

CURRICULUM VITAE

SOURYA BASU

Graduate student

Electrical & Computer Engineering

University of Illinois at Urbana-Champaign

email: sourya@illinois.edu

Mobile: +1 2177218603

RESEARCH INTERESTS

Information theory, data compression, and machine learning.

EDUCATION

- 2018 **MS in Electrical & Computer Engineering**, *University of Illinois at Urbana-Champaign*
- present Advisor: Prof. Lav R. Varshney
GPA - 3.88
- 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

- MARCH 2020 **Sourya Basu**, Daewon Seo, and Lav R. Varshney, “**Functional Epsilon Entropy**”, to appear in *Proceedings of the IEEE Data Compression Conference*, Snowbird, Utah, 24-27 March 2020. [[arXiv version](#)]
- JULY 2019 **Sourya Basu** and Lav R. Varshney, “**Polar Codes for Simultaneous Information and Energy Transmission**”, in *Proceedings of the 20th IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Cannes, France, 2-5 July 2019. [[Paper](#)]
- DECEMBER 2018 **Sourya Basu** and Lav R. Varshney, “**Succinct Source Coding of Deep Neural Networks**”, in *Proceedings of NeurIPS Compact Deep Neural Network Representation with Industrial Applications Workshop (CDNNRIA)*, Montreal. [[Paper](#)]
- NOVEMBER 2018 Aditya Raikar, **Sourya Basu**, and Rajesh M. Hegde, “**Single Channel Joint Speech Dereverberation and Denoising using Deep Priors**”, 2018 *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*. [[Paper](#)]
- APRIL 2017 **Sourya Basu** and Lav R. Varshney, “**Universal Source Coding of Deep Neural Networks**”, *Proceedings of the IEEE Data Compression Conference*, Snowbird, Utah, 4-7 April 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](#)]

PREPRINTS & WORKING PAPERS

- JANUARY 2020 **Sourya Basu**, Daewon Seo, and Lav R. Varshney, “**Hypergraph-based Coding Schemes for Two Source Coding Problems under Maximal Distortion**” (*submitted to IEEE International Symposium on Information Theory (ISIT)*).
- APRIL 2018 **Sourya Basu** and Lav R. Varshney, “**Universal and Succinct Source Coding of Deep Neural Networks**”, (*submitted to IEEE Transactions on Information Theory*). [[arXiv version](#)]

AWARDS AND ACHIEVEMENTS

- **James M. Henderson Fellow** at the University of Illinois at Urbana-Champaign.

- **Dilip and Sandhya Sarwate Graduate Fellow** at the University of Illinois at Urbana-Champaign.
- **ECE Distinguished Research Fellow** at the University of Illinois at Urbana-Champaign.
- 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.

RELEVANT COURSES

- **Communications:** Information Theory, Principles of Communications, Communication Systems, Digital Communication Networks, Representation of random Signals.
- **Computer Science:** Statistical learning theory, Fundamentals of computing, Data structures and algorithms, Artificial intelligence programming, Machine learning techniques.
- **Signal Processing:** Signals, systems and networks, Digital Signal Processing, Speech Signal Processing.
- **Mathematics:** Concentration inequalities, Introduction to abstract algebra, Random Processes, 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.

UNDERGRADUATE 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**.

UNDERGRADUATE 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.

UNDERGRADUATE 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.

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 5^{th} to 8^{th} in the topics of mathematics and science.
- Conducted a science exhibition for elementary and middle school students.

EXTRA-CURRICULAR ACTIVITIES

- Ranked 2^{nd} 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