arenanse@gmail.com
arenanse.github.io

Animesh Renanse

Education

Department of Mathematics, University of California, Santa Cruz Santa Cruz, CA
PhD in Mathematics 2025 - 2030 (*expected*)

Statistics & Mathematics Unit, Indian Statistical Institute Bangalore, India
Master of Mathematics, Distinction 2023 - 2025

- Percentage : 93.1

Department of Mathematics & Statistics, Indian Institute of Science Education & Research, Kolkata Kolkata, India
Master of Science in Mathematics (Left after one year) 2022 - 2023

Department of Electronics & Electrical Engineering, Indian Institute of Technology, Guwahati Guwahati, India
B.Tech in Electronics & Electrical Engineering with minor in Mathematics 2018 - 2022

- CGPA: 8.49

Publications and Preprints

1. A. Renanse, A. Sharma, R. Chandra, *Memory capacity of recurrent neural networks with matrix representation*. Neurocomputing, Volume 560, December 2023, 126824, Elsevier.
2. S. Sharma, A. Renanse, *C-triviality of manifolds of low dimensions*. arXiv:2411.05558.

Projects

Simplicial Sets & The Cobar Construction - Spring 2025 *Dr. Anita Naolekar, ISIB*
After covering basics of simplicial sets and simplicial homotopy theory, studied the cobar construction of Adams. Ended with the study of homotopy coherent realization and the work of Dugger-Spivak on its mapping simplicial sets, which is then used in proving Adams' theorem on homology of loop spaces, following the work of Rivera. Report.

Intersection Theory in Algebraic Geometry - Fall 2024 *Dr. Suresh Nayak, ISIB*
Covered main results on Chow groups and intersection product from the books by Fulton and Eisenbud-Harris. Serre's Tor formula gives a correct product for properly intersecting cycle which descents to Chow groups via a moving lemma. After calculating Chow ring for $\mathbb{A}^n$ & $\mathbb{P}^n$, ended with geometry and Chow ring of Grassmannians via Chern classes. Report.

Algebraic K-Theory - Summer 2024 *Dr. Rahul Gupta, IMSc*
Studied classical definitions, results and examples of K_0, K_1 & K_2 of a commutative ring with 1 and then studied the first definition of higher K-theory via the $+$-construction on $BGL(R)$. After studying Loday's product in K-theory, ended with homotopy groups with coefficients which is then used to calculate K-groups with coefficients for $\bar{\mathbb{F}}_p$. Gave a proof of the uniqueness of the homotopy type of X^+. Report.

Function Fields & Algebraic Curves - Spring 2022 *Prof. Rupam Barman, IITG*
Studied algebraic function fields of one variable and algebraic curves and showed that they are equivalent. Covered Riemann-Roch theorem for curves and studied ElGamal elliptic curve cryptosystem from the book of Niederreiter and Xing. Report.

Generalized Galois Theories - Fall 2021 *Prof. Rupam Barman, IITG*
Studied Galois theory for finite and infinite dimensional commutative K-algebras for an extension L/K, establishing an equivalence between K-algebras split by L and profinite spaces with $\mathrm{Gal}(L/K)$-action. Ended with an overview of categorical Galois theorem of Janelidze. Report.

Sheaves & Topos Theory - Summer 2021 *Dr. Amit Kuber, IITK*
Studied sheaves and topoi from the book of MacLane and Moerdijk. After studying general results about internal logic in a topos, studied categorical logic and semantics from Johnstone's book and ended by reading the proof of independence of AC and CH via topos theoretic tools. Report.

Memory Capacity of Neural Networks - Summer 2020 *Dr. Rohitash Chandra, UNSW*

After setting up Fisher information matrix for a recurrent network with matrix representations, we generalized some known bounds on Fisher information classically known only in vector representation case. We also introduced a new memory network similar to the classical neural Turing machine but which stores matrix representations and did a comparison on some algorithmic tasks. Paper.

Fellowships

- **M.Math Fellowship.** ISIB, 2023-Present
- **IMSc Summer Research Fellow.** IMSc, May-July 2024
- **Samsung Research Scholarship.** Fellowship for bachelor's projects. IITG, 2021-2022
- **O.P. Jindal Engineering & Management Scholarship.** IITG, 2019

Talks and Presentations

- **The oriented cobordism ring.** Seminar on Characteristic Classes, ISI Bangalore, March 2025.
- **Simplicial sets & homotopy theory.** eCHT Kan Seminar (online), March 2025.
- **Chern classes & cohomology ring of $\mathbb{C}$-Grassmannian.** Seminar on Characteristic Classes, ISI Bangalore, February 2025.
- **Cohomology long exact sequence for sheaves & Dolbeault's theorem.** Riemann Surfaces Seminar, ISI Bangalore, April 2024.
- **Perverse sheaves : Examples and properties.** Intersection Homology Learning Seminar, ISI Bangalore, March 2024.
- **Memory capacity of matrix recurrent networks.** Transitional AI Seminar, Univ. New South Wales (online), October 2023.
- **Galois theorem for commutative algebras.** DMS Day, IISER Kolkata, February 2023.
- **Categories & functors.** Indian School on Logic & Applications, IIT Kanpur, May 2022.
- **Memory capacity of matrix recurrent networks.** Machine Learning Research Week, IIT Guwahati, March 2021.

Advanced Coursework (ISIB)

- Topology-2 : Covering spaces, homology & CW-complexes
- Topology-3 : Cohomology & homotopy theory
- Differential geometry - I
- Vector bundles & characteristic classes
- Complex analysis
- Measure theory
- Functional analysis
- Algebraic geometry
- Symplectic geometry
- Differential geometry - II

Seminars and Conferences

- eCHT Kan Seminar by Dr. Jack Carlisle, Notre Dame (online), Jan-April 2025.
- Operads in Topology, National Center of Mathematics Workshop, IIT Bombay, Dec 2024.
- Intersection Homology Learning Seminar by Dr. Charanya Ravi, ISI Bangalore, Jan-April 2024.
- Indian School on Logic & Applications, IIT Kanpur, May 2022.

Mathematical Writeups

A detailed list of notes and writeups can be found at my webpage here.

Software Experience

Python, C++ and ML packages like PyTorch and TensorFlow. Major projects can be found here.

References

- Dr. Amit Kuber
  Associate Professor
  Department of Mathematics & Statistics
  Indian Institute of Technology, Kanpur
  askuber@iitk.ac.in
- Dr. Suresh Nayak
  Associate Professor
  Statistics & Mathematics Unit
  Indian Statistical Institute, Bangalore
  snayak@isibang.ac.in
- Dr. Aniruddha Naolekar
  Associate Professor
  Statistics & Mathematics Unit
  Indian Statistical Institute, Bangalore
  ani@isibang.ac.in
- Dr. Anita Naolekar
  Associate Professor
  Statistics & Mathematics Unit
  Indian Statistical Institute, Bangalore
  anita@isibang.ac.in
- Dr. Manish Kumar
  Associate Professor
  Statistics & Mathematics Unit
  Indian Statistical Institute, Bangalore
  manish@isibang.ac.in
- Dr. Rahul Gupta
  Reader
  Department of Mathematics
  The Institute of Mathematical Sciences
  rahulgupta@imsc.res.in