Shubhajit Dey

Email | Webpage | GitHub | LinkedIn | ResearchGate

RESEARCH INTERESTS

[Analysis on ODEs/PDEs for their computational/numerical solutions] Functional analysis on ODEs and PDEs which are fruitful for developing numerical algorithms and computational schemes for efficiently solving them. In particular, Fourier, Chebyshev spectral methods for eigenvalue problems.
[Continuous Optimisation] Optimisation over continuous domains which are crucial from the perspective of deep learning. In particular, optimisation over manifolds and their applications in developing better gradient descent optimisers.

EDUCATION

BSMS. Mathematics and Data Science 2019 - 2024
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL

- Advisors : Dr. Anandateertha Mangasuli, Dr. Ambuj Pandey
- Thesis : Theoretical & computational considerations of Sturm-Liouville systems [pdf]

PROFESSIONAL EXPERIENCES

Teaching Fellow (Head) Jan 2025 - Jun 2025
ASHOKA UNIVERSITY, NCR
Taught undergrads and aided host Prof. Partha Pratim Das in the Discrete Mathematics course.

Teaching Fellow Sep 2024 - Dec 2024
ASHOKA UNIVERSITY, NCR
Taught undergrads and aided host Prof. Bhargab Bikram Bhattacharya in the Quantitative Reasoning & Mathematical Thinking (QRMT) course.

Graduate Researcher May 2024 - Sep 2024
UNIVERSITÉ DU QUÉBEC À MONTRÉAL, MONTRÉAL
Worked under the guidance of Dr. Janosch Ortmann & Prof. Walter Rei on extension of the Mitacs Globalink project.

RESEACH EXPERIENCES & PROJECTS

Theoretical & computational considerations of Sturm-Liouville systems *(MS thesis project)* Aug 2023 - May 2024
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL

- Advisors : Dr. Anandateertha Mangasuli, Dr. Ambuj Pandey
- Studied the theory of regular SL systems, in particular its oscillation theory, asymptotic analysis and completeness theory of eigenfunctions.
- Conducted numerical experiments to compute and visualise Fourier and Chebyshev approximations, Gibbs phenomenon.
- Explored theoretical foundations of pseudo-spectral methods, in particular discrete computation of Chebyshev coefficients along with numerics.
- Thesis : [pdf] — Code : [GitHub Repo]

Signature based computational alegraic geometry required for optimisation under uncertainty *(MITACS project)* May 2023 - Aug 2024 + May 2024 - Sep 2024
UNIVERSITÉ DU QUÉBEC À MONTRÉAL, MONTRÉAL

- Advisors : Dr. Janosch Ortmann, Prof. Walter Rei
- Investigated signature-based algorithms and their role in discarding redundant calculations in Gröbner Basis computations relevant to stochastic programming.
- Performed theoretical surveys and contributed towards the theoretical foundations of the signature-approach of the considered optimisation problem.
- Report : *progressing towards a publication; preprint to be available soon.*

On characterising dense and compact subspaces of $\mathbf{C}(\mathbf{X}, \mathbb{R})$ May 2022 - Aug 2022
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL

- Supervisor : Dr. Anandateertha Mangasuli
- Explored foundational analysis of functional approximation theory from the perspective of metric-space topology. Studied Ascoli's theorem, Weierstrass approximation and Stone-Weierstrass theorem.
- Report : [pdf]

On Taylor's approximation and some associated theorems for convergence of power series with computational applications Aug 2023 - May 2024
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL

- Supervisor : Dr. Anandateertha Mangasuli
- Studied analytical results on convergence of Taylor's series. Primary focus was on Bernstein's theorem, Abel's limit theorem and Tauber's first theorem from the perspective of analytical approximation theory.
- Explored theory on minimisation of error in Taylor's approximation, via it's integral form.
- Additionally studied '*Higher-order Taylor method to numerically solve DEs*' as a computational application of the theory (implementation in python).
- Report : [pdf] — Code : [Jupyter Notebook]

Acoustic scene classification using auditory datasets – statistical data analysis and scientific AI Aug 2021 - Dec 2021
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL

- Supervisor : Dr. Vaibhav Kumar
- Built a system employing a CNN based framework (*PyTorch, Librosa*) to classify audio scenes.
- Used robust statisitcal data analysis and data pre-processing including exploitation of physics based Mel spectograms to boost predictability.
- Report : [pdf] — Code : [GitHub Repo]

A preliminary survey on 'Deep Maths' *(Reading project)*
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL

- Supervisor : Dr. Vinod K Kurmi
- Studied the collaborative works done by Google DeepMind and Oxford University, and the foundations of problem-specific ANNs in solving problems in abstract mathematics.
- Explored advancements in active research on guiding mathematical intuition using AI.
- Report : [pdf]

CONFERENCES & TALKS

WORKSHOPS ATTENDED

- **Explorations in Statistics, Probability, Learning and Optimization Research -** (**exSPLORE 2025**), a five-day workshop for research in industrial computer science and applied mathematics, conducted jointly by Safexpress Centre for Data, Learning and Decision Sciences & Google. | ASHOKA UNIVERSITY, NCR Jan 2025
- **Annual Mathematics Symposium 2024 -** (**Analysis**), a three-day conference conducted to present insights on the active research conducted at the Dept. of Mathematics at IISER Bhopal. INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL Feb 2023
- **Indian School of Logic & its Applications -** (**ISLA 2020**), a virtual school on advancements in research on mathematical logic and its applications, conducted jointly by IISERB and Association of Logic in India (ALI). | held online, due to COVID-19 Dec 2020

GRANTS & AWARDS

- MITACS GRI Grant - CAD 10,000 May 2023 - Aug 2023

SCHOLASTIC ACHIEVEMENTS

- Obtained an **A-grade** for the research work done during my MS Thesis project. 2024
- Obtained an **O-grade** for outstanding performance in the course DSE 309 : Advanced programming in Python 2021
- Cleared ISI B.Math entrance examination - round 1, clearance only for top 150 out of 50k+ applicants 2019
- Obtained **94%** in AISSCE (CBSE class XII boards examination in India) 2019

ADMINISTRATIVE RESPONSIBITIES

- **Event Coordinator & Core-team member**, for the Interactive Quiz Event in the annual outreach programme of IISER-B, responsibility as a host and an event manager.
  INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL 2022
- **Department Representative**, for the mathematics 2019 batch, responsibility to represent the entire batch to the department and solve relevant issues and grievances.
  INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL 2022
- **Coordinator**, at IISERB QUIZ CLUB for 2 consecutive academic years, responsibility to conduct infotainment quizzes.
  INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL 2020

SKILLS

Language	Fluent: Python, C++ | Familiar: R
Programming	Fluent: Object Oriented Programming | Familiar: Functional Programming
Software	MATLAB, Wolfram Mathematica
Analytics	Jupyter Notebook, RStudio
Tools	LaTeX, HTML
Libraries	Fluent: NumPy, Matplotlib, Pandas, SciPy, Scikit-Learn, PyTorch Familiar: Keras, Qiskit, Librosa

REFERENCES

- **Dr. Anandateertha Mangasuli**, **Assistant Professor**
  INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL
  anand@iiserb.ac.in
- **Dr. Janosch Ortmann**, **Associate Professor**
  UNIVERSITÉ DU QUÉBEC À MONTRÉAL, MONTRÉAL
  ortmann.janosch@uqam.ca
- **Prof. Partha Pratim Das**, **Professor** **[Teaching Reference]**
  ASHOKA UNIVERSITY, NCR
  partha.das@ashoka.edu.in