2 Bayesian Classification

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Group-16

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Contents

1 Bayesian Classifier

Consider the data consists **C** different number of classes, each class consist **N** number of Data Points, each data point is **d-dimensional** feature vector.Each class is having some prior probability associated with them.Prior Probabilty we can specify for each class based on data,in most of the cases we will assign prior probability for classes equally.**Bayesian Classifer** uses **Bayes Rule** to classify the Data points.Bayesian Classifier represents the whole class using single Probability Guassian disturbution X $\sim \mathcal{N}(\vec{\mu}, \vec{\sum})$.

$$P(X/C) = \frac{1}{\sqrt{2\pi}|\sum|^{\frac{d}{2}}} \exp\left[-\frac{1}{2}\left(\vec{x}-\vec{\mu}\right)^t \sum^{-1}\left(\vec{x}-\vec{\mu}\right)\right] \qquad (1)$$

Figure shows the how we are representing the total data points using Gaussian Distrubution.

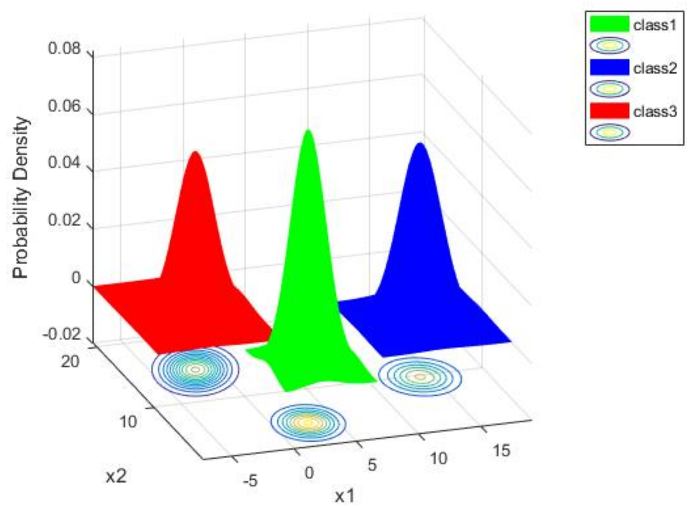

Figure 1: Gaussian Distribution

1.1 Linearly Separable Data

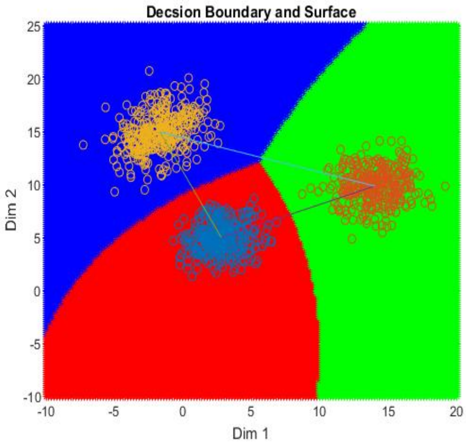

Figure 2: Decision Boundary case 2

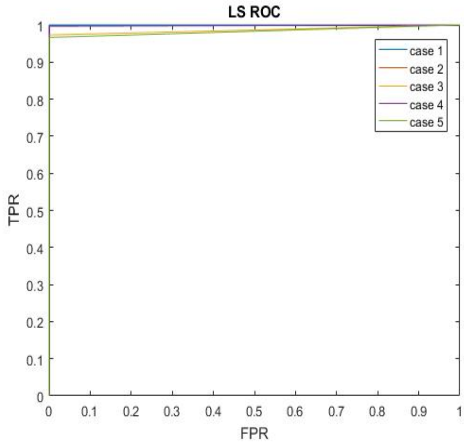

Figure 3: ROC

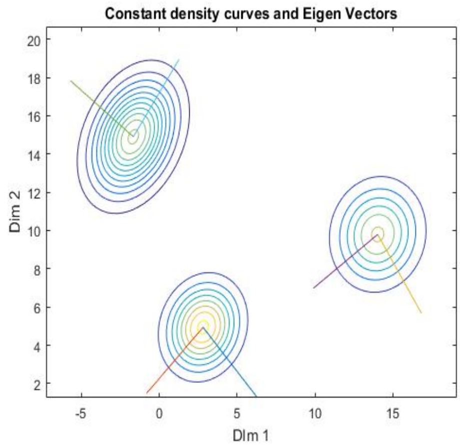

Figure 4: Contour Plot case 2

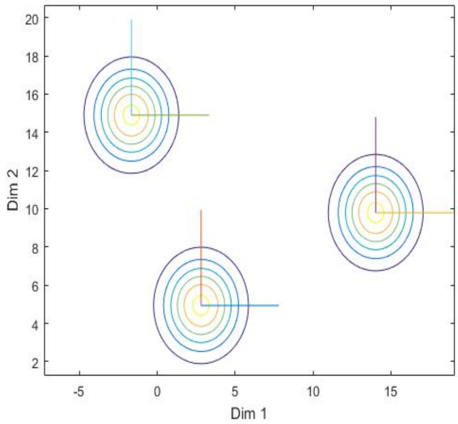

Figure 5: Contour Plot case 3

1.2 Non-Linearly Separable Data

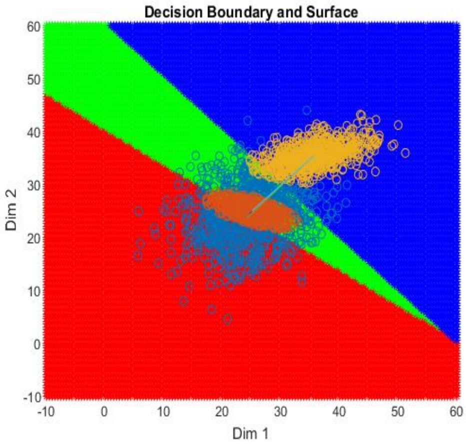

Figure 6: Decision Boundary case 3

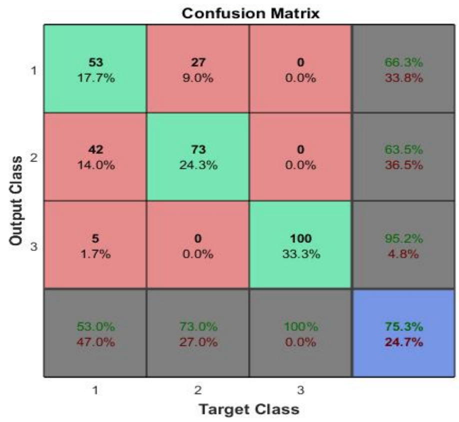

Figure 7: Confusion Matrix case 1

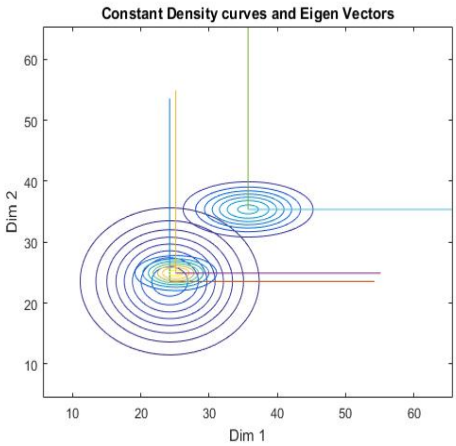

Figure 8: Counter Plot case 5

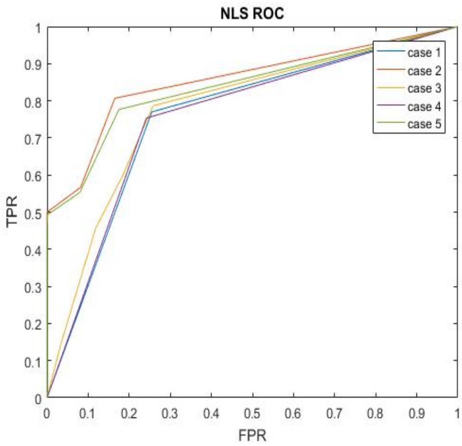

Figure 9: ROC

1.3 Real Data

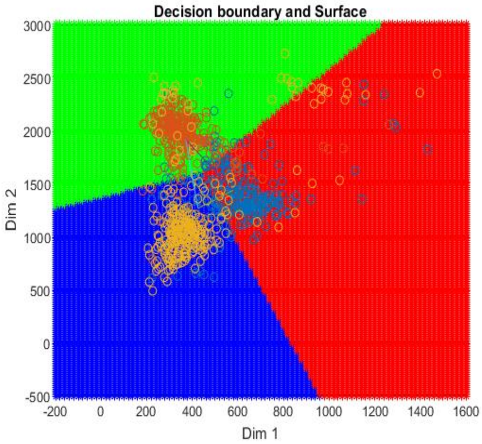

Figure 10: Decision boundary case1

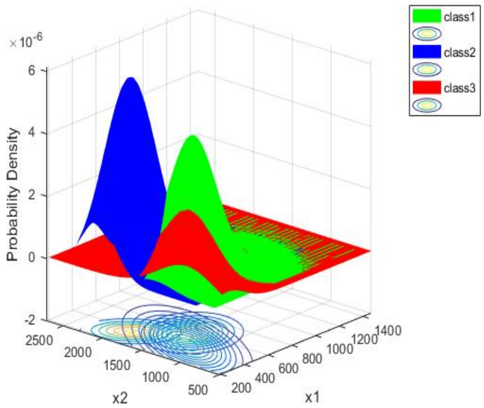

Figure 11: PDF case 2

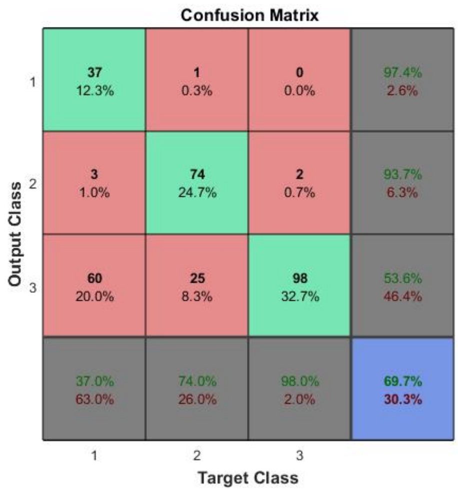

Figure 12: Confusion matrix case 2

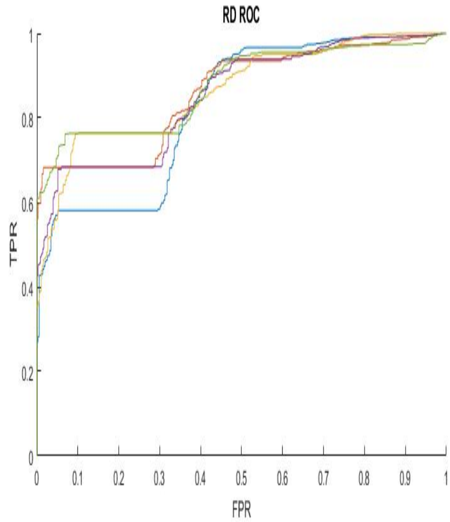

Figure 13: ROC

Decision Boundary:

Decision boundary between two classes can be found out by equating thier discriminant function. i.e., g1(x)-g2(x)=0

1. If covariance matrix of both the classes are same then we will get a straight line as the decision boundary.
2. If covariance matrix of both the classes are different then we will get a 2nd degree curve as the decision boundary.

Constant Density Curves:
A Constant density curve consist of those set of points which have same PDF values for a given class. 1. If variance of both the feature vectors of a class is same then Constant Density Curves will be circles 2. If variance of both the feature vectors of a class is different then Constant Density Curves will be ellipses The axis of these circles and ellipses are nothing but eigen vectors of covariance matrix of that class. Also these eigen vectors will be orthogonal to each other. The center point of these curves is mean of both the feature vectors as x and y coordinate respctively. Therefore, these eigen vectors are orthogonal only if we shift our origin to center of these cuves.

ROC: Receiver Operating Characteristics Curve is plot between Sensitivity and 1-Specificity.The more the area under the curve , means the model is trained better.