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 though 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 Enterpreneurial 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(Engligh Medium) under WBBSE	*2009-2019*

Achievements & Honors

Hackathons:

StatusCode1 (Awarded 1st Rank in GIAN Track) ⌨ — *2024*
Developed an AI-based Search Engine for GIAN's Database For Abandoned US Patents — 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) — *2023*
Developed a Domestic Waste Type Data analysis tool for a proposed Start-Up Solution — IIIT-Kalyani

National Level Basic Sciences Competitions:

ChemEnigma (1st Rank) — *2025*
Emerged champions at 72 hours Chemistry contest of theoretical, experimental and concept-presentation — IISc-Bangalore

All Bengal Chemistry Quiz (2nd Runners Up) — *2025*
Solved chemistry based quesionaires under time constraints — Presidency University

Mimansa (Zonal Topper) — *2024*
Contributed to the team in Mathematical problem solving — IISER-Pune

NAEST-National Anveshika Experimental Skill Test (Zonal Runners Up) — *2023*
Create extensive experimental setup using homely items- see papers — NANI, IIT Kanpur and Shiksha Sopan

Competitive Examinations:

Qualified JEE Mains and Advanced — *2022*
Ranked in Top 0.1 fraction of Candidates

Qualified IAT(IISER-Apitude Test) — *2022*
Ranked in top 0.06 fraction of candidates

Qualified WBJEE — *2022*
Ranked in Top 0.05 fraction of Candidates

Scholarships and Honors:

Reliance Foundation Undergraduate Scholar — *2023*
Qualified the RF-UG Aptitude test to be in the top 5000 students to be awarded this

Best Young Scientist Speaker on NanoTechnology — *2019*
Successfully presented at the prestigious conference — World Science Conference, Jadavpur University

Professional Experience

Web Development for Anicon 3.0 — *2024-2025*
Inquivesta XI — IISER Kolkata
- Developed and leaded the web development of Anicon 3.0 Event. 🌐

Web Development for EFAML — *2025*
Inquivesta XI — IISER Kolkata
- Developed and designed the researchers lab info page available under Dr. Soumyajit Roy's homepage. 🌐

Private Educator & Technical Trainer — *2018-Present*
Advanced Computing & Basic Sciences Instruction (Self-Employed) — 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 — *2021-Present*
Self-Employed — 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 — *2020*
MindScapes (ISBN: 978-9389923209) — 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

References available upon request