

Probabilistic Operator Algebra Seminar

Organizer: Dan-Virgil Voiculescu

November 29 **Reda Chhaibi**, University Paul Sabatier Toulouse 3

Title: *Jacobians of neural networks and Free Probability*
Joint work with Tariq Daouda and Ezechiel Kahn

Gradient descent during the learning process of a neural network can be subject to many instabilities. The spectral density of the Jacobian is a key component for analyzing robustness. Following the works of Pennington et al. such Jacobians are modelled using free multiplicative convolutions from Free Probability Theory. The goal of this talk is to present a numerical method for computing these Jacobians – to an audience of free probabilities. Beyond machine learning the method is certainly of independent interest in free probability and high dimensional statistics. First I will survey available numerical methods available in FPT. Second, I will present the problem from Machine Learning that I am interested in and how it is formalized in FPT. Empirically, thanks to an experiment, our FPT metrics are very correlated to the real-life performance of neural networks. Finally I will present our method for computing the spectral densities associated with a neural network.