Trishan Mondal

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My Website

About Me

I am Trishan Mondal, a third-year B.Math student at the Indian Statistical Institute, Bangalore. My academic interest revolves around algebra, geometry, and topology. Currently, I'm focusing more on learning Algebraic topology and algebraic geometry.

Recent Project works

2023 (summer) **VSRP (TIFR, Mumbai)** Under Professor S.K. Roushon's guidance, I completed an algebraic topology project. I studied homology, including singular, simplicial, and cellular homology, along with equivalences using the *Acyclic model theorem*. Applications like the Hairy Ball theorem, Lefschetz fixed point theorem, and the Brouwer-separation theorem were explored. Additionally, I focused on cohomology for topological spaces, utilizing the *Universal coefficient theorem*, cap and cup products, and *Poincaré Duality*. I covered duality for manifolds with boundary and *Alexander-duality*. The project's highlight was the *cohomology ring*. It concluded with a significant question: whether a topological space X can exist with $H^*(X, -) = A$ for a given algebra A. I also noted an affirmative result for algebras over rationals, found in Quillen's paper on *Rational Homotopy theory*.

2023 **Project on Knot theory,** I completed a knot theory project under Dr.Anubhav Mukharjee(lecturer at Princeton). We covered basics of algebraic topology like, fundamental group and covering spaces, moved to differential topology, and then delved into knot theory. I explored knot invariants like knot groups, knot complement homology (via Alexander duality), and computed Alexander and Jones polynomials. I also studied Ribbon knots and Seifert surfaces and genus, concluded the project by calculating ribbon numbers for various knots using Alexander polynomials and other methods.

Few more projects

Polymath **Hankel Operator on the Hartog triangles,** This project was guided by Nathan Wagner (Assistant Professor at Brown university). Our group worked on characterizing bounded Hankel operators on the Hartogs triangle. The Hartogs triangle is a domain in $\mathbb{C}^2$ which is a source of many counterexamples and interesting phenomena in the complex analysis due to its non-smooth boundary, and Hankel operators act on spaces of holomorphic functions known as Bergman spaces. We tried to find necessary and sufficient conditions to guarantee the boundedness of such operators in the case of the Hartogs triangle and with respect to different L^p norms. We have mainly focused for giving bound for p outside the range of $(1, \frac{4}{3})$. Our work is yet to be public (can not give more details without the permission of the instructor).

2022(Winter) **Reading project on commutative algebra,** Since I was interested in doing algebraic geometry, I wanted to have a good base on commutative algebra beforehand. I started reading commutative algebra in the fall semester of 2022 under the guidance of prof. Maneesh Thakur(Professor at ISI,Bangalore) and continue reading this during the winter of 2022. In this reading project, I basically followed the textbook by *Atiyah, Macdonald* and the book by *Matsumura* for some references.

Few more projects (continued)

2022(summer) **Reading on Quantum mechanics,** I always wanted to explore about Quantum mechanics. In the reprised syllabus of our institution, there was no course on Quantum mechanics (unlike the previous). So I approached prof. Prabuddha Chakraborty and did this reading project under his guidance.

Miscellaneous Experience

Awards and Achievements

2023 **VSRP**, A summer research programme organised by TIFR, Mumbai. I was one of the selected students for this programme.

2022-23 **Polymath,** selected for the polymath junior program, it is an online REU organized by Williams Collage.

2021 **Madhava Math competttion**, Organised by National Board of Higher Mathematics, Mumbai. (Top scorer from our collage at first round)

Indian Olympiad Qualifier in Physics, qualified.

2020 **National Standard Examination on Physics,** qualified

2019 **Jagadish Chandra Bose National talent search examination**, qualified.

2018,19 **Pre Regional Mathematics olympiad** qualified.

Scholarships

2021-2024 **Stipend by Indian Statistical Institute.**

INSPIRE scholarship, by Indian Govt. (declined due to convenience of ISI stipend)

2019-2021 **JBNSTS scholarship**.

Swami Vivekananda scholarship given by West Bengal Govt.

Activities

Scribing I have scribed notes of the course Analysis of several variables by Prof.Jaydeb Sarker.

I have scribed some notes of the (ongoing) course Functional Spaces by prof. Soumyashant Nayak.

WRP It is a winter reading program where the senior students of ISI,Bangalore mentor first-year students for a reading project. I have been a mentor for a winter-long reading project on 'Topology and Basic algebraic topology'.

Math Club I am a member of ISI, Bangalore Math Club, where we organize some talks meant for students.

LIMIT The students of ISI, Bangalore organize an annual math competition named 'LIMIT'. I am a member of the QST and Contact team of LIMIT.

Videos On my leisure I used to make mathematics-related videos and upload them in youtube.

Activities (continued)

Some Talks by Me

2023 (July) On Jordan-Brouwer separation theorem and its applications.

2022 (Dec) Thom space of a vector bundle and its relation with reduced suspension.

Skills

Coding Python, R, LaTeX, …