

# Shubhajit Dey

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## RESEARCH INTERESTS

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[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

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**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

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**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

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**Theoretical & computational considerations of** Aug 2023 - May 2024

**Sturm-Liouville systems** (*MS thesis project*)

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** May 2023 - Aug 2023

**required for optimisation under uncertainty** (*MITACS project*)

+ 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 $C(X, \mathbb{R})$

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

Dec 2021 - Jan 2022

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 statistical data analysis and data pre-processing including exploitation of physics based Mel spectrograms 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

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### 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

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

## SCHOLASTIC ACHIEVEMENTS

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- 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 RESPONSIBILITIES

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- **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

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<b>Language</b>	Fluent: Python, C++   Familiar: R
<b>Programming</b>	Fluent: Object Oriented Programming   Familiar: Functional Programming
<b>Software</b>	MATLAB, Wolfram Mathematica
<b>Analytics</b>	Jupyter Notebook, RStudio
<b>Tools</b>	L <sup>A</sup> T <sub>E</sub> X, HTML
<b>Libraries</b>	Fluent: NumPy, Matplotlib, Pandas, SciPy, Scikit-Learn, PyTorch Familiar: Keras, Qiskit, Librosa

## LINGUISTICS

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English	■ ■ ■ ■ ■
Hindi	■ ■ ■ ■ ■
Sanskrit	■ ■ ■ ■ ■
German	■ ■ ■ ■ ■

## REFERENCES

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- **Dr. Anandateertha Mangasuli, Assistant Professor**  
INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH, BHOPAL  
[anand@iiserb.ac.in](mailto:anand@iiserb.ac.in)
- **Dr. Janosch Ortman, Associate Professor**  
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[ortmann.janosch@uqam.ca](mailto:ortmann.janosch@uqam.ca)
- **Prof. Partha Pratim Das, Professor** [Teaching Reference]  
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