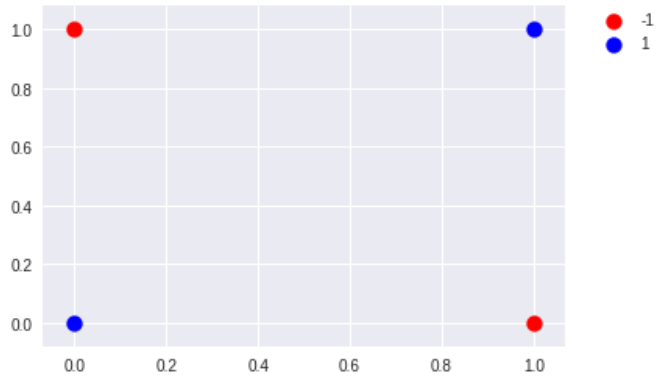
ECE194N HW2
Deren Lei
derenlei@umail.ucsb.edu

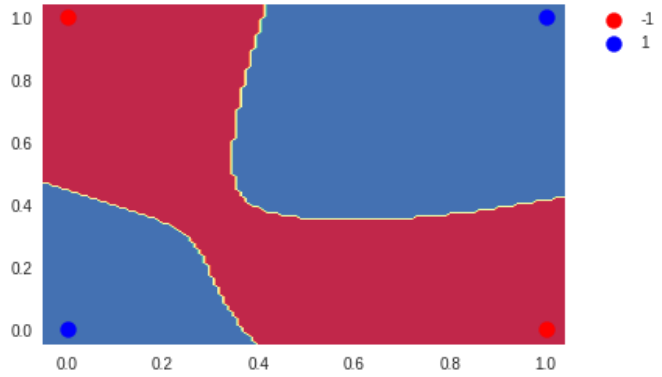
Question 1 (XOR)

(a)



(b) I implement the neural network with 4 layers: 1 input layer, 2 hidden layer both with 4 neurons and 1 output layer. The input layer has 2 neurons because each point has 2 values (x and y). The output layer has 2 neurons because the label is converted to one hot representation. Index 0 represent class 1 and index 1 represents class -1. The loss function I choose are tanh except the output layer which is sigmoid since the output layer should be the probability of each label. I set the hidden layer in this form after seceral experiments and this one has a relatively better classification region when visualizing it. The loss function is cross-entropy loss. It measures the performance of a classification model whose output is a probability value between 0 and 1. Cross-entropy loss increases as the predicted probability diverges from the actual label.

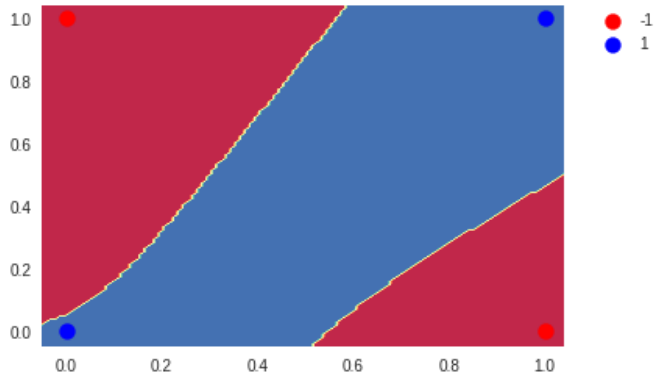
(c)



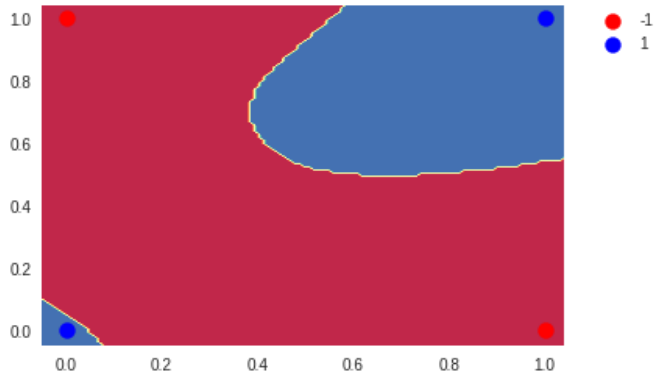
The visualization of the final classification regions on the 2 dimensional space is above. I first calculate the minimum of x and y and maximum of x and y in the training data with a padding of 0.05. The create data staring from (min(x)-0.05, min(y)-0.05) to (max(x)+0.05, max(y)+0.05) with a increase of 0.01 for each point. In other words, it roughly calculated the label of all the points that could show on the board. If its -1, mark it as red; if 1, mark it as blue.

(d)

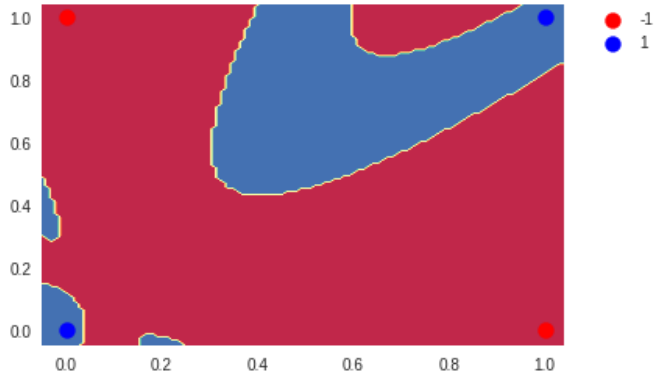
Classification region with sigma = 0.5:



Classification region with sigma = 1:



Classification region with sigma = 2:



When sigma = 0.5, the classification region is acceptable even though it's not as accurate as training without noise. When sigma increases to 1 and 2, the classification region starts to become unreasonable shape. It happens because the model starts to overfiting the training data since there are too much nosie in the training data. The capability of generalization starts to decrease as sigma increases. Modifying the number of layers and neurons could slightly help.