

**Indiana University-Purdue University  
Indianapolis**  
**Department of Mathematical Sciences**

STATISTICS SEMINAR

12:15pm—1:15pm, Tuesday, December 04, 2018  
LD 265

**Speaker:** Dr. Ruiqi Liu  
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**Title:** Statistical Optimality of Deep Neural Network Estimator

**Abstract:**

Deep neural network (DNN) is a state-of-art method in modern science and technology. In many complex applications such as object detection on images and speech recognition, DNN can be successfully trained to achieve impressive results. Compared with its fast technological growth, theoretical understanding on DNN seems not sufficient. The main challenge is that a neural network is highly non-linear and overfitting in the parameters, hence, traditional statistical theory is no longer applicable. Moreover, the function class is non-convex and different regularization methods are often combined in practice which cause additional technical difficulty. Recently, a number of authors have been devoted to understanding the theoretical performance of DNN in statistical estimation. However, all results are suboptimal.

In this talk, we discuss the following topics. Given a class  $\mathcal{F}(L, T)$  of ReLU neural networks with  $L$  hidden layers and  $T$  neurons, and a class  $\mathcal{H}$  of smooth functions, what is the optimal upper bound of  $\inf_{\hat{f} \in \mathcal{F}(L, T)} \sup_{f \in \mathcal{H}} \mathbb{E}_f \|\hat{f} - f\|^2$ ? Sufficient conditions on  $L, T$  will be provided such that the upper bound becomes minimax optimal. We also provide confidence interval and hypothesis testing procedures based on DNN estimators. The testing procedure is minimax optimal under suitable choice of  $L, T$ .