Task_1

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Perceptron:

Different Features:

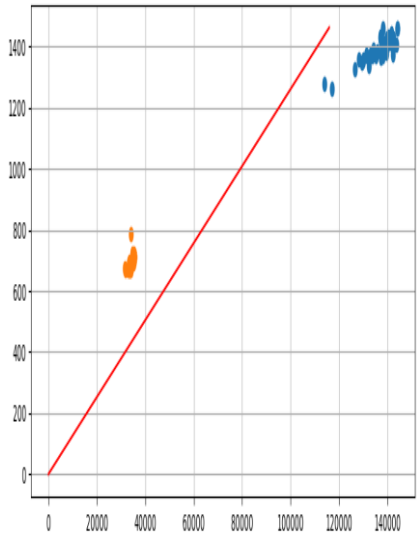
Hyperparameters

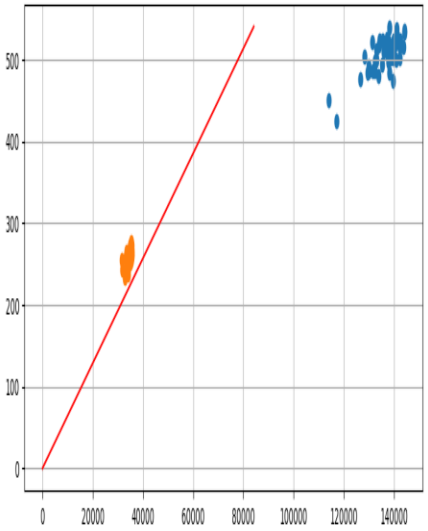
Class = Bombay, C2 = Cali, eta = 0.001, epochs = 150, b = False

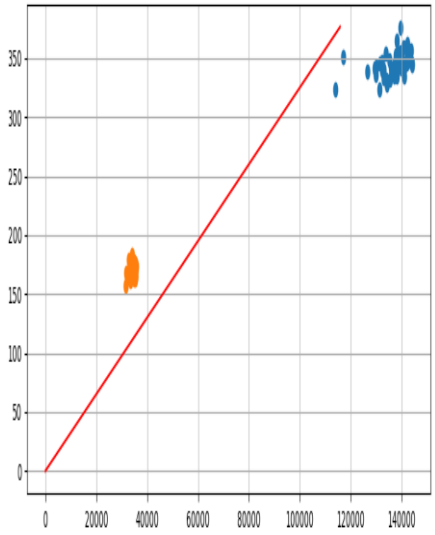
Features

F1 = Area, F2 = Perimeter	F1 = Area, F2 = MajorAxisLength	F1 = Area, F2 = MinorAxisLength

Visualization





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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
```

Analysis

Perceptron algorithm managed to discriminate between different features all in one epoch with an accuracy of 100% as all of them are linearly separable as none of them took all the epochs.

Different Classes:

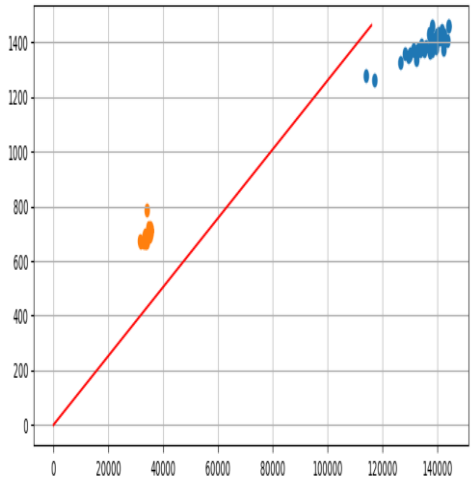
Hyperparameters

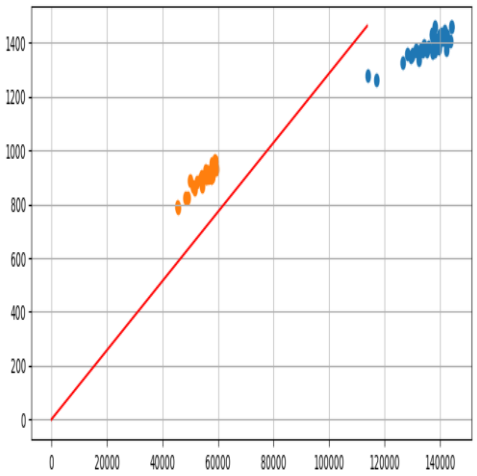
F1 = Area, F2 = Perimeter, eta = 0.001, epochs = 150, b = True

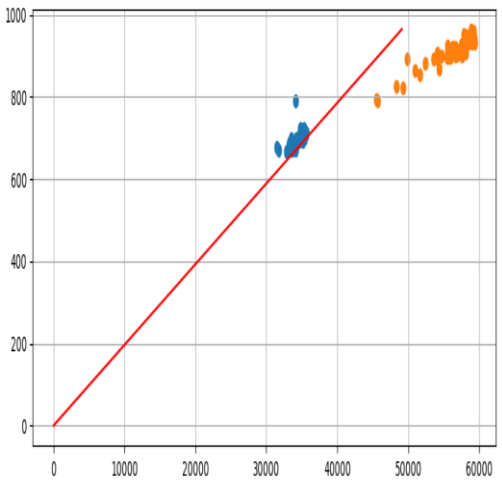
Classes

C1 = Bombay, C2 = Cali	C1 = Bombay, C2 = Sira	C1 = Sira, C2 = Cali

Visualization





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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
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Correct: 20 From 20 Incorrect 0
Correct: 19 From 20 Incorrect 1
accuracy: 97.5
```

Analysis

The second case shows that the accuracy is 97.5% and it took all the epochs which means the model needs more epochs to discriminate well or these features with these classes are not linearly separable.

Different eta:

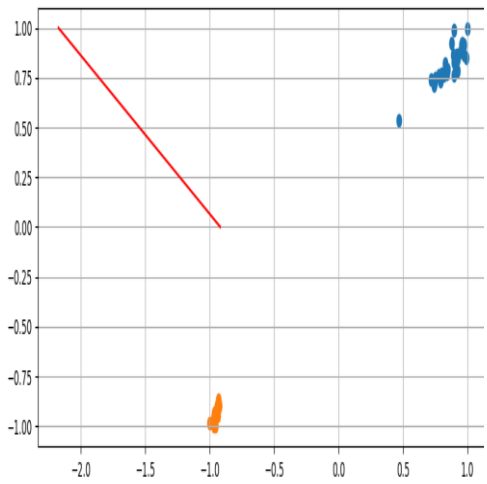
Hyperparameters

F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, m = 150, b = True

Eta

Eta = 0.2	Eta = 0.5	Eta = 20

Visualization



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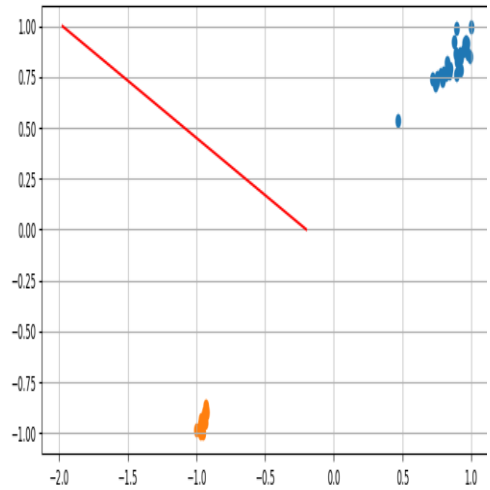

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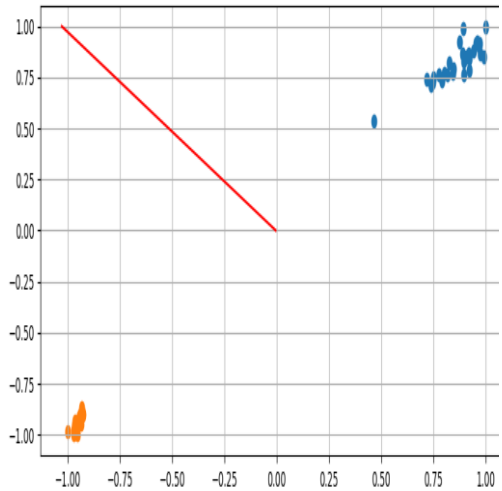

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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
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Analysis

Changing the learning rate affects how fast the model reaches the local minimum as shown when the eta is too small it takes more epochs to reach the local minimum.

Different epochs:

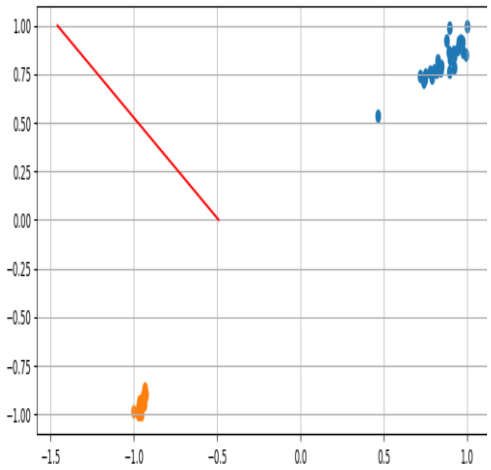
Hyperparameters

F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, eta = 0.001, b = True

Epochs

M = 10	M = 100	M = 1000

Visualization



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accuracy: 100.0
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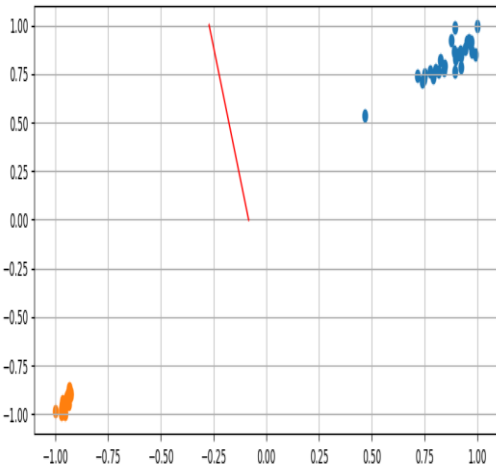

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Correct: 20 From 20 Incorrect 0
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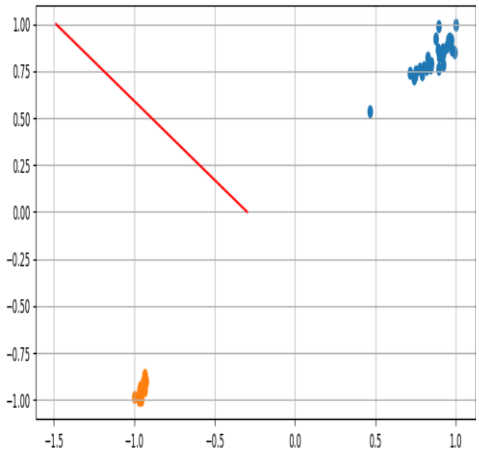

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Correct: 20 From 20 Incorrect 0
accuracy: 100.0
```

Analysis

Changing the number of epochs affects the accuracy if it's too small the model may need more epochs to be well-trained.

Different bias:

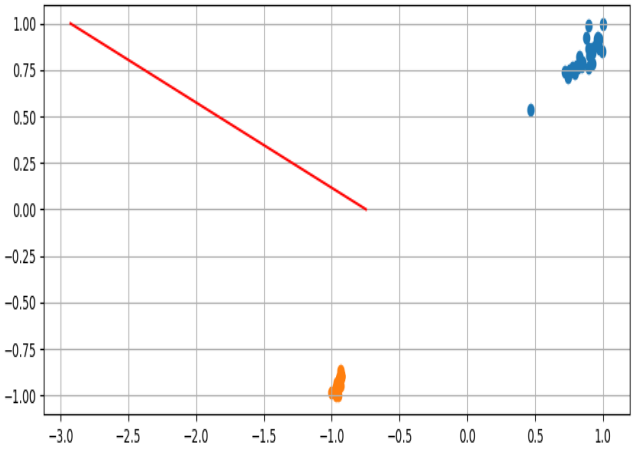
Hyperparameters

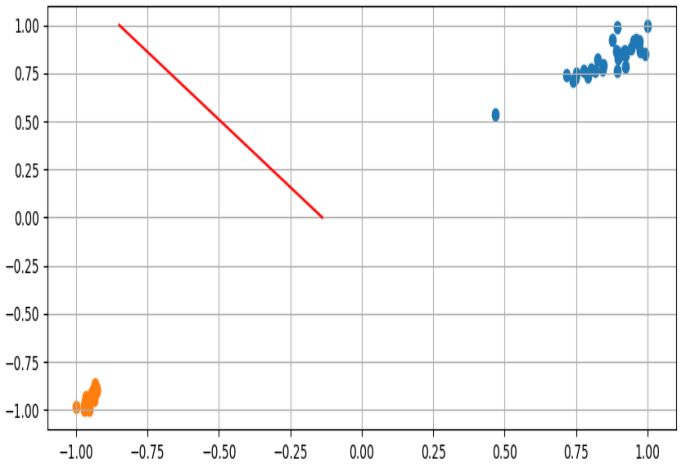
F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, eta = 0.01, m = 150

Bias

B = False | **B = True**

Visualization



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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
```

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Correct: 20 From 20 Incorrect 0
Correct: 20 From 20 Incorrect 0
accuracy: 100.0
```

Analysis

Adding bias to the model affects the accuracy. Sometime the model train better with bias.

Adaline:

Different Features:

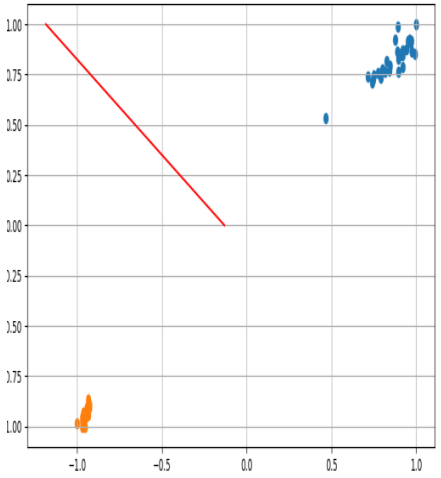
Hyperparameters

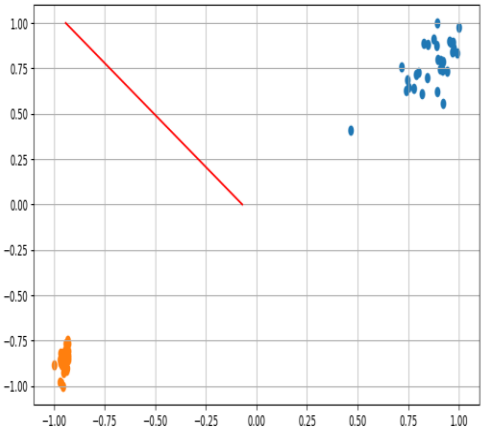
C1 = Bombay, C2 = Cali, eta = 0.01, m = 150, b = 0, MSE = 0.01

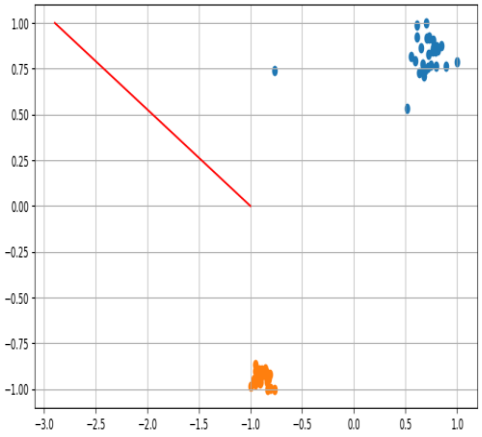
Features

F1 = Area, F2 = Perimeter **F1 = Area, F2 = MajorAxisLength** **F1 = MinorAxisLength, F2 = Perimeter**

Visualization







Analysis

Adaline algorithm managed to discriminate between different features all in one epoch with an accuracy of 100% as all of them are linearly separable.

Different Classes:

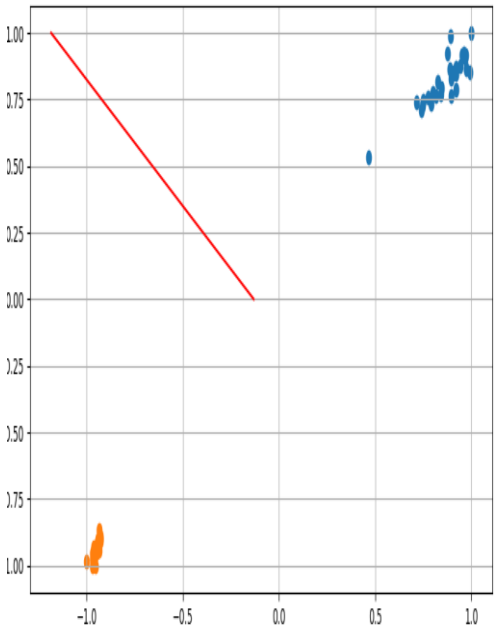
Hyperparameters

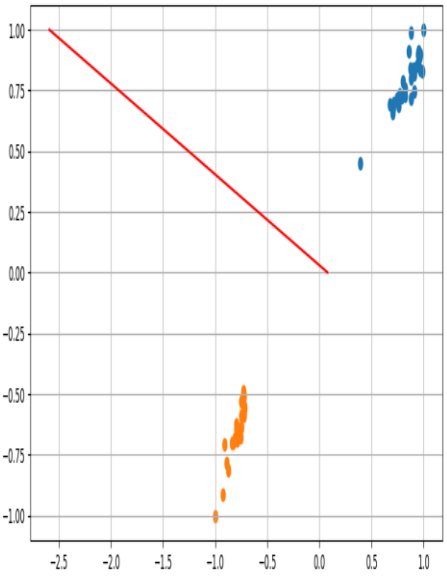
F1 = Area, F2 = Perimeter, eta = 0.01, m = 150, b = True, MSE = 0.01

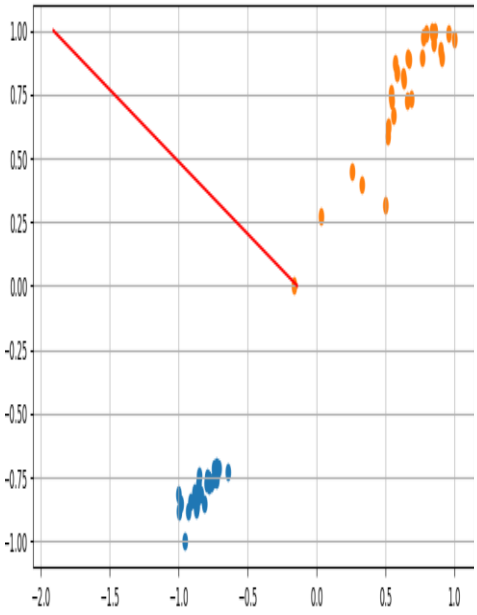
Classes

C1 = Bombay, C2 = Cali	C1 = Bombay, C2 = Sira	C1 = Cali, C2 = Sira

Visualization



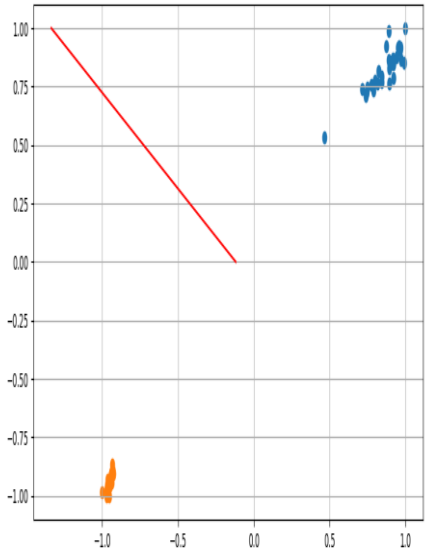
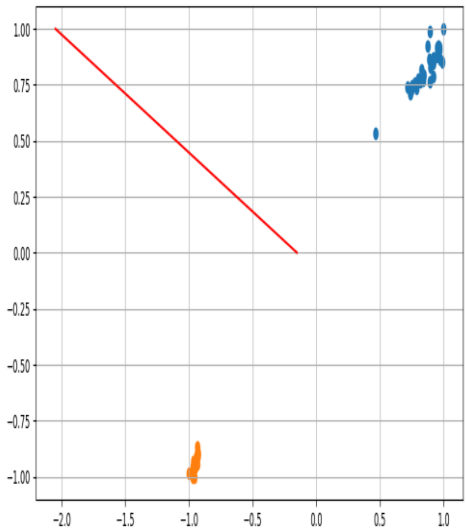
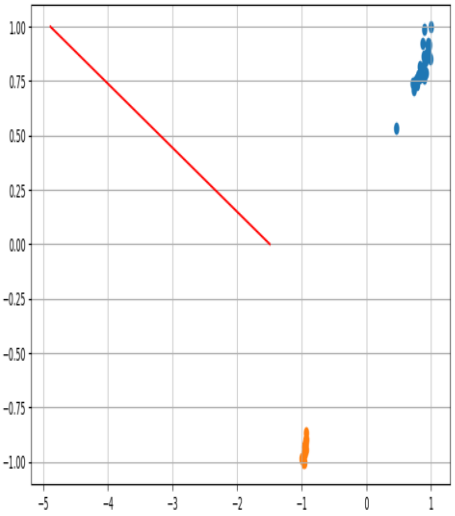




Analysis

The second case shows that the accuracy is 98% and it took all the epochs which means the model needs more epochs to learn or these two classes aren't linearly separable.

Different eta:

Hyperparameters		
F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, m = 150, b = True, MSE = 0.01		
Eta		
Eta = 0.1	**Eta = 0.01**	**Eta = 0.00001**
Visualization		
		
Analysis		
Changing the learning rate affects how fast the model reaches the local minimum as shown when the eta is too small it takes more epochs to reach the local minimum.		

Different epochs:

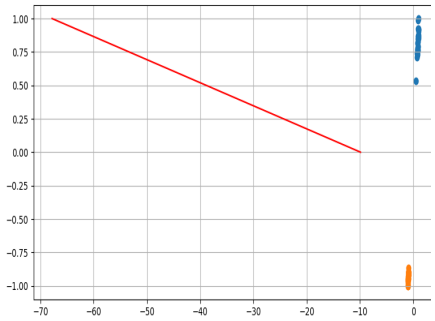
Hyperparameters

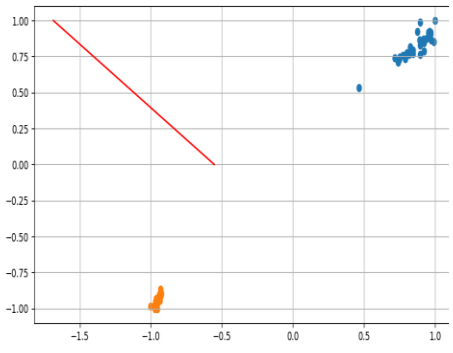
F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, eta = 0.01, b = True, MSE = 0.01

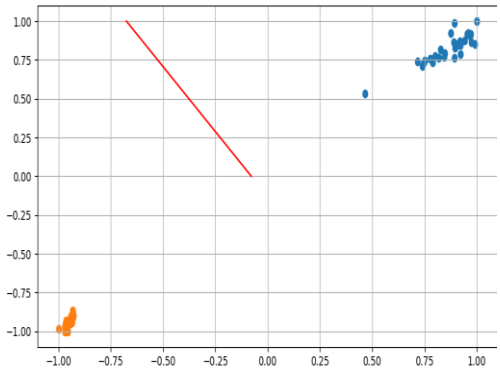
Epochs

M = 10	M = 100	M = 1000

Visualization







Analysis

Every time the model takes all the epochs because of 2 outliers from the given classes or they aren't linearly separable.

Different bias:

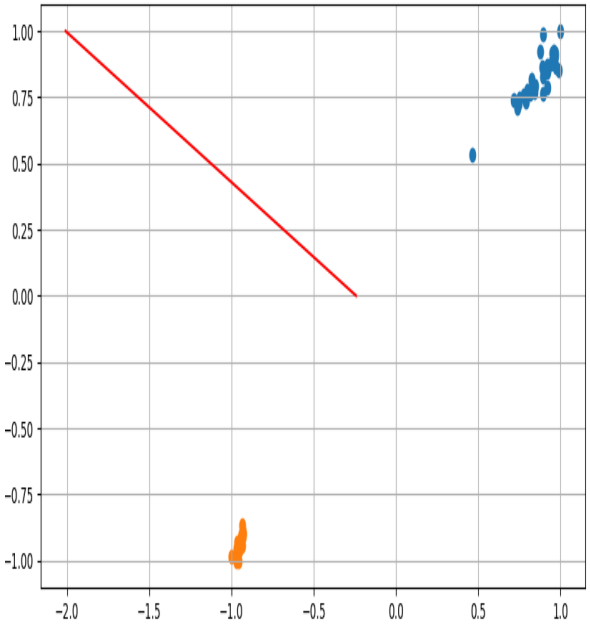
Hyperparameters

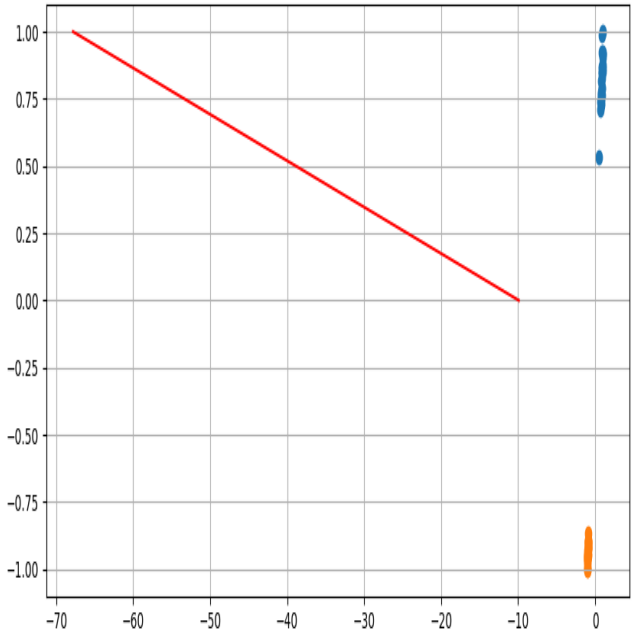
F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, eta = 0.01, m = 150, MSE = 0.01

Bias

B = False **B = True**

Visualization





Analysis

Adding bias to the model affects the accuracy. Sometimes the model trains better with bias, in this case it didn't affect the accuracy but it took less epochs (faster convergence).

Different MSE:

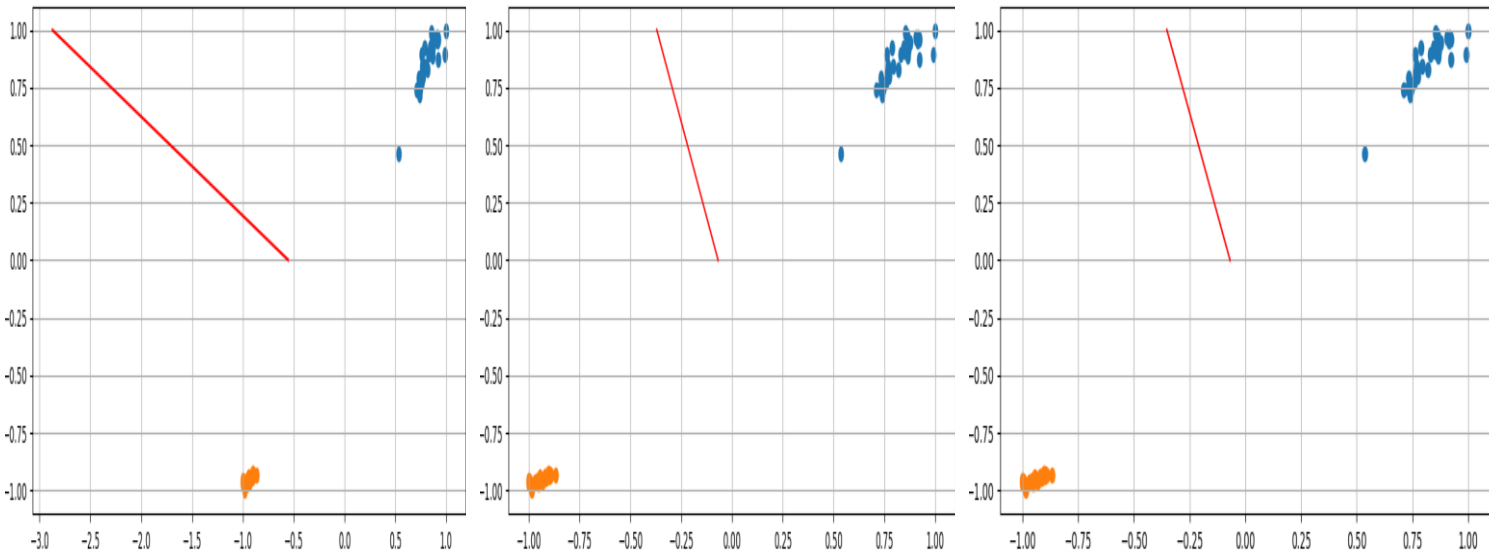
Hyperparameters

F1 = Area, F2 = Perimeter, C1 = Bombay, C2 = Cali, m = 150, b = True, eta = 0.01

MSE

MSE= 0.1	MSE = 0.01	MSE = 0.00001

Visualization



Analysis

Achieving lower MSE requires more training epochs.

Conclusion

In general, Adaline is an improvement as it solves the problem of cost function by using Mean Square Error while Perceptron doesn't have a cost function to stop and might lead to an infinite loop in case of non-linearly separable data because it stops only in case of zero error.