

# SUSHRUT THORAT

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## CONTACT INFORMATION

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## INTERESTS

Unsupervised Learning, Biological Neural Networks, Information Representation in the Brain, Subjective Experience

## EDUCATION

**Masters in Cognitive Neuroscience** *Ongoing*  
CIMEC, University of Trento, Rovereto, Italy

**B.Tech. in Engineering Physics** *August, 2015*  
Indian Institute of Technology - Bombay, Mumbai, India

## PUBLICATIONS

**Implementing a Reverse Dictionary, based on word definitions, using a Node-Graph Architecture** (*paper*)

*Co-author: Varad Choudhari* *December, 2016*  
*Conference: International Conference on Computational Linguistics, Osaka, Japan*

We designed a method to process any forward language dictionary to build a reverse dictionary, using a n-level reverse search on a graph, through word definitions. The reverse dictionary takes any input phrase and outputs a set of words with high semantic correlation to the input, and performs atleast as well as the state-of-the-art.

**Arithmetic Computing via Rate Coding in Neural Circuits with Spike-triggered Adaptive Synapses** (*paper*)

*Co-author: Bipin Rajendran* *July, 2015*  
*Conference: International Joint Conference on Neural Networks, Killarney, Ireland*

We presented spiking neural circuits with spike-time dependent adaptive synapses capable of the arithmetic operations - addition, subtraction, multiplication and division, as well as other non-linear transformations - exponentiation and logarithm, for time dependent signals in real-time.

## WORK EXPERIENCE

**Content Developer**

*Employer: Avanti Fellows, Delhi* *Summer 2013*  
Researched about and developed ConceptTests as required by Avanti's Learning Centre Curriculum. The Curriculum is based on Eric Mazur's *Peer Instruction* model which he successfully employed at Harvard University.

## PROJECTS

**Principles of information representation in the Human Visual System as compared with Convolutional Neural Networks**

*Guide: Marius Peelen* *Ongoing*

Representations in the CNN layers correlate highly with the visual ventral stream representations, even in the case of stimuli confounding visual features as in Proklova, et.al., 2016. Visual features are rich contributors to semantic representations. This project aims to find out how much the ventral temporal cortex is driven by visual features alone in representing animacy, using a CNN as an approximation of feed-forward visual contribution.

**Independent Study: The neural basis of cross-modal numerosity perception** (*report*)

*Guides: Marco Buiatti and Manuela Piazza* *Spring 2016*

The project aims to understand the said neural basis using frequency-tagging EEG with newborn babies. I developed an algorithm for generating the stimuli, which accounts for the variance in the non-numerical factors (item size, sparsity, etc.) which affect number cognition, and was involved in conducting the pilot EEG experiment on adult subjects.

**Senior Thesis: A Spiking Neural Network as a Quadcopter Flight Controller** ([report](#))  
*Guide: Bipin Rajendran* *Spring 2015*

We developed a model-based control scheme for velocity-waypoint navigation in the presence of wind, noisy and delayed IMU data, for a quadcopter. We built small spiking neural networks with simple spike-triggered adaptive synapses for implementing arithmetic operations. **We wrote a paper explaining these networks, which has been published in the proceedings of IJCNN'15.** We outlined a method of developing a spiking neural network for quadcopter Control to analyse the gain in computational power and stability provided by spike-based networks.

**Junior Thesis: On Quantum Computation** ([report](#), [presentation](#))

*Guides: Tathagat Avatar Tulsi and Suddhasatta Mahapatra*

*Autumn 2013*

Wrote a report on, and presented the basics of Quantum Computation viz. Quantum Circuits and Quantum Algorithms, and their applications, primarily based on the first two parts of the book 'Quantum Computation and Quantum Information' by Nielsen and Chuang.

**ATTEND(-ED/-ING)  
WORKSHOPS**

**IBRO-SIMONS Computational Neuroscience Imbizo (ISi-CNI)**  
Cape Town, South Africa

*January, 2017*

**Computational Approaches to Memory and Plasticity (CAMP)**  
NCBS, Bangalore, India

*June, 2015*

**ACADEMIC  
ACHIEVEMENTS**

- Ranked **721 among 450,000 students** in the Joint Entrance Examination (**JEE, 2011**) conducted towards admission to the IITs.
- Awarded the **KVPY scholarship** (2010), awarded to **150 promising young researchers** throughout India, by the Dept. of Science & Technology, Govt. of India.
- **Winner** at the **Annual All India Web-Design Contest** (2008) hosted by SJIIT, Pune (India).
- Awarded the **NTSE scholarship** (2007), awarded to **1000 students** throughout India with **excellent all-round skills**, by the National Centre for Educational Research and Technology, Govt. of India.

**TECHNICAL SKILLS**

**Programming:** Python, MATLAB (PsychToolbox, MatConvNet)

**Web-Design:** HTML5, CSS3, JavaScript

**Neuro-Imaging:** EEG, fMRI

**COURSE PROJECTS**

**Understanding human visual processing with deep neural networks** ([presentation](#))

*Neural Decoding (James Haxby)*

*Spring 2016*

**Predisposition to towards-gravity periodic motion in chicks** ([report](#))

*Foundations of Cognitive Psychology (Sang Ah Lee)*

*Autumn 2015*

**Non-Linearity in Neural Systems** ([presentation](#))

*Non-linear Dynamics (Anirban Sain)*

*Autumn 2014*

**The Origin of Consciousness** ([report](#))

*Topics in Evolution (Kiran Kondabagil)*

*Spring 2014*

**Gesture Lock** ([report](#))

*Micro-controllers Lab (Pradeep Sarin)*

*Autumn 2013*

**OTHER  
ACTIVITIES**

- Co-founded **Neuro Mondays** in 2015, a weekly meeting at CIMeC, where students discuss a review, a specific paper, or their work about cutting-edge ideas in neuroscience and psychology.
- Maintain a blog, **Meadows**, of my writings.