

机器学习理论作业2

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Q: 针对表4.1(P63)的数据, 采用拉普拉斯平滑建立贝叶斯分类器, 并求点 $x=(3, S)^T$ 的类标记

表 4.1 , 训练数据

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
$X^{(1)}$	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
$X^{(2)}$	S	M	M	S	S	S	M	M	L	L	L	M	M	L	L
Y	-1	-1	1	1	-1	-1	-1	1	1	1	1	1	1	1	-1

取 $\lambda = 1$, 由于 $P_{\lambda}(Y = c_k) = \frac{\sum_{i=1}^N I(y_i=c_k) + \lambda}{N + K\lambda}$, 故带入可得:

$$P(Y = 1) = \frac{10}{17}, P(Y = -1) = \frac{7}{17}$$

$$P(X^{(1)} = 1|Y = 1) = \frac{3}{12}, P(X^{(1)} = 2|Y = 1) = \frac{4}{12}, P(X^{(1)} = 3|Y = 1) = \frac{5}{12}$$

$$P(X^{(2)} = S|Y = 1) = \frac{2}{12}, P(X^{(2)} = M|Y = 1) = \frac{5}{12}, P(X^{(2)} = L|Y = 1) = \frac{5}{12}$$

$$P(X^{(1)} = 1|Y = -1) = \frac{4}{9}, P(X^{(1)} = 2|Y = -1) = \frac{3}{9}, P(X^{(1)} = 3|Y = -1) = \frac{2}{9}$$

$$P(X^{(2)} = S|Y = -1) = \frac{4}{9}, P(X^{(2)} = M|Y = -1) = \frac{3}{9}, P(X^{(2)} = L|Y = -1) = \frac{2}{9}$$

$x=(3, S)^T$ 时, 现在要求 $y = \operatorname{argmax}_{c_k} P(Y = c_k) \prod_j P(X^{(j)} = x^{(j)}|Y = c_k)$

$$P(Y = 1)P(X^{(1)} = 3|Y = 1)P(X^{(2)} = S|Y = 1) = \frac{100}{2448} = 0.0408$$

$$P(Y = -1)P(X^{(1)} = 3|Y = -1)P(X^{(2)} = S|Y = -1) = \frac{56}{1377} = 0.0407$$

由于 $0.0408 > 0.0407$, 故 $y = 1$