PRML-第二章作业

1．书面作业

PRML-2019.

(1). 由题，该样本的均值向量和协方差矩阵分别为：

$$m_1 = \frac{1}{4}\sum_{j=1}^{4} x_{1j} = \frac{1}{4}(4,4) = (1,1)^T$$

$$m_2 = \frac{1}{4}\sum_{j=1}^{4} x_{2j} = \frac{1}{4}(20,20) = (5,5)^T$$

$$C_1 = C_2 = C = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \quad C^{-1} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

由 $P(w_1) = P(w_2) = \frac{1}{2}$，且 $C_1 = C_2 = C$，则判别界面方程式为

$$d_1(x) - d_2(x) = (m_1 - m_2)^T C^{-1} x - \frac{1}{2} m_1^T C^{-1} m_1 + \frac{1}{2} m_2^T C^{-1} m_2.$$

$$= -4x_1 - 4x_2 - 16 + 400 = 0$$

$$= -4x_1 - 4x_2 - 1 + 5025 = 0$$

$$\Rightarrow x_1 + x_2 - 6 = 0.$$

所以，该贝叶斯判别界面方程为 $x_1 + x_2 - 6 = 0$.

(2) 该判别界面如下图所示：

贝叶斯判别界面

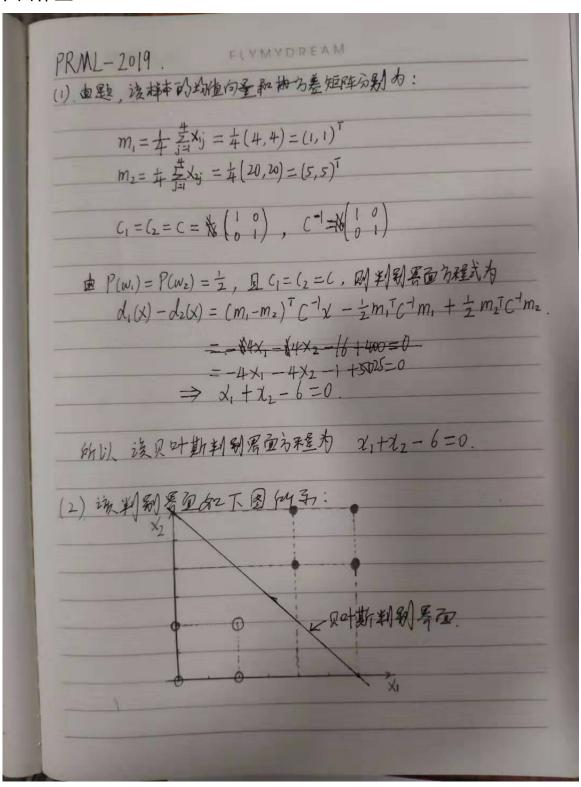## 2. 编程作业

```python
import matplotlib.pyplot as plt
import numpy as np
import math

#坐标数据
a = np.array([[0.,2.,2.,0.], [0.,0.,2.,2.]], dtype=np.float64)
b = np.array([[4.,6.,6.,4.], [4.,4.,6.,6.]], dtype=np.float64)

#计算均值向量和协方差矩阵
a_t=np.matrix(a)
b_t = np.matrix(b)
m1 = np.matrix(a.mean(axis=1)).T
m2 = np.matrix(b.mean(axis=1)).T


c1 = np.cov(a_t) / 4 * 3
c2 = np.cov(b_t) / 4 * 3
c1_i = np.linalg.inv(c1)
c2_i = np.linalg.inv(c2)
c_i =c1_i


d1 = np.matmul((m1-m2).T, c_i)
k1 = 1/2 * np.matmul(np.matmul(m1.T, c_i),m1) - 1/2 * np.matmul(np.
    matmul(m2.T, c_i), m2)

#根据公式得到x2关于x1的直线作为分类的分界线
x = np.arange(0,7,1)
y = k1[0,0]/d1[0,1] - (d1[0,0]*x)/d1[0,1]
# print(m1,'\n\n', c1, '\n\n', c1_i)
# print(m1,'\n\n', c2, '\n\n', c2_i)
# print(d1,d1[0,0], '\n\n', k1[0,0])
#画图
plt.plot(a[0],a[1],"ro")
plt.plot(b[0], b[1], "bo")
plt.plot(x,y)
plt.show()
```

改代码的运行结果如下图所示：