Agnipratim Nag

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Education

Indian Institute of Technology Bombay (IITB) *[Nov 2021 - Present]*
Bachelors of Technology | Department of Physics *GPA:* 9.46/10
Major in **Engineering Physics,** Minor in **Computer Science & Engineering**

Research Experience

Research Intern *[Jan 2023 - Present]*
Guide: Prof. Soham Chakraborty, Technische Universiteit Delft

- Surveying literature on formalising the **concurrency of C++ semantics** and validating optimisations.
- Utilised the **CPPMEM** tool to visualise C++ executions using creation and synchronisation of threads.
- Working on a **translation validation algorithm** to verify correctness of LLVM compiler optimisations.

Minimizing Systems using Alternation Simulation Equivalence *[Jan 2023 - Present]*
Guides: Prof. Krishna S, IIT Bombay and Khushraj M, Max Planck Institute for Software Systems

- Studied formalism of hybrid systems, timed automata and modelling evolution of finite state machines.
- Developing an algorithm to extend the concept of **minimizing transition systems** via **alternating simulation** equivalence to timed automata so as to model real-time systems in an efficient manner.

Key Projects

Automata and Computability *[Dec 2022 - Feb 2022]*
Guide: Prof. Krishna S, IIT Bombay

Studying automata theory and the fundamentals of effective computation covering the following:

- **Kleene Algebra**: Applications in solving systems of linear equations and languages of arbitrary DFAs.
- **DFA State Minimization**: Finding the most efficient DFA for a language using minimization algorithms.
- **Context-Free Grammars**: Formal definition, equivalence to nondeterministic pushdown automata.
- **λ-Calculus & μ-recursive functions**: Syntax and computational equivalence to Turing Machines.

Statistical Analysis of Random Pattern Detection *[Mar 2023 - Apr 2023]*
Course Project | Prof. Pradeep Sarin, IIT Bombay

- Designed an experiment to verify the **Central Limit Theorem** from statistics through digital electronics.
- Developed a circuit that generates pseudo-random bit-strings and performs pattern matching using a **finite state machine** designed using K-maps, and recorded successful matches using a **counter circuit**.
- Plotted the results using Matplotlib to verify CLT by illustrating the **normally distributed nature** of the collected data, and cross-verified it with a Python implementation of the experiment. (Repository)

Learning with Quantum Computers *[Dec 2022 - Jan 2022]*
Winter in Data Science | Analytics Club, IIT Bombay

- Surveyed the fundamentals of quantum computing from *Quantum Computation and Quantum Information.*
- Studied the working and implementation of quantum algorithms to solve the **Deutsch-Josza Problem** and programmed the solution using **Qiskit** to demonstrate its efficiency over classical algorithms.
- Executed a quantum algorithm using **Pennylane** to train a model based on a variational circuit to cluster a dataset using **quantum implementations of machine learning and neural networks**. (Repository)

Dependence of kinematic variables and charge particle multiplicity distribution on charge asymmetry in p-p collisions at 13 TeV *[Oct 2022 - Nov 2022]*
Course Project | Prof. Sadhana Dash, IIT Bombay

- **Statistically analyzed datasets** generated by the Pythia 8 Monte Carlo simulator using the ROOT software containing fluctuations of **2 million+** charged particle multiplicities in proton-proton collisions.
- Studied the distribution of **charge asymmetry in different multiplicity classes** to observe trends in standard deviation and analysed the multiplicity distribution in charge symmetric and asymmetric regions.
- Plotted distributions of transverse momentum, pseudorapidity and azimuthal angle. (Repository)

HyperEntropicPingPong *[Dec 2021 - Jan 2022]*
GameDev Hackathon | Developers' Community, IIT Bombay

- Designed a **multi-level 2D ping-pong game** with non-classical dynamics & quantum tunnelling.
- Executed the idea using vanilla **HTML, CSS and JavaScript** with version control through Git.
- Awarded a **special mention** and an interview for recruitment to the Developers' Community. (Repository)

Entrepreneurial Experience

ViBe Basket | Co-founder *[Jun 2022 - Present]*
Incubated by the Desai Sethi School of Entrepreneurship, IIT Bombay | Awarded a grant of ***INR 2,00,000***

- Building a **community-based application** driven by AI as a **logistic planning tool** for outings.
- Selected as the **only team** from among 30+ applications to qualify to Level 2 of the IDEAS Programme.
- Developing an **MVP**, a problem-solution fit, and eventually a product-market fit. (Pitch Deck)

Positions Of Responsibility

Undergraduate Teaching Assistant *[Nov 2022 - Mar 2023]*
Department of Mathematics and Department of Physics, IIT Bombay

Entrusted with the responsibility of being a teaching assistant for the following courses:

Year	Course Code	Course Instructor
2022	MA 109: Calculus I	*Prof. Sanjoy Pusti*
2023	MA 111: Calculus II	*Prof. Preeti Raman*
2023	PH 111: Classical Physics	*Prof. Alok Shukla*

This included conducting weekly **live tutorial sessions** for **40+** students, helping them with conceptual doubts and preparing **recap slides** using LaTeX. Some of these materials are on the course webpages.

Institute Design Convener *[Jun 2022 - May 2023]*
The Design Club | Institute Cultural Council, IIT Bombay

- Ideating and organizing **Vision: The Design Festival of IIT Bombay**, leading a design team of undergraduate students in planning and executing multiple month long design projects.
- Conducting a series of seminars by eminent professional designers attended by **400+ students**.
- Fulfilling publicity requirements of **80+ events and workshops** of cultural clubs across many genres.
- Training **600+ students** in interface & visual communication designing through **20+ workshops**.

Scholastic Achievements

- Currently ranked **4th** among 64 students in the B.Tech Engineering Physics batch of 2025 *[Present]*
- Awarded the AA grade in Linear Algebra, given to **top 1.7%** freshmen for exceptional performance *[2022]*
- The **Joint Entrance Examination (JEE)**:
  - Secured **99.26 Percentile** in the JEE-Advanced Examination, among 0.15 million candidates *[2021]*
  - Secured **99.73 Percentile** in the JEE-Main Examination, out of over 930 thousand candidates *[2021]*
- Awarded the prestigious **KVPY Fellowship** by the Dept. of Science & Technology, Govt. of India *[2021]*

Technical Skills

Tools and Web Dev	Git, GitHub, LaTeX, HTML, JavaScript, CSS
Languages	Python, C++, Java
Libraries	NumPy, Pandas, Matplotlib, Seaborn, OpenCV, Plotly, SciKit Learn

Key Courses Undertaken

Physics	Quantum Mechanics I, Quantum Information and Computing, Classical Mechanics, Data Analysis & Interpretation, Special Relativity, Waves, Thermal Physics, Digital and Analog Electronics
Mathematics	Linear Algebra, Complex Analysis, Calculus I & II, Differential Equations I & II, Introduction to Numerical Analysis
Computer Science	Logic in CS, Computer Programming and Utilisation, Data Structures and Algorithms, Machine Learning (Coursera)

Extracurricular Activities

- E-Sports
  - Secured **2nd place** and won a cash prize of **35,000 INR** at the Rocket League Minor conducted by the League of Extraordinary Gamers, Bangalore during ILG Cup Season 2 *[2018]*
  - Created several recreational gaming videos and accumulated **170,000+** views and generated advertisement revenue of **6000 INR** on Google AdSense through YouTube *[2017]*
- Sports
  - Secured 1st place at the Hostel 2 Football Championship *[2023]*
  - Represented The Frank Anthony Public School Football Team for 4 years *[2015-2019]*
  - Won the Inter-House Football Championship at the National Centre for Excellence *[2019]*

Volunteer Experiences

Educational Outreach *[Dec 2021 - Jun 2022]*

Open Learning Initiative | National Service Scheme, IIT Bombay

- Worked with National Service Scheme, IIT Bombay to provide free education available to **110,000+** underprivileged students through educational science videos in the Bangla language on YouTube.
- Conducted weekly online classes for school students in Jharkhand to help improve their spoken English.
- Took regular instructive sessions to tutor students in quantitative and qualitative aptitude.