

# Sirshendu Mandal

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## Education

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- Indian Institute Technology, Kanpur** undergraduate  
• *Double majoring in Computer Science and Physics* July'16 - June 2021(expected)  
Minors in Mathematics and Economics CPI : 8.4/10

## Technical Skills

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- **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 Interests

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

## Internship

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- **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 don't 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

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- **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  $\alpha$ ) . It is speculated that there's 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

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- 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

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**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

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- 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

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

## Manufacturing Lab Projects

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- 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

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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**.