Exercise 1

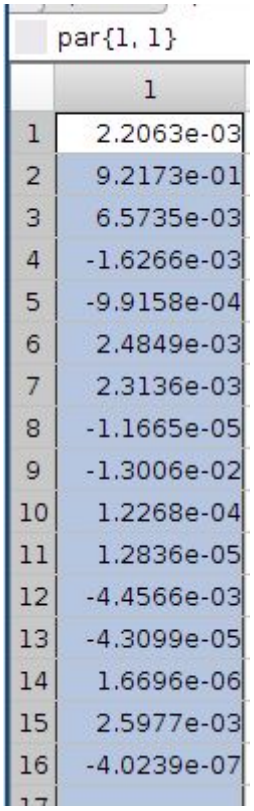
The results for k = 1 and k = 2 are as follows:

k = 2

The optimal p-values acquired are p1 = 5 and p2 = 3.

Screenshots of the learned parameters are provided below:

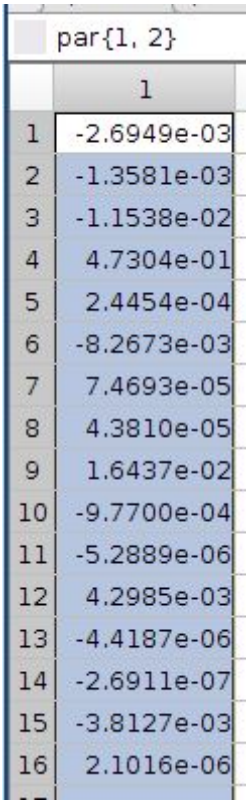
Column Vector 1:



par{1, 1}

	1
1	2.2063e-03
2	9.2173e-01
3	6.5735e-03
4	-1.6266e-03
5	-9.9158e-04
6	2.4849e-03
7	2.3136e-03
8	-1.1665e-05
9	-1.3006e-02
10	1.2268e-04
11	1.2836e-05
12	-4.4566e-03
13	-4.3099e-05
14	1.6696e-06
15	2.5977e-03
16	-4.0239e-07

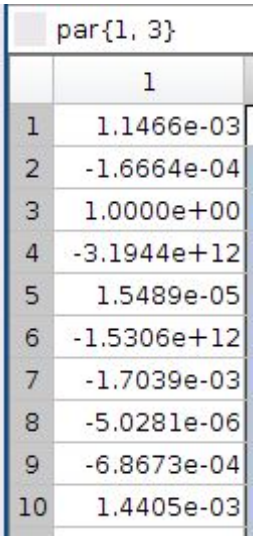
Column Vector 2:



par{1, 2}

	1
1	-2.6949e-03
2	-1.3581e-03
3	-1.1538e-02
4	4.7304e-01
5	2.4454e-04
6	-8.2673e-03
7	7.4693e-05
8	4.3810e-05
9	1.6437e-02
10	-9.7700e-04
11	-5.2889e-06
12	4.2985e-03
13	-4.4187e-06
14	-2.6911e-07
15	-3.8127e-03
16	2.1016e-06

Column Vector 3:



par{1, 3}

	1
1	1.1466e-03
2	-1.6664e-04
3	1.0000e+00
4	-3.1944e+12
5	1.5489e-05
6	-1.5306e+12
7	-1.7039e-03
8	-5.0281e-06
9	-6.8673e-04
10	1.4405e-03

k = 5

Optimal p-values: p1 = 4 and p2 = 1.

Learned parameters:

Column vector 1:

par{1, 1}

	1
1	2.5044e-03
2	9.1976e-01
3	-2.8554e-03
4	-7.4385e-04
5	-1.0342e-03
6	1.3743e-03
7	2.4869e-03
8	1.3601e-04
9	-2.6908e-04
10	6.6926e-05
11	1.3061e-05
12	-4.2816e-03
13	-4.5174e-05

Column Vector 2:

par{1, 2}

	1
1	-4.3238e-03
2	-1.0015e-03
3	1.4480e-03
4	4.6798e-01
5	5.6850e-04
6	-2.5277e-03
7	-1.0251e-03
8	1.9246e-05
9	-1.6742e-03
10	-6.7254e-04
11	-7.8462e-06
12	3.4766e-03
13	8.7155e-06

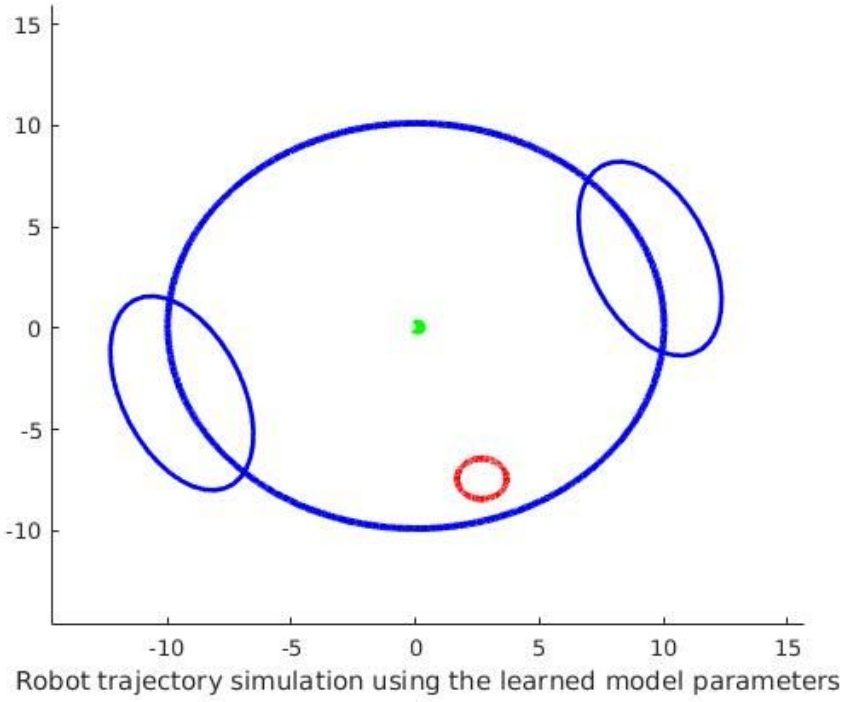
Column Vector 3

par{1, 3}

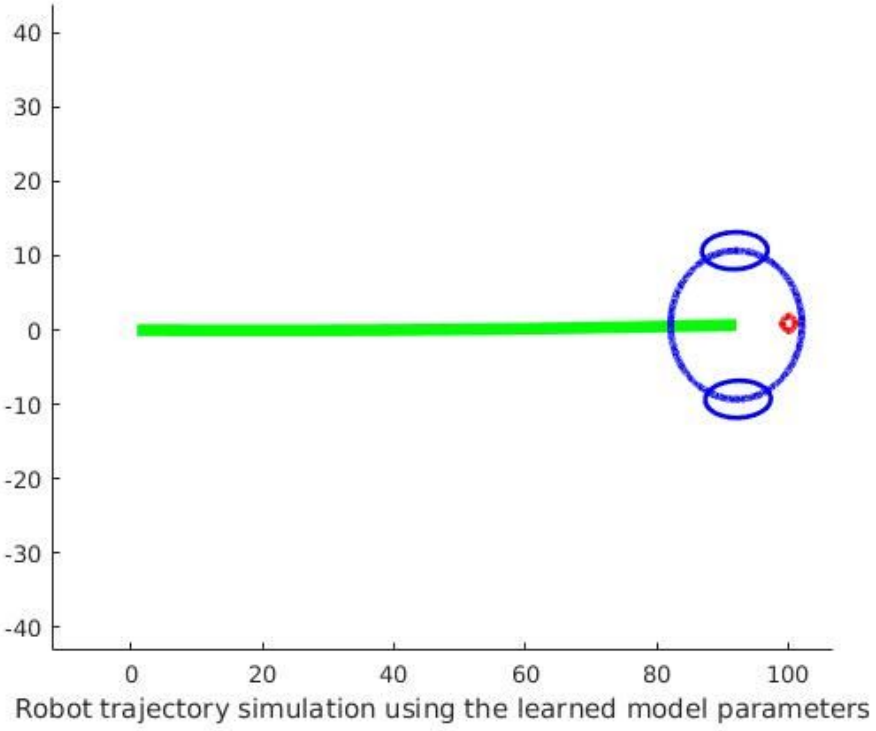
	1
1	5.7406e-04
2	-3.2074e-04
3	9.9870e-01
4	4.5541e-04

Plotting the robot with the learned parameters in the saved ‘par’ file reveals the following plots:

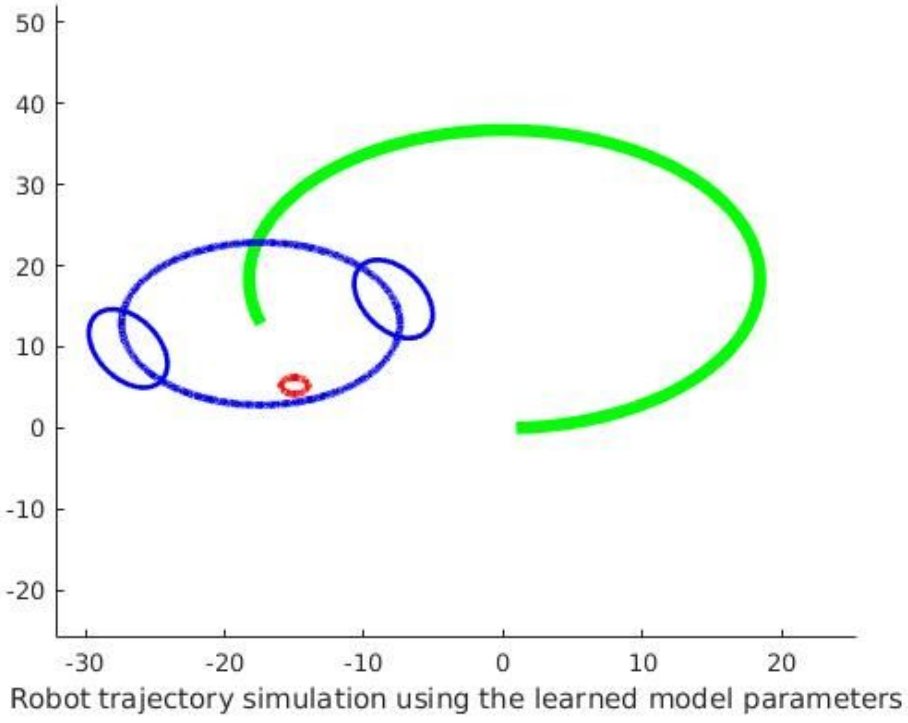
(v,w) = (0, 0.05):



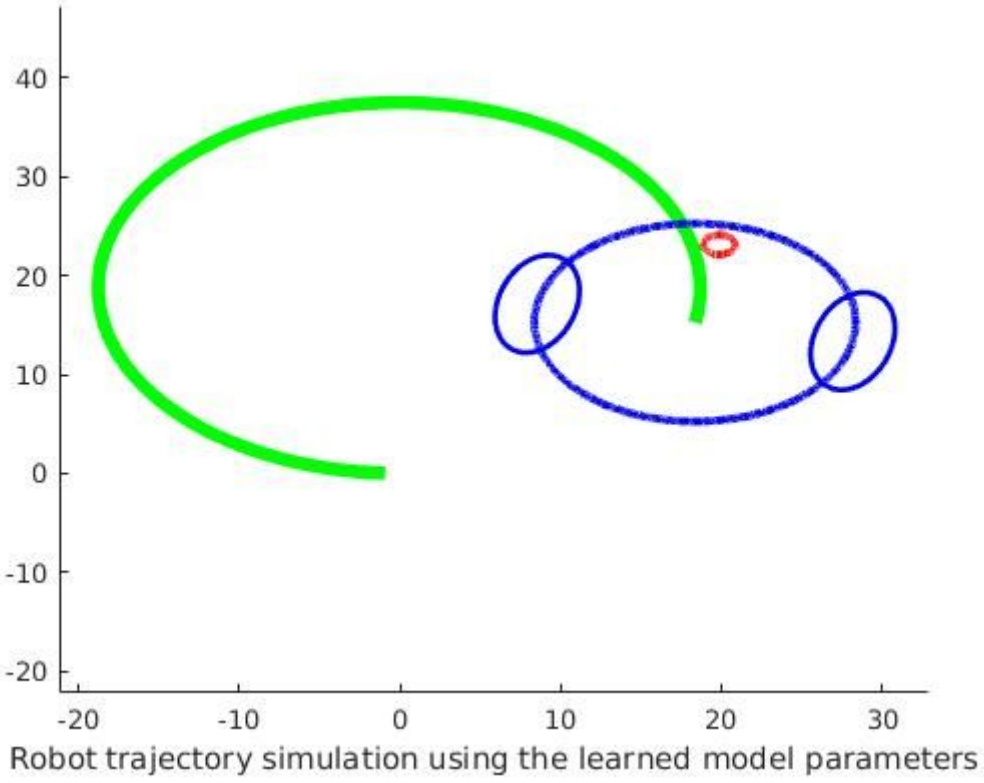
(v,w) = (1, 0):


40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
Robot trajectory simulation using the learned model parameters

(v,w) = (1, 0.05):


50
40
30
20
10
0
-10
-20
-30
-20
-10
0
10
20
Robot trajectory simulation using the learned model parameters

(v,w) = (-1, -0.05):


40
30
20
10
0
-10
-20
-20
-10
0
10
20
30
Robot trajectory simulation using the learned model parameters

Exercise 2

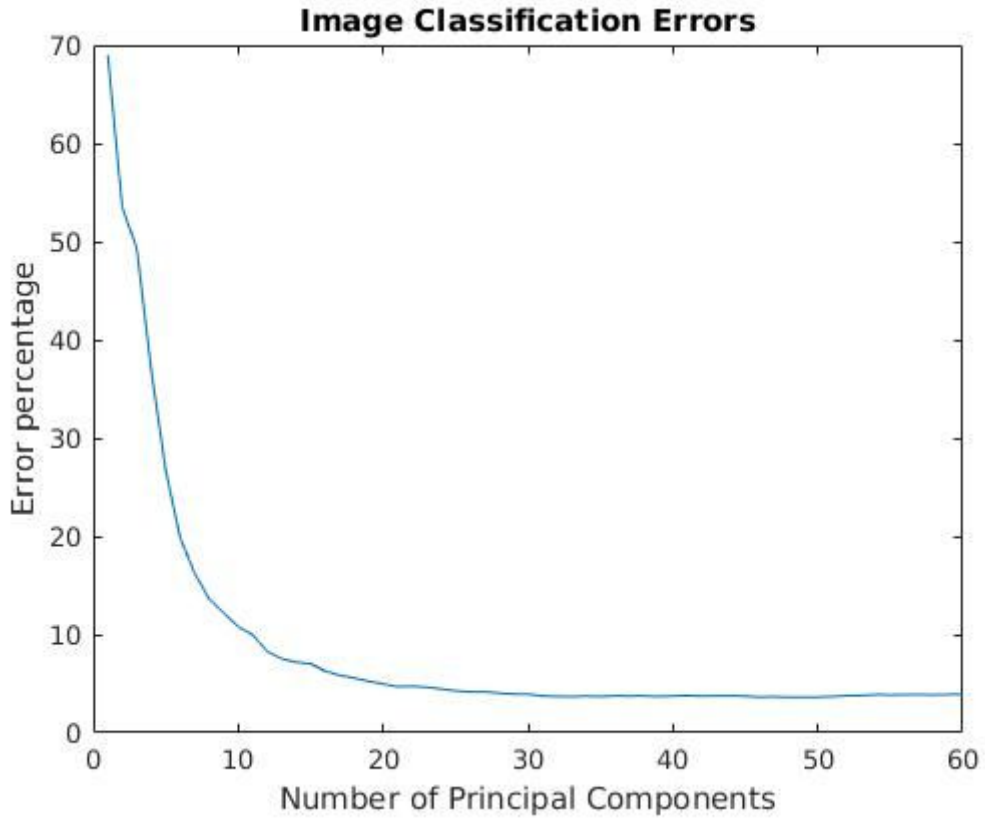
The optimal d value after running the algorithm is obtained to be d = 48.

The classification error at d=48 is 3.62%, as can also be seen in the error plot below.

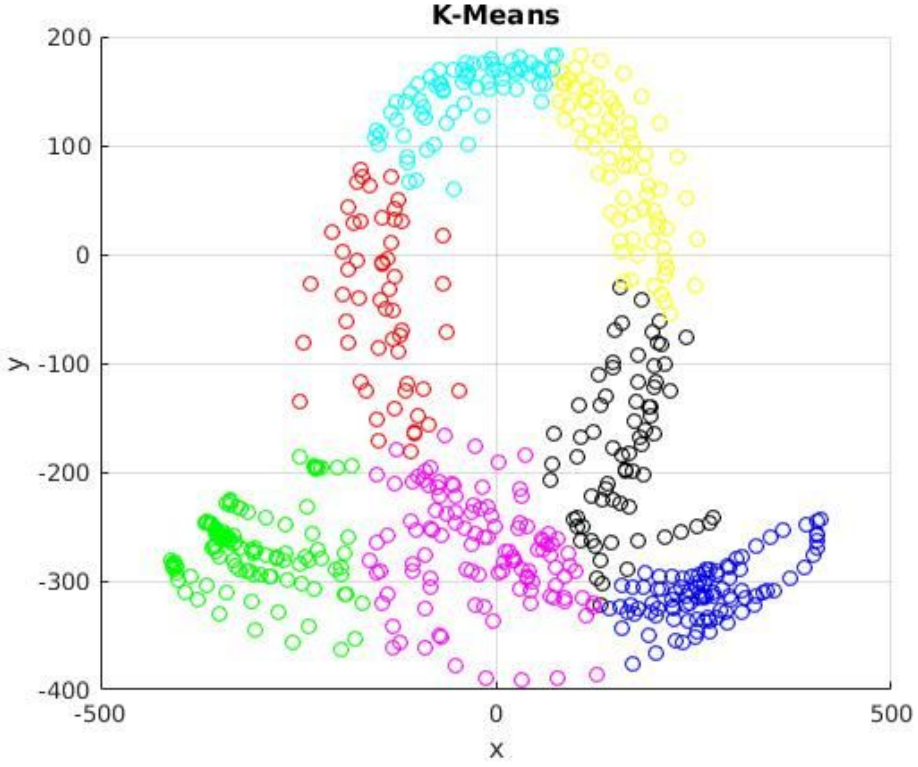
The confusion matrix acquired after running the function is:

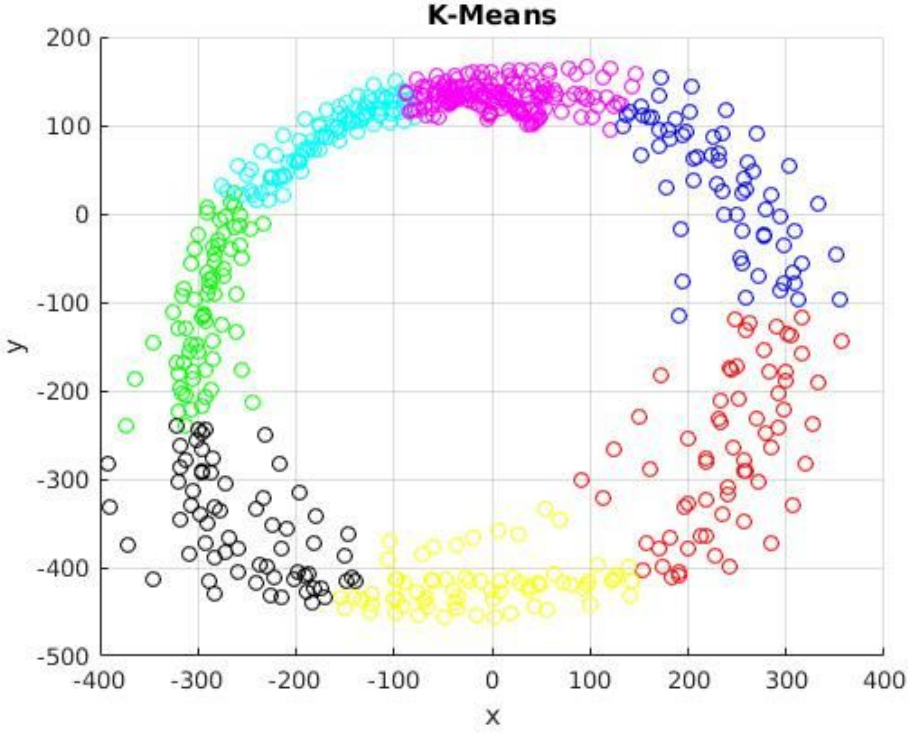
digit	0	1	2	3	4	5	6	7	8	9
0	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
1	0.00	0.97	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
2	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.00	0.02	0.00
3	0.00	0.00	0.01	0.96	0.00	0.00	0.00	0.00	0.02	0.00
4	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00	0.02	0.00	0.96	0.00	0.00	0.01	0.00
6	0.01	0.00	0.00	0.00	0.00	0.01	0.96	0.00	0.01	0.00
7	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.93	0.01	0.02
8	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.97	0.01
9	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.94

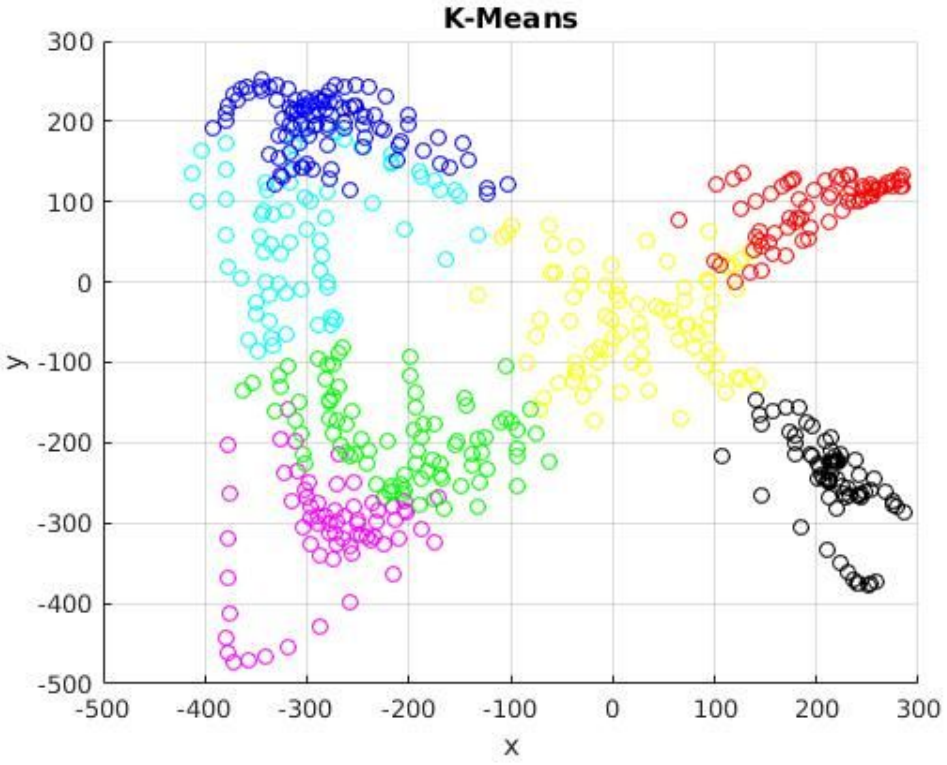
Error plot:



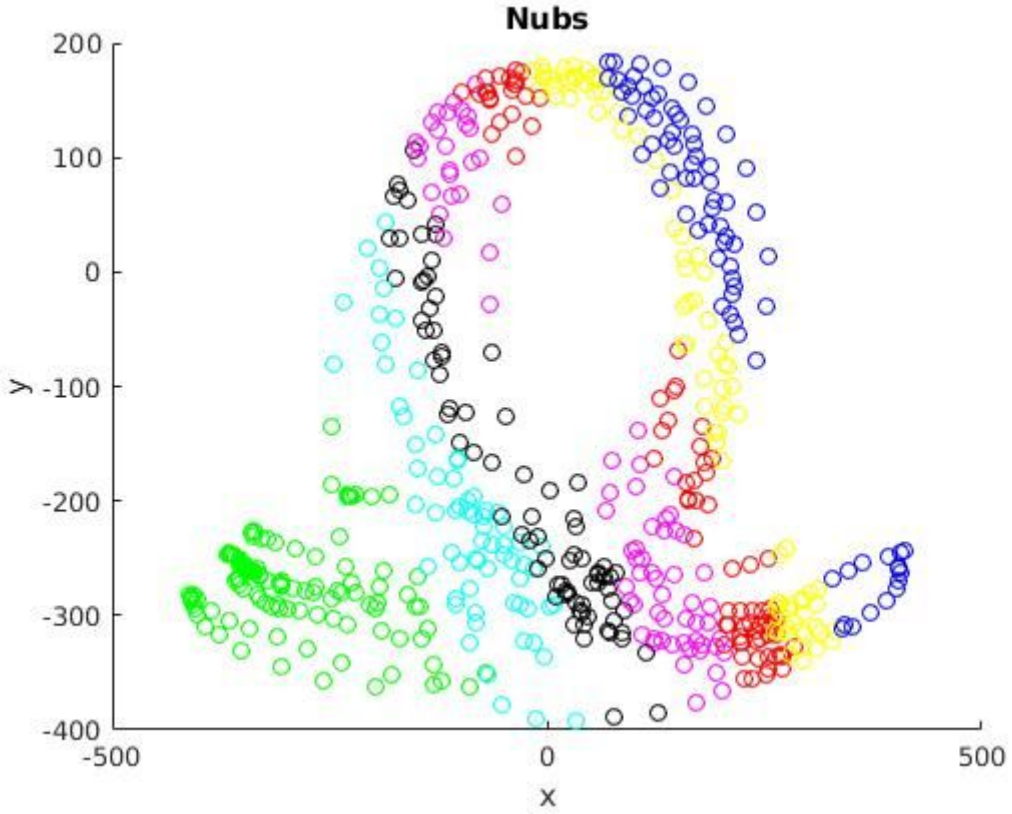
Exercise 3a

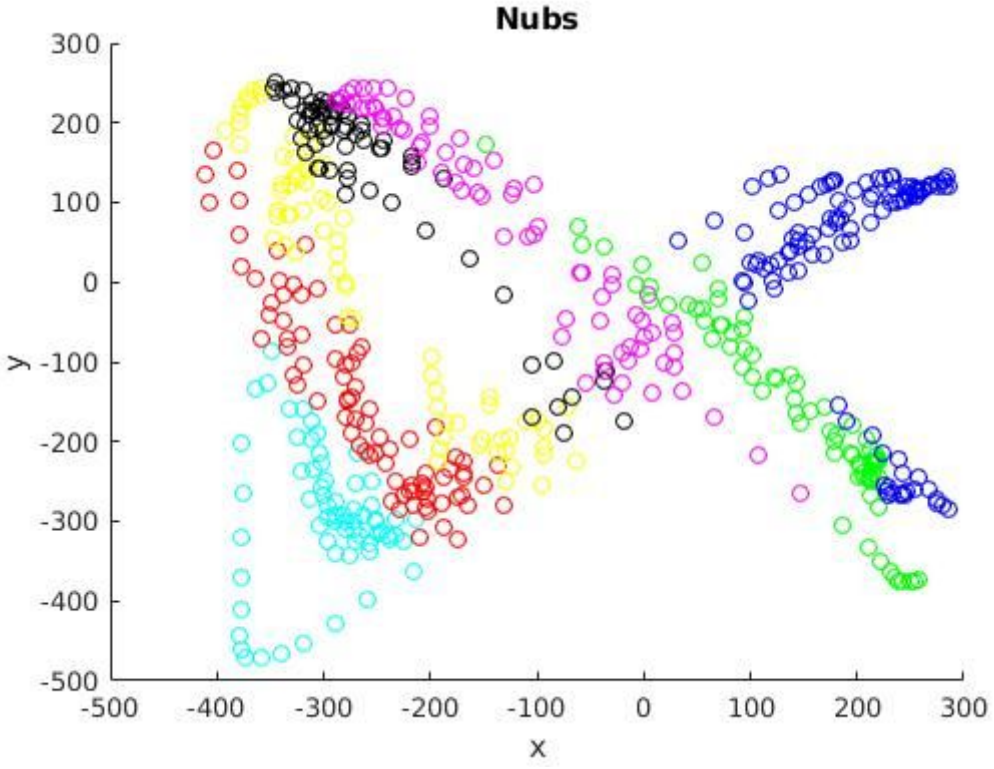

K-Means
200
100
0
-100
-200
-300
-400
y
-500
0
500
x

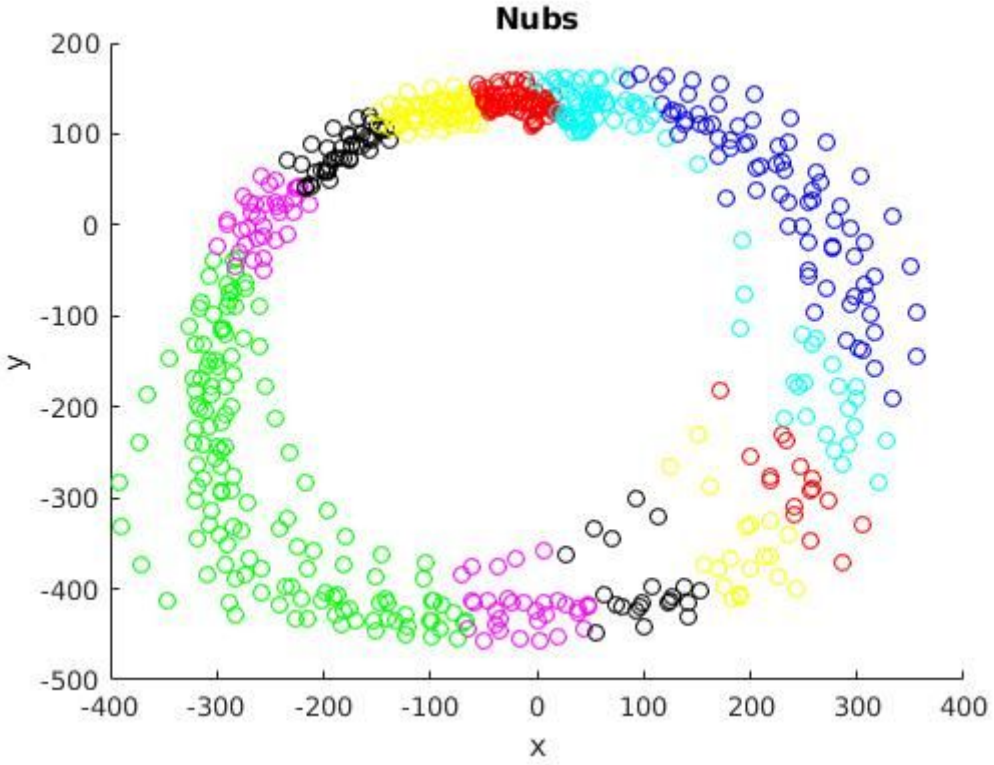

K-Means
200
100
0
-100
-200
-300
-400
-500
y
-400
-300
-200
-100
0
100
200
300
400
x


K-Means
300
200
100
0
-100
-200
-300
-400
-500
y
-500
-400
-300
-200
-100
0
100
200
300
x

Exercise 3b


Nubs
200
100
0
-100
-200
-300
-400
y
-500
0
500
x


Nubs
300
200
100
0
-100
-200
-300
-400
-500
y
-500
-400
-300
-200
-100
0
100
200
300
x


Nubs
200
100
0
-100
-200
-300
-400
-500
y
-400
-300
-200
-100
0
100
200
300
400
x