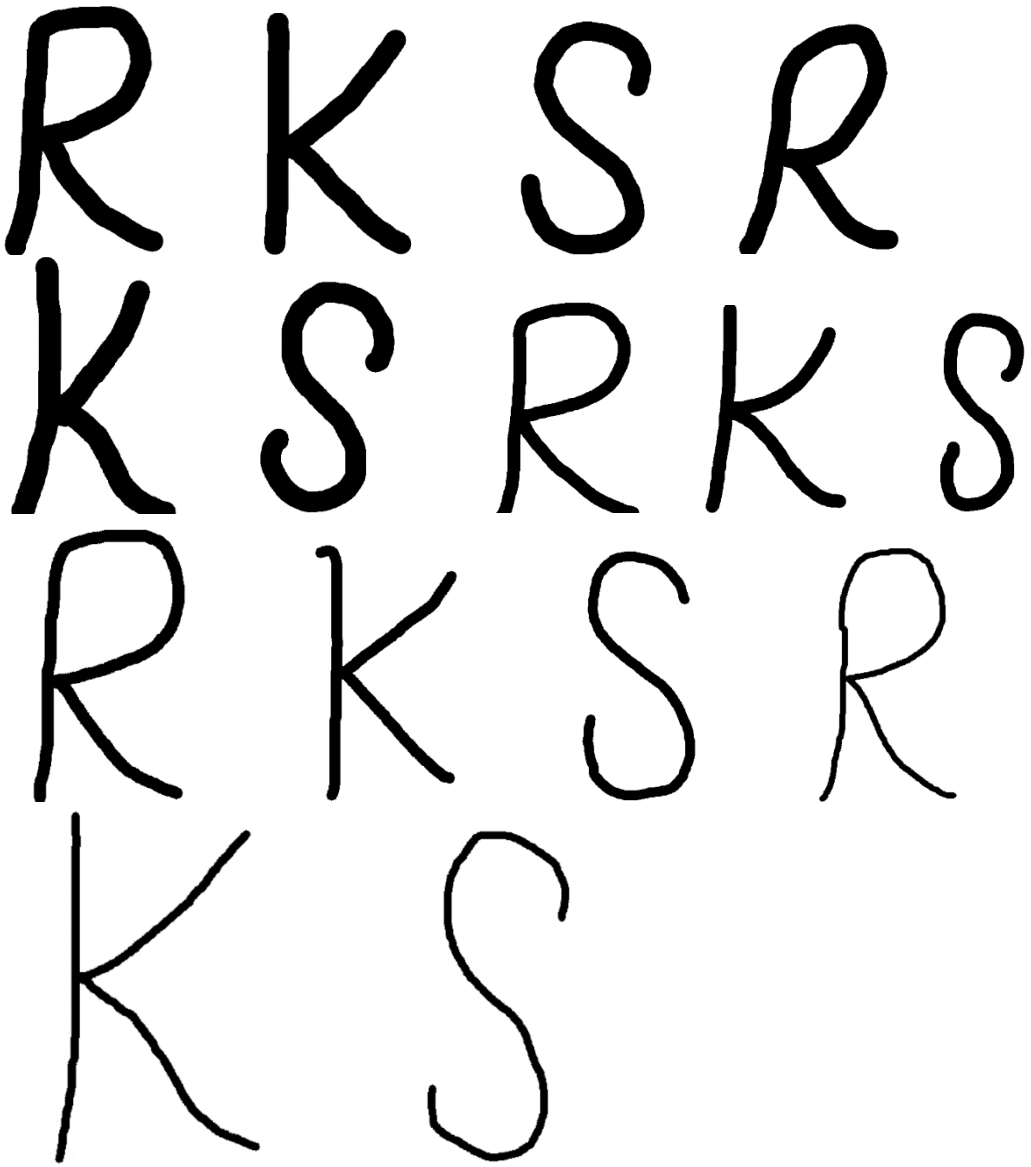
Neuro Fuzzy techniques – Assignment 1

By- Rishu Kumar(BT18CSE060)

Learned Input Images:

These are the sample images of the training input given to the NN.

(Initials were taken to be R, K, S).



Input feature vectors:

I am only showing the input feature vector for one set of 3 inputs (1 for R, 1 for K, 1 for S)

R : [1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1]

K : [1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1]

S : [1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1]

Architecture of NN:

The output makes predictions on 2 neural networks, one having single hidden layer and another one having 2 hidden layers, the input, hidden and output nodes can be specified by the user during runtime. The number of input nodes both NN's have is 100, and the output nodes are 3. The activation function used in the network is the sigmoid function.

Number of layers: 1,2

Activation Function : Sigmoid Function

Hidden Layer nodes: User defined for the both the layers

No. of input nodes: 100

Hyperparameters of the NN:

The learning rates used for the predictions are variable, predictions can be obtained for every learning rate in the set **{0.01, 0.05, 0.1, 0.2, 0.4, 0.8}**. The number of epochs have a ceiling of **1000**. The threshold error value is taken to be **0.01**. As soon as any error value lesser than 0.01 is encountered, the NN is considered to be converged. If not, then it runs for 1000 epochs at max.

Testing of the Neural network:

I have used a total of **7** images for testing, for given of values of alpha. I am quoting the results for the 2 -layer neural net, with **alpha=0.2** here because the results are mostly the same for all alpha values, only the time to convergence and the number of epochs to convergence differ. Out of those **6** images**, 3** are from the test set itself, and 3 are different images which are not in the training set, but they are of the same letters which are seen by the neural network. The remaining image is of a letter which is not learned by the network. Following are the results I obtained:

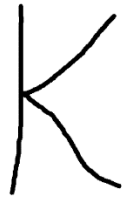
[1,0,0] implies "**R**"

[0,1,0] implies "**K**"

[0,0,1] implies "**S**"

From the training set:

(0.9937633340561 0.0060007254742 0.0015710645177097)



(0.009645233708463 0.9908635819258 0.004548447484444)

(0.004595947312662 0.005211885744835 0.9938894639839)

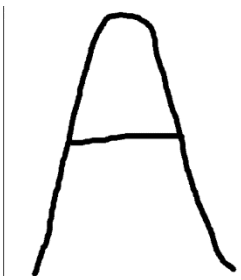
From the test set:

(0.9720037362843 0.063689838256 0.010701303069205)

(0.004600014140882 0.9892927411895 0.011945205839669)

(0.006141034005443 0.011960825120138 0.9810381478867)

RANDOM LETTER:



(0.009318990638515 0.4388451620363 0.28853513290748)

Conclusion:

The neural network was able to identify all the images it was trained for, identifying all 6/6 images of “R”, “K” and “S” correctly. Although, when presented with an input which is not known to it, it gives a random value to and taking round of that value gives [0, 0, 0].