

### Exercise 1: AdaBoost - Updates

Suppose you apply AdaBoost on a data set  $\mathcal{D}$  consisting of 19 instances  $(\mathbf{x}^{(1)}, y^{(1)}), \dots, (\mathbf{x}^{(19)}, y^{(19)})$ . AdaBoost just completed the  $(m-1)$ -th iteration and the weights for the next iteration are:

$$w^{[m](i)} = 0.01 \quad \text{for } i = 1, \dots, 10, \quad \text{and} \quad w^{[m](i)} = 0.1 \quad \text{for } i = 11, \dots, 19.$$

For the beginning of the  $m$ -th iteration consider three cases:

- (a)  $\hat{b}^{[m]}$  is only wrong for  $i = 5$  and the rest is correct.
- (b)  $\hat{b}^{[m]}$  is correct for  $i = 11, 12, 13, 14, 19$  and the rest is wrong.
- (c)  $\hat{b}^{[m]}$  is only correct for  $i = 10$  and the rest is wrong.

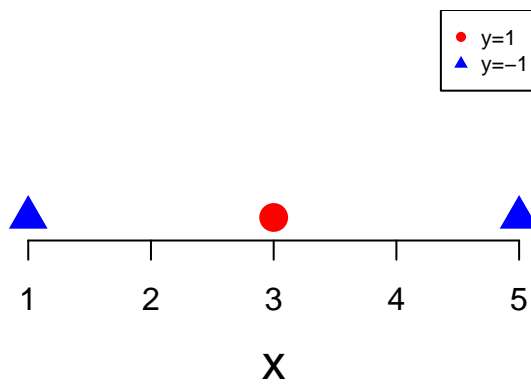
Compute  $\text{err}^{[m]}$ ,  $\hat{\beta}^{[m]}$  and the new weights  $w^{[m]}$  before the normalizing step for each case. Use the following table:

| Case | $\text{err}^{[m]}$ | $\hat{\beta}^{[m]}$ | $w^{[m+1]}(i)$ |
|------|--------------------|---------------------|----------------|
| (a)  |                    |                     |                |
| (b)  |                    |                     |                |
| (c)  |                    |                     |                |

*Hint:* You can use that  $\sqrt{99} \approx 9.95$  and  $99^{-1/2} \approx 0.1$ .

### Exercise 2: AdaBoost - Decision Stump

Suppose you apply AdaBoost with a decision stump on the data set as in the following figure:



- (a) What would be a decision boundary for the first decision stump?
- (b) How do the weights of the points change after the first iteration?
- (c) How many iterations are at least needed such that AdaBoost's training error is zero?