In [1]:

```
#unsuperised learning
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:

```
data_train =  np.loadtxt('/home/bhavy/Dropbox/7th-semester/courses/ML/Assignments/A
```

In [3]:

```
N =  len(data_train)
gamma = 0.1
L = 1
ITER =10
```

In [4]:

```
def selecting_L_random_data_points(L):
    idx = np.argsort(np.random.random(N))[:L]
    return data_train[idx], idx
```

In [5]:

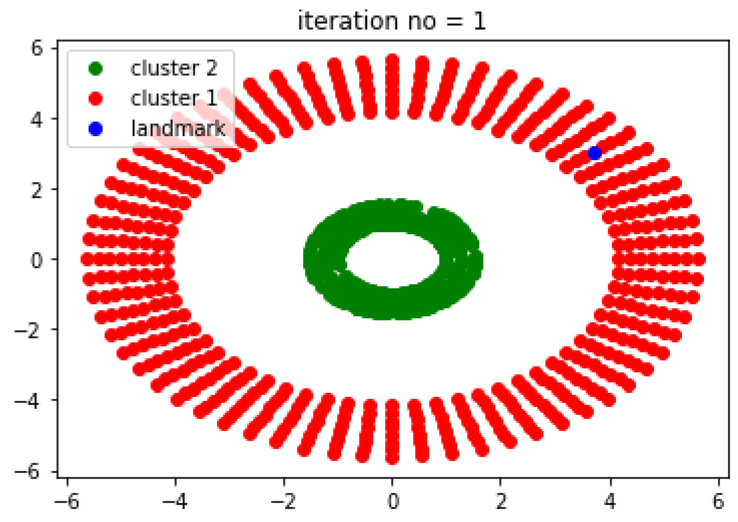
```
def kernel(xn, xm):
    #gamma = 0.1 given
    return np.exp(-gamma*np.dot(np.transpose(xn-xm), xn-xm)) #rbf kernel
```

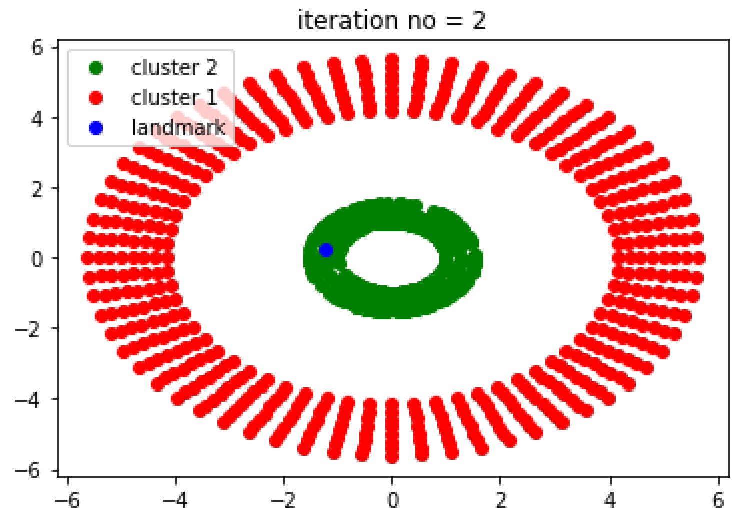
In [6]:

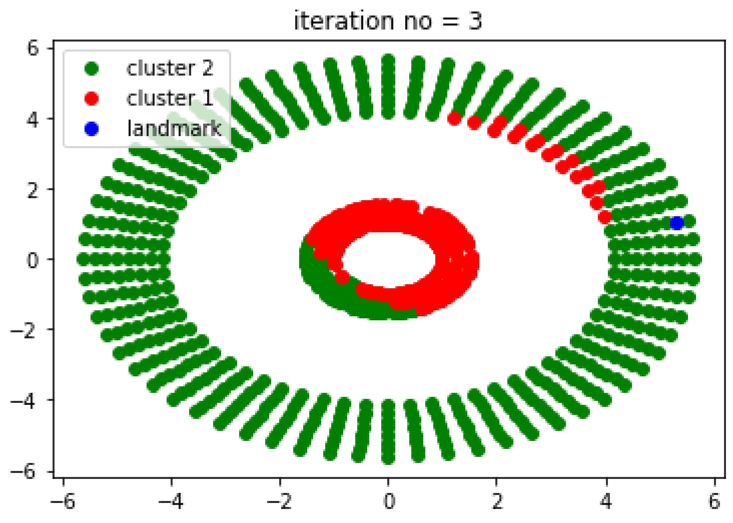
```
def compute_X(X_psi, landmark):
    for i in range(N):
        for j in range(L):
            X_psi[i, j] = kernel(data_train[i],landmark[j])
    return X_psi
```

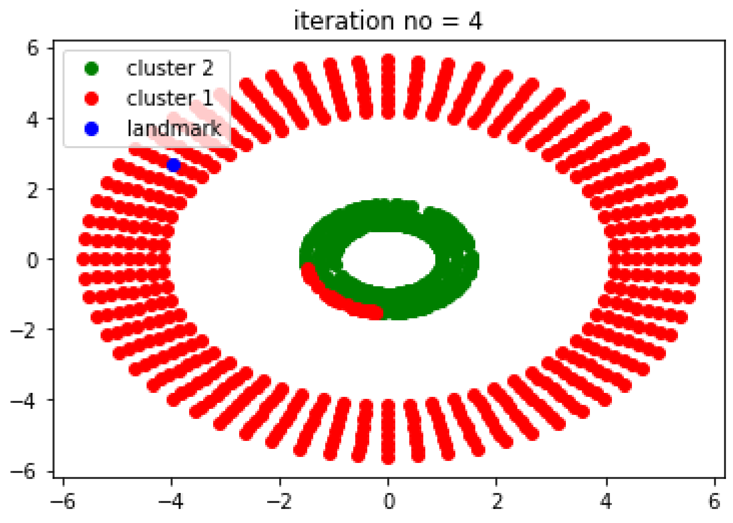
In [7]:

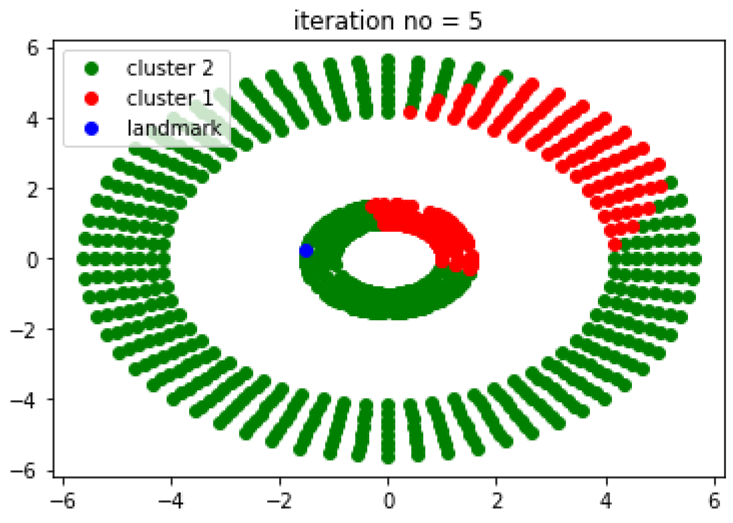
```
for i in range(ITER):
    landmark, idx = selecting_L_random_data_points(L)[0][:, 0], selecting_L_random_
    X = np.zeros((N, L), dtype='float32')
    X = compute_X(X, landmark)

    #initital cluster means
    mu0, mu1 = X[0], X[1]
    #label
    y = np.zeros(N) - 1


    p = np.diag(np.dot(X-mu0, np.transpose(X-mu0)))
    q = np.diag(np.dot(X-mu1, np.transpose(X-mu1)))
    y = (p>q).astype(int)
    mu0 = np.sum( X[y == 0]  , axis = 0)/len(X[y==0])
    mu1 = np.sum( X[y == 1]  , axis = 0)/len(X[y==1])
    #print(len(X[y==0]))

    plt.figure(i + 1)
    plt.plot(data_train[y==0][:, 0], data_train[y==0][:, 1], 'go', label = 'cluster
    plt.plot(data_train[y==1][:, 0], data_train[y==1][:, 1], 'ro', label = 'cluster
    plt.plot(data_train[idx][0][0], data_train[idx][0][1], 'bo', label = 'landmark'
    plt.legend(loc = 'upper left')
    plt.title('iteration no = '+ str(i+1) )
    plt.savefig('k-means - iteration ' + str(i)+'-landmark.png')
```

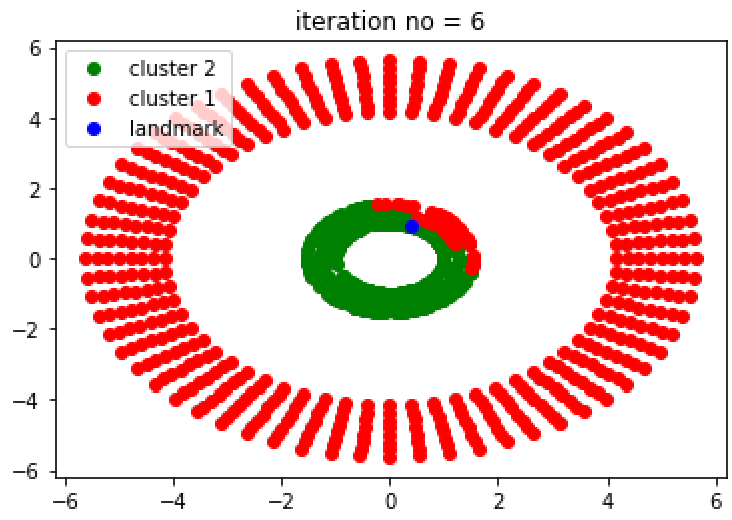


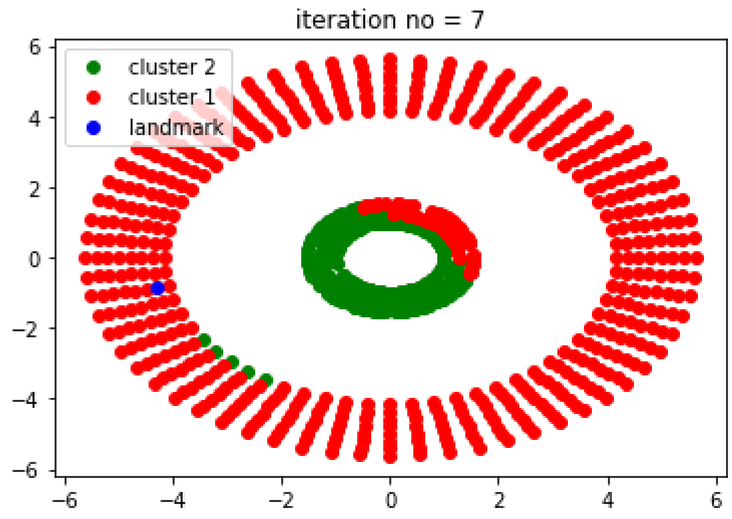


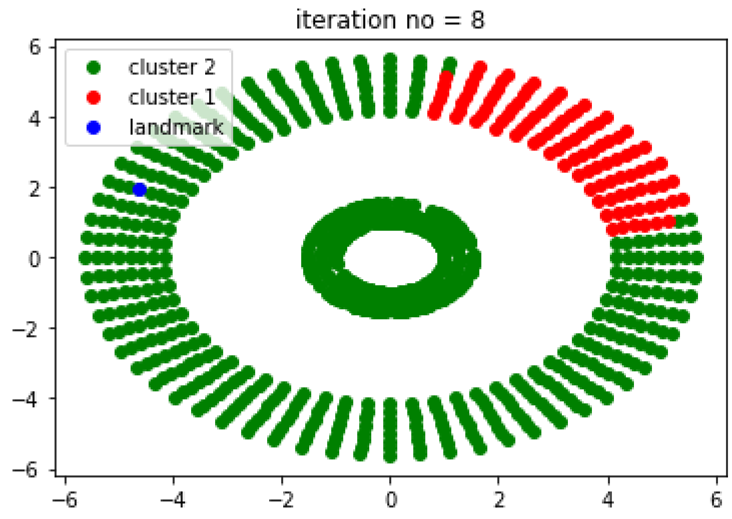

iteration no = 3
cluster 2
cluster 1
landmark
6
4
2
0
−2
−4
−6
−6
−4
−2
0
2
4
6

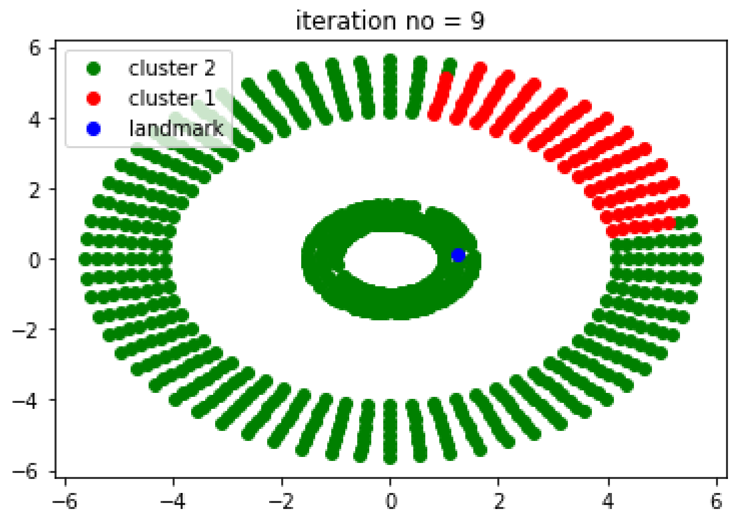

iteration no = 4
cluster 2
cluster 1
landmark
6
4
2
0
−2
−4
−6
−6
−4
−2
0
2
4
6

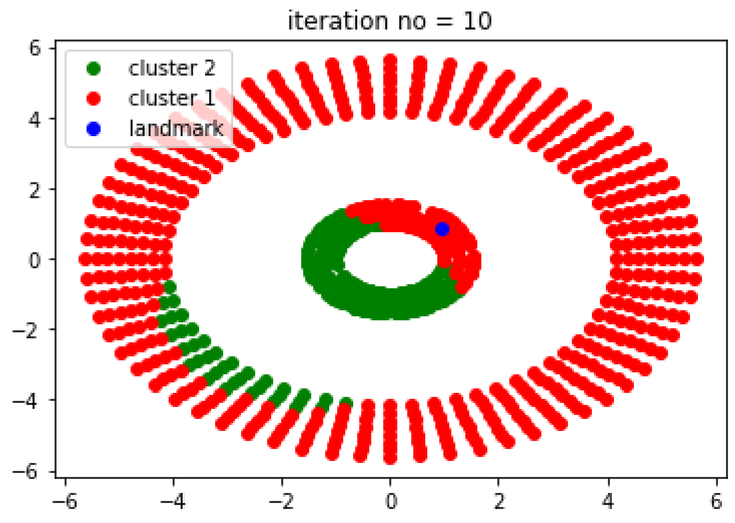

iteration no = 5
cluster 2
cluster 1
landmark
6
4
2
0
−2
−4
−6
−6
−4
−2
0
2
4
6


iteration no = 6
cluster 2
cluster 1
landmark


iteration no = 7
cluster 2
cluster 1
landmark


iteration no = 8
cluster 2
cluster 1
landmark


iteration no = 9
cluster 2
cluster 1
landmark


iteration no = 10
cluster 2
cluster 1
landmark