

### Lecture3 习题作业

1, 假设训练样本集为  $D = \{(\vec{x}_1, y_1) = ((0.2, 0.7)^T, 1), (\vec{x}_2, y_2) = ((0.3, 0.3)^T, 1), (\vec{x}_3, y_3) = ((0.4, 0.5)^T, 1), (\vec{x}_4, y_4) = ((0.6, 0.5)^T, 1), (\vec{x}_5, y_5) = ((0.1, 0.4)^T, 1), (\vec{x}_6, y_6) = ((0.4, 0.6)^T, -1), (\vec{x}_7, y_7) = ((0.6, 0.2)^T, -1), (\vec{x}_8, y_8) = ((0.7, 0.4)^T, -1), (\vec{x}_9, y_9) = ((0.8, 0.6)^T, -1), (\vec{x}_{10}, y_{10}) = ((0.7, 0.5)^T, -1)\}$ , 使用线性回归算法 (Linear Regression Algorithm), 通过广义逆来求解, 并设计这两类的分类函数, 讨论结果。

解: 令  $D = \{(\vec{x}_i, y_i) = ((1, x_i^1, x_i^2), y_i)\}, i = 1 \sim 10$ , 故可写出

$$\mathbf{X}^T = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.2 & 0.3 & 0.4 & 0.6 & 0.1 & 0.4 & 0.6 & 0.7 & 0.8 & 0.7 \\ 0.7 & 0.3 & 0.5 & 0.5 & 0.4 & 0.6 & 0.2 & 0.4 & 0.6 & 0.5 \end{bmatrix}$$
$$\mathbf{y} = (1, 1, 1, 1, 1, -1, -1, -1, -1, -1)$$

进而计算可得

$$\mathbf{X}^\dagger = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T$$
$$= \begin{bmatrix} -0.16 & 0.7 & 0.11 & -0.1 & 0.67 & -0.13 & 0.63 & 0.04 & -0.55 & -0.20 \\ -0.53 & -0.39 & -0.16 & 0.25 & -0.78 & -0.14 & 0.20 & 0.43 & 0.67 & 0.45 \\ 1.1 & -0.88 & 0.14 & 0.17 & -0.41 & 0.64 & -1.33 & -0.31 & 0.7 & 0.19 \end{bmatrix}$$

于是有

$$\mathbf{W} = \mathbf{X}^\dagger \mathbf{y}$$
$$= (1.43, -3.22, 0.24)^T$$

因此这两类的分类函数为

$$h(\mathbf{x}) = \text{sign}(\mathbf{W}^T \mathbf{x})$$

其中  $\mathbf{W} = (1.43, -3.22, 0.24)^T$