CSCI 4100 Assignment 3

Boliang Yang 661541863

1. Exercise 1.13 in LFD

(a) When or , then makes error.

Then we have

(b) , and we want it to be independent of , then we have , which gives us , and .

2. Exercise 2.1 in LFD

(a) Positive rays:

is the break point since for dichotomy cannot shatter all possibilities of points. For example, +1 on the left and -1 on the right.

From formula, , then .

(b) Positive intervals:

is the break point since for dichotomy cannot shatter all possibilities of points. For example, [+1, -1, +1].

From formula, , then .

(c) Convex sets:

Break point for convex sets does not exist since dichotomy will always shatter all possibilities of points.

From formula, , then for all N.

3. Exercise 2.2 in LFD

(a) (i) Positive rays:

The break point is , the polynomial degree is 1. Since , then holds where .

(ii) Positive intervals:

The break point is , the polynomial degree is 2. Since , then holds where .

(iii) Convex sets:

Since convex sets don’t have a break point, the Theorem 2.4 cannot be applied here.

(b) From class we know there are only two types of hypothesis sets: either be of the form or polynomial. Since is neither of those types, then there does not exist such hypothesis set.

Prove by contradiction: is a break point since . By Theorem 2.4, . But when , , which contradicts the Theorem 2.4.

4. Exercise 2.3 in LFD

If is the smallest break point for then .

(i) Positive rays: since the break point is , then .

(ii) Positive intervals: since the break point is , then .

(iii) Convex sets: since for all , then .

5. Exercise 2.6 in LFD

(a) Error bar for :

where , then

Error bar for :

We have one hypothesis then we can use Hoeffding’ inequality for a single fixed hypotheisis. where . Then we have .

Thus, the error bar for is higher.

(b) If we have a larger test set, then we will have less data for training set. There is a trade-off between samples for and . In this case, we will not have enough samples for training, and we will have a good but worse and wild and .

6. Problem 1.11 in LFD

For CIA:

For supermarket:

7. Problem 1.12 in LFD

(a)

If we want to minimizes the , we need . Then , which gives us .

(b) , again, we need in order to minimize the . Then . Each of the fractions is either +1 or -1 since can be positive or negative. And since , then half of the data points are at most , and half of the data points are at least , here should be the median .

(c) Since is the average of sum of , then when is perturbed to where , will grow more and more and .

But since is the median of all the data points, when is perturbed to where , will shift at most by one. If original is below , then will increase by one point; if original is above , then will not change.