

Sagnik Bhattacharya | CV

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Senior Undergraduate, Indian Institute of Technology, Kanpur

Education

Bachelor of Technology in Electrical Engineering <i>Indian Institute of Technology, Kanpur (IIT-K)</i> Minors in Quantum Mechanics and Theory of Computation	8.9/10 (Ongoing) 2019
Class XII, All India Senior School Certificate Examination (AISSCE) <i>Apeejay School, Park Street, Kolkata</i>	96.6% 2015
Class X, CBSE Board Certification Examination <i>Apeejay School, Park Street, Kolkata</i>	10.0/10.0 2013

Research Interests

- Information and Coding Theory
- Quantum Information and Computing
- Boolean Functions

Research Papers

Shared Randomness in Arbitrarily Varying Channels:

Sagnik Bhattacharya, Amitalok Budkuley, Sidharth Jaggi (to appear at ISIT 2019) [\[link\]](#)

A method to find the volume of a sphere in the Lee metric, and its applications:

Sagnik Bhattacharya, Adrish Banerjee (to appear at ISIT 2019) [\[link\]](#)

Research Experience

Zero-error Capacity Bounds for General Metrics:

Under Prof. Adrish Banerjee, IIT Kanpur Aug 2018 - Ongoing [\[link\]](#)

- Studied possible generalisations of the known coding theory bounds like the MRRW bound to AVCs
- Generalized Navon and Samorodnitsky's Fourier analytic proof of the MRRW bound to q -ary channels
- Looked at ways to use the Fourier analytic technique to prove an analogous bound for the Lee metric

Common Randomness for Communication over Adversarial Channels:

Under Prof. Sidharth Jaggi, Chinese University of Hong Kong (CUHK) May 2018 - Ongoing [\[link\]](#)

- Studied adversarial channel models, their capacity characterisations and the role of common randomness
- Gave matching upper and lower bounds for the amount of common randomness required to communicate at the randomized coding capacity with zero-error for state deterministic AVCs

Polynomial Methods in Quantum Query Complexity:

Under Prof. Rajat Mittal, IIT Kanpur Jan 2018 - Ongoing [\[link\]](#)

- Studied polynomial methods to prove lower and upper bounds on the query complexity of functions
- Read and understood constructions of polynomials with desired properties using Chebyshev polynomials given in *Algorithmic Polynomials* by A. Sherstov and *Polynomial Method Strikes Back* by Kothari, Bun and Thaler.
- Worked on finding classes of functions for which dual block composition technique gives good lower bounds

Selected Projects

Boolean Functions and Information Theory:

Course Project for EE667 - Information Theory under Prof. R K Bansal, IIT Kanpur Aug - Nov 2018 [\[link\]](#)

- Read about applications of Boolean functions in information theory and some open problems
- Read the paper *Which Boolean Functions Maximize Mutual Information on Noisy Inputs?* and gave a talk on the same, introducing the conjecture in the paper and the known progress towards a solution

The Resource Theory of Quantum Information:

Course project for CS682 - Quantum Computing under Prof. Rajat Mittal, IIT Kanpur Aug - Nov 2017

- Read the book *From Classical to Quantum Shannon Theory* by Mark Wilde for an introduction to classical and quantum information theory, supplemented by *Cover and Thomas* as a reference.
- Presented an introduction to density matrices and quantum channels in the mid-term presentation. [\[slides\]](#)
- Presented an introduction to unit quantum protocols in the end-term presentation. [\[slides\]](#)

- Final project report on unit quantum protocols, quantum channels and typicality can be found [here].

Selected Talks

The Lovasz theta function, a pentagon and an umbrella Presented in Science Coffeehouse, IIT Kanpur	August 2018 [notes]
Approximate Degree of Polynomials and Quantum Query Complexity Final presentation for undergraduate project under Prof. Rajat Mittal	April 2018 [slides]
The coin weighing problem and an introduction to coding theory Presented in Science Coffeehouse, IIT Kanpur	March 2018 [notes]

Academic Achievements

Academic Excellence Award 2016: Awarded by the Indian Institute of Technology, Kanpur

NSEP 2015: Among top 1% in National Standard Examination in Physics (NSEP) conducted by IAPT. Qualified for both Indian National Physics Olympiad (INPhO) and Indian National Chemistry Olympiad

KVPY National Fellowship 2014: A National Science Fellowship Program to encourage research in the basic sciences funded by the Department of Science and Technology, Government of India. National Rank 102

National Talent Search Examination (NTSE) 2011: Organized by NCERT, Govt. of India, National Rank 114

Relevant Courses

- Information Theory
- Topics in Combinatorics ‡
- Quantum Computing
- Quantum Mechanics - 1
- Abstract Algebra
- Algorithmic Information Theory ‡
- Communication Systems
- Coherence and Quantum Entanglement
- Mathematical Structures of Signals and Systems
- Probability and Statistics
- Bioinformatics and Computational Biology
- Riemann Hypothesis and Applications in CS

‡ - Next Semester Courses

Teaching and Mentorship Experience

Academic Mentor for Introduction to Electrodynamics under Counselling Service, IIT Kanpur 2016-17

- Took institute level remedial classes for academically weak students on various topics
- **One-to-one mentoring** to help academically weak students understand the course content better

Summer Project on Quantum Computation under Science Coffeehouse, IITK 2017-18

- Mentored a group of 5 students over the summer, introducing them to quantum computation
- Covered the content of a first course on quantum computation, oversaw individual projects in different areas

Technical skills

Programming: C/C++, Python, Bash

Technical Tools: \LaTeX , GNUPlot, Git, SolidWorks, ANSYS, Octave, Matlab, Mathematica

Web-Dev: HTML, CSS, Jekyll

Extra-Curricular Activities

Science Coffeehouse:

- Chosen as the leader of the Science Coffeehouse, IITK, where discussions and talks are held on a wide number of scientific topics, for the academic year 2017-18 and made the group more organised and popular
- Organized and conducted four events during Takneek 2017, an intra-college science and technology competitions. Questions and solutions I made for one of the events can be found [here].

Quizzing Have been an avid quizzier from high school. Won the **Travel, Living and Culture quiz** of **Antaragni 2018**, won the **Fresher's Sports Quiz (2015)**, IITK, reached national semi-finals of **ESPN Sports Quiz (2012)** and won the national finals of **Quizomania 2011**, organized by The Times of India.

Blogging I blog sporadically on science, travel and humour at *Thoughts, Quantized*, link [here]

Shannon Centenary Day (2016) An event that was part of the Shannon centenary celebrations of the IEEE Information Theory Society. Attended several talks on Information and Coding theory.