**MEng Design Project Announcement – 2017-18 AY**

**Project title:** Phase transitions in single hidden layer random weight neural networks

**Brief Description of Design Project Goals:**

**Overview:** Feed forward neural networks with a single hidden layer classify efficiently even with randomized weights. From an informational view, this represents the relative independence of the classifier on the input weighting to the hidden layer. From a physics view, this appears as a phase transition in the midst of short range and long range interactions. Phase transitions happen with a universality in fluctuations across scales. This project will implement a model randomized weight feed forward single hidden layer, and then utilize it to explore the phase transition region to explore the connections between teachings of statistical mechanics and simulated behavior of neural networks. In particular, it will look for the correspondences related to the order of the transition, universality of fluctuations as seen through correlations, and of under-and over-fitting arising when the number of hidden neurons and training data are comparable.

**Specific MEEng Contribution:**
(a) write code in python, (b) perform simulations, (c) explore mathematically correlations, variances, and (d) extract conditions and conclusions for different order phase transitions.

The student is expected to have a background knowledge in neural network principles and statistical mechanics, an understanding of solid state, and know matlab. All the code writing will be in python.

**ECE Field Advisor Name:** Sandip Tiwari  
- Email – st222@cornell.edu  
- Phone – 255-4021  
- Office – Phillips 410

**Number of MEEng Students Needed:** 1

**Required Skills:**  
Python, probability and statistics, neural networks, solid-state and statistical mechanics.

**Estimated Project Time Frame:**  
The advisor will meet the student at least once a week individually and in group. Weekly effort and discussions are expected with a strong collaboration that develops in-depth understanding.

2017-18 Academic Year, Two (2) Semesters