Machine Learning

HW 5: SVM SMO Algorithm

11/5/2017

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The program appears to work as expected as it trims out unfit points in the group of support vectors. There are some quirks that reduce the test accuracy that appear sometimes. If the training set can be classified perfectly relatively quickly (<4 iterations), the model is slightly overfit and will not result in 100% test accuracy. If it can train for >4 iterations, it has a fairly good chance at obtaining 100% test accuracy as demonstrated below. This is a result of the performance optimization of the SMO optimization where the algorithm can get stuck in a local misclassification minima, rather than a global one due to the fact that only one pair of alphas are optimized per iteration, rather than all of them.

Results from a run:

Text Output:

Standardization Result

ans =

-0.0000 -0.0000 -0.0000 -0.0000

1.0000 1.0000 1.0000 1.0000

Random alpha assignment

-19.0205

Enforce Zero Sum condition

-1.7764e-15

Iteration 1 Accuracy:

74 / 76

Iteration 2 Accuracy:

74 / 75

Iteration 3 Accuracy:

72 / 73

Iteration 4 Accuracy:

70 / 71

Iteration 5 Accuracy:

69 / 69

Final w:

-14.8375 19.5798 -24.1473 -22.9963

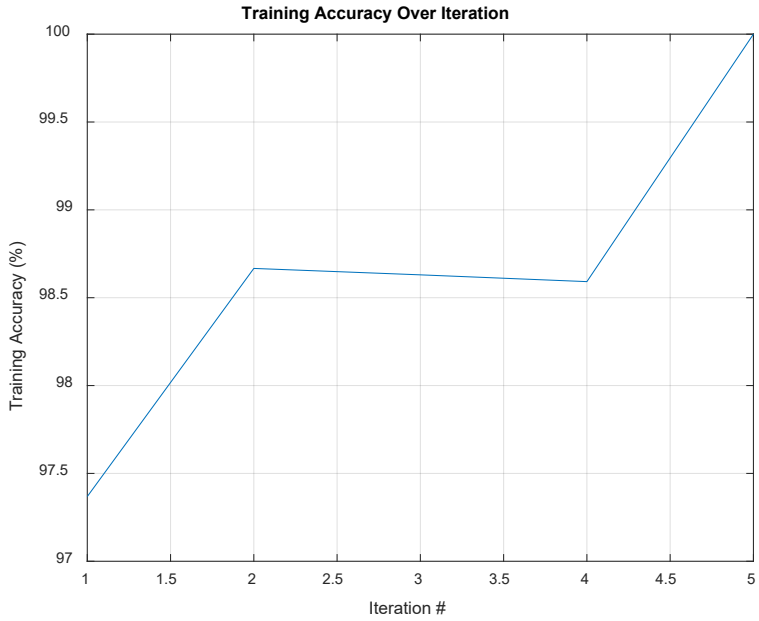
Final b: -1.8999

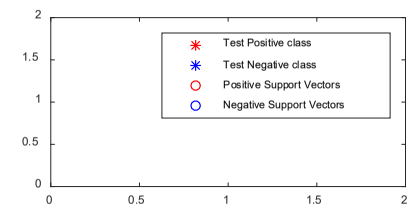
Number of support Vectors : 69

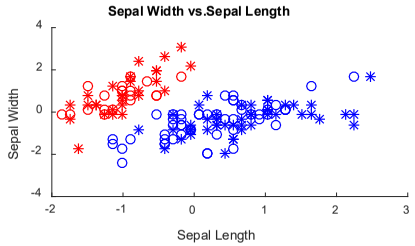
Test Accuracy:

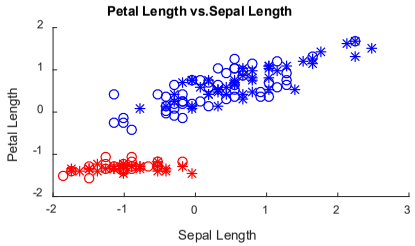
100.00

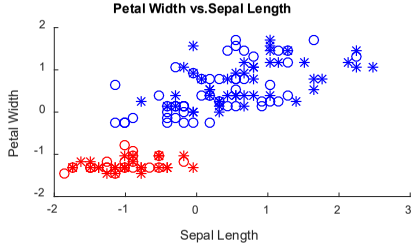
Figures:

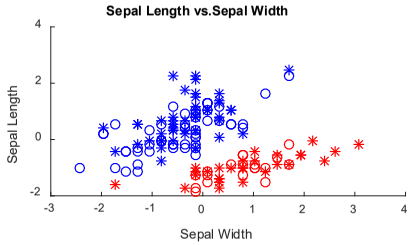

Training Accuracy Over Iteration
Training Accuracy (%)
Iteration #
100
99.5
99
98.5
98
97.5
97
1
1.5
2
2.5
3
3.5
4
4.5
5

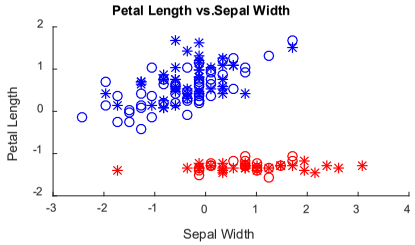

Test Positive class
Test Negative class
Positive Support Vectors
Negative Support Vectors

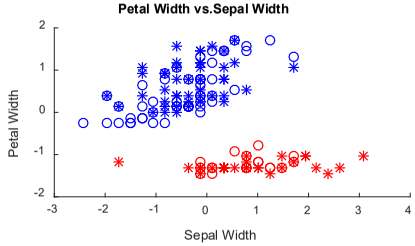

Sepal Width vs.Sepal Length
Sepal Width
Sepal Length

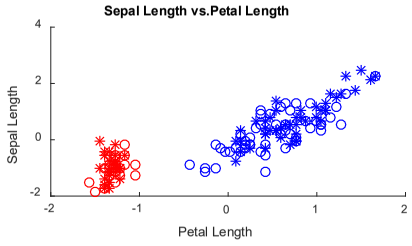

Petal Length vs.Sepal Length
Petal Length
Sepal Length

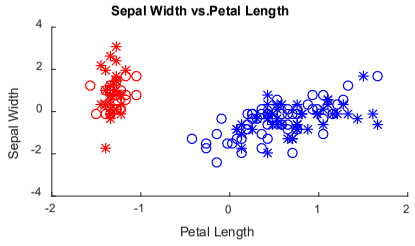

Petal Width vs.Sepal Length
Petal Width
Sepal Length

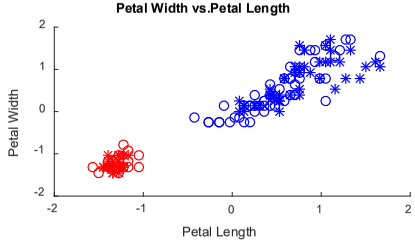

Sepal Length vs.Sepal Width
Sepal Length
Sepal Width


Petal Length vs.Sepal Width
Petal Length
Sepal Width


Petal Width vs.Sepal Width
Petal Width
Sepal Width


Sepal Length vs.Petal Length
Sepal Length
Petal Length


Sepal Width vs.Petal Length
Sepal Width
Petal Length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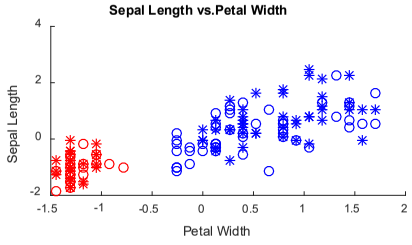
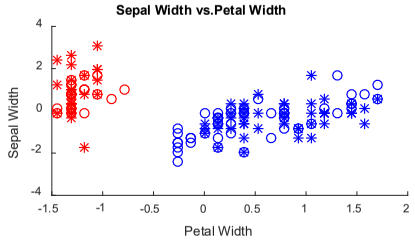
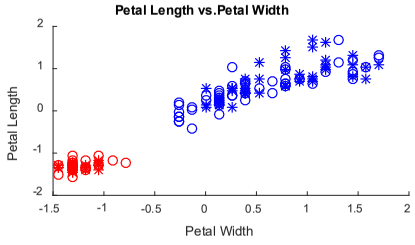
Petal Width
Petal Length


Sepal Length vs.Petal Width
Sepal Length
Petal Width


Sepal Width vs.Petal Width
Sepal Width
Petal Width


Petal Length vs.Petal Width
Petal Length
Petal Width

Another Run:

Standardization Result

ans =

-0.0000 -0.0000 -0.0000 -0.0000

1.0000 1.0000 1.0000 1.0000

Random alpha assignment

-12.2359

Enforce Zero Sum condition

-4.1078e-15

Iteration 1 Accuracy:

83 / 85

Iteration 2 Accuracy:

76 / 83

Iteration 3 Accuracy:

77 / 81

Iteration 4 Accuracy:

75 / 79

Iteration 5 Accuracy:

73 / 77

Iteration 6 Accuracy:

71 / 75

Iteration 7 Accuracy:

69 / 73

Iteration 8 Accuracy:

67 / 71

Iteration 9 Accuracy:

66 / 69

Iteration 10 Accuracy:

64 / 67

Iteration 11 Accuracy:

62 / 65

Iteration 12 Accuracy:

61 / 63

Iteration 13 Accuracy:

58 / 61

Iteration 14 Accuracy:

57 / 59

Iteration 15 Accuracy:

54 / 57

Iteration 16 Accuracy:

52 / 55

Iteration 17 Accuracy:

51 / 53

Iteration 18 Accuracy:

50 / 51

Iteration 19 Accuracy:

48 / 49

Iteration 20 Accuracy:

46 / 47

Iteration 21 Accuracy:

44 / 45

Iteration 22 Accuracy:

43 / 43

Final w:

-4.7455 8.6197 -8.8776 -7.0176

Final b: 0.4286

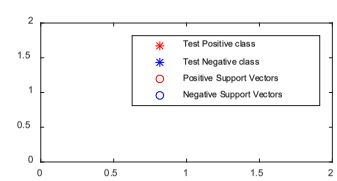
Number of support Vectors : 43

Test Accuracy:

100.00

Figures:

Training Accuracy Over Iteration
Training Accuracy (%)
Iteration #
100
99
98
97
96
95
94
93
92
91
0
5
10
15
20
25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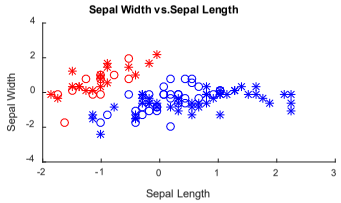
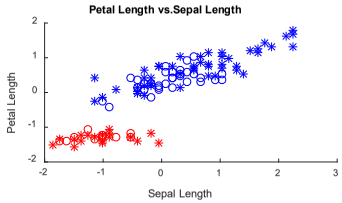
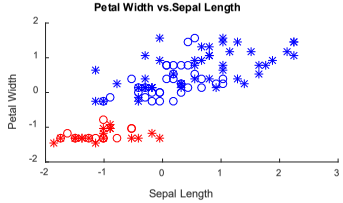

Sepal Width vs.Sepal Length
Sepal Width
Sepal Length


Petal Length vs.Sepal Length
Petal Length
Sepal Length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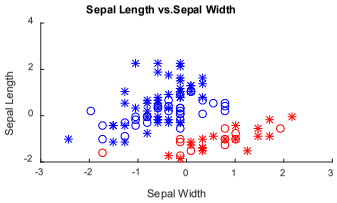
Petal Width
Sepal Length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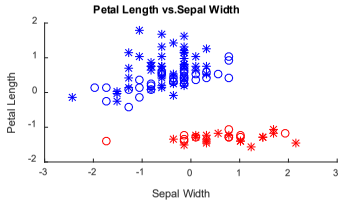
Sepal Width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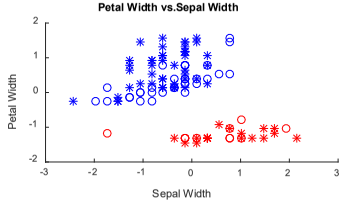
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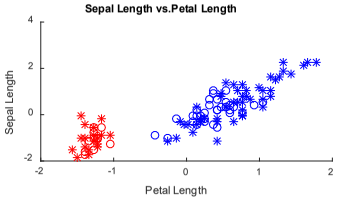
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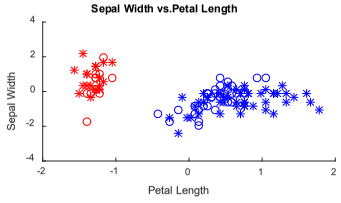
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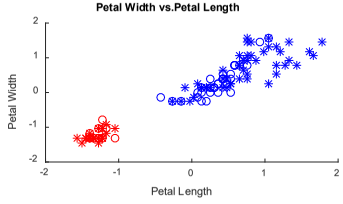
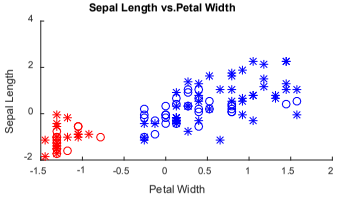
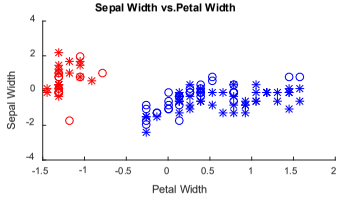
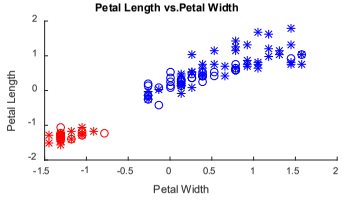

Petal Width vs.Petal Length
Petal Width
Petal Length


Sepal Length vs.Petal Width
Sepal Length
Petal Width


Sepal Width vs.Petal Width
Sepal Width
Petal Width


Petal Length vs.Petal Width
Petal Length
Petal Width