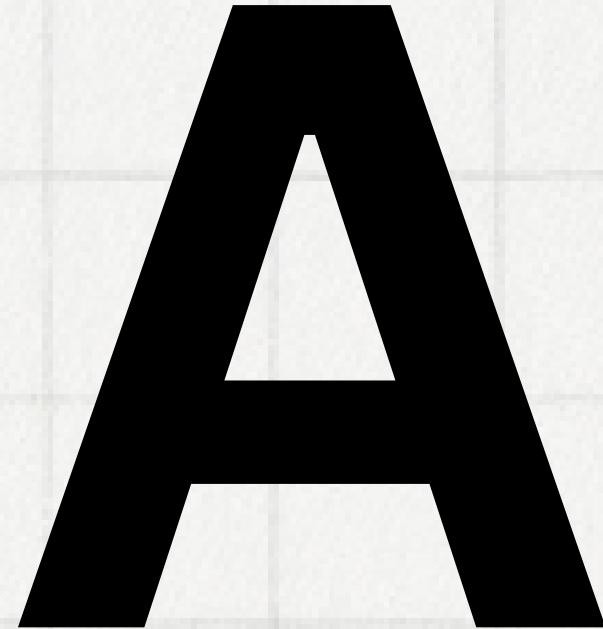
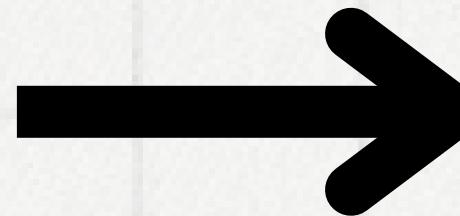


Handwritten letter recognition using multi-layer perceptron

By: Artur Sahakyan , Arbi Balaban



The process

01

The goal/
Introduction

02

Data pre-processing

03

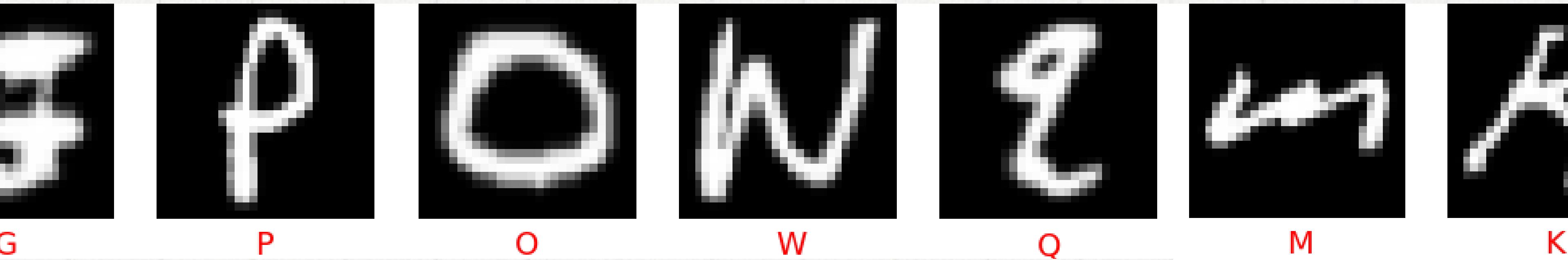
Neural Network
Architecture

04

Experiments
and Results

The goal

The goal is to develop a feed forward neural network that can accurately classify handwritten letters based on their visual representations.



The dataset for handwritten letters we chose is **Extended MNIST**.

The **EMNIST** Letters dataset merges a balanced set of the uppercase and lowercase letters into a single 26-class task.

Data pre-processing

The first column of the datasets were the labels

Labels were then one-hot encoded.

The pixels have been normalized

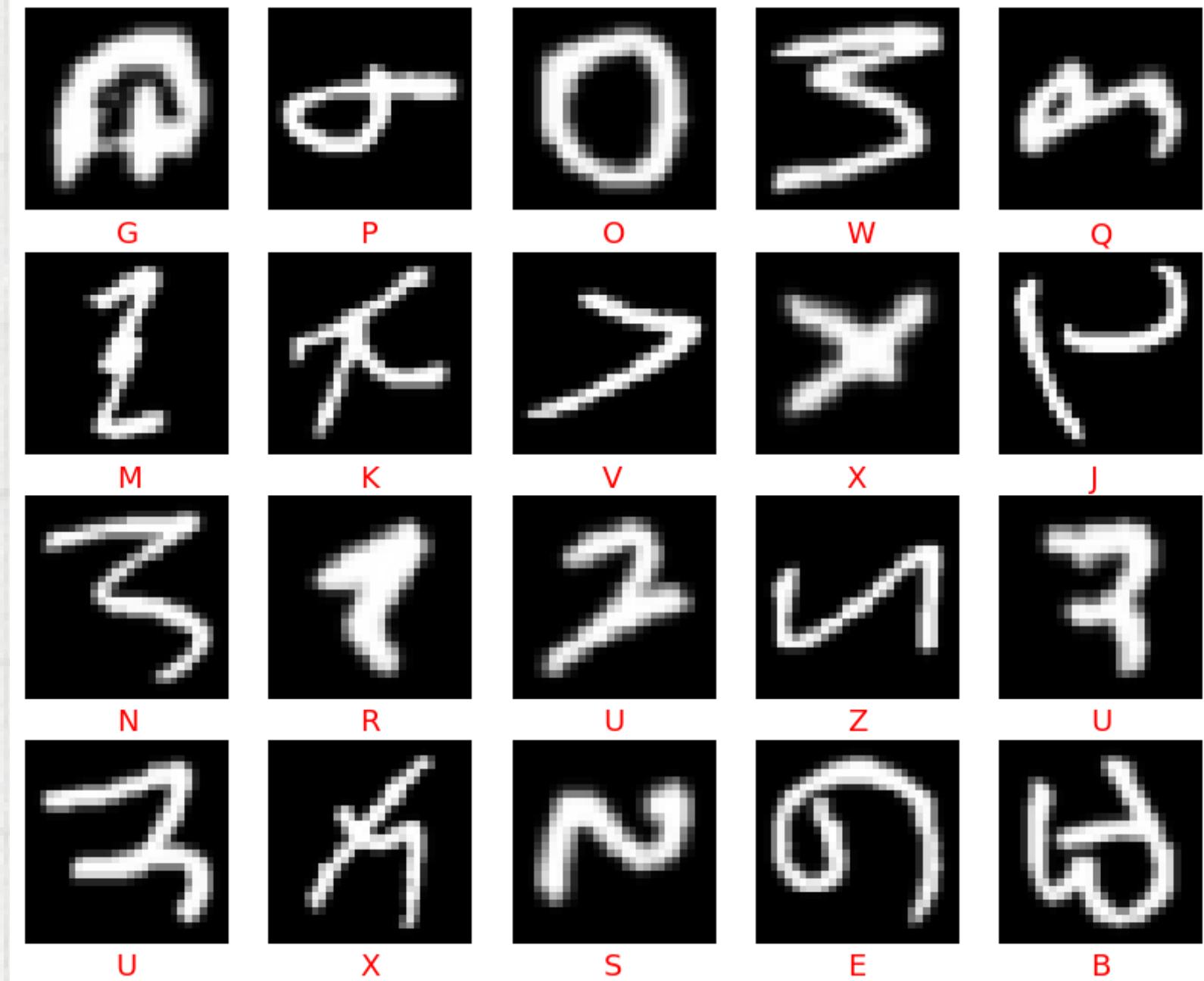
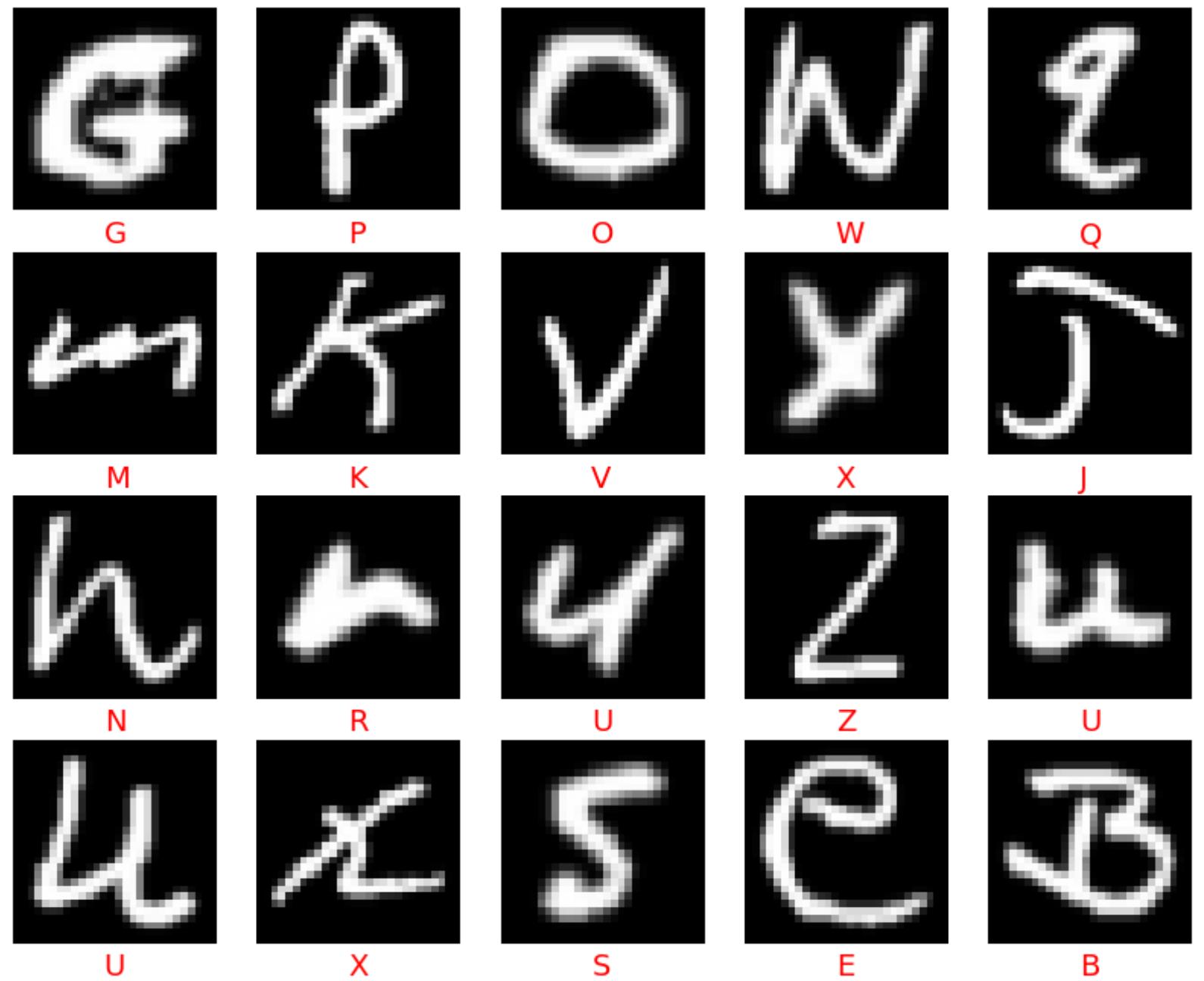
26 labels

784 pixel values

A	B	C	D	E	F	G	.	.	.	Z								
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	

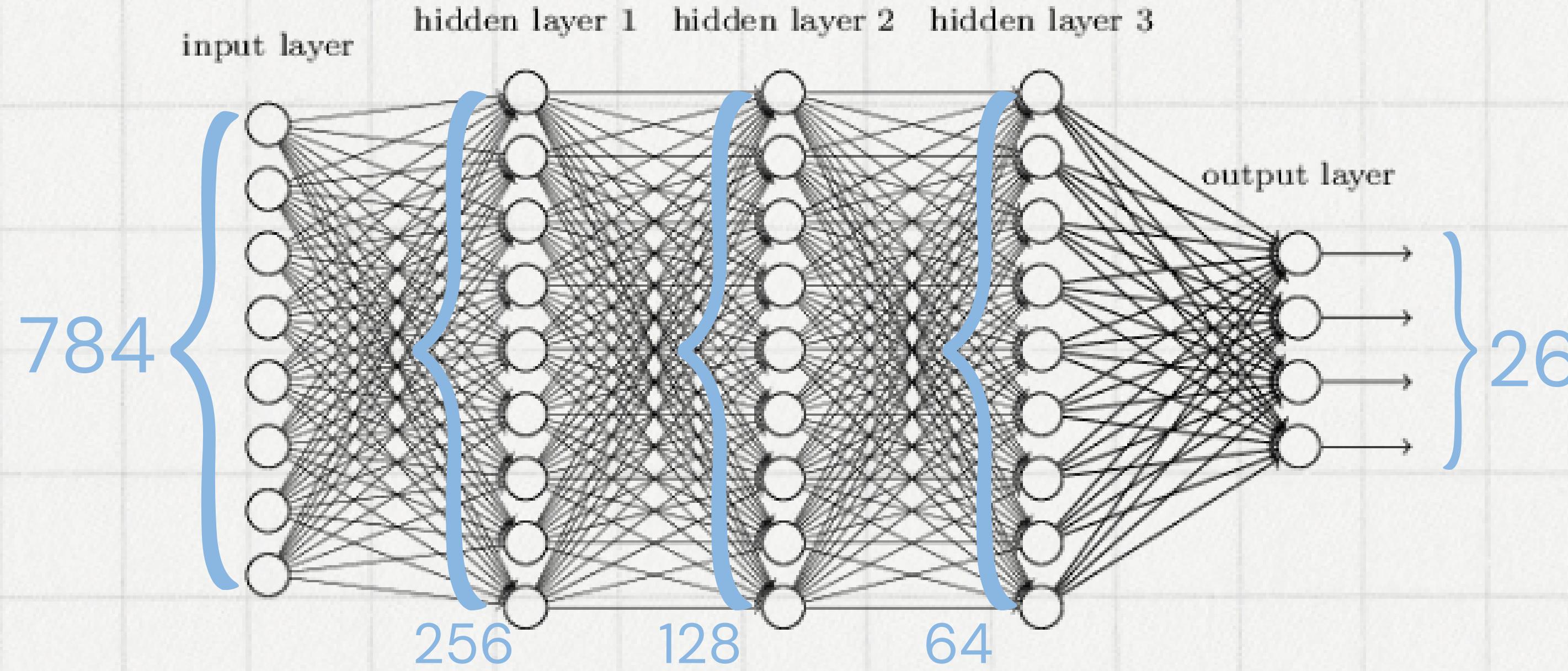
working with pixel data

we experimented with the right angle
and horizontal flip for the pixel data
provided in dataset



Neural Network Architecture

The architecture is composed of linear layers with activations after each



Neurons of those layers are connected through weights, which are initialized from a random uniform distribution in range $-0.5, 0.5$

$$f(x) = \ln(1 + e^x)$$

In forward propagation each layer has then been activated by Softplus activations.

Softplus is a smooth approximation to the ReLU activation function. Through Softplus we dealt with the "vanishing" gradient problem in the back propagation.

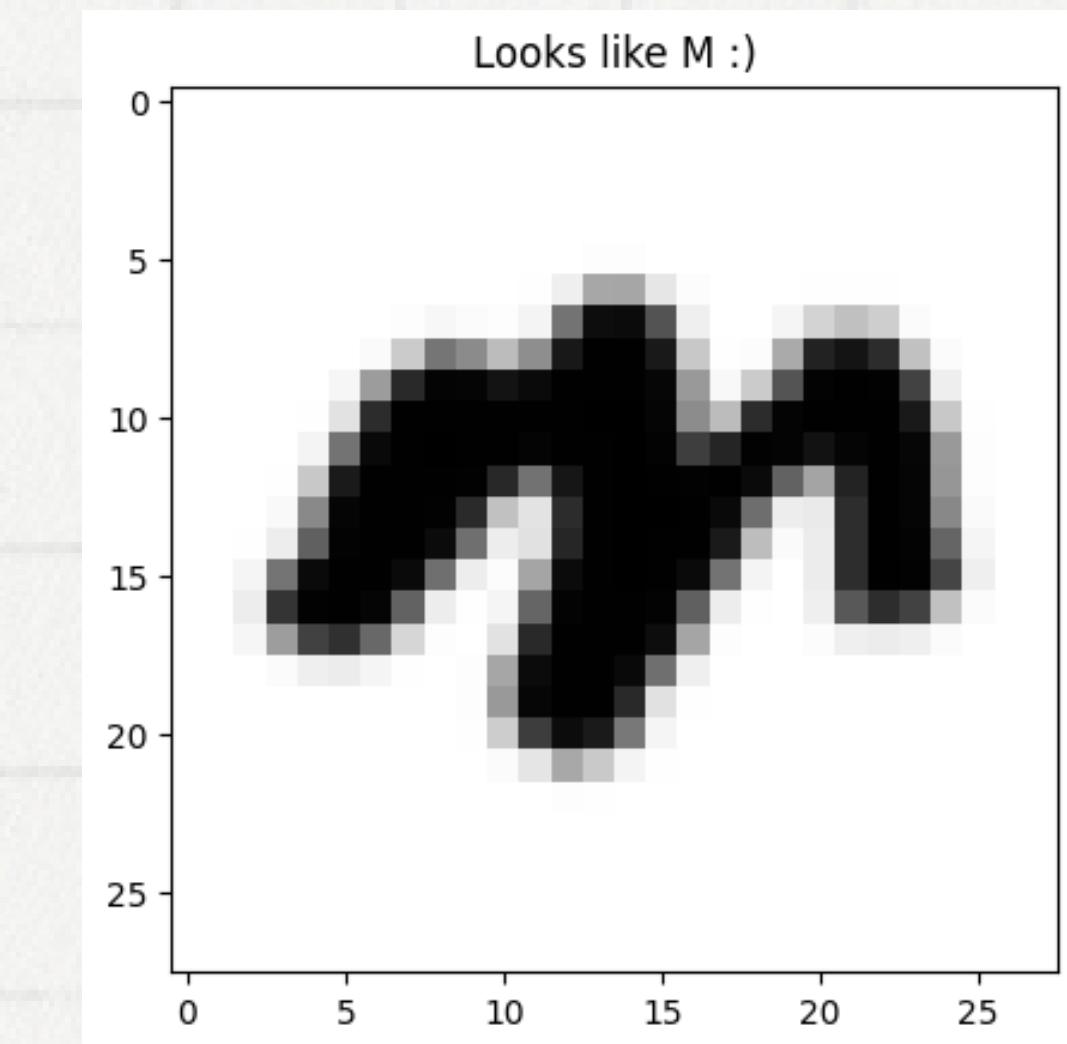
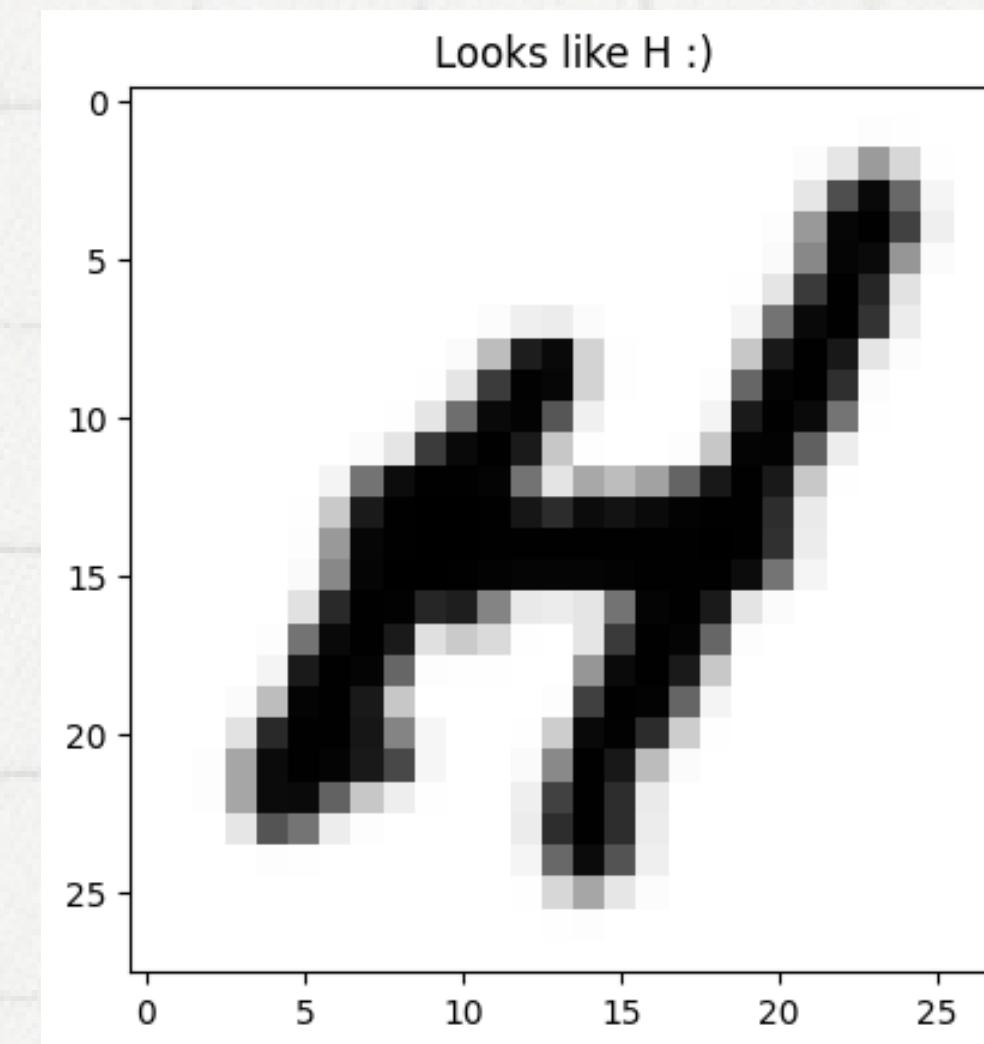
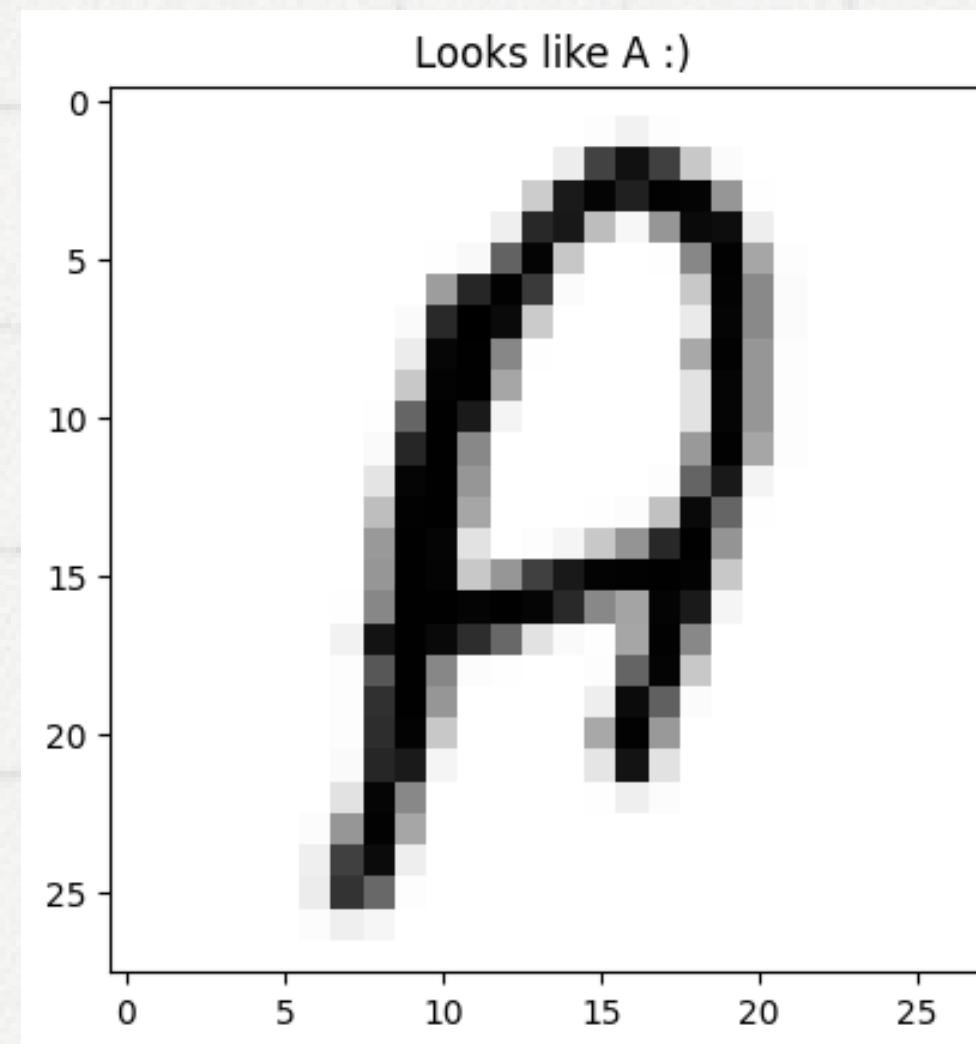
$$f'(x) = \frac{d}{dx} \ln(1 + e^x) = \frac{1}{1 + e^x} \cdot e^x$$

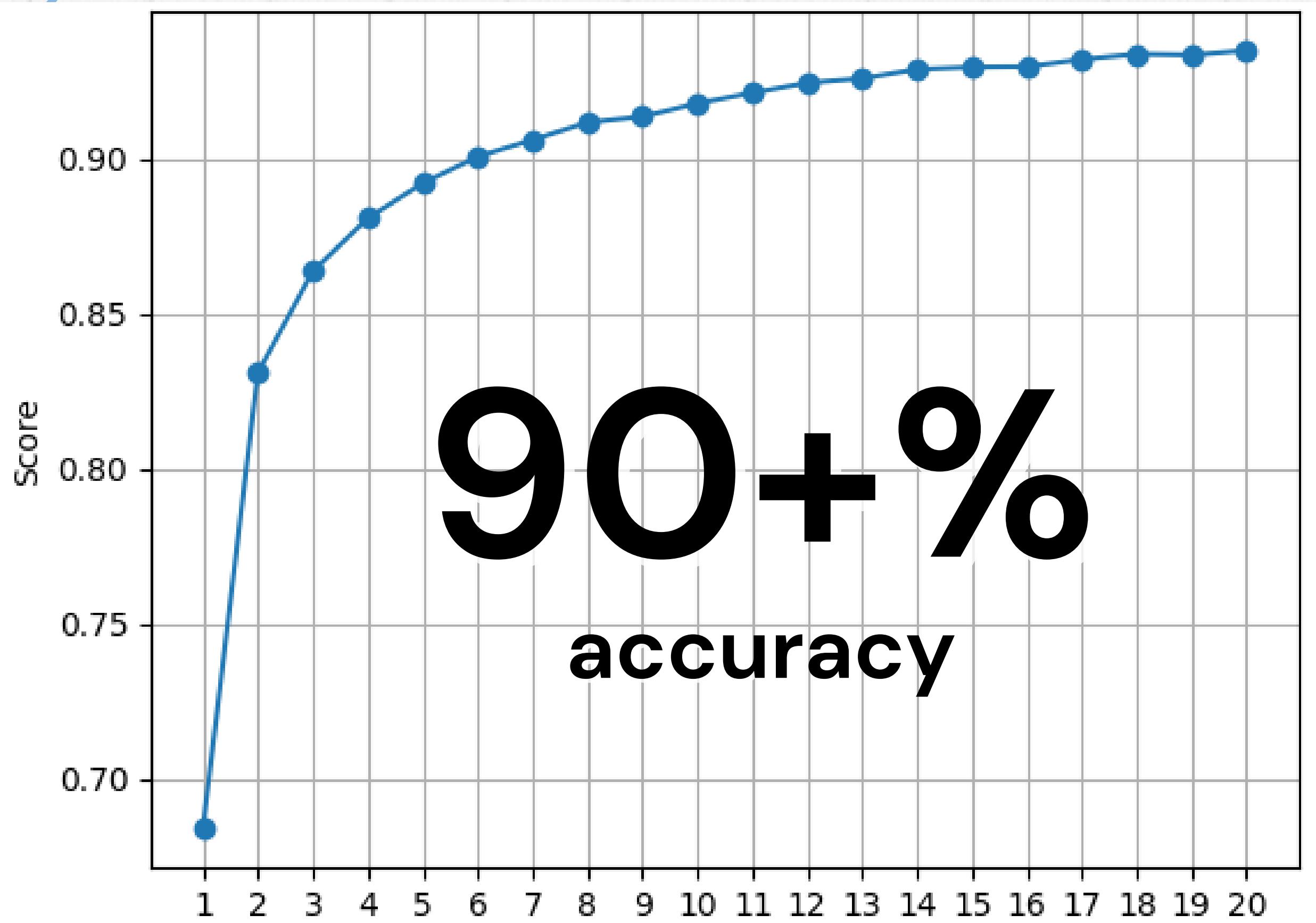
In forward propagation each layer has then been activated by Softplus activations.

Softplus is a smooth approximation to the ReLU activation function. Through Softplus we dealt with the "vanishing" gradient problem in the back propagation.

Experiments and Results

Our experiments were aimed at increasing the rate of accuracy during training and giving correct classifications during testing.





**Thank you
very much!**