operating system primitives like segmentation, paging and task switching in x86 assembly language.
- Compression Codec** - Codec based on Huffman code. Simulated a small network to send large compressed files between two machines.
- Human Friendly Graph Language** - Defined a human friendly graph language; designed and implemented efficient compiler for the same.
- Language Translators** - Designed and coded language translators translating high level language to assembly language.

### Artificial Intelligence

- Spam Filter** - A ML model for classifying spam emails.
- 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, Hierarchical etc; unsupervised learning [[PDF1](#)] [[PDF2](#)] [[PDF3](#)]
- Neural Networks with Back Propagation from Scratch** - Implemented Neural Networks and Back Propagation algorithm from scratch in Matlab for multi-class classification.
- 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

## 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; 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 National Service Scheme IITM.
- Helped cheer up children suffering from cancer at children Cancer hospital by interacting and playing with them under National Service Scheme IITM.
- Worked on beaches, protecting eggs of endangered turtle species under Students Sea Turtle Conservation society.