

# Neural Network Programming Assignment 1:

## *Image Decryption by a Single-Layer Neural Network*

### **Introduction**

An image was encrypted using two key images and the original image using the equation

$$E = w_1K_1 + w_2K_2 + w_3I$$

where  $K_1$  and  $K_2$  are the key images,  $I$  is the original image to be encrypted, and  $[w_1, w_2, w_3]$  is the weight vector to produce an encrypted image  $E$ .

Given an encrypted image  $E$ , a simple single layer neural network is used to calculate the weight vector.

Use the derived weight vector to decrypt an image.

### **Training Samples**

The training data,  $K_1$ ,  $K_2$ , and an encrypted image  $E$  were given as test data.

### **Program parameters**

maxIterLimit = 20  
epsilon = 0.00000001  
alpha = 0.00001  
epoch = 1

**maxIterLimit:** defines the maximum number of epochs the program is allowed to run.

**Epsilon:** is the vigilance level for checking the convergence of weight vectors. (allowed error difference)

**Alpha:** is the learning rate.

**Epoch:** is one iteration of the program

## **Derived Weight Vector**

$W = [ \quad 2.491433e-01 \quad \quad 6.613819e-01 \quad \quad 8.923952e-02 \quad ]$

## **Decrypted image**



## **Problems encountered**

The largest problem encountered during this assignment was setting up and learning how to run Python. Most of the guides on the internet use the Linux version of the installation and command line keywords by default so I wasn't aware that they could not work on Windows.

Another problem encountered was an issue where the image would get decrypted but the training data image,  $I$ , would be a part of that image.



The problem was due to an error in the training algorithm code where the current  $w$  vector ( $k$ ) was updated instead of the next one ( $k+1$ ).

## **Experience**

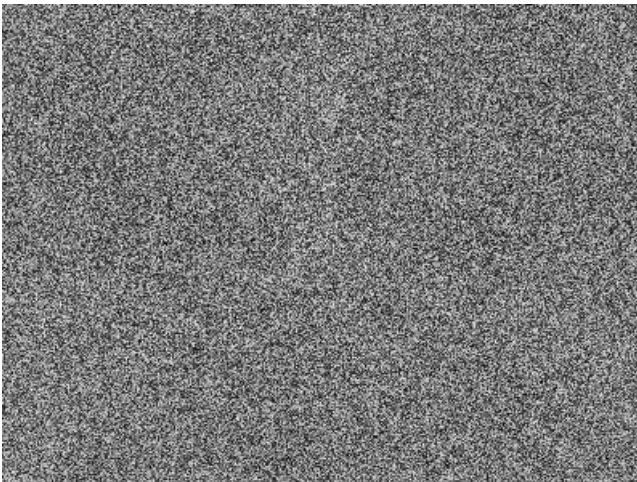
From this assignment I learned a lot. I am now more comfortable using Python and learned how to use image related libraries. The assignment also helped me to understand a little better how training algorithms work. Also, since I usually programmed in IDE's, learning to use the command line to install libraries, other software, and to run code was also a great experience.

As practice and to gain more experience with Python, I also used the derived  $w$  and wrote code to encrypt images of the same dimension as the keys.

Original image, I3



Encrypted image, E3



Decrypted image, I3prime

