Pursuing a **Minor** in **Centre for Machine Intelligence and Data Science** from **IIT Bombay**

Scholastic Achievements

- Secured an **All India Rank 20** in **Joint Entrance Examination** (Advanced) among nearly **1,50,000** students *('22)*
- Acquired **All India Rank 18** (100 Percentile) in **Joint Entrance Examination** (Mains) among over **1 million** *('22)*
- Awarded the **KVPY** fellowship by the prestigious **IISc Bangalore** for achieving **All India Rank 13** (SX)   *('22)*
- Got selected in **Indian Olympiad Qualifier in Physics**, one among the **300** students selected throughout India *('22)*
- Awarded 2 **AP** (Advance Performer) grades (given to only **top 1%** students) in **Linear Algebra** and **Physical Chemistry** and **AA** grade in **Automata Theory** and **Logic**, the highest grade given to only **4** among nearly **200**

Technical and Research Experience

Computational Modelling and Synthetic Biology   *Summer 2024 - Present*
iGEM IIT Bombay | Guide : Prof. Kiran Kondabagil, Prof. Arnab Dutta   *BSBE, IIT Bombay*

- Working collaboratively within a team of **20+** towards **genetically engineering** a coccolithophore called ***E. Huxleyi***
- Have been making contributions to computational modelling aspects of the project, being a **core research member**
- Studied about **Flux Balance Analysis** and used it to model metabolism of ***Escherichia Coli*** with help of **COBRApy**
- Conducted **Gene Knockout** using FBA for listing all the genes necessary for biomass or a specific by-product secretion
- Studied and implemented **Stoichiometric FBA** to quantitatively predict growth and metabolic by-products secretions
- Studied and implemented a **Eulerian phytoplankton seasonal succession model** for oceanic **population dynamics**
- Researched upon available papers to **incorporate** E. Huxleyi and dynamics of its **carbon capturing** process in model
- Analyzed the model through **sensitivity analysis of hyperparameters**, including self-incorporated constants for error correction of model results, as well as for obtaining **inferences on bottleneck nutrients** in carbon capturing

Key Projects

Parallelized Scientific Computing | Seasons of Code Project   *Summer 2024*
Web and Coding Club   *Institute Technical Council, IIT Bombay*

- Learned about **ThreadPoolExecutor** and **ProcessPoolExecutor** and implemented parallized sorting algorithms.
- Explored **Global Interpreter Lock** and implemented an algorithm to test the **inherent concurrency** of threads.
- Learned **CUDA** programming model, acquired knowledge of **GPU memory optimizations** for matrix operations, used **SIMD** Architecture of **GPU** for **Gauss - Seidel method** and finally combined it with python using **PyCUDA**
- Further incorporated optimizations using **Numba Compiler** and through merging **C++** and **Fortran** in python

Stock Market Analysis | Summer of Science Project   *Summer 2024*
Maths and Physics Club   *Institute Technical Council, IIT Bombay*

- Gained in-depth knowledge of **market structures** and **trading mechanisms**, such as order types, market participants
- Mastered **technical analysis** methods, such as chart patterns, moving averages, oscillators, and indicators (e.g., RSI)
- Developed a robust understanding of **fundamental analysis**, including financial statement analysis, valuation ratios
- Explored advanced **derivatives trading**, focusing on **Futures** and **Options**, and evaluated options trading strategies
- Investigated various **trading systems**, including **Pair Trading**, **Momentum Portfolio**, and **Calendar Spread**
- Explored **machine learning** and **statistical methods** like **ADF Test**, Portfolio Variance and **Linear Regression**

Bias Field Correction and Image Segmentation of Brain MRI Images   *Spring 2023*
Medical Image Computing | Guide: Prof. Suyash Awate   *Computer Science and Engineering, IIT Bombay*

- Implemented **generative models** to address **inhomogeneities** in brain MRI images caused by **bias fields**, a significant challenge in MRI analysis and a must-to-do task before using **automated quantitative image segmentation** methods
- Formulated and optimized an objective function using **gradient descent** to accurately estimate and correct bias fields
- Employed **Gaussian Mixture Modeling** (GMM) cum **Expectation-Maximization Algorithm** for image segmentation
- Investigated and implemented a **research paper** integrating **saliency maps** to improve algorithm's accuracy, enhancing delineation of brain structures, backtested it on multiple images from **Berkeley's Image Segmentation Benchmark**
- **Proposed** a similar project in **Seasons of Code, 2024** and guided **3** mentees from different disciplines for **2 months**

F-Society Breachers | Seasons of Code Project *Summer 2024*
Web and Coding Club *Institute Technical Council, IIT Bombay*
- Acheived proficiency of various **client side attacks** and **server side attacks** and **defenses** by successfully completing part 1 - 3 from **CS253 Stanford**, a popular course which gives comprehensive overview of principles of web security
- Acquired knowledge of **Same Origin Policy**, **SameSite Cookies**, **CSRF** and **Cross-Site Scripting** (XSS) attacks
- Analyzed **Server Buffer Exploitation** and **Code Injection** methods like SQL injection and command injection
- Learned about **HTTPS** along with various **Web Authentication** methods, including Certificates, T-OTP, and SSH
- Explored the domain of **Binary Exploitation and Security**, meanwhile learned various tools like **gdb** and **ghidra**

Building Game Strategy Using MILP | Course Project *Autumn 2023*
Guide : Prof. Avinash Bhardwaj *Industrial Engineering and Operations Research, IIT Bombay*
- Analyzed the strategy game **Age of Mythology**, specifically exploring challenges within the mission **The Lost Relic**
- Reduced the complex task of defending the camp, collecting resources, and finding the relic to a **Mixed Integer Linear Program** (MILP), whose outcome will be an **optimal allocation of labor** and resources for defending and searching
- Program was modelled such that the **time** to find the relic is **minimized** while ensuring **effective defence** of the camp
- Analyzed on usage of such programs to **quantify the difficulty level** of the mission and in helping developers tuning it

Other Projects

Hand Written Digit Recognition *Spring 2023*
Winter in Data Science, Web and Coding Club *Institute Technical Council, IIT Bombay*
- Used **Convolutional Neural Network** trained on the MNIST hand-written digits dataset for digit recognition
- Recreated the above with **Kernel Support Vector Machines** and **K-Means Clustering** and analyzed results
- Wrote an article titled **Theoretical Justification behind better performance of Kernel SVM as compare to clustering methods on MNIST dataset** on **Medium**, presenting my views about the performance gap obtained

Conquering Competitive Programming | Seasons of Code *Summer 2024*
Web and Coding Club *Institute Technical Council, IIT Bombay*
- Learned various advanced data structures and algorithms from **cp-algorithms**, a comprehensive set of articles on CP, and practiced on **CSES**, with major focus on **string processing**, **dynamic programming** and **graph algorithms**
- Solved **200+** mixed problems, participated in around **18 contests** on **codeforces** and achieved **1603 (Expert)** rating

Line Follower Bot | Course Project *Spring 2022*
Guide : Prof. P.C. Pandey *Mechanical and Electrical Engineering, IIT Bombay*
- Made a bot with **Arduino UNO** and **L298N Motor driver** which gets movement signals from black strip on track
- Equiped it with high torque motors and **conveyor belt** for transporting **300 grams** of weight on a **30 degree** slope
- Learned and used **Laser Cutting**, **3D Printing** and **Autodesk Fusion 360** to design various physical components

Automated Trading Bot | Course Project *Autumn 2023*
Data Structures and Algorithms | Guide : Prof. Ashutosh Gupta *Computer Science and Engineering, IIT Bombay*
- Mimicked a stock **market match maker** like the one running in stock exchanges and an **automated trading bot**
- Implemented an algorithm for the trading bot using **C++**, which finds trading opportunities such as **arbitrage**
- Used **socket programming** for **market-trader communication** and data structures like **trie** for efficient storage

Technical Skills

- **Languages:** Proficient in C++, Python | Familiar with bash, sed, awk, CUDA, x86 assembly, MIPS
- **Libraries:** matplotlib, numpy, pandas, pyCUDA, SciPY, matlab, scikit-learn, COBRApy,
- **Miscellaneous:** Git, LaTeX, AutoCAD, Fracktory, ModelSim, GTKWave, GDB, ghidra, make, VHDL, cobra

Position of Responsibility

Core Team Member | Dry Lab Researcher | iGEM IIT Bombay *Summer 2024 - Present*
- Working in a team of **20+** members to solve **climate crisis** problem caused by carbon emission using **Syn Biology**
- Contributing through researching on **computational modelling** and helped in **interviews** and **recruitment**

Teaching Assistant | Linear Algebra and Differential Equations *Spring 2023*
- Conducted weekly **tutorials** for a batch of **40+** students and also **help sessions** to help students in theoretical doubts

Key Courses Undertaken

- **Computer Science:** Computer Programming and Utilization, Computer Architecture, Data Structures & Algorithms, System Softwares Lab, Operating Systems, Automata Theory & Logic, Medical Image Computing, Artificial Intelligence & Machine Learning, Data Analysis & Interpretation, Design & Analysis of Algorithms, Discrete Structures
- **Others:** Optmization Models, Economics, Quantum Physics, Linear Algebra and Differential Equations, Calculus

Extracurriculars

- Built a **Wi-Fi controlled bot** in XLR8, conducted by Electronics & Robotics Club, IIT Bombay *Autumn 2022*
- Mentored 4 students for **CodeWars**, a strategy based game programming contest by WnCC, IIT Bombay *Spring 2023*
- Mentored 5 students for **DSA** under **Summer of Science 2024**, conducted by MnP, IIT Bombay *Summer 2024*
- Completed a one year course on **Green Campus** under **National Social Service** from IIT Bombay *2022 - 2023*
- Completed two months training on **classical keyboard**, covering fundamentals of music and piano *Summer 2024*
- Wrote an article titled **Importance Sampling: Key Principle and it's Beauty** on **Medium** *Summer 2024*