Few-shot learning using pre-training and known data enriched shots

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Abstract

We use the EMNIST dataset of handwritten digits to test a simple approach for few shot learning. Choosing a fully connected net with inputs and layer outputs between 0 and 1 and no bias parameters we first trained the network with a subset of the digits. The pre-trained net is used for few shot learning with the untrained digits. Two basic idea were necessary: first the training of the first layer was disabled (or very slow) during few shot learning, and second using a shot consists of one untrained digit together with four previously trained digits and perform a training up to a predefined threshold. This way we reach a 90% accuracy for all handwritten digits after 10 shots.

1 Introduction

Neural networks have shown stunning success[4], but they usually needed a very big training database or were able to generate a hight amount of training examples from rules [5]. Obviously it is not always possible to fulfill this restrictions, e. g. if you want to teach a computer by hand. Therefore we are interested to learn from few examples Several approaches were tried [6].

We use a very simple neural network and try to keep it similar to what is known from the human brain [1]. We do not want to choose a neural network, which is especially good for the test task, therefore we only use fully connected layers with weights and no bias. As activation function we use a function between 0 and 1. To stay similar to what is know about human neurons the function is close to 0 for input 0. Similar to human neurons, a 0 (not firing) can not influence a connected neuron, as it is only multiplied by a weight. A few tests indicated, that this restriction was not very important for the success of our few shot learning approach, but as it seems to be closer to human neurons, we did not see a reason to change it.

The few shot test cases were taken from the EMNIST dataset of handwritten digits[2]. We used 8 digits for pre-training. The idea is, even humans have seen a lot of lines and shapes during there live, before they try to read digits. Therefore the have a pre-trained brain. Than we use the two digits, which the

neural network has never seen before. The neural networks learns them from few examples.

The pre-training is done with a standard gradient descend. The few shot learning is also done this way, but only uses one new sample at a time, and stops learning depending on a stop-criteria. Without any additional ideas, this does not succeed. Two ideas were necessary to succeed with the approach. First the learning was disabled for the first layer, or at least slowed down for the first layer. Second, with every shot some previously known samples are added, but the stop criteria still depends only on the new sample. The idea is, that the network does not forget the old labels. This is consistent with human experience: if you do not use old knowledge, you forget it. This way we reach about 90% accuracy with 10 shot learning[3].

2 The network

References

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