

EDUCATION

Year	Degree / Certificate	Institute / School	CPI / Percentage
2016	M.Tech., Computer Science and Engineering	IIT Kanpur	9.3 / 10.0
2016	B.Tech., Computer Science and Engineering	IIT Kanpur	8.7 / 10.0
2010	Class XII (ISC)	Don Bosco School, Siliguri	93.75%
2008	Class X (ICSE)	Mahbert School, Siliguri	90.2%

SCHOLASTIC ACHIEVEMENTS

- Secured an All India Rank of **234** in **IIT-JEE, 2011** and a rank of **62** in **WBJEE, 2011**.
- One of the five students from the institute selected for the **INRIA** research programme in summers of 2014.
- Awarded a Merit Certificate for a commendable performance in the Green Olympiad, 2008.

MASTERS' THESIS

- Laplacian Solvers and Graph Sparsification** (January, 2015 - June, 2016)
Guide: Dr. Rajat Mittal (CSE Department, IIT Kanpur)
 - Solving a linear system of equations usually takes *cubic time*. However, for the linear system associated with the **Laplacian matrix of a graph**, one can try to exploit the graph sub-structure of the matrix to obtain **nearly linear time solvers**.
 - These solvers use **Spectral Sparsification** of graphs as a subroutine in the algorithm. However their usage extends beyond Laplacian solvers, and have been employed in various settings since their discovery.
 - Through this thesis, we tried to understand the scope of spectral sparsification algorithms used in solvers, and also to refine the scope of the current state-of-the-art Laplacian solvers.

INTERNSHIPS

- Validation of a compiler for critical embedded software** (May, 2014 - July, 2014)
Guide: Dr. Francesco Zappa Nardelli and Dr. Mark Pouzet (INRIA, Paris-Rocquencourt and ENS, Paris)
 - Lustre** is a data synchronous language, designed for description and verification of real-time systems. The compiler for these systems need to fool-proof to prevent any unexpected outcome.
 - In this project considered one such compiler for Lustre, *Heptagon*. To verify this compiler, we built a **symbolic validation framework** in *OCaml*. It generated the symbolic representation for the *Lustre* program and the resulting C program.
 - The representations were then compared using **Z3 SMT solvers** to authenticate their equivalence, and it was observed that the compiler indeed generated correct equivalent programs for common constructs in *Lustre*.
- Study of Statistical Learning Algorithms** (May, 2013 - July, 2013)
Guide: Dr. Ambedkar Dukkipatti (CSA Department, Indian Institute of Science, Bangalore)
 - Applied concepts of **Information Theory** such as *Entropy* as suggested by *Kamal Nigam* and *Andrew McCallum*, to get a better model for **document classification**.
 - The generated model was tested on the WEBKB dataset and found to be *better* than the models based on Bayes' method of classification. The accuracy was further increased when prior probability of the classes was introduced.

ACADEMIC PROJECTS

- Survey Project on Additive Combinatorics** (August, 2014 - April, 2015)
Guide: Dr. Nitin Saxena and Dr. Rajat Mittal (CSE Department, IIT Kanpur)
 - Additive Combinatorics is relatively new discipline in mathematics with connections to **additive number theory, fourier analysis, incidence geometry and graph theory**.
 - We first surveyed the **Szemerédi-Trotter theorem**, which attempts to bound the maximum number of incidences between a set of lines and a set of points. We studied and examined the theorem in the case of real and finite fields.
 - Further, we studied the **Szemerédi's Regularity lemma**, a graph theoretic result and its applications to number theory, specifically to **Szemerédi's Theorem**.
- Graph Theoretical Analysis of Functional Connectivity In the Brain** (September, 2014 - November, 2014)
Guide: Dr. Amitabha Mukherjee (CSE Department, IIT Kanpur)
 - Functional MRI** is a non-invasive technique for studying brain activity to extract useful information such as locations of enhanced brain activity during cognitive tasks, **functional brain connectivity**, etc.
 - In this work, we use two freely available fMRI datasets to obtain functional brain connectivity during the performance of simple auditory and visual tasks. We used this information to model the brain as a **network of co-activated regions**.
 - From the graph analysis of the obtained *brain network*, we concluded that the network satisfies certain expected properties of *efficient* networks like **modularity, transitivity, community structure, efficient spatial arrangement**.

• Satisfiability Solver in Haskell

(September, 2015 - November, 2015)

Guide: Dr. Piyush P. Kurur (CSE Department, IIT Kanpur)

- ★ The **Boolean Satisfiability problem** is one of the most well known NP-Complete problems. However, using certain heuristics one can design relatively efficient and scalable algorithms to solve SAT.
- ★ We implemented multiple SAT solver algorithms in Haskell and tested their efficiency compared to the basic backtracking algorithm.
- ★ The use of Haskell as the programming language greatly improved the efficiency due to inherent recursive nature of these algorithms.

• Compiler for Scala to LLVM-IR

(March, 2014 - April, 2014)

Guide: Dr. Subhajit Roy (CSE Department, IIT Kanpur)

- ★ Built a compiler to transform a **Scala** program to **LLVM instruction register code**.
- ★ Basic functional and imperative features of the language were covered by the compiler, which also included an **interactive terminal mode**, similar to the ones seen in Python, Haskell compilers.
- ★ Even though the current implementation included just the basic features of the language, this is the first compiler, in our knowledge, which compiled Scala to LLVM-IR.

• Instruction Set Architecture for an FPGA

(March, 2013 - April, 2013)

Guide: Dr. Subhajit Roy (CSE Department, IIT Kanpur)

- ★ A Field Programmable Gate Array (FPGA) is an integrated circuit that can be customized, by user-given software, to perform basic computational tasks.
- ★ We used **Verilog** to build an Instruction Set Architecture for an FPGA, that could perform basic operations like loading and storing data and text from memory and perform mathematical operations on the data.

RELEVANT COURSES

- | | |
|---|---------------------------------------|
| • Approximation Algorithms | • Linear Programming and Applications |
| • Computational Complexity | • Randomized Algorithms |
| • Computational Number Theory and Algebra | • Advanced Graph Algorithms |
| • Functional Programming | • Cognitive Science |
| • Pseudo-Random Generators [Audit] | • Theory of Computation |

OTHER ENDEAVOURS

• Quakely

1st Prize, Ideas - Social Track, Techkriti, 2014 | Crew's Choice Award, Yahoo HackU, 2014 | 1st Prize, Elevator Pitch, Techkriti, 2014

- ★ Built an Android application which would **detect earthquakes, with a high accuracy**, using a customized algorithm, and broadcast the alert message to other phones in the corresponding effected area.
- ★ The possibilities of false alarms were reduced by maintaining several checks on the client side, as well the broadcast server side.

• DreamSter

1st Prize, Google - GDG DevFest, 2013

- ★ Built a package of an **Android** and **Raspberry-Pi** application which would give the users sleep personalization options and self-adjust various other factors to ensure a good sleep.
- ★ Various factors like REM sleep, deep sleep and the research on the same, were considered while developing the application.

• Run2Down

1st Prize, Hackathon, Techkriti, 2013

- ★ Built a package of an **Android** and a complementary **Linux** application, which helps the user to remain fit by providing the incentive of higher internet speed to PC for doing more exercise.

POSITIONS OF RESPONSIBILITY

• Teaching Assistant for the following courses

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|------------------------------------|----------------------------------|
| ★ Theory of Computation | ★ Data Structures and Algorithms |
| ★ Online Learning and Optimization | ★ Fundamentals of Computing |

• Manager, Computing Events, Techkriti 2014, which included organising the following events :

- ★ **International Online Programming Contest**, one the biggest college annual algorithmic contest in the country.
- ★ **International High Programming Computing Contest**, one of the first high performance computing contest in the country, conducted in collaboration with the *Center for Development of Advanced Computing [CDAC], Pune*.
- ★ **Chaos**, an esoteric programming language contest.

MISCELLANEOUS

- Active member of the **Programming Club** and the **Quiz Club**.
- **Github handle** : vijaykeswani