Sarthak Garg

Curriculum Vitae

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Interests

Algorithm Design, Data Mining, Distributed Processing

Education

2013–2017	**B.Tech in Computer Science and Engineering**, *Indian Institute of Technology Kanpur*, GPA 9.9/10.
2013	**Higher Secondary Examination**, *Cambridge School Noida*, 94.5%.

Honours and Awards

- Two time recipient of the **Academic Excellence Award** for outstanding academic achievement (2013-14, 2014-15).
- Secured **A*** grade for excellent performance in CS345: Analysis and Design of Algorithms, ESC101: Introduction to Computer Programming, CS640: Computational Complexity Theory.
- Secured All India Rank 962 in JEE Advanced 2013 given by 0.15 million students.
- Secured All India Rank of 993 in JEE Mains 2013 given by 1.4 million students.
- Selected for the **Kishore Vaigyanik Protsahan Yojana** fellowship 2013.
- Figured in top 300 in National Standard Examination in Physics and selected for **INPhO**(Indian National Physics Olympiad).

Research Experience

Ongoing	**Improving Circuit Lower Bounds for Bipartite Matching in Grid Graphs Undergraduate Project, IIT Kanpur**

Guide: Prof. Raghunath Tewari

Worked on improving the circuit upper bound for bipartite matching in planar grid graphs from ACC_0 to AC_0. Recently Hansen, Komarath et al. reduced bipartite matching in grid graphs to the monoid word problem. This problem reduces to proving the non existence of a periodic path in the shifted superposition of any perfect matching in a grid graph with itself. We were able to prove the hypothesis for these subcases

- Nonexistence of a periodic path which is piece-wise monotone in the y-direction.
- Nonexistence of a periodic path which enters the topmost and the bottommost layer of the grid graph atleast once.

We aim to generalize the proofs without any restriction on the path

Ongoing	**Extending Saturation Algorithms for Ordered Tree Pushdown Systems Undergraduate Project, IIT Kanpur**

Guide: Prof. Anil Seth

Researched extensively the class of saturation algorithms which compute whether some 'error' states in a pushdown system are reachable or not. Recently Clemente, Parys, Salvati and Walukiewicz introduced Ordered Tree Pushdown Systems(OTPS) which subsume several classes of pushdown systems. Clemente et al. developed an algorithm for deciding the reachability problem. We are working on extending it to compute any μ modal calculus denotation along the lines of M. Hague and C.-H. L. Ong's works.

▬▬ Work Experience

Summer 2016	**Software Engineering Intern**, *Samsung Electronics*, Seoul, Korea

Guides: Sunyoung Choi, Sai Bhargav Yalamanchi

Worked on the problem of estimating locations of cellular devices based on their LTE signal strength data. Designed and implemented a matching algorithm to generate labelled data from signal strength and location data streams based on triangulation and feedback from trained ML models.
- Referred a research paper, Outdoor Location Estimation Using Received Signal Strength-Based Fingerprinting by Ning, Li et al. and designed a clustering-classification pipeline approach.
- A median error of 40m was obtained as opposed to earlier approach based only on telecommunication theory which had a median error of 110m.
- Developed a web app for visualizing the estimated locations through a call heat map overlaid upon a geographic map. The type of plots and the parameters of the ML algorithms could be selected through a basic GUI.

Summer 2015	**Software Engineering Intern**, *Altisource Labs*, Bangalore, India

Guide: Raghavendra Kopalle

Worked on the problem of Actor Equivalence, i.e. tracking the activities of a e-commerce website user after he/she has logged out of an account.
- Proposed a clustering based algorithm for resolving Actor Equivalence problem.
- Did a survey of basic clustering algorithms. Parsed, quantified and clustered real life consumer attributes to arrive at meaningful inferences using K-means, and DBSCAN clustering algorithms and a machine learning tool Weka.

▬▬ Key Projects

April 2016	**Code Cloud, code sharing and managing app**.

Guide: Prof. Sumit Ganguly
- Built a code management website mainly focused on competitive programming using Django for backend and bootstrap3 for frontend. The website allowed for private and public code sharing, annotating and searching algorithmic problems.

April 2016	**Object Detection in Traffic Surveillance Video**.
	Guide: Prof. Harish Karnick

- Extracted regions of interest from the video using image processing algorithms and refined them using NMS (non maximal supression) algorithm on a pyramid of gaussians built on the subframes of the initial regions.
- Experimented with different feature representations of images like HoG and SIFT for training the classifiers. Achieved a classification accuracy of 88.8% using Linear SVC as classifier and HoG feature representation.
- Tested a preexisting object detection framework Faster R-CNN based on convolutional networks (Developed by Shaoqiong Ren) on the project dataset.

Summer 2014	**Augmented Reality Fluidic Interface** - **Auraplay**.
	Under Electronics Club, IIT Kanpur

- Developed an interactive computer interface in the form of a motorized mechanical arm mounted with a Raspberry Pi, a camera and a projector.
- Applied image processing algorithms (Blob detection and Contour detection) using OpenCV to track a laser pointer which was used as a medium to interact with the projection. Positional feedback was sent to an Arduino unit which controlled the movement of the mechanical arm.

April 2016	**Scala to x86 Compiler**.
	Guide: Prof. Subhajit Roy

- Programmed a Scala to x86 assembly compiler with support for basic datatypes, conditional statements, looping statements, arrays, type checking, basic type inference, nested functions and recursion.

November 2015	**On worst case to average case reduction of NP problems**.
	Guide: Prof. Raghunath Tewari

- Studied the computational complexity class Distributional NP and explored whether or not the existence of problems in NP which have no polynomial time heuristic algorithms can be related to the NP $\subseteq$ BPP question.
- Studied the paper titled 'On worst case to average case reductions for NP problems' by Luca Trevisan and Andrej Bogdanov and gave a class seminar presenting their ideas and approach.

Extra Curricular Activities

- Secured runners up position in **Microsoft Code.Fun.Do Hackathon**. Developed a windows app which extracted questions from pdf documents and organized them into a question bank by attaching metadata. This bank was used to generate tests satisfying various user criterion.
- Secured India rank **3** in the July Long Challenge hosted on codechef.com (A competitive programming site) out of nearly 5500 contestants.
- Secured India rank **3** in International Online Programming Contest hosted by IIT Kanpur as part of it's tech-fest.
- Served as a **Secretary** of **Electronics Club**, IIT Kanpur
  - Part of a team of 15 members to manage the activities of the club.
  - Organized lectures, managed the club inventory and mentored freshmen in the competitions organized by the club.
- Served as a caller in the ACP (Alumni Contact Program) team. Notified the alumni about recent news regarding the institute and guided them through various donation programs.