Harisankar Binod

Integrated MSc Mathematics (Minor: Computer Science), NISER Bhubaneswar

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Research Interests

Automated reasoning, formal methods, theoretical computer science and machine learning: systems that reason about, verify and synthesize correct software and mathematics. Currently automated theorem proving and Lean; more broadly logic, foundations of computation, and formal reasoning meets ML.

Education

Integrated MSc in Mathematics, Minor in Computer Science 2022 – 2027 (expected)
National Institute of Science Education and Research (NISER), Bhubaneswar

Higher Secondary Education 2022
Sarvodaya Central Vidyalaya, Thiruvananthapuram, Kerala

Research Experience

Research Intern, FP Launchpad, IIT Madras May – Jul 2026
Advisor: Dr. KC Sivaramakrishnan

- Formal verification of replicated data types for distributed systems in Lean 4, using the Sal verification framework.
- Mechanised a tombstone-free Replicated Growable Array (RGA), proved it RA-linearizable, and then showed it still reorders text on delete: convergence alone is not enough.
- Contributed the tombstone-free RGA and its successor **EmbedRGA**, which repairs the anomaly using immutable coordinates, to Sal.

Summer Research Programme, IMSc Chennai Summer 2025
Advisor: Dr. Meena Mahajan, Theoretical Computer Science group

- Studied formal logic and automated theorem proving, and experimented with Lean.

Research Intern, NISER Bhubaneswar Summer 2023
Advisor: Dr. Subhankar Mishra

- Surveyed applications of artificial intelligence in oral health (diagnosis, treatment and patient care), resulting in a Springer book chapter.

Winter Reading Project, Indian Institute of Science (IISc), Bangalore Winter 2023
Advisor: Dr. L. Sunil Chandran

- Read and summarised a research paper in graph theory.

Publications

Harisankar Binod, T. Shithij, A. Tichy, and S. Mishra. *Artificial Intelligence in Oral Health.* In *Artificial Intelligence for Oral Health Care: Applications and Future Prospects*, eds. F. Schwendicke, P. K. Chaudhari, K. Dhingra, S. E. Uribe, M. Hamdan. Springer Nature Switzerland, Cham, 2025, pp. 1–21. doi:10.1007/978-3-031-84047-0_1

Talks

- **Hands-on Lean**, *Lean for the Working Mathematician* workshop, NISER Nov 2026
  Third, hands-on session: propositions as types and writing proofs with core tactics. [slides]
- **Convergence is Not Enough: Verifying a Tombstone-Free Sequence MRDT in Lean 4** Jul 2026
  Internship presentation, FP Launchpad, IIT Madras. [slides]
- **Transformers Learn Shortcuts to Automata** (with Yash Chauhan) Apr 2025

Advanced Machine Learning course, NISER; on Liu et al. (2022), covering Krohn–Rhodes decomposition and circuit complexity. [slides · report]

- **An Introduction to Turing Machines**, Code N Coffee, NISER (building one in Python) Sep 2024

Schools, Workshops and Hackathons

- LeanLang Summer School, IISc Bangalore (organised by EmergenceAI) Jul 2026
- Foundational Lecture Series in Theoretical Computer Science, IMSc Chennai Jun 2026
- LeanLang for Verified Autonomy Hackathon, IISc Bangalore (organised by EmergenceAI) Apr 2026

Teaching and Outreach

- **Lean workshop, NISER**: co-organised with Aneesh Ukidve and Dr. Anamay Tengse Nov 2026
  Wrote the hands-on slides, a one-page tactic cheat sheet and follow-along exercise files. [materials]
- **Topology Assignment Solutions**: class-wide LaTeX compilation 2026
  Set up the shared build and file layout, and assembled solutions from over twenty students. [repo]
- **NISER Open Day**: interactive demos for visiting school students 2024, 2025
  Path finding with Dijkstra and A* (2024); live pose detection with MediaPipe and YOLO (2025).
- **Cybersecurity awareness talk** for school students, Prerna (Zariya club) Mar 2025

Selected Projects

- **Tombstone-free sequence MRDT in Lean 4** – RA-linearizable RGA and EmbedRGA, contributed to the Sal framework. [repo · write-up]
- **How QR Codes Work** – interactive explainer from encoding to Reed–Solomon error correction over $\mathbb{F}_{256}$ and scanner geometry. [site · repo]
- **Catacaustic Curve Explorer** – interactive visualisation of caustics formed by reflective curves. [site · repo]
- **Problem of the Week** – weekly competitive-programming platform with an automated leaderboard. [site · repo]
- **Umang '25 website** – official site of NISER's annual fest, with a self-refreshing live results board. [site]

Leadership and Service

- **Head, Coding Club, NISER** – organise events and plan initiatives that promote coding and technology.
  - Started *Code N Coffee* (Jun 2024), informal meetups for coding enthusiasts, and *Problem of the Week* (Oct 2024).
  - Organised *Switcheroo* (Sep 2024), a paired coding contest, and built its Flask submission and scoring server; organised *Against Time* (Mar 2025), a competitive programming event.
- **Core member, MathematiX Club, NISER** – Pi Day Celebration 2024; helped organise SUMS, SRS and AXIOM talks.

Relevant Coursework

Mathematics	Real Analysis, Complex Analysis, Functional Analysis, Measure Theory, Topology, Linear Algebra, Group Theory, Rings and Modules, Number Theory, Graph Theory, Probability Theory
Computer Science	Data Structures and Algorithms, Design and Analysis of Algorithms, Theory of Computation, Algorithmic Coding Theory, Computational Geometry, Advanced Machine Learning

Skills

Formal Methods	Lean 4, Mathlib
Programming	Python, JavaScript
Machine Learning	PyTorch, TensorFlow, scikit-learn, OpenCV, MediaPipe
Scientific	NumPy, SciPy, Pandas, Matplotlib, Mathematica, LaTeX
Web and Tooling	Flask, Django, React, HTML/CSS, Google Apps Script, Git, Make