Pattern Recognition

CS669

ASSIGNMENT 5

Group Number 18

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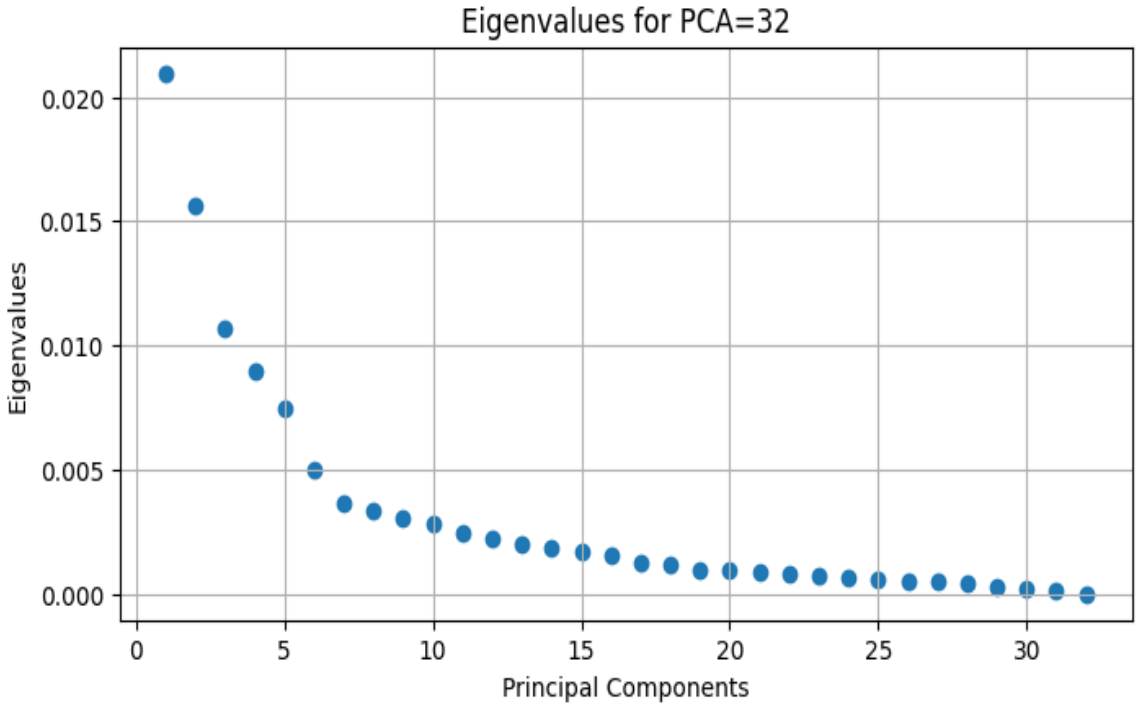
1. **Build Bayes classifier using Gaussian mixture model (GMM) with 1, 2, 4 and 8 mixtures on the reduced dimensional representations of Dataset-2 obtained using PCA. • Perform the experiments on different values of l (including l=1), the reduced dimensions in PCA.**

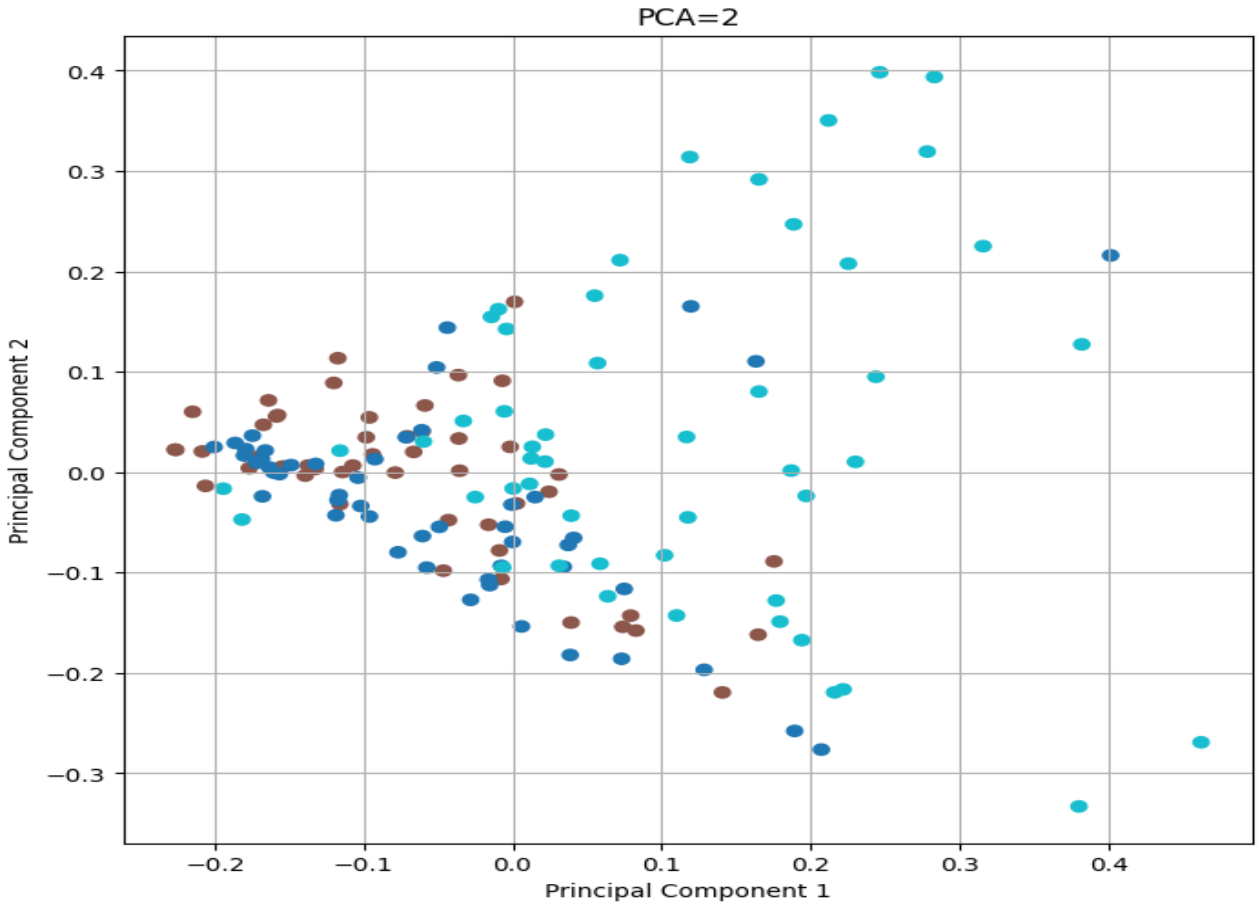


Plot of eigenvalues in ascending order during PCA

Inference from the graph:

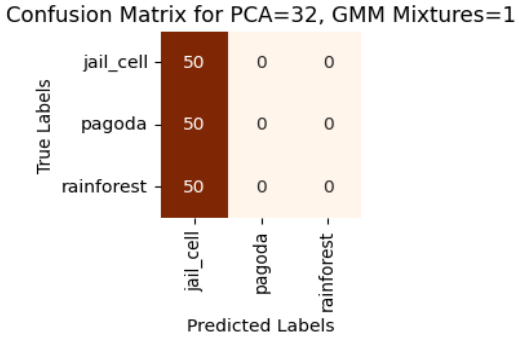
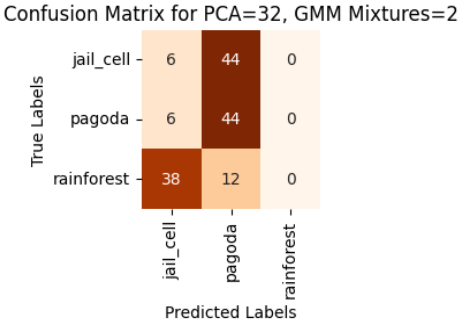
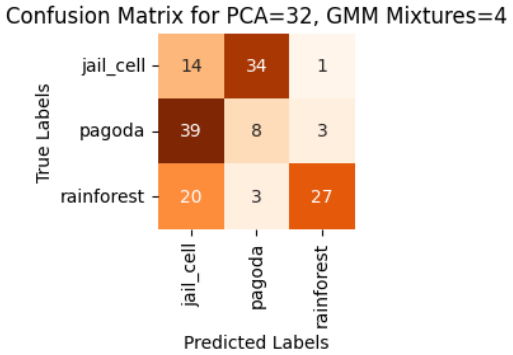
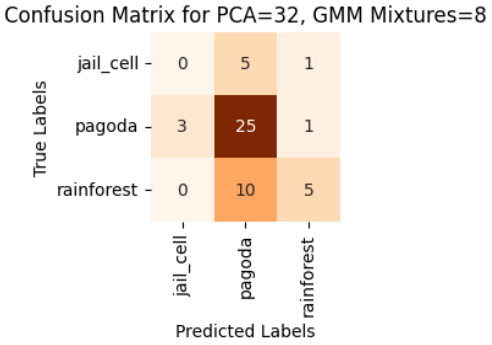
- 20 seems to be the ideal number of principal components for us to represent the 32 dimensional original data to a lower dimension while retaining as much variance as possible.
- Since we need to consider distinct values of the lower dimensions/principal components hence the graph does not have a continuous line, it has a discrete nature.

Plot of 2-dimensional reduced dimensional representations using PCA.

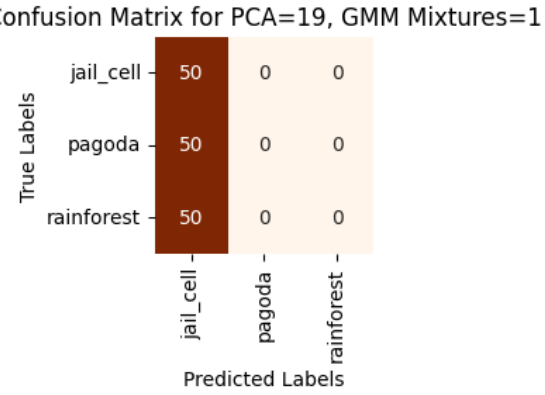
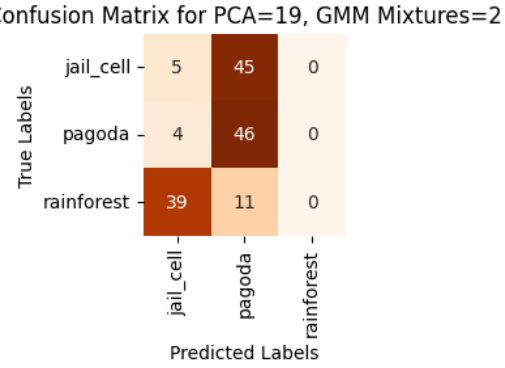
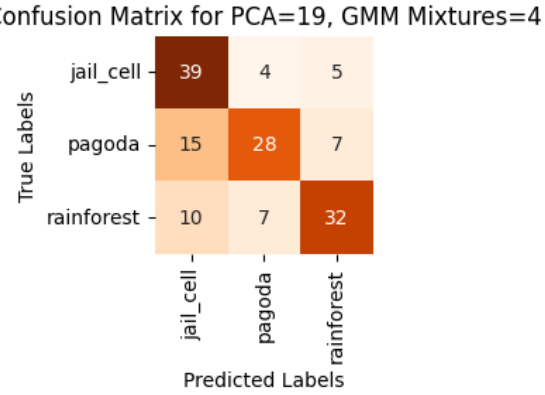
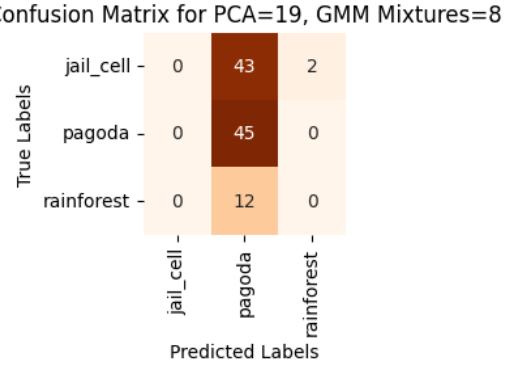


- **Results and Observations for the different number of principal components:**

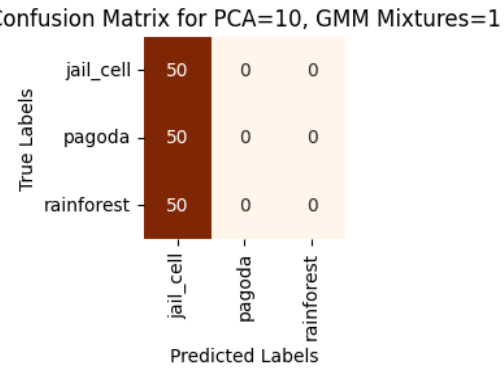
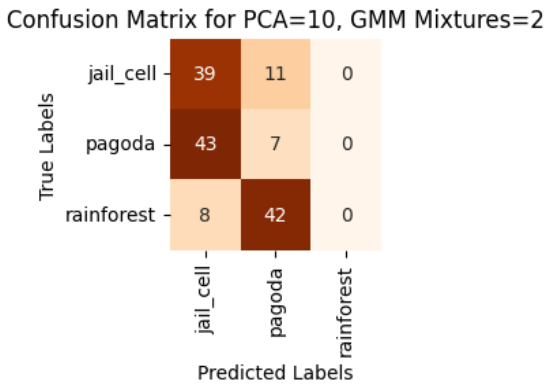
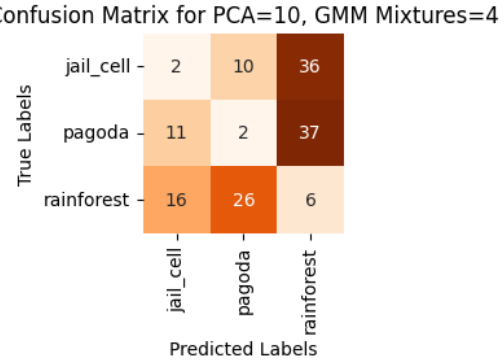
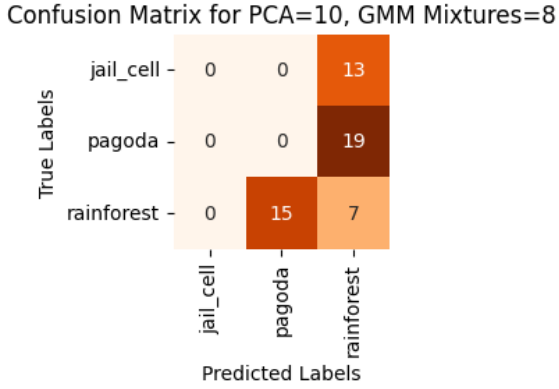
A) PCA components = 32

GMM = 1	**GMM = 2**
Accuracy = 0.33 Precision = 0.77 Recall = 0.33 F1 Score = 0.16 	Accuracy = 0.33 Precision = 0.52 Recall = 0.33 F1 Score = 0.23 
GMM = 4	**GMM = 8**
Accuracy = 0.32 Precision = 0.41 Recall = 0.32 F1 Score = 0.35 	Accuracy = 0.20 Precision = 0.44 Recall = 0.20 F1 Score = 0.57 

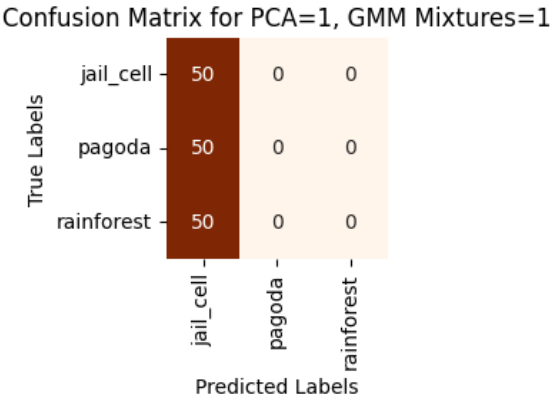
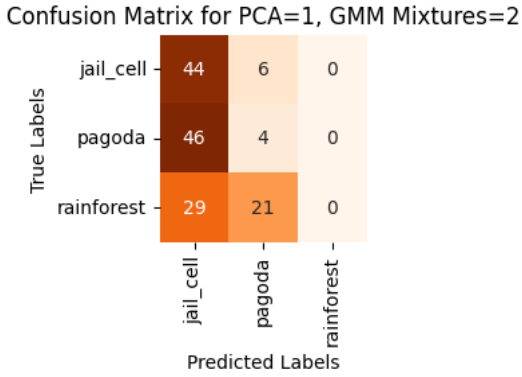
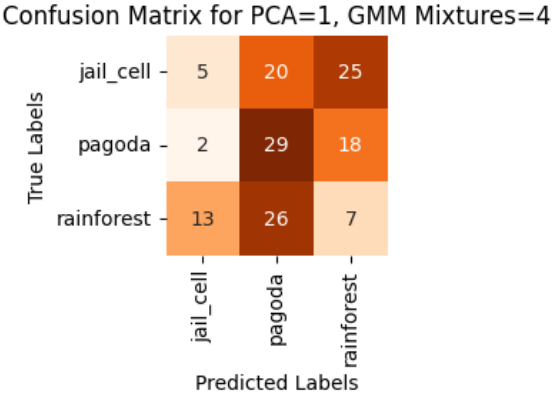
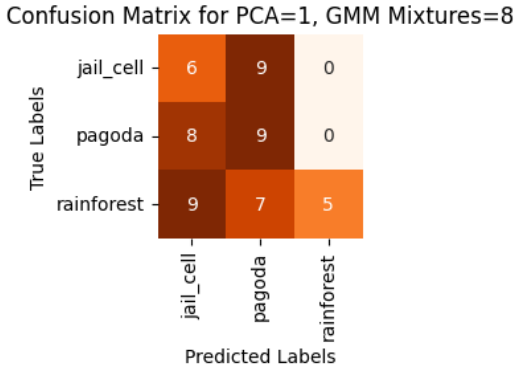
B) PCA components = 19

GMM = 1	**GMM = 2**
Accuracy = 0.33 Precision = 0.77 Recall = 0.33 F1 Score = 0.16 	Accuracy = 0.34 Precision = 0.51 Recall = 0.34 F1 Score = 0.23 
GMM = 4	**GMM = 8**
Accuracy = 0.66 Precision = 0.68 Recall = 0.66 F1 Score = 0.66 	Accuracy = 0.3 Precision = 0.48 Recall = 0.3 F1 Score = 0.53 

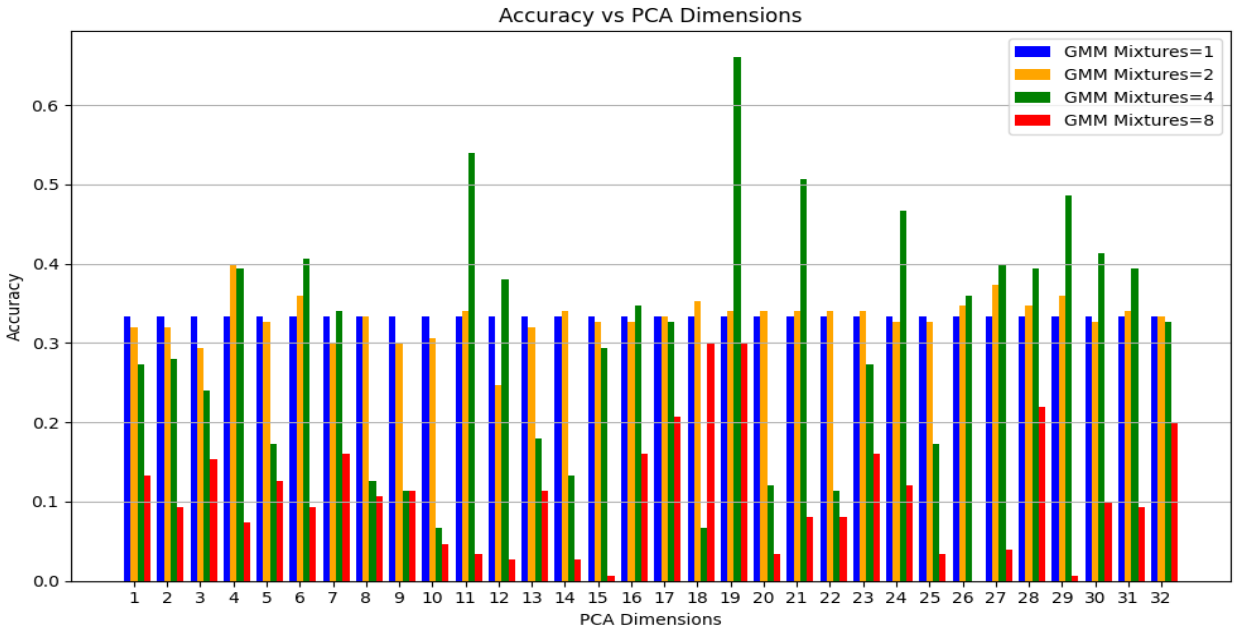
C) PCA component = 10

GMM = 1	GMM = 2
Accuracy = 0.32 Precision = 0.49 Recall = 0.32 F1 Score = 0.20 	Accuracy = 0.30 Precision = 0.51 Recall = 0.30 F1 Score = 0.22 
GMM = 4	**GMM = 8**
Accuracy = 0.06 Precision = 0.065 Recall = 0.066 F1 Score = 0.063 	Accuracy = 0.046 Precision = 0.39 Recall = 0.0466 F1 Score = 0.38 

D) PCA component = 1

GMM = 1	**GMM = 2**
Accuracy = 0.33 Precision = 0.77 Recall = 0.33 F1 Score = 0.16 	Accuracy = 0.32 Precision = 0.49 Recall = 0.32 F1 Score = 0.20 
GMM = 4	**GMM = 8**
Accuracy = 0.27 Precision = 0.25 Recall = 0.27 F1 Score = 0.24 	Accuracy = 0.13 Precision = 0.54 Recall = 0.13 F1 Score = 0.19 

E) PCA components vs. Accuracy plots:



Maximum Accuracy	0.66
GMM Mixtures	4
PCA components	19

2. Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (a)

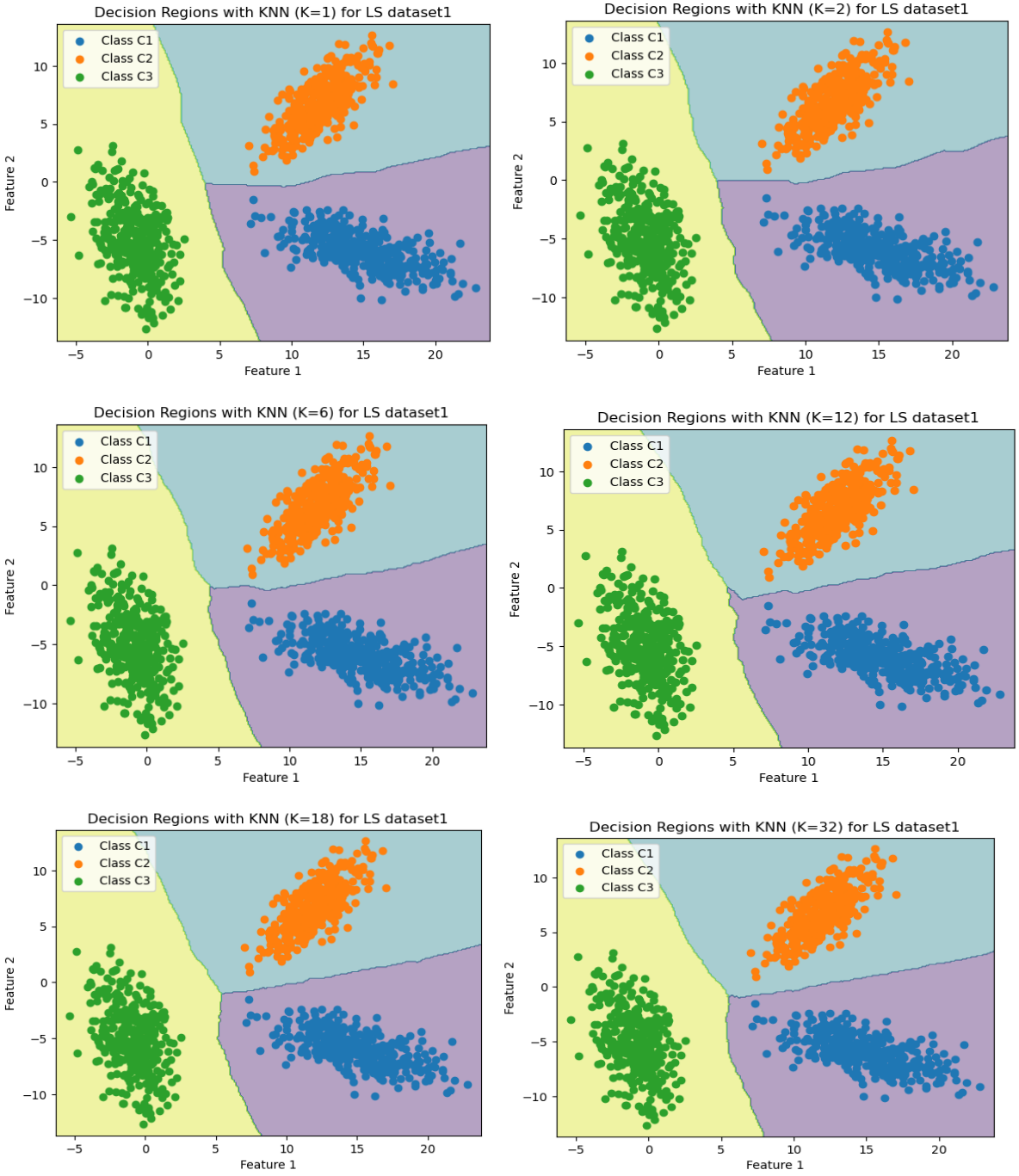
(a) LS data

Dataset description:

- Linearly separable dataset
- Total sample size: 1500
- Total classes: 3
- Samples in each class: 500
- Dimensionality: each point is 2D

Note: This data description will be valid and hence not mentioned again whenever LS dataset term is used in the report.

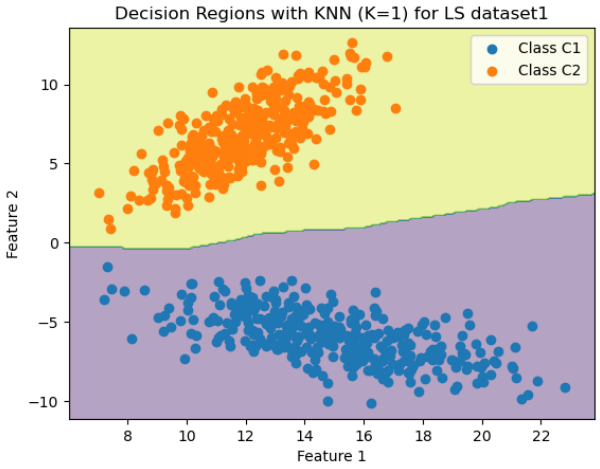
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (a)/ linearly separable dataset for class 1 Vs class 2 Vs class 3 as the values of k varies (1, 2, 6, 12, 18, 32).**

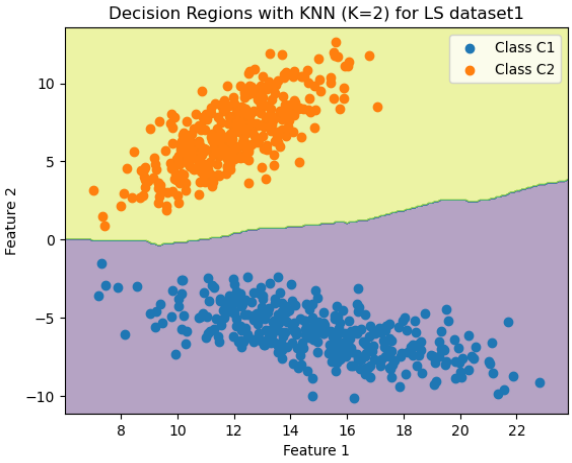


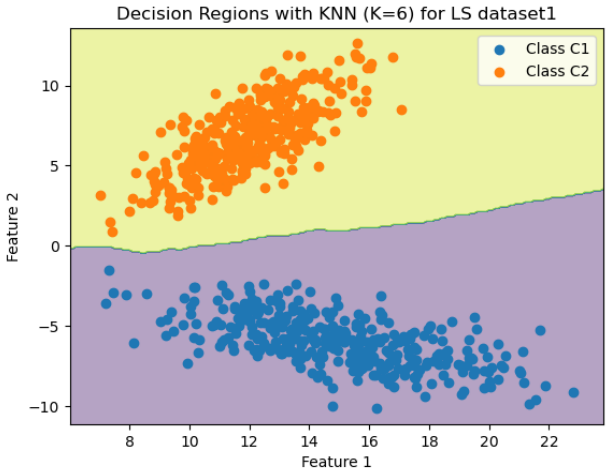
Inferences:

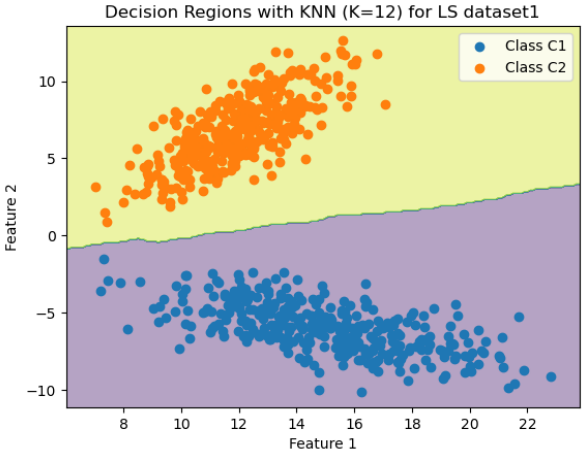
- At k=1 we have the decision boundary as the perpendicular bisector of the nearest points. Overall the shape is non linear but it is piecewise linear.
- As the k value increases the decision boundary between the classes becomes more smooth.

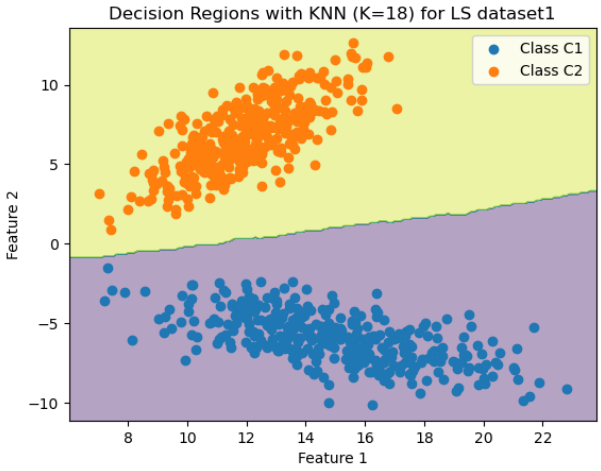
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (a)/ linearly separable dataset for class 1 Vs class 2 as the values of k varies (1, 2, 6, 12, 18, 32).**

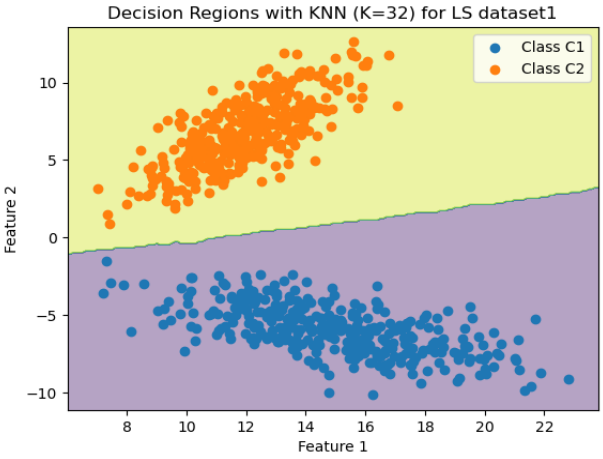




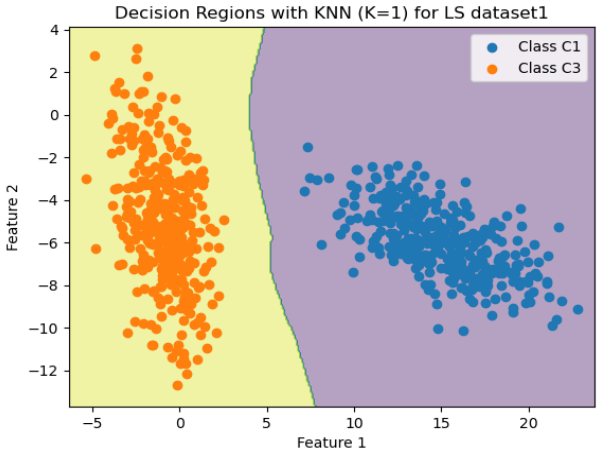


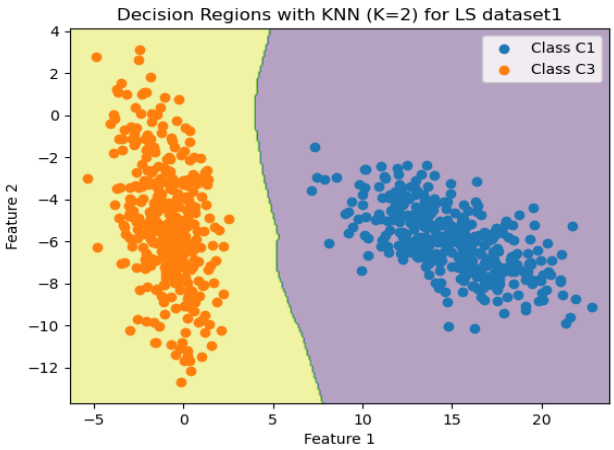


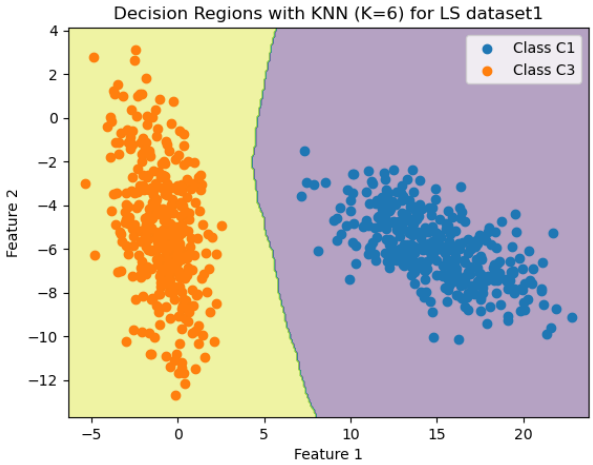


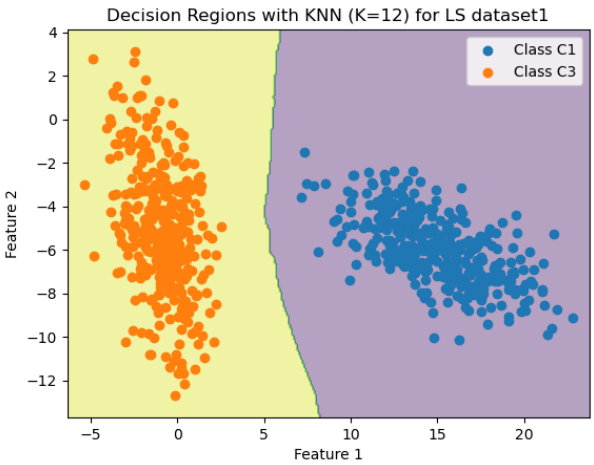


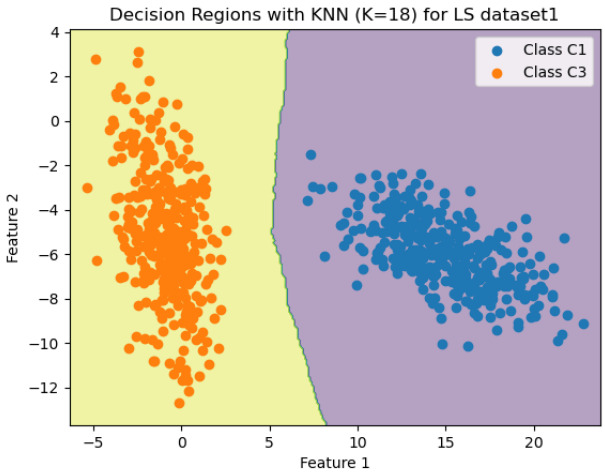
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (a)/ linearly separable dataset for class 1 Vs class 3 as the values of k varies (1, 2, 6, 12, 18, 32).**

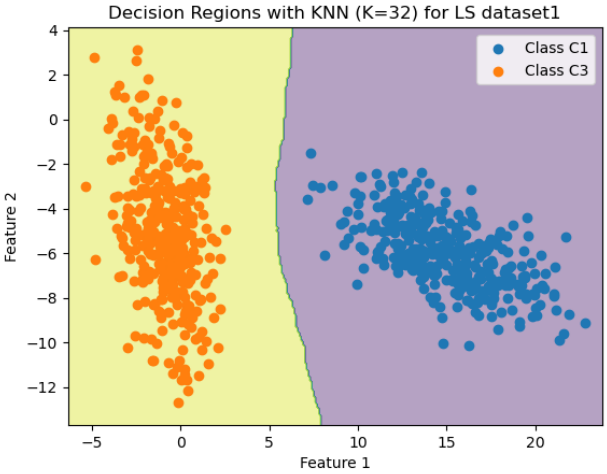




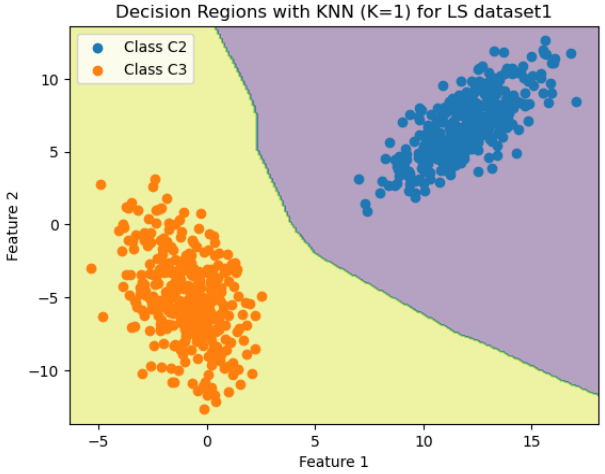


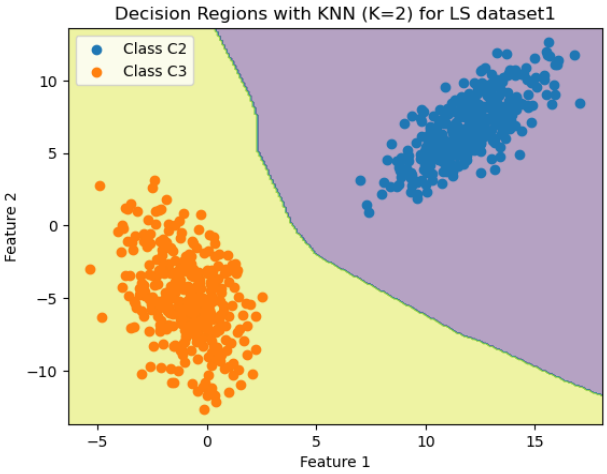


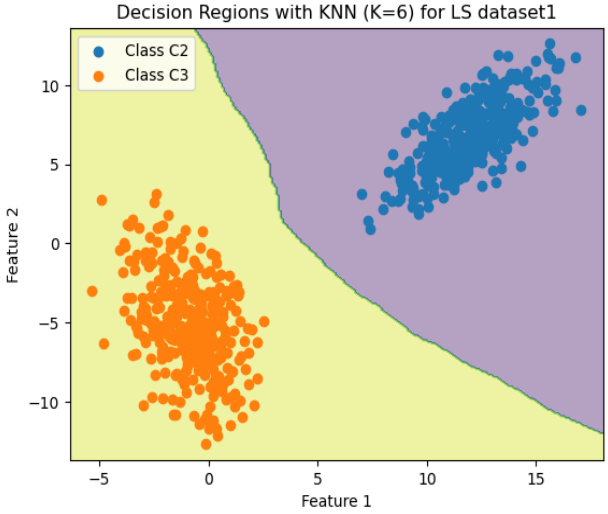


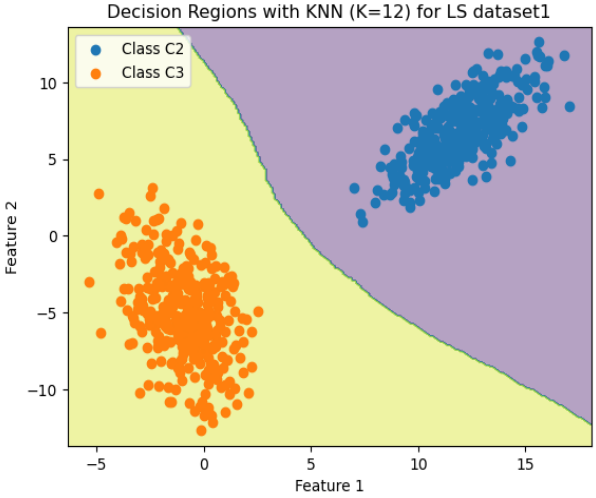


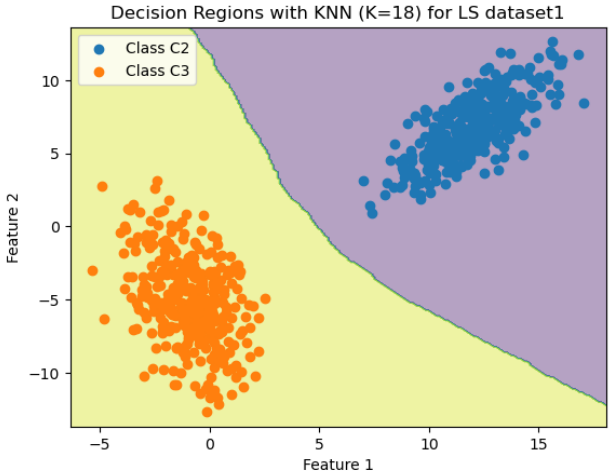
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (a)/ linearly separable dataset for class 2 Vs class 3 as the values of k varies (1, 2, 6, 12, 18, 32).**

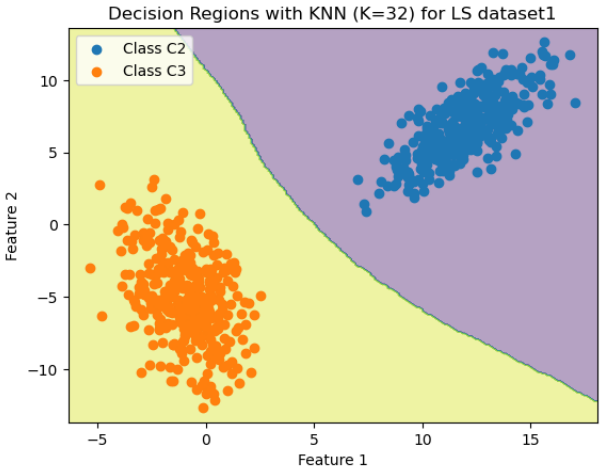












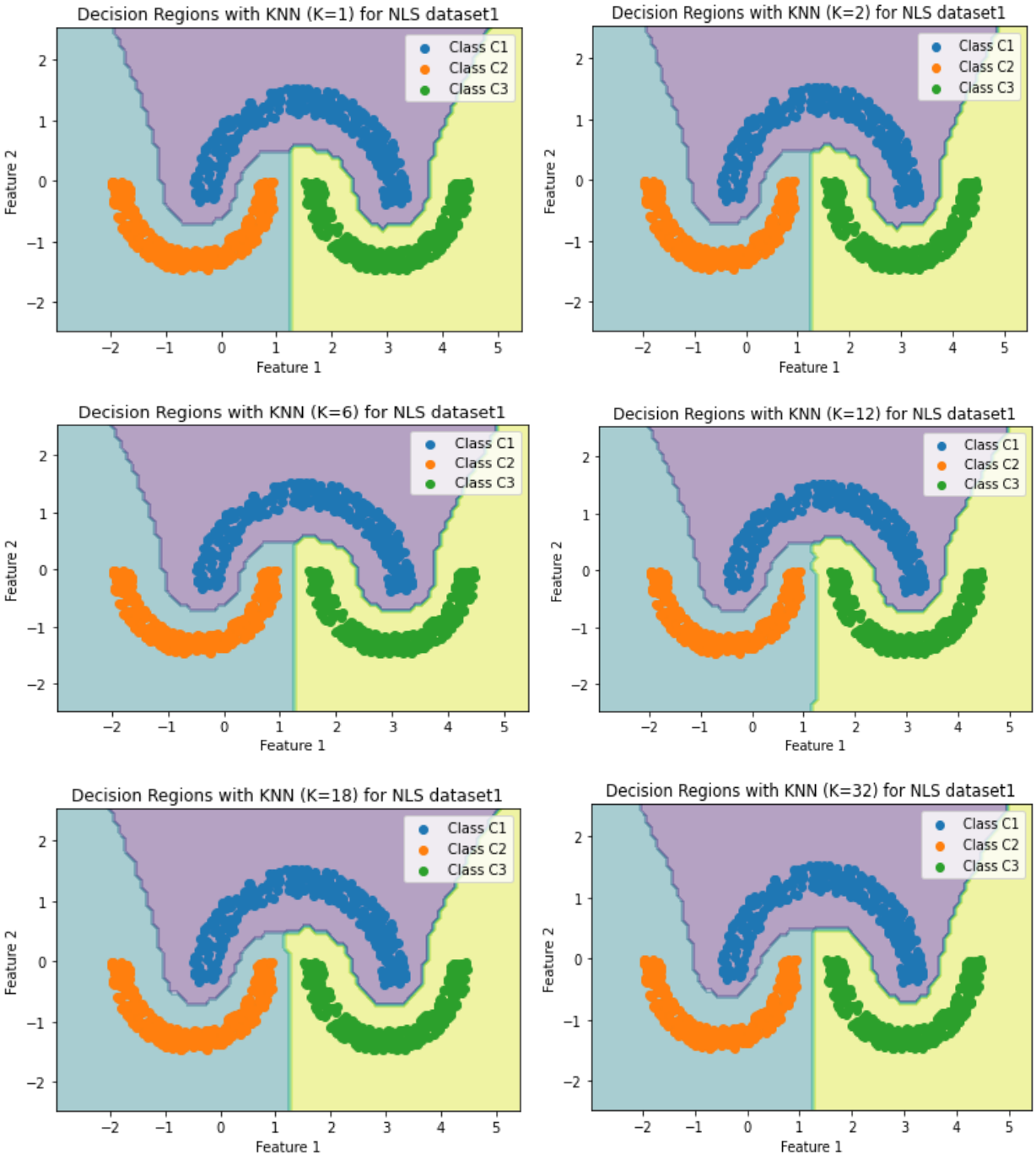
b) Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for NLS Dataset-1 (b).

(b) NLS data
Dataset description:

- Non Linearly separable dataset
- Total sample size: 1500
- Total classes: 3
- Samples in each class: 500
- Dimensionality: each point is 2D

Note: This data description will be valid and hence not mentioned again whenever NLS dataset term is used in the report.

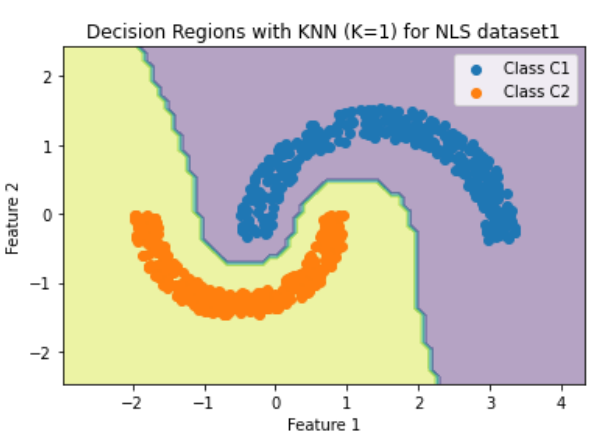
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (b)/ non linearly separable dataset for class 1 Vs class 2 Vs class 3 as the values of k varies (1, 2, 6, 12, 18, 32).**

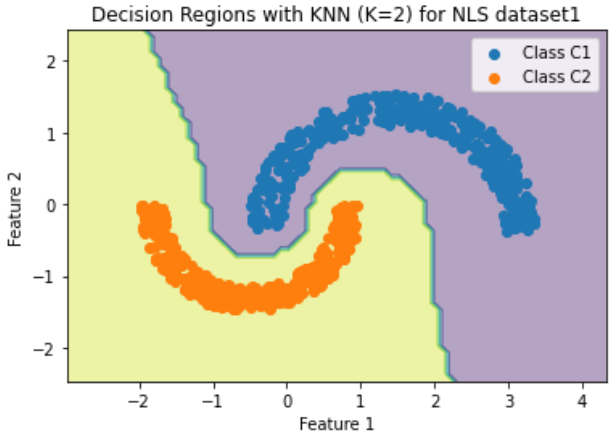


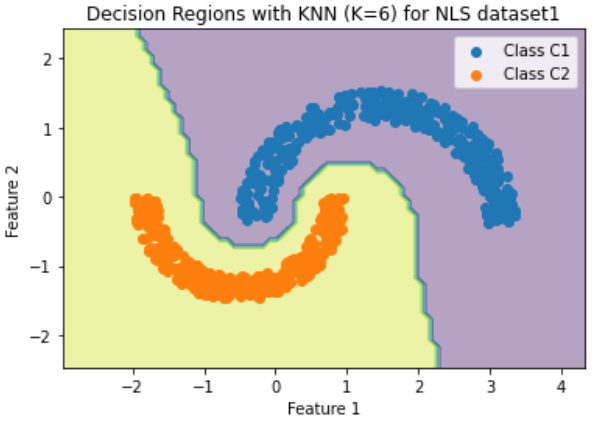
Inferences:

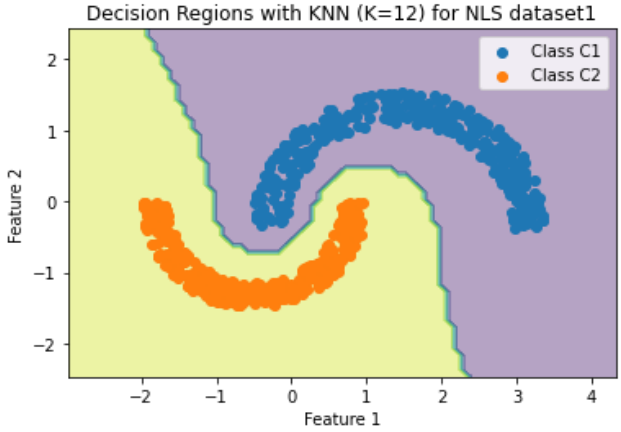
- At k=1 we have the decision boundary as the perpendicular bisector of the nearest points. Overall the shape is non linear but it is piecewise linear.
- As the k value increases the decision boundary between classes becomes more smooth.

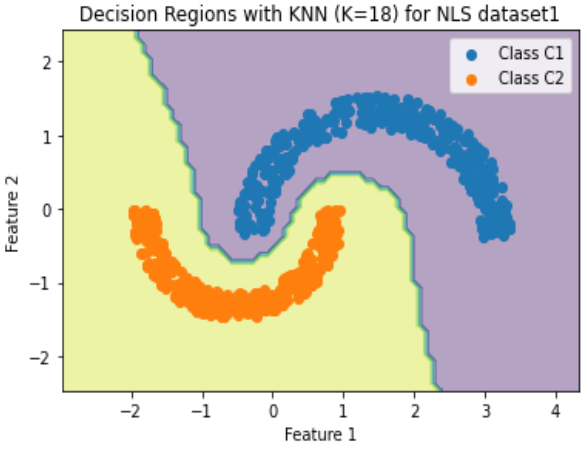
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (b)/non linearly separable dataset for class 1 Vs class 2 as the values of k varies (1, 2, 6, 12, 18, 32)**

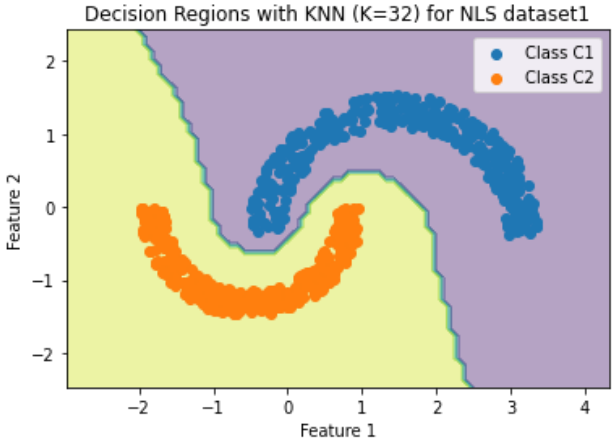




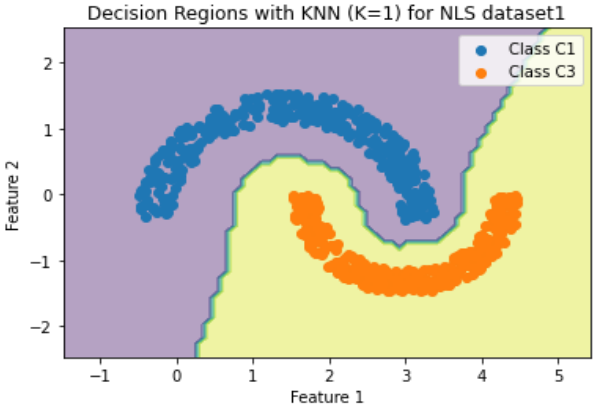


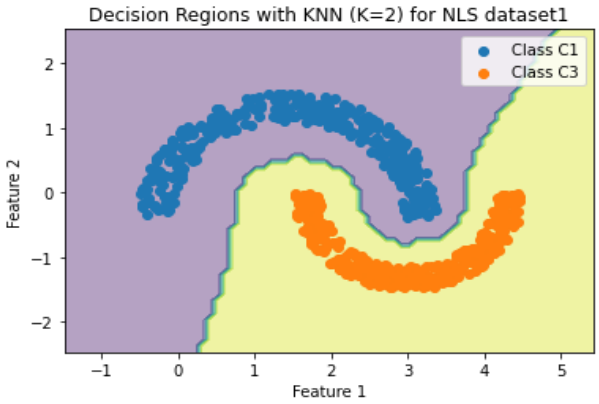


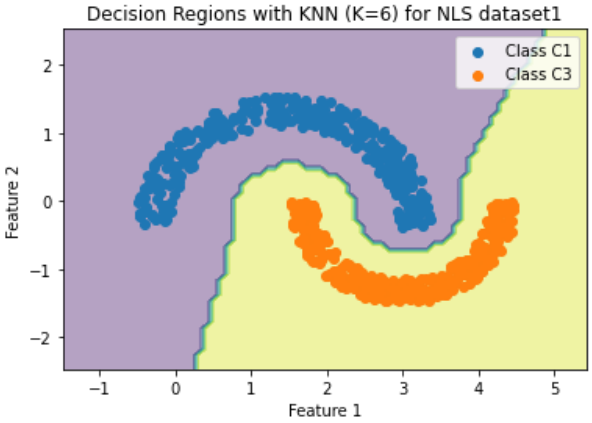


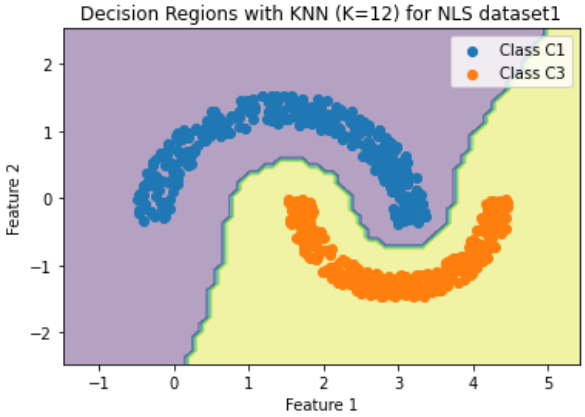


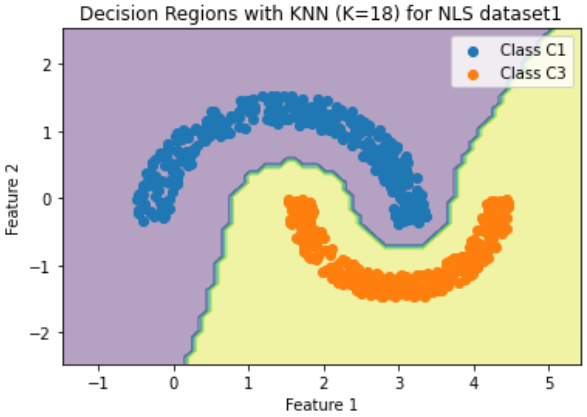
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (b)/non linearly separable dataset for class 1 Vs class 3 as the values of k varies (1, 2, 6, 12, 18, 32)**

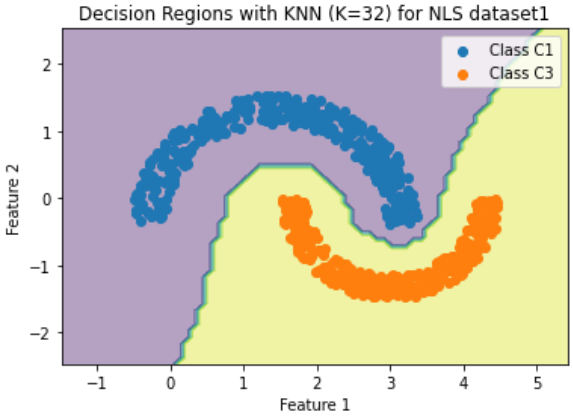




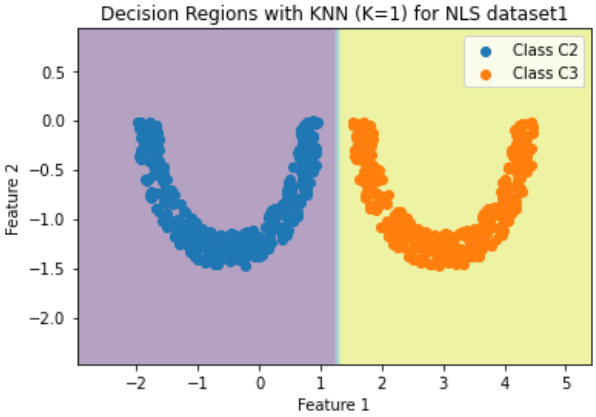


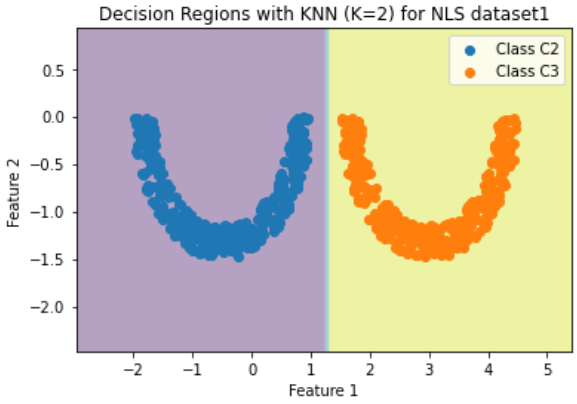


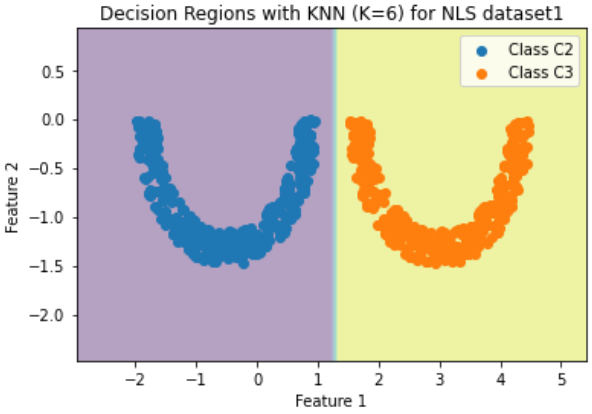


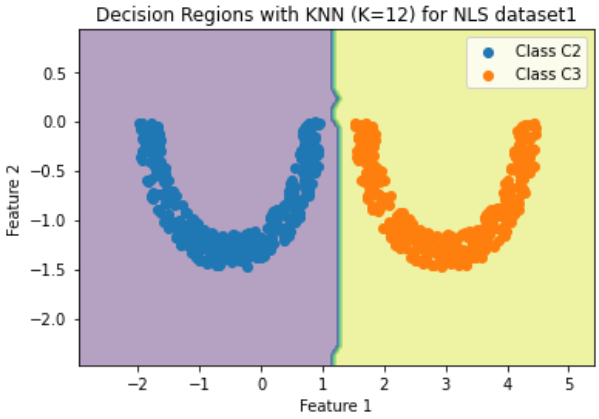


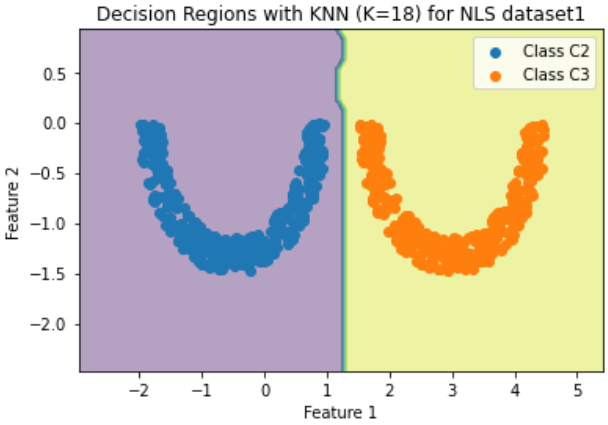
- **Bayes classifier using the density estimated from K-nearest neighbor (KNN) method for Dataset-1 (b)/non linearly separable dataset for class 2 Vs class 3 as the values of k varies (1, 2, 6, 12, 18, 32)**

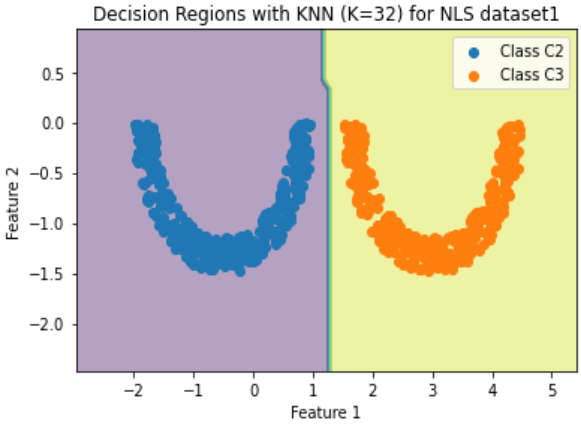












(c) KNN for 32D BovW data:

For k-nearest neighbors = 1 the specifics are:

Classification Accuracy: 0.72

Classification Report:

Class 1:
- Precision: 0.7955
- Recall: 0.7000
- F1-Score: 0.7447
- Support: 50.0

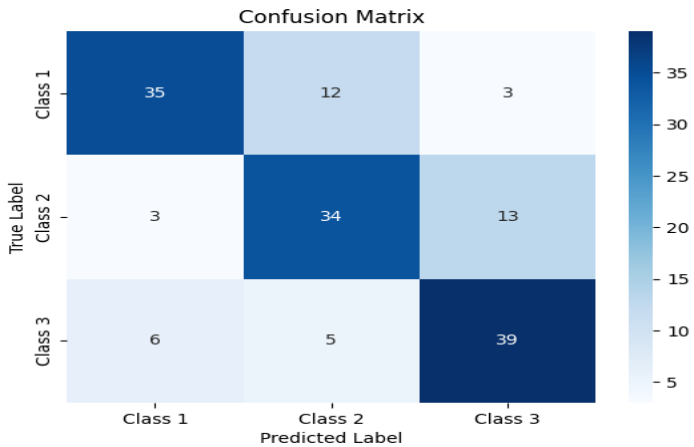
Class 2:
- Precision: 0.6667
- Recall: 0.6800
- F1-Score: 0.6733
- Support: 50.0

Class 3:
- Precision: 0.7091
- Recall: 0.7800
- F1-Score: 0.7429
- Support: 50.0

Mean Precision: 0.7237373737373737
Mean Recall: 0.7200000000000001
Mean F1-Score: 0.720268440217882

Confusion Matrix:

```
[[35 12  3]
 [ 3 34 13]
 [ 6  5 39]]
```



For k-nearest neighbors = 3 the specifics are:

Classification Accuracy: 0.7066666666666667

Classification Report:

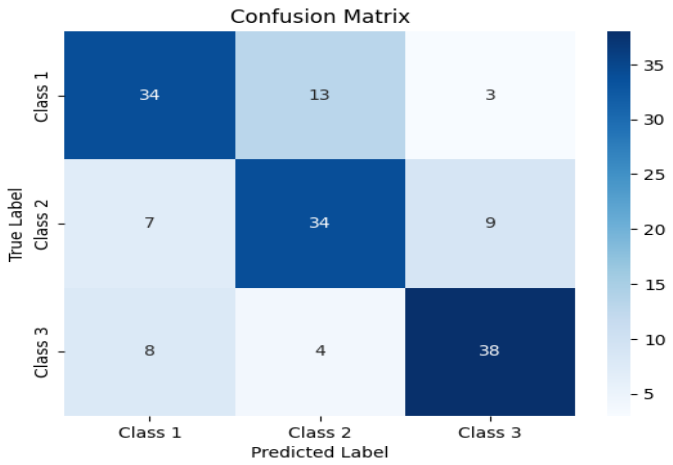
Class 1:
  Precision: 0.6939
  Recall: 0.6800
  F1-Score: 0.6869
  Support: 50.0

Class 2:
  Precision: 0.6667
  Recall: 0.6800
  F1-Score: 0.6733
  Support: 50.0

Class 3:
  Precision: 0.7600
  Recall: 0.7600
  F1-Score: 0.7600
  Support: 50.0

Mean Precision: 0.7068480725623583
Mean Recall: 0.7066666666666667
Mean F1-Score: 0.7067120045337868

Confusion Matrix:
 [[34 13 3]
 [7 34 9]
 [8 4 38]]



For k-nearest neighbors = 5 the specifics are:

Classification Accuracy: 0.7266666666666667

Classification Report:

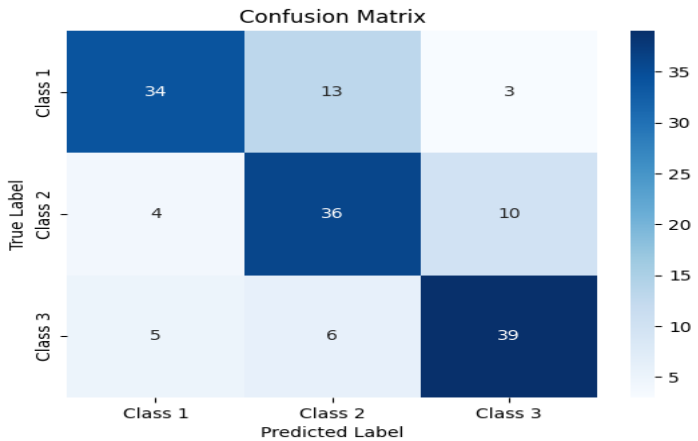
Class 1:
  Precision: 0.7907
  Recall: 0.6800
  F1-Score: 0.7312
  Support: 50.0

Class 2:
  Precision: 0.6545
  Recall: 0.7200
  F1-Score: 0.6857
  Support: 50.0

Class 3:
  Precision: 0.7500
  Recall: 0.7800
  F1-Score: 0.7647
  Support: 50.0

Mean Precision: 0.7317477096546864
Mean Recall: 0.7266666666666666
Mean F1-Score: 0.7272009879220506

Confusion Matrix:
 [[34 13 3]
 [4 36 10]
 [5 6 39]]



For k-nearest neighbors = 7 the specifics are:

Classification Accuracy: 0.7466666666666667

Classification Report:

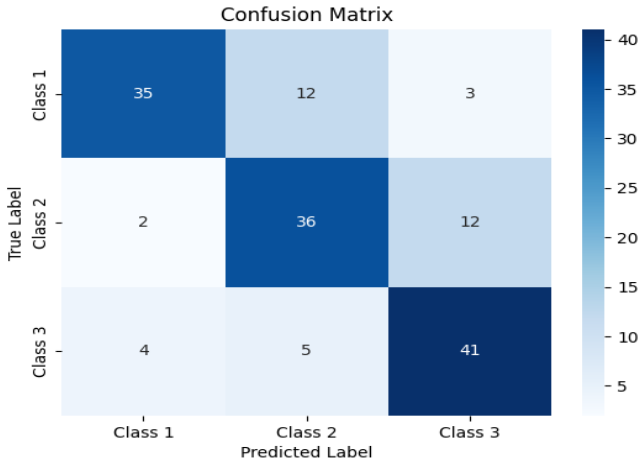
Class 1:
  Precision: 0.8537
  Recall: 0.7000
  F1-Score: 0.7692
  Support: 50.0

Class 2:
  Precision: 0.6792
  Recall: 0.7200
  F1-Score: 0.6990
  Support: 50.0

Class 3:
  Precision: 0.7321
  Recall: 0.8200
  F1-Score: 0.7736
  Support: 50.0

Mean Precision: 0.7550155589156969
Mean Recall: 0.7466666666666666
Mean F1-Score: 0.7472816003682462

Confusion Matrix:
 [[35 12 3]
 [2 36 12]
 [4 5 41]]



For k-nearest neighbors = 9 the specifics are:

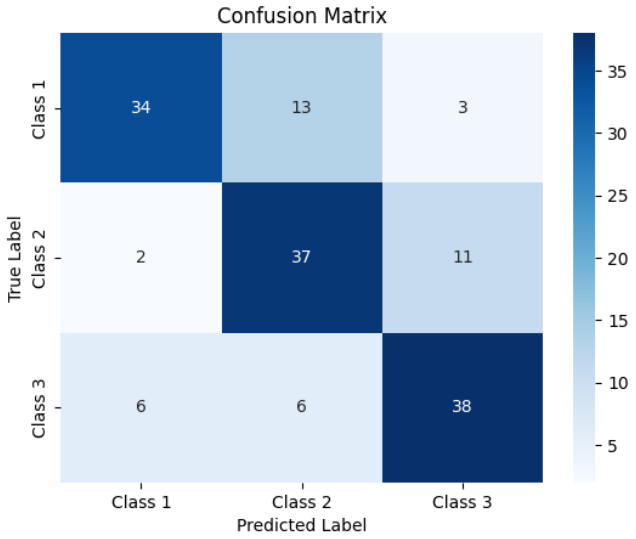
Classification Accuracy: 0.7266666666666667
Classification Report:
Class 1:
Precision: 0.8095
Recall: 0.6800
F1-Score: 0.7391
Support: 50.0

Class 2:
Precision: 0.6607
Recall: 0.7400
F1-Score: 0.6981
Support: 50.0

Class 3:
Precision: 0.7308
Recall: 0.7600
F1-Score: 0.7451
Support: 50.0

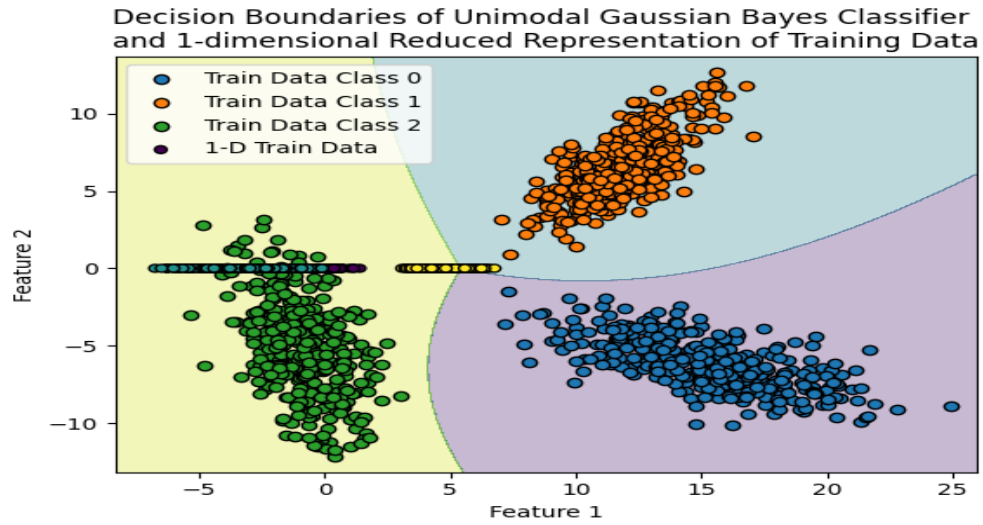
Mean Precision: 0.7336691086691087
Mean Recall: 0.7266666666666666
Mean F1-Score: 0.7274472271818216

Confusion Matrix:
[[34 13 3]
[2 37 11]
[6 6 38]]



3. Apply Fisher linear discriminant analysis (FDA) on Dataset-1 and Dataset-2. Use Bayes classifier using both unimodal Gaussian and GMM.

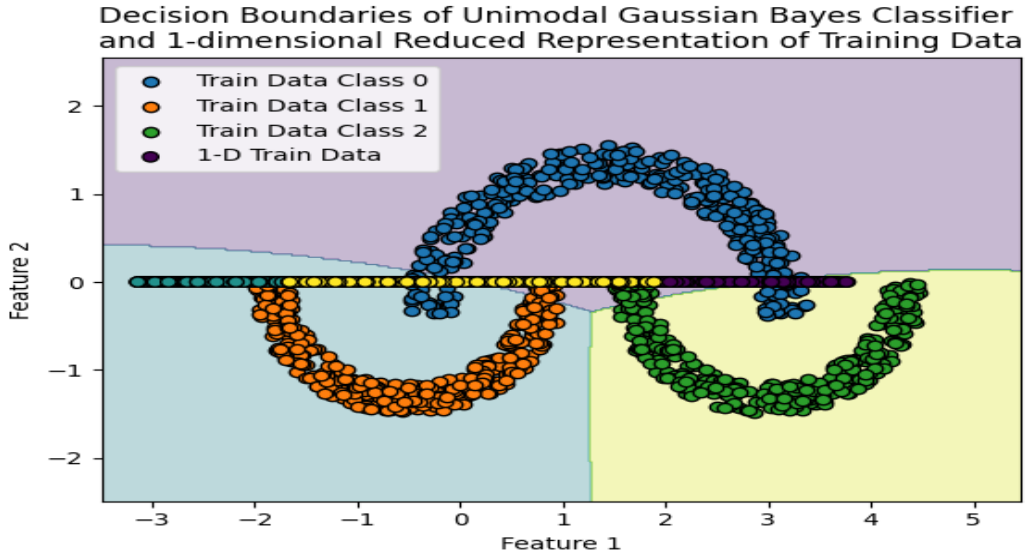
For LS dataset:



Metrices	Scores
Accuracy	**0.9**
Precision (Class-wise)	**(0.84, 0.86, 1.00)**
Mean Precision	**0.9047**
Recall (Class-wise)	**(0.87, 0.84, 1.00)**
Mean Recall	**0.904**
F-measure (Class-wise)	**(0.85, 0.85, 1.00)**
Mean F-measure	**0.904**

		Predicted output		
		Class 1	**Class 2**	**Class 3**
	Class 1	**131**	**19**	**0**
Actual output	**Class 2**	**24**	**126**	**0**
	Class 3	**0**	**0**	**150**

For NLS Dataset:

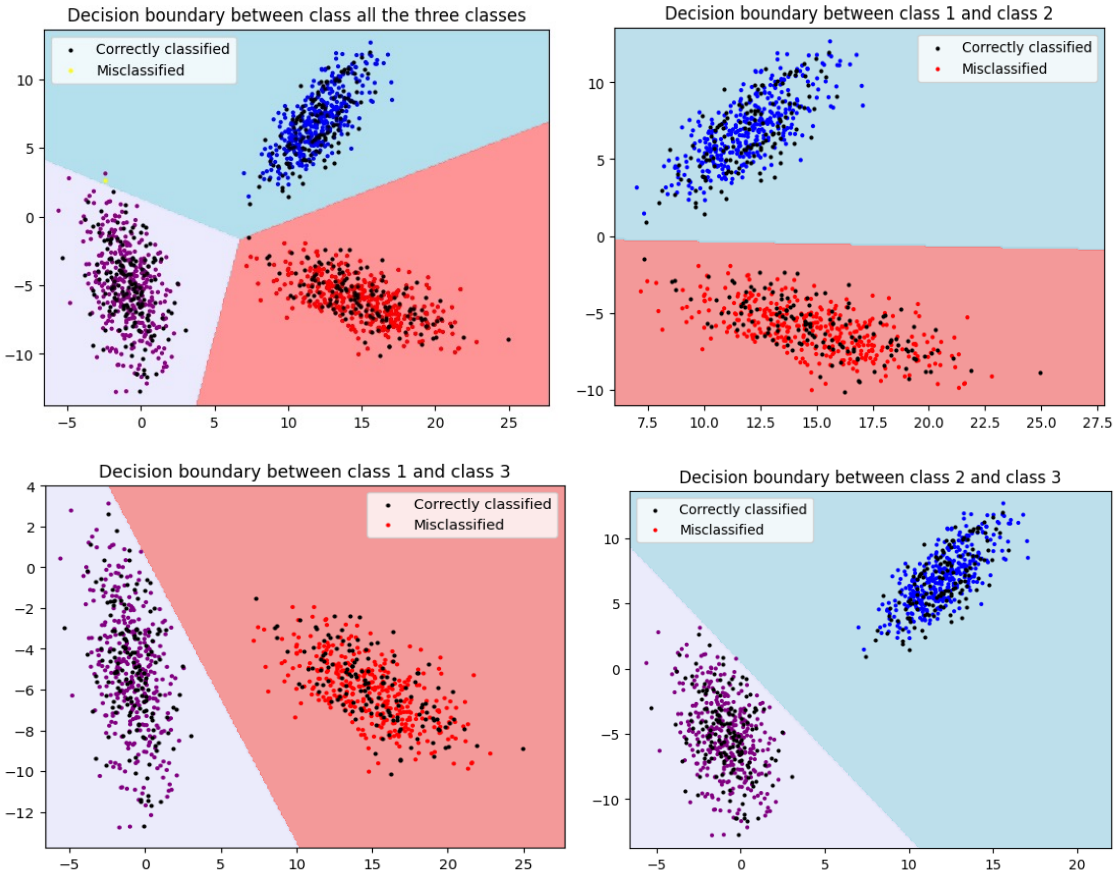


Metrices	Scores
Accuracy	**0.72**
Precision (Class-wise)	**(0.93, 0.67, 0.58)**
Mean Precision	**0.73**
Recall (Class-wise)	**(0.80, 0.80, 0.56)**
Mean Recall	**0.72**
F-measure (Class-wise)	**(0.86, 0.73, 0.57)**
Mean F-measure	**0.904**

		Predicted output		
		Class 1	**Class 2**	**Class 3**
	Class 1	**121**	**0**	**29**
Actual output	**Class 2**	**0**	**120**	**30**
	Class 3	**8**	**58**	**84**

4. Perceptron-based classifier:

4.a) LS Dataset:



Precision, Recall and F1-score on Test set for all LS classes independently:

Class Label	Precision	Recall	F1-score	Total instances
Class 1	1	0.99	1	148
Class 2	0.99	1	1	141
Class 3	1	1	1	161

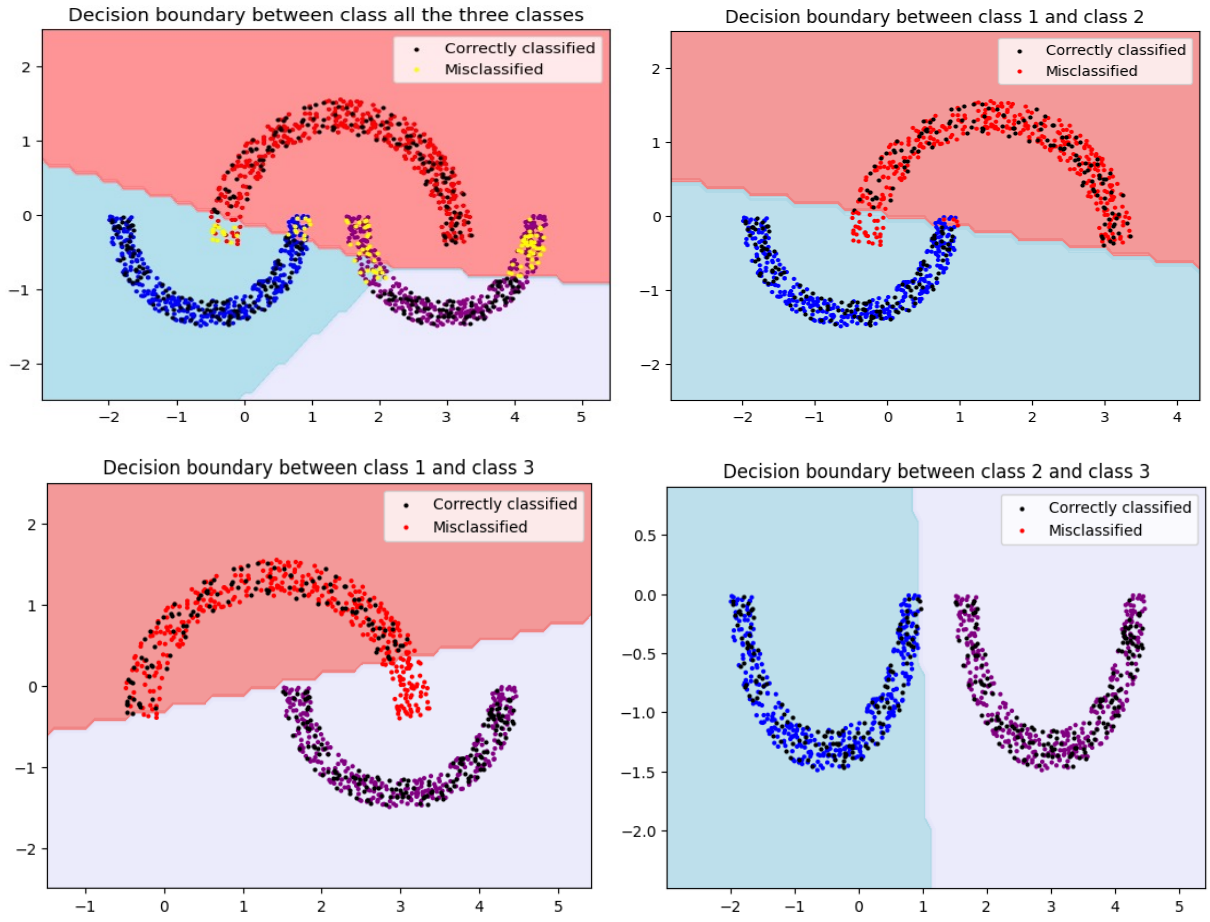
Confusion Matrix for 450 test data of LS dataset:

		Predicted output		
		Class 1	**Class 2**	**Class 3**
	Class 1	**147**	**1**	**0**
Actual output	**Class 2**	**0**	**141**	**0**
	Class 3	**0**	**0**	**161**

Accuracy score for test data of all three classes of LS data:

Accuracy = 1 (100%).

b) NLS dataset:



Precision, Recall and F1-score on Test set for all NLS classes independently:

Class Label	Precision	Recall	F1-score	Total instances
Class 1	0.97	0.75	0.84	148
Class 2	0.91	0.98	0.94	141
Class 3	0.87	0.99	0.93	161

Confusion Matrix for 450 test data of NLS dataset:

		Predicted output		
		Class 1	**Class 2**	**Class 3**
	Class 1	111	14	23
Actual output	**Class 2**	3	138	0
	Class 3	1	0	160

Accuracy score for test data of all three classes of NLS data:
Accuracy = 0.9

c) Perceptron based classifier for 32 Dimensional Bag OF Words representation:

Test Classification Report:

	precision	recall	f1-score	support
jail_cell	0.74	0.50	0.60	50
pagoda	0.47	0.90	0.62	50
rainforest	0.90	0.38	0.54	50
accuracy			0.59	150
macro avg	0.70	0.59	0.58	150
weighted avg	0.70	0.59	0.58	150

Test Confusion Matrix:

		Predicted output		
		Class 1	**Class 2**	**Class 3**
	Class 1	25	23	2
Actual output	**Class 2**	5	45	0
	Class 3	4	27	19

Test Classification Report with PCA:

	precision	recall	f1-score	support
jail_cell	0.21	0.30	0.25	50
pagoda	0.32	0.50	0.39	50
rainforest	0.00	0.00	0.00	50
accuracy			0.27	150
macro avg	0.18	0.27	0.21	150
weighted avg	0.18	0.27	0.21	150

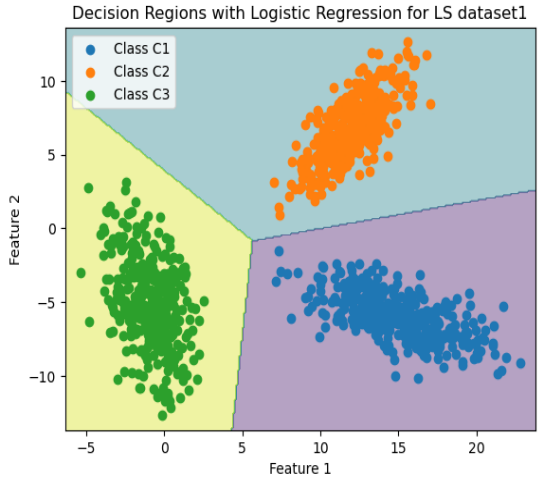
Test Confusion Matrix with PCA:

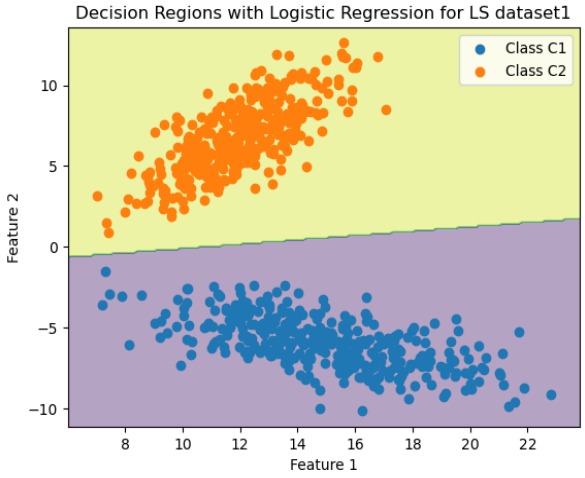
		Predicted output		
		Class 1	**Class 2**	**Class 3**
	Class 1	15	34	1
Actual output	**Class 2**	25	25	0
	Class 3	31	19	0

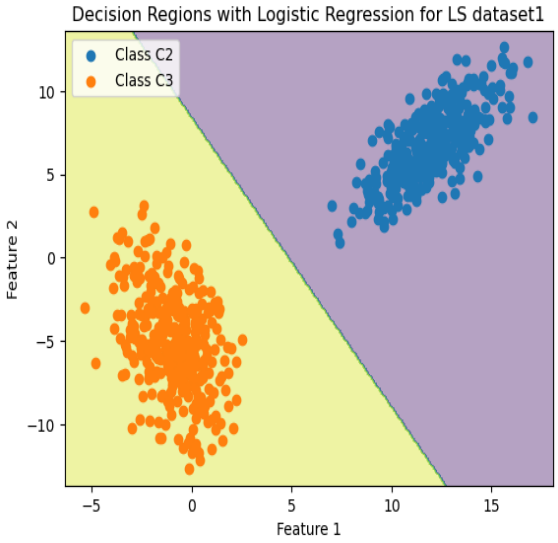
5. Logistic regression classifier on LS Dataset-1 (a)

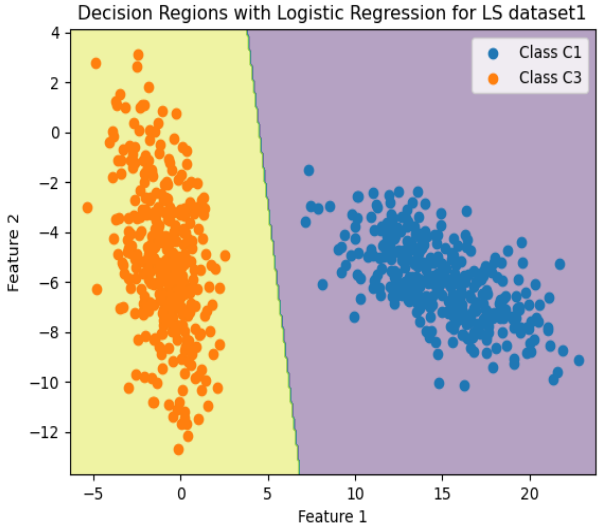
Dataset description:

- Linearly separable dataset
- Total sample size: 1500
- Total classes: 3
- Samples in each class: 500, each point being 2D





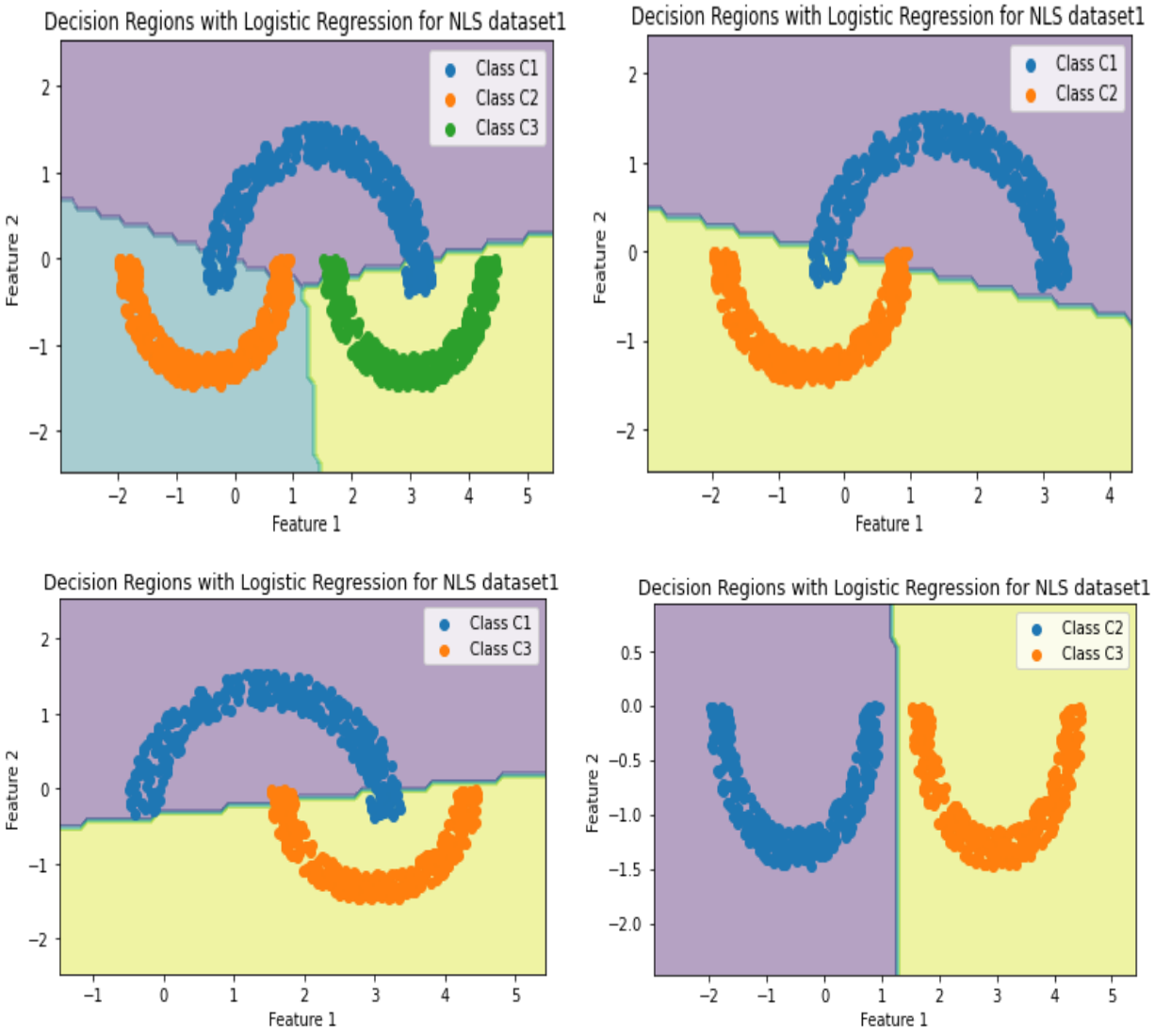




Logistic regression classifier on NLS Dataset-1 (b)

Dataset description:

- Non Linearly separable dataset
- Total sample size: 1500
- Total classes: 3
- Samples in each class: 500
- Dimensionality: each point is 2D



Logistic regression for 32D BovW representation.

LOGISTIC REGRESSION

Classification Accuracy: 0.7266666666666667

Classification Report:

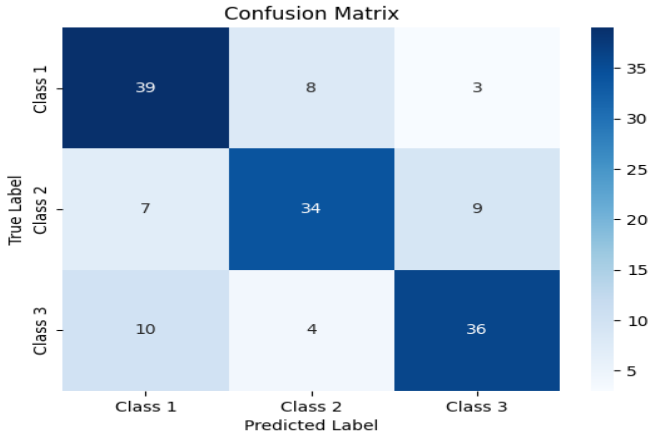
Class 1:
  Precision: 0.6964
  Recall: 0.7800
  F1-Score: 0.7358
  Support: 50.0

Class 2:
  Precision: 0.7391
  Recall: 0.6800
  F1-Score: 0.7083
  Support: 50.0

Class 3:
  Precision: 0.7500
  Recall: 0.7200
  F1-Score: 0.7347
  Support: 50.0

Mean Precision: 0.72851966873706
Mean Recall: 0.7266666666666666
Mean F1-Score: 0.7262920891627092

Confusion Matrix:
[[39 8 3]
 [7 34 9]
 [10 4 36]]

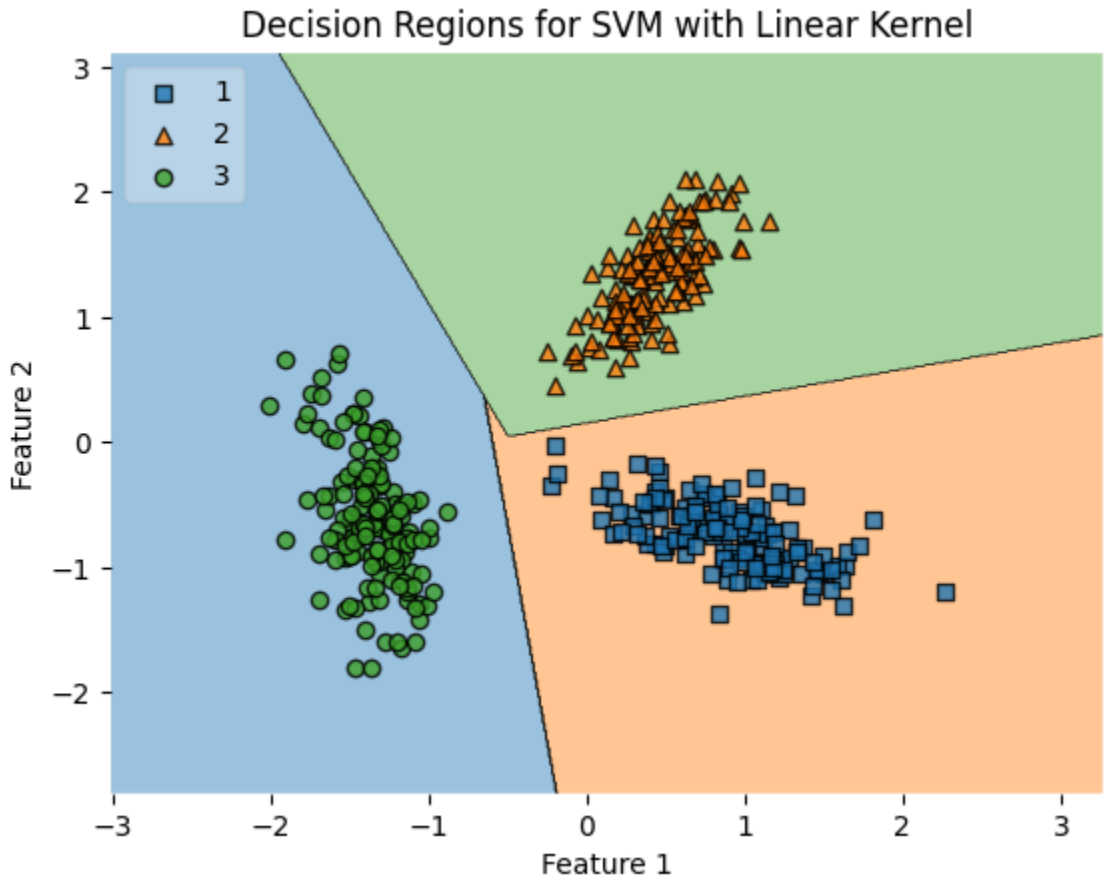


6. SVM-based classifier using (a) linear kernel, (b) polynomial kernel and (c) Gaussian/RBF kernel on Dataset-1 (a) Linearly Separable (LS).

Accuracy: 1.0

Precision per class: [1. 1. 1.]
Mean Precision: 1.0
Recall per class: [1. 1. 1.]
Mean Recall: 1.0
F1 Score per class: [1. 1. 1.]
Mean F1 Score: 1.0

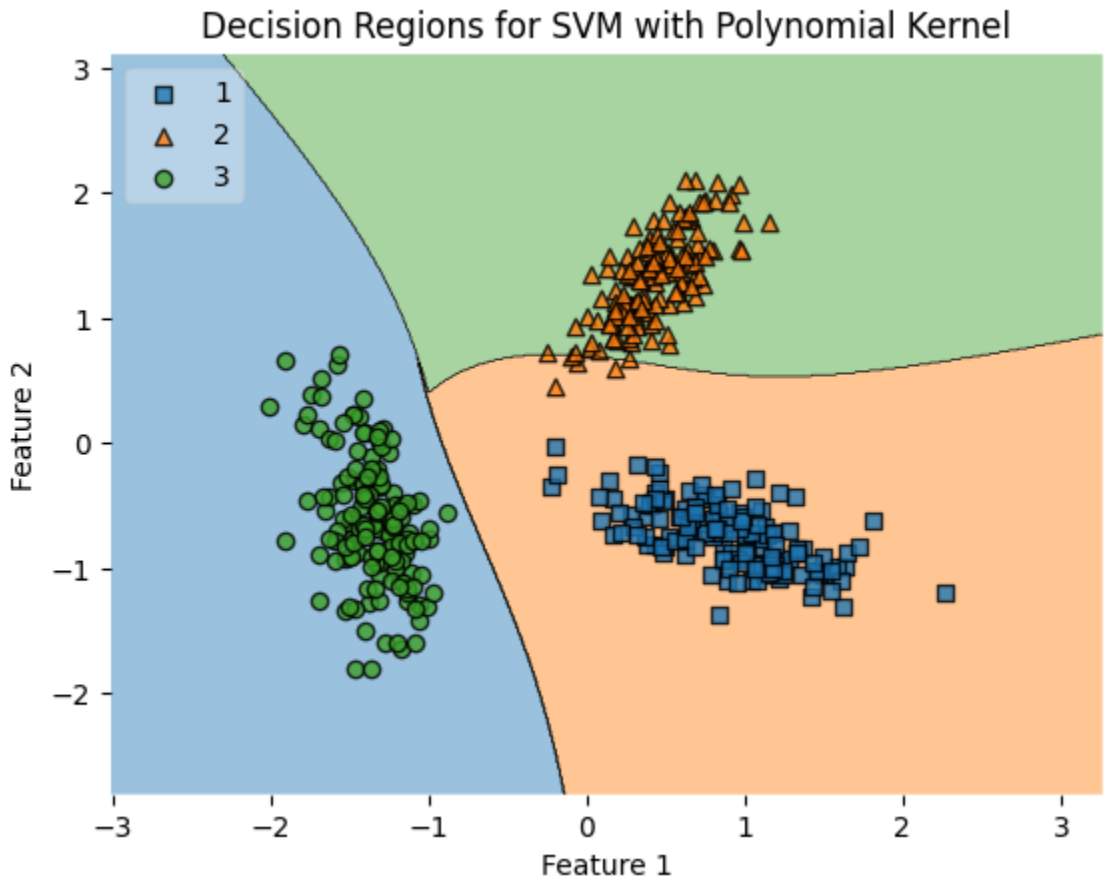
Confusion Matrix:
[[146 0 0]
[0 147 0]
[0 0 157]]



Accuracy: 0.9911111111111112

Precision per class: [0.97333333 1. 1.]
Mean Precision: 0.9911111111111112
Recall per class: [1. 0.97278912 1.]
Mean Recall: 0.9911111111111112
F1 Score per class: [0.98648649 0.9862069 1.]
Mean F1 Score: 0.9911111111111112

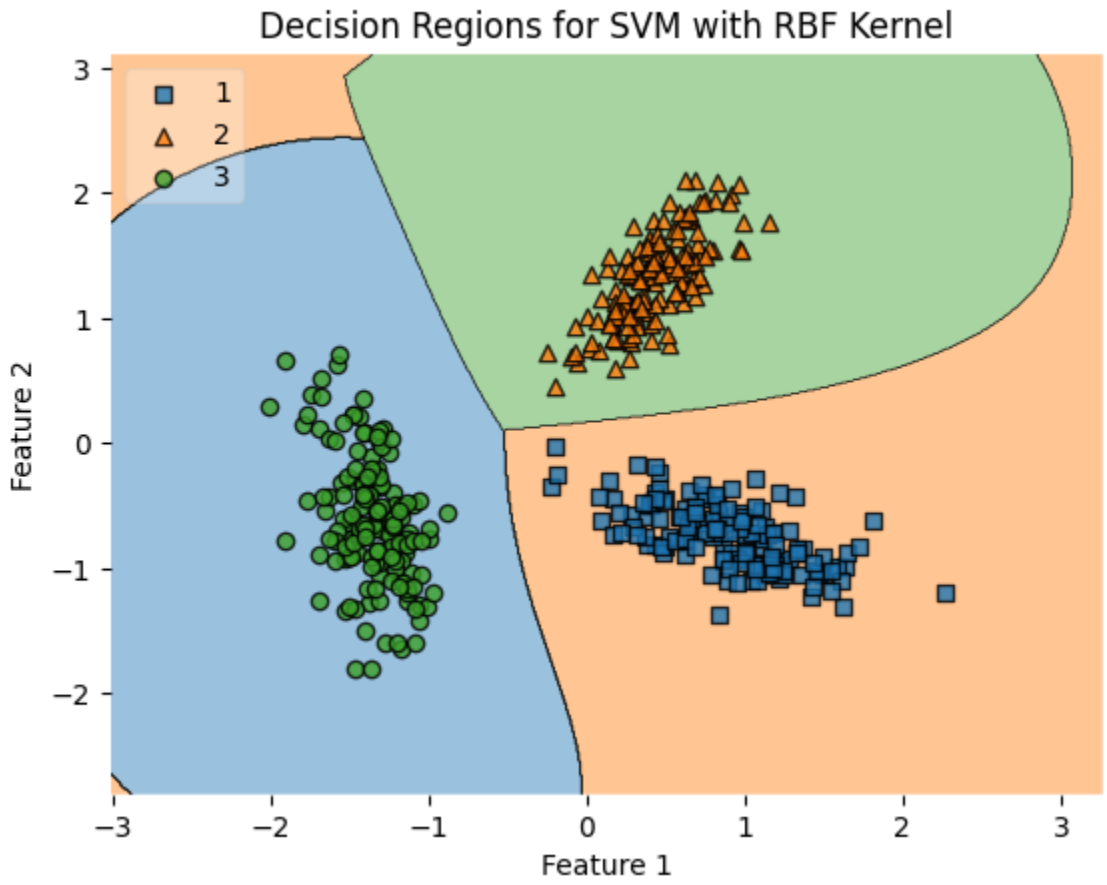
Confusion Matrix:
[[146 0 0]
[4 143 0]
[0 0 157]]



Accuracy: 1.0

Precision per class: [1. 1. 1.]
Mean Precision: 1.0
Recall per class: [1. 1. 1.]
Mean Recall: 1.0
F1 Score per class: [1. 1. 1.]
Mean F1 Score: 1.0

Confusion Matrix:
[[146 0 0]
 [0 147 0]
 [0 0 157]]

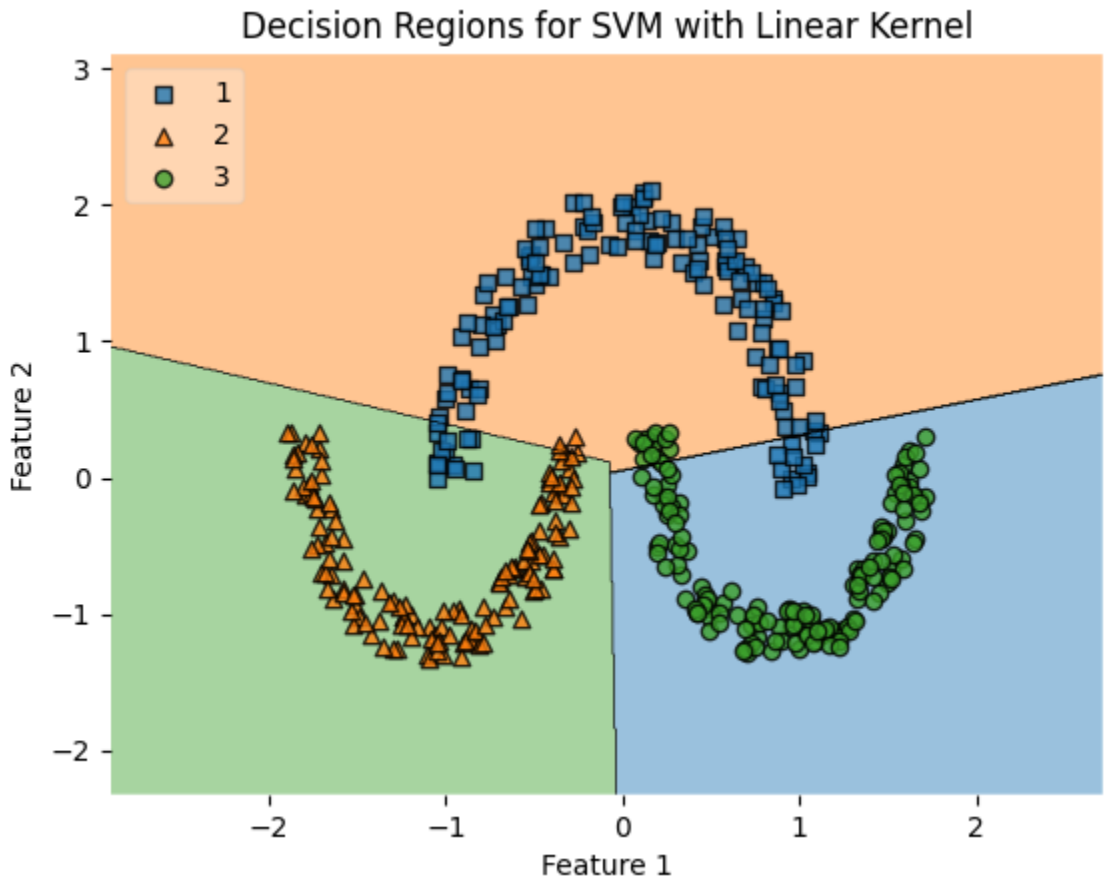


SVM-based classifier using (a) linear kernel, (b) polynomial kernel and (c) Gaussian/RBF kernel on Dataset-1 (b) Non Linearly Separable (NLS).

Accuracy: 0.9111111111111111

Precision per class: [0.88405797 0.92307692 0.92307692]
Mean Precision: 0.9111111111111111
Recall per class: [0.83561644 0.97959184 0.91719745]
Mean Recall: 0.9111111111111111
F1 Score per class: [0.85915493 0.95049505 0.9201278]
Mean F1 Score: 0.9111111111111111

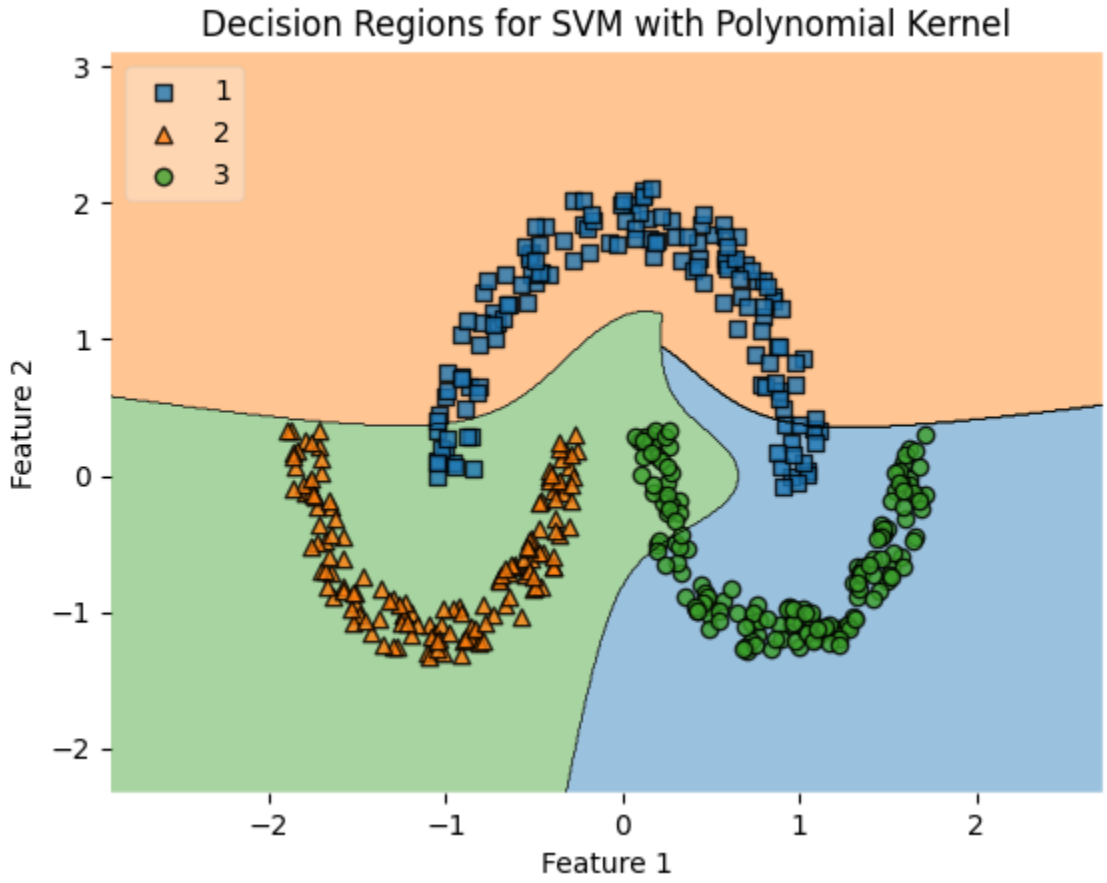
Confusion Matrix:
[[122 12 12]
[3 144 0]
[13 0 144]]



Accuracy: 0.8711111111111111

Precision per class: [1.   0.77368421 0.89361702]
Mean Precision: 0.8711111111111111
Recall per class: [0.81506849 1.   0.80254777]
Mean Recall: 0.8711111111111111
F1 Score per class: [0.89811321 0.87240356 0.84563758]
Mean F1 Score: 0.8711111111111111

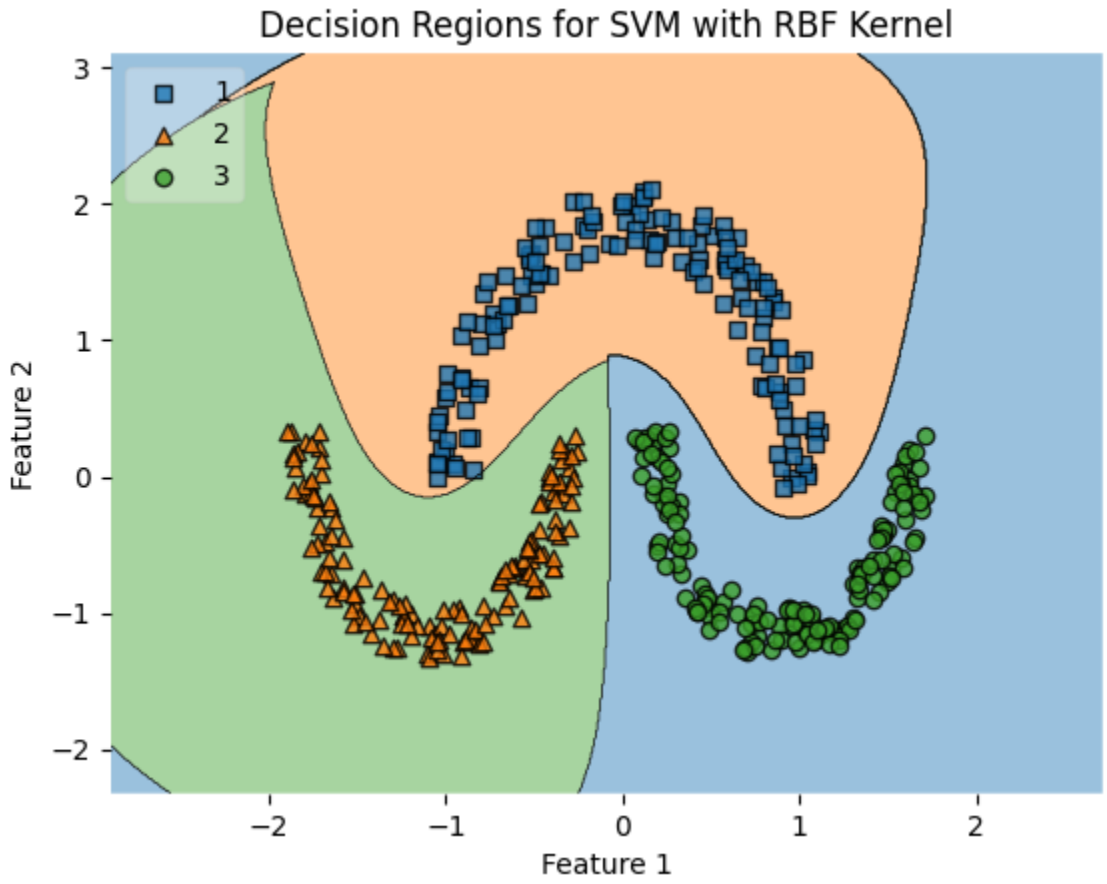
Confusion Matrix:
[[119 12 15]
 [0 147   0]
 [0 31 126]]



Accuracy: 1.0

Precision per class: [1. 1. 1.]
Mean Precision: 1.0
Recall per class: [1. 1. 1.]
Mean Recall: 1.0
F1 Score per class: [1. 1. 1.]
Mean F1 Score: 1.0

Confusion Matrix:
[[146 0 0]
 [0 147 0]
 [0 0 157]]



SVM-based classifier using (a) linear kernel, (b) polynomial kernel and (c) Gaussian/RBF kernel on Dataset-2 which has 32D BovW representation.

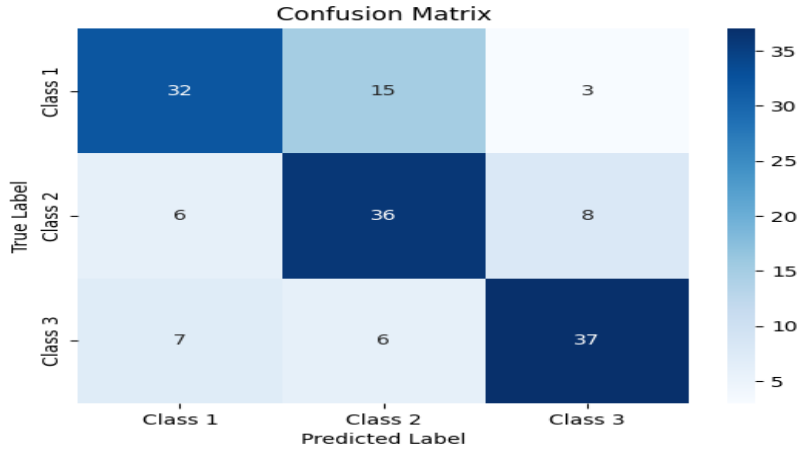
SVM Linear Kernel

Classification Accuracy: 0.7
Classification Report:
Class 1:
Precision: 0.7111
Recall: 0.6400
F1-Score: 0.6737
Support: 50.0

Class 2:
Precision: 0.6316
Recall: 0.7200
F1-Score: 0.6729
Support: 50.0

Class 3:
Precision: 0.7708
Recall: 0.7400
F1-Score: 0.7551
Support: 50.0

Mean Precision: 0.7045077972709551
Mean Recall: 0.6999999999999998
Mean F1-Score: 0.7005611492014415
Confusion Matrix:
[[32 15 3]
[6 36 8]
[7 6 37]]



SVM Polynomial Kernel

SVM Polynomial Kernel, degree = 1

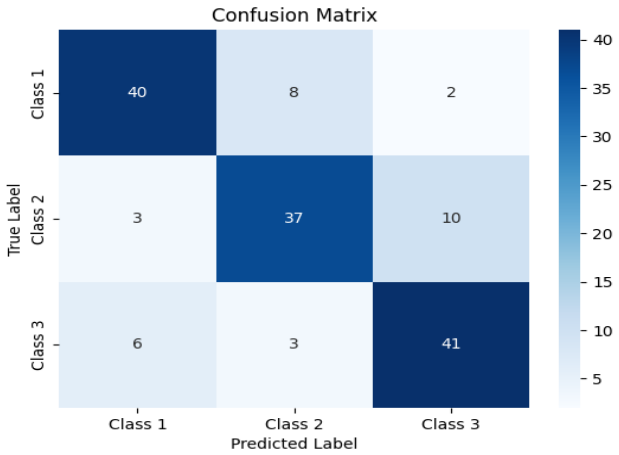
Classification Accuracy: 0.7866666666666666
Classification Report:
Class 1:
  Precision: 0.8163
  Recall: 0.8000
  F1-Score: 0.8081
  Support: 50.0

Class 2:
  Precision: 0.7708
  Recall: 0.7400
  F1-Score: 0.7551
  Support: 50.0

Class 3:
  Precision: 0.7736
  Recall: 0.8200
  F1-Score: 0.7961
  Support: 50.0

Mean Precision: 0.7869149232019853
Mean Recall: 0.7866666666666666
Mean F1-Score: 0.7864331179171679

Confusion Matrix:
[[40 8 2]
 [3 37 10]
 [6 3 41]]



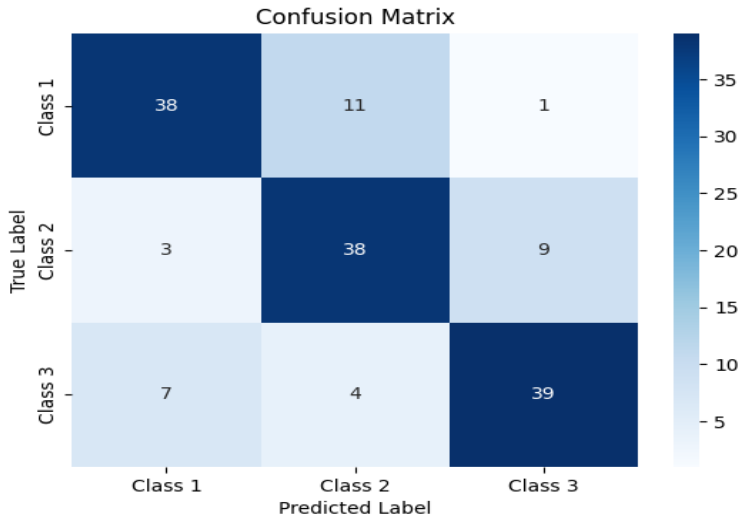
SVM Polynomial Kernel, degree = 2

Classification Accuracy: 0.7666666666666667
Classification Report:
Class 1:
  Precision: 0.7917
  Recall: 0.7600
  F1-Score: 0.7755
  Support: 50.0

Class 2:
  Precision: 0.7170
  Recall: 0.7600
  F1-Score: 0.7379
  Support: 50.0

Class 3:
  Precision: 0.7959
  Recall: 0.7800
  F1-Score: 0.7879
  Support: 50.0

Mean Precision: 0.7681887220296924
Mean Recall: 0.7666666666666666
Mean F1-Score: 0.7670843565434411
Confusion Matrix:
 [[38 11 1]
 [3 38 9]
 [7 4 39]]



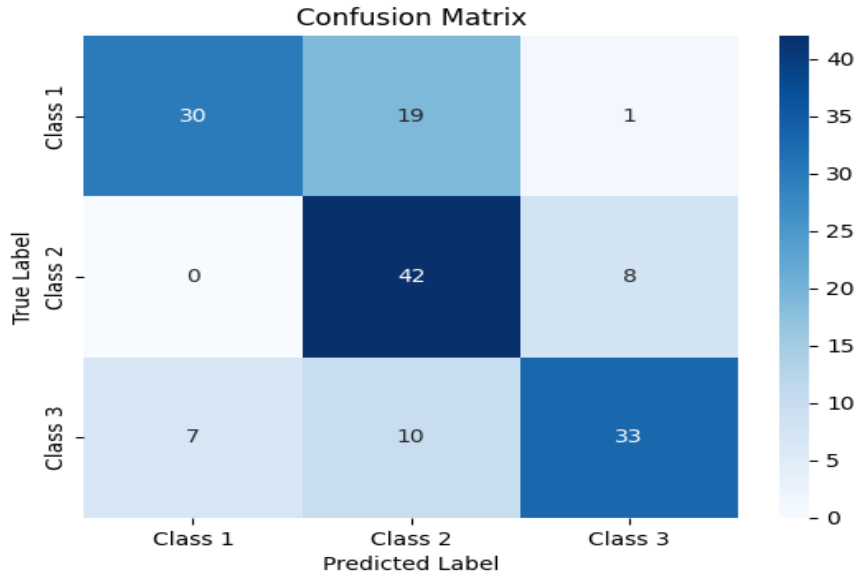
SVM Polynomial Kernel, degree = 5

Classification Accuracy: 0.7
Classification Report:
Class 1:
  Precision: 0.8108
  Recall: 0.6000
  F1-Score: 0.6897
  Support: 50.0

Class 2:
  Precision: 0.5915
  Recall: 0.8400
  F1-Score: 0.6942
  Support: 50.0

Class 3:
  Precision: 0.7857
  Recall: 0.6600
  F1-Score: 0.7174
  Support: 50.0

Mean Precision: 0.7293581307665815
Mean Recall: 0.7000000000000001
Mean F1-Score: 0.700420450931559
Confusion Matrix:
[[30 19 1]
 [0 42 8]
 [7 10 33]]



SVM RBF Kernel

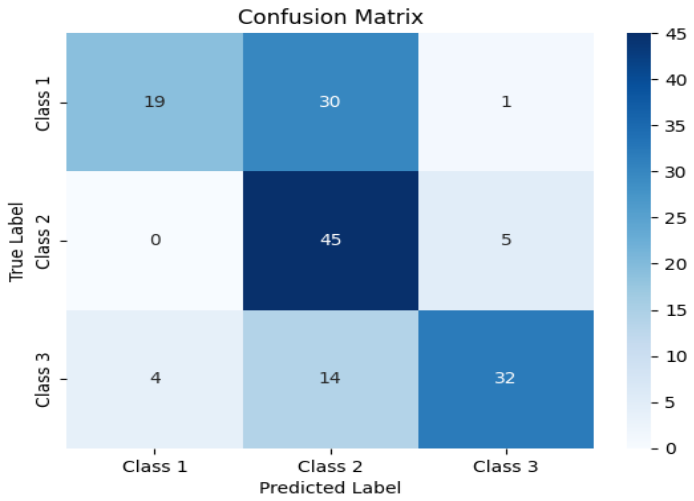
SVM RBF Kernel: degree = 1, gamma = 0.001, width = 1000.0

Classification Accuracy: 0.64
Classification Report:
Class 1:
  Precision: 0.8261
  Recall: 0.3800
  F1-Score: 0.5205
  Support: 50.0

Class 2:
  Precision: 0.5056
  Recall: 0.9000
  F1-Score: 0.6475
  Support: 50.0

Class 3:
  Precision: 0.8421
  Recall: 0.6400
  F1-Score: 0.7273
  Support: 50.0

Mean Precision: 0.7246033990692412
Mean Recall: 0.64
Mean F1-Score: 0.6317675622888985
Confusion Matrix:
 [[19 30 1]
 [0 45 5]
 [4 14 32]]



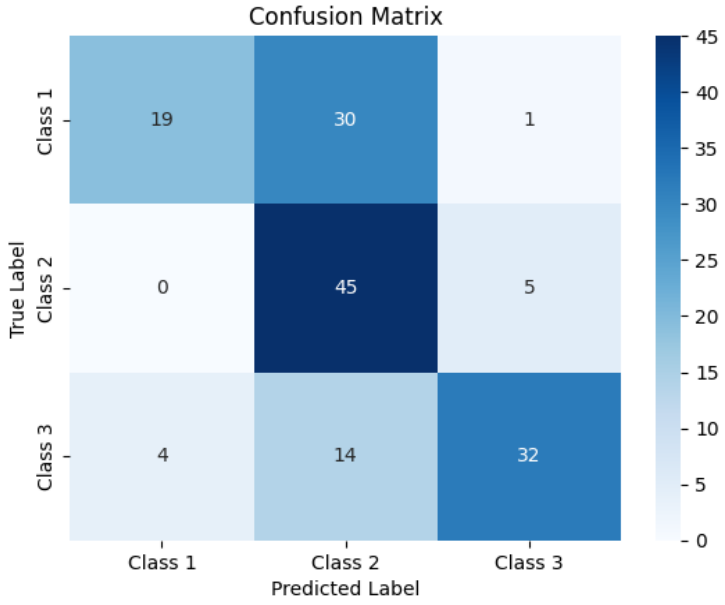
SVM RBF Kernel: degree = 1, gamma = 0.01, width = 100.0

Classification Accuracy: 0.64
Classification Report:
Class 1:
  Precision: 0.8261
  Recall: 0.3800
  F1-Score: 0.5205
  Support: 50.0

Class 2:
  Precision: 0.5056
  Recall: 0.9000
  F1-Score: 0.6475
  Support: 50.0

Class 3:
  Precision: 0.8421
  Recall: 0.6400
  F1-Score: 0.7273
  Support: 50.0

Mean Precision: 0.7246033990692412
Mean Recall: 0.64
Mean F1-Score: 0.6317675622888985
Confusion Matrix:
[[19 30 1]
 [0 45 5]
 [4 14 32]]



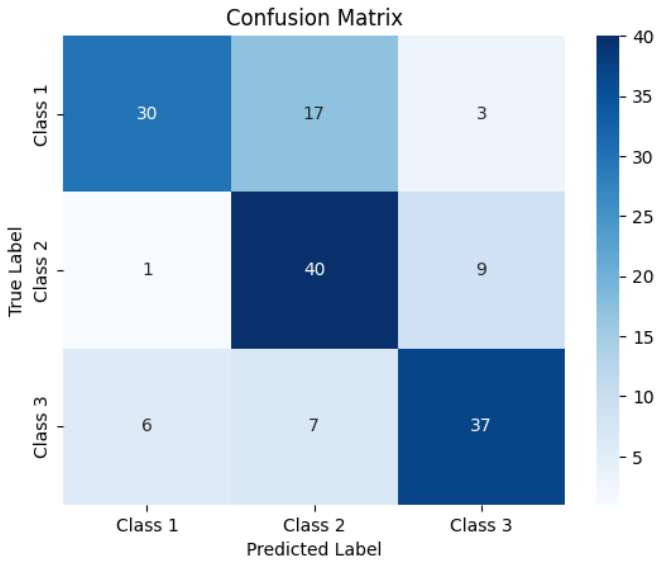
SVM RBF Kernel: degree = 1, gamma = 0.5, width = 2.0

Classification Accuracy: 0.7133333333333334
Classification Report:
Class 1:
  Precision: 0.8108
  Recall: 0.6000
  F1-Score: 0.6897
  Support: 50.0

Class 2:
  Precision: 0.6250
  Recall: 0.8000
  F1-Score: 0.7018
  Support: 50.0

Class 3:
  Precision: 0.7551
  Recall: 0.7400
  F1-Score: 0.7475
  Support: 50.0

Mean Precision: 0.7303042838757126
Mean Recall: 0.7133333333333333
Mean F1-Score: 0.7129614352844843
Confusion Matrix:
 [[30 17 3]
 [1 40 9]
 [6 7 37]]



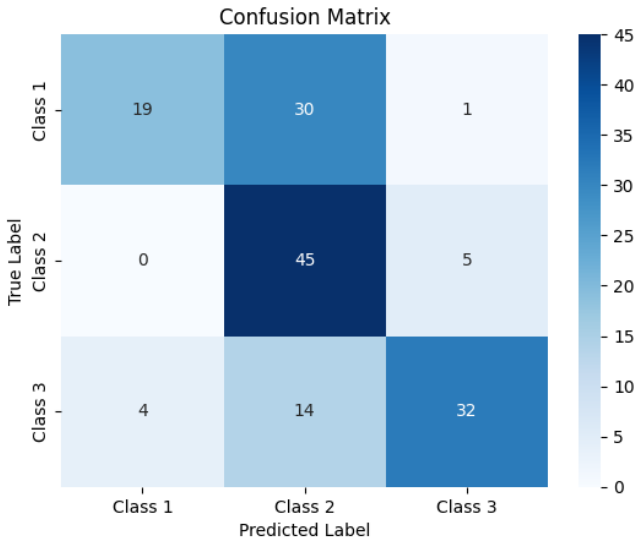
SVM RBF Kernel: degree = 1, gamma = 0.1, width = 10.0

Classification Accuracy: 0.64
Classification Report:
Class 1:
  Precision: 0.8261
  Recall: 0.3800
  F1-Score: 0.5205
  Support: 50.0

Class 2:
  Precision: 0.5056
  Recall: 0.9000
  F1-Score: 0.6475
  Support: 50.0

Class 3:
  Precision: 0.8421
  Recall: 0.6400
  F1-Score: 0.7273
  Support: 50.0

Mean Precision: 0.7246033990692412
Mean Recall: 0.64
Mean F1-Score: 0.6317675622888985
Confusion Matrix:
 [[19 30 1]
 [0 45 5]
 [4 14 32]]



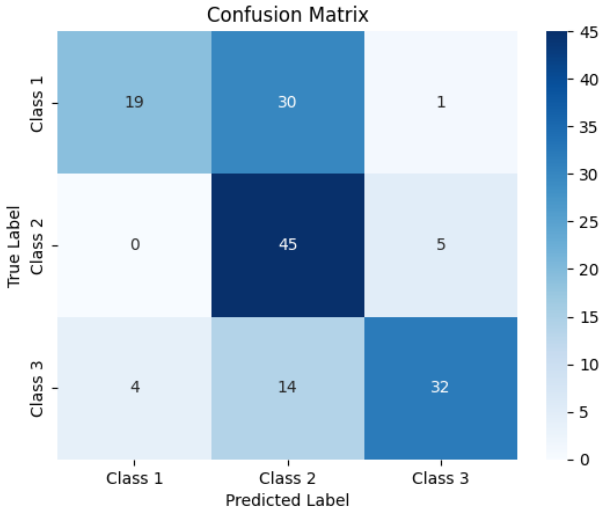
SVM RBF Kernel: degree = 5, gamma = 0.01, width = 100.0

Classification Accuracy: 0.64
Classification Report:
Class 1:
  Precision: 0.8261
  Recall: 0.3800
  F1-Score: 0.5205
  Support: 50.0

Class 2:
  Precision: 0.5056
  Recall: 0.9000
  F1-Score: 0.6475
  Support: 50.0

Class 3:
  Precision: 0.8421
  Recall: 0.6400
  F1-Score: 0.7273
  Support: 50.0

Mean Precision: 0.7246033990692412
Mean Recall: 0.64
Mean F1-Score: 0.6317675622888985
Confusion Matrix:
 [[19 30 1]
 [0 45 5]
 [4 14 32]]



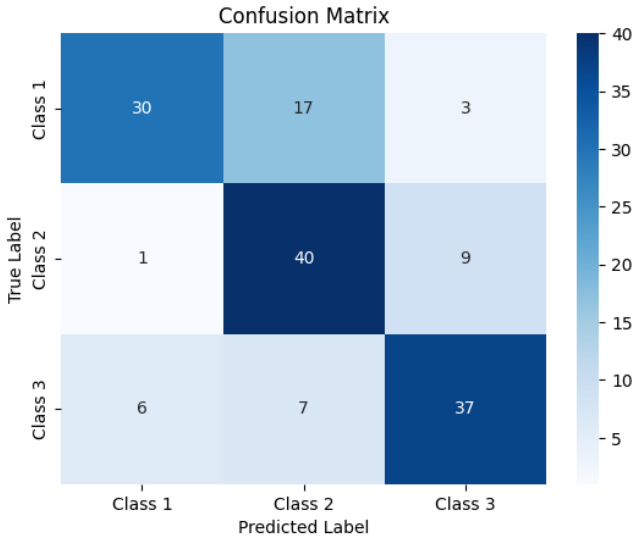
SVM RBF Kernel: degree = 5, gamma = 0.5, width = 2.0

Classification Accuracy: 0.7133333333333334
Classification Report:
Class 1:
  Precision: 0.8108
  Recall: 0.6000
  F1-Score: 0.6897
  Support: 50.0

Class 2:
  Precision: 0.6250
  Recall: 0.8000
  F1-Score: 0.7018
  Support: 50.0

Class 3:
  Precision: 0.7551
  Recall: 0.7400
  F1-Score: 0.7475
  Support: 50.0

Mean Precision: 0.7303042838757126
Mean Recall: 0.7133333333333333
Mean F1-Score: 0.7129614352844843
Confusion Matrix:
[[30 17 3]
 [1 40 9]
 [6 7 37]]



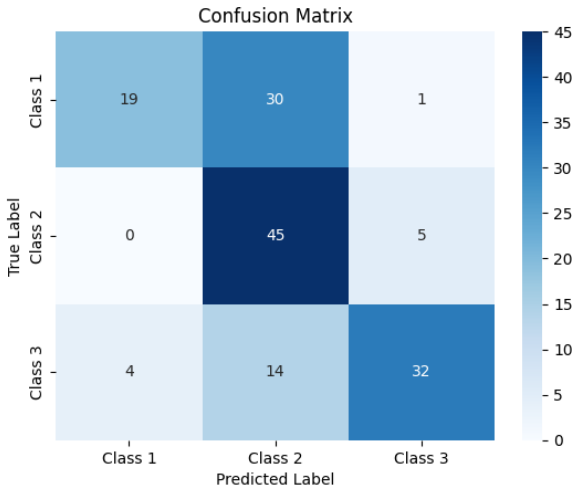
SVM RBF Kernel: degree = 5, gamma = 0.1, width = 10.0

Classification Accuracy: 0.64
Classification Report:
Class 1:
  Precision: 0.8261
  Recall: 0.3800
  F1-Score: 0.5205
  Support: 50.0

Class 2:
  Precision: 0.5056
  Recall: 0.9000
  F1-Score: 0.6475
  Support: 50.0

Class 3:
  Precision: 0.8421
  Recall: 0.6400
  F1-Score: 0.7273
  Support: 50.0

Mean Precision: 0.7246033990692412
Mean Recall: 0.64
Mean F1-Score: 0.6317675622888985
Confusion Matrix:
[[19 30 1]
 [0 45 5]
 [4 14 32]]



The various values of parameters have been taken along with various degrees so essentially we have done experiments on various values of parameters.