Vikhyat Agrawal

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Education

2024 – Present	**École polytechnique fédérale de Lausanne (EPFL), Switzerland**	-
	Master of Science in *Data Science*	

2020 – 2024	**Indian Institute of Technology Bombay, India**	Grade: 9.03/10
	B.Tech. *Engineering Physics*	
	Minor in *Artificial Intelligence and Data Science*	

Publications

2024   Federated Learning and Differential Privacy Techniques on Multi-hospital Population-scale Electrocardiogram Data. **V Agrawal**, S Kalmady, V Malipeddi, M Manthena, W Sun, S Islam, A Hindle, P Kaul, R Greiner. International Conference on Medical and Health Informatics (**ICMHI 2024**) [pre-print][paper]

2023   Deep Multi-task Learning for Early Warnings of Dust Events: Evidence from The Middle East. R Sarafian, Nissenbaum D, Raveh-Rubin S, **V Agrawal** & Rudich Y. **NPJ Climate and Atmospheric Science** [paper]

Research Experience

2024*   **Kolmogorov–Arnold Networks (KANs) for Image Recognition**   *LIONS Lab @ EPFL*
- Neural Architecture Search (NAS) on Kolmogorov–Arnold Networks (KANs) for Image Recognition tasks

2023   **Hospital Re-admissions with Neural TPPs**   *Guide: Prof. Russell Greiner | University of Alberta*
- Performed comparative analysis on censored hospital re-admission data between state of the art **Temporal Point Process models** and Individual Survival Distribution models for **survival analysis**
- Enhanced transformer-based time-series prediction TPP models (HYPRO, DualTPP) for right-censored patient data by integrating event/patient meta-data and multi-label sequence generation
- Worked on implementing Federated Learning and Differential Privacy techniques for diagnosing cardiovascular diseases using ECG data

2022   **Explainable AI for Multi-task learning** *Guide: Prof. Yinon Rudich | Weizmann Institute of Science*
- Employed meteorological data of 18 years for predicting dust storms in Israel, 24 hours ahead in time
- Developed model interpretability visualisation tools for various model outputs
- Explained model performance by implementing Explainable AI tools like **Integrated Gradients, Saliency Maps, GradientSHAP** and demonstrated cluster formation by model embeddings
- Improved Recall by 9% and Precision by 20% compared to prior state-of-the-art models in literature

Professional Experience

2024* ▮ **Machine Learning Intern**   *Wadhwani AI: AI for Social Impact*
- Working to address the Active Case Finding problem of Tuberculosis (TB) in India, with the aim of reaching an estimated 500,000 missing cases of TB in the country
- Utilising geospatial data to identify and map TB hotspots across the nation

2022 ▮ **Data Science Intern**   *Marsh McLennan*
- Explored and reviewed various **Differential Privacy** and **Synthetic Data** generation algorithms
- Experimented and tested the limitations of data synthesizers such as GoogleDP, YData, Gretel
- Experimented, compared and quantified the performance of various generative models (CGAN, WGAN,etc) for generating synthetic tabular data and synthetic time series data
- Received a full-time employment offer from the company, however, decided to decline the position

Projects

2023 ▮ **Grammatical Error Correction**   *Academic Project, Deep Learning for NLP*
- Designed and evaluated two models for Grammatical Error Correction (GEC) on the C4 dataset
- Adapted and improved a Multi-layer Convolutional Encoder-Decoder Neural Network for GEC
- Achieved a BLEU score of 0.732 along with an F0.5 score of 0.693 using GloVe word embeddings
- Fine-tuned the T5 model for GEC and achieved a BLEU score of 0.871 and a F0.5 score of 0.832

 ▮ **Transformation Optics for Material Design**   *Academic Project, Electromagnetic Theory*
- Created a Simulated replication and demonstration of the Space Transformation technique in optics
- Explored the application of transformation optics to enhance optical gradient forces

 ▮ **Modelling Tuberculosis in India**   *National Disease Modelling Consortium*
- Modelled transmission of Tuberculosis (TB) transmission dynamics using differential equations
- Estimated key indicators of data by calibrating model parameters to equilibrium
- Adapted a Bayesian Synthesis framework to capture real-life uncertainty in the model inputs
- Recreated the code-base of existing literature in collaboration with the original authors

2022 ▮ **2-D Ideal Gas on Arduino** [code]   *Academic Project, Microprocessors lab*
- Designed and implemented a real-time simulation of a 2-D ideal gas using Arduino
- Visualised it by dynamically representing gas particles on an LED Matrix as the container for gas
- Devised an approach to calculate and display real-time pressure and temperature of the simulated gas and implemented collision detection algorithms to track the number of particle-wall collisions
- Expanded the project's scope for showcase at Techfest, Asia's Largest Science & Technology Festival

 ▮ **Traffic Sign Classification using CNNs** [code]   *Winter in Data Science, Analytics Club*
- Enhanced proficiency in image augmentation methods and applied a customized LeNet Convolutional Neural Network (CNN) architecture to the German Traffic Sign Recognition dataset
- Performed object detection and classification on this dataset with 43 different types of traffic signs

 ▮ **Assesing Solar Wind Synergy in India**   *Supervised Learning Project*
- Assessed the Spatio-temporal synergy between wind and solar energy resources for India
- Quantitatively assessed hybrid solar-wind power plant feasibility as an alternative to coal plants
- Used parallel computing frameworks (e.g., DASK, XArray) for resource-intensive computations

2021 ▮ **Integrated Visual Perception Projects** [code]   *Learner's Space, IIT Bombay*
- Implemented a Numeric digit classifier which recognizes handwritten digits by implementing customized convolutional neural networks with an accuracy of 98.25% using the MNIST handwritten digit dataset
- Implemented a Sudoku Solver which reads a Sudoku from an image and solves it using backtracing
- Designed an Image Stitcher which stitches multiple images to form a single panorama image

Projects (continued)

Analysing Spatiotemporal COVID-19 Data   *Guide: Prof. Mithun Mitra | IIT Bombay*
- Evaluated and Assessed the success of Contact Tracing Program deployed by MCGM(Government)
- Cleansed large spatio-temporal COVID-19 government data and visualised its spread
- Extracted key insights by modelling the spread by using a tree-based transmission graph model

Ranking Football Club Performance [code]   *Academic Project, Programming for Data Science*
- Analyzed Premier League Data of 4 seasons and created a team/individual performance index
- Compared the standings obtained due to the performance index with the actual league standings and got Kendall Tau Correlation coefficient of 0.68

Analysis of Ion Multiplicity Fluctuations   *Academic Project, Data Analysis and Interpretation*
- Reported the event-by-event fluctuations of charged particle multiplicities and their distributions as a function of centrality in p-p collisions, generated by PYTHIA 8 Monte Carlo event generator
- Analyzed and visualised data of millions of events on ROOT data analysis framework by CERN

Teaching

2021-24   Teaching Assistant at IIT Bombay for the following courses

Semester	Course
Spring 2024	PH110: Introduction to Classical and Quantum Physics
Spring 2023	PH 111: Introduction to Classical Physics
Spring 2022	PH 108: Basics of Electricity & Magnetism
Fall 2022	DS203: Programming for Data Science

- Teaching responsibilities included discussion of **weekly problem sets**, **grading** the exam papers, and conducting weekly tutorial quizzes

Leadership and Involvement

2022   **Technical Team Member**   *Data Analytics and Visualisation Team*
- Provided data-driven solutions to external organizations and insights into university grading data
- Collaborated with Prof. Sunita Sarawagi from CSE, IIT-B for projects leveraging public Indian datasets by investigating demographics data by the government to predict crime indicators

Mentor for Artificial Intelligence [drive]   *Summer of Science, Maths and Physics Club*
- Mentored 10 freshers by providing curated handpicked resources in the field of artificial intelligence

Mentor for Applied ML in Astronomy [code]   *Summer of Coding, Web and Coding Club*
- Instructed and assessed 6 undergraduates on topics in Machine Learning and Deep Learning
- Assisted them in crafting intelligent algorithms for Kaggle's Stellar Classification challenge

Department Academic Mentor   *Department of Physics*
- Mentored 6 sophomores, actively involved in bridging the student-faculty gap and making their academic experience better by writing blogs about the department and writing course reviews

Scholastic Achievements

2023   Secured **Department Rank 8** out of 66 students

Awarded the **MITACS Globalink** fellowship for pursuing undergraduate research in Canada

2020   Secured **All India Rank 590** in **JEE Advanced** among 150,000 aspirants (Top 0.4%)

Scholastic Achievements (continued)

- Secured **99.80 percentile** in **JEE Main** amongst 0.92 million candidates (Top 0.2%)

Technical Skills

Programming	Python, C++, FORTRAN, R
Software	MATLAB, LTSpice, Git, AutoCAD, Google Cloud, AWS, Azure
Machine Learning	PyTorch, TensorFlow, Captum, OpenCV, Scikit-learn, NumPy, Pandas, Scipy

Courses Undertaken

Machine Learning	Deep Learning for Natural Language Processing, Foundations of Intelligent and Learning Agents, Advanced Topics in Machine Learning, Automatic Speech Recognition, Optimization in Machine Learning, Introduction to Machine Learning, Programming for Data Science, Data Analysis and Interpretation
Mathematics	Calculus, Linear Algebra, Differential Equations, Complex Analysis, Numerical Analysis
Physics	Introduction to Special Theory of Relativity, Thermal Physics, Classical Mechanics, Quantum Mechanics, Waves & Oscillations & Optics, Photonics, Advanced Simulation Techniques in Physics, Electromagnetic Theory, Statistical Physics, Introduction to Condensed Matter Physics, Introduction to Nuclear & Particle Physics, Introduction to Atomic and Molecular Physics, Methods in Analytical Techniques in Physics, Physics of Semiconductor Devices
Others	Contemporary Issues in Data Policy and Management, Introduction to Science and Technology Studies, Earth's Climate: Past, Present and Future, Digital Systems, Economics, Philosophy, Electronics Lab (Microprocessors)

References

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Professor

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