

# SAYAN PATRA

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY,  
BIOSCIENCES AND BIOENGINEERING DEPARTMENT,  
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## RESEARCH INTERESTS

Omics-Based System Biology || Single-Cell-Omics || Computational Cancer Biology || Structural Biology ||  
Bioinformatics || Data Science || Machine Learning || Deep Learning || Artificial Intelligence in Healthcare ||  
Computational Neuroscience || Biophysics

## EDUCATION

### INDIAN INSTITUTE OF TECHNOLOGY BOMBAY, INDIA

August 2023 – Present

Master of Science (M.Sc.)

Major in Biotechnology

CGPA: 9.36/10

### MIDNAPORE COLLEGE (AUTONOMOUS)

September 2020 – July 2023

### VIDYASAGAR UNIVERSITY, INDIA

Bachelor of Science (B.Sc.)

Major in Microbiology

CGPA: 9.58 /10

### PANCHBERIA RAMCHANDRA SMRITI SIKSHA MANDIR, WBCHSE, INDIA

May 2018 - June 2020

Higher Secondary Education

Discipline: Science

Major Courses: Physics, Chemistry, Mathematics, Biological Sciences, English, Bengali

Percentage: 96.20 % (WBCHSE)

### JOTEBHAGABAN HIGH SCHOOL, WBBSE, INDIA

January 2012 – May 2018

Matriculation Examination

Percentage: 92.00% (WBBSE)

## RESEARCH EXPERIENCES

### MULTI-OMICS-BASED STUDY TO EXPLORE THE THERAPEUTIC POTENTIAL OF REPURPOSED DRUG BY TARGETING PI3K/AKT/mTOR PATHWAY IN GROUP 3 MEDULLOBLASTOMA (Master's Thesis) JULY 2024 – MAY 2025

ADVISOR: DR. Sanjeeva Srivastava, IITB, INDIA

- Conducted Cell Proliferation Assay to uncover the IC50 concentration of the drug NGI-on Group-3 Medulloblastoma Cell line, HD-MBO3, which was previously investigated for viral treatment. The Western Blot was conducted to validate the downregulation of Receptor Tyrosine Kinases and Proteins related to Glycolytic Metabolism.
- A comprehensive multi-omics analysis—including proteomics, metabolomics, and lipidomics—was conducted to gain mechanistic insights into the effects of NGI-1 on the HD-MB03 cell line.
- Proteomics Investigation reveals cell cycle arrest after NGI-1 treatment. Molecular checkpoints of G1 phase, S Phase, and G2-M transition were downregulated after the NGI-1 treatment. The integrative multi-omics pathway analysis opens up the downregulation of sugar metabolism, S-adenosine methionine synthesis, Polyamine synthesis, endoplasmic reticulum to lysosome protein transport, and membrane lipid modeling, and PI3K-AKT-mTOR Pathway. Whereas, the Unfolded protein response, Sphingosine synthesis, Phosphatidylglycerol, and Triglycerides were upregulated. Overall, the study reveals cell cycle arrest, lysosomal dysfunction, endoplasmic reticulum, and mitochondrial stress.

## **TRANSCRIPTOMICS LANDSCAPE OF MEDULLOBLASTOMA: IDENTIFYING THE SIGNIFICANT MOLECULAR SIGNALS IN SUBGROUP CLASSIFICATION.**

**(Master's Course Project)**

**October 2024 – December 2024**

**ADVISOR:** DR. Saket Choudhary, IITB, INDIA

- Downloaded publicly available Medulloblastoma RNA-Seq data from GEO (GSE16477). The data was preprocessed in R. Used DESeq2 for the statistical analysis. Plotted PCA for clustering the data. Used enrichR for enrichment analysis. Filtered and plotted group-specific upregulated and downregulated genes.
- Looked for the chromosome on which the highly upregulated genes are expressed. Used Xcell for analyzing the Immune enrichment across samples and each medulloblastoma subgroup.
- Performed Logistic Regression with the significant genes to classify the samples based on their molecular signature. Plotted a confusion matrix and classification report along with the ROC curve to determine the model accuracy and precision.

## **PREDICTING HIGHER-DIMENSIONAL FEATURES OF MOLECULAR DYNAMICS SIMULATIONS FROM LOWER-DIMENSIONAL REPRESENTATION USING DEEP NEURAL NETWORKS.**

**[Summer Research Internship (USA)]**

**JUNE 2024 – AUGUST 2024**

**ADVISOR:** DR. Diwakar Shukla, UIUC, USA

- A pentapeptide (Trp1-Leu2-Ala3-Leu4-Leu5) was simulated using  $25 \times 500$  ns MD trajectories. Coordinates from  $5 \times 500$  ns trajectories were extracted with MDTraj as labels. Input features were obtained by reducing dimensionality into a tIC space using Deeptime. Neural Networks were built with PyTorch, and data was split 60:20:20 for training, validation, and testing.
- The developed model has five hidden layers. It has four ReLU activation methods at the beginning and a Sigmoid activation at the last hidden layer, along with a dropout for each ReLU activation. The optimization of the model was done by the ADAM optimizer. The Loss function is modified accordingly by the Mean square error of coordinates and 2X mean square error of tICs space.
- Test predictions were mapped onto the test tIC space to assess deviations. Predicted high-dimensional coordinates were converted to PDB format and visualized in VMD.

## **DECODING THE STRUCTURAL AND FUNCTIONAL SECRETS OF STREPTOCOCCUS PNEUMONIAE FtsZ PROTEIN: A HOLISTIC APPROACH THROUGH MOLECULAR CLONING TO SPECTROSCOPIC TECHNIQUES.**

**(Master's iLab Project)**

**MARCH 2024 – APRIL 2024**

**ADVISOR:** DR. Prashant S. Phale, DR. Anirban Banerjee, DR. Ashutosh Kumar

- Cloned, expressed, and purified the FtsZ protein from Streptococcus pneumoniae using E. coli BL21 (DE3 RIPL); confirmed molecular weight (~47 kDa with His-tag) via SDS-PAGE and characterized polymerization through GTPase activity and light scattering assays.
- Performed biophysical analyses including fluorescence spectroscopy, circular dichroism, and confocal microscopy to assess structural dynamics, temperature/chemical denaturation, and intracellular localization of SpnFtsZ.
- Demonstrated reversible folding behavior of SpnFtsZ in support of Anfinsen's principle; identified two distinct tryptophan residues with dual excitation/emission maxima, indicating unique folding and functional properties.

## **IN SILICO COMPARISON OF PRIMARY, SECONDARY, AND TERTIARY STRUCTURE OF BOTULINUM TOXIN B, BOTULINUM TOXIN F, AND TETANUS TOXIN AND DETERMINATION OF ZN BINDING RESIDUES IN BOTULINUM TOXIN F.**

**(Master's Course Project)**

**OCTOBER 2023 – NOVEMBER 2024**

**ADVISOR:** DR. Prasenjit Bhaumik, IITB, INDIA

- Performed pairwise sequence alignment and multiple sequence alignment of Botulinum toxin type B, Botulinum toxin type F, and Tetanus toxin.
- Performed secondary structure prediction and comparative analysis of Botulinum toxin types B, F, and Tetanus toxin using ESPrnt 3, highlighting structural diversity across helices,  $\beta$ -strands, and turns
- Performed structural superimposition of catalytic, translocation, and binding domains of Botulinum toxins (types B & F) and Tetanus toxin, revealing domain-specific RMSD variations (0.708–1.480 Å), highlighting evolutionary and functional similarities.

## ISOLATION OF PESTICIDE DEGRADING BACTERIA FROM SOIL, DETERMINATION OF THEIR BIOCHEMICAL PROPERTIES, AND SCREENING OF THEIR PLASMID DNA

(Bachelor's Project)

OCTOBER 2023 – NOVEMBER 2024

ADVISOR: DR. Saroja Chhettri, MIDNAPORE COLLEGE (AUTONOMOUS), INDIA

- Isolation of pesticide-degrading bacteria from soil samples using selective aseptic techniques.
- Studying the biochemical properties of the isolated bacterial strains using various biochemical methods and identifying the genus of the bacteria.
- Isolation of the Plasmid DNA by the Alkaline Lysis Method of the isolated bacteria to confirm the presence of plasmid for Pesticide Degradation.

## SKILLS

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**WET LAB SKILLS:** Proteomics, Metabolomics, Lipidomics Sample Preparation || LC-MS Analysis || Protein Sequencing || Colorimetric Techniques || Western Blotting || Mammalian Cell Culture || Cell Proliferation Assay || Cell Counting || Bacterial Cloning || PCR || Restriction Digestion || DNA Ligation || SDS PAGE || Agarose Gel Electrophoresis || Bradford Assay || BCA Assay || Protein Expression || Protein Purification || Affinity Chromatography || Size-Exclusion Chromatography || Thin layer chromatography || Fluorescence spectroscopy || Circular Dichroism || UV-Vis Spectroscopy || ATR-FTIR || Genomic DNA Isolation || Plasmid DNA Isolation || Bacterial Plating

**Software and Web-Tool-Skills:** FragPipe || DIA-NN || Compound Discoverer || Lipid Search || Orange || Perseus || VMD || Metaboanalyst 6.0 || ImageJ || Skyline || Reactome || Omics Net || STRING || GSEA || WINCOOT || PyMol || Cluster Omega || Cluster X2 || BLAST || Primer Designing || ExPASy || Swiss Model || Marvin Sketch || EMBOSS || ChEMBL || PDB || PubMed || Mascot search engine || Microsoft Office (Excel, PowerPoint, Word) || Canava || Sequence alignment || AlphaFold

**Programming Language and Library:** Python || R || C || HTML || CSS || MDTraj || PyTorch || Matplotlib || Pandas || NumPy || Seaborn || Scikit-Learn || BiocManager || ComplexHeatmap || DESeq2 || EnrichR || DEP || dplyr || ggplot2 || GEOquery || ggrepel || Big Data Analysis || Tidyverse || UpSetR || Conda || Linux

**Language:** English || Hindi || Bengali

## WEBINAR AND WORKSHOPS

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- ❖ Attended “**Illuminate Oncology Town Hall 2.0**” organized by “**Sir H.N. Reliance Foundation Hospital & Research Centre**” February 2025
- ❖ Participated in “**Introduction to Omics and Its Role in Clinical Research**” conducted by the **Graduate School of Science.** April 2024
- ❖ Attended “**Workshop on Communication Skills**” conducted by **Biosciences and Bioengineering, IIT Bombay.** January 2024
- ❖ Participated in “**C Programming Basics: Kick start your programming career**” conducted by **Simplilearn.** December 2023
- ❖ Participated in “**DECODE PROTEOMICS WITH R PROGRAMMING**” organized by the **NyBerMan Bioinformatics Europe.** October 2023
- ❖ Completed “**Introduction to HTML**” organized by **Simplilearn.** October 2023
- ❖ Participated in “**Idea, Invention, Innovation – How companies are born and how they die**” conducted by **Biosciences and Bioengineering, IIT Bombay.** October 2023
- ❖ Attended “**Design Workshop using CANVA**” conducted by **Biosciences and Bioengineering, IIT Bombay.** October 2023
- ❖ Attended “**Demonstration and Brief Training for Flow Cytometer**” conducted by the **Society for Innovation & Entrepreneurship, IIT Bombay.** September 2023
- ❖ Participated in “**Analytical Techniques to Study from Biomolecules to Tissues (ASTBT-2021)**” organized by the **Indian Institute of Information Technology, Allahabad.** June 2021

POSTER PRESENTATION

Presented a poster on “Lipidomics Study Reveals Potential of AKT/mTOR Signaling Downregulation and Induction of Programmed Cell Death Via N-Linked Glycosylation Inhibition in Group-3 Medulloblastoma” in **Advances in Proteomics Technologies 2025 (APT 2025)** conducted by **Proteomics Lab, Biosciences and Bioengineering, IIT Bombay.** February 2025

SCHOLARSHIP

- ❖ **Department of Science and Technology, Govt. of India** 2021 – 2025  
Awarded **DST INSPIRE Scholarship** for academic excellence.
- ❖ **Indo-U.S. Science and Technology Forum, Department of Biotechnology, Govt. of India** 2024  
Awarded **Khorana Scholarship** for Summer Research at the **University of Illinois Urbana-Champaign, USA.**

SCHOLASTIC ACHIEVEMENTS

- ❖ Secured **AIR 93** in **CSIR-UGC-NET Life Science**, December 2024. 2025
- ❖ Secured **AIR 18** in **IIT JAM 2023** in **Biotechnology.** 2023
- ❖ Secured **AIR 73** in **GATE Biotechnology(BT) 2023.** 2023
- ❖ Secured **AIR 309** in **GATE Life Science (XL) 2023.** 2023
- ❖ Qualified **TIFR GS 2023** in **Biology.** 2023
- ❖ Secured **AIR 40** in **GATB.** 2023
- ❖ **Silver Medalist** of **B.Sc. Microbiology 2023** in **Midnapore College.** 2023
- ❖ Secured **3<sup>rd</sup> Position** in **Panchberia Ramchandra Smriti Siksha Mandir** during HS. 2020
- ❖ Secured **1<sup>st</sup> Position** in **Jotebhagaban High School** during **Matriculation Examination.** 2018

COURSES

Proteomics: Principles and Techniques || Computational Multiomics || Genomics and Proteomics || Mathematical and Numerical Methods for Biologists || Bioinformatics || Cell Biology || Molecular Biology || Genetics || Biochemistry and Bioenergetics || Biological Thermodynamics and Kinetics || Analytical Biochemistry || Microbiology || Genetic Engineering || Biomolecular Spectroscopy || Molecular Immunology || Molecular Enzymology || Research Methodology and Scientific Communication Skills || Protein engineering || Cell Signaling || Bacteriology || Virology || Microbial Physiology and Metabolism || Microbial Genetics || Environmental Microbiology || Food and Dairy Microbiology || Industrial Microbiology || Medical Microbiology || Recombinant DNA Technology || Instrumentation and Biotechniques || Microbial Biotechnology || Biosafety and Intellectual Property Rights || Microbial Analysis of Air and Water

POSITION OF RESPONSIBILITY

- **Web Team Co-Ordinator | Symbiotek Council | BSBE Department | IIT Bombay** September, 2023 - January, 2024  
Coordinated on building and maintaining the Official Website of Genvision 2024 of Bioscience and Bioengineering of the Indian Institute of Technology, Bombay, using HTML, CSS.
- **Logistic Team Coordinator | Symbiotek Council | BSBE Department | IIT Bombay** September, 2023 - January, 2024  
Coordinated the logistics work of Genvision 2024 of Bioscience and Bioengineering of the Indian Institute of Technology, Bombay.
- **Event Coordinator – Organizing Team | APT-2025 | Proteomics Lab | IIT Bombay** January, 2025 – February, 2025  
Actively engaged in organizing the APT-2025 and coordinated the Workshop – “Advances in 4D Proteomics” and “Mass Spectrometry and Big Data Analysis (AI/ML)”.