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CS 1675: Intro to Machine Learning

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Problem Assignment 9

Problem 1. K-means clustering

Part a.

Sizes of groups: 66, 98, 36

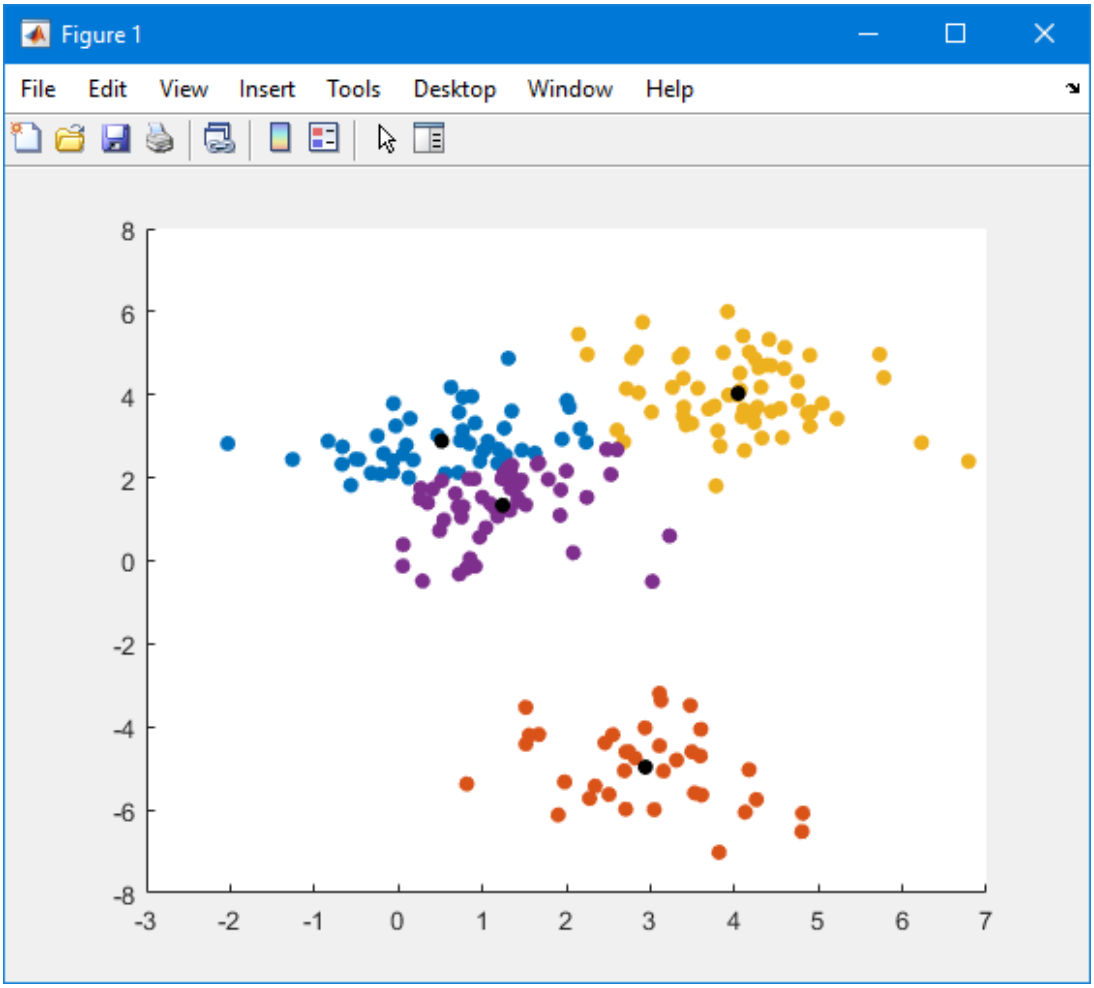
Distance: 76.4997

Plot 1: k-means clustering – 3 clusters

Part b.

Sizes of groups: 49, 36, 63, 52

Distance: 84.2883

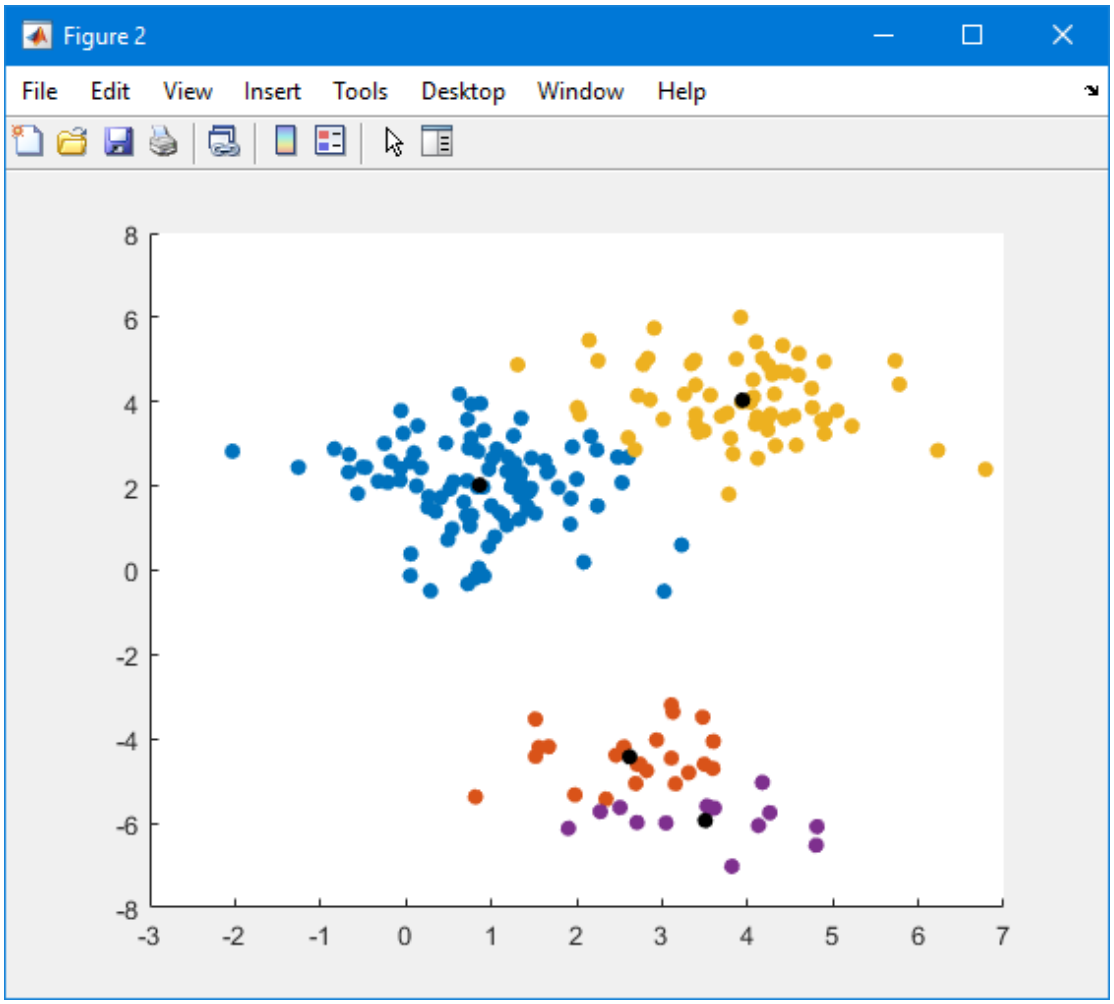


Plot 2: k-means clustering – 4 clusters

Part c.

Sizes of groups: 98, 23, 66, 13

Distance: 96.7493



Plot 3: k-means clustering – 4 clusters (rerun)

Part d.

Since the k-means clustering algorithm converges to centers minimizing the sum of squared center-point distances, the run with the smallest distance would be the best one.

A math expression that would help me compare these different clusterings and pick the best is:

$$bestCluster = \min(distances)$$

where

$$distance = \sum_{i=1}^{k} \sum_{x_j \in S_i} \|x_j - u_i\|^2$$

Part e.

Run #	Cluster Sizes				Distance
1	65	36	39	60	85.2187
2	98	10	66	26	96.5767
3	36	63	51	50	84.2718
4	39	36	65	60	85.2187
5	52	63	49	36	84.2883
6	18	66	18	98	96.0650
7	60	54	36	50	81.6453
8	96	36	40	28	83.3128
9	98	10	66	26	96.5767
10	36	63	69	32	82.2638
11	96	36	28	40	83.3128
12	23	98	66	13	96.7493
13	61	36	40	63	83.1815
14	51	36	52	61	81.7123
15	98	23	66	13	96.7493
16	63	36	49	52	84.2883
17	52	36	61	51	81.7123
18	69	63	32	36	82.2638
19	63	38	63	36	83.1438
20	38	36	98	28	83.1076
21	61	36	42	61	82.2850
22	60	36	54	50	81.6453
23	46	89	36	29	82.7662
24	31	36	92	41	82.7317
25	66	10	98	26	96.5767
26	66	10	26	98	96.5767
27	32	36	69	63	82.2638
28	36	89	46	29	82.7662
29	98	26	66	10	96.5767
30	38	36	29	97	83.2772

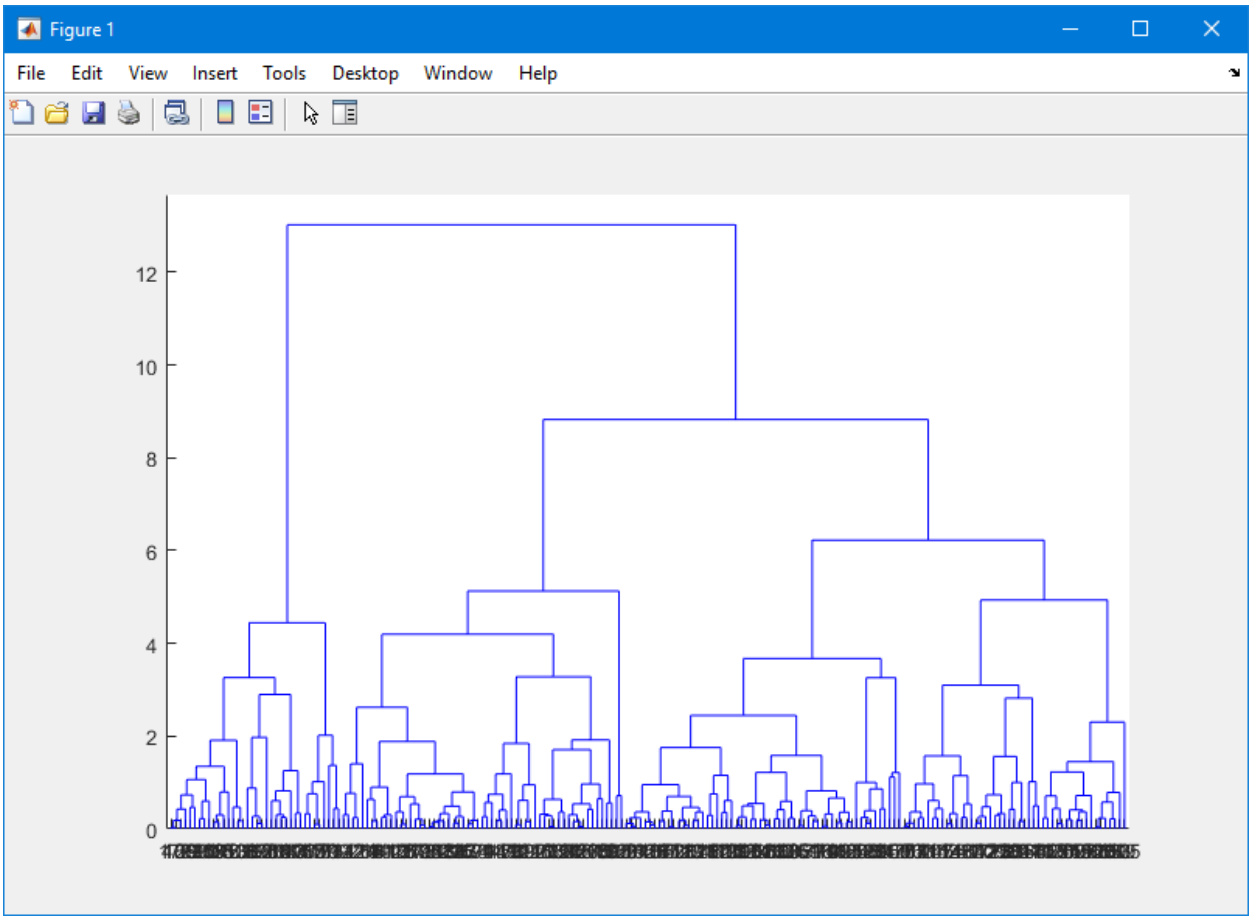
Table 1: K-means with k =4

- By using the formula from Part d, the clustering that is the best is:
    - Run #7 with a cluster size of [60 54 36 50] and a distance of 81.6453

Plot 4: Run #7 – k-means clustering

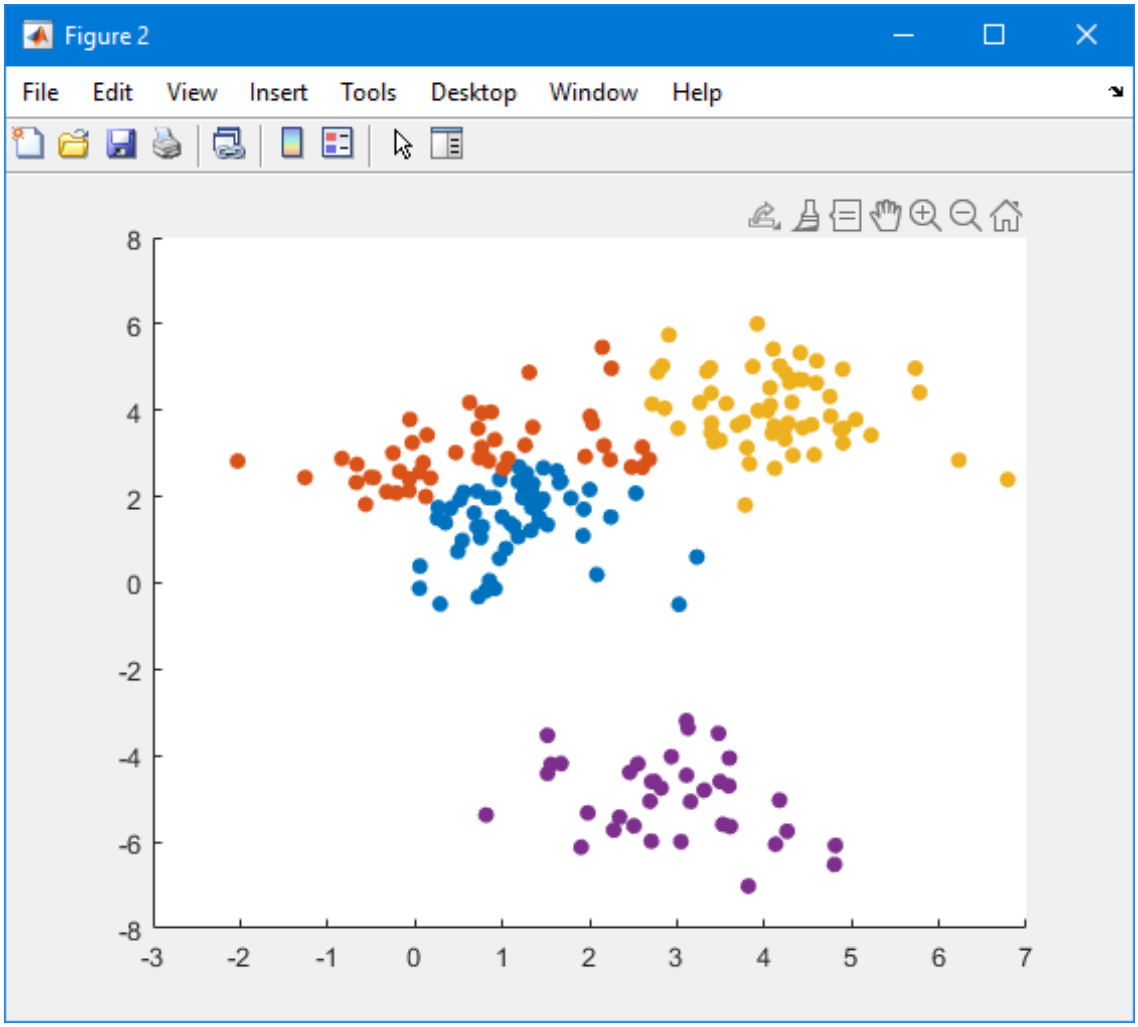
Problem 2. Hierarchical clustering

Part a.



Graph 1: Dendrogram of Full Cluster

Part b.



Plot 5: Hierarchical Clustering Scatter Plot

- Comparing these results to the ones of Problem 2. Part e., the two clusters are different. One of the groupings match between the two (the purple from plot 5 and the yellow from plot 4).

Problem 3. Feature/Input ranking

Part a.

Top	Dimension	Fisher score
1	48	0.3192
2	25	0.2140
3	21	0.1910
4	70	0.1892
5	65	0.1693
6	40	0.1673
7	29	0.1650
8	19	0.1402
9	57	0.1255
10	20	0.1212
11	24	0.0995
12	30	0.0950
13	12	0.0858
14	47	0.0846
15	61	0.0607
16	10	0.0579
17	34	0.0527
18	27	0.0462
19	39	0.0461
20	41	0.0422

Table 2: Top 20 Fisher scores

Part b.

Top	Dimension	AUROC score
1	25	0.7340
2	29	0.6837
3	11	0.6695
4	47	0.6661
5	19	0.6315
6	34	0.6174
7	32	0.6021
8	30	0.6021
9	9	0.6000
10	56	0.5971
11	27	0.5953
12	60	0.5929
13	51	0.5881
14	26	0.5874
15	53	0.5845
16	7	0.5797
17	10	0.5709
18	61	0.5686
19	43	0.5567
20	44	0.5422

Table 3: Top 20 AUROC scores

- Comparing the results from part a to the ones from part b, the ordered lists are different. The two lists share only a small number of similar dimensions, but even so they are not ranked the same. Generally you would not find these two to be the same since the Fisher score is used to solve maximum likelihood, while AUROC is a performance metric for discrimination.