

# CSIE 5432/5433 HW6 PDF

YiWenLai

TOTAL POINTS

**10 / 0**

## QUESTION 1

### 1 Problem 10 -10 / 0

+ 20 pts correct

+ 20 pts Your answer is correct but your don't choose [e].

+ 10 pts Almost correct.

+ 0 pts You don't choose any answer.

✓ - 10 pts incorrect

- 10 pts Almost without any description.

- 10 pts Your explanation doesn't make sense to me.

💬 Your answer is incorrect.

❶ Here should be "-2 || x' - x|| "

## QUESTION 2

### 2 Problem 12 20 / 0

✓ + 20 pts correct

+ 15 pts one mistake

+ 10 pts two mistakes

+ 5 pts three mistakes

+ 0 pts Your explanation doesn't make sense to me

+ 0 pts I have no idea

- 10 pts Wrong answer

- 10 pts Little to no explanation

## QUESTION 3

### 3 Problem 14 0 / 0

✓ + 0 pts Correct

- 10 pts wrong page

- 20 pts no submission

- 20 pts Use ineligible package

8. c

8. classify

	wrong	right
3		2
4		1
5		0

$$E_{out}(G_1) = C_3^5 0.4^3 (1-0.4)^2 + C_4^5 0.4^4 (1-0.4) + (0.4)^5$$

$$= 10 \cdot 4^3 \cdot 6^2 \cdot (0.1)^5 + 5 \cdot 4^4 \cdot 6 \cdot (0.1)^5 + 4^5 (0.1)^5$$

$$= 10^{-5} (23040 + 1680 + 1024) \approx 0.31744$$

9. b

9.

$$\left(1 - \frac{1}{N}\right)^{0.5N} = \left(\left(1 - \frac{1}{N}\right)^N\right)^{0.5} = \left(\frac{1}{e}\right)^{0.5} \approx 0.6065$$

10. e, because there is no the same answer as what I derived.

The  $|x_i' - x_i| / 2$  in the last row should be  $|x_i' - x_i|$ , since I forgot to add two cases together, so there will be no answer according to all answers except (e).

10:

$$\phi_{ds}(x)^T \phi_{ds}(x') = \sum_{S \subseteq \Theta} \sum_{i \in S} s_i \text{sign}(x_i' - \theta) \text{sign}(x_i - \theta) = 2 \sum_{S \subseteq \Theta} \text{sign}[(x_i' - \theta)(x_i - \theta)]$$

$\frac{|x_i' - x_i|}{2}$  numbers of  $\theta$  will cause value to  $-1$ ,  $\frac{2R-1-(2L+1)}{2} + 1 = R-L$

$(R-L) - \frac{|x_i' - x_i|}{2}$  numbers of  $\theta$  will cause value to  $1$

$S = \pm 1$  is the same, and there are  $d$  dim.

$\therefore \sum_{i=1}^d \left( (R-L) - \frac{|x_i' - x_i|}{2} \right) = 2d(R-L) - \|x' - x\|_1$

11. a

11- first

$$u_+^{(1)} = \frac{1}{N}, u_-^{(1)} = \frac{1}{N}, \epsilon_t = \frac{5}{100}, \sigma_L = \sqrt{\frac{1 - \frac{5}{100}}{\frac{1}{100}}} = \sqrt{19}$$

$$u_+^{(2)} = \frac{1}{N} \cdot \sqrt{19}, u_-^{(2)} = \frac{1}{N} \cdot \sqrt{19}, \frac{u_+^{(2)}}{u_-^{(2)}} = \frac{\sqrt{19}}{\frac{1}{\sqrt{19}}} = 19$$

12. d

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💬 Your answer is incorrect.

1 Here should be " $-2 \parallel x' - x \parallel$ "

12.

$$\varepsilon_t = \frac{\sum_{n=1}^N M_n^t [y_n + g_t(x_n)]}{\sum_{n=1}^N M_n^t} \Rightarrow U_t \varepsilon_t = \sum_{n=1}^N M_n^t [y_n + g_t(x_n)]$$

$$\sum_{n=1}^N M_n^t [y_n + g_t(x_n)] = U_t (1 - \varepsilon_t)$$

$$\frac{U_{t+1}}{U_t} = \frac{\frac{1}{N} \sum_{n=1}^N \exp(-y_n \sum_{\tau=1}^t \alpha_\tau g_\tau(x_n))}{\frac{1}{N} \sum_{n=1}^N \exp(-y_n \sum_{\tau=1}^{t-1} \alpha_\tau g_\tau(x_n))} = \frac{\frac{1}{N} \sum_n \exp(-y_n \sum_{\tau=1}^{t-1} \alpha_\tau g_\tau(x_n)) \cdot \exp(-y_n \alpha_t g_t(x_n))}{U_t}$$

$$(M' = \frac{1}{N}) \Rightarrow = \frac{\sum M_n^t \cdot \exp(-y_n \alpha_t g_t(x_n))}{U_t} = \frac{\sum [y_n = g_t(x_n)] M_n^t \exp(-\alpha_t \sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}}) + \sum [y_n \neq g_t(x_n)] M_n^t \exp(-\alpha_t \sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}})}{U_t}$$

$$= \frac{\left\{ U_t (1 - \varepsilon_t) \frac{1}{\sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}}} + U_t \varepsilon_t \sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}} \right\}}{U_t} = 2 \sqrt{\varepsilon_t (1 - \varepsilon_t)} \leq \exp(-2T(\frac{1}{2} - \varepsilon)^2)$$

$\because 0 \leq \varepsilon_t < \varepsilon < \frac{1}{2}$

$$\mathbb{E}_m(\eta_T) \leq U_{t+1} = \frac{U_{t+1}}{U_t} \cdot \frac{U_t}{U_{t-1}} \cdots \frac{U_2}{U_1} \leq \exp(-2T(\frac{1}{2} - \varepsilon)^2) \quad \times$$

13. d

13. max of  $1 - |M_+ - M_-| = 1$ , when  $M_+ = M_- = 0.5$

if  $M_+ > M_-$ ,  $1 - |M_+ - M_-| = 1 - M_+ + M_- = 2M_-$ ,  $\because M_+ = 1 - M_-$

$M_- > M_+$ ,  $1 - |M_+ - M_-| = 2M_+$

for two case, the error is  $2 \min(M_+, M_-)$ , which is equivalent to the normalized classification error  $\times$

14. c

```
yiwenlai@YiWens-MacBook-Pro ~/Desktop/hw6 INSERT
14: 0.166
15: 0.229115
16: 0.014
17: 0.155
18: 0.072
```

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$$(M' = \frac{1}{N}) \Rightarrow = \frac{\sum M_n^t \cdot \exp(-y_n \alpha_t g_t(x_n))}{U_t} = \frac{\sum [y_n = g_t(x_n)] M_n^t \exp(-\alpha_t \sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}}) + \sum [y_n \neq g_t(x_n)] M_n^t \exp(-\alpha_t \sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}})}{U_t}$$

$$= \frac{\left\{ U_t (1 - \varepsilon_t) \frac{1}{\sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}}} + U_t \varepsilon_t \sqrt{\frac{1-\varepsilon_t}{\varepsilon_t}} \right\}}{U_t} = 2 \sqrt{\varepsilon_t (1 - \varepsilon_t)} \leq \exp(-2T(\frac{1}{2} - \varepsilon)^2)$$

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```

```

train_x, train_y, test_x, test_y = dataloader()
root = DecisionTree(train_x, train_y, '', 'root')
err_count = 0
for i in range(test_x.shape[0]):
    node = root
    result = 0
    while(True):
        i_feature, s, theta = node.data
        result = np.sign(test_x[i][i_feature] - theta) * s
        if result > 0:
            if node.right == None:
                # print('here')
                break
            node = node.right
        else:
            if node.left == None:
                # print('here')
                break
            node = node.left
    # print(i, result)
    if result != test_y[i]:
        err_count += 1
print('Q14: ', err_count/1000)

```

15. d

### 3 Problem 14 0 / 0

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