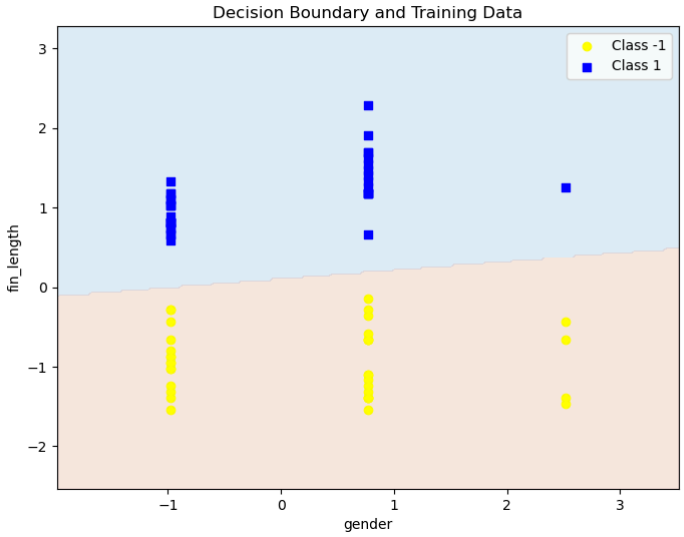
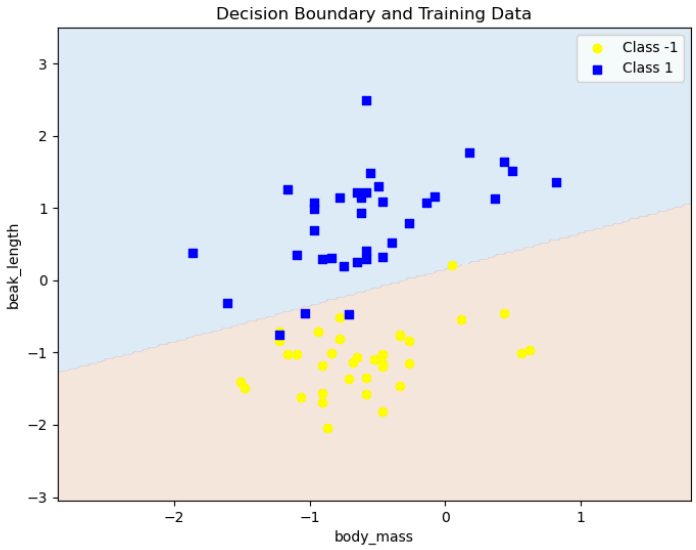
Report on Adaline and Perceptron Results

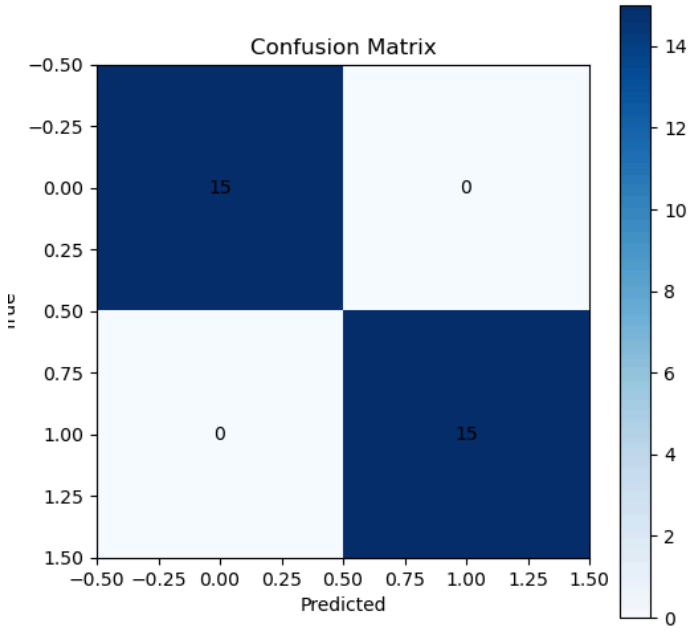
Adaline Model Analysis

1. **High-Performance Combinations**:
    - For classes **A and B**, several combinations achieved a perfect 100% accuracy, including:
        - `gender` & `fin length`
        - `body mass` & `beak depth`
        - `body mass` & `fin length`
        - `beak length` & `beak depth`
        - `beak length` & `fin length`
        - `beak depth` & `fin length`

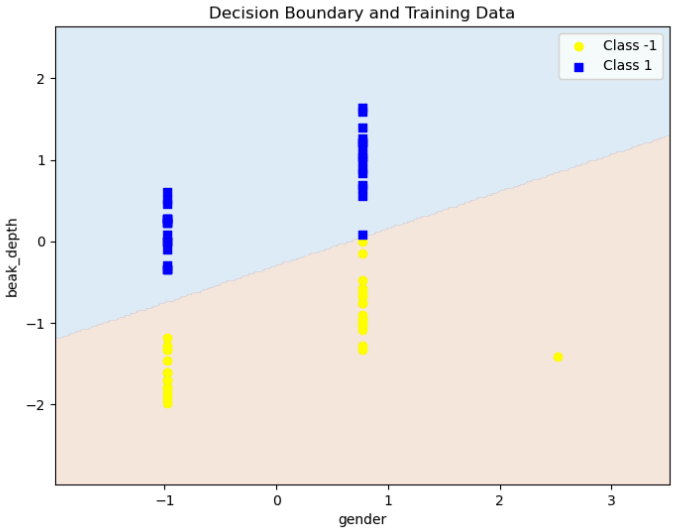


    - Similarly, for **A and C**, combinations like `gender` & `beak length` and `body mass` & `beak length` also reached 100% accuracy.

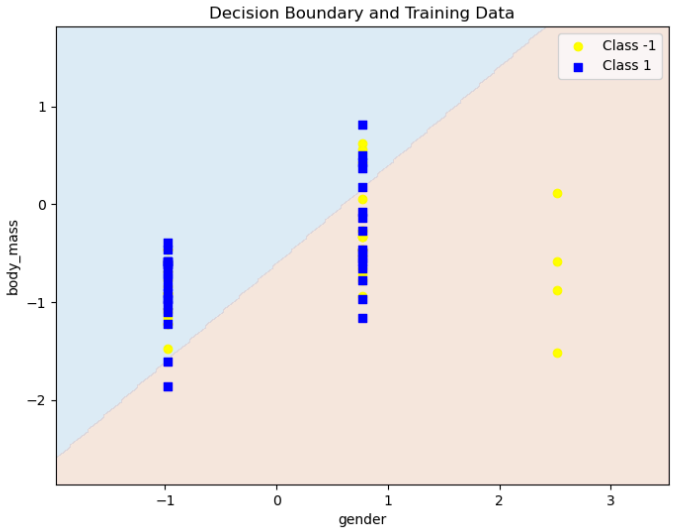


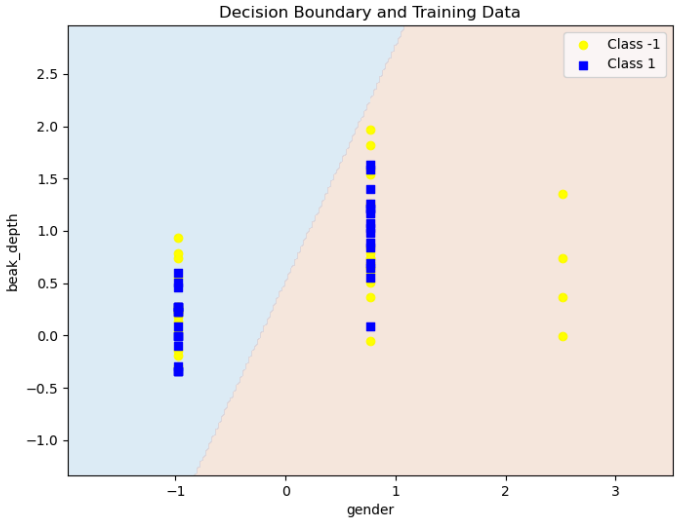


- For **B and C**, high accuracy was achieved with `gender` & `beak depth`, `body mass` & `beak depth`, and `beak length` & `beak depth` combinations.

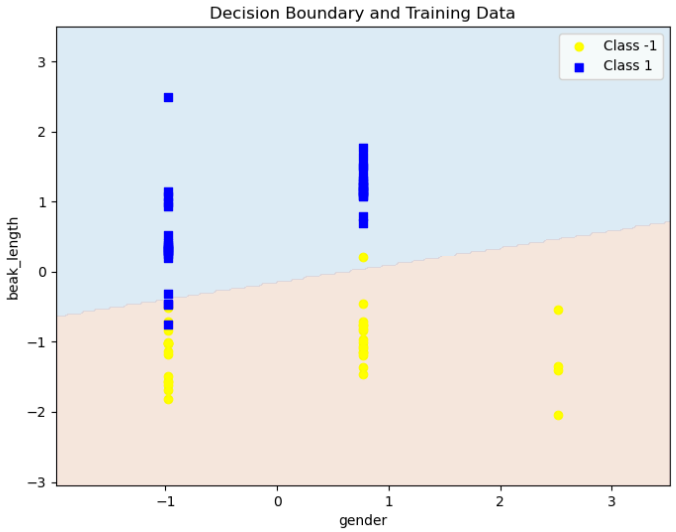


2. **Conclusion**: The consistent high performance of pairs involving **beak depth, beak length, and fin length** suggests that these features are particularly effective in distinguishing between species A and B, B and C, and to some extent, A and C.
3. **Low-Performance Combinations**:
    - For classes **A and C**, some feature pairs yielded notably low accuracy:
        - `gender` & `body mass` (40%)
        - `gender` & `beak depth` (43.33%)





- For **B and C**, `gender` & `beak length` showed a lower accuracy of 60%.

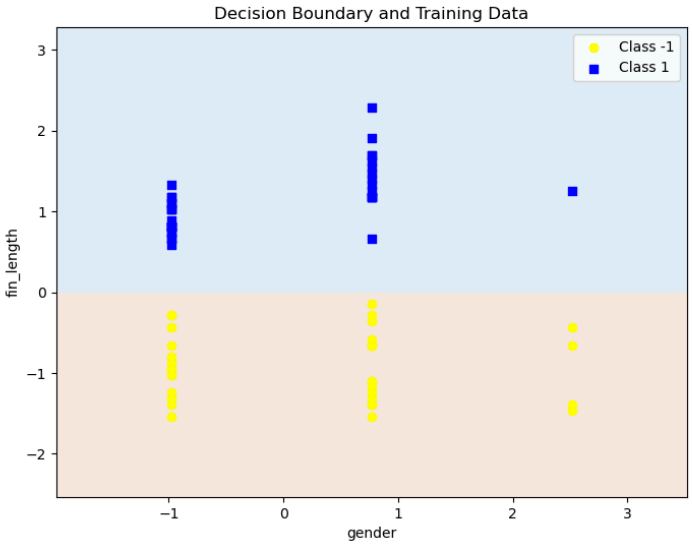


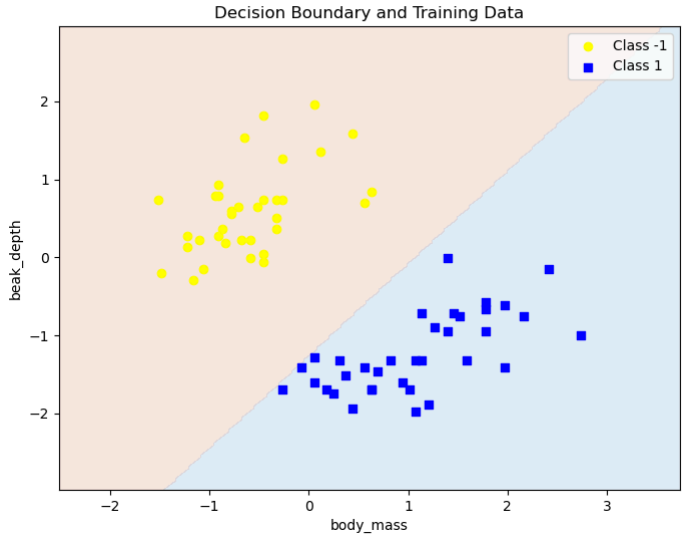
4. **Conclusion**: The lower accuracy when using `gender` in combination with other features (especially `body mass` or `beak depth`) suggests that **gender may be a less informative feature** for distinguishing between species A and C, and sometimes B and C.

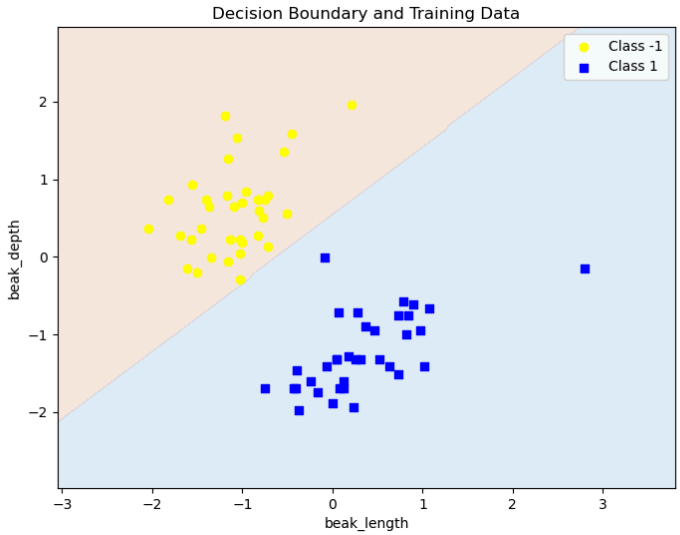
Perceptron Model Analysis

1. **High-Performance Combinations**:
   - Similar to Adaline, the Perceptron model achieved 100% accuracy with several feature combinations for **A and B**:

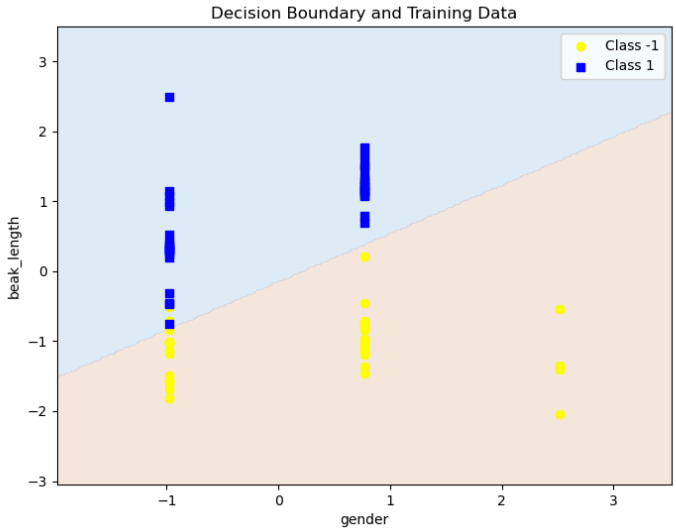
- gender & fin length
- body mass & beak depth
- beak length & beak depth

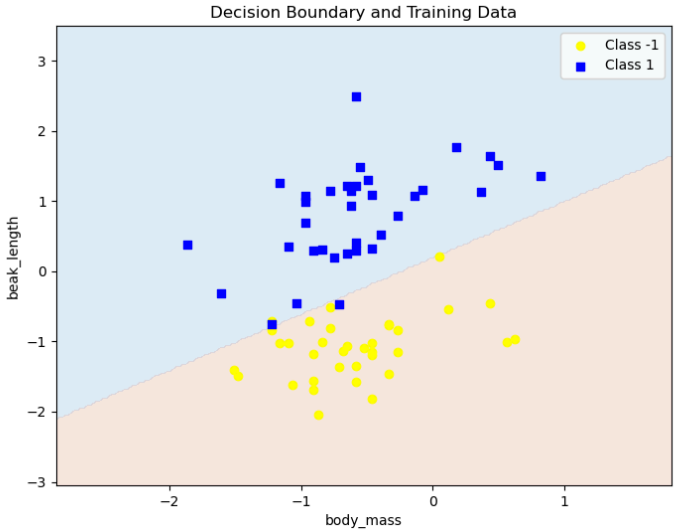


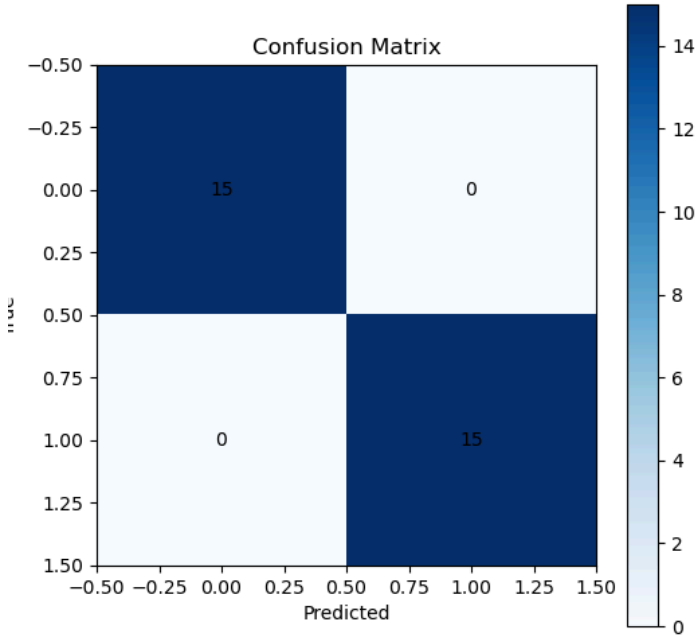




- For **A and C**, 100% accuracy was also achieved with pairs like `gender` & `beak length` and `body mass` & `beak length`.



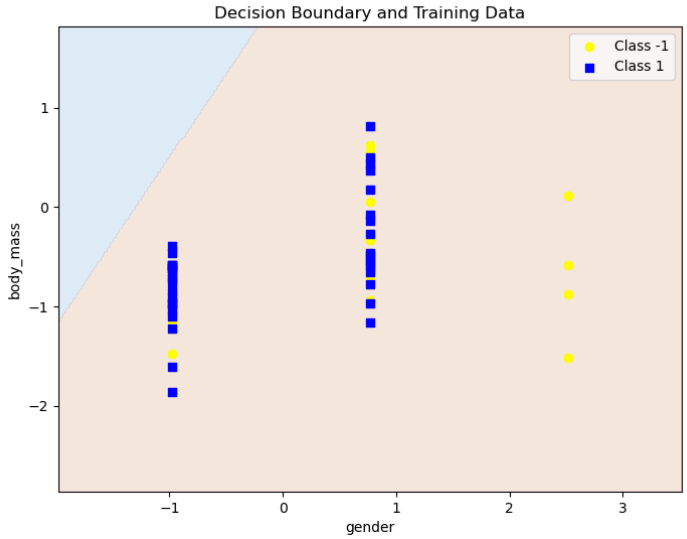




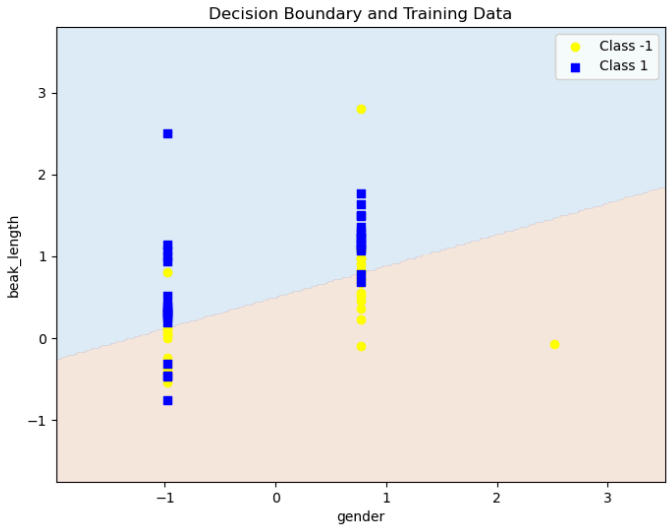
- In **B and C**, combinations including `beak depth` and `fin length` (like `gender` & `beak depth`, `body mass` & `beak length`, and `beak length` & `beak depth`) frequently achieved high accuracy.

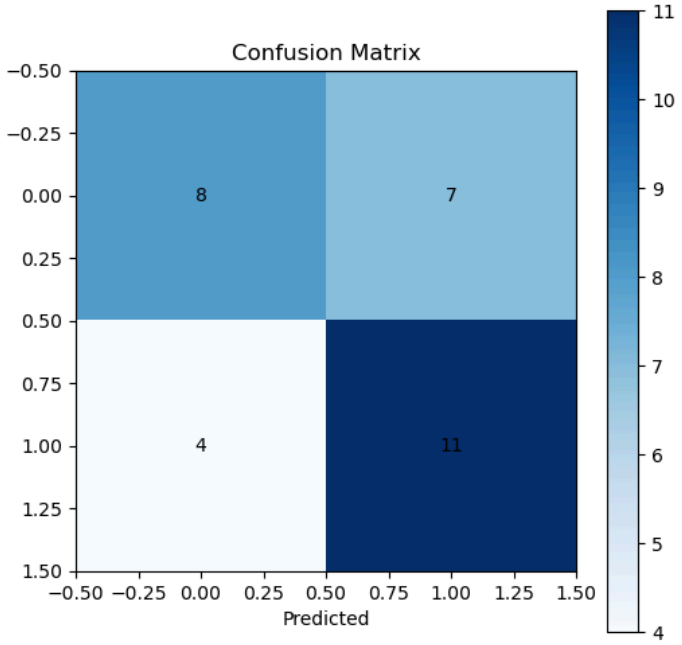
2. **Conclusion**: The Perceptron model, like Adaline, shows that **beak depth, beak length, and fin length** are effective at separating species across all pairs, with `body mass` also showing some utility.
3. **Low-Performance Combinations**:

- For classes **A and C**, using `gender` in combination with other features resulted in notably lower accuracy:
  - `gender` & `body mass` (50%)
  - `gender` & `beak depth` (50%)



- For **B and C**, `gender` & `beak length` resulted in a lower accuracy of 63.33%.





4. **Conclusion**: These results confirm that **gender and beak depth** are less informative, especially for distinguishing species pairs like A and C, or B and C. This trend is consistent across both models.

Feature Discrimination and Conclusion

Based on the results across different feature combinations and species pairs:

- **Most Discriminative Features**: **Beak depth, beak length, and fin length** are the most effective features for separating species pairs across both models. This suggests these features capture significant species-specific characteristics.
- **Least Discriminative Feature**: **Gender** shows inconsistent performance, particularly when combined with `body mass` or `beak depth` for certain species pairs. This suggests it may not be a reliable feature for classification on its own.

Final Note on Highest Accuracy Features

The highest accuracy across both models was achieved with combinations involving **beak length, beak depth, and fin length**. These features consistently supported accurate classification, indicating that they are the most valuable for distinguishing between species A, B, and C in this dataset.