

SOURYA BASU

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RESEARCH INTERESTS

Information Theory, Data Compression and Artificial Neural Networks

EDUCATION

- 2017 | **B. Tech. in Electrical Engineering**, *Indian Institute of Technology Kanpur*
Minor in Artificial Intelligence, CPI - 9.6/10.0
- 2013 | **Senior School Certificate Examination**, *S.M.Arya Public School, New Delhi*
Scored 89.8% marks in XII AISSE
- 2011 | **Secondary School Certificate Examination**, *S.M.Arya Public School, New Delhi*
CGPA - 9.8 in X AISSE

PUBLICATIONS

- APRIL 2017 | **Sourya Basu and Lav R. Varshney, "Universal Source Coding of Deep Neural Networks",** *Data Compression Conference (DCC)*, IEEE, 2017. [[Paper](#)]
- JUNE 2016 | **Sourya Basu, Shivam Chaturvedi, and Rajesh M Hegde, "Text Compression Using Lexicographic Permutation of Binary Strings",** *Eleventh International Conference on Signal Processing and Communications (SPCOM)*, IEEE, 2016. [[Paper](#) | [Presentation](#)]
- MARCH 2016 | **Manu Seth, Sourya Basu, Shivam Chaturvedi, and Rajesh M Hegde, "Multi Character Frequency based Encoding for Efficient Text Messaging in Indian Languages",** *Communications (NCC), 2016 Twenty Second National Conference on.* IEEE, 2016. [[Paper](#) | [Poster](#)]

AWARDS AND ACHIEVEMENTS

- Received **Academic Excellence Award** at IIT Kanpur for distinctive academic performance for the years 2013-16.
- Ranked amongst the **top 10** teams across all the IITs in **Ericsson Innovation Award 2014-2015**.
- Secured **All India Rank 181** in **JEE ADVANCED 2013** out of 0.15 million students.
- Kishore Vaigyanik Protsahan Yojna (KVPY) Scholar, awarded to top 600 students in India.
- Certificate of Merit** for qualifying for **Indian National Chemistry Olympiad (Theory) 2013**.
- Certificate of Merit** for being placed in National Top 1% in **National Standard Examination in Physics-2012-13** among 40,000 candidates.
- Certificate of Merit** for being placed in State wise Top 1% in **National Standard Examination in Astronomy-2012-13**.
- Secured **16th** rank in **Junior Science Talent Search Examination**, conducted by Science Branch, Directorate of Education, Govt. of NCT of Delhi (in 9th grade).
- Participated in the **Kishore Vaigyanik Protsahan Yojna (KVPY) Camp** held at IISER Mohali and IISc Bangalore during May 2012 and December 2012 respectively.

RESEARCH INTERNSHIP

Universal Compression of Graphs and Graph Signals

Summer 2016

Guided by Prof. Lav R. Varshney, University of Illinois at Urbana-Champaign

- Aim:** To develop universal compression algorithms for graphs and graph signals, taking into account various invariant properties that are present in group-theoretic characterization of these discrete structures.
- Results:** Computed entropy bounds for several graphical structures, graph signal models and proposed efficient compression algorithms whose performance was compared to the achieved bounds. The work was published in *Data Compression Conference (DCC)*, 2017.

PROJECTS

Deep Q-Learning based PC Game

Spring 2017

Course Project, Neural Networks, Prof. Laxmidhar Behera, IIT Kanpur

[[Code](#) | [Video](#)]

- Objective:** Control a car in a PC game using reinforcement learning such that the car collects as many coins as possible and avoids as many obstacles possible.
- Algorithm:** Collected the frame from the game and was fed to a CNN for object identification, followed by an Actor network which gave the next move to be played and was provided with the feedback mechanism of Q-Learning. Feedback consisted of both penalty and reward.
- Result:** The car showed excellent performance in both avoiding obstacles and collecting coins.

Zero Shot Learning: A Comprehensive Survey

Fall 2016

Course Project, Machine Learning, Prof. Piyush Rai, IIT Kanpur

- Zero Shot Learning is about recognizing new categories of instances without training examples, by providing a high level description of the new categories that relate them to categories previously learned by the machine.
- Studied and implemented some recent works in the field and in particular different approaches to solve the problem like Zero-Shot learning with semantic output or cross modal transfer.
- Used two datasets: fMRI and aPascal & aYahoo [Datasets](#) and processed the data according to our requirements.

Application of NEAT algorithm in PC Games

Spring 2016

Course Project, Artificial Intelligence Programming, Prof. Harish Karnick, IIT Kanpur

[\[Report\]](#) [\[Poster\]](#)

- A 2-D artificially intelligent computer game was made using python in which 2 robots learnt to fight each other starting from a random fight to a highly skilled fight, over several generation of their evolution.
- The learning task was based on the NEAT (NeuroEvolution of Augmenting Topologies) algorithm, using an evolving neural network with the final generation ($\sim 100^{th}$) of networks having about 5 hidden layers.

Recognition of Facial Speech Gestures

Fall 2014

Guided by Prof. A.R. Harish, IIT Kanpur

[\[News\]](#)

- Developed a device that recorded the variation in face muscle potential of the user, using which it could detect the the sounds that were produced by the user while conversing.
- The device was capable of recognizing the syllables 'a' and 'e' correctly in 6 out of 8 cases. This device may find use in applications such as silent speech or facial gesture recognition.
- The project was ranked among the top 10 projects across all the IITs in Ericsson Innovation Award 2014-2015 and was awarded with a fund of ₹25000 for prototype development.

Sleep and Fitness Tracker

Summer 2014

Under Electronics club, IIT Kanpur

[\[Report\]](#) [\[Video\]](#)

- A device consisting of an accelerometer and a Bluetooth antenna was made to track the 3-D motion of the user and send it via Bluetooth to any connected Android device, using an Android app that was also developed.
- The data sent to the Android device was used to analyze the performance of physical activities by the user such as walking, running, jogging or jumping.
- The device could also be worn by the user during sleep in which case it gives an analysis of deep and light sleep and also uses a smart alarm to wake up the user after optimum amount of deep and light sleep.

RESEARCH PROJECTS

Text Compression Using Lexicographic Permutation of Binary Strings

Fall 2015

Guided by Prof. Rajesh M. Hegde, IIT Kanpur

[\[Paper\]](#) [\[Presentation\]](#)

- A novel text compression algorithm was developed based on concepts from combinatorics and also relative frequency of letters in text files.
- The proposed algorithm used the Unique Lexicographic Rank (ULR) of the message which when tested on Calgary and Project Gutenberg corpus could achieve compression ratio as low as 0.53 using a trigram model encoder.

Multi Character Frequency based Encoding for Efficient Text Messaging in Indian Languages

Summer 2015

Guided by Prof. Rajesh M. Hegde, IIT Kanpur

[\[Paper\]](#) [\[Poster\]](#)

- The motivation of the project was to develop efficient compression algorithm for text files in Indian languages like Gujarati, Marathi, Hindi and Tamil.
- A bi-gram algorithm was introduced for the same which showed better compression ratio than the existing Table marker algorithm when the probability factor was greater than $\frac{2}{3}$, and it was verified that this was the case in real life examples with high probability.

RELEVANT COURSES

- **Communications:** Principles of Communications, Communication Systems, Digital Communication Networks, Representation of random Signals.
- **Signal Processing:** Signals, systems and networks, Digital Signal Processing, Speech Signal Processing.
- **Computer Science:** Fundamentals of computing, Data structures and algorithms, Artificial Intelligence Programming, Machine learning techniques.
- **Mathematics:** Probability and Statistics, Linear Algebra, Complex Analysis, Differential Equations, Calculus, Mathematical Logic.
- **Electronics:** Introduction to electronics, Microelectronics, Digital electronics.
- **Other relevant course:** Neural Networks, Introduction to game theory, Control systems analysis, Power systems, Electromagnetic theory.

TECHNICAL SKILLS

Languages: C, C++, PYTHON

Tools: MATLAB, MATHEMATICA, ARDUINO, ECLIPSE, PROCESSING, GNU OCTAVE, SOLIDWORKS, \LaTeX

Platforms: LINUX, WINDOWS

POSITIONS OF RESPONSIBILITY & SOCIAL INITIATIVES

Secretary, Electronics Club, IITK:

Fall 2014

- Conducted workshops on Digital Clock for freshmen giving them hands-on experience of several ICs and their application in digital devices. Also, mentored freshmen for Electromania, an event under electronics club in TAKNEEK 2014, intra-IITK Science and Technology Championship.

National Service Scheme:

Fall 2013 & Spring 2014

- Tutored students from class 5th to 8th in the topics of mathematics and science.
- Conducted a science exhibition for elementary and middle school students.

EXTRA-CURRICULAR ACTIVITIES

- Ranked 2nd in TAKNEEK'14 in second year and made a multiplayer Pong game creating a two way communication between computer and Arduino via Bluetooth.
- Participated in TECHKRITI'14, inter-college Science and Technology Championship in first year and made a two way Morse code communication module and transferred data between the two modules using infrared and TSOP sensors