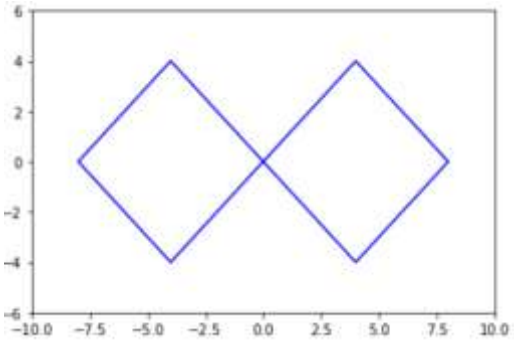
ICS 471, Term 201
Artificial Neural Networks and Deep Learning

HW# 2

Due date: Sunday, Oct. 4, 2020

We would like to design a MLP neural network to classify points whether they are inside the blue shape given below or not: Note that the coordinates of the points on the given shape are: (-8,0), (-4,4), (-4,-4), (0,0), (4,4), (4,-4), (8,0).

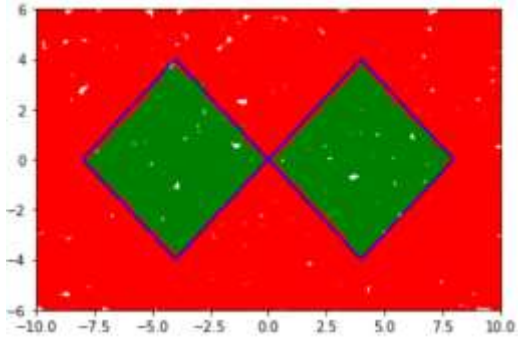


i. Design an MLP to classify the given decision boundary, assuming simple perceptron: $output = 1\ if\ \sum_i w_i x_i + b_i \geq 0$. Clearly show the used weights and biases. (10 points)

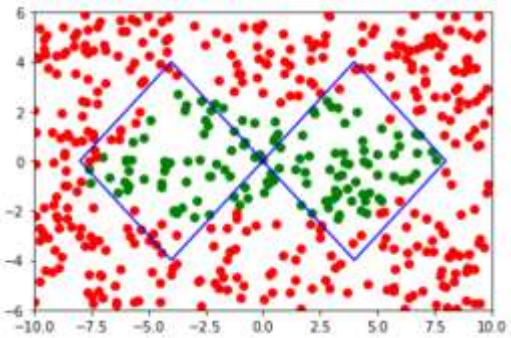
ii. Model your designed MLP in (i) using the derived weights and biases. (5 points)

iii. Generate a training set of 10,000 samples, validation test of 500 samples, and test set of 500 samples. The x-axis ranges from -10 to 10 and the y-axis ranges from -6 to 6. Your generated samples should be within this boundary. (5 points)

iv. Test your model in (ii) using the generated training, validation, and test sets. You should get 100% accuracy. Plotting the training set should show a figure similar to the one below. (5 points)



v. Build an MLP network with 2 inputs, a single hidden layer with 8 neurons, and 2 outputs using ReLU activation function for the hidden layer. Train your network using SGD, with learning rate = 0.01, for 10,000 iterations, and using nn.CrossEntropyLoss(). Report the training and validation losses and training and validation accuracies. Also plot the classification results of the test samples. You should get a figure similar the one shown below. (10 points)



vi. Repeat step (v) using 50 neurons in the hidden layer. Compare the results you got with the model in (v). Also plot the classification results of the test samples. (5 points)

vii. Build an MLP network with 2 inputs, first hidden layer with 8 neurons, second hidden layer of 2 neurons and 2 outputs using ReLU activation function for the hidden layers. Train your network using SGD, with learning rate = 0.01, for 10,000 iterations, and using nn.CrossEntropyLoss(). Report the training and validation losses and training and validation accuracies. Also plot the classification results of the test samples. Compare the obtained results against those obtained in (v) and (vi). (10 points)