Homework 4

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Problem 4-1. Spectral Clustering

In this problem, we will try a dimensionality reduction based clustering algorithm Spectral Clustering.

(a) We will first experiment Spectral Clustering on synthesis data

Answer:

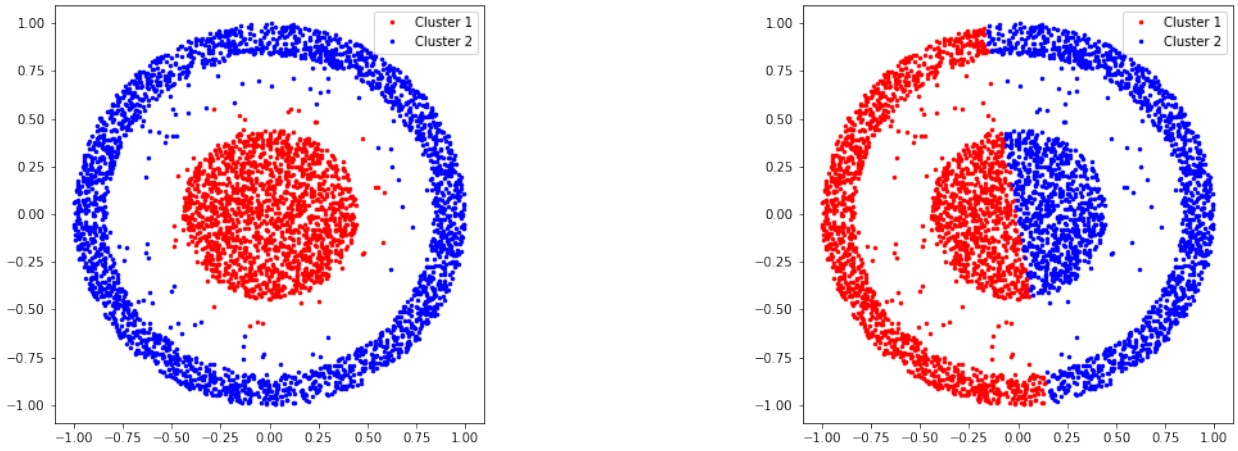

Figure 1: spectral clustering, k-means

(b) Now let us try Spectral Clustering on real-world data.

Answer:

Spectral Clustering:

accuracy = 0.75 nmi = 0.62

kmeans:

accuracy = 0.53 nmi = 0.15

Problem 4-2. Principal Component Analysis Let us deepen our understanding of PCA by the following problems.

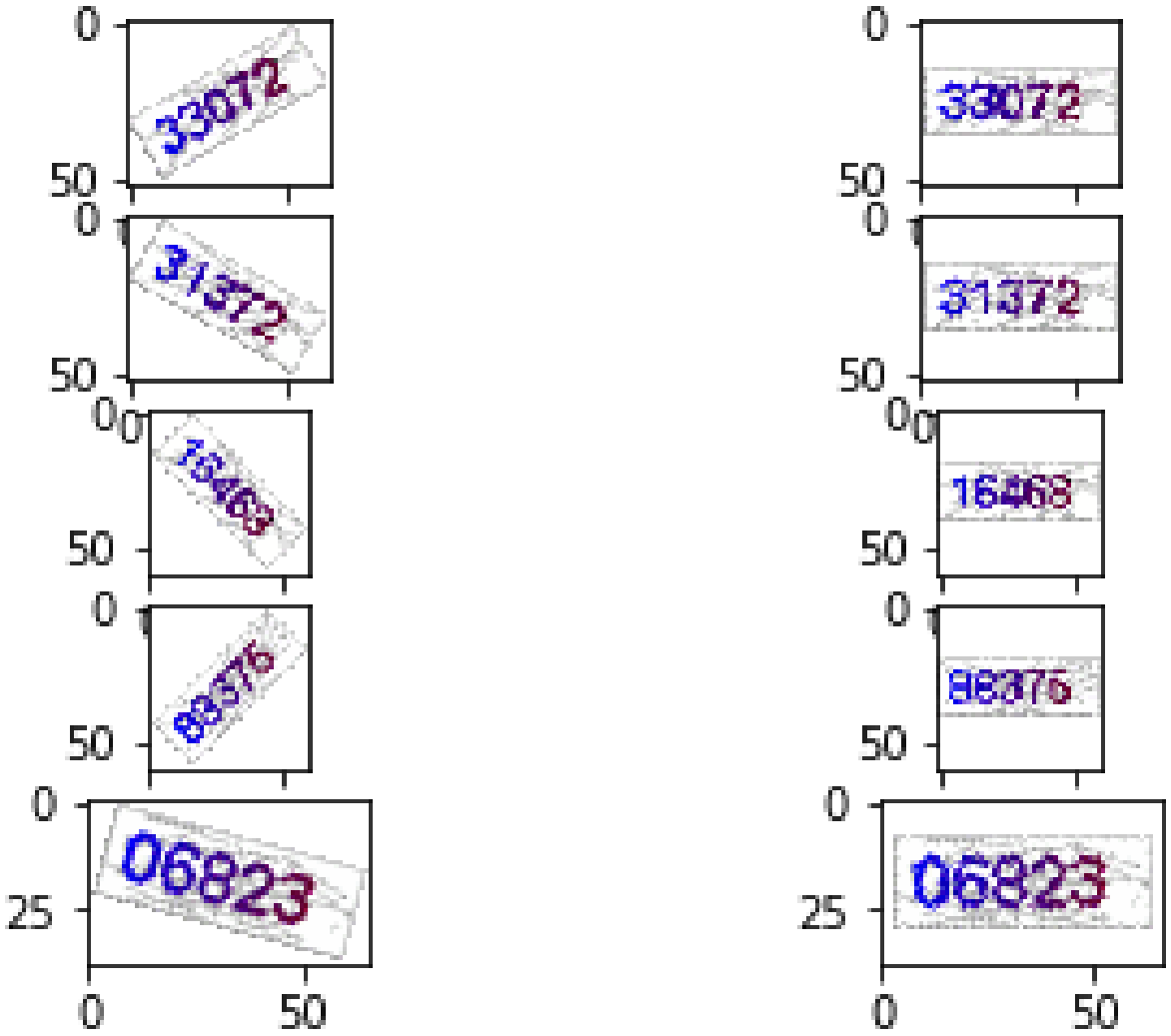
0
33072
50
0
31372
50
0
16468
50
0
88376
50
0
06823
25
0
50
0
33072
50
0
31372
50
0
16468
50
0
88376
50
0
06823
25
0
50

Figure 2

(a) Your task is to implement *hack_pca.m* to recover the rotated CAPTCHA image using PCA.

Answer: see figure2

(b) Now let us apply PCA to a face image dataset.

Answer: (i) Eigenface

Figure 3

(ii)
d = 8, accuracy = 0.74
d = 16, accuracy = 0.815
d = 32, accuracy = 0.855
d = 64, accuracy = 0.88
d = 128, accuracy = 0.875
(iii)

Figure 4: d = 8

Figure 5: d = 16

Figure 6: d = 32

Figure 7: d = 64

Figure 8: d = 128