Lab 1 - 732A75 - Clustering Algorithms

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1. SimpleKmeans

Apply "SimpleKMeans" to your data. In Weka euclidian distance is implemented in SimpleKmeans. You can set the number of clusters and seed of a random algorithm for generating initial cluster centers. Experiment with the algorithm as follows:

1.

Choose a set of attributes for clustering and give a motivation. (Hint: always ignore attribute "name". Why does the name attribute need to be ignored?)

Results Simple K Means, k = 2, seed = 1

```
Number of iterations: 6
Within cluster sum of squared errors: 5.9104334390998226
Missing values globally replaced with mean/mode

Cluster centroids:
                        Cluster#
Attribute    Full Data          0          1
                  (27)       (11)       (16)
==========================================
Energy        207.4074   122.7273    265.625
Protein             19    16.7273    20.5625
Fat            13.4815     4.6364    19.5625
Calcium         43.963    94.2727      9.375
Iron            2.3815     2.1455     2.5438



Time taken to build model (full training data) : 0.01 seconds

=== Model and evaluation on training set ===

Clustered Instances

0      11 ( 41%)
1      16 ( 59%)
```

The attributes for the simpleKmeans clustering algorithm we choose are 2 clusters, with seed = 1. Two clusters is the minimum that we can choose, and it is a good start to see what happens if we simply want to divide the data into two groups. For the seed we started with 1, just so we can easily compare to other seeds. The output is depicted in the image.

The name attribute needs to be ignored because it is a string with labels, which is already a categorization of different groups.

2.

Experiment with at least two different numbers of clusters, e.g. 2 and 5, but with the same seed value 10.

Results Simple K Means, k = 2, seed = 10

```
Number of iterations: 2
Within cluster sum of squared errors: 5.069321339929419
Missing values globally replaced with mean/mode

Cluster centroids:
                         Cluster#
Attribute    Full Data          0          1
                  (27)        (9)       (18)
============================================
Energy         207.4074   331.1111   145.5556
Protein              19         19         19
Fat             13.4815    27.5556     6.4444
Calcium          43.963     8.7778    61.5556
Iron             2.3815     2.4667     2.3389



Time taken to build model (full training data) : 0.01 seconds

=== Model and evaluation on training set ===

Clustered Instances

0       9 ( 33%)
1      18 ( 67%)
```

Results Simple K Means, k = 5, seed = 10

```
Number of iterations: 4
Within cluster sum of squared errors: 2.750432407251998
Missing values globally replaced with mean/mode

Cluster centroids:
                        Cluster#
Attribute    Full Data          0          1          2          3          4
                  (27)        (7)        (8)        (6)        (1)        (5)
=================================================================================
Energy         207.4074   352.8571    153.125      102.5        180        222
Protein              19    18.5714      23.25       13.5         22       18.8
Fat             13.4815    30.1429       5.75     3.8333          9         15
Calcium          43.963     8.7143      23.75       87.5        367        8.8
Iron             2.3815     2.4143       2.45     2.5333        2.5       2.02



Time taken to build model (full training data) : 0.01 seconds

=== Model and evaluation on training set ===

Clustered Instances

0       7 ( 26%)
1       8 ( 30%)
2       6 ( 22%)
3       1 (  4%)
4       5 ( 19%)
```

3.

Then try with a different seed value, i.e. different initial cluster centers. Compare the results with the previous results. Explain what the seed value controls.

Results Simple K Means, k = 2, seed = 11

```
Number of iterations: 4
Within cluster sum of squared errors: 5.082974846131301
Missing values globally replaced with mean/mode

Cluster centroids:
                         Cluster#
Attribute    Full Data          0          1
                  (27)       (19)        (8)
=============================================
Energy         207.4074   150.7895    341.875
Protein              19    19.1053      18.75
Fat             13.4815          7    28.875
Calcium          43.963    58.7895       8.75
Iron             2.3815     2.3579     2.4375



Time taken to build model (full training data) : 0 seconds

=== Model and evaluation on training set ===

Clustered Instances

0      19 ( 70%)
1       8 ( 30%)
```

Results Simple K Means, k = 5, seed = 11

```
Number of iterations: 10
Within cluster sum of squared errors: 3.413323983598554
Missing values globally replaced with mean/mode

Cluster centroids:
                        Cluster#
Attribute    Full Data          0          1          2          3          4
                  (27)       (11)        (6)        (3)        (1)        (6)
=================================================================================
Energy         207.4074   159.5455   341.6667   238.3333        420        110
Protein              19    21.5455    19.1667    19.6667         15       14.5
Fat             13.4815     6.8182    28.6667         17         39        4.5
Calcium          43.963    20.3636          9     8.3333          7   146.1667
Iron             2.3815     2.0364     2.4833        2.6          2     2.8667



Time taken to build model (full training data) : 0.01 seconds

=== Model and evaluation on training set ===

Clustered Instances

0      11 ( 41%)
1       6 ( 22%)
2       3 ( 11%)
3       1 (  4%)
4       6 ( 22%)
```

The seed value controls for different initial centroids. Different initial centroids could lead to different clustering outcomes.

4.

Do you think the clusters are "good" clusters? (Are all of its members "similar" to each other? Are members from different clusters dissimilar?)

Comparing 2 clusters versus 5 clusters we find a number of differences. Since we only have 27 observations, 5 clusters is dividing the data into small groups. As can be seen in the outputs of k = 5, for both seeds, cluster 3 only contains 1 element. This cluster can thus be seen as an outlier and does not provide much information. Moreover, looking at the cluster centroids it often appears that some clusters share certain attributes, but then differ on others. For example, in the results of question 3, in the model with k = 5 and seed = 11, we see that clusters 3 and 4 share a very similar protein level, yet other attributes differ widely.

When looking at the results of the cluster models with k = 2, we notice that some attributes are less differentiating than others. In both models with k = 2, the protein levels are very similar in both clusters,

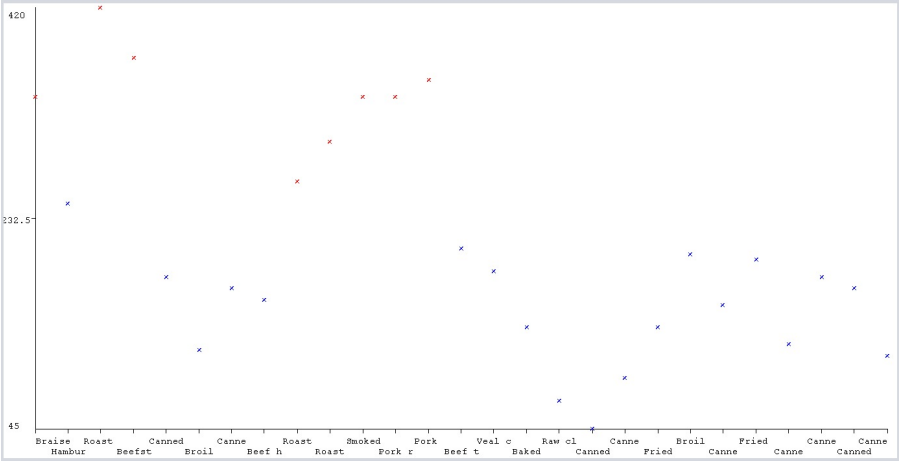
thus not providing much information. The differentiation between the clusters is made when considering Fat, Calcium and the Energy levels, because the centroids differ more.

5.

What does each cluster represent? Choose one of the results. Make up labels (words or phrases in English) which characterize each cluster.

As we look at the graph below, when can distinguish that the two clusters are foods with high energy levels, and low energy levels. The foods with high energy are mostly red meats, while the lower energy rich foods are either non-red meats or more heavily processed (such as canned goods). So potential cluster names could be "red meat vs non-red meat", or "Energy rich foods vs Non-energy rich foods", or "non-processed foods vs processed foods"

Results of k = 2, seed = 11; Energy of various foods



2. MakeDensityBasedClusters

Now with MakeDensityBasedClusters, SimpleKMeans is turned into a denstiy-based clusterer. You can set the minimum standard deviation for normal density calculation. Experiment with the algorithm as the follows:

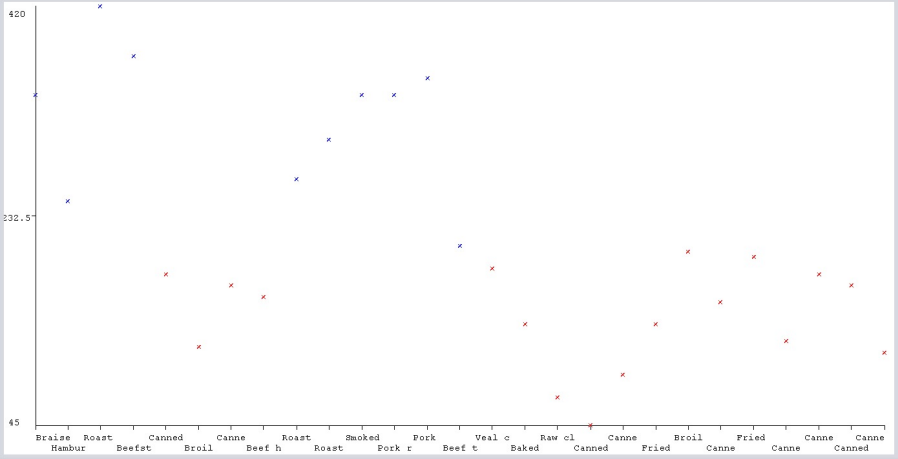
1.

Use the SimpleKMeans clusterer which gave the result you haven chosen in 5).

Results Density Based Cluster, seed = 11, standard deviation = 1.0e-6

```
Final cluster centroids:
                          Cluster#
Attribute    Full Data          0          1
                (27.0)      (9.0)     (18.0)
=============================================
Energy         207.4074   331.1111   145.5556
Protein              19         19         19
Fat             13.4815    27.5556     6.4444
Calcium          43.963     8.7778    61.5556
Iron             2.3815     2.4667     2.3389
```

Results Density Based Cluster, seed = 11, standard deviation = 1.0e-6



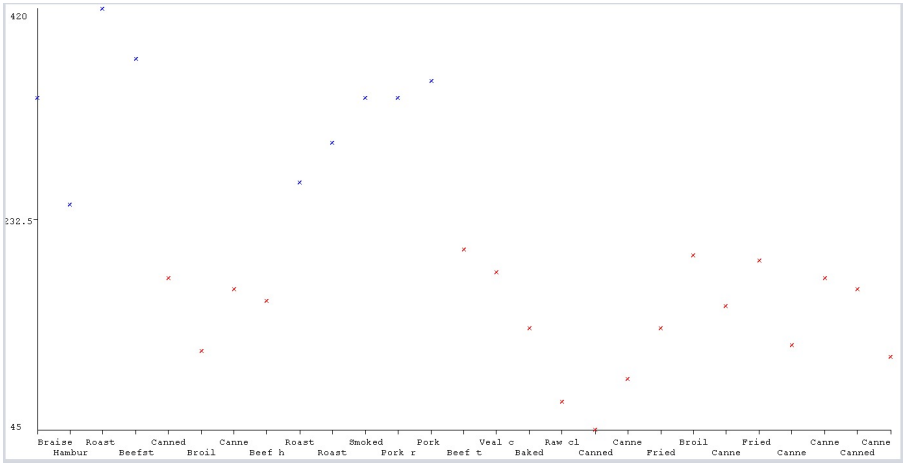
2.

Experiment with at least two different standard deviations. Compare the results. (Hint: Increasing the standard deviation to higher values will make the differences in different runs more obvious and thus it will be easier to conclude what the parameter does)

Results Density Based Cluster, seed = 11, standard deviation = 1

```
Final cluster centroids:
                        Cluster#
Attribute    Full Data          0          1
                (27.0)      (9.0)     (18.0)
=============================================
Energy         207.4074   331.1111   145.5556
Protein              19         19         19
Fat             13.4815    27.5556     6.4444
Calcium          43.963     8.7778    61.5556
Iron             2.3815     2.4667     2.3389
```

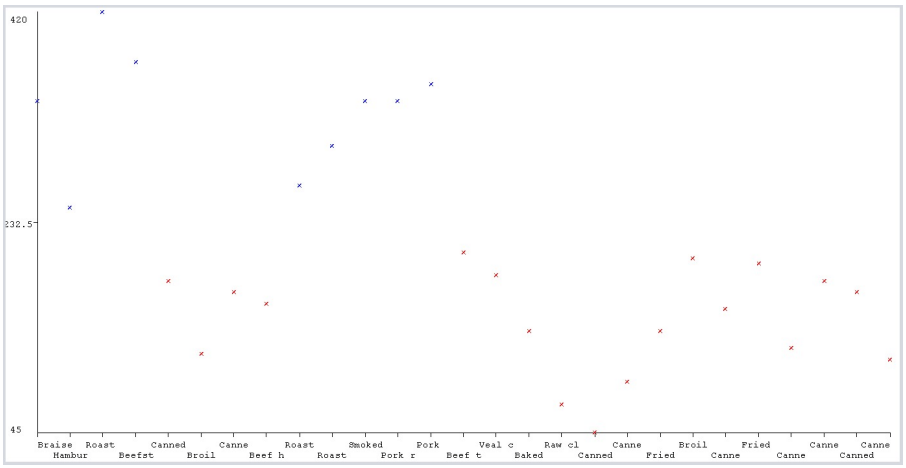
Results Density Based Cluster, seed = 11, standard deviation = 1



Results Density Based Cluster, seed = 11, standard deviation = 2

```
Final cluster centroids:
                        Cluster#
Attribute    Full Data          0          1
                (27.0)      (9.0)     (18.0)
=============================================
Energy         207.4074   331.1111   145.5556
Protein              19         19         19
Fat             13.4815    27.5556     6.4444
Calcium          43.963     8.7778    61.5556
Iron             2.3815     2.4667     2.3389
```

Results Density Based Cluster, seed = 11, standard deviation = 2



Results Density Based Cluster, seed = 11, standard deviation = 100

Final cluster centroids:

		Cluster#	
Attribute	Full Data	0	1
	(27.0)	(9.0)	(18.0)
Energy	207.4074	331.1111	145.5556
Protein	19	19	19
Fat	13.4815	27.5556	6.4444
Calcium	43.963	8.7778	61.5556
Iron	2.3815	2.4667	2.3389

Results Density Based Cluster, seed = 11, standard deviation = 100