Trishan Mondal

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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.

Education

Indian Statistical Institute, Bangalore | Bachelor of Mathematics (2021 -Present)
Grades : 94.3 % over 5 semesters.

Projects

(Ongoing Reading seminar) **Intersection homology | During the 2024 spring semester**
Organized by Professors of Algebraic Geometry department

- In this seminar we will be reading about 'Intersection homology and Perverse Sheaves' from the book of 'Kirwan and wolf'. I will keep updating about this seminar on this page.
- We studied Intersection homology on a stratified spaces, then we focused mainly into intersection homology of Pseudomanifolds. Algebraic,topological normalization and thir relation via Zariski main theorem, Pseudomanifold structure of Quasi projective variety via Whitney stratification and Intersection homology on them.
- Then we studied sheaf theoretic intersection homology and noted how it is a stratification invariant via Deligne sheaf construction. Then we studied Perverse sheaf and it's properties.

Homology, cohomology, dualities and cup product rings | VSRP, TIFR-Mumbai (Summer of 2023)
Guided by Prof. S.K.Roushon

- I studied Homology theory for topological spaces and equivalences of ordinary Homology theories via *Acyclic model theorem* from the book of E.Spanier. Applications like the Hairy Ball theorem, Lefschetz fixed point theorem, and the Jordan, Brouwer-separation theorem were explored.
- I further 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 $H^*(X, R) = A$ for a given graded R-module A. I also noted an affirmative result for algebras over rationals, found in Quillen's paper on Rational Homotopy theory.

Knot theory 2023
Guided by Prof. Anubhav Mukharjee (lecturer at Princeton University)

I reviewed basics of algebraic topology like, fundamental group and covering spaces, results from homology and cohomology, 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.

Hankel Operator on the Hartog triangles Polymath
Guided by Nathan Wagner (Assistant Professor at Brown university) [Presentations]

- Our group worked on characterizing bounded Hankel operators on the Hartogs triangle.
- The Hartogs triangle is a domain in $\mathbb{C}$ 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.

Further Projects

§ **Commutative algebra :** During the 2022 fall semester, I read commutative algebra from *Atiyah Macdonald* and from *Matsumura* under the guidance of Prof.*Maneesh Thakur*.

Presentations / Talks

- (Upcoming) **What is cohomology**, a part of 'What is ...?' seminar Math Club (ISI B) [abstract and talk] (2024)
- (Upcoming) **Realizing algebra over rationals as cohomology ring of some spaces**, Math Club (ISI B) (2024)
- **Discussion on Kähler package in the context of Intersection Homology**, Intersection Homology seminar (2024)
- **Intersection homology for Quasi Projective Variety and it's first properties**, Intersection Homology seminar (2024)
- **Jordan-Brouwer separation theorem and it's application via homology theory**, during VSRP (2023)
- **Boundedness of Hankel operators on Hartogs triangles**, during polymath Presentations (Polymath)
- **Thom space of a vector bundle and its relation with reduced suspension**, this was delivered as a part of WRP organized by Mathclub. (2022)
- **Lifting the exponent in Number theory and it's applications to olympiad problems**, this was delivered in my school *Nirmal Hriday Ashram*, this talk was organized by me. (2019)

Achievement and Scholarships

Achievements

2023 VSRP, A summer research program organized by TIFR, Mumbai. I was one of the selected students for this program.

2022 Polymath, selected for the polymath junior program, it is an online REU organized by Williams College.

2021 Madhava Math competition, 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

2021-24 Stipend by *Indian Statistical Institute*.
Stipend by *Govt. of India*, INSPIRE SCHOLARSHIP (declined due to convenience of ISI stipend).

2019-21 Stipend by *Govt. of west Bengal*, SWAMI VIVEKANANDA SCHOLARSHIP.
JBNSTS scholarship.

Activities

- **Grader** — I have graded papers of RMO(Karnataka Region) on the year 2023.
- **Blogs and website** — I write blogs on my website. One can find it here. I also update resources page of my website on a regular basis. I upload notes/assignments of my semester works there, along with some notes/papers that I used while some studies/projects.
- **Scribe** — I have scribed notes of the course Analysis of several variables by Prof.Jaydeb Sarker. I have scribed some notes of the 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'.
- **Furthers** — I am a member of Mathclub at ISI, Bangalore and a member of LIMIT QST. On my leisure I used to make videos on youtube.

Technical Skills

Programming	C, R, Python & HTML
Design	Illustrator, Photoshop
Tools	Git, LaTeX