Kartik Patekar

Education

University of Cambridge

MASTER OF ADVANCED STUDIES IN APPLIED MATHEMATICS   *Oct. 2020 - Present*

- Statistics
- Probability Theory

IITB (Indian Institute of Technology, Bombay)   *CGPA : 9.89/10*

BACHELOR OF TECHNOLOGY   *Aug. 2016 - May 2020*

- Major : Engineering Physics (Honors)
- Minor : Mathematics

CBSE (Central Board of Secondary Education)   *Percentage : 91.6*

INTERMEDIATE/+2   *July 2015 - Mar. 2016*

Scholastic Achievements

IIT-B Academic Excellence Award   *Aug. 2016-Mar. 2020*

- Awarded **R. P. Singh Memorial Award** and **Silver Medal** by IIT-Bombay for my academic performance.
- Consistently ranked first in my department throughout my undergraduate studies.

IChO 2016 (International Chemistry Olympiad)   *Aug. 2016*

- Selected among the four students to **represent India at IChO 2016** held in Tbilisi, Georgia.
- Received **silver medal** for my performance in practical and theoretical exams.

IIT-JEE (Indian Institute of Technology - Joint Entrance Exam)   *May. 2016*

- Secured **All India Rank 6** amongst 200,000 students who appeared in the entrance exam for IIT.

Fellowships   *2016-2020*

- Recipient of the **S. N. Bose Scholarship** awarded by the **Indo-U.S. Science and Technology Forum** to undertake a research project in an American University.
- Obtained **All India Rank 5** in selection test for **KVPY fellowship** funded by Dept. of Science and Technology, Government of India.

Professional Experiences

Quantitative Researcher

GRAVITON RESEARCH CAPITAL   *July. 2020 - Sept. 2020*

- Worked on **high-frequency trading strategies** for trading stocks and futures at National Stock Exchange, India.
- Using insights about dependence of market behaviour on predictors, made modifications in the trading algorithm to increase PnL and Sharpe ratio. Performed statistical analysis of simulation data to obtain range of relevant coefficients.

Automation of deal entry process from Courthouse documents   *Certificate URL*

FIRM: ENVERUS   *Mar. 2020-May 2020*

- Utilized various **NLP techniques** to extract relevant information such as company names, dates and assets from text data.
- Designed an deep learning model to understand **Out of vocabulary words** using a Bi-directional Recurrent Neural Network with a Long-Short Term Memory cell.
- Understood and tuned the google's **Albert** model to find relevant entities from the text.
- Extensively utilized **image processing** and **OCR** to obtain text data from a scanned documents. Wrote algorithms for image segmentation, tabular structure detection, handwritten data detection, and integrated **pytesseract** into the code.

Key Projects

Gauge Theory of Doped Cuprates   *Report URL*

GUIDE: PROFESSOR SUBIR SACHDEV, HARVARD UNIVERSITY   *May. 2019-July 2019*

- Worked on **Gauge Theory** developed by Professor Sachdev to describe the **phase diagram of doped cuprates**. Used the strong coupling expansion to obtain effective Lagrangian describing the system.
- Used the **saddle point approximation** in the limit of large number of Higgs Flavors to obtain the phase diagram by exploiting the symmetry of the system. Analytically solved the saddle point equations to obtain various phases.
- The results obtained in the saddle point limit were supported by **Monte Carlo simulation** performed on physical case of four Higgs Flavor, thus establishing the existence of the Topological phase.
- **Publication**: H. D. Scammell, K. Patekar, M. S. Scheurer, and S. Sachdev, "Phases of $SU(2)$ gauge theory with multiple adjoint Higgs fields in 2+1 dimensions.", Phys. Rev. B 101, 205124, May 2020

Quantum Measurement at Variable Strength

Report URL

GUIDE: PROFESSOR HOLGER F. HOFMANN, HIROSHIMA UNIVERSITY

Dec. 2018

- Came up with a **measure** of the resolution of the measurement and explained physical importance of it. Showed how the resolution relates to the amount of back action caused due to interaction.
- Studied the Arthurs-Kelly joint measurement scheme and analysed the joint measurement of two non-commuting observables.
- Analysed importance of meter readout basis in determining the information extraction of system and reversing the back action.
- **Publication**: K. Patekar and H. F. Hofmann, "The role of system–meter entanglement in controlling the resolution and decoherence of quantum measurements." New Journal of Physics, 21(10):103006, oct 2019.

Superconducting Quantum Circuits

Report URL

GUIDE: PROFESSOR STEVEN GIRVIN, YALE UNIVERSITY

May. 2018 - July 2018

- Studied the Theory of **Circuit Quantization** and applied it to various circuit. Realised the significance of Uncoupled modes.
- Understood the theory of Transmission line and Input output theory, both in Classical as well as Quantum case. Also, studied the theory of Amplification using Transmission line and negative resistance.
- Devised a simple circuit for three wave mixing and used analytical methods to find it's solution.

Course Projects

Machine Learning

GUIDE: PROFESSOR AMIT SETHI, DEPARTMENT OF ELECTRICAL ENGINEERING, IIT-B

Jan. 2020- Mar. 2020

- Trained various **classification models** to predict employee attrition. Realized that Gradient Boosting machines gives highest accuracy compared to methods such as bagging of several identical models.
- Worked with **imbalanced data** to predict fraud in credit card transactions using oversampling and undersampling techniques.

Random Walker on FPGA

GUIDE: PROFESSOR PRADEEP SARIN, PHYSICS DEPARTMENT, IIT-B

Mar. 2018- Apr. 2018

- Configured FPGA to simulate **300 random walkers** in parallel which moved a step with probability 0.5 on pressing a switch.
- Calculated the position of each random walker on FPGA and transferred them to PC in real time to obtain the relevant statistics.

Dimer Model

Report URL

GUIDE: PROFESSOR SUMIRAN PUJARI, PHYSICS DEPARTMENT, IIT-B

Aug. 2018 - Nov. 2018

- Studied the exact solution of dimer model using **Kasteleyn theory**. Looked at the extension of Kasteleyn theory for the case of periodic boundary conditions.
- Analysed the variation of probability of occurrence of a dimer on the lattice edges using **perturbation theory** and **computational methods**. Also analysed the effect of emergence of long distance interaction from nearest neighbour interaction.

Gesture Mouse

Report URL

GUIDE: PROFESSOR PRADEEP SARIN, PHYSICS DEPARTMENT, IIT-B

Jul. 2018 - Nov. 2018

- Made a **wireless device** which can **control the mouse pointer** of a computer using hand movements and gestures.
- Used the data obtained using magnetometer HMC-5883l to move the pointer. A sudden rotation of the device was used to implement left/right clicks. Added the functionality of "hold left mousebutton" to allow scrolling.

Technical Skills

- Proficient in working with **C, C++, Python and Mathematica**. Have working knowledge of Linux
- Knowledge about **microcontrollers** such as AT-mega328. Have used **Arduino** and **FPGA** in several projects.

Positions of Responsibility

Manager, Maths and Physics Club

IIT-BOMBAY

Apr. 2018 - Mar. 2019

- **Lead a team of eight** to foster enthusiasm in Physics and Mathematics, tending to a community of over 500 on campus and an outreach of over 7000 online.
- Organised **group discussions** on various topics such as Paradoxes in Physics , Quantum entanglement.
- Administered **lectures** by notable researchers and professors in their field of interest.
- Conducted **Summer of Science**, an initiative to help students study their chosen topics during summers through the guidance of mentors assigned to them. More than 400 students participated in SoS-2018.

Miscellaneous

- Volunteered for **Social Service** through the National Service Scheme. Helped underprivileged people living around my institute's campus with their basic needs and bringing a change in their life. **Made people aware** about the useful government schemes are procedures to avail their benefit.
- **Teaching Assistant for 2 courses** at IIT-Bombay: Quantum Mechanics I and Thermal Physics.
- Participated in Mimamsa 2018-**national level annual Science Quiz** organised by IISER Pune. My team for 4 students came **Second** in the final round.
- Team Leader in Institute Technical Summer Project, where I lead a team of four people to build an **Autonomous bot** capable of long distance path calculation, utlizing GPS navigation and obstacle avoidance.