

Shuvam Banerji Seal

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Research Experience

Developing an Advanced Retrieval Model for TREC-Tip of Tongue Queries

2024 (*TREC 2024 Proceedings*)

Guided by *Dr. Dwaipayan Roy*, Dept. of Computation and Data-Science, IISER-Kolkata

Engineered multi-layer BM-25 filtering system (in Lucene, Java) with dynamic search-domain contraction based on extracted keywords and implemented transformer-based query expansion and semantic matching using Local LLMs through multi-shot and chain-of-thought prompting achieving results on par with specifically-modified DPR models

Computational Modeling of [VO(SALIEP)(DTP)] as Water Reducing Catalyst

2024 (to be submitted)

Guided by *Dr. Soumyajit Roy*, Dept. of Chemical Sciences, IISER-Kolkata

Implemented DFT methods (B3LYP) for MO energy calculations and electronic structure analysis using Gaussian and conducted mechanistic studies using transition state theory and reaction pathway analysis catalyst performance prediction for water reduction

On the Nature of Information

2023-24 (Under Review)

Guided by *Dr. Soumyajit Roy*, Dept. of Chemical Sciences, IISER-Kolkata

Developed novel mathematical models for information flow analysis and applied entropy principles to quantify information evolution for a set of constraints to identify and characterize critical inflection points in information dynamics

Projects

Developed a complete GUI full-stack application using GTK4 in C 🌐

2024

Under the supervision of *Dr. Kripabandhu Ghosh*, Dept. of Computation and Data-Science, IISER-Kolkata

Implementing a complete GUI application in C using GTK4 and Glade using SQLite3 as the local Database Management along with a static Context ChatBot with NLP using optimized BM25 retrieval

Porting the SMC Canteen system for IISER-Kolkata to Python3 Django

2024

Student Monitored Canteen System of IISER-Kolkata

Contributing to the SMC system that serves 2000+ students of IISERK by modernizing it to a more modern system running Django Framework

Developed RAG Application for CCA-2015 based Legal Document Retrieval for INCI Entrepreneurial Summit 🌐

2025

Created a robust RAG stack using Selenium for web-scraping, Mistral-OCR for creating the JSON document base, ChromaDB, Nomic Embeddings, LLaMA3.2:1b for retrieval and the StreamLit interface for UI

Technical Expertise

Research Computing : Algorithm Development | Information Retrieval (Lucene in Java) | Bio-Informatics | Molecular Dynamics | DFT Computations

Programming Languages : Python | C/C++ | Java | Rust | QBASIC | GWBASIC | Fortran

Python Libraries : Numpy | Pandas | Matplotlib | Tensorflow | Transformers | NLTK | Spacy | Plotly | Manim | StreamLit

Scientific Software : LAMMPS | VMD | Gaussian | Origin Pro | Scilab

Bio-Informatics : PyMol | ChimeraX | PyDock | AutoDock Vina

Development Stack : Full Stack (HTML/CSS/Javascript) | Databases (MongoDB, MySQL, SQLite3, ChromaDB) | Version Control (Git) | Containerization (Docker) | CMake | Make

Framework : Django

GUI Development : GTK4 in C | QT in C++ | Glade for Designing

Operating Systems & Server Management : Linux | Server Handling- SSH, OpenSSL | CUDA Programming (Python)

Laboratory Instrumentation : UV-Vis | ATR-FTIR | TGA | DSC | Optical Bench | XRD | GC-MS | Column Chromatography | Fluorimeter | SEM | TEM | AFM

Additional Tools : LaTeX | Shell Scripting (Bash) | UI/UX Design (Figma) | HTML E-mailing

Education

Indian Institute of Science Education and Research - Kolkata

CGPA: 8.2

BS-MS (Chemistry Major, Computer Science Minor)

2022-2027 (expected)

Calcutta University

CGPA: 8.308

B.Sc Honours in Physics (1st Year Only)

2021-2022

Jodhpur Park Boys' High School

83%

Higher Secondary Education in Physics, Mathematics, Chemistry, Computer Science (WBCHSE)

2019-2021

The New Horizon High School

83.75%

Secondary Level Schooling(English Medium) under WBBSE

2009-2019

Achievements & Honors

Hackathons:

- StatusCode1 (Awarded 1st Rank in GIAN Track)

Developed an AI-based Search Engine for GIAN's Database For Abandoned US Patents

2024
IIIT-Kalyani
- A searching algorithm based on Nomic Embeddings of the patent abstracts and similarity computations thus enabling the user to search for patents in natural language without the use of specific terminologies.
 - Also created a web-scraping algorithm to get the patent data using Selenium, BeautifulSoup and fake_useragent for anti-scraping measures by the website
- StatusCode0 (Awarded 1st Rank in MATLAB Track)

Developed a Domestic Waste Type Data analysis tool for a proposed Start-Up Solution

2023
IIIT-Kalyani

National Level Basic Sciences Competitions:

- ChemEnigma (1st Rank)

Emerged champions at 72 hours Chemistry contest of theoretical, experimental and concept-presentation

2025
IISc-Bangalore
- All Bengal Chemistry Quiz (2nd Runners Up)

Solved chemistry based questionnaires under time constraints

2025
Presidency University
- Mimansa (Zonal Topper)

Contributed to the team in Mathematical problem solving

2024
IISER-Pune
- NAEST-National Anveshika Experimental Skill Test (Zonal Runners Up)

Create extensive experimental setup using homely items- see papers

2023
NANI, IIT Kanpur and Shiksha Sopan

Competitive Examinations:

- Qualified JEE Mains and Advanced

Ranked in Top 0.1 fraction of Candidates

2022
- Qualified IAT(IISER-Aptitude Test)

Ranked in top 0.06 fraction of candidates

2022
- Qualified WBJEE

Ranked in Top 0.05 fraction of Candidates

2022

Scholarships and Honors:

- Reliance Foundation Undergraduate Scholar

Qualified the RF-UG Aptitude test to be in the top 5000 students to be awarded this

2023
- Best Young Scientist Speaker on NanoTechnology

Successfully presented at the prestigious conference

2019
World Science Conference, Jadavpur University

Professional Experience

- Private Educator & Technical Trainer

Advanced Computing & Basic Sciences Instruction (Self-Employed)

2018-Present
Kolkata
- Developed and conducted courses in Computer Science, Physics, Chemistry and English for High School students (ICSE, CBSE, WB Board)
 - Mentored 50+ students for Board and competitive examinations
- Technical Consultant

Self-Employed

2021-Present
Kolkata
- Designed and implemented high-performance computing solutions
 - Expertise in system optimization, BIOS/UEFI configuration, and OS installation
 - Successfully completed 30+ custom build projects with 100% client satisfaction
- Published Author

MindScapes (ISBN: 978-9389923209)

2020
Kolkata
- Published creative work focusing on scientific and philosophical themes
 - Conducted workshops on technical and creative writing

Leadership & Community Impact

- Event Management:

Organized Anicon 3.0 (500+ participants) in 2025 | Organized Supra-Molecular Discussions 2024 | Organized GIAN Courses on Soft-Oxometalates and X-Ray Crystallography
- Social Impact:

COVID-19 relief coordinator | Educational mentor for Ek-Pehal program
- Additional Activities:

District Level Debate and Quiz finalist | Shotokan Karate practitioner | 4th Year Art and Painting Student with major works in Stroke art and Portraits