Utilization of the fractal dimension metric in training of dense Neural Networks

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June 4, 2021

Abstract

The process of training of Artificial Neural Networks essentially is optimization of the values of the weights $ w_{pq} $ associated with the arcs, connecting the nodes of the layers. This is a process of minimization of the Loss function (maximization of Accuracy function). During the training, the training data set recursively is utilized at subsequent stages, called \textit{Epochs}. The training continues until a satisfactory values of the Loss, Accuracy etc. parameters are reached. The matrices $ W^{UV} $ comprising the weights of the arcs connecting the layers $ U $ and $ V $, can be regarded as gray-scale images of a surface. Starting as random matrices, processed by recursive procedures, they gradually become fractal structures, characterized with respective fractal dimension $ D_f $. In the presented article we have made an attempt to utilize the correspondence of $ D_f $ with the Loss/Accuracy values, in order to forecast the optimal ending point of the NN training process. Similar conclusions were made for the correspondence between the number of layer's nodes and $ D_f $. An attempt to apply statistically more rigorous approach in the determination of the slope of the regression line in Richardson-Mandelbrot plot, was made.

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