Homework #3

Assign date: 2015-06-21

Due date: 2015-07-01, 6pm

Submission:

1. **Please submit your results <u>in email</u> to the grader: 130301039@svuca.edu Chi Zhang**
2. **Please separate the written answers from the python code: you should submit 2 files in your email – cs596-29-hw3_yourID#.doc & cs596-29-hw3_yourID#.py**
3. **30 pts per day will be deducted for late submission**

Problem 1) K-means clustering (20 pts.)

You are given the following 10 data points of height & weight:

ID	1	2	3	4	5	6	7	8	9	10
Height	66	73	72	70	74	68	65	64	63	67
Weight	170	210	165	180	185	155	150	120	125	140

Manually apply k-means algorithms to get 2 clusters. Please produce the center and grouping step by step, using the following parameters:

a) Initialize with ID=1 and ID=2
b) Assume Euclidean distance

Answer:

step- 0

[([66, 170], [1, 3, 4, 5, 6, 7, 8, 9, 10]), ([73, 210], [2])]

step- 1

[([67.6666667, 154.4444446], [1, 3, 4, 6, 7, 8, 9, 10]), ([73.0, 210.0], [2, 5])]

step- 2

[([66.875, 150.625], [1, 3, 6, 7, 8, 9, 10]), ([73.5, 197.5], [2, 4, 5])]

step- 3

[([66.42857, 146.42857], [1, 2, 4, 5]), ([72.33333, 191.66667], [3, 6, 7, 8, 9, 10])]

step- 4

[([70.75, 186.25], [1, 2, 3, 4, 5]), ([66.5, 142.5], [6, 7, 8, 9, 10])]

step- 5

[([71.0, 182.0], [1, 2, 3, 4, 5]), ([65.4, 138.0], [6, 7, 8, 9, 10])]

Problem 2) Agglomerative clustering (20 pts.)

Using the same 10 data points of height & weight as in Problem-1, apply agglomerative clustering manually. Produce the distance matrix and the resulting dendrogram. Use the following assumptions:

a) Euclidean distance
b) Single linkage for cluster dissimilarity

Answer:

Step by step agglomerative clustering:

['1', '2', '3', '4', '5', '6', '7', '8', '9', '10']

['1', '2', '3', '4', '5', '6', '7', (8,9), '10'] 5.1

['1', '2', '3', '4', '5', (6,7), (8,9), '10'] 5.8

['1', '2', '3', (4,5), (6,7), (8,9), '10'] 6.4

[(1,3), '2', (4,5), (6,7), (8,9), '10'] 7.8

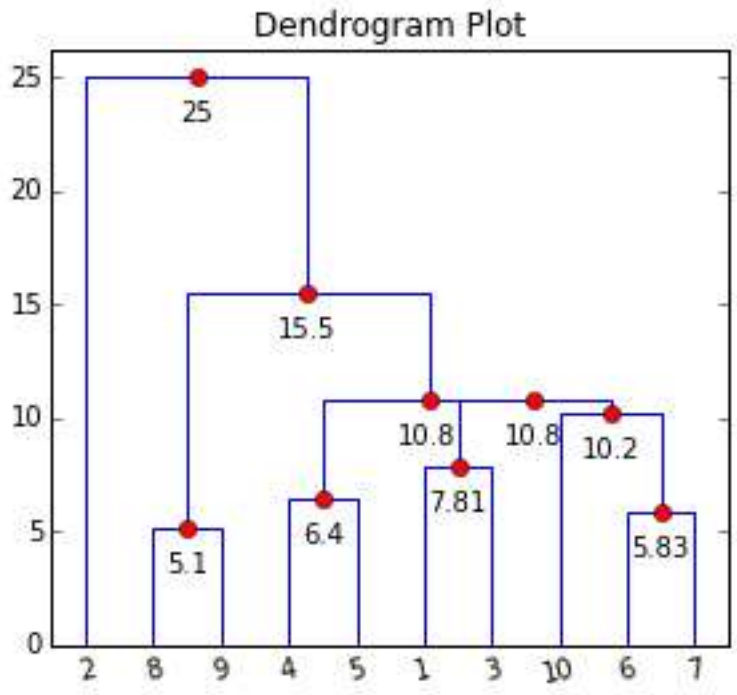
[(1,3), '2', (4,5), ((6,7),10), (8,9)] 10.2

[((1,3),(4,5)), '2', ((6,7),10), (8,9)] 10.8

[(((1,3),(4,5)),((6,7),10)), '2', (8,9)] 10.8

[((((1,3),(4,5)),((6,7),10)),(8,9)), '2'] 15.5

(((((1,3),(4,5)),((6,7),10)),(8,9)),2) 25



Problem 3) Model Evaluation (20 pts.)
We are given the following classification results for a cancer screening test. Please derive the evaluation parameters:

a) Accuracy
b) Specificity
c) Sensitivity
d) Precision
e) Recall

Actual / Prediction	test = positive	test = negative	Total
cancer = yes	**90**	**210**	300
cancer = no	**140**	**9560**	9700
Total	230	9770	10000

Answer:

a) Accuracy = (90+9560) / 10000 = 0.965
b) Specificity = 9560 / 9700 = 0.9856
c) Sensitivity = 90 / 300 = 0.3
d) Precision = 90 / 230 = 0.3913
e) Recall = 90 / 300 = 0.3

Problem 4) Python program (40 pts)

Take the sk-learn sample code *cluster_kmeans.py* discussed in the class that is used for clustering iris dataset. Make the following changes:

1. In addition to using PCA to reduce features from 4 to 2, also evaluate using the original feature pairs (1,2) and (3, 4).
2. For all the 3 clustering settings (original, (1,2), (3, 4)), calculate the clustering quality CQ = IE / EV as defined in the class:

$$IV = \sum_{C} \sum_{x \in C} d(x, c) \quad \text{and} \quad EV = \frac{1}{N} \sum_{i} \sum_{j} \delta(C(x_i) \neq C(x_j)) d(x_i, x_j)$$

Output:

3 plots of k-means clustering results for PCA, features (1,2), and features (3,4).

3 CQ values for PCA, features (1,2), and features (3,4).