Task1: $x(n) \rightarrow \boxed{\uparrow 5} \rightarrow \boxed{H(z)} \rightarrow \boxed{\downarrow 4} \rightarrow y(n)$

passband $[0, 5.5]$ KHz.

stopband $[\frac{15}{2}, \frac{12\times5}{2}]$ KHz $\rightarrow [7.5, 30]$ KHz.

Task2: Case 1: $x(n) \rightarrow \boxed{H(z)} \rightarrow \boxed{\downarrow 12} \rightarrow y(n)$

passband $[0, 0.45]$ KHz. stopband $[0.5, 6]$ KHz.

$\Delta f = \frac{0.5-0.45}{12}$ $N = \frac{3.3}{\Delta f} = 793$

Case 2: $x(n) \rightarrow \boxed{H_1(z)} \rightarrow \boxed{\downarrow 6} \rightarrow \boxed{H_2(z)} \rightarrow \boxed{\downarrow 2} \rightarrow y(n)$

P_1 $[0, 0.45)$ KHz S_1 $[1, 6]$ KHz. $\Delta f_1 = \frac{1-0.45}{12}$ $N_1 = \frac{3.3}{\Delta f_1} = 73$

P_2 $[0, 0.45]$ KHz S_1 $[0.5, 1]$ KHz $\Delta f_2 = \frac{0.5-0.45}{2}$ $N_2 = \frac{3.3}{\Delta f_2} = 133$

$N = N_1 + N_2 = 206$.

Case 3: $x(n) \rightarrow \boxed{H_1(z)} \rightarrow \boxed{\downarrow 4} \rightarrow \boxed{H_2(z)} \rightarrow \boxed{\downarrow 3} \rightarrow y(n)$

P_1 $[0, 0.45]$ KHz S_1 $[1.5, 6]$ KHz $\Delta f_1 = \frac{1.5-0.45}{12}$ $N_1 = 39$

P_2 $[0, 0.45]$ KHz S_2 $[0.5, 1.5]$ KHz $\Delta f_2 = \frac{0.5-0.45}{3}$ $N_2 = 199$

$N = N_1 + N_2 = 238$.

Case 4: $x(n) \rightarrow \boxed{H_1(z)} \rightarrow \boxed{\downarrow 3} \rightarrow \boxed{H_2(z)} \rightarrow \boxed{\downarrow 4} \rightarrow y(n)$

P_1 $[0, 0.45]$ KHz. S_1 $[2, 6]$ KHz. $\Delta f_1 = \frac{2-0.45}{12}$ $N_1 = 27$

P_2 $[0, 0.45]$ KHz S_2 $[0.5, 2]$ KHz. $\Delta f_2 = \frac{0.5-0.45}{4}$ $N_2 = 265$

$N = N_1 + N_2 = 292$

Task3: case 1: $MPS = \sum_{i=1}^{I} M_i F_i = 12 \times 793 = 9516$.

case 2: $MPS = 12 \times 73 + 2 \times 133 = 1142$

case 3: $MPS = 12 \times 39 + 3 \times 199 = 1065$

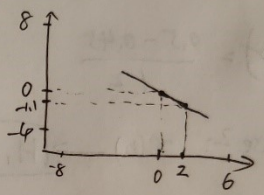
case 4: $MPS = 12 \times 27 + 4 \times 265 = 1384$.

Task4: $w = (C_1 + C_2)^{-1}(\mu_1 - \mu_2)$

$= \begin{pmatrix} 6 & 4 \\ 4 & 9 \end{pmatrix}^{-1} \begin{pmatrix} 4 \\ -1 \end{pmatrix}$

$= \frac{1}{6 \times 9 - 4 \times 4} \times \begin{pmatrix} 9 & -4 \\ -4 & 6 \end{pmatrix} \begin{pmatrix} 4 \\ -1 \end{pmatrix}$

$= \frac{1}{38} \times (40 \quad -22)$.

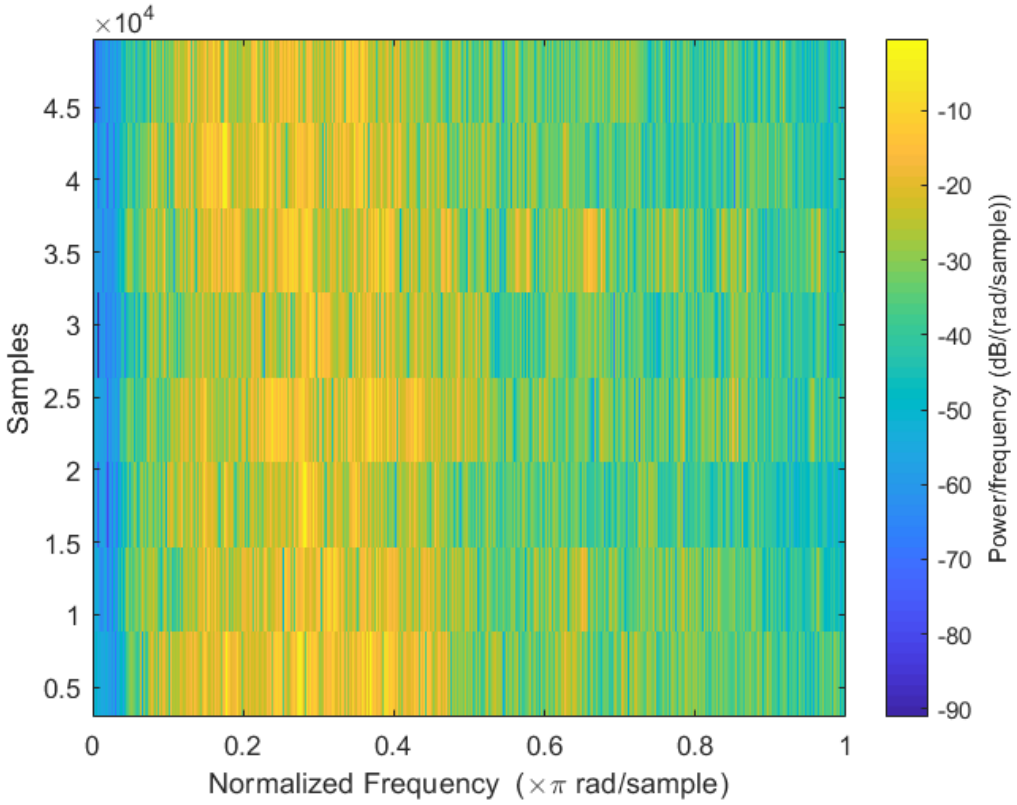


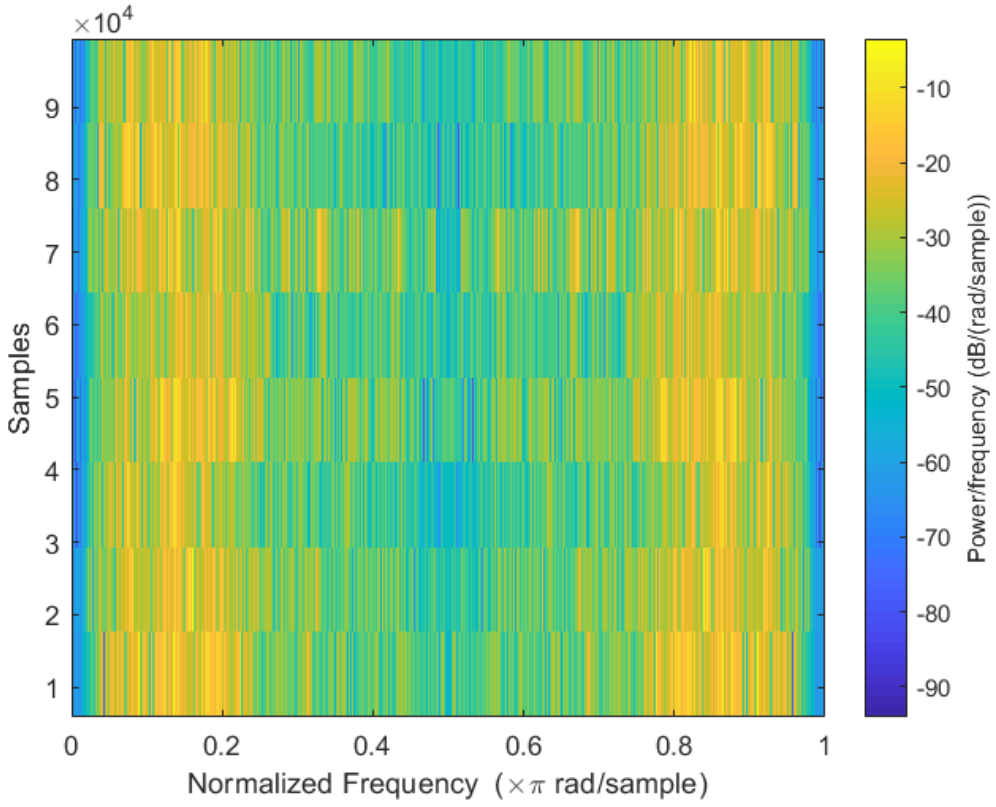
Task5: ① $w^T \mu_0 = \frac{1}{38} \times (40 \ -22) \begin{pmatrix} -1 \\ 1 \end{pmatrix} = \frac{1}{38} \times -62$

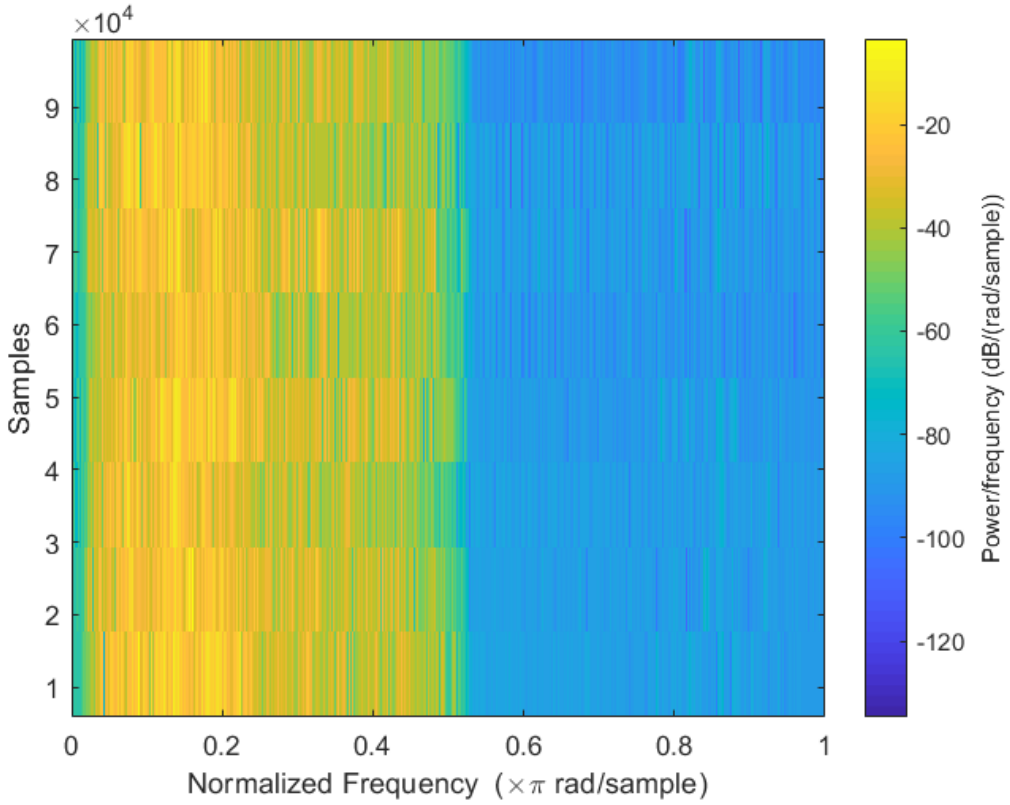
② $w^T \mu_1 = \frac{1}{38} \times (40, -22) \begin{pmatrix} -5 \\ 2 \end{pmatrix} = \frac{1}{38} \times -244$.

③ $C = \frac{w^T \mu_0 + w^T \mu_1}{2} = -\frac{62+244}{2 \times 38} = -\frac{306}{2 \times 38} \approx 4.0263$.

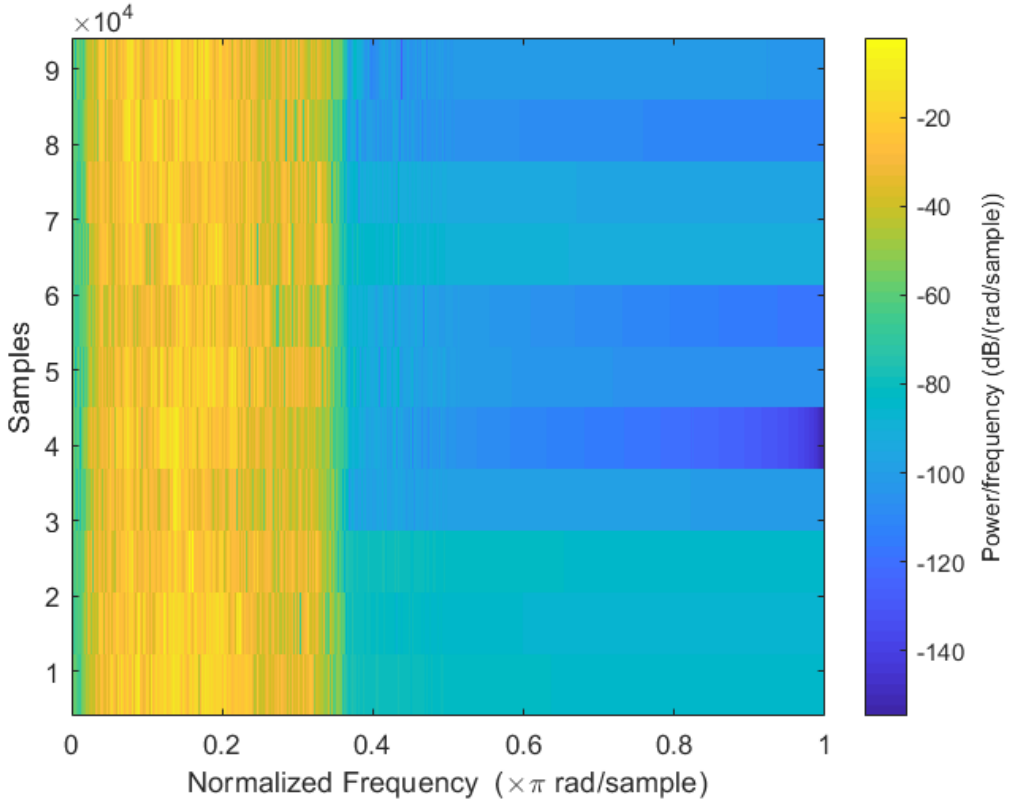
task6

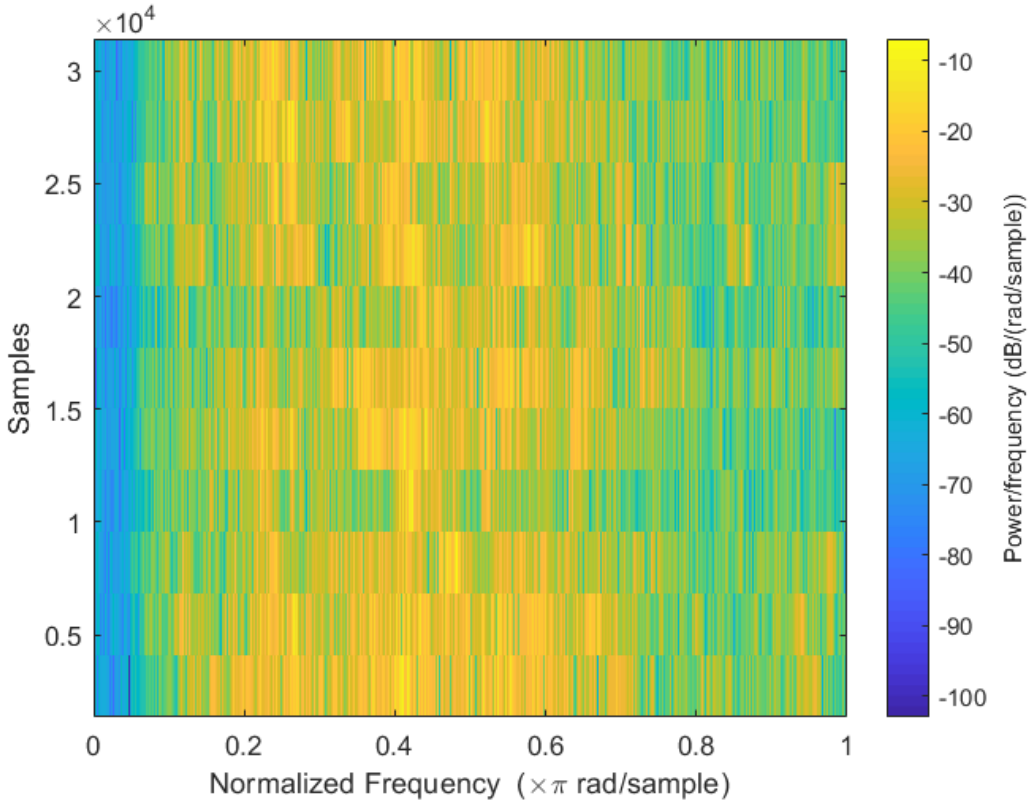

×10^4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
Samples
0
0.2
0.4
0.6
0.8
1
Normalized Frequency (×π rad/sample)
-10
-20
-30
-40
-50
-60
-70
-80
-90
Power/frequency (dB/(rad/sample))


×10^4
9
8
7
6
5
4
3
2
1
Samples
0
0.2
0.4
0.6
0.8
1
Normalized Frequency (×π rad/sample)
-10
-20
-30
-40
-50
-60
-70
-80
-90
Power/frequency (dB/(rad/sample))

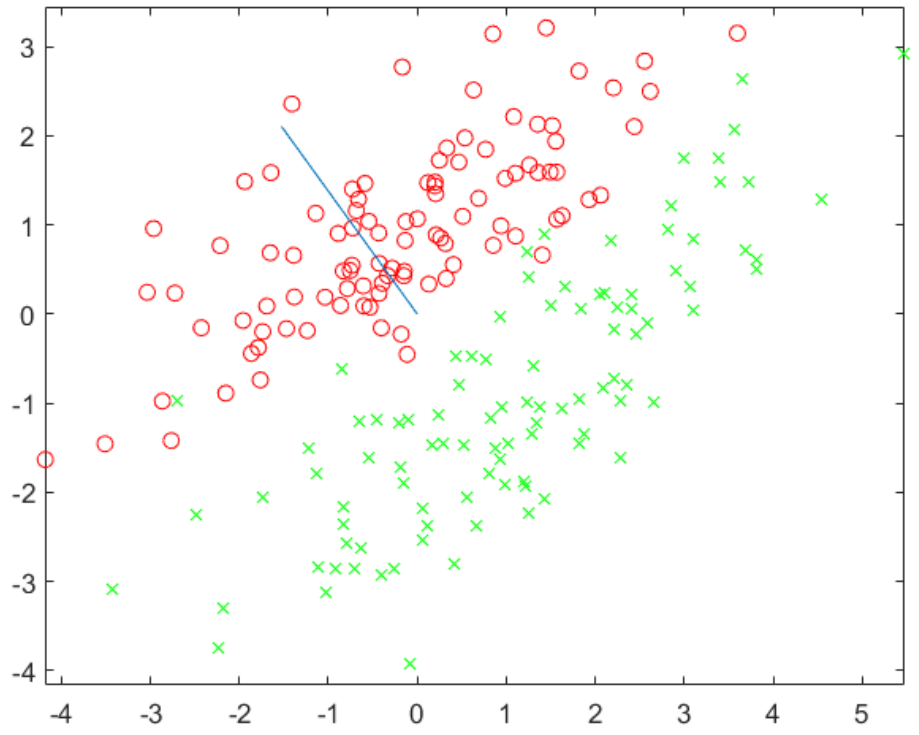

×10^4
9
8
7
6
5
4
3
2
1
Samples
0
0.2
0.4
0.6
0.8
1
Normalized Frequency (×π rad/sample)
-20
-40
-60
-80
-100
-120
Power/frequency (dB/(rad/sample))

task7


×10^4
9
8
7
6
5
4
3
2
1
Samples
0
0.2
0.4
0.6
0.8
1
Normalized Frequency (×π rad/sample)
-20
-40
-60
-80
-100
-120
-140
Power/frequency (dB/(rad/sample))


×10^4
3
2.5
2
1.5
1
0.5
Samples
0
0.2
0.4
0.6
0.8
1
Normalized Frequency (×π rad/sample)
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Power/frequency (dB/(rad/sample))

task8


3
2
1
0
-1
-2
-3
-4
-4
-3
-2
-1
0
1
2
3
4
5

task9

percentage of the samples are classified correctly is
   96.5000
task10

警告: 当用作索引时，冒号运算符需要整数操作数