Homework 2

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Problem 2-1. A Walk Through Linear Models

(a) Perceptron

Answer:

1. E_train = 0, E_test = 10.861% when the size of training set is 10; E_train = 0, E_test = 1.44% when the size of training set is 100.
2. The average number of iterations is 10.841 when the size of training set is 10; the average number of iterations is 161.483 when the size of training set is 100.
3. Algorithm can not stop.

(b) Linear Regression

Answer:

1. (no noise) training err rate: 3.864% ; testing err rate 4.873%
2. (with noise) training err rate: 13.16% ; testing err rate 14.38%
3. training err rate: 49% ; testing err rate 54.96%
4. training err rate: 5% ; testing err rate 6.6%

(c) Logistic Regression

Answer:

1. train err rate:1.53%; test err rate:2.445
2. train err rate:11.67%; test err rate:13.467

(d) Support Vector Machine

Answer:

1. train err rate:0, test err rate: 3.671%
2. train err rate:0, test err rate: 1.129%
3. the average number of support vectors is 3.291

Problem 2-2. Regularization and Cross-Validation

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

Answer:

1. λ = 100 (λ is sensitive to the normalization method)
2. $\sum_{i=1}^{m} w_i^2$ is 0.13289524 (with regularization); 1.0204767 (without regularization)
3. with regularization, train err rate: 0, test err rate 8.689%; without regularization, train err rate: 0, test err rate 12.607%

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

Answer: $\lambda = 0.001$.
with regularization, train err rate: 0, test err rate 5.826%; without regularization, train err rate: 0, test err rate 7.132%

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