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 artificial neural networks

Education

2018 - present | **MS in Electrical & Computer Engineering**, *University of Illinois at Urbana-Champaign*
Advisor: Prof. Lav R. Varshney
GPA - 4.00

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 AISSCE

2011 | **Secondary School Certificate Examination,** *S.M.Arya Public School, New Delhi*
CGPA - 9.8 in X AISSE

Publications & Preprints

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]

April 2018 — **Sourya Basu** and Lav R. Varshney, **"Universal & Succinct Source Coding of Deep Neural Networks"**, arXiv preprint arXiv:1804.02800 (2018). [Paper]

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

- **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 **16**th 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:** Information Theory, 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:** 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.

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