

TRISHAN MONDAL

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ABOUT ME

I am Trishan Mondal, a first year M.Math(Master of Mathematics) student at the Indian Statistical Institute, Kolkata. My academic interest revolves around algebra, geometry, and topology.

EDUCATION

Indian Statistical Institute, Kolkata | Master of Mathematics (2024-Present)
Grades : 97.2 % in first semester.

Indian Statistical Institute, Bangalore | Bachelor of Mathematics (2021 - 2024)
Grades : 93 % over 6 semesters.

RESEARCH PROJECTS

Introduction to \mathbb{A}^1 -homotopy | PCMI, IAS-Park City (Summer of 2024)

Primarily we studied simplicial homotopy theory. After that endowing the category of smooth schemes \mathbf{Sm}_k with Nisnevich topology, we defined *Motivic spaces* as a Sheaf of Kan complex on \mathbf{Sm}_k with certain properties. Then we defined \mathbb{A}^1 -homotopy groups on the category of pointed Motivic spaces and studied some properties of them. Finally we proved a few connectivity results using truncated Postnikov towers of motivic spaces.

◦ As a part of PCMI XML projects, I have studied and presented on 'Equivariant stable homotopy of Sphere spectra' [[Presentation can be found here](#)]: Guided by J.D.Quingly (University of Virginia)

Topics in Vector-bundles and computations of lower stable stems | IISER, Kolkata (2024)

Guided by Prof. Somnath Basu

I studied construction and properties of principal G -bundles, Vector-bundles from the paper of Steenrod and further focused on computing 1-stem and 2-stem using framed cobordism via Thom-Pontryagin construction following the paper of Pontryagin and Milnor. I revised the proof of Pontryagin using modern tools. [[PDF](#)]

Intersection homology | During the 2024 spring semester (2024)

Guided by Professors of Algebraic Geometry department at ISIB

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. How it applies to 'Nearby and vanishing cycles' with the decomposition of intersection homology.

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*.

Knot theory

2023

Guided by Prof. Anubhav Mukharjee (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]

- 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

§ **Riemann surfaces and Riemann-Roch theorem** : During the 2024 spring semester (B.Math final year), I read about Riemann surfaces and presented on 'Riemann-Roch theorem' under Guidance of Prof. B.Sury.

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

Notes/Articles and Reports of Few projects

All the notes and articles written by me can be found [here](#). Also Reports of some past projects can be found on the same page.

PRESENTATIONS / TALKS

- **Equivariant stable homotopy of sphere spectra**, as a part of PCMI XML presentation [talk pdf] (2024)
- **Riemann-Roch and it's application**, as a part of reading seminar on Riemann surfaces [talk pdf] (2024)
- **What is cohomology**, a part of 'What is ...?' seminar Math Club (ISI B) [abstract and talk] (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

2024 PCMI, A summer program organized by IAS, New Jersey. I was one of the selected students for this program, this program was held at Park City, Utah.

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 and TA** I have been a grader at AOPS (an online math platform) also assisted few classes on Number theory and Geometry.
- **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