Homework 2

Collaborators:

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Problem 2-1. A Walk Through Linear Models

(a) Perceptron

Answer:

1. 10: train error 0.0, test error 0.106
   100: train error 0.0, test error 0.141
2. 10: 5.468 steps
   100: 20.458 steps
3. Beacuse the data is non-linearly separable, we get a model with some training error.

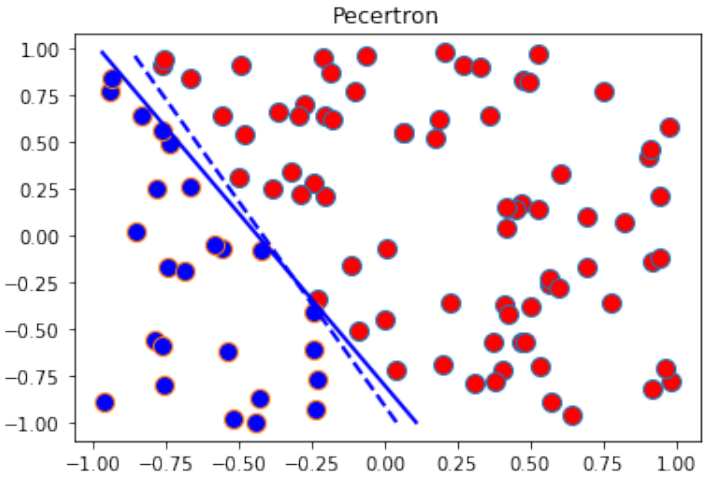

Figure 1: The plotting result for perceptron when nTrain = 100.

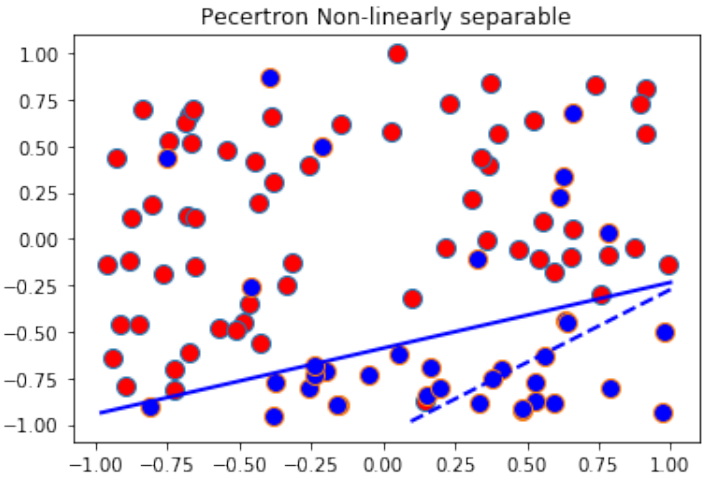

Figure 2: The plotting result for perceptron when training data is not linearly seperable.

(b) Linear Regression

Answer:

1. Train error is 0.398, test error is 0.05
2. Train error is 0.132, test error is 0.0597
3. Training error is 0.49, testing error is 0.5496.
4. Training error is 0.05, testing error is 0.066.

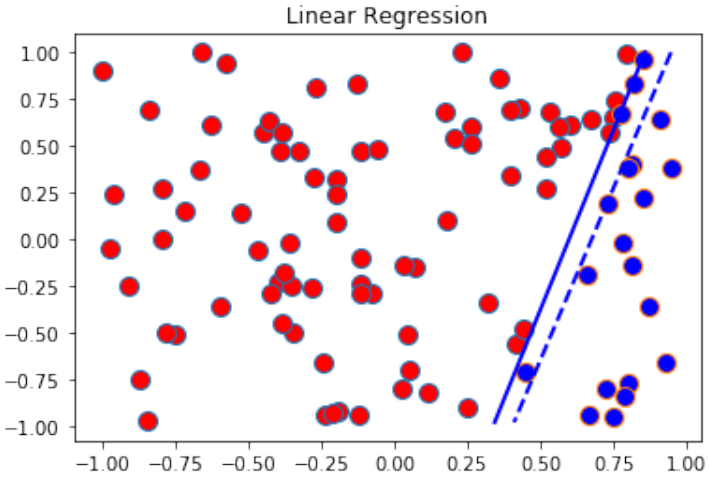

Figure 3: The plotting result for linear regression.

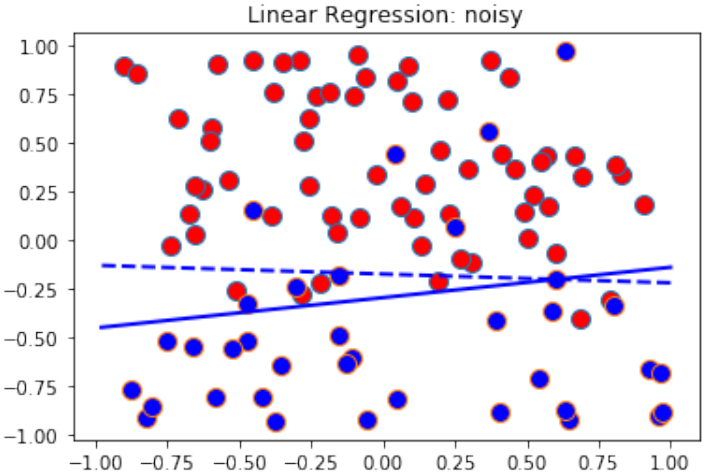

Figure 4: The plotting result for linear regression when training data is not linearly seperable.

(c) Logistic Regression

Answer:

1. Train error is 0.0064, test error is 0.0182
2. Train error is 0.123, test error is 0.0444

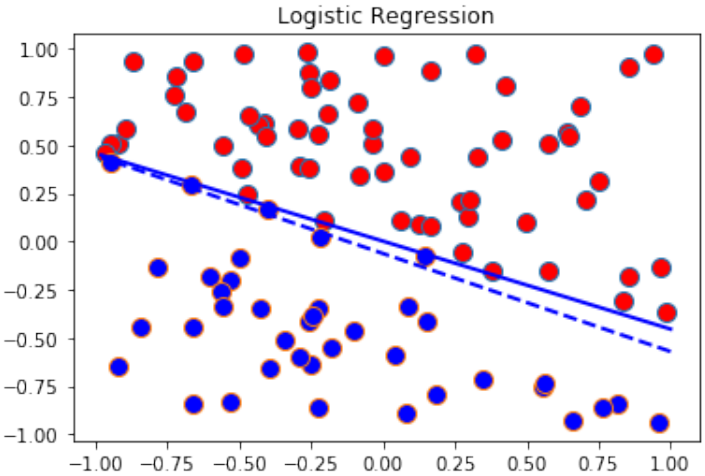

Figure 5: The plotting result for logistic regression.

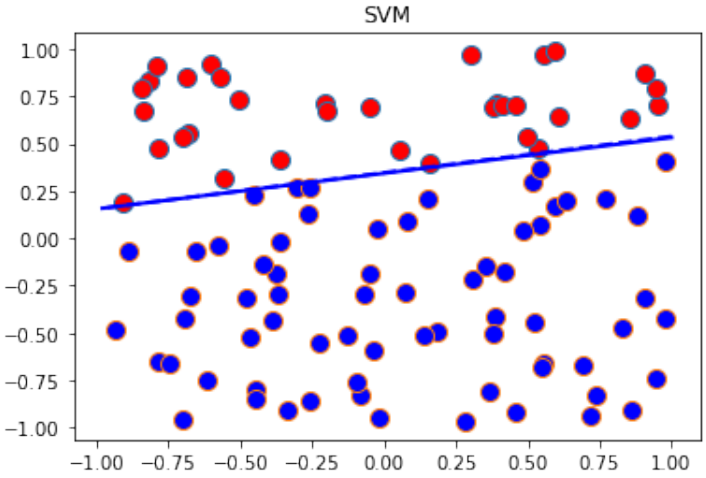

Figure 7: The plotting result for SVM when nTrain is 100.

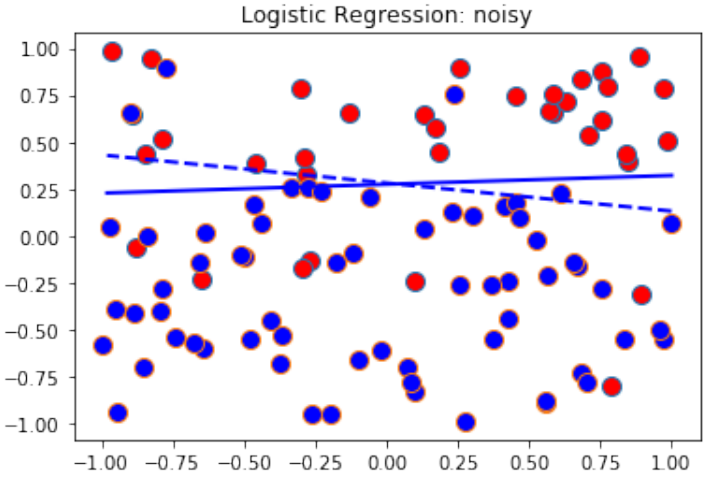

Figure 6: The plotting result for logistic regression when training data is not linearly seperable.

(d) Support Vector Machine

Answer:

1. Train error is 0.0, test error is 0.0345
2. Train error is 0.0, test error is 0.0109
3. There are 3 support vector

Problem 2-2. Regularization and Cross-Validation

(a) Implement Ridge Regrssion, and use LOOCV to tune the regularization parameter λ.

Answer:

1. 100.0
2. with reg is 0.133, without reg is 1.02
3. with reg: train error is 0.0, test error is 0.059
   without reg: train error is 0.0, test error is 0.126

(b) Implement Logistic Regrssion, and use LOOCV to tune the regularization parameter λ.

Answer: Every lambda error count is same, so 0.001 chosen by LOOCV
with reg: train error is 0.105, test error is 0.123
without reg: train error is 0.105, test error is 0.123

Problem 2-3. Bias Variance Trade-off

Let's review the bias-variance decomposition first. Now please answer the following questions:

(a) True of False

Answer:

1. False
2. False
3. True
4. False
5. False