EE583 Pattern Recognition HW1

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Question 1

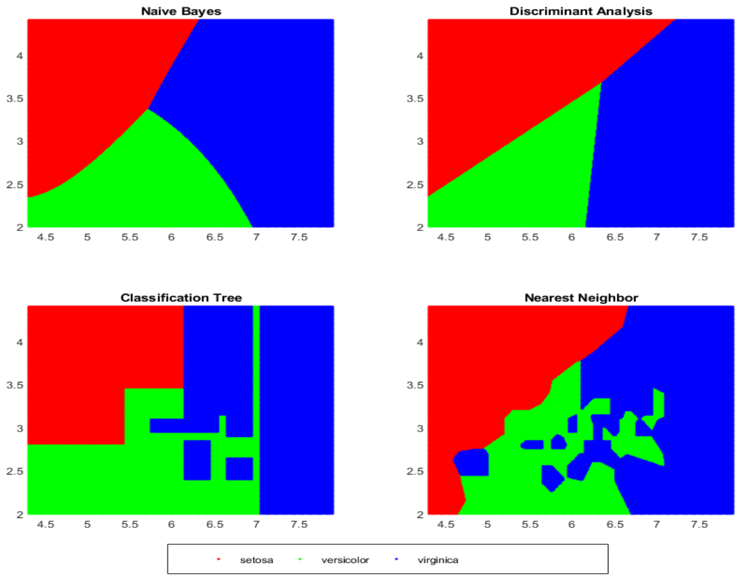
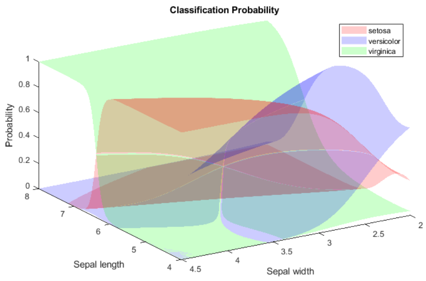


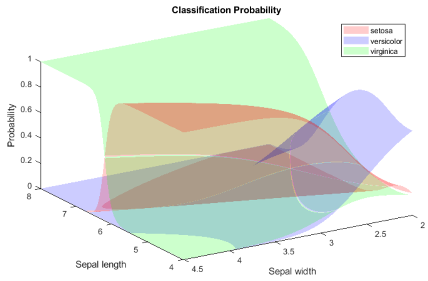
Figure 1: Decision boundaries for flower classes

In Figure 1, boundaries of 4 different classifiers are shown. Boundaries of Nearest Neighbors and Classification tree seem to overfit the data, *i.e.*, it memorized the training data and boundaries have high variability to fit it. On the other hand, the boundaries of the remaining classifiers show that they are better at generalizing, *i.e.*, they make better statistical inferences on the data that model has never seen, test data. In addition, Discriminant Analysis classifier has almost linear decision boundaries, in contrast to Naïve Bayes.
I would choose Naïve Bayes classifier in such a classification task. Although it has comparable performance with Naïve Bayes for class **setosa**, the decision boundary between the remaining two classes is represented better by the Naïve Bayes classifier in terms of generalization.

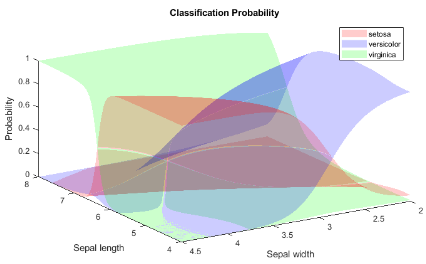
Question 2



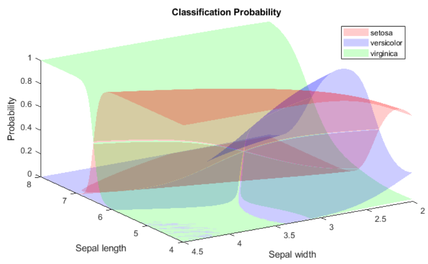
(a) Prior Probabilities = 0.33,0.33,0.33



(b) Prior Probabilities = 0.10,0.15,0.75



(c) Prior Probabilities = 0.10,0.75,0.15



(d) Prior Probabilities = 0.75,0.10,0.15

Figure 2: Posterior probabilities based on different priors

$$p(w_j|x) = \frac{p(x|w_j)P(w_j)}{p(x)} \tag{1}$$

Considering the posterior distribution given in Eqn. 1, the value gets bigger for a fixed class and feature vector when prior probability of a class, $p(w_j)$ is increased. Hence, it is investigated that the portion of the feature space where class setosa gets the probability of 1 largely increased when figures a and d are compared. Same observation can also be made for versicolor class in the comparison of figures b and c.

Question 3

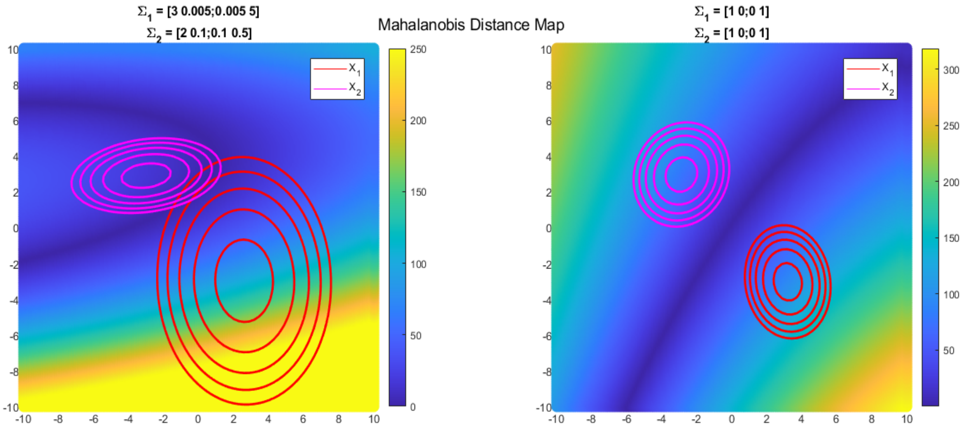
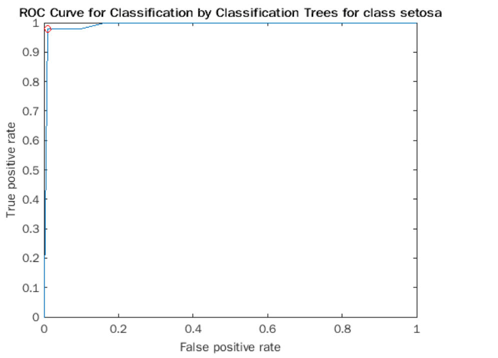


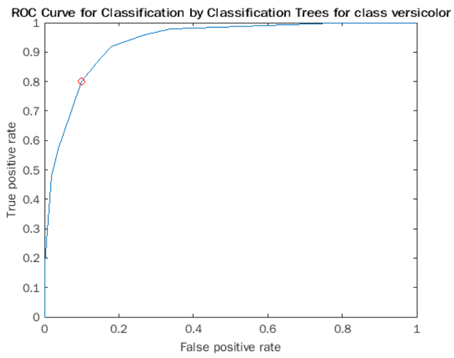
Figure 3: Mahalanobis Distances for 2 normal distributions

For the given covariance matrices in Figure 3, Mahalanobis distances are plotted to the background of the figure. The boundary where Mahalanobis distance is around 0 is observed to have a quadratic shape, whereas it is almost linear in the plot on the right.

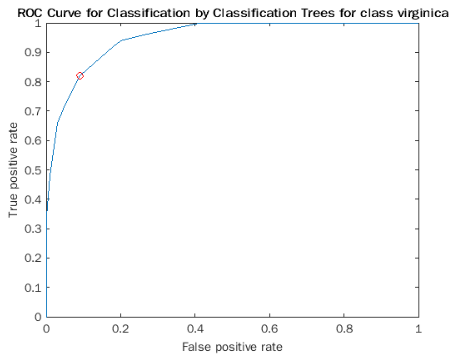
Question 4



(a) ROC1



(b) ROC2



(c) ROC3

Figure 4: ROC curves for different class predictions