ML Lab-10 (SVM)

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Section: C

Moons Dataset Questions

1. **Inferences aboutthe Linear Kernel's performance.**
   The linear kernel achieved an accuracy of 0.87, it performs well but not perfectly because the dataset is not linearly seperable , so it struggles to classify non linearly distributed data
2. **Comparison between RBF and Polynomial kernel decision boundaries.**
   the rbf is more flexible than the polynomial one , and it is clearly evident in the plots, the polynomial one is less precise so concluding that the rbf captures more data

Banknote Dataset Questions (2 questions):

1. **In this case, which kernel appears to be the most effective?**
   the rbf appears to be more effective than the other kernals as it's more smoother and capture the data well
2. **The Polynomial kernel shows lower performance here compared to the Moons dataset. What might be the reason for this?**
   the polynomial kernel often stuggle with the higher dimensional data, it tries to vreate complex decison boundries which might lead to overfitting and underfitting

Analysis Questions

1. **Compare the two plots. Which model, the "Soft Margin" (C=0.1) or the "Hard Margin" (C=100), produces a wider margin?**

   the soft margin produces the wider margin, because the value of c is small so, more margin between classes creates a smoother boundary that is tolerant to small outliers

2. **Why does the soft margin model allow "mistakes"?**
   the primary goal is achieve a balance between maximizing the margin and minimizing classification errors,flexibility helps the model handle noisy data and hence it allows some mistakes
3. **Which model is more likely to be overfitting and why?**

   The hard margin svm is more likely to overfit, a high value of C forces the model to classify every training point correctly even if that means adjusting the boundary to fit outliers

4. **Which model would you trust more for new data and why?**

   The soft margin svm would be more trustworthy on unseen data, its wider margin and tolerance for small errors so lower value of c

SCREENSHOTS

Training results

Moon dataset

a. **Classification Report for SVM with LINEAR Kernel with SRN**

```
SVM with LINEAR Kernel PES2UG23CS166
              precision    recall  f1-score   support

           0       0.85      0.89      0.87        75
           1       0.89      0.84      0.86        75

    accuracy                           0.87       150
   macro avg       0.87      0.87      0.87       150
weighted avg       0.87      0.87      0.87       150

----------------------------------------
```

b. **Classification Report for SVM with RBF Kernel with SRN**

```
SVM with RBF Kernel PES2UG23CS166
              precision    recall  f1-score   support

           0       0.95      1.00      0.97        75
           1       1.00      0.95      0.97        75

    accuracy                           0.97       150
   macro avg       0.97      0.97      0.97       150
weighted avg       0.97      0.97      0.97       150
```

c. **Classification Report for SVM with POLY Kernel with SRN**

```
SVM with POLY Kernel PES2UG23CS166
              precision    recall  f1-score   support

           0       0.85      0.95      0.89        75
           1       0.94      0.83      0.88        75

    accuracy                           0.89       150
   macro avg       0.89      0.89      0.89       150
weighted avg       0.89      0.89      0.89       150

----------------------------------------
```

Banknote dataset

a. **Classification Report for SVM with LINEAR Kernel**

```
SVM with LINEAR Kernel PES2UG23CS166
              precision    recall  f1-score   support

      Forged       0.90      0.88      0.89       229
     Genuine       0.86      0.88      0.87       183

    accuracy                           0.88       412
   macro avg       0.88      0.88      0.88       412
weighted avg       0.88      0.88      0.88       412

----------------------------------------
```

b. **Classification Report for SVM with RBF Kernel**

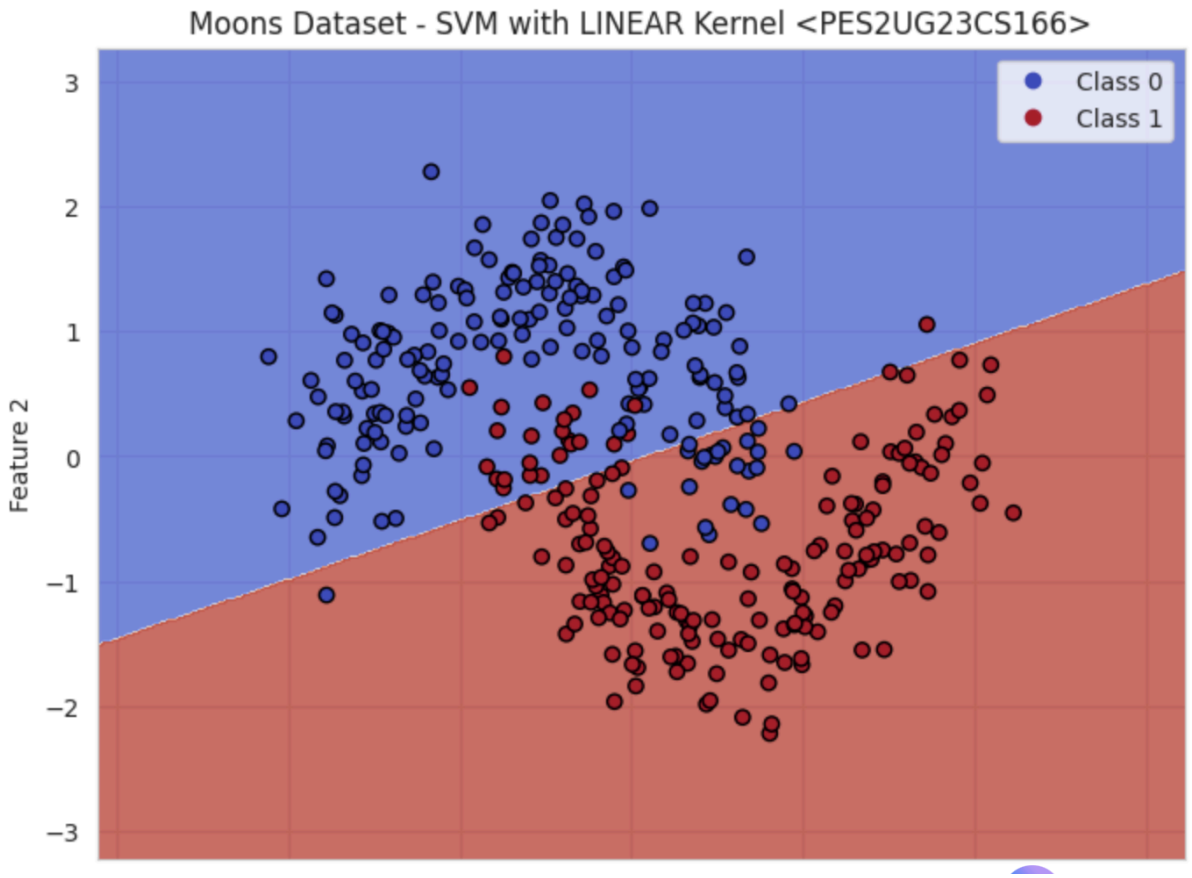
```
SVM with RBF Kernel PES2UG23CS166
              precision    recall  f1-score   support

      Forged       0.96      0.91      0.94       229
     Genuine       0.90      0.96      0.93       183

    accuracy                           0.93       412
   macro avg       0.93      0.93      0.93       412
weighted avg       0.93      0.93      0.93       412

----------------------------------------
```

c. **Classification Report for SVM with POLY Kernel**

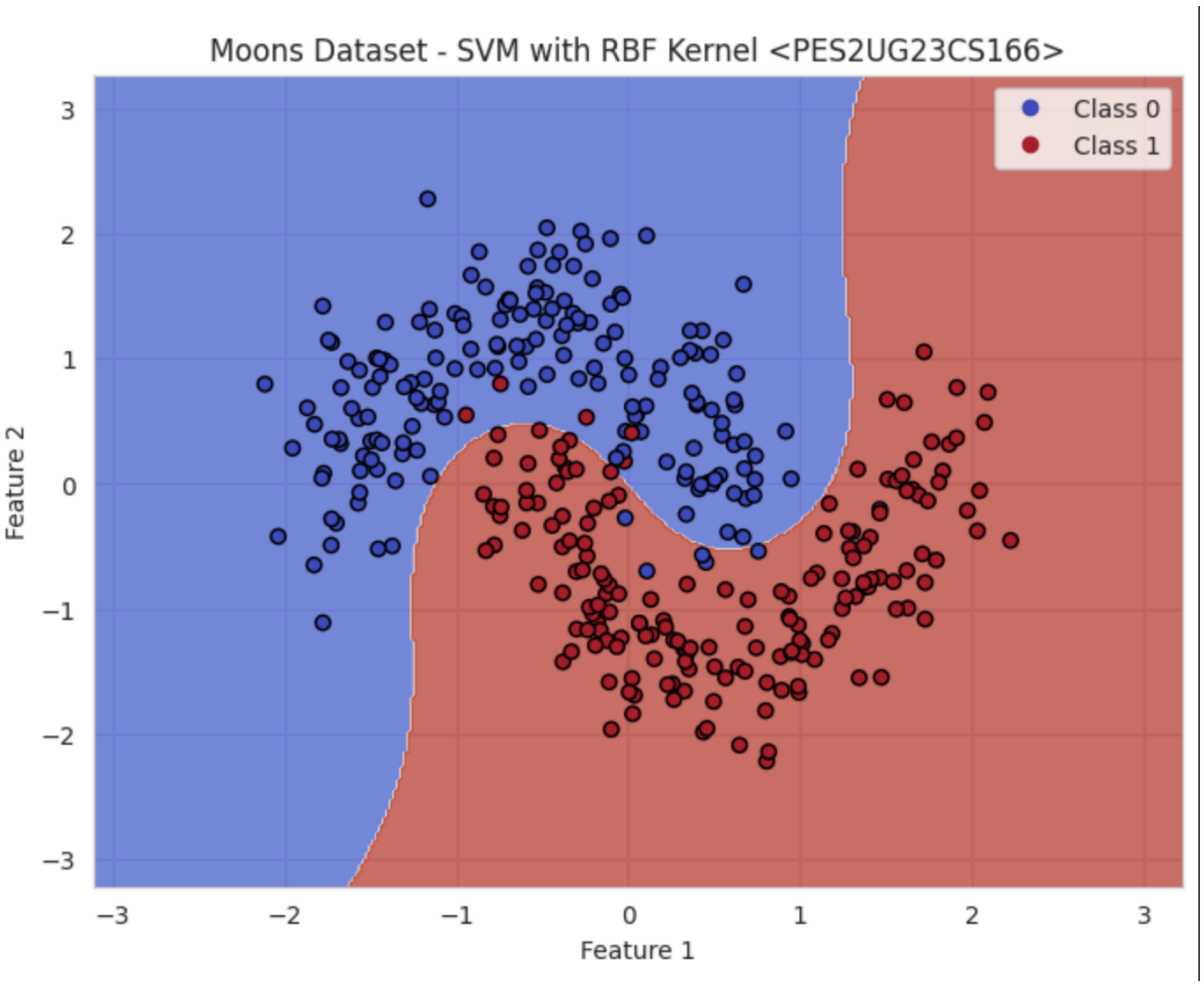
```
SVM with POLY Kernel PES2UG23CS166
              precision    recall  f1-score   support

      Forged       0.82      0.91      0.87       229
     Genuine       0.87      0.75      0.81       183

    accuracy                           0.84       412
   macro avg       0.85      0.83      0.84       412
weighted avg       0.85      0.84      0.84       412

----------------------------------------
```

1. MOON Dataset

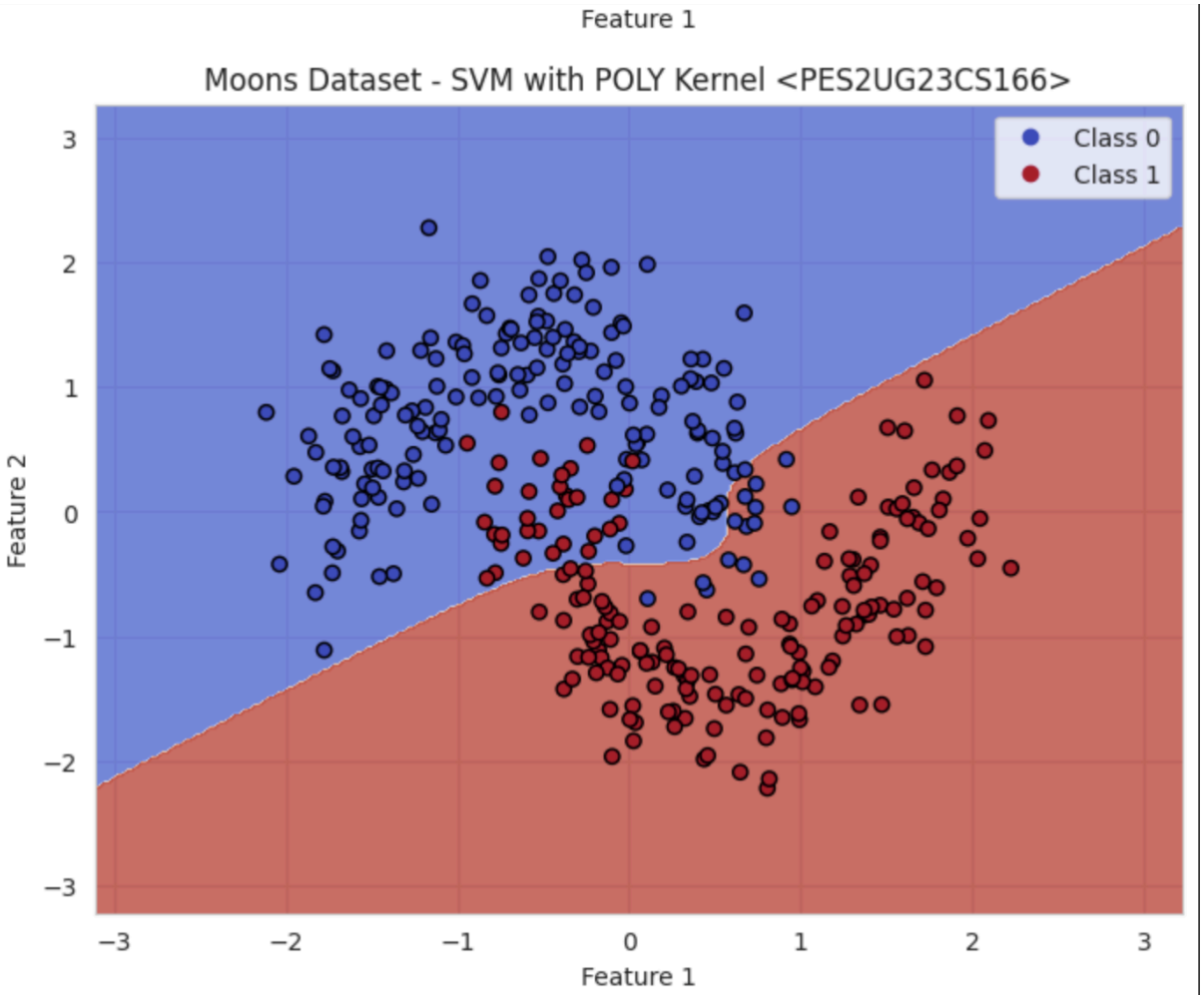
a. SVM with LINEAR Kernel with SRN



b. SVM with RBF Kernel with SRN

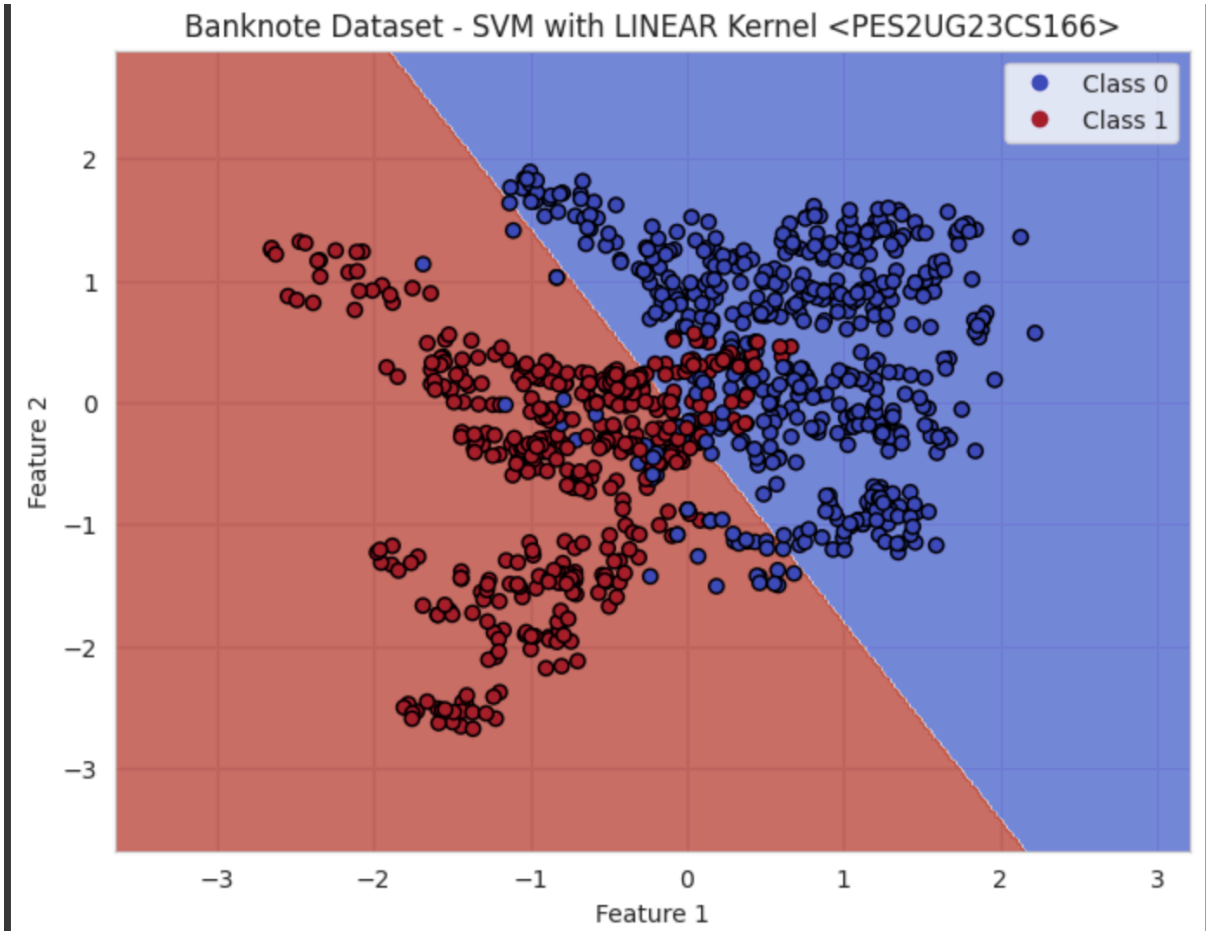


c. SVM with POLY Kernel with SRN

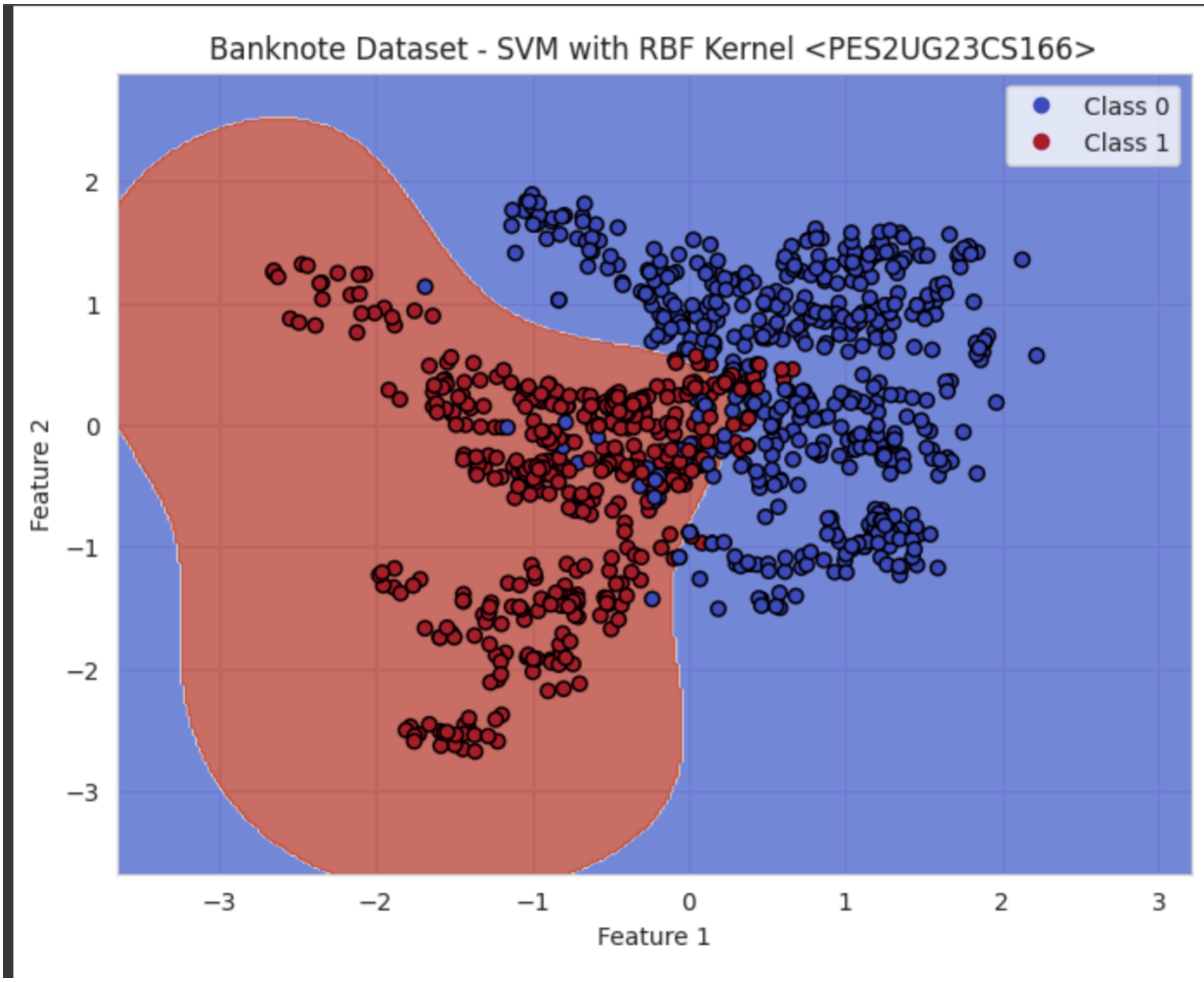


2. **Banknote dataset**

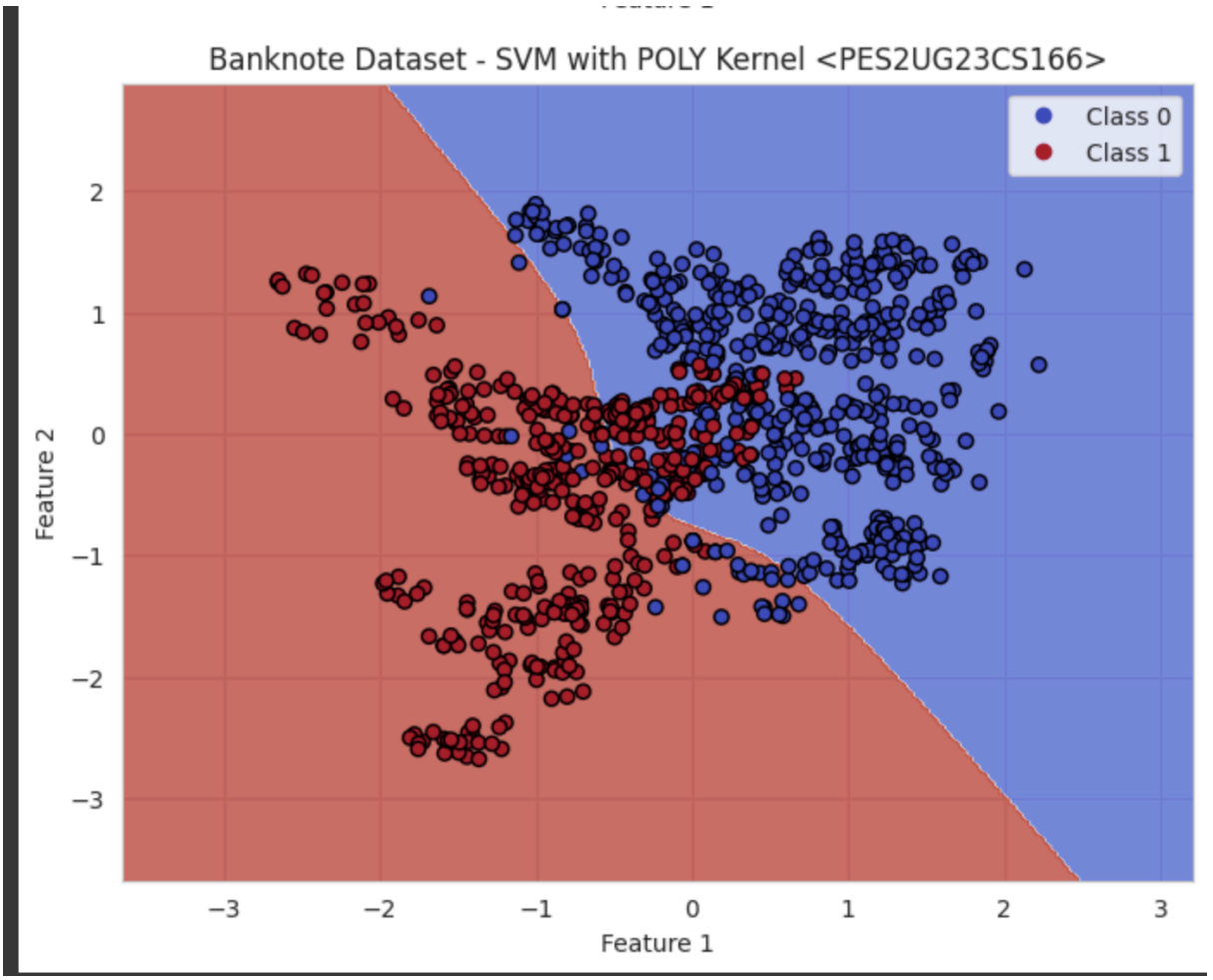
a. Banknote Dataset - SVM with LINEAR Kernel



b. Banknote Dataset - SVM with RBF Kernel

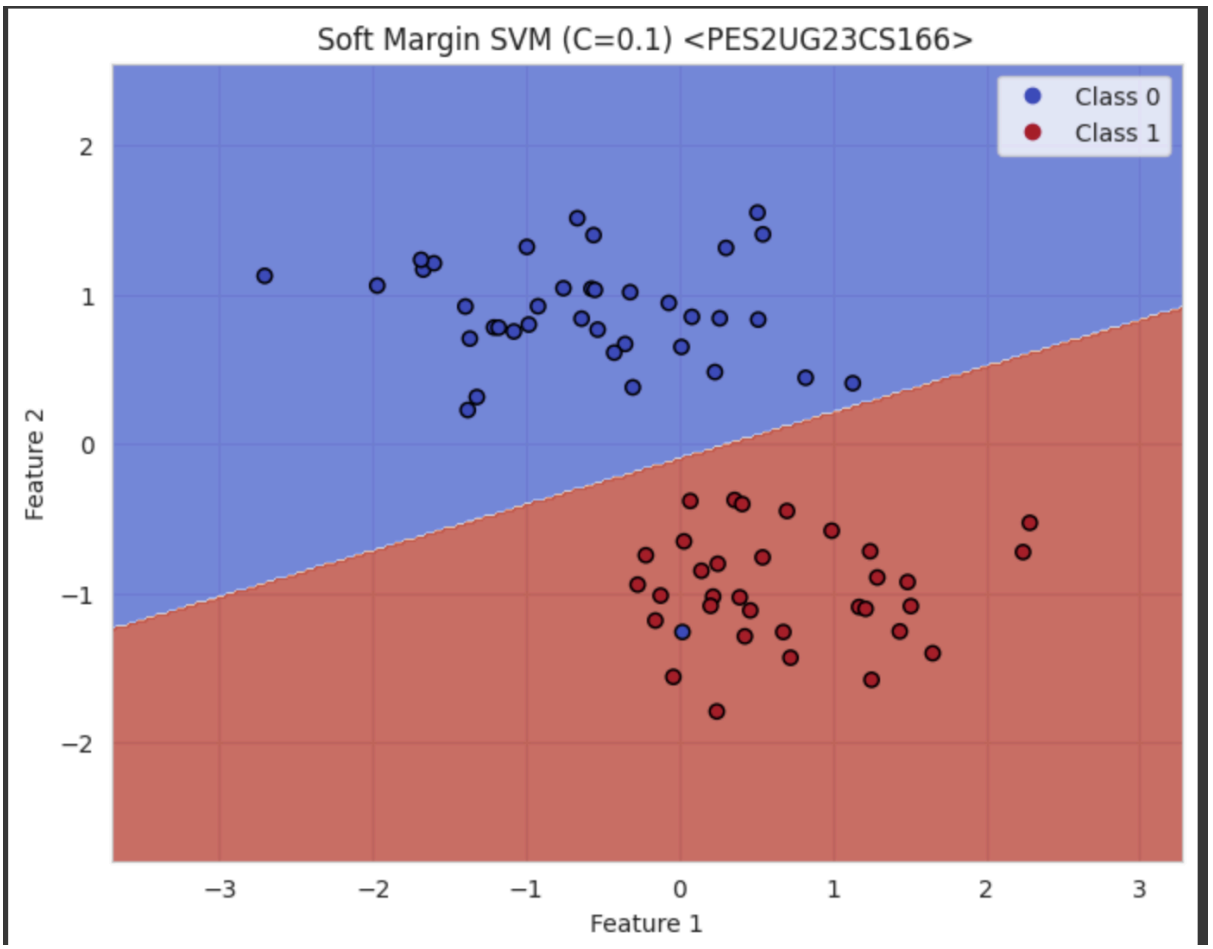


c. Banknote Dataset - SVM with POLY Kernel

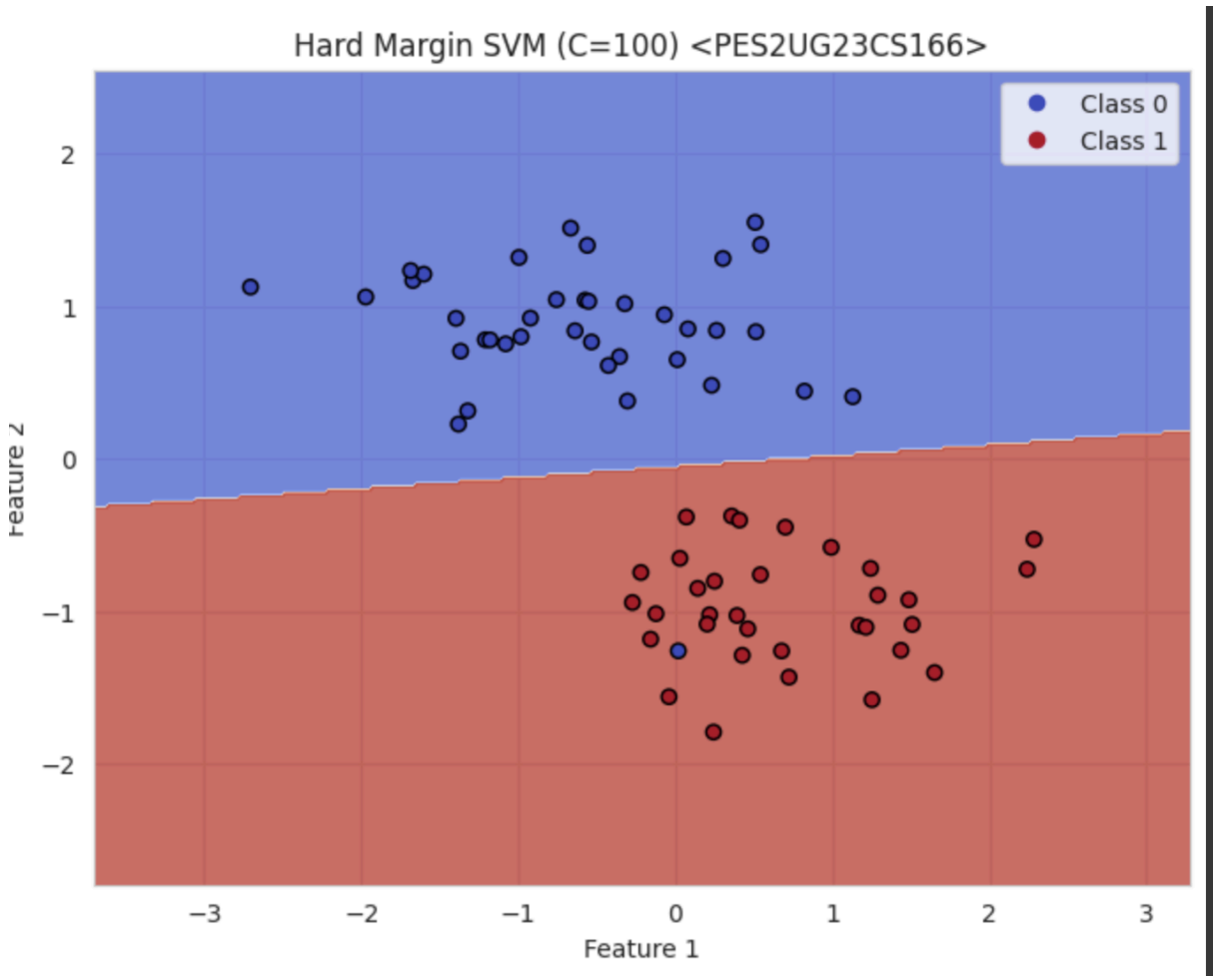


3. **Margin analysis**

   a. Soft margin(c=0.1)



b. Hard margin (c=100)


Hard Margin SVM (C=100) <PES2UG23CS166>
Class 0
Class 1
Feature 2
Feature 1
2
1
0
−1
−2
−3
−2
−1
0
1
2
3