RAJARSHI DUTTA

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Fourth Year Undergraduate, Materials Science and Engineering, Indian Institute of Technology Kanpur | Rajarshi

Academic Qualifications

Year	Degree/Certificate	Institute	CPI/%
2020 - Present	B.Tech	Indian Institute of Technology, Kanpur	8.1/10
2020	Grade XII (ISC)	St Xavier's School, Raiganj	97.2%
2018	Grade X (ICSE)	St Xavier's School, Raiganj	95.6%

Scholastic Achievements

- Selected for the **Mitacs Globalink Research Internship** programme in **University of Toronto, Scarborough**
- Secured **Bronze Medal** in **Inter IIT Tech Meet 11.0** - ISRO's **The Chandrayan Moon Mapping Challenge**
- Secured **Second Position** in **Inter IIT Tech Meet 10.0** - ISRO's **Web Based X-Ray Burst Identification**
- Secured **Second Position** in the **Cosmic Innovation Challenge** in Shastra 2023 conducted by **IIT Madras**
- Awarded the **INSPIRE** Scholarship 2020 by the **Division of Science and Technology (DST), Government of India**
- Secured **All India Rank 5610** in **Joint Entrance Examination Advanced 2020** among 1.5 lakh shortlisted candidates
- Secured **All India Rank 3814** in **Joint Entrance Examination Mains 2020** among 12 lakh candidates
- Secured **Rank 164** in **West Bengal Joint Entrance Exam 2020** among 80+ thousand candidates

Work Experience

- **Graph Neural Networks for quantum chemical screening of optoelectronic materials** Repository
  Research Intern, Prof. Oleksandr Voznyy, UofT-Scarborough *(May'23 - Present)*
  - Optimized the **CGCNN** architecture for **bandgap** and **Orbital energies** prediction from **wurzite** and **rocksalt** based structures using **local representations (molecular props)** and **Element embeddings** like **mat2vec**, **matscholar**
  - Developed **Bilinear**, **Pooling**, **Message passing** based models and obtained a **MSE** score of **0.03** and **0.23** for **orbital energies** and **bandgaps** prediction on the validation set consisting of all bilinear molecules
  - Testing **GCNs** and other models on **organic** and **inroganic** benchmark datasets for comparative analysis
  - Used Sequence models for regression analysis on **2048 sized Morgan fingerprints** from **organic XTB dataset** and acheived a **MSE** score of **0.30** on the **validation set** generated via **Density Functional theory** calculations
- **Analysis of TEM Images** Presentation link | *Research Intern, SURGE IITK, Dr. Shikhar Misra* *(May'22-June'22)*
  - Implemented **Contour Detection** on TEM images for nanoparticle detection and creation of training set for **YOLOv3**
  - Used image segmentation methods like **K-Means Clustering, GMMs** for foreground isloation from grayscale images
  - Utilized **AutoDetect-mnP** framework which is based on an unsupervised **clustering** based approach

Key Projects

- **ISRO's Chandrayaan Moon mapping challenge** Repository | *11th Inter IIT Techmeet, IIT Kanpur* (*February'23*)
  - Developed AI/ML model for generating **high-resolution map** using **Chandrayaan's Orbiter's imaging payloads**
  - Generated a global lunar atlas (digital) using **MATLAB** based on the medium/low-resolution data available by creating an effective Image Stitching method and creating effective data storage for such large-size images
  - Implemented **SRGAN** on overlapping data from **Orbiter Higher Resolution Camera (OHRC)** and **Terrain Mapping Camera-2 (TMC-2)** payloads to generate high-resolution (30 cm) from medium resolution (5-10 cm) lunar terrain images
- **Introduction to Machine Learning** Repository | *Course Project CS771A, Dr. Puroshottam Kar* (*March'23-May'23*)
  - Created a writeup and implementation of cracking the **XORRO PUF** using a linear regression model in python
  - Implemented a **ID3 Decision tree** for creation of a **wordle solver** while optimizing model storage and execution time
  - Worked on a comparative analysis among different non-linear models like **XGBoost**, **KNN**, **Random Forests** and **linear models** on prediction of O_2 and NO_2 levels from **sensor data** with features like temperature, humidity etc
- **Range based Control law for trajectory generation using Unicycle Model** Repository
  Undergraduate Project, Dr. Twinkle Tripathy (*August'22-Oct'22*)
  - Implemented trajectory generation of a **differentiable holonomic drive** in **ROS** with simulations in **Gazebo**
  - Created **MATLAB** Scripts for creating bounded generating functions in plane, solving **range based control law** using ODE solvers like **Euler Integration, Runga-Kutta Fourth Order Solver**
  - Implemented **Type 1** and **Type 2** trajectories of **unicycle model** based on multiple target points using intermediate trajectories in a bounded region in **MATLAB** with switching radius calculated from their **generating functions**
  - Tested the trajectory algorithm in **Turtlebot 3** and managed latency using **ROS Multimaster**
- **ISRO's Web Based X-Ray Burst Identification** Repository | *10th Inter IIT TechMeet, IIT Kharagpur* (*March'22*)
  - Developed a standalone web-based application named **Jux** for identification of Solar Flares from lightcurve files
  - Used preprocesing methods like **FFT Smoothening**, **Windowing**, **Interpolation** on raw **Solar flare data**
  - Implemented filtering approach with **slope, height thresholding**, **Isolation Forest** for feature detection and classification
  - Created a standalone website for **plug-and-analyze** feature for handling solar flares data using **React** and **Flask**
  - Deployed the entire codebase as a fully functional python package in **PyPI** with an updated version release of 1.0.0
- **Swarm Robotics** Repository | *Aerial MiniProject* (*May'21-Aug'21*)
  - Created a **ROS melodic** package of four drones integrated with simulations in physics-based engine **gazebo** and **Rviz**
  - Devised an algorithm which allows drones to follow set of waypoints, maintaning a particular formation

  - Incorporated **inter-drone** and **vertical repulsion** between the drones to enable a stable configuration.

- **Model Zoo** Repository | *SNT Summer Project* (*May'21-Aug'21*)
  - Implemented **deep learning** models from various research papers with proper documentation summarising the paper
  - Studied and tuned **SOTA** architectures on pivotal domains like **Image Classification** and **Action Recognition**
  - Implemented **Classification models** like **MobileNetV1**, **ResNet-34**, **XceptionNet** and an **Action Recognition** model **InflatedInception 3D** using keras framework and analyzed train and val loss curves on benchmark datasets
- **Quantum Algorithms** Project-page | *Stamatics Project* (*April'21-July'21*)
  - Studied important concepts of **Quantum Mechanics** and **Quantum Information theory** and solved problems of the book **Quantum Computation and Quantum Information by Neilsen and Chuang**
  - Learnt about topics like **Quantum Teleportation**, **Bell states**, **Quantum Fourier Transform**, **Quantum Error Correction protocol**, **Grover Search**, **Quantum Phase Estimation** , **Repitition codes** etc
  - Studied various quantum algorithms like **Bernstein Vazirani**, **QFT** and implemented them using **IBM Qiskit** framework
- **Orbital Dynamics Challenge** Repository | *Shastra'23 Cosmic Innovation Challenge* (*Feb'23*)
  - Created a real time calculator for inferring the **geographical coordinates** of satellite from its **Keplerian parameters** and **attitude quaternions** of the **satellite imager** using coordinate transformations
  - Approach based on transformation of **perifocal parameters** to **ECI**, **ECEF** and to **World Geodetic System (WGS84)**
  - Created and deployed an end-to-end web application in **versel** using **ReactJS**

Interests

- **Machine Learning:** Graph networks, Data Analysis, Natural Language processing, Driverless vehicles, materials discovery, Generative AI, Data collection and Annotation, Feature Engineering, Probabilistic Models
- **Control Systems:** Control System Modeling and Analysis, Feedback Control, Matlab/Simulink, PID Control

Technical Skills

- **Programming Languages:** C/C++, Python, MATLAB, Java, Javascript, R, bash
- **Frameworks:** Pytorch, Keras, Scipy, Spacy, Scikit-learn, Flask, Angular, Express, OpenCV, Selenium, librosa, Qiskit, ROS
- **Tools:** Git Bash, Slurm, MongoDB, SQL, Simulink, LaTeX, Docker, AutoCAD, PowerBI, Microsoft Office, Micro

Positions of Responsibility

- **Team Head — AerialRobotics**, **IIT Kanpur** (*June'22 - May'23*)
  - Leading a team of **28 UG students** for participating in various Aerial Robotics competitions based on drone racing, trajectory estimation, swarm, object detection, obstacle avoidance and developing hardware stack.
  - Worked on implementation of **Swarm Robotics** and **HKUST (Teach-Repeat-Replan)** Module.
  - Established guidelines for software stack development and documentation
  - Mentoring a group of students on **Map Generation** using packages like **Gmapping**, **voxblox planning library** to handle generation of **TSDF** and **ESDF** maps for exploration of the environment.
- **Secretary — Programming Club**, **IIT Kanpur** (*August'21 - May'22*)
  - Making contributions on club repositories like **modelzoo**, **puppylove** that affects the campus community.
  - Organizing **Hackathons**, **Workshops** for more 100+ freshers and writing blogs on diverse topics of Computer Science.
- **Secretary — Quiz Club**, **IIT Kanpur** (*June'21 - May'22*)
  - Organizing Quizzes like **SciBizTech**, **Mela** quizzes for 100+ freshers on topics like Science, Art, Literature, Mythology etc.
  - Writing articles on Quizzing Genres like **HELM**, **SciTech** to help develop a quizzing aptitude.
- **Project Mentor, XUVI — Astronomy Club**, **IIT Kanpur** (*May'22 - June'22*)
  - Mentoring group of **6 students** in **Astronomical Data Analysis**, **Exoplanet Detection, Solar Flares, Spectroscopy**
  - Creating and organising lectures based on **python libraries** like numpy, pandas, astropy, scipy and also theories relating to **lightcurves**, **flare classification**, **transit photometry** from curated sources
  - Developing algorithms based on transit photometry, X-Ray Analysis, exoplanet detection along with proper documentation

Relevant Courses — Ongoing courses marked with *

Statistical NLP*	Cyberphysical Systems	Introduction to ML	Probability & Statistics
Statistical Business Analytics*	Introduction to Electronics	Computational methods	Rate Processes
Quantum Physics I	Thin Films and device fabrication	Optoelectronics	Electrodynamics
Dislocations and Plasticity*	Nature and properties of materials	Control Systems Theory	Phase transformations

Extracurricular

- Speaker of **Matsoc - Intro to Profiles** session in the field of Data Science with 100+ attendies
- Qualified for the State level **National Children's Science Congress** held in Kolkata which was conducted by **Department of Science and Technology, Government of India** aimed at solving a societal problem experienced locally, using practical scientific methods by the school students
- Secured **13th position** in **RaScionix 2020** conducted by **IIT Bombay** amongst 100+ participants
- Secured **1st position** in **Techweek SnT Code** organised by **Science and Technology Council**, IIT Kanpur
- Participated in the **Marsh McLennan Webcrawler Spiderbot** Design Challenge, an Inter-college **Techfest** event organized by in **IIT Bombay**