

# Nishant Rai

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## EDUCATION

April 2017	B.Tech (COMPUTER SCIENCE AND ENGINEERING)	IIT KANPUR	9.9/10.0
April 2013	Class XII (CENTRAL BOARD FOR SENIOR EDUCATION)	K.V. DELHI	96.20 %
April 2011	Class X (CENTRAL BOARD FOR SENIOR EDUCATION)	K.V. SHILLONG	10.0/10.0

## ACADEMIC ACHIEVEMENTS

- Received **Charpak Research Scholarship** for the year **2015**.
- Received the **Academic Excellence Award** for exceptional academic performance in **13-14** and **14-15** academic session.
- Secured AIR - **257** in **JEE (Advanced) 2013** and AIR - **79** in **JEE (Mains) 2013**.
- One amongst the **6 INMO Awardees** selected for **IMO training camp**, after clearing **INMO '13**.
- Awarded Gold medal for being selected for **IPhO training camp**, after clearing **INPhO '13**.
- Awarded **Ashray Hasta Award and Scholarship, 2013** for exceptional performance in **AISSCE, 2013**.
- Selected for the prestigious **KVPY** scholarship, in stream **SX**.
- Secured **Rank 1** in **Regional Mathematics Olympiad '12** (Delhi Region).

## ACHIEVEMENTS IN PROGRAMMING

- Secured **1<sup>st</sup>** place in **Microsoft CodeHunt** amongst individuals from over the country. Selected for **finals** in **China**.
- Secured **13<sup>th</sup>** place in **IOPC** (International Online Programming Contest) amongst **900+** teams from over the world held during **Techkriti '15**.
- Secured **1<sup>st</sup>** place in the event **Chaos** (Esoteric Programming Contest) held during **Techkriti '15**
- Secured **17<sup>th</sup>** place in **Morgan Stanley Codeathon 2014** amongst **1000+** individuals from over the country.
- Secured **26<sup>th</sup>** place in **ACM ICPC Onsite Contest 2014** amongst **250+** teams from over the country.
- Secured **1<sup>st</sup>** place in the **Web-dev** event during **Takneek '14** (Inter-Hostel Technical Competition).
- Secured **1<sup>st</sup>** place in the programming event **Blackbox** during **Takneek '13** (Inter-Hostel Technical Competition).

## INTERNSHIPS

### X.R.C.I

Xerox Research Center India  
Bangalore, India

### RESEARCH INTERNSHIP

Dec '15

#### MULTI VIEW CLUSTERING VIA NON NEGATIVE MATRIX FACTORIZATION:

Mentored by Om Deshmukh, Senior Researcher (Area Manager, Multimedia Analytics), XRCI and Sumit Negi, Principal Researcher, XRCI, for developing and evaluating algorithms for Multi View Clustering using Non Negative Matrix factorization.

- Literature Survey on **existing work** and **Variants** of Multi View Clustering: **Partial/Constrained Multi View Clustering**.
- Studied various algorithms for optimization including **Greedy Coordinate Descent**, **Alternating Least Squares**, Method of **alternate Optimizations**, **Augmented Lagrangian** methods. **Formulated update rules** for our methods based on them.
- Proposed, implemented and evaluated several models to tackle the Partial Multi View problem. **Outperform** existing models.
- Artificially created Partial View data and ran experiments on them. Used both **Image** and **Textual** data to analyze the performance of our algorithms with previous work according to different clustering metrics.
- Studied the effect of **Graph Regularization** on the results and the effect of **varying Kernels** on it.

### I.N.R.I.A.

The French Institute for Research in Computer Science and Automation  
Rocquencourt, France

### RESEARCH INTERNSHIP

May '15 - Jul '15

#### ALTERNATE PATHS IN ROAD NETWORKS:

Mentored by Laurent Viennot, Senior Researcher, INRIA and Adrian Kosowski, Researcher, INRIA, for finding routes substantially different from the shortest path based on different criteria.

- Implemented various **shortest path** algorithms and compared their efficiency on **real world road networks**.
- Proposed algorithms to compute paths according to another feasible definition.
- Created **measures** to **compare** different algorithms developed efficient algorithms for the involved computations.

#### FEATURE BASED REPRESENTATION OF SOCIAL NETWORKS:

Mentored by Adrian Kosowski, Researcher, INRIA, finding good local features which are suitable predictors for global features

- Studied **information spread models** and about maximizing spread, **Local Ranking** problem, **Pagerank** algorithm.
- Implemented and studied randomized **rumor spreading**, the relation between size and steps for spread of the rumor
- Studied and explored different **local features** in graphs based on **walks**, **subgraph densities**, **centrality measures** and their relation with other **global properties** along with arguments to explain the obtained results.

# PROJECTS

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## DEEP LEARNING FOR VISUAL QUESTION ANSWERING:

MAR '16 - APR '16

- **Course Project** for course CS676A: Computer Vision and Image Processing, under Prof. Vinay Nambodiri.
- Project aimed at constructing Neural Network-based models for **Answering Open-ended questions** about images.
- Task reduced to **multi-class classification** after selecting the top K answers from the training set, and restricting the final output.
- Image embeddings are activations of the last layer of a **Convolutional Neural Network** (pre-trained on the **ImageNet** dataset).
- Question embeddings are computed using the **Glove Word Vectors** of the constituent words and **LSTM Networks**.
- **Multiple methods** used for combining the embeddings and their effect on the performance was studied. The entire network (except the CNN for image features) is trained **End-to-End**.
- Studied about **Spatial-Attention** and **External Knowledge** Based Models for Visual Question Answering. Implemented a **Semantic-Attention** model, where the attention cues are extracted using the question.

## REAL-TIME VEHICLE AND LICENSE PLATE RECOGNITION:

FEB '16 - APR '16

- **Course Project** for course CS771A: Machine Learning: Tools and Techniques, under Prof. Harish Karnick.
- Project aimed at **Real-time vehicle Recognition** along with **Extracting Registration Numbers** from the **License Plates** of four-wheelers in real world **surveillance** videos.
- Proposed method involves processing the video frames to extract **candidate regions** containing vehicles. **Tracking** performed using **inter-frame information** and **SIFT-based interest point matching**.
- Performed classification on the proposed regions using **SVMs**, **Random Forests**, **CNNs** and **Ensembles** (Boosted through **AdaBoost**).
- Studied the effect of the different features (Such as **HOG**, **SIFT** and **CNN** based features) on the performance.
- License plate **localized** after processing the candidate region. **OpenALPR** used to further narrow and extract the Vehicle number.

## ADA COMPILER:

JAN '16 - APR '16

- **Course Project** for the completion of the course CS335A: Compiler Design, under Prof. Subhajit Roy.
- Project involved creating an **End-to-End Compiler** for a subset of the programming language **ADA** in the **x86** architecture.
- Implemented a **Lexical Analyzer** and **Assembly-Code Generator** in python, constructed grammar rules for parsing our identified language and created the **TAC** (Three Address Code) for intermediate code. Used **Yacc** and **Lex** for the same.
- Implemented basic types, operations for **Strings**, **Library support**, **Short circuiting**, conditionals, **Loops** with strict **type-checking** and error handling. Implemented **functions** (Allowed **overloading**) with multiple return values and scopes.

## ADAPTIVE STRATEGIES FOR INFINITE PRISONER'S DILEMMA:

JAN '16 - APR '16

- **Case Study** for the completion of the course ECO502A: Applied Game Theory, under Prof. Vimal Kumar.
- Studied existing literature on the work related to **Prisoner's Dilemma** and the analysis of the Infinite Case.
- Implemented and studied the performance of both Single-Objective and Multi-Objective **Evolutionary Algorithms** to compute good strategies for the same. Confirm results proposed by **Axelrod** by conducting tournaments amongst multiple strategies.
- Proposed new **adaptive** strategies based on **Reinforcement Learning** and study its performance by conducting various experiments.
- Studied about methods such as **Q-Learning**, **Deep Reinforcement Learning** and its possible applications in learning new strategies.

## WORD EMBEDDINGS WITH MULTIPLE WORD PROTOTYPES:

AUG '15 - NOV '15

- **Course Project** for course CS671A: Introduction to Natural Language Processing, under Prof. Amitabha Mukherjee.
- Project aimed at constructing of **Multiple Sense Embeddings** for different words using purely **unsupervised approaches**.
- Proposed algorithms involved **Online clustering**, analysis of Word-Word **co-occurrence matrix** and **Non-parametric clustering** using penalties based on **Negative Sampling**.
- **Outperform existing methods** in **Local Similarity** Metric and **comparable** in terms of other metrics, result in more semantically coherent senses than the state of the art methods.

## NACHOS OPERATING SYSTEM:

JULY '15 - NOV '15

- **Course Project** for course CS330A: Operating Systems, under Prof. Mainak Chaudhuri.
- **Extended** the **NachOS** operating system to perform basic operating system functions including **Fork**, **Join**, **Sleep** and **Exec**.
- Implemented and evaluated performance of various algorithms for scheduling processes.
- Developed and added support for **Demand Paging**, **Shared Memory**, **Condition Variables** and **Semaphores**.

## MULTI MODAL EMOTION RECOGNITION:

MAY '14 - JUN '14

- Project aimed at performing **Emotion Detection** using three features i.e. **textual**, **speech** and **visual**.
- Recognition of facial expressions using **Eigenfaces**. Further narrowed down the features by detecting important parts such as Eyes, Nose, etc using **Haar Cascade** Classifiers.
- Used **acoustic features** of audio such as **Mel Frequency Cepstral Coefficients (MFCC)** to extract sentiment out of speech.
- Merged the results of the three classifiers to identify emotions more accurately.
- Learnt about **Facial Action Codings**, **Active Shape/Appearance Models** and other prevalent methods for emotion classification.

## GEOMETRIC DATA STRUCTURES:

SEP '14 - NOV '14

- Project for **Advanced Track** in course CS210: Data Structures and Algorithms, under Prof. Surendar Baswana.
- Project involved **re-invention**, **implementation** and **analysis** of **geometric** data structures to efficiently answer given queries.
- Developed efficient algorithms for maintaining **Dynamic Convex Hulls** and **Range Search Queries**.
- **Queries handled**: Point in Polygon, Polygon-Line intersection, Simplex problem, Orthogonal Range Search, Half Plane problem.

## NEWS REPORT CLASSIFICATION:

JAN '14 - APR '14

- Project aimed at **classifying news articles** into various categories.
- Trained **Naive Bayes Classifier** after processing the article text (**Tokenisation, Stemming, removing Stopwords**, etc)
- Implemented **K Nearest Neighbors** and **automated scraping** of online news articles for collection of Training data.

## SENTIMENT ANALYSIS OF SOCIAL MEDIA:

AUG '14

- Application developed during **Web-Dev, Takneek '14** and secured **First** position.
- Interface to analyze the past and present **social sentiment of brands** and **their products**.
- Identifies the **"good" and "bad" features** of the product to act upon them.

## OTHER MINOR PROJECTS:

- Created models for **Predicting Search trends, Topic Assignment** based on keywords, **Spam Detection** and **Multi-Label Question classification** (Tested on questions taken from **Quora**).
- Implemented a **Captcha Decoder**, able to work with some level of noise. **Clustering** and **Segmentation** based methods used for extracting candidate regions containing characters.
- Completed project to discover patterns and trends about the **New York Subway**, under the **Udacity** course: **Intro to Data Science**.

## TECHNICAL SKILLS

Programming Languages (PROFICIENT):

C, C++, PYTHON, MATLAB, GNU OCTAVE, ASSEMBLY (VERILOG)

Programming Languages (FAMILIAR):

JAVA, CSS, JAVASCRIPT, PHP, MYSQL

Software and Utilities:

GIT, GNUMPLOT, L<sup>A</sup>T<sub>E</sub>X, AUTOCAD, INVENTOR

## INTERESTS

Algorithms and Data Structures

Artificial Intelligence

Competitive Programming

Computer Vision

Machine Learning

Natural Language Processing

## POSITIONS OF RESPONSIBILITY

Jan '15 - Current

**Member, Core Team Academics, Counseling Service**

Responsible for managing remedial lectures, mentor allotment and other academics related issues.

Managing a team of 100+ Academic Mentors to help and guide academically troubled students.

Assisting peer students in departmental courses by conducting classes as well as personal tutoring.

Aug '14 - Mar '15

**Senior Executive, Public Relations, Techkriti '15, IIT Kanpur**

Responsible for inviting eminent personalities for talks, shows and looking after their publicity and hospitality

Responsible for smooth conduction of 5 talks and 2 shows in the festival along with other teammates.

Managed a team of 15 members to organise TechPlanet which witnessed footfall of over 3000 people

Apr '14 - Apr '15

**Secretary, Programming Club**

Jun '14 - Apr '15

**Academic Mentor (MTH101/102), Counselling Service**

Jun '14 - Apr '15

**Student Guide, Counselling Service**

Previous

**Secretary, Hospitality Cell, Udghosh '14**

**Volunteer, Hospitality Cell, Udghosh '13**

## RELEVANT COURSES

**ESC101** : Fundamentals of Computing

**CS201** : Discrete Mathematics

**Udacity**: Intro to Data Science

**CS203** : Abstract Algebra

**CS345** : Algorithms - II

**CS252** : Computing Laboratory - II

**CS676** : Computer Vision and Image Processing

**MTH101** : Analytical Calculus

**CS210** : Data Structures and Algorithms

**CS251** : Computing Laboratory

**CS220** : Computer Organization

**CS330** : Operating Systems

**CS671** : Natural Language Processing

**CS335** : Compiler Design

**MTH102** : Linear Algebra and DE

**Coursera**: Algorithms

**CS202** : Mathematical Logic

**MSO201** : Probability and Statistics

**CS340** : Theory of Computation

**CS771** : Machine Learning: Tools and Techniques

\* - ONGOING

## EXTRA-CURRICULAR ACTIVITIES

Secured **1<sup>st</sup>** place in **Reviews** - Lifestyle event in **Spectrum '14** (Inter-Hostel Competition).

Secured **1<sup>st</sup>** place in **Tennis (Singles)** in **Freshers' Inferno '13** (Inter-Hostel Sports Competition).

Selected for **CBSE Tennis Regionals** (Guwahati Region), 2009.

Selected for participation in **U-17 Inter School Table-Tennis Tournament**, Shillong in 2010.

Secured **1<sup>st</sup>** place in **U-17 Tennis Open** held at Basava International School, New Delhi in 2011.