Akshay Kumar

Contact Information

Fifth Year Undergraduate
Dept. of Computer Science and Engineering
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Research Interests

Algorithms, Automata Theory, Logic

Education

Indian Institute of Technology, Kanpur
B. Tech. / M. Tech. (Dual Degree) in Computer Science & Engineering *July 2010 - Present*

- M. Tech. CPI of **10.0** (on a scale of 10)
- B. Tech. CPI of **8.9** (on a scale of 10)

Patent & Publications

B. Bollig, P. Gastin and **A. Kumar**. *Parameterized Communicating Automata: Complementation and Model Checking.* In Proceedings of the 34th Conference on Foundations of Software Technology and Theoretical Computer Science (**FSTTCS' 14**). To appear. [pdf]

B. V. Crinivasan, **A. Kumar**, S. Gupta, K. Gupta. *Stemming the flow of information in a social network.* In Proceedings of the 6th International Conference on Social Informatics (**SocInfo' 14**). [pdf]

Invention Disclosure: Filed a U.S. patent application entitled "*Identifying Target Customers To Stem The Flow Of Negative Campaign*" as one of the inventor. United States 14056624. Filed on October 17, 2013.

Research Internships

PCA: Complementation and Model Checking *May - July 2014*
Mentored by Prof. Paul Gastin & Benedikt Bollig at LSV, ENS Cachan
Studied the language-theoretical aspects of parameterized communicating automata (PCAs), in which processes communicate via rendez-vous. Showed that, under a context bound, which restricts the local behavior of each process, PCAs are effectively complementable and used it to obtain a mondadic second-order (MSO) logic characterization of PCA.

- This work was presented at **Highlights 2014**. [slides]

Stemming the flow of Information in a Social Network *May - July 2013*
Research Intern at Adobe Research Labs under the supervision of Dr. Balaji Vasan
Developed an end-to-end system for stemming the flow of information in a network by estimating of information flow in a network and finding a set of nodes/users instrumental in checking the spread of this information. Devised novel mathematical functions based on various centrality measures and predicted information flow pattern for finding the susceptibility of a node.

Research Experience

Parametrized Algorithms & Kernelization for NP−Hard problems *Dec 2013 - Present*
Ongoing Master's Thesis project under the guidance of Prof. S K Mehta
Looking at Parametrized Algorithm and Kernelization Techniques for various NP−Hard optimization problem. Designed a FPT algorithm for the problem of vertex/edge deletion on a graph such that each connected component has weight less than K. Also developed a PTAS for counting number of paths of length less than L between a pair of vertices in a directed graphs.

Concentration Bounds for Absolutely Normal Real Numbers *July 2013 - Present*
Bachelors Project under guidance of Prof. Satyadev Nandakumar
Improved the currently exisiting bounds of Turing's Unproved Lemma on Absolutely Normal Real Numbers. Used Talagrand's Inequality to get a concentration bound on non-independent Bernoulli variables. [report]

Game Arguments in Algorithm Information Theory *January - April 2013*
Research course project under guidance of Prof. Satyadev Nandakumar
Devised an alternate proof for Levin's Coding Theorem using ideas from Game Theory. Investigated other important results of AIT like Friedburg's unique numbering, Muchnik Vyugin Theorem, etc. and at their proof involving Game Theory arguments. [report]

Selected Projects

Advanced Data Structure *November 2012 - January 2013*
Winter Project under guidance of Prof. Surender Baswana
Studied advanced data structues such as persistent/retroactive data structures, cache oblivious data structures & algorithms, dynamic graphs and succinct data structures. Also looked into LCA-RMQ problem with linear preprocessing time & constant query time algorithm for the same.

Movie Recommender System *July - November 2013*
Course Project in CS771 (Machine Learning) under guidance of Prof. Harish Karnick
Devised a recommender system to guess movie ratings given by a user using an improved version of Matrix Factorization algorithm for movie recommendation used in Netflix contest. Algorithm used is a hybrid filtering algorithm which uses both movie's and user's attributes. [report]

Hand Gesture Recognition using Microsoft's Kinect *March - April 2012*
Course Project in CS365 (Artificial Intelligence) under guidance of Prof. Amitabha Mukerjee
Recognized robust hand gestures by applying FEMD (Field Earths Mover Distance) on shape of hand extracted by Kinect. Hacked Kinect to detect robust hand gestures using PointCloud Library and OpenCV. Accuracy of nearly 75% reported. [report]

Talks Given

- Unique Games Conjecture: Subhash Khot wins the Nevanlinna prize. *SIGTACS talk.* [webpage]
- Google Similarity Distance. *As part of course CS687 (Algorithmic Information Theory).* [ppt]
- A Combinatorial, Primal-Dual Approach to Semidefinite Programs. *As part of course CS698C (Semidefinite Progamming).* [ppt]
- Stemming the spread of rumors in a social network. *Talk given at Adobe Research Lab.* [ppt]

Academic Achievements

- Ranked **first in the department** amongst the M. Tech. batch of 108 students.
- Ranked in **Top 0.02%** (amongst 1M candidates) in AIEEE 2010 and **Top 0.04%** (amongst 0.5M candidates) in IIT JEE 2010.
- Awarded **Academic Excellence Award** for the term 2011-12.
- Awarded the **CBSE Merit Scholarship** for Professional Studies - AIEEE for 2010-2014.
- **Gold medallist**, Junior Science Olympiad (2007) & **Bronze Medallist**, Junior Mathematics Olympiad (2007).
- Awarded **KVPY fellowship** by Department of Science & Technology, Government of India.

Relevant Course Work

Theory & Algorithms: Finite Automata on Infinite Input, Algorithmic Information Theory, Computational Complexity, Data Compression, Randomized Algorithms, Semidefinite Programming, Approximation Algorithms, Advanced Algorithms, Theory of Computation, Discrete Mathematics, Introduction to Mathematical Logic, Data Structures & Algorithms

Mathematics: Linear Programming, Convex Optimizations, Linear Algebra, Complex Analysis, Real Analysis, Multi variable calculus, Differential Equations

Computer Science: Machine Learning, Artificial Intelligence, Principles of Programming Languages, Computer Networks, Database Management System, Compiler Design, Operating System, Computer System & Organization, Introduction to Computing, Introduction to Electronics

Technical Skills

Programming Languages: C, C++, Python, Haskell, Java, R, Oz, SQL, PHP
Other Tools: LaTeX, MATLAB, GNU Octave, Lex, Yacc, weka

Positions Of Responsibility

Teaching	– **Teaching Assistant** for the course Linear programming (58 students). – **Mentored** group of first years working on ACA semester project: **'Hypercomputation: Beyond Turing Machines'**.
Competitions	– **Yahoo HackU 13**: Designed an app 'Lets Meet' which suggests a cluster of distinct type of meeting places based on proximity between users. – **Finalists** in **Ideas' 13**: Developed a SMART Grid based android app for remotely controlling electrical appliances. – **Assistant Coordinator**, IORC (India Open Rubiks Cube), Techkriti 2011.