

Sayantan Roy

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Skills

Programming Languages: Python, Bash, C, Mathematica **Database:** SQL, Redis

Frameworks and Libraries: Numpy, Scipy, Jupyter, Pandas, Scikit-learn, Pytorch, Git

Machine Learning: Regression, Ridge/Lasso, K clustering, PCA, Random Forests, Autoencoder Neural Networks, NLP

Techniques: Monte Carlo Simulations, Data analysis, Bayesian Inference, Probability, Statistics, Deep Learning

Work experience

Ohio State University, Columbus: Graduate Research/Teaching Assistant

August 2019-present

- TA for undergraduate physics courses for 5 semesters. Conducted recitation and labs, held office hours, graded exams.
- Designed and managed 4 projects for graduate research. Implemented large scale numerical simulations on HPC clusters.
- Published 3 scientific articles, presented research at APS 2022, 2023, GRS 2022.

University of Regensburg, Germany: Summer Research Intern

May-July 2018

- Collaborated with senior researcher on large scale quantum simulations. Conducted data visualization+analysis to corroborate experimental findings. Reproduced experimental data within 5 % error bar.

Forschungszentrum Julich, Germany: Summer Research Intern

June-August 2017

- Collaborated with research group at JCMS-2 for material synthesis and sample characterization by XRD techniques. Synthesized compound with 70 % yield which showed promising technological application in memory storage.

Projects

Quantum Monte Carlo simulations and Bayesian Inference: Graduate research project.

May 2022-present

- Performed Determinant **Monte Carlo simulations** over large parameter sets in phase diagram of High T_c superconductors.
- Conducted **statistical data analysis to extract physical quantities from large (~55000) datasets**. Discovered significant correlations, identified novel phases; proposed algorithm for mitigating sign problem in QMC simulations.
- **Maximum likelihood estimations** to predict spectral functions (>90 % accuracy) from QMC data ; confirmed by experiments.

Feature selection for viability models: Erdos Institute data science project.

September-December 2023

- Collaborated on data collection for 83 features impacting Salmon viability; performed **data cleaning and time series analysis**.
- Conducted **supervised learning** for feature ranking to identify top 5% features impacting viability the most.
- Built **regression model** for predicting salmon viability for 4 different species with high accuracy of 85% .

Neural network for matrix inversion problems: Graduate research project.

September-December 2023

- Collaborated on **Variational Autoencoder Neural network** approach to ill posed matrix inversion problems.
- Implemented highly flexible architecture to allow variable number of relevant regularization schemes. Trained network on real data; Neural network surpassed widely used Maximum entropy methods in performance, providing 4x simulation speedup.

Machine learning for modeling interacting spin systems: Undergraduate research project.

May-July 2016

- Built **Restricted Boltzmann Machine** for isotropic Heisenberg model under external field. Achieved > 85 % accuracy for predicting ground state energies and wave-functions.

Education

Ohio State University

Ph.D in Physics, GPA - 4.0/4.0

August 2019- present

Indian Institute of Science

BSc & MSc in Physics, GPA - 6.4/8.0

August 2014-July 2019

Leadership and Collaborations

- Mentored 5 undergraduate students for OSU-REU 2021,2022; currently mentoring 2 junior graduate students.
- Collaboration with Martin Zwierlein's group at MIT; benchmarking cold atom experiment data (Presented at APS 2023).
- Collaboration with Thereza Paiva's group at UFRJ Brazil; efficient energy storage devices (Presented at APS 2023).
- Ongoing collaboration with Maciej Maska's group at WUST, Poland; Neural network methods for better analytic continuation results compared to conventional approaches.