

### Exercise 1

$$\mathcal{T} = \{(0.3, 1), (1.8, 1), (1.5, 1), (4.8, 2), (2.6, 2)\}$$

$$\mathcal{T}^{(1)} = \{(0.3, 1), (1.8, 1), (1.5, 1), (4.8, 0), (2.6, 0)\}$$

$$\mathcal{T}^{(2)} = \{(0.3, 0), (1.8, 0), (1.5, 0), (4.8, 1), (2.6, 1)\}$$

$$X = \begin{bmatrix} 1 & 0.3 \\ 1 & 1.8 \\ 1 & 1.5 \\ 1 & 4.8 \\ 1 & 2.6 \end{bmatrix}$$

$$Y = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}$$

$$X^T X = \begin{bmatrix} 5 & 11 \\ 11 & 35.38 \end{bmatrix}$$

$$X^T Y = \begin{bmatrix} 3 & 2 \\ 3.6 & 7.4 \end{bmatrix}$$

$$X^T X \beta = X^T Y \Leftrightarrow \left[ \begin{array}{cc|cc} 5 & 11 & 3 & 2 \\ 11 & 35.38 & 3.6 & 7.4 \end{array} \right] \Rightarrow$$

$$\left[ \begin{array}{cc|cc} 5 & 11 & 3 & 2 \\ 0 & 11.18 & -3 & 3 \end{array} \right] \Rightarrow$$

$$\beta_1^{(1)} = 1.19$$

$$\beta_1^{(2)} = -0.19$$

$$\beta_2^{(1)} = -0.27$$

$$\beta_2^{(2)} = 0.27$$

Evaluating  $x_1$ :

$$f^{(1)}(2.4) = 0.54$$

$$f^{(2)}(2.4) = 0.46$$

Hence  $\hat{y}_1 = 1$

Evaluating  $x_2$ :

$$f^{(1)}(6.2) = -0.48$$

$$f^{(2)}(6.2) = 1.48$$

Hence  $\hat{y}_2 = 2$

0-1 Loss

$$\overline{TE}_{0-1} = \frac{1}{|\mathcal{T}_{\text{train}}|} \sum_{i=1}^{|\mathcal{T}_{\text{train}}|} L_{0-1}(\hat{f}(x_i), y_i)$$

$$- \hat{f}(0.3) = \text{class 1}$$

$$- \hat{f}(1.5) = \text{class } \mathbf{1}$$

$$- \hat{f}(2.6) = \text{class } \mathbf{2}$$

$$- \hat{f}(1.8) = \text{class 1}$$

$$- \hat{f}(4.8) = \text{class 2}$$

$$\overline{TE}_{0-1} = \frac{1}{5} (0 + 0 + 0 + 0 + \mathbf{0}) = \frac{\mathbf{0}}{5} = \mathbf{0} //$$