

# Pattern Recognition Report3

## Chapter3

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### 1 Question1

In my program of this question,function u1.m compute question(a),u2.m for question(b) ,u3.m for question(c),u4.m for question(d).

#### 1.1 (a)

According to the maximum likelihood estimation on the Gaussian distribution,we can get :

$$\hat{\mu} = \frac{1}{N} \sum_{k=1}^N x_k \quad (1)$$

$$\hat{\Sigma} = \frac{1}{N} \sum_{k=1}^N (x_k - \hat{\mu})(x_k - \hat{\mu})^T \quad (2)$$

In terms of (1) and (2),we could compute the value of the parameters by the program . The results are as follows:

feature	$\hat{\mu}$	$\hat{\sigma}^2$
$x_1$	-0.0709	0.9062
$x_2$	-0.6047	4.2007
$x_3$	-0.9110	4.5419

#### 1.2 (b)

Similar with (1) and (2),we can get the results as follows:

$$\begin{aligned} \mu_{12} &= (-0.0709, -0.6047)^T & \Sigma_{12} &= \begin{pmatrix} 0.9062 & 0.5678 \\ 0.5678 & 4.2007 \end{pmatrix} \\ \mu_{23} &= (-0.6047, -0.9110)^T & \Sigma_{23} &= \begin{pmatrix} 4.2007 & 0.7337 \\ 0.7337 & 4.5419 \end{pmatrix} \\ \mu_{13} &= (-0.0709, -0.9110)^T & \Sigma_{13} &= \begin{pmatrix} 0.9062 & 0.3941 \\ 0.3941 & 4.5419 \end{pmatrix} \end{aligned}$$

### 1.3 (c)

According to (1) and (2), we get the results as follows:

$$\mu = (-0.0709, -0.6047, -0.9110)^T$$

$$\Sigma = \begin{pmatrix} 0.9062 & 0.5678 & -0.9110 \\ 0.5678 & 4.2007 & 0.7337 \\ 0.3941 & 0.7337 & 4.5419 \end{pmatrix}$$

### 1.4 (d)

The results computed by the program :

$$\mu = (-0.1126, 0.4299, 0.0037)^T$$

$$\Sigma = \begin{pmatrix} 0.0539 & 0 & 0 \\ 0 & 0.0460 & 0 \\ 0 & 0 & 0.0073 \end{pmatrix}$$

### 1.5 (e)

The value of  $\mu_i$  computed by the first three algorithms are the same. In terms of that the estimate of  $\mu$  is not affected by other dimensional data. So we have the same results .

Similar ,the forth method's results are the same .

### 1.6 (f)

According to the forms of (2).The results are the same.

## 2 Question2

In my program ,work3.m calculate the results.And the function  $p(x_1, x_2, x_3, h)$  calculate the probability of the point  $(x_1, x_2, x_3)$  in three distribution, and decision which class it is.

### 2.1 (a)

When  $h = 1$  The results are:

point	class
$(0.5, 1.0, 0.0)^T$	$\omega_2$
$(0.31, 1.51, -0.50)^T$	$\omega_2$
$(-0.3, 0.44, -0.1)^T$	$\omega_2$

### 2.2 (b)

When  $h = 0.1$ , the result are same with (a):

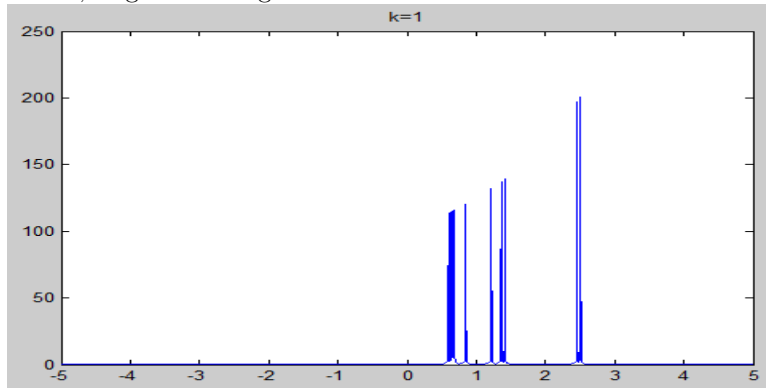
point	class
$(0.5, 1.0, 0.0)^T$	$\omega_2$
$(0.31, 1.51, -0.50)^T$	$\omega_2$
$(-0.3, 0.44, -0.1)^T$	$\omega_2$

### 3 Question3

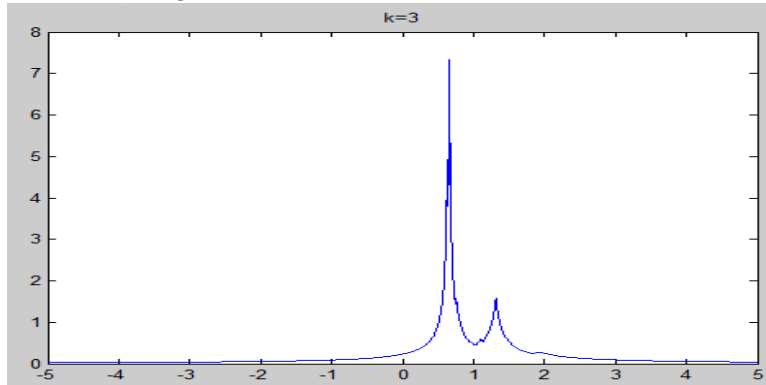
In my program ,function  $v1.m$  calculate the one-dimensional density estimation of the  $n$  samples. function  $v2.m$  calculate the two-dimensional density estimation of the  $n$  samples.function  $v3.m$  calculate the probability of the point  $(x_1, x_2, x_3)$

#### 3.1 (a)

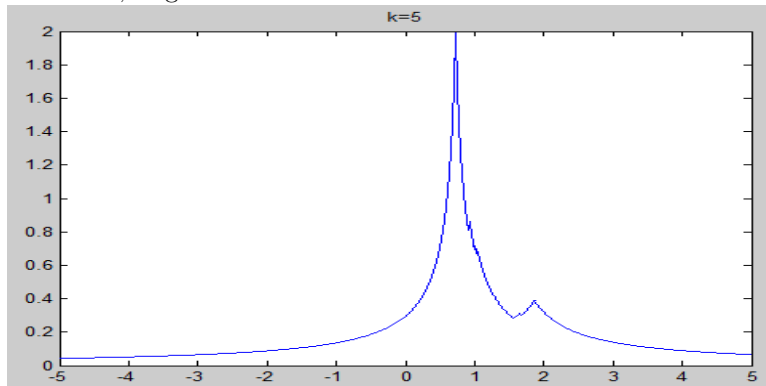
Let  $k = 1$ ,we get the image :



Let  $k = 3$ , we get that:

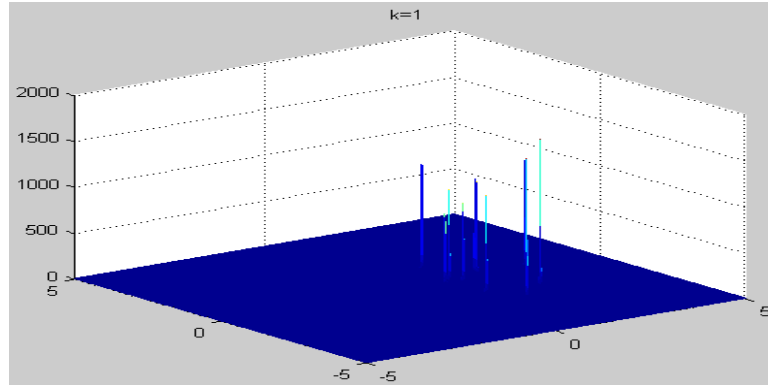


Let  $k = 5$ ,we get that :

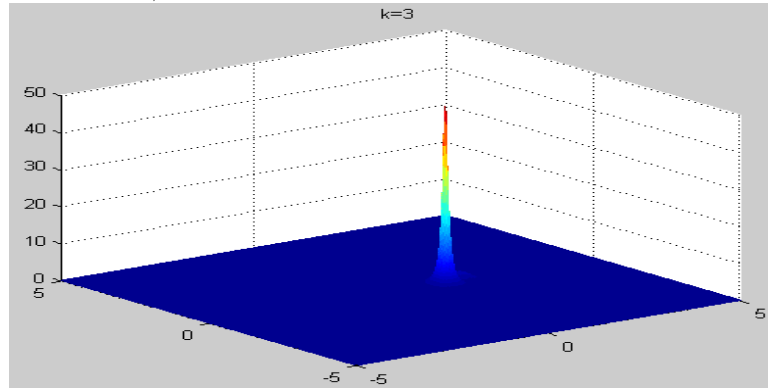


### 3.2 (b)

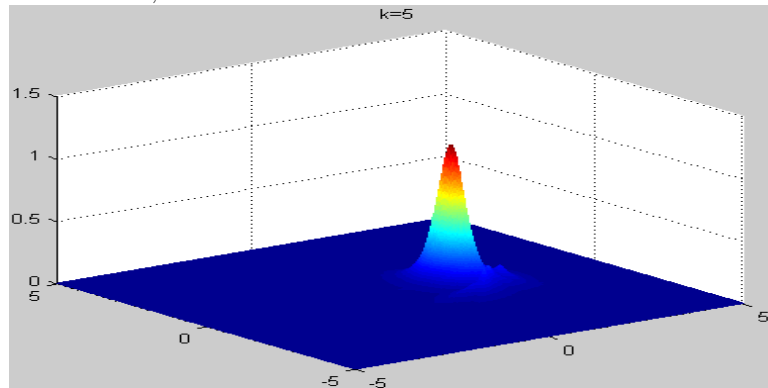
When  $k = 1$ , we have:



When  $k = 3$ , we have :



When  $k = 5$ , we have:



### 3.3 (c)

Let  $k = 3$ , we calculate the probability ,the results are follows:

$p_{11}$	0.0021
$p_{21}$	0.0553
$p_{31}$	0.0358
$p_{12}$	0.0043
$p_{22}$	9.6478e-04
$p_{32}$	0.0021
$p_{13}$	0.0026
$p_{23}$	0.0869
$p_{33}$	0.0085