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Deep Learning Using Dropout by Intermittency Chaos

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1. Introduction

A team who using the new machine learning method of the deep learning won the championship at competition of the image recognition in 2012. It is said that the main factor is a technique that is called dropout. We focus on technique in dropout and propose a new system. Because the neural network is too strong in expression and occurs overfitting. The dropout is used to suppress overfitting. The propability of dropout is detarmined by random function. We propose the technique using the chaos function instead of random function. Furthermore, we investigate error rate of neural network which has 4 and 10 hidden nodes.

2. Proposed system

Proposed system that is used in this study is shown in Fig. 1. When a node transmits information to the next layer, the network ignores a node for preventing the network from transmiting information with any probability in dropout. The propability of dropout depends on the random function in the conventional method. The proposed system uses a logistic map for chaos function to decide the probability instead of random function. Parameter a makes the logistic map constant value, periodic vibration or aperiodic complicated behavior that is called the chaos. We determine that the parameter a is 3.828327. We call the part which shifts from the periodic orbit to the chaos orbit intermittency chaos. We show intermittency chaos in Fig. 2.

$$f(x_n) = ax_n(1-x_n) \quad (1)$$

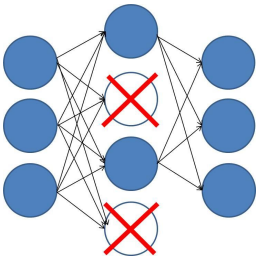

Figure 1: Dropout.

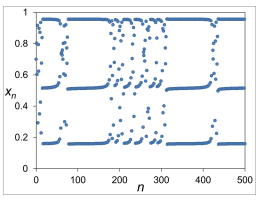

Figure 2: Logistic map ($a = 3.828327$).

3. Simulation results

We show error rate in Fig. 3. The plot of the lozenge shows error rate that is used chaos function. The plot of the square shows error rate that is used random function. When the probability rises, the error rate rises. When we see Fig. 3 partially, error rate with chaos function is smaller than it with random function at the time of 33.3% and 66.6%. Table 1 shows the comparison between random function and chaos function at the time of 33.3% and 66.6%.

We show error rate with each number of hidden node in Figs. 3 and 4. The difference value with 4 hidden node between random function and chaos function is bigger than it with 10 hidden node.

Table 1: An error rate at the time of 33.3% and 66.6% with 4 hidden nodes.

probability(%)	random	chaos
33.3	0.0854	0.0839
66.6	0.1052	0.1047

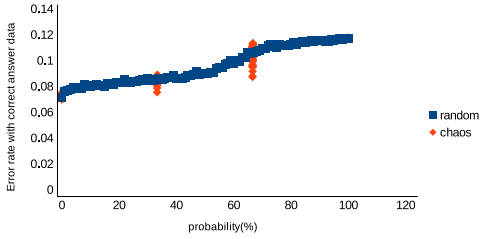

Figure 3: A error rate of each function with 4 hidden nodes.

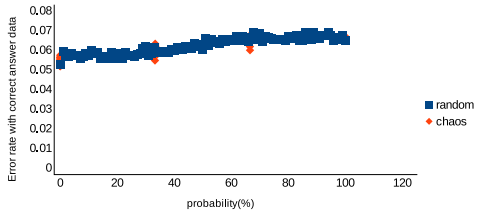

Figure 4: A error rate of each function with 10 hidden nodes.

4. Conclusions

The propability of dropout is detarmined by random function in conventional method. In this study, we use chaos function instead of random function. We use logistic map for a chaos function in this time. And the parameter assumes it $a = 3.828327$. Error rate with chaos function is smaller than it with random function at the time of 33.3% and 66.6%.