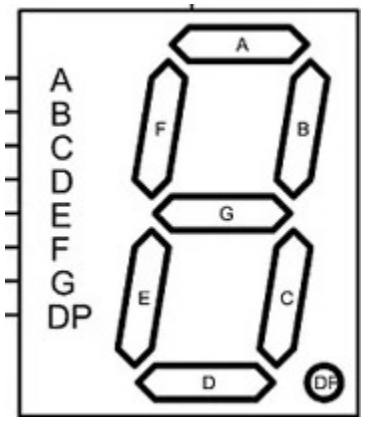
Assignment 5

Neural Network using Backpropagation on 7-Segment Display

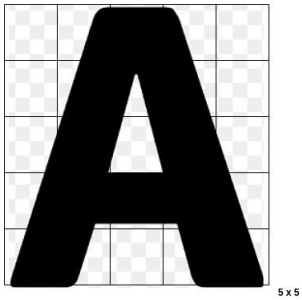
1. Implement backpropagation (BP) on feedforward perceptron neural network with 2 hidden layers for recognizing digits 0-9, assuming 7-segment display as input and outputs 1 when K (0…9) is input, else outputs 0. Use Sigmoidal activation function and MSE as loss function. See the input patterns below.
   (i) Examine effect of learning rate, hidden layers and nodes in each hidden layer.
   (ii) Study convergence by plotting loss vs. iterations.
   (iii) Perform N-fold cross validation for evaluating performance metrics (Accuracy, Specificity, Sensitivity, Precession, Recall, and F-Measure)



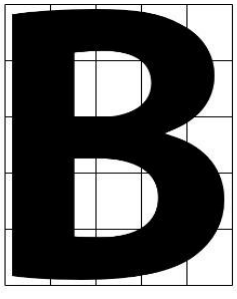
Decimal	7 Segment Code a b c d e f g
0	1 1 1 1 1 1 0
1	0 1 1 0 0 0 0
2	1 1 0 1 1 0 1
3	1 1 1 1 0 0 1
4	0 1 1 0 0 1 1
5	1 0 1 1 0 1 1
6	0 0 1 1 1 1 1
7	1 1 1 0 0 0 0
8	1 1 1 1 1 1 1
9	1 1 1 0 0 1 1

(b) Repeat the problem for A-Z Handwritten Alphabets using 5×5 grid structure. Use multiple patterns for each handwritten alphabet.

For example, a "simple" representation of 5x5 grid-based dataset for A and B alphabets might be:



0	1	1	1	0
0	1	0	1	0
0	1	0	1	0
1	1	1	1	1
1	0	0	0	1



1	1	1	1	0
1	0	0	0	1
1	1	1	1	0
1	0	0	0	1
1	1	1	1	0

'A': [0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1,1,1, 1, 1, 1,0, 0, 0, 1],

'B': [1, 1, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0]