**Design Description Document (FINAL)**

Design Intent: Combining two weeks of learning in data processing and basic neural network building, I was inspired to try to use neural networks as a function approximation tool, so my design project was selected as data image classification. We know that using gradient calculation to find a precision optimization direction from a neural network allows the network model to continuously approximate the actual prediction results. For example, for an image corresponding to a classification of cats, what we want is to map each pixel on the image through a neural network and ultimately convert it into a category ID. This category id corresponds to a real category representation such as (1: dog, 2: cat). So how to design this network? It is known from class that each image is mapped to the pixel value of the value domain (0255), and the function of collecting these image pixels and corresponding labels is implemented in the DataReader source code.

In this way, training data and test data can be obtained. At this time, the neural network is designed to predict the mapping relationship from image pixels to image labels. First, we designed a four-layer neural network structure, and the corresponding neural network is implemented in the Model source code. Given training data, our image pixels will perform forward addition and multiplication calculations with network parameters, collectively referred to as forward propagation. Afterwards, we use the obtained prediction results and labels to calculate gradients, thereby using chain rule to update each neural network layer, gradually learning to predict correct results, and our network structure has initially achieved very high prediction accuracy, This also proves that the correctness of our model update implementation is guaranteed.

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