DEEP LEARNING BASICS

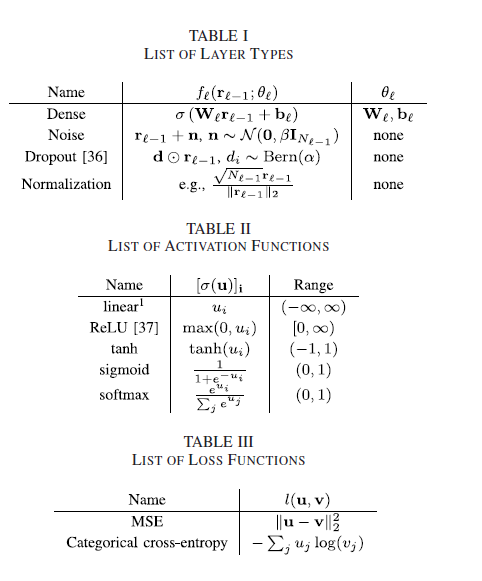
A feedforward Neural Network with L layers is to describe a mapping , which is an input vector to an output vector , and there are through L iterative processing steps:

(1)

Where is the mapping carried out by the th layer. This mapping depends on the output vector and a set of parameters . This work presents that has the form

(2)

the th layer is called *dense* or *full-connected* layer, where , and is an *activation* function, and . Common activation functions and layer types are listed in *Table. 1* and *Table. 2* respectively.



This paper uses labelled training data to train neural networks. For instance, the labelled data is a set of input and output vector pairs , i=1,…,S, where is the desired output vector and is the input vector.

The training process is mainly to reduce the loss to minimum value:

(3)

Where is the loss function, which is categorical cross-entropy function; and is the output and we use as input. Several commonly used loss functions are presented in *Table.3*.

Then we use the most popular stochastic gradient decent (SGD) algorithm to find sets of parameters . The SGD starts with where is some random initial parameters and then updates iteratively as

(4)

Where the learning rate , and is the approximation of the categorical cross-entropy function.

Note that detailed description of Neural Networks is presented in [10].

[10] I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge,

MA, USA: MIT Press, 2016.

This paper defines and trains NNs by the existing DL libraries presented in RELATED WORK. To simulate autoencoder concept from [8], this work mainly uses TesnsorFlow [40] and Keras [43].

[8] Timothy J. O’Shea and Jakob Hoydis. An introduction to machine

learning communications systems. CoRR, abs/1702.00832, 2017.

[40] M. Abadi *et al.* (2015). *TensorFlow: Large-Scale Machine Learning on*

*Heterogeneous Systems*. [Online]. Available: http://tensorflow.org/

[43] F. Chollet. (2015). *Keras*. [Online]. Available:

https://github.com/fchollet/keras