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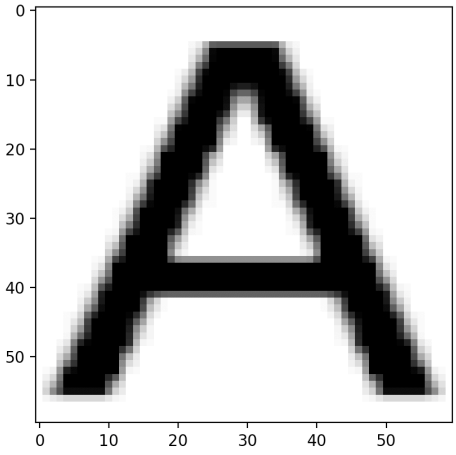
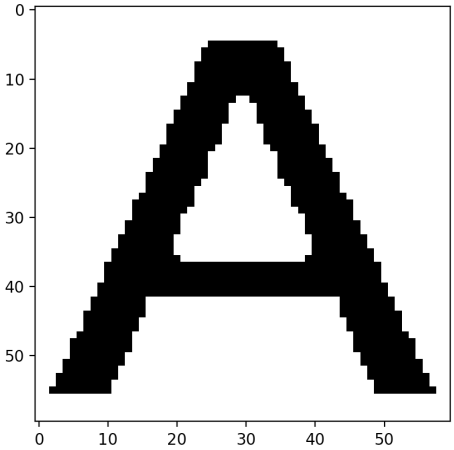
Neural Networks and Deep Learning

Homework #1: Classification with Single Layer Neural Networks

Part A: Discrete-neuron Perceptron

for this part, first i convert all PNG images into bipolar values of +1 for white and -1 for black pixels.





[0-255] {1, -1}

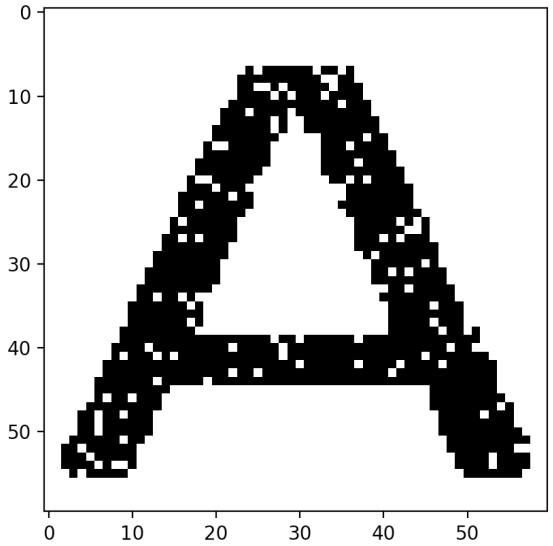
for this part, my output 26 length bipolar vector, if data is from class 1 output vector is [1, -1, -1, …] . and inputs are 3600 vector with data {1, -1} after that i Train the Neural Network model using the training data with the help of continuous-neuron Perceptron algorithm. then i classify the test letters. To examine the generalization ability, i use leave-one-out cross validation (LOOCV) method and the accuracy is:

To

```
percent of correct prediction 92.6923076923077
error 0.013313609467455627
```

to examine its robustness to noise, i train the network using all training letters and then test it using degraded training letters with 15% and 25% of noise and this is the result

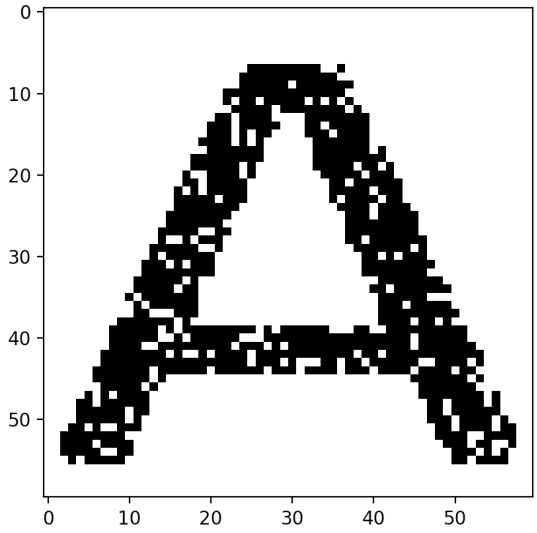
15% noise data(15% of black pixels converted to white pixel):



result:

```
accuracy 15 % noise is 94.03846153846153 %
```

25% noise data(25% of black pixels converted to white pixels):



result:

```
accuracy 25 % noise is 87.5 %
```

Part B: Continuous-neuron Perceptron:

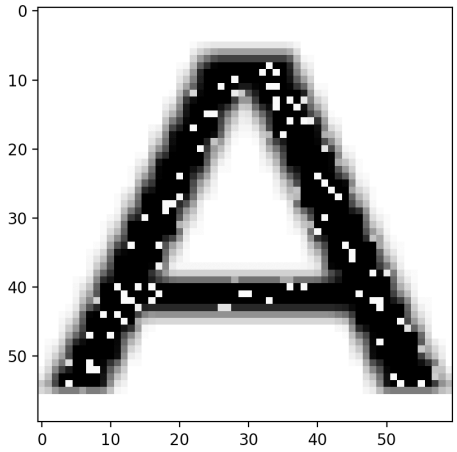
for this part, my output 26 length bipolar vector, if data is from class 1 output vector is [1, -1, -1, …] . and inputs are 3600 vector with data [0,255]. to train this part i use delta rule with this activation function:

Bipolar sigmoid so $\Delta w_i = \alpha\, t - y\, (1 - y^2) x_i$

```
err 0.0154142581888246 73
accuracy 90.5587668593449
```

to examine its robustness to noise, i train the network using all training letters and then test it using degraded training letters with 15% and 25% of noise and this is the result:

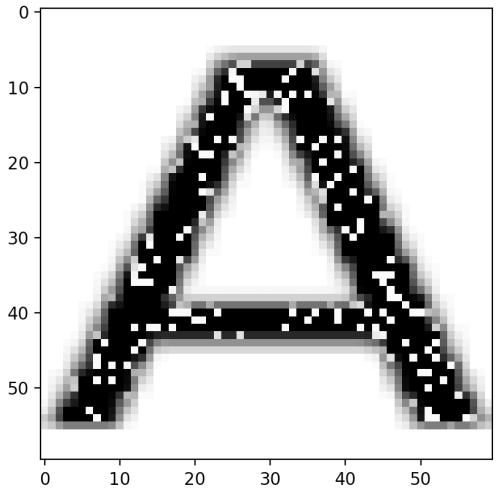
the 15% noise data:



result:

```
accuracy 15 % noise is 90.76923076923077 %
```

the 25% noise data:



result:

```
accuracy 25 % noise is 76.34615384615384 %
```