VIPUL SINGH

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Interests

Natural Language Processing, Machine Learning and Forecasting.
Quantum Computation, Number Theory and Cryptography.

Education

- Currently enrolled in the Master's of Science Program in School of Computer Science at **Carnegie Mellon University**
- 2010-14 **B.Tech in Computer Science and Engineering with Honours, and Minor in Mathematics**, *Indian Institute of Technology, Bombay*, GPA: 9.79/10 - **Ranked** 1^{st} **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

Quantum Computing + NLP
Advisor: Prof. Pushpak Bhattacharyya
Undergraduate thesis, IIT Bombay
July 2013 - ongoing

- Examined various search and optimization techniques - Viterbi algorithm, Boltzmann machines, Entropy maximization, Iterative Scaling, etc.
- Applied the Quantum Exponential Search algorithm to come up with a quantum Viterbi for the Part-of-Speech tagging problem.
- Paper titled "A Quantum Computing Approach to Part-of-Speech Tagging: A Quantum Viterbi decoding Algorithm" submitted to ICON 2014.
- The stage I report can be found at www.cse.iitb.ac.in/~vipulsingh/btp1report

Clustering in Forecasting
Advisor: Prof. Bernard Menezes
RnD project, IIT Bombay
January 2013 - October 2013

- Clusters in time series pertaining to retail sales of various items - furniture, apparel, housing, beverages, etc. have been identified
- Trying to understand, at a very fundamental level, the basis of this clustering.
- Performing a detailed study of the mathematical characteristics of various cluster-specific forecasting models, to achieve the same.

Quantification of Entanglement
Advisor: Prof. Prasanta Panigrahi
NIUS Project, IISER Kolkata
December 2011

- Studied quantum entanglement and its applications to teleportation
- Worked on quantifying entanglement using ideas like (i)representation of the state as a point in an n-dimensional cube and looking at distance from centre (ii)using K-map reduction
- Tried to explain the failure of W-state in teleportation, using this quantification

Internships

Research Intern, Group Henzinger — IST Austria
Mentor: Prof. Thomas Henzinger — Summer 2012

- Studied the effect of stochastic delay on biological 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 — Facebook HQ, Menlo Park
Mentor: Jason Fotinatos — 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
- Represented India at **Asian Science Camp '09**, Japan attended by 7 Nobel laureates and 200 students from all over Asia
- Awarded **AP grade** for exceptional performance in *Modern Physics*, *Economics*, *Numerical Analysis* and *Computer Programming and Utilization* at IIT Bombay
- 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 5^{th} and 8^{th} National Cyber Olympiads and 3^{rd} 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 12^{th} National Science Olympiad and 7 other single-digit ranks in such national-level exams since VI^{th} standard

Key Academic Projects

Quantum Computer Simulator — *Guide : Prof. Amitabha Sanyal* — **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.cse.iitb.ac.in/~vipulsingh/QuiCkS.html`.

Accelerometer Biometric Competition — *Guide: Prof. Sunita Sarawagi* — **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 — *Guide : Prof. Varsha Apte* — **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 — *Guide : Prof. Deepak B. Phatak* — **Autumn 2010**

Implemented in C++ with a *3-level debugger*. 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 *Guide : Prof. Saketha Nath* **Autumn 2012**

Efficacy of the Accelerated Proximal Gradient Method for large-scale convex optimization.

Artificial Intelligence *Guide : Prof. Pushpak Bhattacharyya* **Spring 2013**

Maximum Entropy Markov Model and its application to Part-of-Speech tagging.

Complexity Theory *Guide : Prof. Nutan Limaye* **Spring 2013**

Oracle Turing Machines and the Baker-Gill-Solovay Theorem.

NLP, Speech and the Web *Guide : Prof. Pushpak Bhattacharyya* **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, Linear Algebra, Automata Theory, Differential Equations 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 the lead role 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
- 8^{th} in Mumbai at the **Times Sudoku Championship** 2013
- 1^{st} in 2013 and 3^{rd} 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

- **Hostel Technical Citation**, 2010-14 for my contribution to technical activities at Hostel 3
- 2^{nd} in East Zone and **National Semi-finalist** at **India's Child Genius** Quiz 2004
- Winner of the 1^{st} **Tata Inter School Quiz** in 2007
- 3^{rd} 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 **Materials Quiz** 2008 held at **IGCAR**, Kalpakkam
- Represented Kenya in General Assembly at **DPS Model United Nations-2007**
- Silver Medalist in **Avantika International Talent Search Essay Contest**