Penguin_Classification

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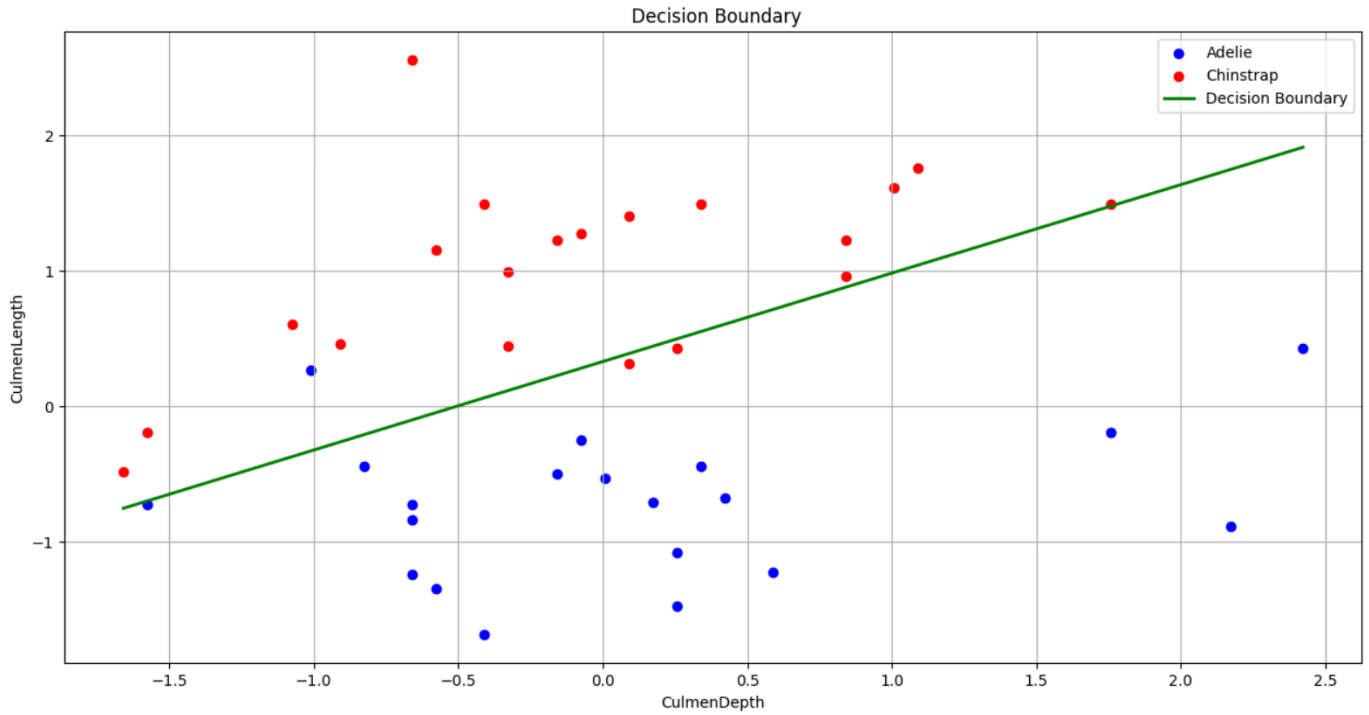
Perceptron Algorithm

Adelie vs Chinstrap – Features: CulmenDepth & CulmenLength



Parameters:

- Learning rate:0.01
- Number of epochs: 50
- Used Bias

Results

Train Accuracy: 100.00%

Train Confusion Matrix:
[[30 0]
[0 30]]

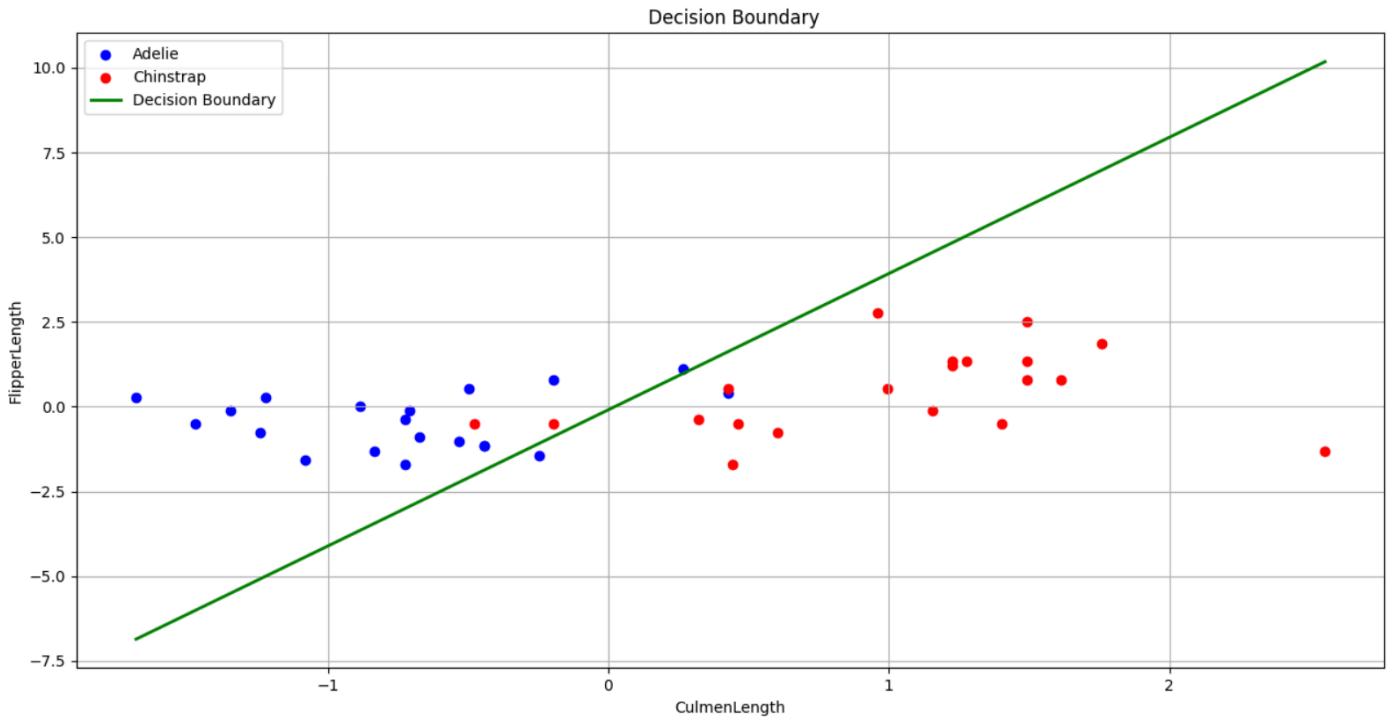
Test Accuracy: 92.50%

Test Confusion Matrix:
[[19 1]
[2 18]]

The figure shows that CulmenDepth and CulmenLength provide strong separation between Adelie and Chinstrap classes. Although there is some overlap in the center, the decision boundary correctly classifies most points, achieving high accuracy (92.5%), which indicates these features are good for distinguishing the two classes.

Perceptron Algorithm

Adelie vs Chinstrap – Features: FlipperLength & CulmenLength



Parameters:

- Learning rate:0.01
- Number of epochs: 50
- Used Bias

Results

Train Accuracy: 100.00%

Train Confusion Matrix:
[[30 0]
[0 30]]

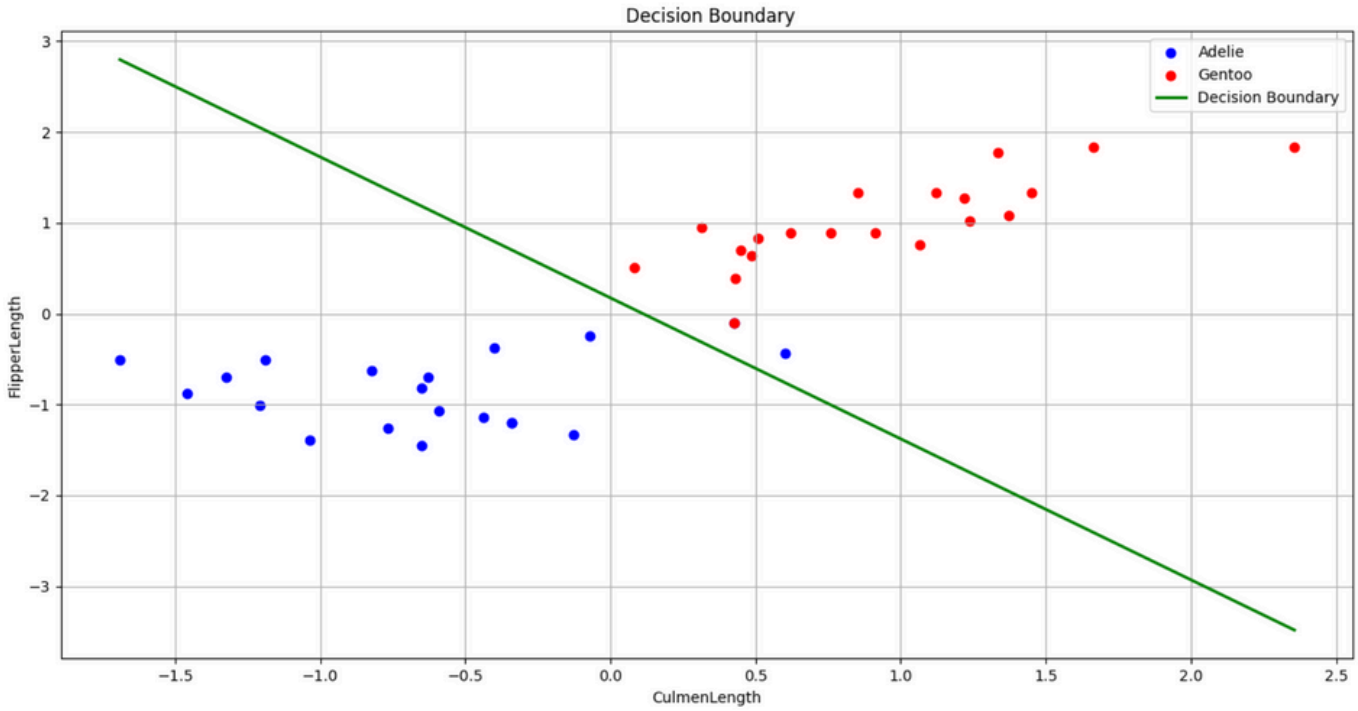
Test Accuracy: 90.00%

Test Confusion Matrix:
[[18 2]
[2 18]]

The figure shows that CulmenLength and FlipperLength provide good separation between Adelie and Chinstrap classes. Although there is some overlap near the center, the decision boundary correctly classifies most points, achieving an accuracy of 90%, which indicates these features are good for distinguishing the two classes.

Perceptron Algorithm

Adelie vs Gentoo - Features: FlipperLength & CulmenLength



Parameters:

- Learning rate:0.01
- Number of epochs: 50
- Used Bias

Results

Train Accuracy: 100.00%

Train Confusion Matrix:
[[30 0]
[0 30]]

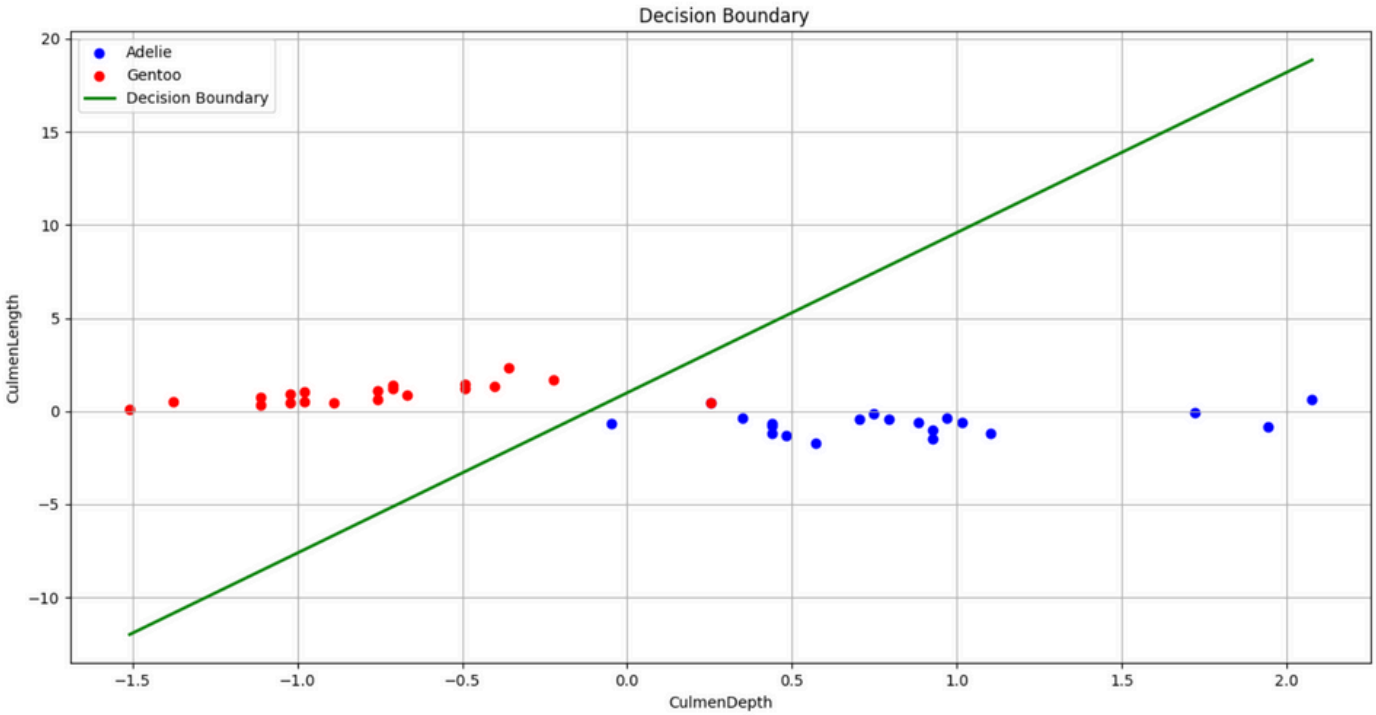
Test Accuracy: 95.00%

Test Confusion Matrix:
[[18 2]
[0 20]]

The figure shows that CulmenLength and FlipperLength provide very strong separation between Adelie and Gentoo classes. The decision boundary clearly divides the two groups with minimal overlap, achieving a high accuracy of 95%, which indicates these features are highly effective for distinguishing the two classes.

Perceptron Algorithm

Adelie vs Gentoo - Features: CulmenDepth & CulmenLength



Parameters:

- Learning rate:0.01
- Number of epochs: 50
- Used Bias

Results

Train Accuracy: 100.00%

Train Confusion Matrix:
[[30 0]
[0 30]]

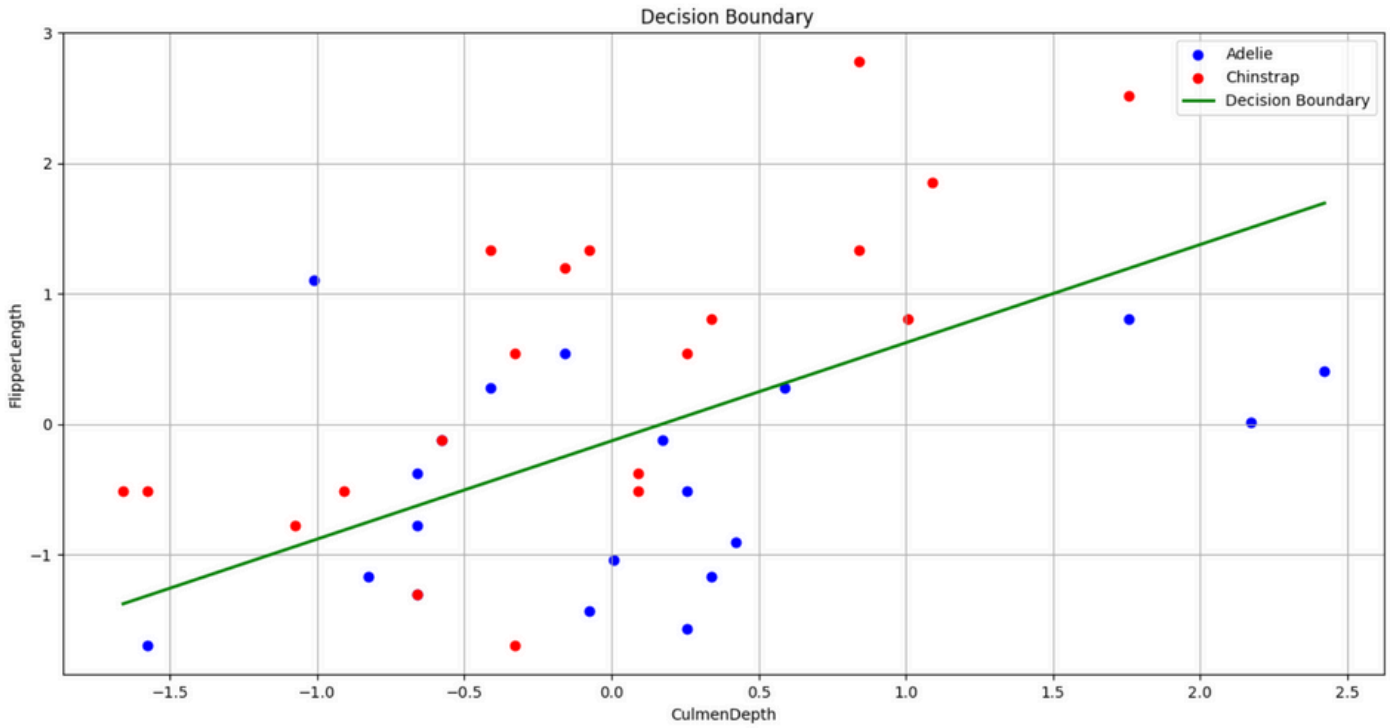
Test Accuracy: 97.50%

Test Confusion Matrix:
[[20 0]
[1 19]]

The figure shows that CulmenDepth and CulmenLength provide excellent separation between Adelie and Gentoo classes. The decision boundary correctly classifies almost all points, achieving a very high accuracy of 97.5%, which indicates these features are highly effective for distinguishing the two classes.

Perceptron Algorithm

Adelie vs Chinstrap - Features: CulmenDepth &FlipperLength



Parameters:

- Learning rate:0.2
- Number of epochs: 500
- Used Bias

Results

Train Accuracy: 80.00%

Train Confusion Matrix:
[[21 9]
[3 27]]

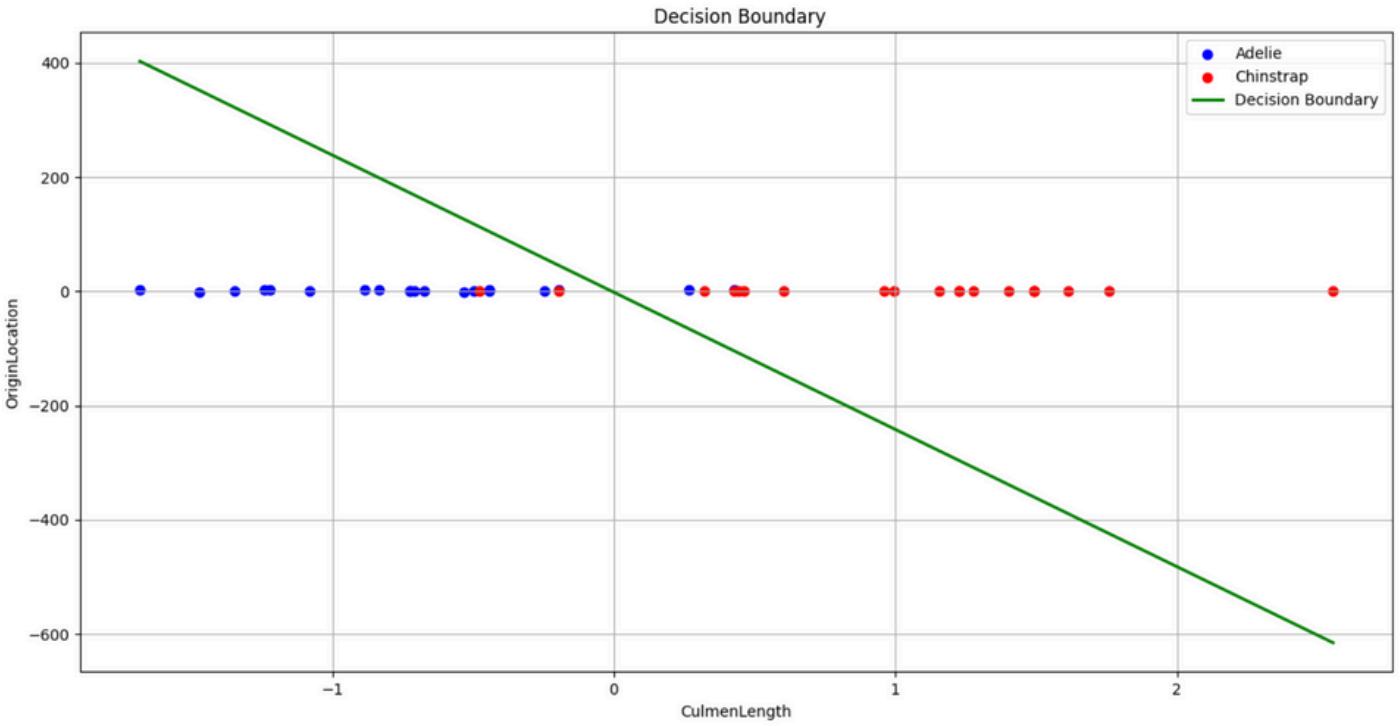
Test Accuracy: 77.50%

Test Confusion Matrix:
[[15 5]
[4 16]]

The figure shows that CulmenDepth and FlipperLength provide weak separation between Adelie and Chinstrap classes. There is significant overlap between the two classes, and the decision boundary misclassifies many points, resulting in a relatively low accuracy of 77.5%. This indicates these features are not very effective for distinguishing the two classes.

Adaline Algorithm

Adelie vs Chinstrap – Features: CulmenLength &OriginLocation



Parameters:

- Learning rate:0.01
- Number of epochs: 50
- Used Bias
- MSE Threshold: 0.0000001

Results

Train Accuracy: 95.00%

Train Confusion Matrix:
[[29 1]
[2 28]]

Test Accuracy: 90.00%

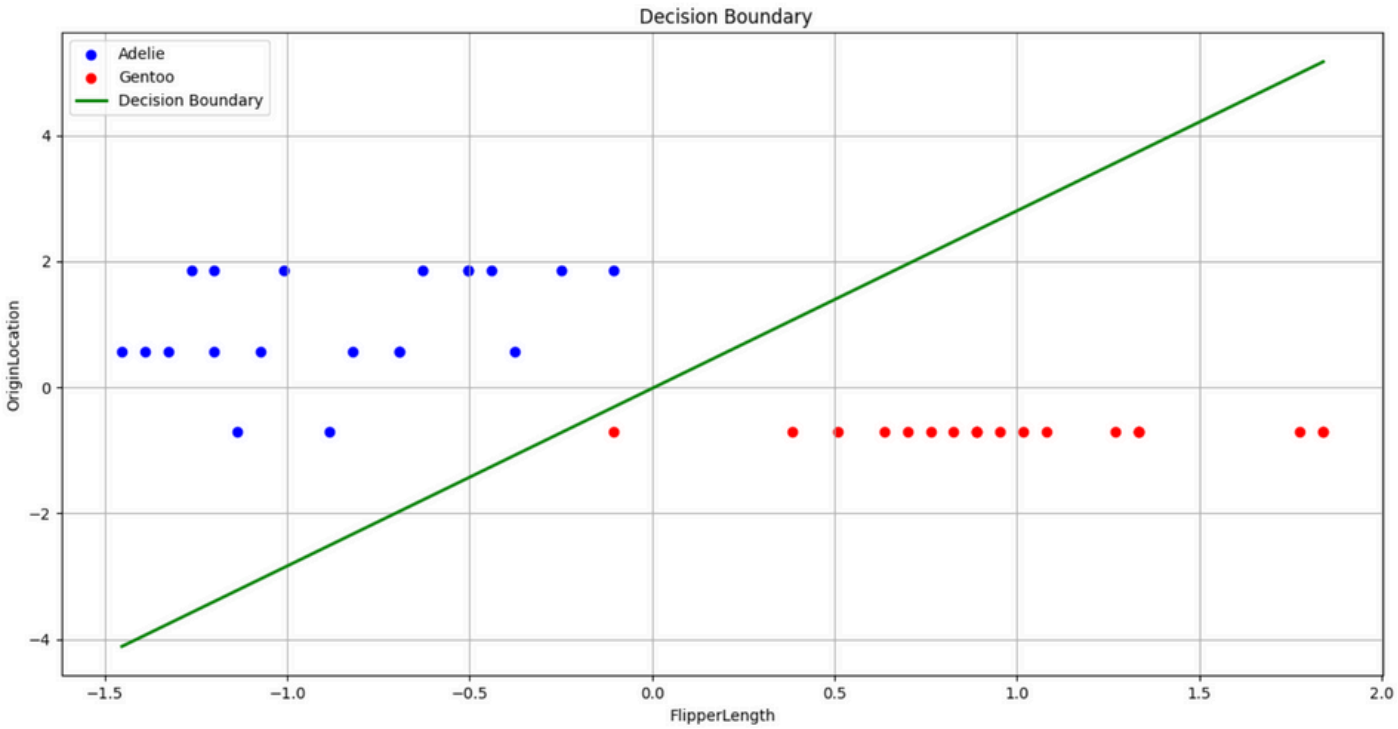
Test Confusion Matrix:
[[18 2]
[2 18]]

Train MSE: 0.1000
Test MSE: 0.2000

The figure shows that CulmenLength and OriginLocation provide a strong separation between the Adelie and Chinstrap classes. The decision boundary clearly divides the two groups, with most Adelie points (blue) on the left and Chinstrap points (red) on the right. There is minimal overlap between the classes, and only a few points are close to the boundary. This results in a relatively high accuracy of 90%, indicating that these features are highly effective for distinguishing between the two classes.

Adaline Algorithm

Adelie vs Gentoo- Features: FlipperLength &OriginLocation



Parameters:

- Learning rate:0.01
- Number of epochs: 500
- Used Bias
- MSE Threshold: 0.0000001

Results

Train Accuracy: 100.00%

Train Confusion Matrix:
[[30 0]
[0 30]]

Test Accuracy: 100.00%

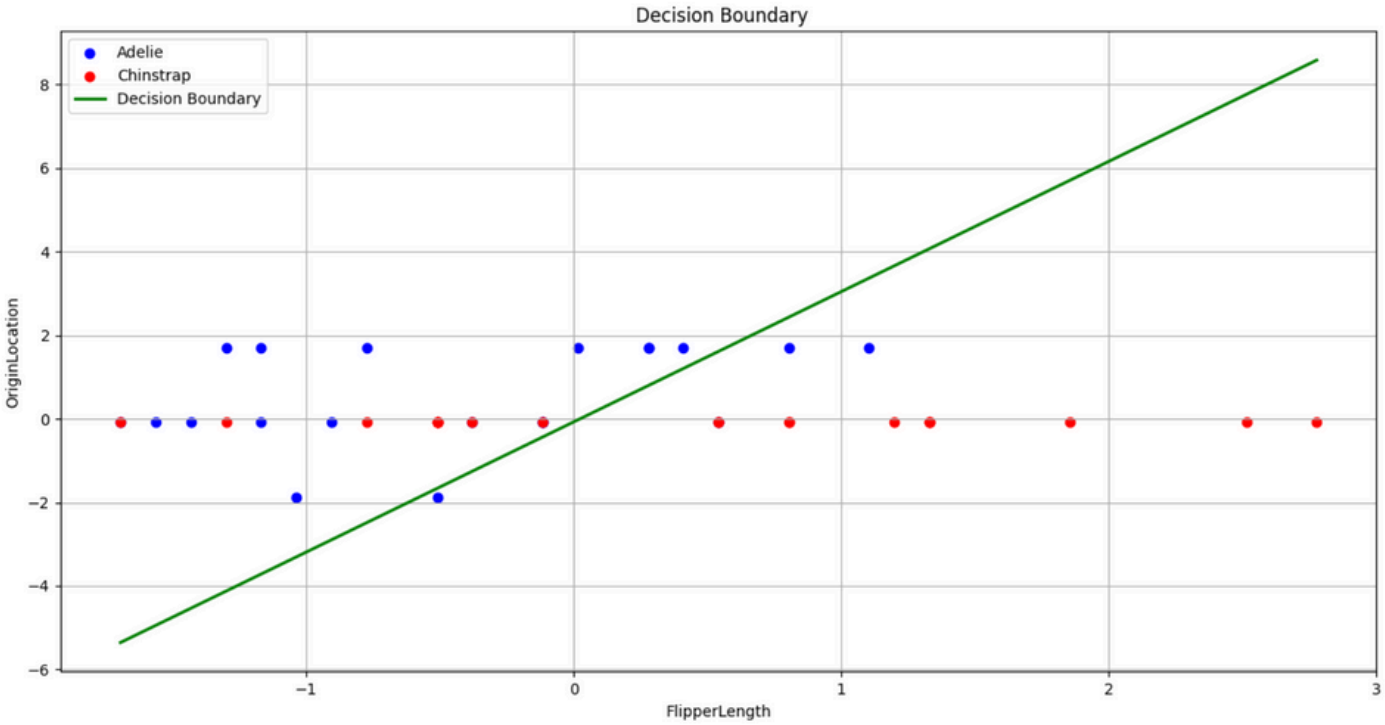
Test Confusion Matrix:
[[20 0]
[0 20]]

Train MSE: 0.0000
Test MSE: 0.0000

The figure shows that FlipperLength and OriginLocation provide a very strong separation between the Adelie and Gentoo classes. The decision boundary (green line) clearly divides the two groups, with most Adelie points (blue) located on the upper-left side and Gentoo points (red) on the lower-right side. There is almost no overlap between the classes, and only one or two points are close to the boundary. This results in a perfect accuracy of 100%, indicating that these features are highly effective for distinguishing between the two classes.

Adaline Algorithm

Adelie vs Chinstrap – Features: FlipperLength &OriginLocation



Parameters:

- Learning rate:0.01
- Number of epochs: 50
- Used Bias
- MSE Threshold: 0.0000001

Results

Train Accuracy: 81.67%

Train Confusion Matrix:
[[23 7]
[4 26]]

Test Accuracy: 67.50%

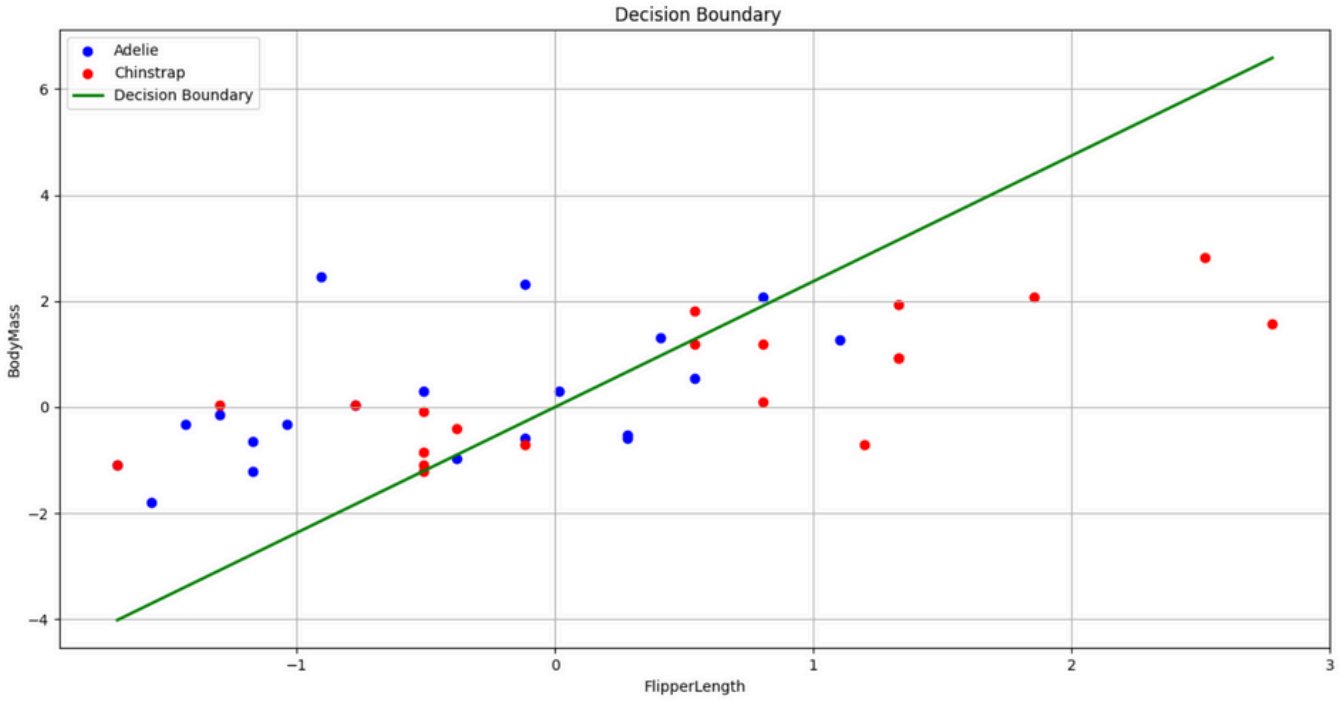
Test Confusion Matrix:
[[16 4]
[9 11]]

Train MSE: 0.3667
Test MSE: 0.6500

The figure shows that FlipperLength and OriginLocation provide a weak separation between the Adelie and Chinstrap classes. The decision boundary (green line) attempts to divide the two groups, but there is significant overlap. Many Adelie points (blue) and Chinstrap points (red) are close to the boundary or even on the wrong side, which reduces the classifier's ability to distinguish between the classes. This results in a relatively low accuracy of 67.5%, indicating that these features are not effective for separating Adelie and Chinstrap compared to other feature combinations.

Adaline Algorithm

Adelie vs Chinstrap – Features: FlipperLength &BodyMass



Parameters:

- Learning rate:0.01
- Number of epochs: 500
- No Bias
- MSE Threshold: 0.0000001

Results

Train Accuracy: 85.00%

Train Confusion Matrix:
[[24 6]
[3 27]]

Test Accuracy: 65.00%

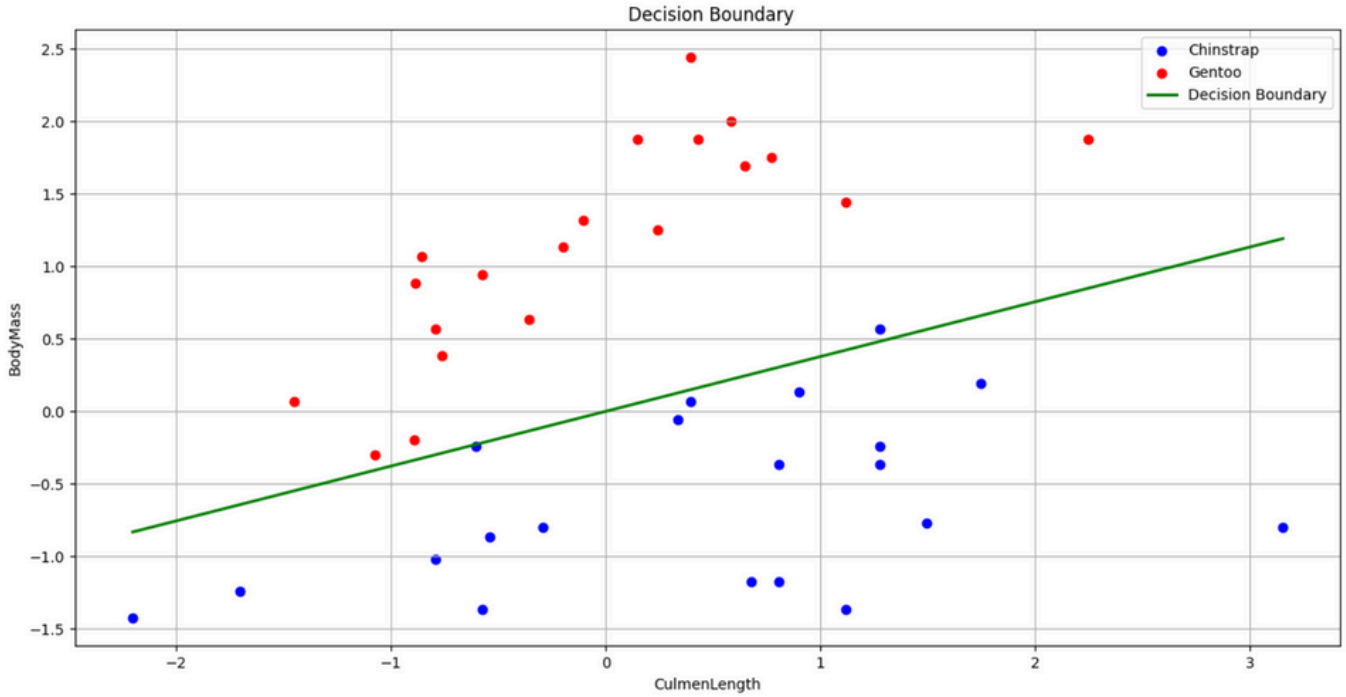
Test Confusion Matrix:
[[14 6]
[8 12]]

Train MSE: 0.3000
Test MSE: 0.7000

The figure shows that FlipperLength and BodyMass provide a weak separation between the Adelie and Chinstrap classes. The decision boundary (green line) attempts to divide the two groups, but there is significant overlap. Many Adelie points (blue) and Chinstrap points (red) are close to the boundary or even on the wrong side, which reduces the classifier's ability to distinguish between the classes. This results in a relatively low accuracy of 65%, indicating that these features are not effective for separating Adelie and Chinstrap compared to other feature combinations.

Adaline Algorithm

Chinstrap vs Gentoo – Features: CulmenLength &BodyMass



Parameters:

- Learning rate:0.01
- Number of epochs: 500
- No Bias
- MSE Threshold: 0.0000001

Results

Train Accuracy: 100.00%

Train Confusion Matrix:
[[30 0]
[0 30]]

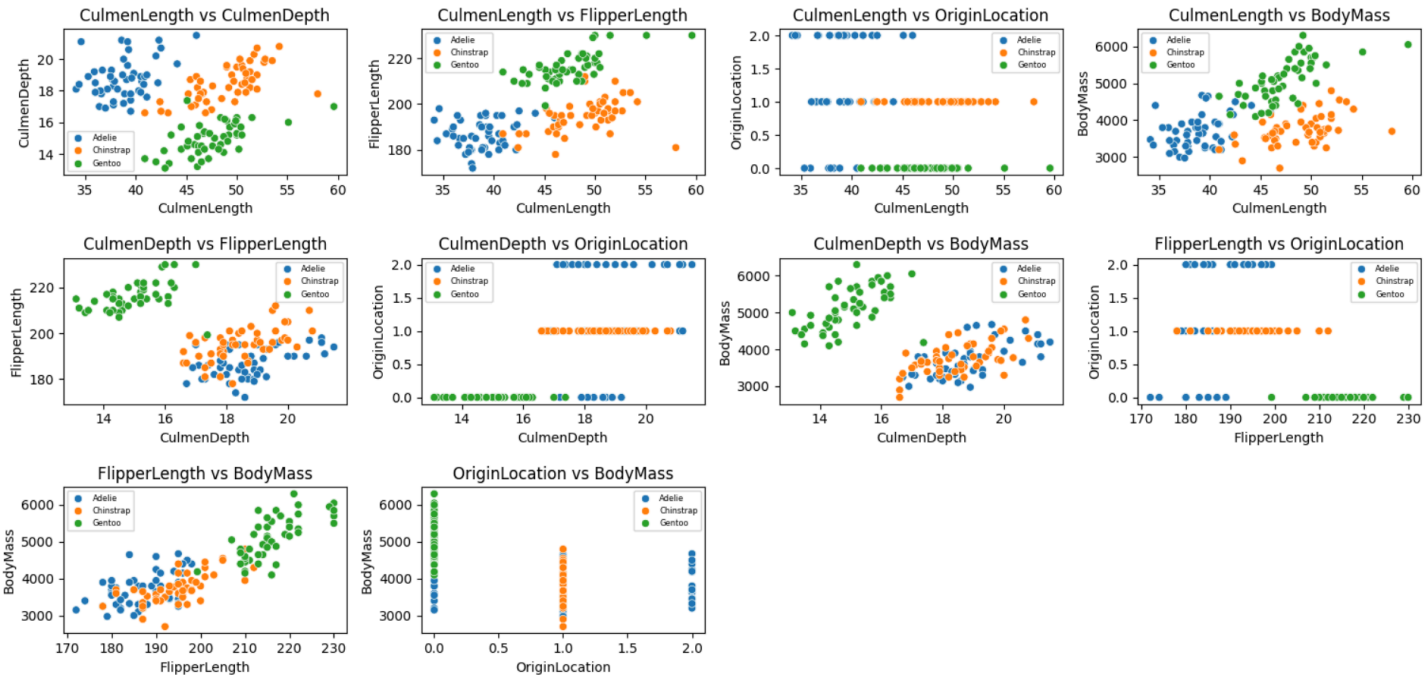
Test Accuracy: 97.50%

Test Confusion Matrix:
[[19 1]
[0 20]]

Train MSE: 0.0000
Test MSE: 0.0500

The figure shows that CulmenLength and BodyMass provide a very strong separation between the Chinstrap and Gentoo classes. The decision boundary (green line) clearly divides the two groups, with almost all Chinstrap points (blue) located below the boundary and Gentoo points (red) above it. There is minimal overlap, and only one or two points are close to the boundary. This results in a very high accuracy of 97.5%, indicating that these features are highly effective for distinguishing between Chinstrap and Gentoo penguins.

Visualization of Feature Relationships and Class Distribution in the Dataset



The previous scatter plots illustrate the relationships between different feature pairs and how they contribute to class separation.

Conclusion:

Based on the analysis across both Perceptron and Adaline, the features that consistently achieved the highest accuracy and showed excellent separation between classes are:

- FlipperLength & CulmenLength
- CulmenDepth & CulmenLength
- CulmenLength & OriginLocation

These feature pairs are highly effective for distinguishing.