Principles of Data Mining: HW 06

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August 2018 - December 2018

Question 1

You will need to remove one of the attributes in the CSV file. Which one should you *always be certain* to remove?

The ID attribute should always be removed because it serves as a unique record identifier and should not be used as a feature for clustering.

Question 2

Remark on the cross-correlation coefficients of the attributes. What information do they reveal?

	ID	MILK	PETFOOD	VEGGIES	CEREAL	BREAD	RICE	MEAT	EGGS	YOGURT	CHIPS	COLA	FRUIT
ID	1.00	-0.09	-0.11	0.05	-0.03	-0.04	0.01	-0.05	0.04	0.05	-0.06	-0.06	-0.01
MILK	-0.09	1.00	0.43	-0.01	0.66	0.61	0.14	-0.59	0.01	-0.16	-0.13	-0.04	-0.22
PETFOOD	-0.11	0.43	1.00	-0.30	0.56	0.50	-0.26	-0.28	0.00	-0.41	0.28	0.31	-0.43
VEGGIES	0.05	-0.01	-0.30	1.00	-0.37	-0.29	0.71	-0.08	0.01	0.67	-0.62	-0.75	0.59
CEREAL	-0.03	0.66	0.56	-0.37	1.00	0.72	-0.23	-0.48	-0.02	-0.51	0.23	0.31	-0.55
BREAD	-0.04	0.61	0.50	-0.29	0.72	1.00	-0.14	-0.42	-0.01	-0.40	0.11	0.25	-0.43
RICE	0.01	0.14	-0.26	0.71	-0.23	-0.14	1.00	-0.27	0.02	0.73	-0.71	-0.84	0.61
MEAT	-0.05	-0.59	-0.28	-0.08	-0.48	-0.42	-0.27	1.00	0.01	-0.04	0.20	0.21	0.05
EGGS	0.04	0.01	0.00	0.01	-0.02	-0.01	0.02	0.01	1.00	0.02	-0.00	0.02	-0.00
YOGURT	0.05	-0.16	-0.41	0.67	-0.51	-0.40	0.73	-0.04	0.02	1.00	-0.63	-0.77	0.66
CHIPS	-0.06	-0.13	0.28	-0.62	0.23	0.11	-0.71	0.20	-0.00	-0.63	1.00	0.71	-0.53
COLA	-0.06	-0.04	0.31	-0.75	0.31	0.25	-0.84	0.21	0.02	-0.77	0.71	1.00	-0.66
FRUIT	-0.01	-0.22	-0.43	0.59	-0.55	-0.43	0.61	0.05	-0.00	0.66	-0.53	-0.66	1.00

Rice and cola, yogurt and cola, veggies and cola all have a very high negative cross-correlation coefficient, meaning that they are generally inversely related to one another. This probably reflects the group of party animal shoppers that purchase mostly chips instead of other “healthy” foods. They are likely to buy chips since they have a very high positive cross-correlation coefficient between cola and chips.

Healthy “family” shoppers are represented by the high positive correlation between the cereal and bread purchases, rice and yogurt purchases, and veggies and rice purchases.

In terms of largest cross-correlation coefficient values, we have the following:

Item 1	Item 2	Cross-correlation coefficient
Rice	Cola	-0.84
Yogurt	Cola	-0.77
Veggies	Cola	-0.75
Rice	Yogurt	0.73
Cereal	Bread	0.72
Chips	Cola	0.71
Rice	Chips	-0.71

Question 3

You can keep all of the other attributes, or remove a few of them. Which attribute(s), if any, did you remove?

I removed eggs from consideration since eggs had a near zero cross-correlation coefficient with all other items, meaning it would tell us very little about purchase habits and would not be a useful feature to cluster.

Question 4

At each stage of clustering, you record the size of the smaller cluster being merged in. For the last ten merges, what was the size of the smaller cluster that was merged in? What does this indicate about the true number of clusters?

During the last ten merges, a large cluster was merged with a cluster of size 1 during a few of the merges. This likely indicates a number of outliers being merged in. The true number of clusters is probably lower since many of the "clusters" at that step only contained a single point. According to the merging information, when the agglomeration algorithm reduces down to 3 clusters, they respectively have 125, 150, and 62 data points.

Question 5

Look at the average amount of milk, etc... purchased by the third cluster of shoppers. What typifies the third cluster? What nickname should we give these customers?

MILK	PETFOOD	VEGGIES	CEREAL	BREAD	RICE	MEAT	EGGS	YOGURT	CHIPS	COLA	FRUIT
7.6	4.8	7.7	8.0	6.5	8.3	3.9	5.0	5.3	3.0	2.8	5.0
4.9	4.8	4.8	7.1	5.5	2.5	6.6	5.1	2.0	6.5	9.0	2.9
2.2	1.9	9.1	0.9	1.5	8.9	7.7	5.1	8.2	2.4	1.1	8.1

The second group typifies the party animal shoppers who buy large quantities of chips and cola together. The first group likely represents family shoppers who buy milk and cereal, pet food, veggies, and rice. The third cluster in this group makes purchases of veggies, rice, meat, yogurt, and fruit. They also do not purchase either pet food or junk food. This group is likely a group of healthy eaters.

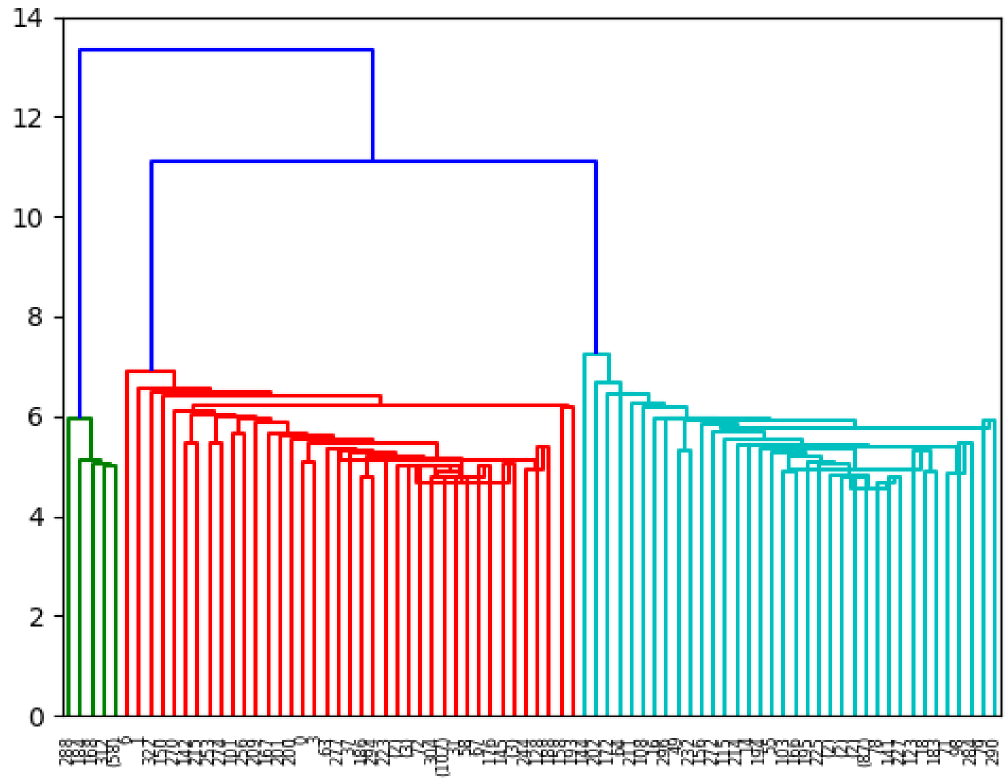
Question 6

If we switched from a "central link" to a "single link" merge step, what else would you need to add to the algorithm when computing the distance between two clusters?

We would need to be able to compute the distance between the closest two points in any two clusters. This could either be done on the fly or by precomputing all distances between all points. Instead of comparing the cluster centers (centroids), we would have to compare all the points in both clusters.

Question 7

Generate a dendrogram of the clusters as they are being merged.



While I was able to implement dendrogram data generation in my agglomeration algorithm, I was not able to get it properly display in `scipy`. I used `scipy`'s `linkage()` method to generate this dendrogram. See the comments in the agglomeration algorithm for further details.

If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech