MACHINE LEARNING IN ROBOTICS
Assignment 1

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Exercise 1

Exercise 1.a - 1.b

k=2

(1) Optimal value of p1, p2 :

p1	p2
5	3

(2) Learned parameter values :

par{1,1}	par{1,2}	par{1,3}
2.2063e-03	-2.6949e-03	-5.9515e-04
9.2173e-01	-1.3581e-03	-1.7107e-04
6.5735e-03	-1.1538e-02	9.9971e-01
-1.6266e-03	4.7304e-01	8.3936e-04
-9.9158e-04	2.4454e-04	1.2687e-04
2.4849e-03	-8.2673e-03	1.7827e-03
2.3136e-03	7.4693e-05	-1.4105e-04
-1.1665e-05	4.3810e-05	-4.5223e-06
-1.3006e-02	1.6437e-02	-6.2224e-04
1.2268e-04	-9.7700e-04	-1.3221e-05
1.2836e-05	-5.2889e-06	
-4.4566e-03	4.2985e-03	
-4.3099e-05	-4.4187e-06	
1.6696e-06	-2.6911e-07	
2.5977e-03	-3.8127e-03	
-4.0239e-07	2.1016e-06	

k=5

(1) Optimal value of p1, p2 :

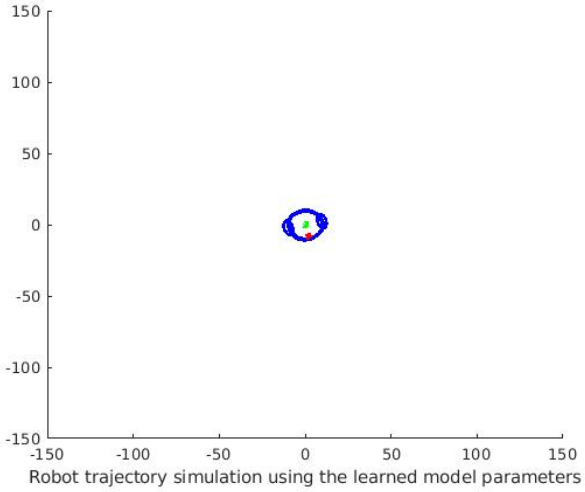
p1	p2
4	1

(2) Learned parameter values :

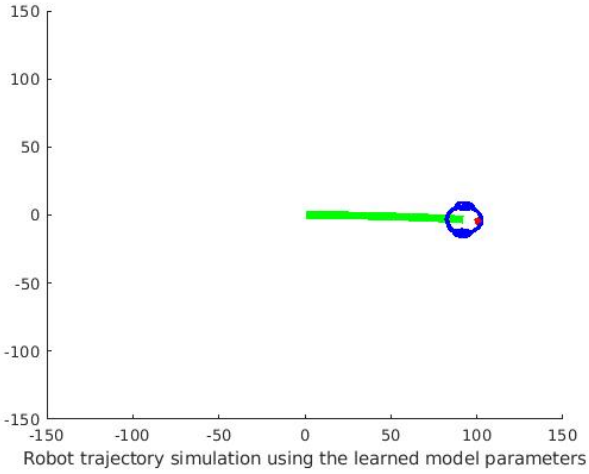
par{1,1}	par{1,2}	par{1,3}
2.5044e-03	-4.3238e-03	8.0784e-04
9.1976e-01	-1.0015e-03	-3.1902e-04
-2.8554e-03	1.4480e-03	9.9870e-01
-7.4385e-04	4.6798e-01	3.2142e-04
-1.0342e-03	5.6850e-04	
1.3743e-03	-2.5277e-03	
2.4869e-03	-1.0251e-03	
1.3601e-04	1.9246e-05	
-2.6908e-04	-1.6742e-03	
6.6926e-05	-6.7254e-04	
1.3061e-05	-7.8462e-06	
-4.2816e-03	3.4766e-03	
-4.5174e-05	8.7155e-06	

Exercise 1.c

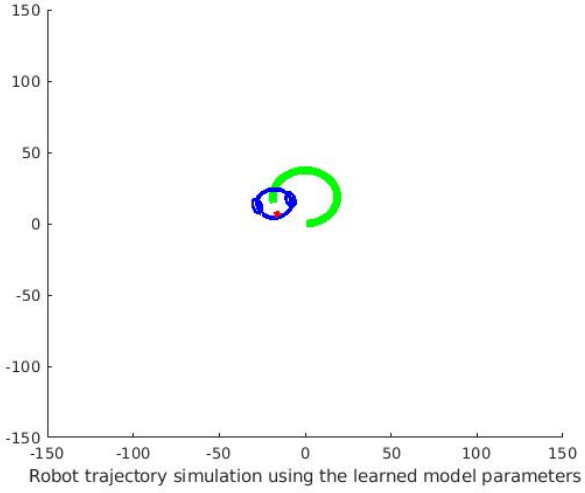
k=2



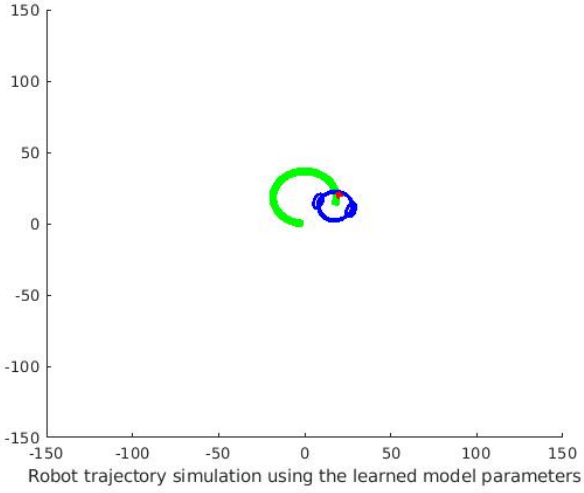
(a) Simulation (v, w) = (0, 0.05)



(b) Simulation (v, w) = (1, 0)

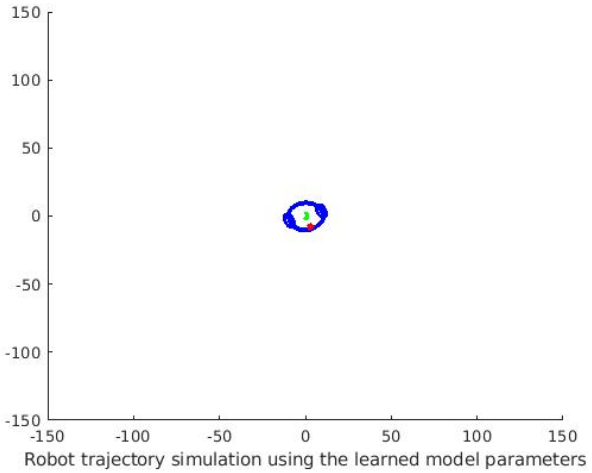


(c) Simulation (v, w) = (1, 0.05)

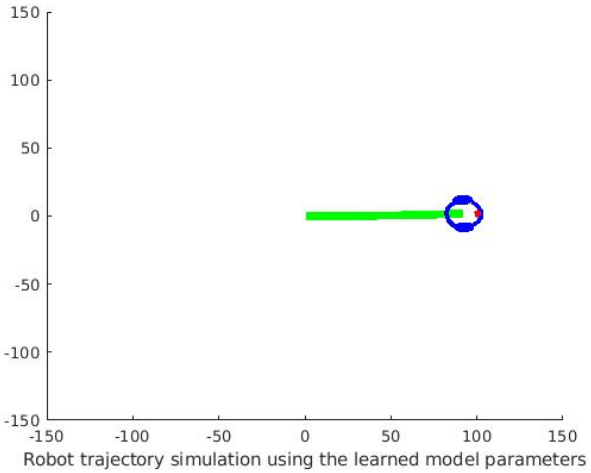


(d) Simulation (v, w) = (-1, -0.05)

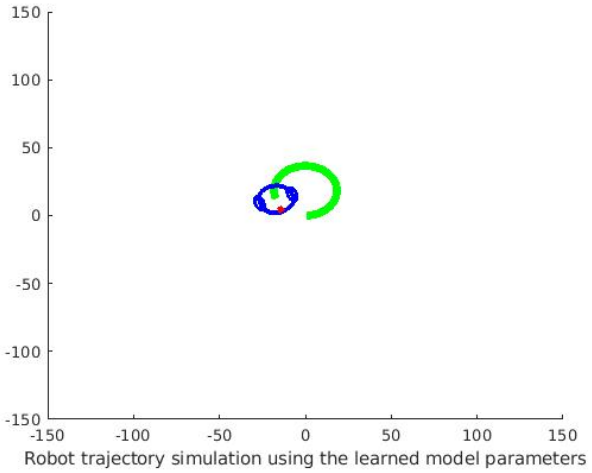
k=5



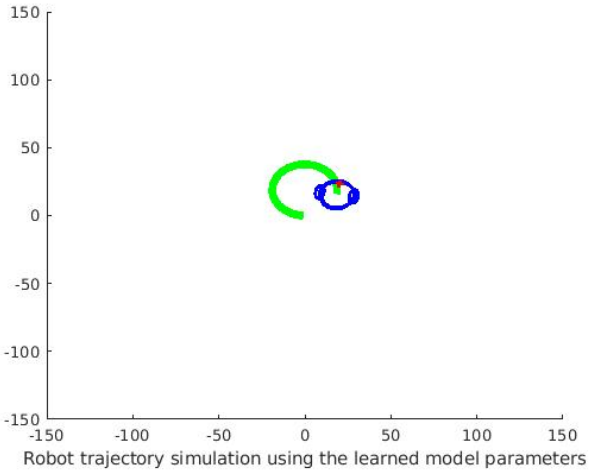
(a) Simulation (v, w) = (0, 0.05)



(b) Simulation (v, w) = (1, 0)



(c) Simulation (v, w) = (1, 0.05)



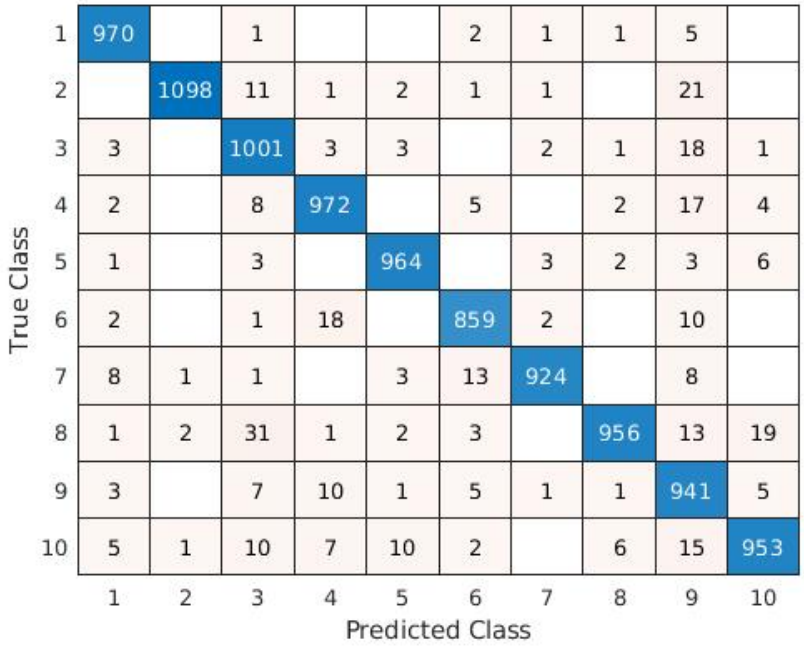
(d) Simulation (v, w) = (-1, -0.05)

Exercise 2

(1) The optimized number of principal components and respective classification error:

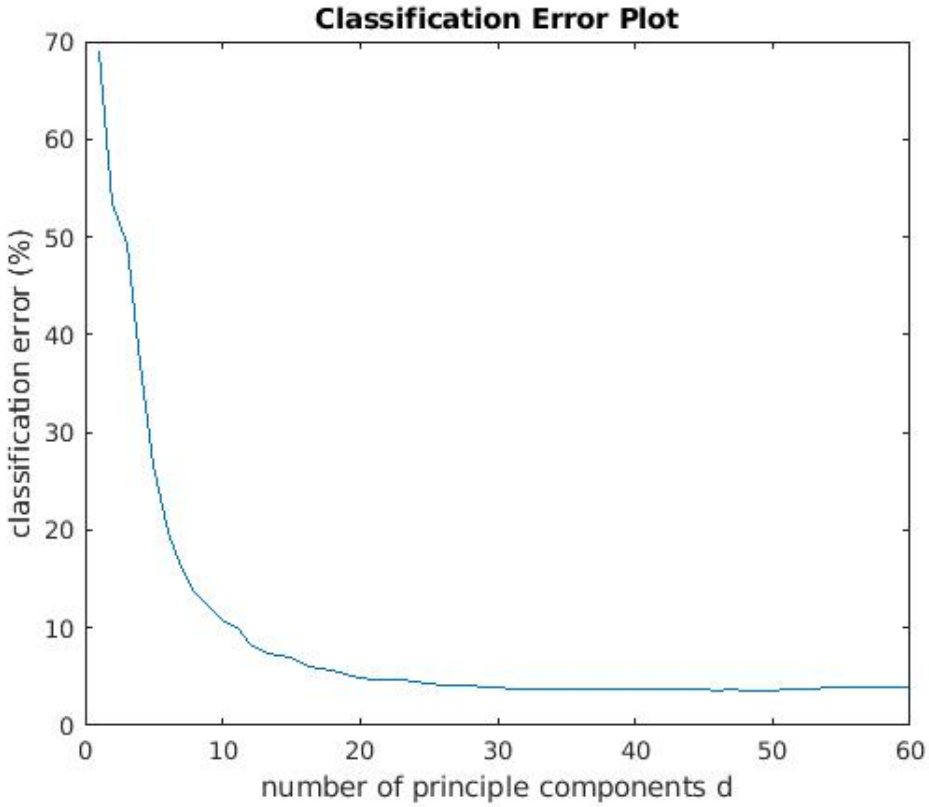
d_{opt}	err_{min}
48	3.620%

(2) confusion matrix:

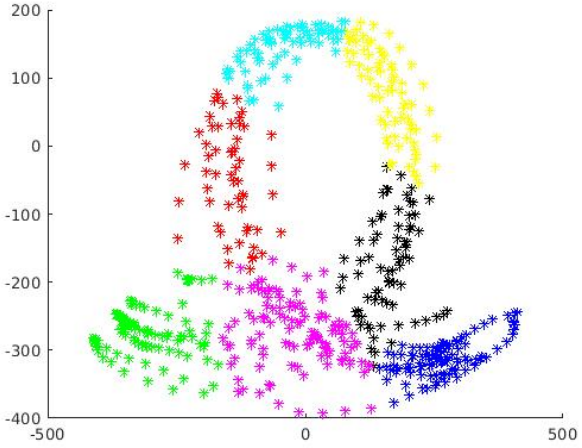


digit	0	1	2	3	4	5	6	7	8	9
0	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
1	0.00	0.97	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
2	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.00	0.02	0.00
3	0.00	0.00	0.01	0.96	0.00	0.00	0.00	0.00	0.02	0.00
4	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00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

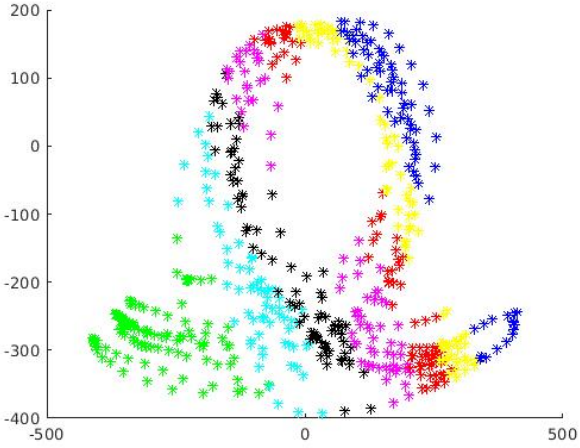
(3) plot of classification error:



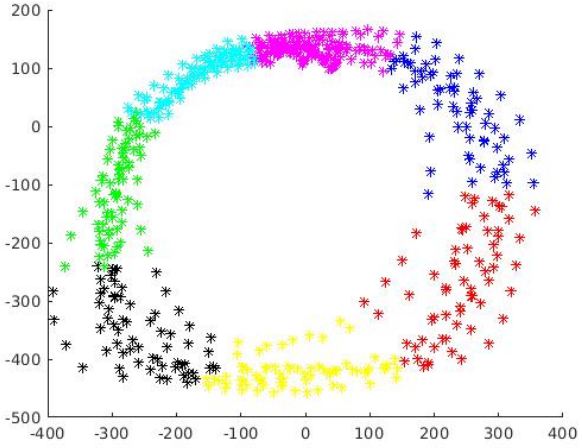
Exercise 3



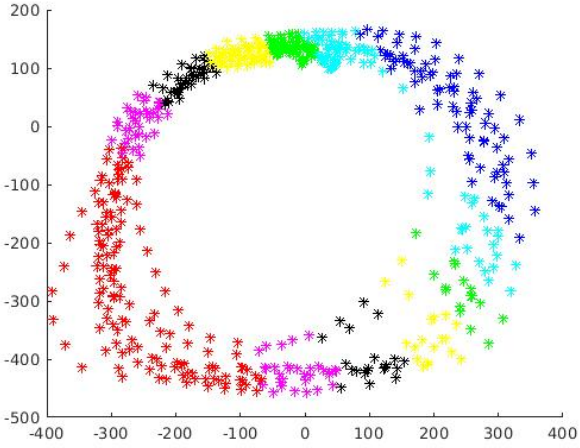
(a) gesture l clustering using kmeans



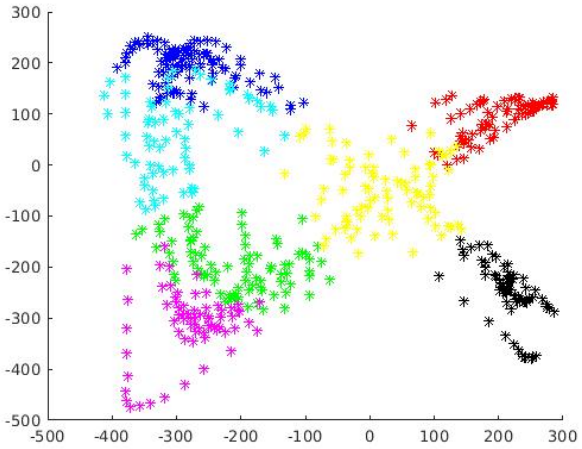
(b) gesture l clustering using nubs



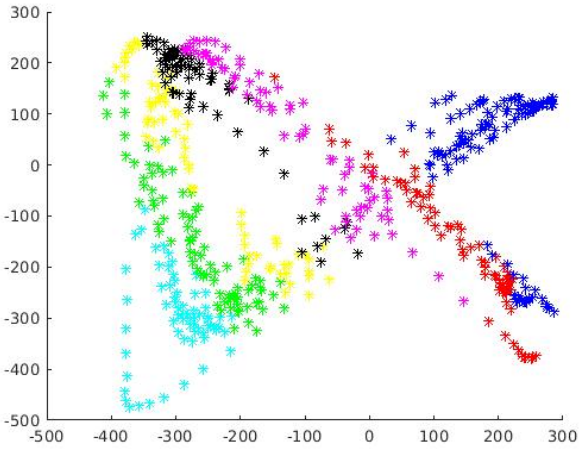
(c) gesture x clustering using kmeans



(d) gesture x clustering using nubs



(e) gesture o clustering using kmeans



(f) gesture o clustering using nubs