Machine Learning in Robotics
Assignment 1

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Note: To run each exercise, run the file named "main.m" in the respective exercise folder

Exercise 1

a. k=2

i. Polynomial Degree **`p1=5`**

ii. Weight Matrix/Parameter Values for p1 (Error=0.3586). First two columns give parameter values for (x, y) positions.

```
-0.0034   -0.0013   -0.0008
 0.9219   -0.0020   -0.0002
-0.0112    0.0124    0.9982
 0.0087    0.4703    0.0005
 0.0014    0.0001    0.0001
 0.0009   -0.0035    0.0005
-0.0018    0.0004   -0.0002
 0.0001    0.0002   -0.0000
 0.0069   -0.0154    0.0018
-0.0005   -0.0009   -0.0000
-0.0000    0.0000   -0.0000
-0.0000    0.0008   -0.0001
 0.0000   -0.0000    0.0000
-0.0000   -0.0000    0.0000
-0.0001    0.0034   -0.0001
 0.0000    0.0000    0.0000
```

iii. Polynomial Degree **`p2=2`** (Error= 0.0798)

iv. Weight Matrix/Parameter Values for p2. Third column gives parameter values for orientation.

```
-0.0000   -0.0031   -0.0005
 0.9224    0.0004   -0.0002
-0.0015    0.0015    1.0008
 0.0019    0.4418    0.0001
 0.0006    0.0002    0.0000
-0.0031    0.0014   -0.0004
-0.0009    0.0001   -0.0001
```

b. k=5

i. Polynomial Degree **`p1=3`** (Error= 0.3586)

ii. Weight Matrix/Parameter Values for p1=3. First two columns give parameter values for (x, y) positions.

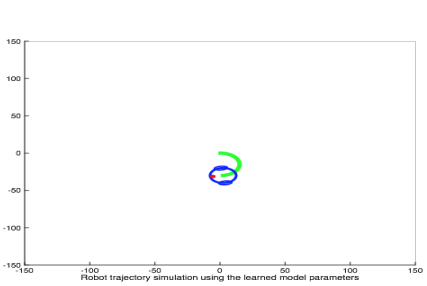
-0.0000	-0.0025	-0.0005
0.9246	-0.0002	-0.0004
-0.0102	0.0005	0.9985
-0.0038	0.4617	-0.0000
0.0006	0.0002	0.0000
-0.0031	0.0003	-0.0004
-0.0009	0.0001	-0.0001
-0.0001	0.0000	0.0000
0.0057	0.0009	0.0015
0.0001	-0.0005	0.0000

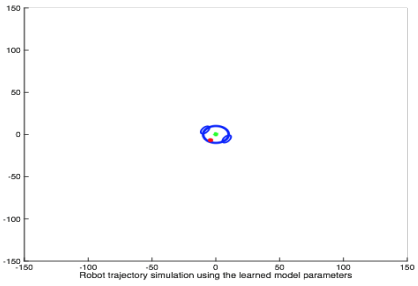
iii. Polynomial Degree **p2=3** (Error=0.0797)

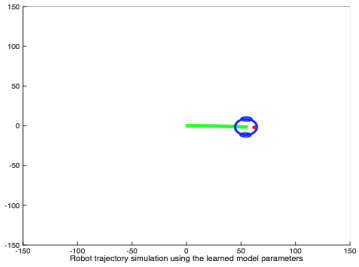
iv. Weight Matrix/Parameter Values for p2 . Third column gives parameter values for orientation.

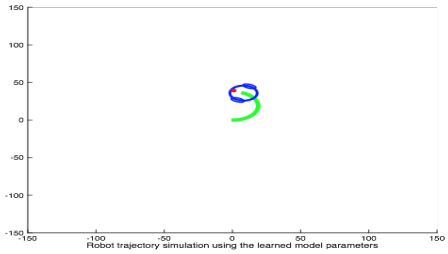
-0.0000	-0.0025	-0.0005
0.9246	-0.0002	-0.0004
-0.0102	0.0005	0.9985
-0.0038	0.4617	-0.0000
0.0006	0.0002	0.0000
-0.0031	0.0003	-0.0004
-0.0009	0.0001	-0.0001
-0.0001	0.0000	0.0000
0.0057	0.0009	0.0015
0.0001	-0.0005	0.0000

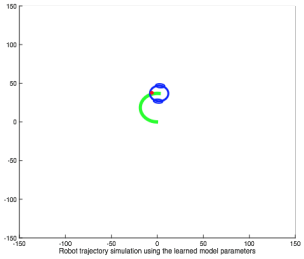
C. The below plots are for input values (0.5,-0.03), (0,0.05), (1,0), (1,0.05) and (-1, -0.05) respectively











Exercise 2

a.

Mu= [176.6303, 128.8086, 103.7527]

Sigma=

$$1.0e+03 * \begin{bmatrix} 1.7206 & 1.4262 & 1.4428 \\ 1.4262 & 1.4197 & 1.4444 \\ 1.4428 & 1.4444 & 1.5887 \end{bmatrix}$$

b.

Mu= [101.4045, 97.0688, 85.8460]

Sigma=

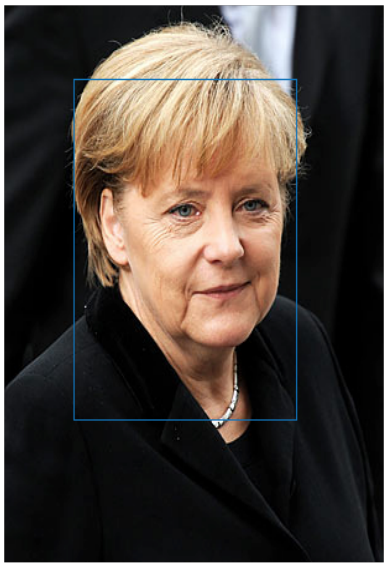
$$1.0e+03 * \begin{bmatrix} 5.2428 & 4.5364 & 4.1369 \\ 4.5364 & 4.6206 & 4.3846 \\ 4.1369 & 4.3846 & 4.8578 \end{bmatrix}$$

c. Skin Model

d. Background Model

e. Binary Image

f. Face Recognition

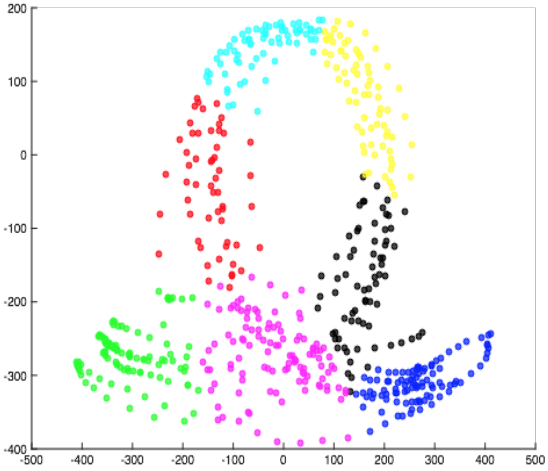


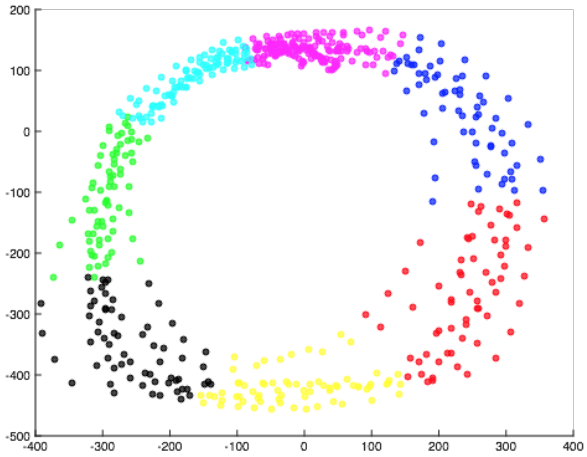
Pixel info: (X, Y) [R G B]

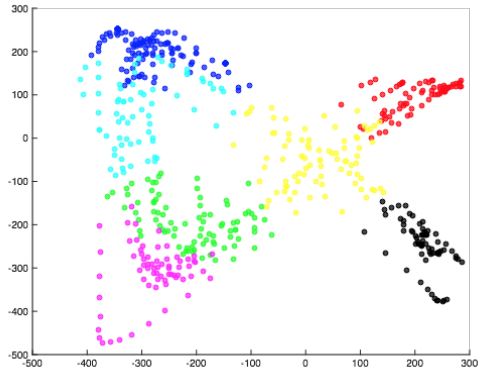
Pixel info: (X, Y) [R G B]

Exercise 3

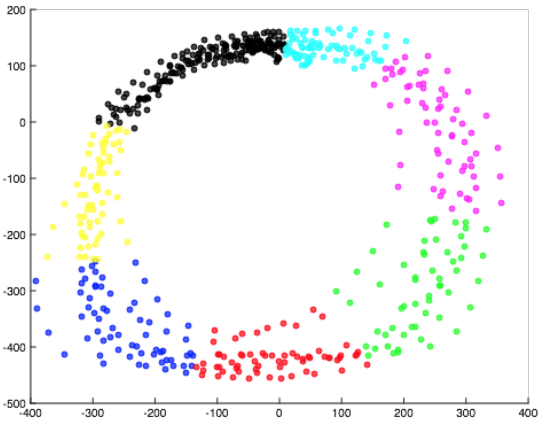
a. K-Means clustering

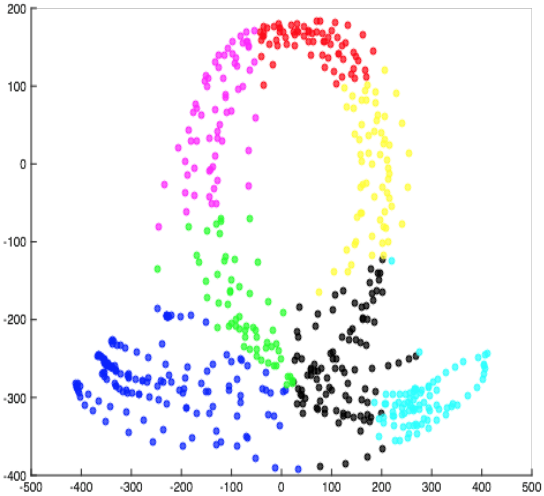


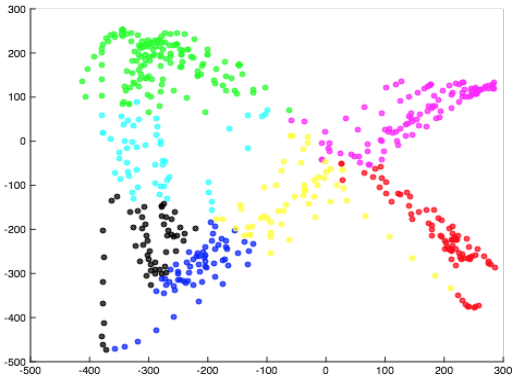




b. Non Uniform Binary Split (Random vectors added is eigen vector of covariance matrix)


200
100
0
-100
-200
-300
-400
-500
-400
-300
-200
-100
0
100
200
300
400


200
100
0
-100
-200
-300
-400
-500
-400
-300
-200
-100
0
100
200
300
400
500



Comparison:

1. No of iterations in Non Uniform Binary split is less than K-Means.
2. Non uniform binary split may not give optimal solutions. The boundaries once created will not be removed.
3. The output of k means is dependent on initial means chosen.