

VIPUL SINGH

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Interests

Statistical Machine Learning, Optimization, Learning Theory
Natural Language Processing, Artificial Intelligence

Education

- 2014-15 **MS in Computer Science**, *Carnegie Mellon University, Pittsburgh*, QPA: 4.07/4
- 2010-14 **B.Tech in Computer Science and Engineering with Honours, and Minor in Mathematics**, *Indian Institute of Technology, Bombay*, GPA: 9.77/10 - **Ranked 1st in the department**
- 2010 **All India Senior School Certificate Examination**, *MGM Senior Secondary School, Bhilai*, 96.20% - CBSE Merit Certificates for being in the top 0.1% in India in Physics, Chemistry and Maths
- 2008 **All India Secondary School Examination**, *Delhi Public School, Bhilai*, 96.20%

Research Projects

Nuclear Fusion Instability Detection
Advisor: Prof. Jeff Schneider

Master's thesis, CMU
2015

- Working on **predicting tearing mode instabilities** in magnetically confined plasmas, using data from a General Atomics nuclear fusion reactor in San Diego
- Studied and implemented **distribution-to-real regression** using orthogonal series function estimation for radial variables in dataset
- Applied innovative techniques to deal with features that act as surrogate for time, and yield false optimistic results
- Using ensembles and feature selection, able to obtain **AUC scores of 0.97** as compared to a baseline score of 0.64 from the physicists

Quantum Computing + NLP
Advisor: Prof. Pushpak Bhattacharyya

Undergraduate thesis, IIT Bombay
July 2013 - May 2014

- Examined various search and optimization techniques - Viterbi algorithm, Boltzmann machines, Entropy maximization, Iterative Scaling, etc.
- Explored applications of quantum computation, e.g., the Grover search to come up with innovative quantum designs for search in Natural Language Processing tasks.
- Implemented a **quantum** version of **Viterbi** algorithm for the Part-of-Speech (POS) tagging problem
- Modeled **machine translation** among close languages as a POS tagging problem, and applied the above algorithm to it
- The report can be found at www.andrew.cmu.edu/user/vipuls/btpreport.pdf

Internships

Machine Learning R&D
Mentor: Dr. Leonid Razoumov

Bloomberg L.P, New York City
Summer 2015

- Applied **ensemble methods** built with strong constituents to big data problems, in order to reduce training time
- Experimented with a variety of aggregation techniques to achieve good performance
- Extended our methods to **multi-label classification** using clustering and classifiers in the space of decision functions from constituents

Research Intern, Group Henzinger
Mentor: Prof. Thomas Henzinger

IST Austria
Summer 2012

- Studied effects of stochastic delay on processes such as protein production and transcriptional signaling.
- Formally verified the correctness of the **delayed Continuous Time Markov Chain** (CTMC) model for gene regulatory circuits for a 1-particle system.

Software Engineer Intern, Team Timeline
Mentor: Jason Fotinatos

Facebook HQ, Menlo Park
Summer 2013

- Built a basic version of a **new in-house application** collection for the user timeline.
- Worked with tools such as mercurial, javascript and HPHP, i.e, HipHop for PHP, a series of PHP execution engines and improvements created by Facebook.
- Fixed many bugs related to timeline visibility and an experimental timeline maps application.

Scholastic Achievements

- **Silver Medalist** (World Rank 41) at **International Physics Olympiad 2010** held in Croatia involving around 380 students from 80 nations
- **All India Rank 5** in IIT-JEE 2010 among 0.45 million candidates
- **All India Rank 1** in AIEEE 2010 among a million candidates
- One of 100 Student Scholars selected to attend the **Web Summit**, Dublin in Nov. 2014
- Represented India at **Asian Science Camp '09**, Japan attended by 7 Nobel laureates
- Awarded **AP grade** for exceptional performance in *Modern Physics, Economics, Numerical Analysis* and *Computer Programming and Utilization* at IIT Bombay
- Offered full-time positions for Machine Learning Scientist at **Amazon** and **Bloomberg**; and Software Engineer at **Google** and **Oracle**

- Certificate of Merit and Gold medal in **Indian National Olympiads** in **Physics, Chemistry** and **Astronomy**, 2010 for being among the *top 35* in both
- **All India Rank 1** in *5th* and *8th* National Cyber Olympiads and *3rd* International Mathematics Olympiad conducted by Science Olympiad Foundation, Delhi
- **All India Rank 1** in Unified Council's National Science Talent Search Exam 2009
- **All India Rank 2** in the *12th* National Science Olympiad and 7 other single-digit ranks in such national-level exams since *VIth* standard

Key Academic Projects

Supervised Mind Reading

Guide: Prof. Eric Xing

Spring 2015

Developed models incorporating semantic and contextual information to predict meaningful words and sentences from magnetoencephalography (MEG) recordings corresponding to brain activity of the reader.

Regression on Distributions

Guide: Prof. Ryan Tibshirani

Spring 2015

Studied and presented regression from distributions to reals/distributions, and the FuSSO (Functional Shrinkage and Selection Operator). Also covered non-parametric divergence estimation, and its application to image classification.

SAT for Sudokus

Guide: Prof. Steven Rudich

Spring 2015

Addressed the problem of **encoding Sudoku puzzles** into conjunctive normal form (CNF), and subsequently solving them using **SAT inference** techniques. Tested the use of genetic algorithm solvers as rating machines to test difficulty levels of new puzzles.

Graph Mining

Guide: Prof. Christos Faloutsos

Fall 2014

Implemented various graph algorithms for computing the degree distributions, pagerank, connected components, radii of the vertices, eigen-decomposition of the adjacency matrix, and triangle counts using SQL.

Quantum Computer Simulator	<i>Guide : Prof. Amitabha Sanyal</i>	Spring 2011
Developed a debugger-cum-simulator in DrScheme for building quantum networks using binary trees and higher order functions. Implemented algorithms such as Grover's, Deutsch-Jozsa and Fast Fourier Transform. The project is available on github, with documentation at www.andrew.cmu.edu/user/vipuls/QuickS.html .		
Accelerometer Biometric Competition	<i>Guide: Prof. Sunita Sarawagi</i>	Autumn 2013
Applied various classifiers (naive Bayes, SVM, ..) along with Welch Power Estimation to classify devices on acceleration data, for a contest on Kaggle.com under the Machine Learning course.		
Wireless Multi-Point Relay	<i>Guide : Prof. Varsha Apte</i>	Autumn 2011
Built a wireless network simulator in C++ using innovative concepts like super-nodes and trunk lines to enable scalability, maximum data transfer and minimum congestion.		
Intel 8085 Simulator	<i>Guide : Prof. Deepak B. Phatak</i>	Autumn 2010
Implemented in C++ with a <i>3-level debugger</i> . The graphical interface is a complete IDE, the user can compose programs, save and retrieve them from disk.		

Scholarships

- Kishore Vaigyanik Protsahan Yojana (**KVPY**) Scholarship, a national fellowship for students interested in science by Dept. of Science and Technology, India (2009-10)
- **INLAKS** Award of Excellence given to one student annually at IIT Bombay (2011-14)
- National Talent Search (**NTSE**) Scholarship by National Council of Education Research and Training (NCERT), India (2008 onwards)
- Awarded the **Institute Academic Prize** thrice by IIT Bombay (2010-13)
- **CBSE Merit Scholarship** for Professional Studies for excelling in AIEEE (2010-14)
- **Prime Minister's Trophy Sarvottam** Scholarship granted by Steel Authority of India Limited in Honor of Outstanding Academic Performance (2010-14)

Seminars

Convex Optimization	<i>Guide : Prof. Saketha Nath</i>	Autumn 2012
Efficacy of the Accelerated Proximal Gradient Method for large-scale convex optimization.		
Artificial Intelligence	<i>Guide : Prof. Pushpak Bhattacharyya</i>	Spring 2013
Maximum Entropy Markov Model and its application to Part-of-Speech tagging.		
Complexity Theory	<i>Guide : Prof. Nutan Limaye</i>	Spring 2013
Oracle Turing Machines and the Baker-Gill-Solovay Theorem.		
NLP, Speech and the Web	<i>Guide : Prof. Pushpak Bhattacharyya</i>	Autumn 2013
Humour Recognition and Generation and a model for the Sense of Humour.		

Teaching/ Mentoring Experience

- **Teaching Assistant** for Modern Physics (twice), Quantum Physics and its Applications, Numerical Analysis and CS101 at IIT Bombay.
- Mentored nearly 3000 students (mostly JEE aspirants) nationwide through live seminars under **Quality Education for All**, a company founded by IITians
- Featured in an advertisement for TataSky **Active Vedic Maths** service in May 2013
- Awarded **Hostel Technical Color** and **Organizational Color** for mentoring the hostel and improving its technical scene during my tenure as Secretary for Technical Activities, 2011-12

Logic

- Winner of the **Institute Logic General Championship** 2013 at IIT Bombay
- 8th in Mumbai at the **Times Sudoku Championship** 2013
- 1st in 2013 and 3rd in 2011-12 at Techfest's **Indian Sudoku Championship**
- Winner of **BRAINZ Mental Ability Quiz** at COFAS 2007 at CMS Lucknow
- Winner of **SudoCube**, a Sudoku and Rubik-cube contest at Avenues 2013, IIT Bombay

Extra Curricular Achievements

- 2nd in East Zone and **National Semi-finalist** at **India's Child Genius Quiz** 2004
- Winner of the 1st **Tata Inter School Quiz** in 2007
- 3rd in the Sweden-India **Nobel Memorial Quiz** - Mumbai round 2012
- East Zone Quarter-finalist at **ESPN School Quiz** 2005 hosted by *Harsha Bhogle*
- Reached the national round of Prof. Brahm Prakash Memorial **Materials Quiz** 2008 held at **Indira Gandhi Centre for Atomic Research**, Kalpakkam
- Represented Kenya in General Assembly at **DPS Model United Nations-2007**
- Column writer for the **Mail Today** national daily on *How to prepare for the IIT-JEE* in late 2011.
- Winner of **World Population Day Debate** 2006 organised by Bhilai Steel Plant
- Silver Medalist in **Avantika International Talent Search Essay Contest**