ML Lab Week 9: SVM Classifier

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Section: C

Moons Dataset Questions (2 questions):

1. Inferences about the Linear Kernel's performance.

- The Linear Kernel performs poorly on the *Moons dataset* because the data is non-linearly separable. A linear decision boundary cannot effectively separate the overlap. So higher misclassifies

2. Comparison between RBF and Polynomial kernel decision boundaries.

- RBF capture the shape of the data more naturally, circular boundaries which holds good for this dataset while Polynomial also does same but produce rigid or more complex curves which gives overfitting boundary for this dataset

Banknote Dataset Questions (2 questions):

1. Which kernel was most effective for this dataset?

- RBF kernel generalizes this data well

2. Why might the Polynomial kernel have underperformed here?

- As the polynomial kernel requires the polynomial function between the variables, it underperformed with this data which have high dimensional numeric features

Hard vs. Soft Margin Questions (4 questions):

1. Which margin (soft or hard) is wider?

- Soft margin

2. Why does the soft margin model allow "mistakes"?

- To tolerate violations for better generalization

3. Which model is more likely to be overfitting and why?

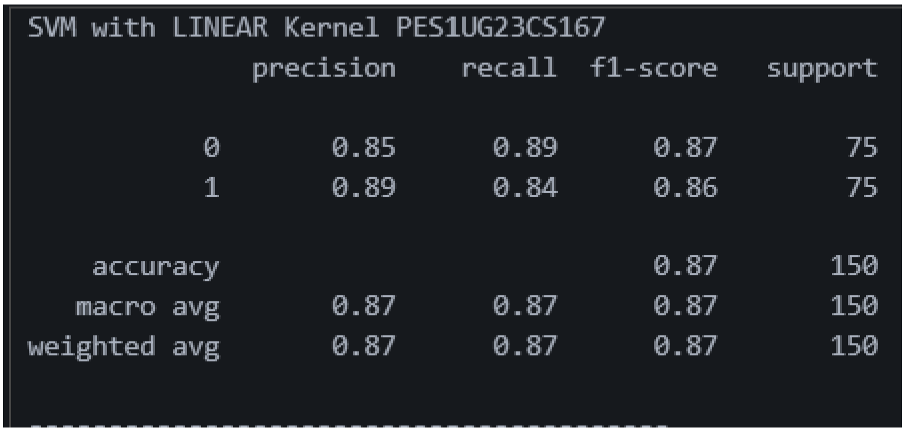
- Hard margin. As it tries to perfectly classify every training point, even noisy or outlier ones, it produces tight decision boundary that doesn’t generalize the data well.

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

- Soft Margin. It generalises the data better and tolerance to noise and misclassifies and real-world application as they have many noises and outliers.

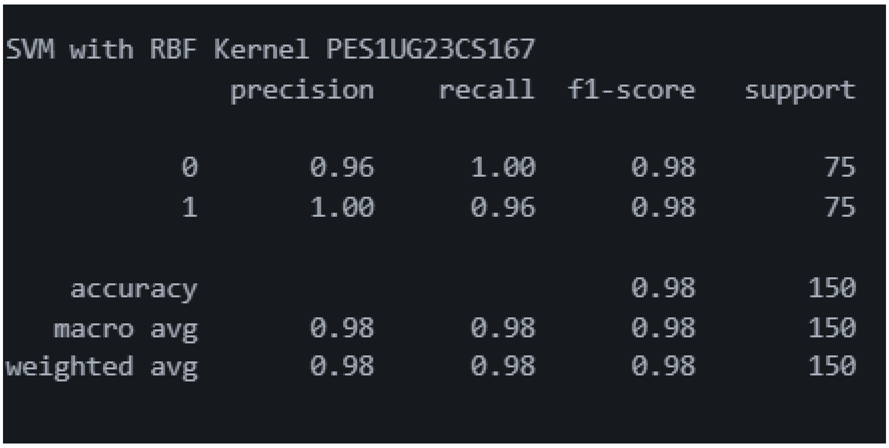
Moons Dataset (3 screenshots):

1. Classification Report for SVM with LINEAR Kernel with SRN



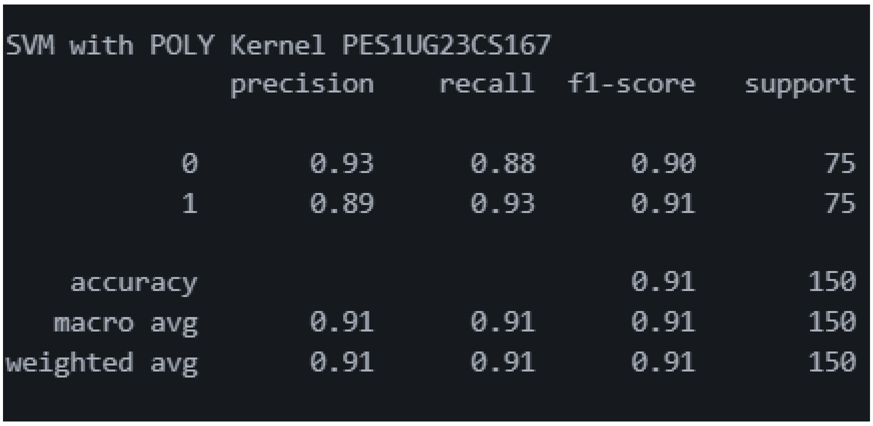
```
SVM with LINEAR Kernel PES1UG23CS167
              precision    recall  f1-score   support

           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
```

2. Classification Report for SVM with RBF Kernel with SRN



```
SVM with RBF Kernel PES1UG23CS167
              precision    recall  f1-score   support

           0       0.96      1.00      0.98        75
           1       1.00      0.96      0.98        75

    accuracy                           0.98       150
   macro avg       0.98      0.98      0.98       150
weighted avg       0.98      0.98      0.98       150
```

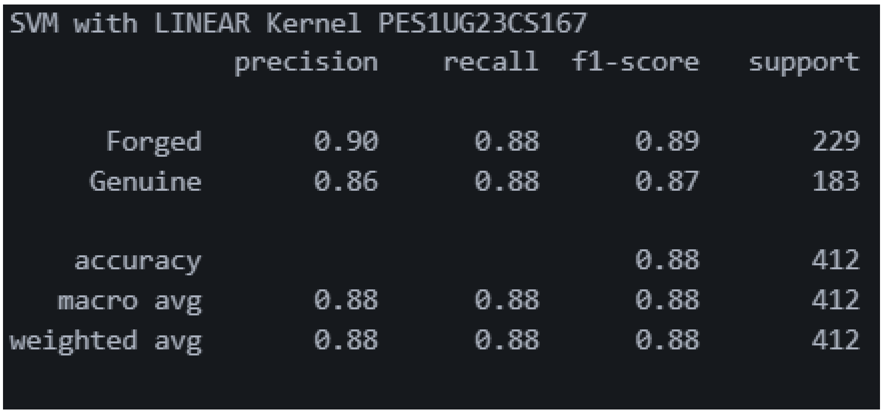
3. Classification Report for SVM with POLY Kernel with SRN



```
SVM with POLY Kernel PES1UG23CS167
              precision    recall  f1-score   support

           0       0.93      0.88      0.90        75
           1       0.89      0.93      0.91        75

    accuracy                           0.91       150
   macro avg       0.91      0.91      0.91       150
weighted avg       0.91      0.91      0.91       150
```

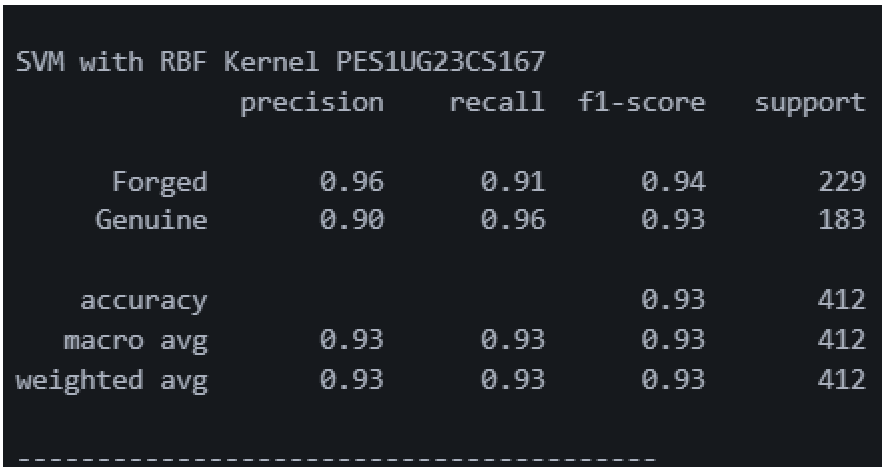
Banknote Dataset (3 screenshots):

4. Classification Report for SVM with LINEAR Kernel



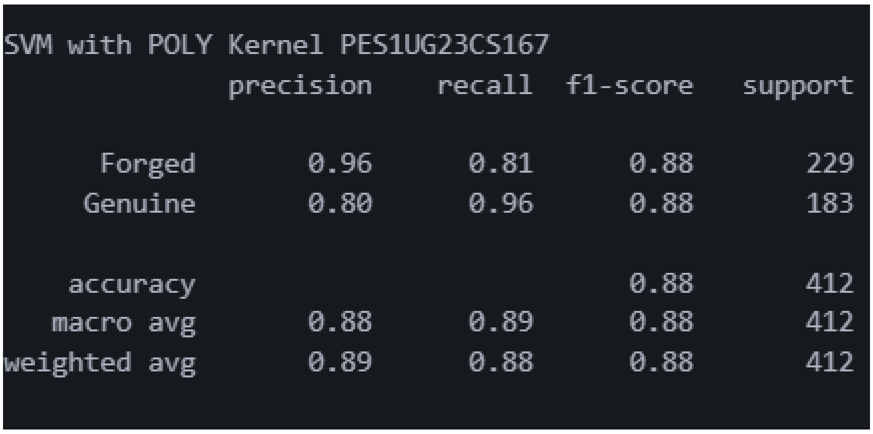
```
SVM with LINEAR Kernel PES1UG23CS167
              precision    recall  f1-score   support

      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
```

5. Classification Report for SVM with RBF Kernel



```
SVM with RBF Kernel PES1UG23CS167
              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

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

6. Classification Report for SVM with POLY Kernel

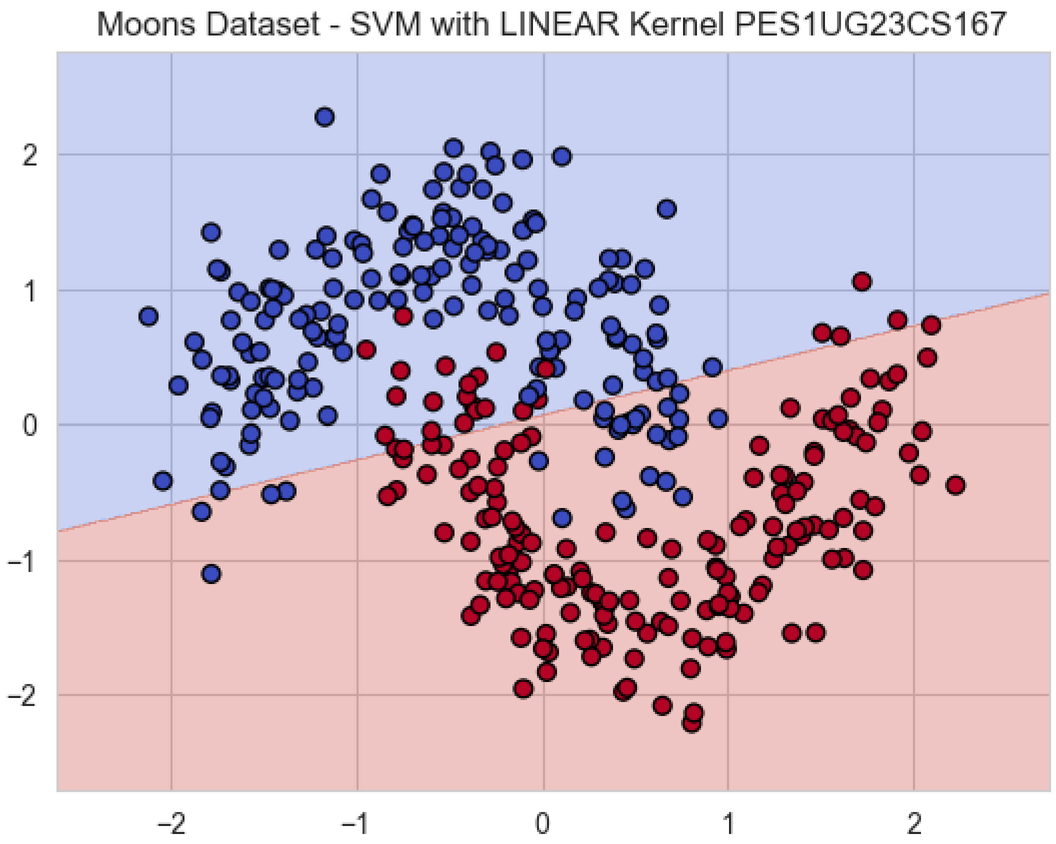


```
SVM with POLY Kernel PES1UG23CS167
              precision    recall  f1-score   support

      Forged       0.96      0.81      0.88       229
     Genuine       0.80      0.96      0.88       183

    accuracy                           0.88       412
   macro avg       0.88      0.89      0.88       412
weighted avg       0.89      0.88      0.88       412
```

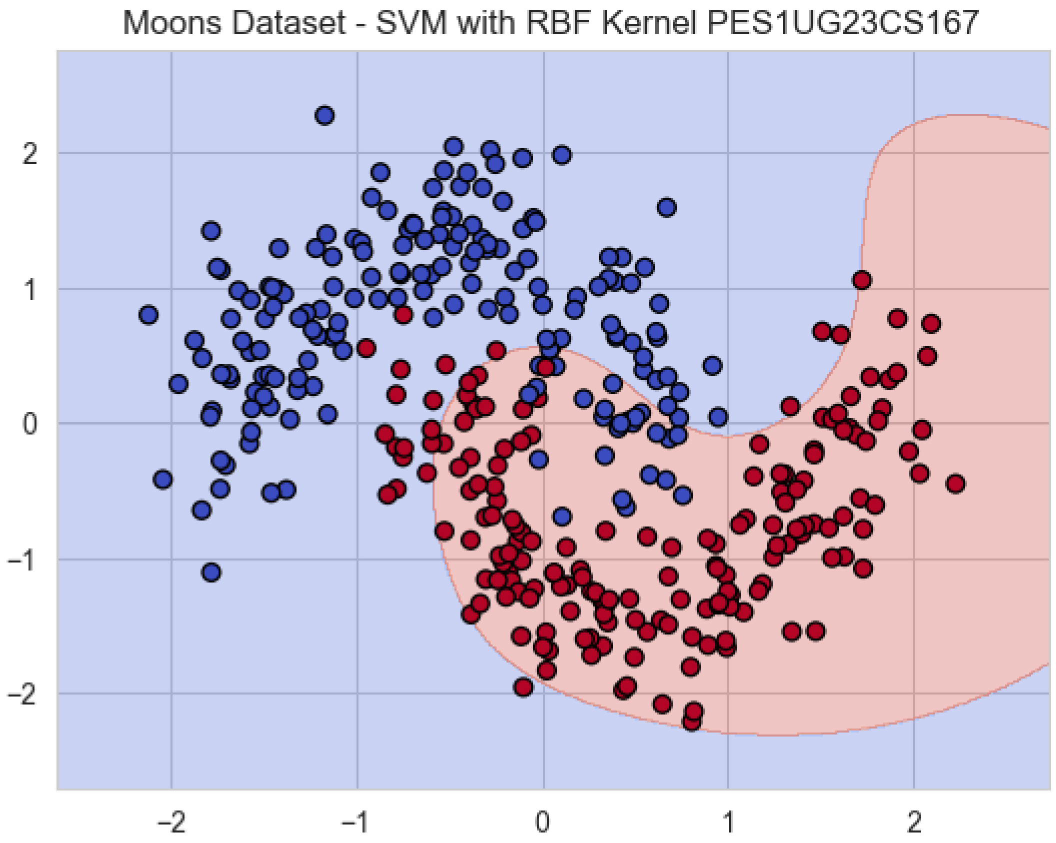
Decision Boundary Visualizations (8 Screenshots)

Moons Dataset (3 plots):

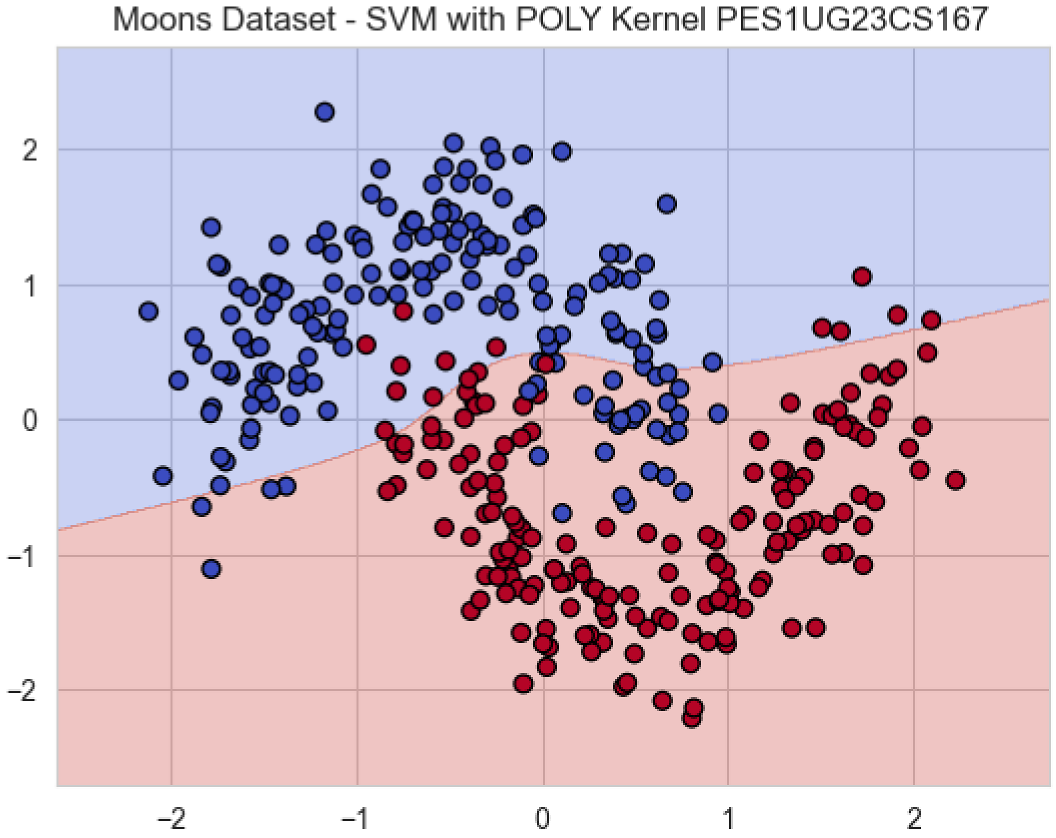
7. Moons Dataset - SVM with LINEAR Kernel



8. Moons Dataset - SVM with RBF Kernel

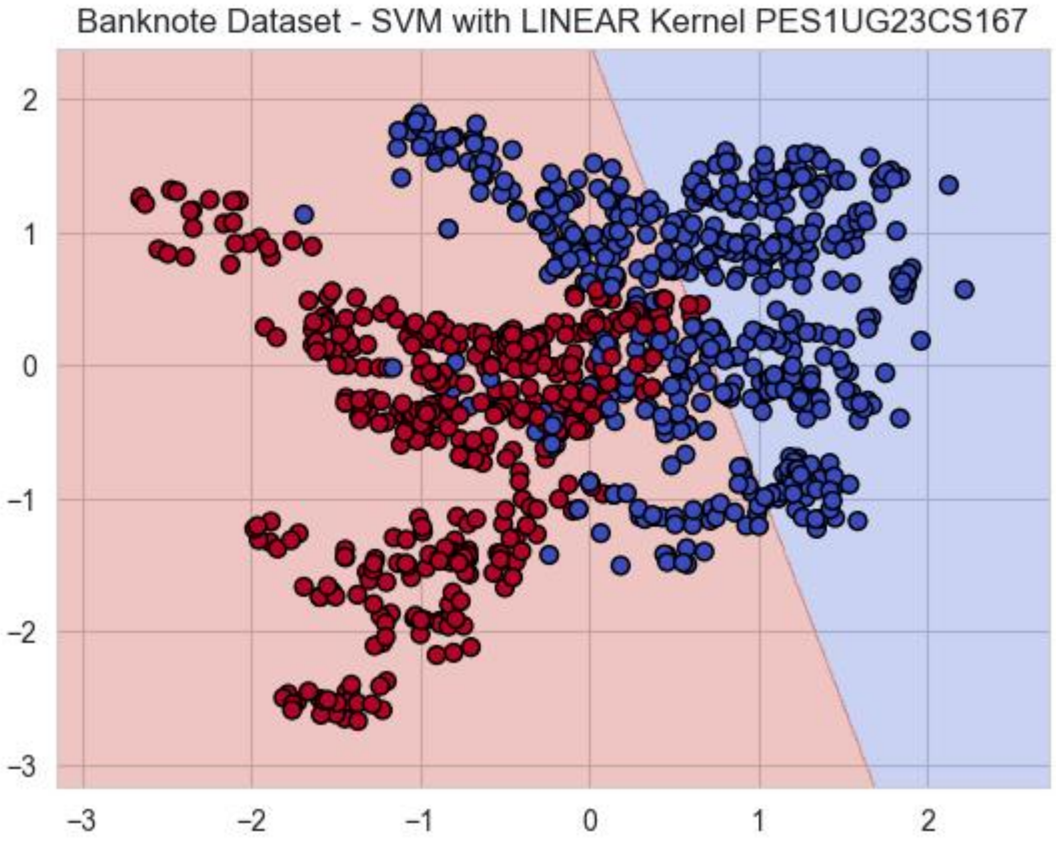


9. Moons Dataset - SVM with POLY Kernel

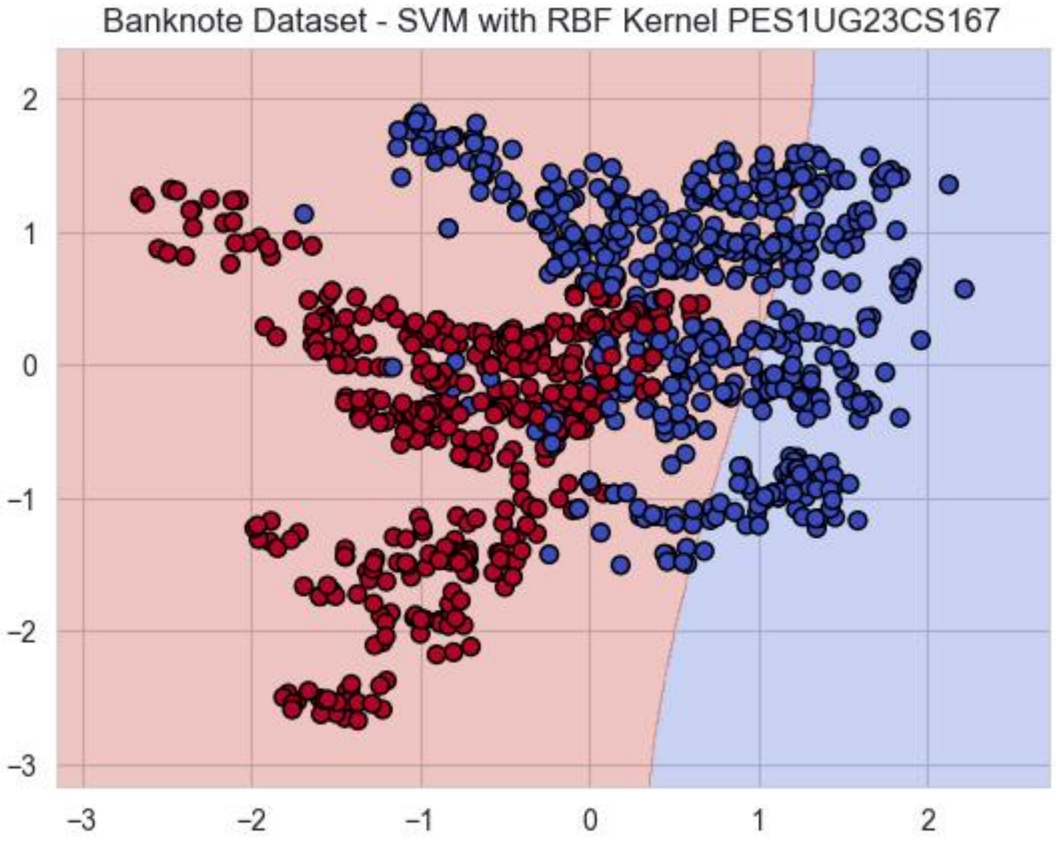


Banknote Dataset (3 plots):

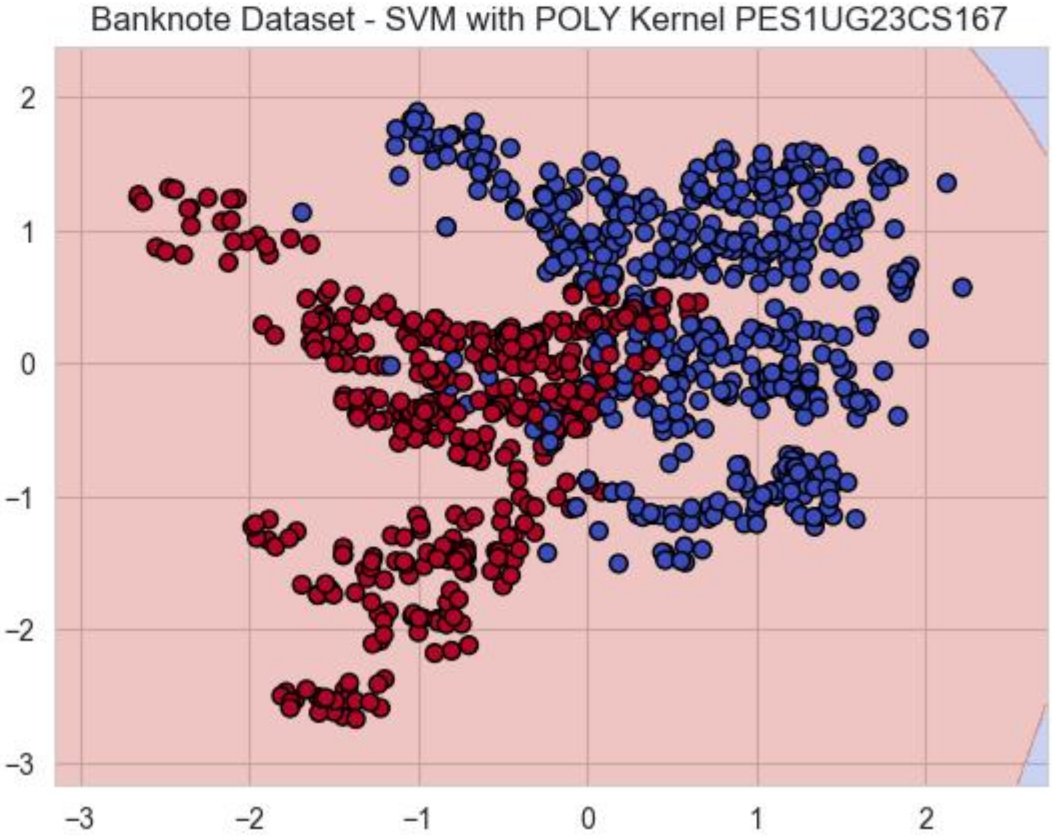
10. Banknote Dataset - SVM with LINEAR Kernel



11. Banknote Dataset - SVM with RBF Kernel

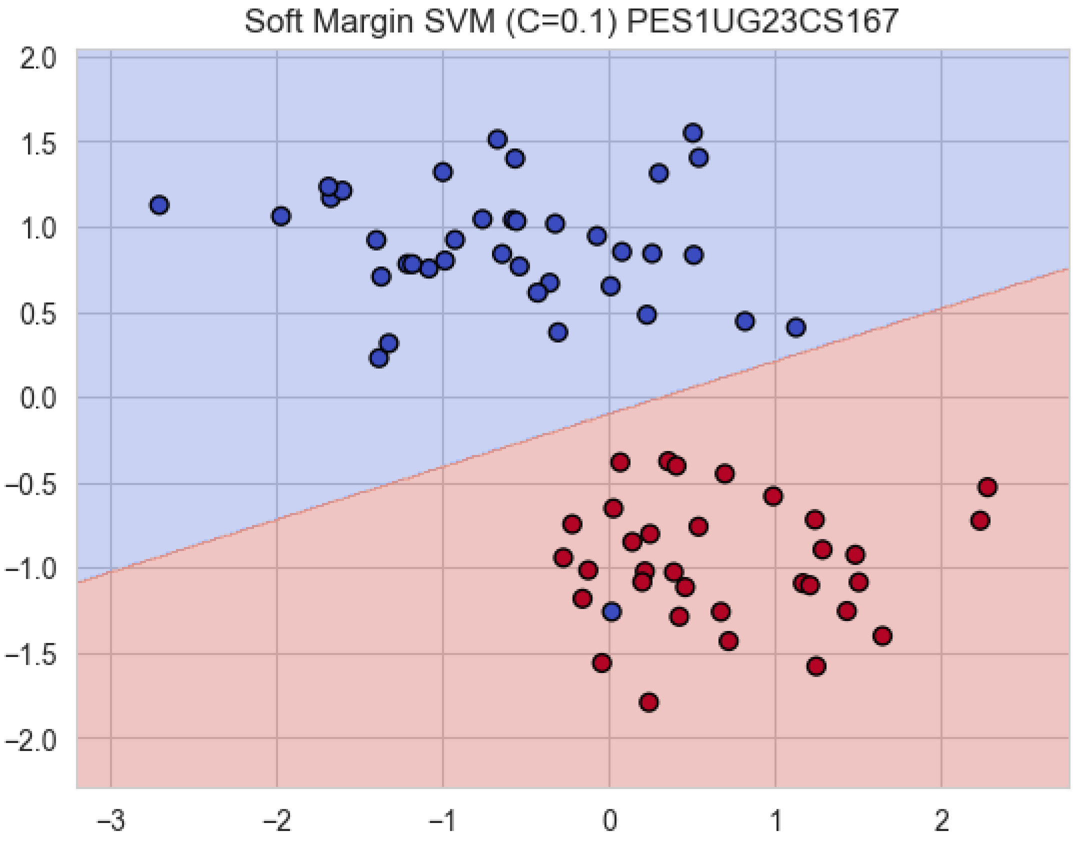


12. Banknote Dataset - SVM with POLY Kernel

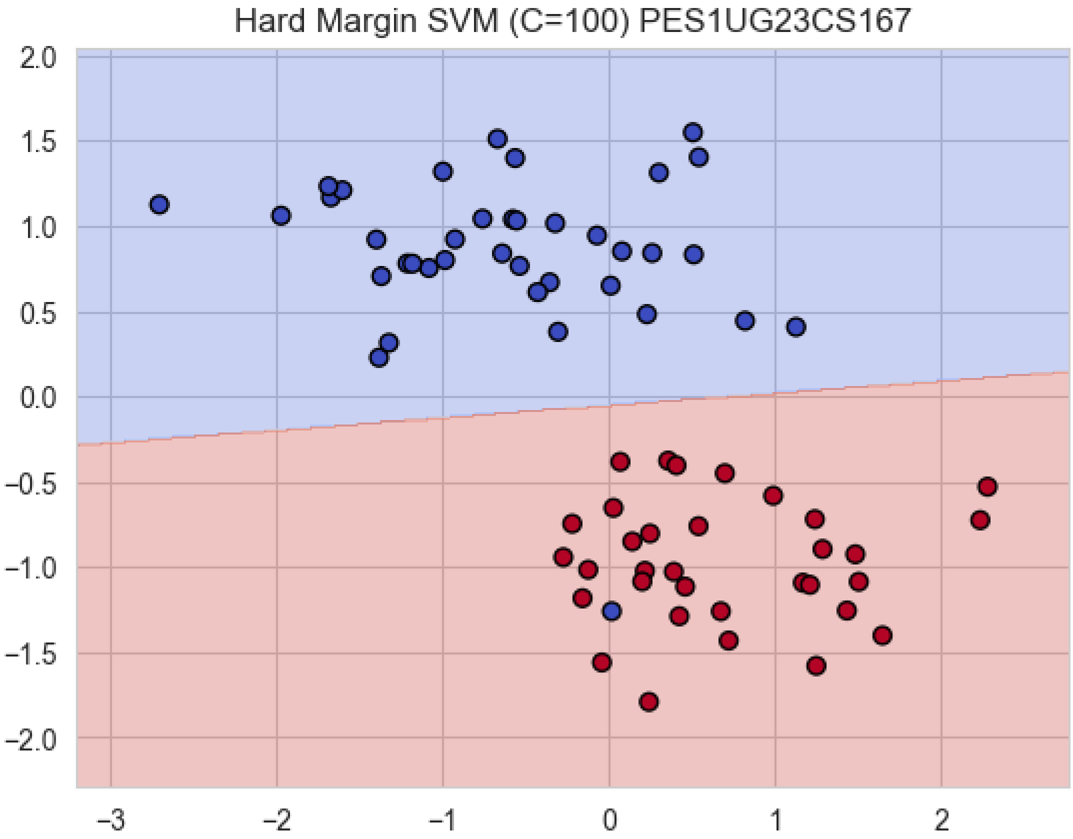


Margin Analysis (2 plots):

13. Soft Margin SVM (C=0.1)



14. Hard Margin SVM (C=100)


Hard Margin SVM (C=100) PES1UG23CS167