Sirshendu Mandal

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Education

Indian Institute Technology, Kanpur — undergraduate
- *Double majoring in Computer Science and Physics* — *July'16 - June 2021(expected)*
  Minors in Mathematics and Economics — *CPI : 8.2/10*

Technical Skills

- **Languages :** C, C++, Python, R, PHP, Bash, Javascript
- **Tools :** Linux Command Line , Git, Latex, GNU Octave
- **Libraries and utilities :** Tensorflow, Pytorch, Eigen, OpenCV
- **Operating Systems :** Ubuntu, Fedora, Windows

Research Intersests

- **Information theory , Quantum Mechanics , Classical Physics ,Biophysics,Quantum Computing Optimization, Computer Vision , Deep Learning ,Reinforcement Learning**

Internship

- **Classification and Detection of objects on DVS images :** Samsung Research Institute
  mentored by Dr.Vijay Narayan Tiwari — *Bangalore , May'19 - July'19*

  DVS images are very different than normal RGB images as they only highlight the temporally changing pixels.Hence dont look like normal images . But since all apples(or chairs) will have a somewhat similar representation even in DVS images too , some form of clustering will exist and existing classification and detection algorithms for RGB images should work. I implemented existing models of the YOLO family , RCNN family, SSD . And since major parts of these images are blank , so classical image processing techniques were extensively used .

Projects

- **Significance of Renyi Entropy:** ongoing
  under Prof. Satyadev Nandakumar, Computer Science Department, IIT Kanpur — *July'19 - Present*

  Normal Shannon Entropy has this nice interpretation as the average coding length of a set of strings. But such general interpretations for the Renyi entropy are available only for some special cases (dependent on the value of α) . It is speculated that theres some connection between fractal volumes and the case of $\alpha < 1$. We are interested in testing this idea and also attempt to the much harder $\alpha > 1$ case.

- **Model Agnostic Meta Learning :** Machine Learning , CS 771
  course project under Prof. Piyush Rai, Computer Science Department, IIT Kanpur — *July'18-Nov'18*

  Explored the use of few shot learning and meta learning in image classification problems(and by using an extra LSTM layer in parallel)obtained a 5 percent increase in accuracy on several datasets . *link to project report*

- **Quantum Information and Game Theory:** ongoing
  under Prof. Chanchal Sow, Physics Department, IIT Kanpur — *Aug'19 - Present*

  It's an informal reading project where I am surveying the existing literature in application of Information theory and Game Theory to Quantum Phenomena. We will identify some topic soon and pursue a more focused project on that domain.

- **Use of random matrices in image dimension reduction:** Numerical Linear Algebra
  course project under Prof. Sumit Ganguly , Computer Science Department, IIT Kanpur *Jan'19 - May'19*

  The random matrices which satisfy Johnson Lindenstrauss(JL) lemma have some nice approximation properties. This project was an attempt to use those methods in image dimension reduction. I used multiple such random matrices , like SRHT , Countsketch etc. and compared their performance and applicability to the task at hand. *link to project presentation*

- **Unsupervised Image Segmentation** Visual Recognition
  course project under Prof. Vinay P. Namboodri , Computer Science Department, IIT Kanpur *Jan'19 - May'19*

  Classical Image segmentation task are done by supervised methods. In this project we explored unsupervised methods for the same , mainly backpropagation based methods . *link to project report and presentation*

- **SAT based classical planning for multi-agent systems**
  under Prof. Indranil Saha , Computer Science Department, IIT Kanpur *Jun'18-Dec'18*

  Explored the use of cardinality constraints to bound the trajectories . And tried to correlate the set of satisfiability clauses of time dependant robot configurations with the distance travelled so far . *link to project report*

- **Use of integer matrices in combinatorics :**
  under Prof. A.K.Lal , Mathematics and Statistics Department , IIT Kanpur *May'18-July'18*

  Surveyed the use of integer matrices in various combinatorial settings , like tiling of a square grid.

Brief Description of my Research Interests

- **Information Theory,Quantum Mechanics,Classical Physics,Biophysics, Quantum Computing Optimization, Computer Vision , Deep Learning ,Reinforcement Learning**

  I am very much interested in all areas of Physics and enjoy solving problems in Classical Mechanics , Classical Field Theories . I wish to continue to strengthen by basics in all the central physics topics. I am particularly interested in the applications of Quantum Mechanics and Biophysics as a domain itself. In Quantum Mechanics, the question pertains to the wealth of phenomena which lie at the boundary of quantum and classical realm and in Quantum Computing. Biology as a problem fascinates me , because to solve it truly ; we need proper and further understanding of the applications of Quantum mechanical principles in the context of condensed matter physics. Also , the processes like RNA transcription and others make it abundantly clear that some sort of computers are working underneath(but whether they are Turing like everywhere needs to be seen) . I will undertake formal coursework in more advanced physics topics , like General Relativity and Particle Physics in the next few semesters. In Theoretical computer science , I have been working on Information Theory for a while now , and it is particularly exiting because information theory allows us to view so many physical laws from a new perspective , something akin to computational process underlying all phenomena.I have extensive experience in Machine Learning and allied topics , and particularly in Computer Vision. I am also exited about the application of Deep Learning in diverse fields , like astrophysics. I am planning to go for higher studies in either Physics or Theoretical Computer Science(in Information Theory or Mechanism design or Quantum Computing) or in Machine Learning(perhaps in Reinforcement Learning , because it's principles are closest to how we naturally learn any "task") .

Relevant Coursework

MTH 102*(Linear Algebra and Ordinary Differential Equations) , **MTH 101*** (Multivariate Calculus) , **MSO 201*** (Probability and Statistics) , **CS 201** (Discrete Mathematics) , **CS 220** (Computer Organisation) ,**CHM 102***(General and Quantum Chemistry),**ESC 101***(Introduction to Computing),**CS 203**(Abstract Algebra),**CS 202**(Logic),**PHY 101***(General Physics Lab), **CHM 101***(General Chemistry Lab), **PHY 102*** (Mechanics) , **PHY 103*** (Electrodynamics) ,**PHY 226B** (Relativity) , **PHY 210A**(Thermodynamics),**ECO 101***(Introduction to Economics),**CS 771** (Introduction to Machine Learning) ,**CS 340** (Theory of Computation) ,**ESO 207**(Data Structures and Algorithms),**CS 252**(Computing Laboratory 2) ,**CS 345** (Algorithms-II) , **ESC 201**(Electronics),**CS 783** (Computer Vision) ,**LIF 101***(Introduction to

Biology), **CS 698C*** (Linear Algebraic Tools for Big Data Analysis) , **CS 687**(Algorithmic Information Theory) , **PSO 201**(Introduction to Quantum Physics), **PHY 421A ****(Mathematical Methods) ,**PHY 431A****(Quantum Mechanics), **CS 330****(Operating Systems),**PHY 401A****(Classical Mechanics), **PHY 670*****(Evolutionary Game Dynamics),**PHY 309*****(Introductory Biophysics)

*awarded an A grade in the course ** Ongoing courses this semester ***courses auditing this semester
I have also completed the online video series on **Quantum Computing** by Umesh Vazirani (which are available on YouTube). I have not done any project work in Quantum Computing , but will undertake one starting this winter.

Awards and Achievements

- Cleared **NSEA 2015** (National Standard Examination in Astronomy) and appeared for INAO(Indian National Olympiad in Astronomy and Astrophysics)
- **Academic Excellence Award** , IIT Kanpur (2016-17)
- Selected for **Research Internship** at Shibaura Institute of Technology , Japan (for the summer , 2019)
- **All India Rank 100** in NEST(National Entrance Screening Test-2016)(Conducted by Department of Atomic Energy , Government of India.
- **All India Rank 14** in National Science Olympiad (Science Olympiad Foundation), 2010
- **All India Rank 53** in National Science Olympiad (Science Olympiad Foundation), 2009
- Awarded **HDFC bank scholarship** for winning the HDFC bank quiz , 2010

Languages

- **English :** Native or Bilingual proficiency
- **Hindi :** Native or Bilingual proficiency
- **Bengali :** Native

Manufacturing Lab Projects

- CAD projects on different aircraft parts on Autodesk as part of engineering-drawing lab project.
- Made a coffee grinder as our Manufacturing Lab 1 project
- Made an oscillatory room cleaner using gears and other parts (adjudged 3rd best project in our Manufacturing lab 2 course)

Extracurriculars

Student volunteer at **Prayas** (a campus NGO aiming to provide free supplementary education for underprivileged children and students from the villages surrounding the IIT campus) and took mathematics and science classes of students of class 10 and onwards . Active member of the **Adventure Sports Club,IIT Kanpur** and **Bicycling Hobby Group,IIT Kanpur**.Active member of the campus **Quiz Club**.