

CSC 466 Lab 4 Report: Clustering

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CSC 466: Knowledge Discovery from Data

Abstract

In this lab, we will use unsupervised learning techniques to discover clusters in five simple datasets. We will implement three cluster analysis methods, k-means clustering, agglomerative hierarchical clustering and DBSCAN. In addition, to evaluate our results, we tested our models by tuning our hyperparameters for each clustering method. Overall, the K-Means Clustering method performed the best, while the Agglomerative Hierarchical Clustering performed the worst. DBSCAN usually performed fairly well, however it also often counted a large percentage of the data points as outliers.

I. Introduction

Clustering is the process of organizing data instances into groups whose members are similar in some way. Likewise, a cluster is a collection of data instances deemed to be similar to each other and dissimilar to other data instances / data points. In clustering tasks, the class variable is not available. The task is not to predict the class of each data point, but to organize data points into groups by their perceived similarity. Thus, clustering is known as unsupervised learning.

II. Study Design

A. K-Means Clustering:

K-Means Clustering is a partitional algorithm, which means it simply separates the dataset into distinct clusters. In order to be able to use a k-means clustering algorithm the notion of the mean must exist for the domain of each attribute. The algorithm takes as input the dataset and an integer k which is the number of clusters to build. The algorithm has the following four steps: (1) select k initial cluster centroids, (2) on each step, for each data point, compute its distances from each of the cluster centroids and assign it to the closest centroid, (3) recompute cluster centroids, (4) steps 2 and 3 are repeated until the process converges. For our specific implementation, we are utilizing Euclidean distance as our distance measure. Additionally, to select our initial centroid, we are randomly picking k random data points from the data set.

B. Agglomerative Hierarchical Clustering

Hierarchical clustering methods construct a dendrogram of the input dataset. Unlike partitional clustering methods, hierarchical clustering methods do not produce specific partitions of data

into disjoint clusters. Rather, the data is organized in the dendrogram by perceived similarity. By cutting the dendrogram horizontal, we obtain clusters. The clusters are associated with the specific cut. The cuts are typically guided by a threshold on the similarity of data points within the cluster. There are two types of hierarchical clustering algorithms: divisive and agglomerative. We will be considering agglomerative hierarchical clustering which means these algorithms start by treating each point in the dataset as a single cluster. On each step, the algorithm computes the distance matrix for the current list of clusters. For our specific implementation, we are utilizing Euclidean distance as our distance measure and average linkage. Then, it selects a pair of clusters with the shortest distance, and merges the two clusters into one, and constructs the appropriate portion of the dendrogram. The algorithm stops when all points are merged into a single cluster. Agglomerative clustering algorithms are bottom up.

C. DBSCAN: Density-Based Clustering

Density-based clustering algorithms are a family of algorithms that determine density-based clusters in the data. We will be implementing DBSCAN, which is a key algorithm for discovery of density-based clusters. DBSCAN takes as input a dataset, and two parameters: (1) ϵ which is the radius of the ϵ -neighborhood in which DBSCAN will search for data points, and (2) the smallest number of points in a ϵ -neighborhood of a point, for it to be declared a core point. For our specific implementation, we are utilizing Euclidean distance as our distance measure. The algorithm has the following steps: (1) core point discovery: DBSCAN scans through the entire dataset and determines the list of core points, (2) cluster construction: each cluster is constructed as follow, the algorithm pulls a yet-to-be visited core point, and recursively computes all density connected points to it. It then proceeds to search for the next unvisited/unlabeled core point until it runs out of core points to expand. Ultimately, the algorithm returns the breakdown of points into clusters, as well as the lists of core, boundary and noise points.

III. 4 Clusters Dataset

A. Dataset Description

The 4 clusters dataset contains information about 4 clusters in 2D space and was made synthetically.

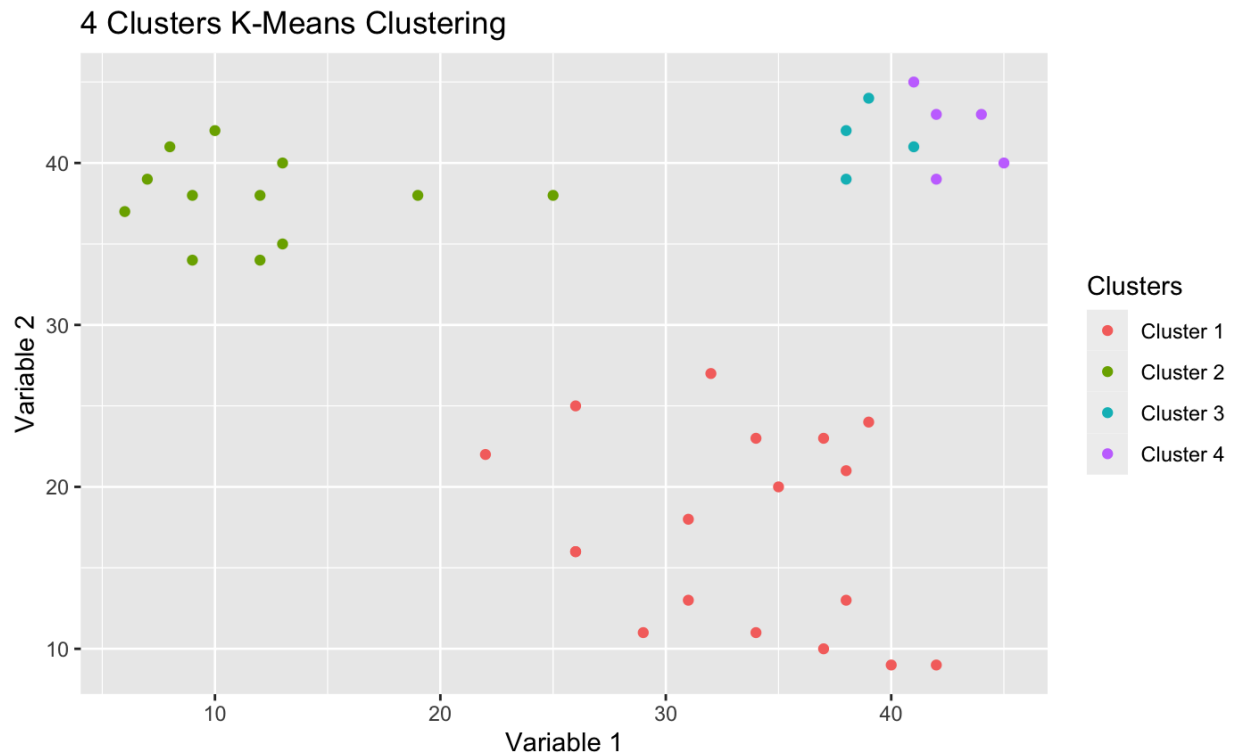
B. K-Means Clustering Results

For the 4 clusters dataset, due to the name being 4 clusters, we set the number of clusters to be 4. Using $k = 4$ produced the following results (full results are in Appendix III.B):

Table 1: 4 Clusters K-Means Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	18	7.58	1164.11
2	12	4.84	390.58
3	4	2.09	19
4	5	2.48	34.8

Figure 1: 4 Clusters K-Means Clustering Results



As we can see from the summary statistics in Table 1 and the figure visualizing the clusters in Figure 1, the first cluster which has the most points also has the most error and variability. When it comes to distance from the center, the points in all 4 clusters seem to be fairly close to the center which means the clusters are grouping similar observations together. The overall SSE is 1,608.49.

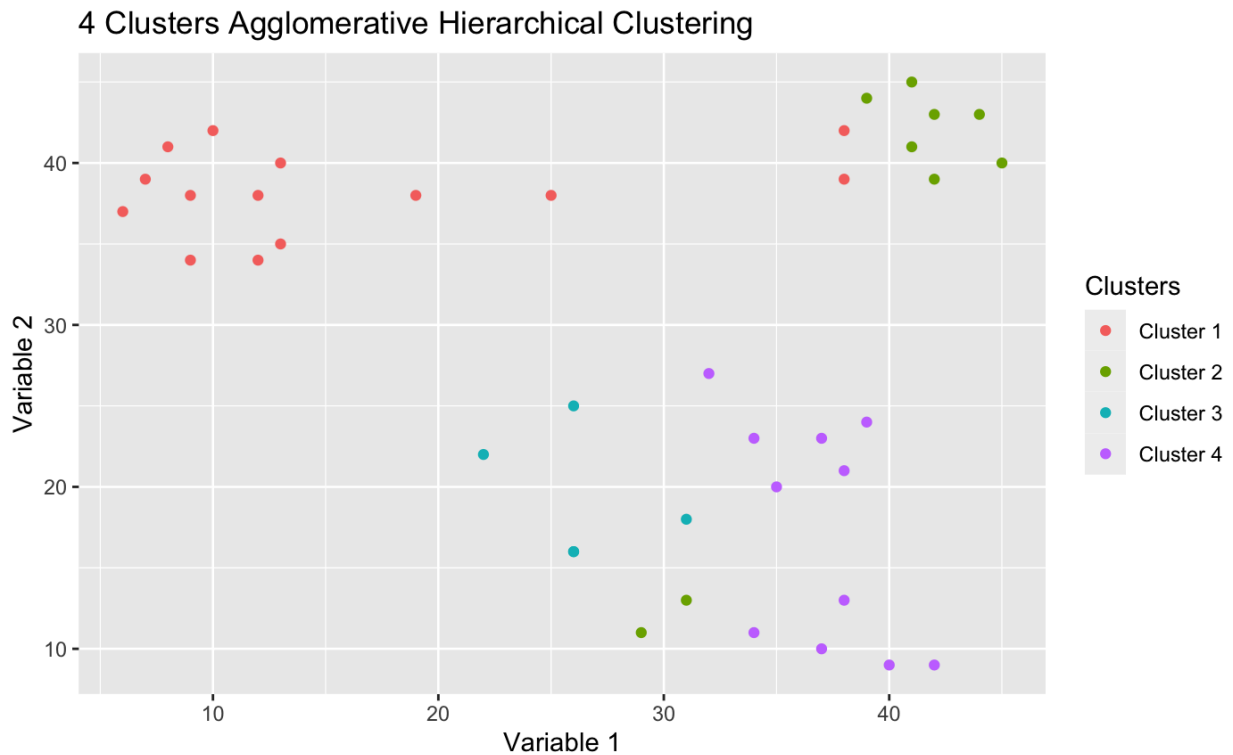
C. Agglomerative Hierarchical Clustering Results

For the 4 clusters dataset, due to the name being 4 clusters, we tested different threshold values so we were getting 4 clusters. Using threshold = 13.1 produced the following results (full results are in the Appendix III.C.1 and the dendrogram is in the Appendix III.C.2):

Table 2: 4 Clusters Agglomerative Hierarchical Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	14	8.73	1573.57
2	9	11.46	1694.22
3	5	4.47	104
4	11	6.77	561.09

Figure 2: 4 Clusters Agglomerative Hierarchical Clustering Results



As we can see from the summary statistics in Table 2, cluster 2 has the highest SSE and maximum, minimum, and average distance to center even though it has the second fewest number of points out of the four clusters. Looking at Figure 2, we can see that our algorithm does not group the clusters very well, especially compared to K-Means. The clusters are kind of all over the place, and are mixing and matching with each other. The overall SSE is 3,932.88.

D. DBSCAN Results

For the 4 clusters dataset, due to the name being 4 clusters, we tried testing different combinations of epsilon (the radius within which DBSCAN shall search for points) and number of points (the minimal number of points within the epsilon distance from a given point to continue building the cluster) to get 4 clusters. However, the closest we were able to get was 3 clusters with five outliers using an epsilon = 8 and number of points = 6, which produced the following results (full results are in the Appendix III.D):

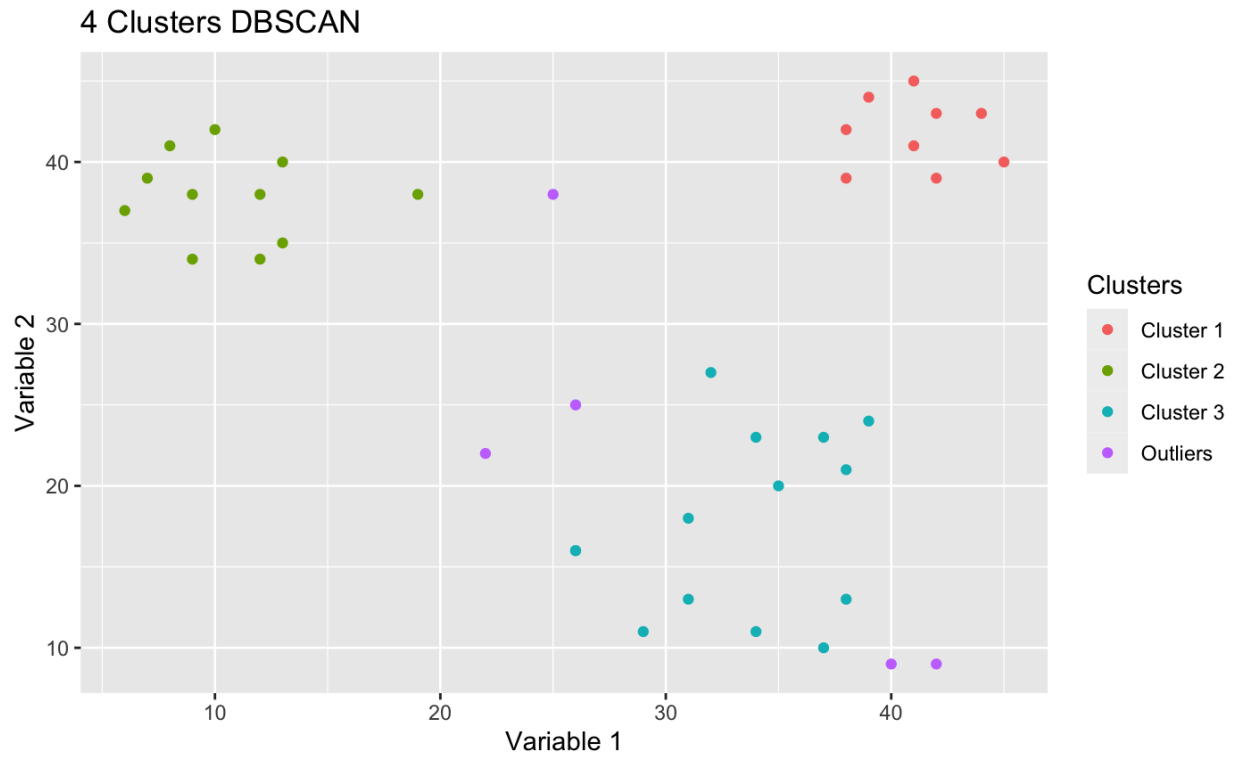
Table 3: 4 Clusters DBSCAN Results

Cluster	Number of Points	Average Distance to Center	SSE
1	9	2.91	86.44
2	11	3.95	203.82
3	14	6.48	642.64

Total Number of Outliers: 5

Percentage of Outliers: 12.82%

Figure 3: 4 Clusters DBSCAN Results



As we can see from the summary statistics in Table 3, the 3 clusters have a fairly even split and the points appear to fit fairly close to the center of their respective cluster. Interestingly, we are getting the same splits in regards to number of points per cluster as hierarchical clustering, however the cluster with 5 points in hierarchical clustering is now the 5 outliers in DBSCAN. Looking at Figure 3, DBSCAN seems to be much better than hierarchical clustering. The clusters are separate from each other and there is no mixing and matching between the clusters for points. The overall SSE is 932.9.

E. Conclusion

Ultimately, it appears that K-Means Clustering and DBSCAN perform the best for the 4 clusters dataset, with Agglomerative Hierarchical Clustering performing quite poorly.

IV. Mammal Milk Dataset

A. Dataset Description

The mammal milk dataset contains a list of animals and the constituents of their milk. The dataset contains information about the name of the animal and the information about the constituents of their milk including the percentages of water, protein, fat, lactose, and ash in that animal's milk.

B. K-Means Clustering Results

For the mammal milk dataset, we tested many different numbers of clusters to find one that minimizes the SSE. Ultimately, we decided on 6 clusters. Using $k = 6$ produced the following results (full results are in Appendix IV.B):

Table 4: Mammal Milk K-Means Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	4	1.31	8.35
2	6	1.84	22.43
3	6	1.69	19.47
4	2	3.88	29.19
5	4	4.45	100.61
6	3	0.95	3.00

As we can see from the summary statistics in Table 4, the clusters are fairly even in size. When it comes to distance from the center, the points in all 6 clusters seem to be fairly close to the center which means the clusters are grouping similar observations together. The overall SSE is 183.05.

C. Agglomerative Hierarchical Clustering Results

For the mammal milk dataset, we tested many different threshold values to find one that minimizes the SSE. Ultimately, we reached a threshold of 8 which produced 6 clusters like we had in K-Means. Using threshold = 8 produced the following results (full results are in the Appendix IV.C.1 and the dendrogram is in the Appendix IV.C.2):

Table 5: Mammal Milk Agglomerative Hierarchical Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	2	3.69	27.19
2	6	1.84	22.43
3	10	2.31	59.41
4	3	0.95	3.00
5	1	0.00	0.00
6	3	2.99	29.21

As we can see from the summary statistics in Table 5, the clusters are not as even in size compared in K-Means. However, when it comes to distance from the center, the points in all 6 clusters seem to be fairly close to the center which means the clusters are grouping similar observations together. It appears that cluster 4 in Table 5 is the same cluster as cluster 6 in Table 4 (K-Means). There is also a cluster that only has one point. The overall SSE is 141.24.

D. DBSCAN Results

For the mammal milk dataset, we tested many different combinations of epsilon (the radius within which DBSCAN shall search for points) and number of points (the minimal number of points within the epsilon distance from a given point to continue building the cluster) to find one that minimizes the SSE while not having too many outliers. Ultimately we decided on using an epsilon = 2.5 and number of points = 1, which produced the following results (full results are in the Appendix IV.D):

Table 6: Mammal Milk DBSCAN Results

Cluster	Number of Points	Average Distance to Center	SSE
1	9	2.17	45.89
2	4	1.25	7.23
3	3	0.95	3.00

Total Number of Outliers: 9

Percentage of Outliers: 36.0%

As we can see from the summary statistics in Table 6, the points in the 3 clusters have a very small distance to the center on average. The first cluster with nine data points has a very large SSE compared to the other 2 clusters. The overall SSE is 56.12.

E. Conclusion

Ultimately, purely based on SSE, DBSCAN produced the best results. However, DBSCAN also identified 36% of the data points as outliers which doesn't contribute to the overall SSE. Based on this, we conclude that Agglomerative Hierarchical Clustering performs the best with this dataset, while all three algorithms perform well and are fairly comparable in terms of overall SSE.

V. Planets Dataset

A. Dataset Description

The planets dataset includes information about sightings of minor planets. Some minor planets may have been sighted more than once. In the table, sightings thought to be of the same planet are listed together. Thus, we have the name of the year of sighting and the initials of the astronomer. For each sighting, we have the node which is the angle, in the earth's plane of orbit, at which the minor planet crosses the earth's orbit. We also have the inclination which is the angle between the orbits of the earth and the minor planet. Lastly, we have the axis which is the maximum distance between the minor planet and the sun, divided by the corresponding quantity for the earth.

B. K-Means Clustering Results

For the planet dataset, we tested many different numbers of clusters to find one that minimizes the SSE. Ultimately, we decided on 5 clusters. Using $k = 5$ produced the following results (full results are in Appendix V.B):

Table 7: Planets K-Means Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	3	10.94	410.93
2	2	0.74	1.08
3	6	7.78	421.94
4	5	5.10	222.18
5	3	16.50	958.95

As we can see from the summary statistics in Table 7, the clusters are fairly even in size. When it comes to distance from the center on average, the points in all 5 clusters seem to vary compared to each other. There are some clusters with very little error, while there are others with much more error. The overall SSE is 2,015.08.

C. Agglomerative Hierarchical Clustering Results

For the planet dataset, we tested many different threshold values to find one that minimizes the SSE. Ultimately, we reached a threshold of 40 which produced 5 clusters like we had in K-Means. Using threshold = 40 produced the following results (full results are in the Appendix V.C.1 and the dendrogram is in the Appendix V.C.2):

Table 8: Planets Agglomerative Hierarchical Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	1	0	0
2	7	10.31	946.42
3	1	0	0
4	8	12.76	2070.76
5	2	0.74	1.08

As we can see from the summary statistics in Table 8, the clusters are not as even in size compared in K-Means. Likewise, the distance from the center on average is also very different between the clusters. This is likely because there are two clusters with just one point in each, and another cluster with just 2 points. The overall SSE is 3,018.26.

D. DBSCAN Results

For the planets dataset, we tested many different combinations of epsilon (the radius within which DBSCAN shall search for points) and number of points (the minimal number of points within the epsilon distance from a given point to continue building the cluster) to find one that minimizes the SSE while not having too many outliers. Ultimately we decided on using an epsilon = 25 and number of points = 2, which produced the following results (full results are in the Appendix V.D):

Table 9: Planets DBSCAN Results

Cluster	Number of Points	Average Distance to Center	SSE
1	8	12.76	2070.76
2	8	14.30	2348.68

Total Number of Outliers: 3

Percentage of Outliers: 15.79%

As we can see from the summary statistics in Table 9, the points in the 2 clusters have a similar average distance to center and SSE compared to one another. There also aren't too many outliers for these results. However, since there are only two clusters, the SSE values for the clusters are very large. The overall SSE is 4,421.44.

E. Conclusion

Ultimately, it appears that K-Means Clustering performed the best for the planets dataset, with Agglomerative Hierarchical Clustering performing quite poorly and DBSCAN performing the worst.

VI. Iris Dataset

A. Dataset Description

The Iris dataset is a dataset containing records of iris flowers. Each record depicts physical dimensions of a specific iris flower from one of three different subspecies of iris: (1) Iris Setosa, (2) Iris Versicolor, or (3) Iris Virginica. There are four physical parameters measured for each flower: (1) sepal length in cm, (2) sepal width in cm, (3) petal length in cm, and (4) petal width in cm.

B. K-Means Clustering Results

For the iris dataset, we have the ground truth of there being three different iris flower species, thus we set the number of clusters to be 3. Using $k = 3$ produced the following results (full results are in Appendix VI.B):

Table 10: Iris K-Means Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	53	0.586	28.57
2	78	0.80	58.36
3	19	0.68	9.78

As we can see from the summary statistics in Table 10, the average distances to the center for the clusters are very small and very similar to one another. However, in SSE, we see more variability, the more data points a cluster has, the larger the SSE. We know that there were 50 observations for each of the three species of flower, so ideally each cluster should have roughly 50 observations, which our first cluster is very close to but our second and third cluster are further away from. However, it is likely that perhaps two species have more similar features to one another which is why they are getting mixed up in the clustering. The overall SSE is 96.71.

C. Agglomerative Hierarchical Clustering Results

For the iris dataset, similarly to our procedure for K-Means, due to there being 3 species of iris flowers, we tested different threshold values so we were getting 3 clusters. Using threshold = 2.2 produced the following results (full results are in the Appendix VI.C.1 and the dendrogram is in the Appendix VI.C.2):

Table 11: Iris Agglomerative Hierarchical Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	75	0.88	71.06
2	5	2.00	31.19
3	70	1.36	145.22

As we can see from the summary statistics in Table 11, hierarchical clustering produces much worse results compared to K-Means. Ideally, each cluster should have 50 observations, however we have two clusters with about 70 observations and one cluster with only 5 observations. The

clusters are kind of all over the place, and are mixing and matching with each other. The overall SSE is 247.47.

D. DBSCAN Results

For the iris dataset, similarly to our procedure for K-Means and DBSCAN, due to there being 3 species of iris flowers, we tried testing different combinations of epsilon (the radius within which DBSCAN shall search for points) and number of points (the minimal number of points within the epsilon distance from a given point to continue building the cluster) to get 3 clusters. Ultimately we are using an epsilon = 0.5 and number of points = 10, which produced the following results (full results are in the Appendix VI.D):

Table 12: Iris DBSCAN Results

Cluster	Number of Points	Average Distance to Center	SSE
1	46	0.43	10.25
2	50	0.63	22.28
3	19	0.39	3.13

Total Number of Outliers: 35

Percentage of Outliers: 23.33%

As we can see from the summary statistics in Table 12, we are seeing the most similar split based on the number of points in each cluster compared to the ground truth. Each cluster ideally should have 50 observations, and here two of our clusters have right around 50 observations, while one has 19 observations, and in the end we have 35 outliers. However, for the three clusters, we have very small distances to the center on average. Thus, the clusters are separate from each other and there is little mixing and matching between the clusters for points. The overall SSE is 35.66.

E. Conclusion

Ultimately, purely based on SSE, DBSCAN produced the best results. However, DBSCAN also identified 23.33% of the data points as outliers which doesn't contribute to the overall SSE. Based on this, we conclude that DBSCAN and K-Means Clustering performs the best with this dataset, while Agglomerative Hierarchical Clustering performs the worst.

VII. Accidents Dataset

A. Dataset Description

The accidents dataset includes data on fatal automotive accidents, collected by Peter Oyler. Each accident is described by five numeric features: (1) number of total vehicles, (2) number of pedestrians, (3) number of lanes, (4) number of fatalities, and (5) number of drunk drivers.

B. K-Means Clustering Results

For the accidents dataset, we tested many different numbers of clusters to find one that minimizes the SSE. Ultimately, we decided on 3 clusters. Using $k = 3$ produced the following results (full results are in Appendix VII.B):

Table 13: Accidents K-Means Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	27	1.18	43.48
2	25	0.85	27.52
3	10	1.67	48.00

As we can see from the summary statistics in Table 13, the first two clusters are similar in size, while cluster 3 is much smaller. On average, the distance from the center in all 3 clusters seem fairly close to the center, with cluster 2 having the tightest fit. The overall SSE is 119.

C. Agglomerative Hierarchical Clustering Results

For the accidents dataset, we tested many different threshold values to find one that minimizes the SSE. Ultimately, we reached a threshold of 2.5 which produced 4 clusters. Using threshold = 2.5 produced the following results (full results are in the Appendix VII.C.1 and the dendrogram is in the Appendix VII.C.2):

Table 14: Accidents Agglomerative Hierarchical Clustering Results

Cluster	Number of Points	Average Distance to Center	SSE
1	1	0	0
2	1	0	0
3	9	1.01	10.44
4	51	1.49	121.57

As we can see from the summary statistics in Table 14, the clusters are not as even in size compared in K-Means. We have two clusters with just one point in each, while another cluster has 9 points and the last has the majority of the data containing 51 points. The overall SSE is 132.01.

D. DBSCAN Results

For the accidents dataset, we tested many different combinations of epsilon (the radius within which DBSCAN shall search for points) and number of points (the minimal number of points within the epsilon distance from a given point to continue building the cluster) to find one that minimizes the SSE while not having too many outliers. Ultimately we decided on using an epsilon = 0.25 and number of points = 5, which produced the following results (full results are in the Appendix VII.D):

Table 15: Accidents DBSCAN Results

Cluster	Number of Points	Average Distance to Center	SSE
1	9	0	0
2	9	0	0
3	9	0	0

Total Number of Outliers: 35

Percentage of Outliers: 56.45%

As we can see from the summary statistics in Table 15, it appears that DBSCAN just grouped together the data points that were identical to each other in their own cluster and labeled everything else as an outlier. Thus, the overall SSE is 0, however 56.45% of the data isn't being counted in this overall SSE tally.

E. Conclusion

Ultimately, it appears that K-Means Clustering performed the best for the accidents dataset, with Agglomerative Hierarchical Clustering performing slightly worse but not horribly, and DBSCAN performing the worst. Although DBSCAN has an overall SSE of 0, this is a false representation since it simply just grouped identical data points together and neglected over half of the data points.

VIII. Analysis

Overall, the K-Means Clustering method performed the best, while the Agglomerative Hierarchical Clustering performed the worst. DBSCAN usually performed fairly well, however it

also often counted a large percentage of the data points as outliers. Ultimately, K-Means Clustering and DBSCAN performed the best on the 4 clusters and iris datasets. K-Means alone performed the best on the planets and accidents dataset. Hierarchical clustering performed the best on the mammal milk dataset. The data was all numerical, the main difference between the datasets was the number of predictors. We did not standardize the data, because we were comparing the values like SSE within the same dataset, not across different datasets.

XI. Appendix

III.B. 4 Clusters K-Means Clustering Results (k = 4)

Cluster 0:

Center: 33.166666666666664, 17.27777777777778,

Max Dist. to Center: 12.124101086698913

Min Dist. to Center: 2.2838671990104937

Avg Dist. to Center: 7.579450143514094

SSE: 1164.1111111111109

18 Points:

32, 27,

26, 25,

39, 24,

34, 23,

37, 23,

22, 22,

38, 21,

35, 20,

31, 18,

26, 16,

31, 13,

26, 16,

38, 13,

29, 11,

34, 11,

37, 10,

40, 9,

42, 9,

Cluster 1:

Center: 11.916666666666666, 37.833333333333336,

Max Dist. to Center: 13.08439486139458

Min Dist. to Center: 0.18633899812498061

Avg Dist. to Center: 4.836295539238219

SSE: 390.58333333333337

12 Points:

10,42,

8,41,

13,40,

7,39,

9,38,

12,38,

19,38,

25,38,

6,37,

13,35,

9,34,

12,34,

Cluster 2:

Center: 39.0,41.5,

Max Dist. to Center: 2.692582403567252

Min Dist. to Center: 1.118033988749895

Avg Dist. to Center: 2.0930423012814945

SSE: 19.0

4 Points:

39,44,

38,42,

41,41,

38,39,

Cluster 3:

Center: 42.8,42.0,

Max Dist. to Center: 3.4985711369071786

Min Dist. to Center: 1.280624847486568

Avg Dist. to Center: 2.4838589216581575

SSE: 34.8

5 Points:

41,45,

42,43,

44,43,

45,40,

42,39,

III.C.1. 4 Clusters Agglomerative Hierarchical Clustering Results (threshold = 13.1)

Cluster 0:

Center: 15.642857142857142, 38.214285714285715,

Max Dist. to Center: 22.67539347812415

Min Dist. to Center: 3.189587651680871

Avg Dist. to Center: 8.727211868186933

SSE: 1573.5714285714284

14 Points:

19.0, 38.0,

25.0, 38.0,

9.0, 34.0,

13.0, 35.0,

12.0, 34.0,

13.0, 40.0,

12.0, 38.0,

10.0, 42.0,

8.0, 41.0,

6.0, 37.0,

7.0, 39.0,

9.0, 38.0,

38.0, 42.0,

38.0, 39.0,

Cluster 1:

Center: 39.333333333333336, 35.444444444444444,

Max Dist. to Center: 26.538813876571588

Min Dist. to Center: 4.444444444444445

Avg Dist. to Center: 11.461166606452585

SSE: 1694.2222222222222

9 Points:

42.0, 43.0,

44.0, 43.0,

41.0, 45.0,

39.0, 44.0,

45.0, 40.0,

41.0, 41.0,

42.0, 39.0,

31.0, 13.0,

29.0, 11.0,

Cluster 2:
 Center: 26.2,19.4,
 Max Dist. to Center: 5.603570290448761
 Min Dist. to Center: 3.4058772731852787
 Avg Dist. to Center: 4.470992090182142
 SSE: 104.0
 5 Points:
 26.0,25.0,
 22.0,22.0,
 31.0,18.0,
 26.0,16.0,
 26.0,16.0,

Cluster 3:
 Center: 36.90909090909091,17.272727272727273,
 Max Dist. to Center: 10.895825267709775
 Min Dist. to Center: 3.3290606224728263
 Avg Dist. to Center: 6.767954973661845
 SSE: 561.0909090909091
 11 Points:
 38.0,21.0,
 39.0,24.0,
 37.0,23.0,
 34.0,23.0,
 35.0,20.0,
 40.0,9.0,
 42.0,9.0,
 34.0,11.0,
 38.0,13.0,
 37.0,10.0,
 32.0,27.0,

III.C.2. 4 Clusters Agglomerative Hierarchical Clustering Dendrogram

```
{
  "type": "root",
  "height": 28.757419461942522,
  "nodes": [
    {
      "type": "node",
      "height": 13.072844121676065,
      "nodes": [
```

```

{
  "type": "node",
  "height": 6.0,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "19,38"
    },
    {
      "type": "leaf",
      "height": 0,
      "data": "25,38"
    }
  ]
},
{
  "type": "node",
  "height": 10.877488110920524,
  "nodes": [
    {
      "type": "node",
      "height": 3.5615528128088303,
      "nodes": [
        {
          "type": "leaf",
          "height": 0,
          "data": "9,34"
        },
        {
          "type": "node",
          "height":
1.4142135623730951,
          "nodes": [
            {
              "type": "leaf",
              "height": 0,
              "data": "13,35"
            },
            {
              "type": "leaf",

```

```

        "height": 0,
        "data": "12,34"
    }
    ]
}
]
},
{
    "type": "node",
    "height": 6.1534404648423875,
    "nodes": [
        {
            "type": "node",
            "height": 5.052916037910906,
            "nodes": [
                {
                    "type": "node",
                    "height":
2.23606797749979,

                    "nodes": [
                        {
                            "type":
"leaf",

                            "height": 0,
                            "data":
"13,40"

                        },
                        {
                            "type":
"leaf",

                            "height": 0,
                            "data":
"12,38"

                        }
                    ]
                },
                {
                    "type": "node",
                    "height":
4.106558690472924,

                    "nodes": [

```

"node",
2.23606797749979,

"type": "leaf",

"height": 0,

"data": "10,42"

"type": "leaf",

"height": 0,

"data": "8,41"

"node",

2.699172818834085,

"type": "leaf",

"height": 0,

"data": "6,37"

"type": "node",

```
{
  "type":
  "height":
  "nodes": [
    {
      },
      {
    }
  ],
  {
    "type":
    "height":
    "nodes": [
      {
        },
        {

```

```
"height": 2.23606797749979,
```

```
"nodes": [
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "7,39"
```

```
},
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "9,38"
```

```
}
```

```
]
```

```
}
```

```
]
```

```
}
```

```
]
```

```
}
```

```
]
```

```
},
```

```
{
```

```
"type": "node",
```

```
"height": 3.0,
```

```
"nodes": [
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "38,42"
```

```
},
```

```

{
  "type": "leaf",
  "height": 0,
  "data": "38,39"
}
]
}
]
}
]
}
]
},
{
  "type": "node",
  "height": 22.850320014330368,
  "nodes": [
    {
      "type": "node",
      "height": 5.105625978844701,
      "nodes": [
        {
          "type": "node",
          "height": 4.571013837018279,
          "nodes": [
            {
              "type": "node",
              "height": 3.525729106681236,
              "nodes": [
                {
                  "type": "node",
                  "height": 2.0,
                  "nodes": [
                    {
                      "type":
"leaf",
                      "height": 0,
                      "data":
"42,43"
                    },
                    {

```

```

"leaf",
"44,43"

2.23606797749979,

"leaf",
"41,45"

"leaf",
"39,44"

    "type":
    "height": 0,
    "data":

    }
  ]
},
{
  "type": "node",
  "height":
  "nodes": [
    {
      "type":
      "height": 0,
      "data":

    },
    {
      "type":
      "height": 0,
      "data":

    }
  ]
}
],
{
  "type": "node",
  "height": 3.64269164289302,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "45,40"
    },
    {

```



```

2.23606797749979,
"leaf",
"41,41"
"leaf",
"42,39"
    "type": "node",
    "height":
    "nodes": [
        {
            "type":
            "height": 0,
            "data":
        },
        {
            "type":
            "height": 0,
            "data":
        }
    ]
    }
    ]
    },
    {
        "type": "node",
        "height": 2.8284271247461903,
        "nodes": [
            {
                "type": "leaf",
                "height": 0,
                "data": "31,13"
            },
            {
                "type": "leaf",
                "height": 0,
                "data": "29,11"
            }
        ]
    }
    ]

```

```

},
{
  "type": "node",
  "height": 13.149898399044597,
  "nodes": [
    {
      "type": "node",
      "height": 8.478898028449114,
      "nodes": [
        {
          "type": "node",
          "height": 5.0,
          "nodes": [
            {
              "type": "leaf",
              "height": 0,
              "data": "26,25"
            },
            {
              "type": "leaf",
              "height": 0,
              "data": "22,22"
            }
          ]
        },
        {
          "type": "node",
          "height": 5.385164807134504,
          "nodes": [
            {
              "type": "leaf",
              "height": 0,
              "data": "31,18"
            },
            {
              "type": "node",
              "height": 0.0,
              "nodes": [
                {
                  "type":
"leaf",

```

```

"height": 0,
"data":
"26,16"
},
{
  "type":
    "height": 0,
    "data":
      "26,16"
    }
  ]
}
]
},
{
  "type": "node",
  "height": 11.424347989961815,
  "nodes": [
    {
      "type": "node",
      "height": 4.165973108952852,
      "nodes": [
        {
          "type": "node",
          "height":
2.699172818834085,
          "nodes": [
            {
              "type":
"leaf",
              "height": 0,
              "data":
"38,21"
            },
            {
              "type":
"node",

```

2.23606797749979,

"type": "leaf",

"height": 0,

"data": "39,24"

"type": "leaf",

"height": 0,

"data": "37,23"

3.1622776601683795,

"leaf",

"34,23"

"leaf",

"35,20"

"height":

"nodes": [
 {

 },
 {

 }

]

}

]

},
{

 "type": "node",
 "height":

 "nodes": [
 {

 "type":

 "height": 0,
 "data":

 },
 {

 "type":

 "height": 0,
 "data":

```

    }
  ]
}
]
},
{
  "type": "node",
  "height": 9.156253729423927,
  "nodes": [
    {
      "type": "node",
      "height": 2.0,
      "nodes": [
        {
          "type":
"leaf",
          "height": 0,
          "data":
"40,9"
        },
        {
          "type":
"leaf",
          "height": 0,
          "data":
"42,9"
        }
      ]
    },
    {
      "type": "node",
      "height":
5.493508991637533,
      "nodes": [
        {
          "type":
"node",
          "height":
3.81720680758398,
          "nodes": [

```

```

"type": "leaf",

"height": 0,

"data": "34,11"
                                },
                                {

"type": "node",

"height": 3.1622776601683795,

"nodes": [

{

"type": "leaf",

"height": 0,

"data": "38,13"

},

{

"type": "leaf",

"height": 0,

"data": "37,10"

}

                                ]

                                }

                                ]

                                },
                                {

"type":

"leaf",

```

```
Cluster 1:
Center: 41.111111111111114, 41.77777777777778,
Max Dist. to Center: 4.275973645531965
Min Dist. to Center: 0.7856742013183874
Avg Dist. to Center: 2.9117006199139848
SSE: 86.44444444444443
9 Points:
41.0, 45.0,
39.0, 44.0,
42.0, 43.0,
44.0, 43.0,
38.0, 42.0,
41.0, 41.0,
45.0, 40.0,
38.0, 39.0,
42.0, 39.0,
```

```
Cluster 2:  
Center: 10.727272727272727, 37.81818181818182,  
Max Dist. to Center: 8.27472503350808  
Min Dist. to Center: 1.2856486930664504  
Avg Dist. to Center: 3.9478650747993274  
SSE: 203.81818181818178
```

11 Points:

10.0,42.0,
8.0,41.0,
13.0,40.0,
7.0,39.0,
9.0,38.0,
12.0,38.0,
19.0,38.0,
6.0,37.0,
13.0,35.0,
9.0,34.0,
12.0,34.0,

Cluster 3:

Center: 33.357142857142854,17.571428571428573,
Max Dist. to Center: 9.52574385118387
Min Dist. to Center: 2.3957871187497712
Avg Dist. to Center: 6.484143046984046
SSE: 642.6428571428572

14 Points:

32.0,27.0,
39.0,24.0,
34.0,23.0,
37.0,23.0,
38.0,21.0,
35.0,20.0,
31.0,18.0,
26.0,16.0,
31.0,13.0,
26.0,16.0,
38.0,13.0,
29.0,11.0,
34.0,11.0,
37.0,10.0,

Total Number of Outliers: 5

Percentage of Outliers: 12.82051282051282%

Outliers:

25.0,38.0,
26.0,25.0,
22.0,22.0,

40.0, 9.0,
42.0, 9.0,

IV.B. Mammal Milk K-Means Clustering Results (k = 6)

Cluster 0:

Center:

86.825, 3.8000000000000003, 3.2750000000000004, 5.3500000000000005,
0.7775000000000001,

Max Dist. to Center: 1.9036166236929117

Min Dist. to Center: 0.42925080081463024

Avg Dist. to Center: 1.3131731936925362

SSE: 8.3510750000000002

4 Points:

87.7, 3.5, 3.4, 4.8, 0.71,

86.9, 4.8, 1.7, 5.7, 0.9,

86.5, 3.9, 3.2, 5.6, 0.8,

86.2, 3.0, 4.8, 5.3, 0.7,

Cluster 1:

Center:

82.0, 7.116666666666667, 6.466666666666668, 4.183333333333334, 0.886
66666666666667,

Max Dist. to Center: 3.025504549290544

Min Dist. to Center: 1.1240749283052491

Avg Dist. to Center: 1.8433834193301044

SSE: 22.429333333333336

6 Points:

82.1, 5.9, 7.9, 4.7, 0.78,

81.9, 7.4, 7.2, 2.7, 0.85,

81.6, 10.1, 6.3, 4.4, 0.75,

81.6, 6.6, 5.9, 4.9, 0.93,

82.8, 7.1, 5.1, 3.7, 1.1,

82.0, 5.6, 6.4, 4.7, 0.91,

Cluster 2:

Center:

89.61666666666667, 1.75, 2.4833333333333334, 5.899999999999995, 0.2
9,

Max Dist. to Center: 2.8790893622038807

Min Dist. to Center: 0.9320884555067092

Avg Dist. to Center: 1.6895585568854743

SSE: 19.47046666666665

6 Points:

90.1,2.6,1.0,6.9,0.35,
88.5,1.4,3.5,6.0,0.24,
88.4,2.2,2.7,6.4,0.18,
90.3,1.7,1.4,6.2,0.4,
90.4,0.6,4.5,4.4,0.1,
90.0,2.0,1.8,5.5,0.47,

Cluster 3:

Center: 45.65,10.149999999999999,38.45,0.45,0.69,

Max Dist. to Center: 3.6872211758992752

Min Dist. to Center: 3.6872211758992677

Avg Dist. to Center: 3.6872211758992712

SSE: 27.191200000000013

2 Points:

46.4,9.7,42.0,0.0,0.85,
44.9,10.6,34.9,0.9,0.53,

Cluster 4:

Center:

72.7,8.600000000000001,13.200000000000001,3.45,1.3824999999999998,

Max Dist. to Center: 7.317701568798773

Min Dist. to Center: 0.8847633864486031

Avg Dist. to Center: 4.445640662119046

SSE: 100.61167499999999

4 Points:

76.3,9.3,9.5,3.0,1.2,
70.7,3.6,17.6,5.6,0.63,
71.3,12.3,13.1,1.9,2.3,
72.5,9.2,12.6,3.3,1.4,

Cluster 5:

Center:

65.16666666666667,10.733333333333334,20.400000000000002,2.233333333333333,1.2166666666666666,

Max Dist. to Center: 1.201850425154663

Min Dist. to Center: 0.5002777006601273

Avg Dist. to Center: 0.9484482783747646

SSE: 3.0016666666666785

3 Points:

65.9,10.4,19.7,2.6,1.4,
64.8,10.7,20.3,2.5,1.4,
64.8,11.1,21.2,1.6,0.85,

IV.C.1. Mammal Milk Agglomerative Hierarchical Clustering Results (threshold = 8)

Cluster 0:

Center: 45.65,10.149999999999999,38.45,0.45,0.69,
Max Dist. to Center: 3.6872211758992752
Min Dist. to Center: 3.6872211758992677
Avg Dist. to Center: 3.6872211758992712
SSE: 27.1912000000000013

2 Points:

46.4,9.7,42.0,0.0,0.85,
44.9,10.6,34.9,0.9,0.53,

Cluster 1:

Center:
81.999999999999999,7.116666666666667,6.466666666666668,4.1833333333333334,0.886666666666667,
Max Dist. to Center: 3.025504549290542
Min Dist. to Center: 1.124074928305244
Avg Dist. to Center: 1.8433834193301044
SSE: 22.429333333333334

6 Points:

81.6,10.1,6.3,4.4,0.75,
82.1,5.9,7.9,4.7,0.78,
81.6,6.6,5.9,4.9,0.93,
82.0,5.6,6.4,4.7,0.91,
81.9,7.4,7.2,2.7,0.85,
82.8,7.1,5.1,3.7,1.1,

Cluster 2:

Center: 88.5,2.57,2.8,5.68,0.48500000000000004,
Max Dist. to Center: 3.4881979588320413
Min Dist. to Center: 0.8765414993027995
Avg Dist. to Center: 2.307742412099644
SSE: 59.412249999999996

10 Points:

86.9,4.8,1.7,5.7,0.9,
86.2,3.0,4.8,5.3,0.7,

87.7,3.5,3.4,4.8,0.71,
 86.5,3.9,3.2,5.6,0.8,
 90.4,0.6,4.5,4.4,0.1,
 88.5,1.4,3.5,6.0,0.24,
 88.4,2.2,2.7,6.4,0.18,
 90.1,2.6,1.0,6.9,0.35,
 90.3,1.7,1.4,6.2,0.4,
 90.0,2.0,1.8,5.5,0.47,

Cluster 3:

Center:

65.16666666666667,10.733333333333334,20.400000000000002,2.233333
 3333333334,1.2166666666666666,

Max Dist. to Center: 1.2018504251546631

Min Dist. to Center: 0.5002777006601271

Avg Dist. to Center: 0.9484482783747646

SSE: 3.0016666666666678

3 Points:

64.8,11.1,21.2,1.6,0.85,
 65.9,10.4,19.7,2.6,1.4,
 64.8,10.7,20.3,2.5,1.4,

Cluster 4:

Center: 70.7,3.6,17.6,5.6,0.63,

Max Dist. to Center: 0.0

Min Dist. to Center: 0.0

Avg Dist. to Center: 0.0

SSE: 0.0

1 Points:

70.7,3.6,17.6,5.6,0.63,

Cluster 5:

Center:

73.36666666666666,10.266666666666667,11.733333333333334,2.733333
 333333333,1.6333333333333335,

Max Dist. to Center: 3.8451990267807443

Min Dist. to Center: 1.7365355036841446

Avg Dist. to Center: 2.986644201243832

SSE: 29.213333333333333

3 Points:

76.3,9.3,9.5,3.0,1.2,

71.3,12.3,13.1,1.9,2.3,
72.5,9.2,12.6,3.3,1.4,

IV.C.2. Mammal Milk Agglomerative Hierarchical Clustering Dendrogram

```
{
  "type": "root",
  "height": 47.37123122873941,
  "nodes": [
    {
      "type": "node",
      "height": 7.374442351798543,
      "nodes": [
        {
          "type": "leaf",
          "height": 0,
          "data": "46.4,9.7,42.0,0.0,0.85"
        },
        {
          "type": "leaf",
          "height": 0,
          "data": "44.9,10.6,34.9,0.9,0.53"
        }
      ]
    },
    {
      "type": "node",
      "height": 12.226552162801845,
      "nodes": [
        {
          "type": "node",
          "height": 3.8982213825282983,
          "nodes": [
            {
              "type": "leaf",
              "height": 0,
              "data": "81.6,10.1,6.3,4.4,0.75"
            },
            {
              "type": "node",
              "height": 2.6210342415062553,
              "nodes": [
```

```

{
  "type": "node",
  "height": 1.864966984633579,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data":
"82.1,5.9,7.9,4.7,0.78"
    },
    {
      "type": "node",
      "height":
1.2043255373859696,
      "nodes": [
        {
          "type":
"leaf",
          "height": 0,
          "data":
"81.6,6.6,5.9,4.9,0.93"
        },
        {
          "type":
"leaf",
          "height": 0,
          "data":
"82.0,5.6,6.4,4.7,0.91"
        }
      ]
    }
  ],
  {
    "type": "node",
    "height": 2.524381112272865,
    "nodes": [
      {
        "type": "leaf",
        "height": 0,

```

```

"81.9,7.4,7.2,2.7,0.85"
"82.8,7.1,5.1,3.7,1.1"
2.6475397632626856,
"leaf",
"86.9,4.8,1.7,5.7,0.9"

"data":
},
{
  "type": "leaf",
  "height": 0,
  "data":
}
]
}
]
}
],
{
  "type": "node",
  "height": 12.200754314412228,
  "nodes": [
    {
      "type": "node",
      "height": 9.165900880212552,
      "nodes": [
        {
          "type": "node",
          "height": 4.181078944165574,
          "nodes": [
            {
              "type": "node",
              "height":
"nodes": [
{
  "type":
"height": 0,
"data":
},
{

```

```
"node",
2.0285363532469924,
```

```
"type": "leaf",
"height": 0,
"data": "86.2,3.0,4.8,5.3,0.7"
```

```
"type": "node",
"height": 1.5126466871017854,
"nodes": [
{
"type": "leaf",
"height": 0,
"data": "87.7,3.5,3.4,4.8,0.71"
},
{
"type": "leaf",
"height": 0,
"data": "86.5,3.9,3.2,5.6,0.8"
}
}
```

```
"type":
"height":
"nodes": [
{
},
{
}
```



```

    }
  ]
}
]
},
{
  "type": "node",
  "height":
3.663210361948349,

  "nodes": [
    {
      "type":
"leaf",

      "height": 0,
      "data":
"90.4,0.6,4.5,4.4,0.1"

    },
    {
      "type":
"node",

      "height":
2.5788640174334896,

      "nodes": [

        {
          "type": "leaf",

          "height": 0,

          "data": "88.5,1.4,3.5,6.0,0.24"

        },

```

```

{
  "type": "leaf",
  "height": 0,
  "data": "88.4,2.2,2.7,6.4,0.18"
}

],
{
  "type": "node",
  "height": 1.4766533365398415,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "90.1,2.6,1.0,6.9,0.35"
    },
    {
      "type": "node",
      "height": 0.9137286249209875,
      "nodes": [
        {
          "type": "leaf",

```

```

    "height": 0,

    "data": "90.3,1.7,1.4,6.2,0.4"

  },

  {

    "type": "leaf",

    "height": 0,

    "data": "90.0,2.0,1.8,5.5,0.47"

  }

]

}

]

}

]

}

]

},

{

  "type": "node",
  "height":

1.8674601481196762,

  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data":

"64.8,11.1,21.2,1.6,0.85"

    },
    {
      "type": "node",

```

```

1.2922847983320163,
"leaf",
"65.9,10.4,19.7,2.6,1.4"
"leaf",
"64.8,10.7,20.3,2.5,1.4"
},
{
  "type": "node",
  "height": 10.132378133085512,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data":
"70.7,3.6,17.6,5.6,0.63"
    },
    {
      "type": "node",
      "height":
5.9727117436237585,
      "nodes": [
        {
          "type": "leaf",
          "height": 0,

```

```

    "data":
      "76.3,9.3,9.5,3.0,1.2"
    },
    {
      "type": "node",
      "height":
        3.7509998667022124,
      "nodes": [
        {
          "type":
            "leaf",
          "height": 0,
          "data":
            "71.3,12.3,13.1,1.9,2.3"
        },
        {
          "type":
            "leaf",
          "height": 0,
          "data":
            "72.5,9.2,12.6,3.3,1.4"
        }
      ]
    }
  ]
}

```

IV.D. Mammal Milk DBSCAN Results (epsilon = 2.5 & NumPoints = 1)

Cluster 1:

Center:

88.28888888888889,2.78888888888889,2.61111111111111,5.82222222
2222222,0.527777777777778,

Max Dist. to Center: 3.082472352263542

Min Dist. to Center: 0.9065393429117763

Avg Dist. to Center: 2.166320700908495

SSE: 45.89277777777772

9 Points:

90.1,2.6,1.0,6.9,0.35,

88.5,1.4,3.5,6.0,0.24,

88.4,2.2,2.7,6.4,0.18,

90.3,1.7,1.4,6.2,0.4,

87.7,3.5,3.4,4.8,0.71,

86.9,4.8,1.7,5.7,0.9,

86.5,3.9,3.2,5.6,0.8,

90.0,2.0,1.8,5.5,0.47,

86.2,3.0,4.8,5.3,0.7,

Cluster 2:

Center: 82.125,6.300000000000001,6.324999999999999,4.5,0.93,

Max Dist. to Center: 1.806972606322518

Min Dist. to Center: 0.7427314454094439

Avg Dist. to Center: 1.2585998081677703

SSE: 7.226800000000004

4 Points:

82.1,5.9,7.9,4.7,0.78,

81.6,6.6,5.9,4.9,0.93,

82.8,7.1,5.1,3.7,1.1,

82.0,5.6,6.4,4.7,0.91,

Cluster 3:

Center:

65.16666666666667,10.733333333333334,20.400000000000002,2.233333

33333333,1.2166666666666666,

Max Dist. to Center: 1.201850425154663

Min Dist. to Center: 0.5002777006601273

Avg Dist. to Center: 0.9484482783747646

SSE: 3.00166666666666785

3 Points:

65.9,10.4,19.7,2.6,1.4,

64.8,10.7,20.3,2.5,1.4,

64.8,11.1,21.2,1.6,0.85,

Total Number of Outliers: 9

Percentage of Outliers: 36.0%

Outliers:

90.4,0.6,4.5,4.4,0.1,
 81.9,7.4,7.2,2.7,0.85,
 81.6,10.1,6.3,4.4,0.75,
 76.3,9.3,9.5,3.0,1.2,
 70.7,3.6,17.6,5.6,0.63,
 71.3,12.3,13.1,1.9,2.3,
 72.5,9.2,12.6,3.3,1.4,
 46.4,9.7,42.0,0.0,0.85,
 44.9,10.6,34.9,0.9,0.53,

V.B. Planets K-Means Clustering Results (k = 5)

Cluster 0:

Center: 49.748,7.580666666666667,2.881433333333333,
 Max Dist. to Center: 16.307787050942526
 Min Dist. to Center: 6.194649249867897
 Avg Dist. to Center: 10.94252309539315
 SSE: 410.9259689933332
 3 Points:
 59.9,5.7,2.79,
 55.144,4.542,3.0343,
 34.2,12.5,2.82,

Cluster 1:

Center: 338.97900000000004,16.42,2.74,
 Max Dist. to Center: 0.736184250035287
 Min Dist. to Center: 0.7361842500352388
 Avg Dist. to Center: 0.7361842500352629
 SSE: 1.0839344999999647
 2 Points:
 338.333,16.773,2.7465,
 339.625,16.067,2.7335,

Cluster 2:

Center:
 126.48833333333333,3.413500000000004,2.585116666666665,
 Max Dist. to Center: 11.455597315783614
 Min Dist. to Center: 3.857429091340786
 Avg Dist. to Center: 7.779701268893809
 SSE: 421.93789020166616
 6 Points:

130.916,4.659,2.2562,
 132.2,4.7,2.13,
 130.07,4.79,2.1893,
 115.072,2.666,3.1676,
 115.072,2.666,3.1676,
 135.6,1.0,2.6,

Cluster 3:

Center: 79.8416,4.5287999999999995,2.68792,
 Max Dist. to Center: 10.368646484782868
 Min Dist. to Center: 1.0873027096443773
 Avg Dist. to Center: 5.100430448475268
 SSE: 222.1774797280003

5 Points:

80.804,4.622,2.189,
 80.804,4.622,2.1906,
 89.9,2.1,3.35,
 69.6,4.7,2.81,
 78.1,6.6,2.9,

Cluster 4:

Center: 170.6,6.1000000000000005,2.466666666666667,
 Max Dist. to Center: 24.38844352921641
 Min Dist. to Center: 7.599211216377072
 Avg Dist. to Center: 16.497411170556674
 SSE: 958.9544666666667

3 Points:

153.1,6.5,2.45,
 194.6,1.8,3.02,
 164.1,10.0,1.93,

V.C.1. Planets Agglomerative Hierarchical Clustering Results (threshold = 40)

Cluster 0:

Center: 34.2,12.5,2.82,
 Max Dist. to Center: 0.0
 Min Dist. to Center: 0.0
 Avg Dist. to Center: 0.0
 SSE: 0.0

1 Points:

34.2,12.5,2.82,

Cluster 1:

Center: 73.46457142857142,4.698,2.751985714285715,

Max Dist. to Center: 18.323410567503686

Min Dist. to Center: 3.8650073717753126

Avg Dist. to Center: 10.310791151765072

SSE: 946.4240339628574

7 Points:

59.9,5.7,2.79,

55.144,4.542,3.0343,

89.9,2.1,3.35,

69.6,4.7,2.81,

78.1,6.6,2.9,

80.804,4.622,2.189,

80.804,4.622,2.1906,

Cluster 2:

Center: 194.6,1.8,3.02,

Max Dist. to Center: 0.0

Min Dist. to Center: 0.0

Avg Dist. to Center: 0.0

SSE: 0.0

1 Points:

194.6,1.8,3.02,

Cluster 3:

Center: 134.51624999999999,4.622625,2.4863375,

Max Dist. to Center: 30.07364190395024

Min Dist. to Center: 2.3447766134604877

Avg Dist. to Center: 12.756935025776222

SSE: 2070.758568513749

8 Points:

153.1,6.5,2.45,

164.1,10.0,1.93,

115.072,2.666,3.1676,

115.072,2.666,3.1676,

135.6,1.0,2.6,

132.2,4.7,2.13,

130.916,4.659,2.2562,

130.07,4.79,2.1893,

Cluster 4:

Center: 338.97900000000004,16.42,2.74,
 Max Dist. to Center: 0.736184250035287
 Min Dist. to Center: 0.7361842500352388
 Avg Dist. to Center: 0.7361842500352629
 SSE: 1.0839344999999647
 2 Points:
 338.333,16.773,2.7465,
 339.625,16.067,2.7335,

V.C.2. Planets Agglomerative Hierarchical Clustering Dendrogram

```
{
  "type": "root",
  "height": 108.7244795674827,
  "nodes": [
    {
      "type": "node",
      "height": 40.105439810829964,
      "nodes": [
        {
          "type": "leaf",
          "height": 0,
          "data": "34.2,12.5,2.82"
        },
        {
          "type": "node",
          "height": 22.37733884918916,
          "nodes": [
            {
              "type": "node",
              "height": 4.901038919453711,
              "nodes": [
                {
                  "type": "leaf",
                  "height": 0,
                  "data": "59.9,5.7,2.79"
                },
                {
                  "type": "leaf",
                  "height": 0,
                  "data": "55.144,4.542,3.0343"
                }
              ]
            }
          ]
        }
      ]
    }
  ]
}
```

```

    }
  ]
},
{
  "type": "node",
  "height": 13.032570785018569,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "89.9,2.1,3.35"
    },
    {
      "type": "node",
      "height":
10.384358971073611,

      "nodes": [
        {
          "type": "leaf",
          "height": 0,
          "data":
"69.6,4.7,2.81"

        },
        {
          "type": "node",
          "height":
3.424687526253572,

          "nodes": [
            {
              "type":
"leaf",

              "height": 0,
              "data":
"78.1,6.6,2.9"

            },
            {
              "type":
"node",

              "height":
0.00159999999999998238,

              "nodes": [

```

```

{

"type": "leaf",

"height": 0,

"data": "80.804,4.622,2.189"

},

{

"type": "leaf",

"height": 0,

"data": "80.804,4.622,2.1906"

}

]

}

]

}

]

}

]

}

]

},

{

"type": "node",

"height": 72.73954511029777,

"nodes": [

{

"type": "node",

"height": 60.28433263388861,

"nodes": [

{

"type": "leaf",

"height": 0,

"data": "194.6,1.8,3.02"

},


```

```

{
  "type": "node",
  "height": 32.54884323826892,
  "nodes": [
    {
      "type": "node",
      "height":
11.555102768906904,

      "nodes": [
        {
          "type": "leaf",
          "height": 0,
          "data":
"153.1,6.5,2.45"

        },
        {
          "type": "leaf",
          "height": 0,
          "data":
"164.1,10.0,1.93"

        }
      ]
    },
    {
      "type": "node",
      "height":
17.264224534135817,

      "nodes": [
        {
          "type": "node",
          "height": 0.0,
          "nodes": [
            {
              "type":
"leaf",

              "height": 0,
              "data":
"115.072,2.666,3.1676"

            },
            {

```

```

"leaf",
"115.072,2.666,3.1676"

"leaf",
"135.6,1.0,2.6"

"node",
1.7117817012927825,

"type": "leaf",
"height": 0,
"data": "132.2,4.7,2.13"

"type": "node",
"height": 0.8586923838022591,
"nodes": [

```

```

{
  "type": "leaf",
  "height": 0,
  "data": "130.916,4.659,2.2562"
},
{
  "type": "leaf",
  "height": 0,
  "data": "130.07,4.79,2.1893"
}
]
}
]
}
]
}
]
}
]
}
],
{
  "type": "node",
  "height": 1.4723685000705258,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "338.333,16.773,2.7465"
    },
  ],
}

```

```

        {
            "type": "leaf",
            "height": 0,
            "data": "339.625,16.067,2.7335"
        }
    ]
}
]
}
]
}
}

```

V.D. Planets DBSCAN Results (epsilon = 25 & NumPoints = 2)

Cluster 1:

Center: 134.51624999999999,4.622624999999999,2.4863375000000003,

Max Dist. to Center: 30.073641903950243

Min Dist. to Center: 2.344776613460488

Avg Dist. to Center: 12.756935025776226

SSE: 2070.7585685137497

8 Points:

130.916,4.659,2.2562,

132.2,4.7,2.13,

130.07,4.79,2.1893,

115.072,2.666,3.1676,

115.072,2.666,3.1676,

135.6,1.0,2.6,

153.1,6.5,2.45,

164.1,10.0,1.93,

Cluster 2:

Center: 68.5565,5.67325,2.7604875,

Max Dist. to Center: 35.028233605909335

Min Dist. to Center: 1.427781250807083

Avg Dist. to Center: 14.303129820159075

SSE: 2348.6836334487502

8 Points:

80.804,4.622,2.189,

80.804,4.622,2.1906,

89.9,2.1,3.35,

59.9,5.7,2.79,

69.6,4.7,2.81,

78.1, 6.6, 2.9,
 55.144, 4.542, 3.0343,
 34.2, 12.5, 2.82,

Total Number of Outliers: 3
 Percentage of Outliers: 15.789473684210526%
 Outliers:
 338.333, 16.773, 2.7465,
 339.625, 16.067, 2.7335,
 194.6, 1.8, 3.02,

VI.B. Iris K-Means Clustering Results (k = 3)

Cluster 0:

Center:

5.005660377358492, 3.3603773584905663, 1.562264150943396, 0.2886792
 4528301886,

Max Dist. to Center: 2.1564172322300905

Min Dist. to Center: 0.11551115369821849

Avg Dist. to Center: 0.5861924755284521

SSE: 28.572830188679244

53 Points:

5.1, 3.5, 1.4, 0.2,
 4.9, 3.0, 1.4, 0.2,
 4.7, 3.2, 1.3, 0.2,
 4.6, 3.1, 1.5, 0.2,
 5.0, 3.6, 1.4, 0.2,
 5.4, 3.9, 1.7, 0.4,
 4.6, 3.4, 1.4, 0.3,
 5.0, 3.4, 1.5, 0.2,
 4.4, 2.9, 1.4, 0.2,
 4.9, 3.1, 1.5, 0.1,
 5.4, 3.7, 1.5, 0.2,
 4.8, 3.4, 1.6, 0.2,
 4.8, 3.0, 1.4, 0.1,
 4.3, 3.0, 1.1, 0.1,
 5.8, 4.0, 1.2, 0.2,
 5.7, 4.4, 1.5, 0.4,
 5.4, 3.9, 1.3, 0.4,
 5.1, 3.5, 1.4, 0.3,
 5.7, 3.8, 1.7, 0.3,
 5.1, 3.8, 1.5, 0.3,

5.4,3.4,1.7,0.2,
5.1,3.7,1.5,0.4,
4.6,3.6,1.0,0.2,
5.1,3.3,1.7,0.5,
4.8,3.4,1.9,0.2,
5.0,3.0,1.6,0.2,
5.0,3.4,1.6,0.4,
5.2,3.5,1.5,0.2,
5.2,3.4,1.4,0.2,
4.7,3.2,1.6,0.2,
4.8,3.1,1.6,0.2,
5.4,3.4,1.5,0.4,
5.2,4.1,1.5,0.1,
5.5,4.2,1.4,0.2,
4.9,3.1,1.5,0.1,
5.0,3.2,1.2,0.2,
5.5,3.5,1.3,0.2,
4.9,3.1,1.5,0.1,
4.4,3.0,1.3,0.2,
5.1,3.4,1.5,0.2,
5.0,3.5,1.3,0.3,
4.5,2.3,1.3,0.3,
4.4,3.2,1.3,0.2,
5.0,3.5,1.6,0.6,
5.1,3.8,1.9,0.4,
4.8,3.0,1.4,0.3,
5.1,3.8,1.6,0.2,
4.6,3.2,1.4,0.2,
5.3,3.7,1.5,0.2,
5.0,3.3,1.4,0.2,
4.9,2.4,3.3,1.0,
5.0,2.3,3.3,1.0,
5.1,2.5,3.0,1.1,

Cluster 1:

Center:

6.088461538461538,2.8217948717948715,4.67948717948718,1.58461538
46153848,

Max Dist. to Center: 1.8955369915994846

Min Dist. to Center: 0.20187321321644627

Avg Dist. to Center: 0.8018655676864074

SSE: 58.361282051282046

78 Points:

7.0,3.2,4.7,1.4,
6.4,3.2,4.5,1.5,
6.9,3.1,4.9,1.5,
5.5,2.3,4.0,1.3,
6.5,2.8,4.6,1.5,
5.7,2.8,4.5,1.3,
6.3,3.3,4.7,1.6,
6.6,2.9,4.6,1.3,
5.2,2.7,3.9,1.4,
5.0,2.0,3.5,1.0,
5.9,3.0,4.2,1.5,
6.0,2.2,4.0,1.0,
6.1,2.9,4.7,1.4,
5.6,2.9,3.6,1.3,
6.7,3.1,4.4,1.4,
5.6,3.0,4.5,1.5,
5.8,2.7,4.1,1.0,
6.2,2.2,4.5,1.5,
5.6,2.5,3.9,1.1,
5.9,3.2,4.8,1.8,
6.1,2.8,4.0,1.3,
6.3,2.5,4.9,1.5,
6.1,2.8,4.7,1.2,
6.4,2.9,4.3,1.3,
6.6,3.0,4.4,1.4,
6.8,2.8,4.8,1.4,
6.7,3.0,5.0,1.7,
6.0,2.9,4.5,1.5,
5.7,2.6,3.5,1.0,
5.5,2.4,3.8,1.1,
5.5,2.4,3.7,1.0,
5.8,2.7,3.9,1.2,
6.0,2.7,5.1,1.6,
5.4,3.0,4.5,1.5,
6.0,3.4,4.5,1.6,
6.7,3.1,4.7,1.5,
6.3,2.3,4.4,1.3,
5.6,3.0,4.1,1.3,
5.5,2.5,4.0,1.3,

5.5,2.6,4.4,1.2,
6.1,3.0,4.6,1.4,
5.8,2.6,4.0,1.2,
5.6,2.7,4.2,1.3,
5.7,3.0,4.2,1.2,
5.7,2.9,4.2,1.3,
6.2,2.9,4.3,1.3,
5.7,2.8,4.1,1.3,
5.8,2.7,5.1,1.9,
6.3,2.9,5.6,1.8,
4.9,2.5,4.5,1.7,
6.7,2.5,5.8,1.8,
6.5,3.2,5.1,2.0,
6.4,2.7,5.3,1.9,
6.8,3.0,5.5,2.1,
5.7,2.5,5.0,2.0,
5.8,2.8,5.1,2.4,
6.4,3.2,5.3,2.3,
6.5,3.0,5.5,1.8,
6.0,2.2,5.0,1.5,
5.6,2.8,4.9,2.0,
6.3,2.7,4.9,1.8,
6.2,2.8,4.8,1.8,
6.1,3.0,4.9,1.8,
6.4,2.8,5.6,2.1,
6.4,2.8,5.6,2.2,
6.3,2.8,5.1,1.5,
6.1,2.6,5.6,1.4,
6.3,3.4,5.6,2.4,
6.4,3.1,5.5,1.8,
6.0,3.0,4.8,1.8,
6.9,3.1,5.4,2.1,
6.9,3.1,5.1,2.3,
5.8,2.7,5.1,1.9,
6.7,3.0,5.2,2.3,
6.3,2.5,5.0,1.9,
6.5,3.0,5.2,2.0,
6.2,3.4,5.4,2.3,
5.9,3.0,5.1,1.8,

Cluster 2:

Center:
 7.173684210526315,3.1526315789473682,6.105263157894737,2.1526315
 789473682,
 Max Dist. to Center: 1.1116357640981875
 Min Dist. to Center: 0.2713462895715838
 Avg Dist. to Center: 0.679944439133686
 SSE: 9.78105263157895
 19 Points:
 6.3,3.3,6.0,2.5,
 7.1,3.0,5.9,2.1,
 6.5,3.0,5.8,2.2,
 7.6,3.0,6.6,2.1,
 7.3,2.9,6.3,1.8,
 7.2,3.6,6.1,2.5,
 7.7,3.8,6.7,2.2,
 7.7,2.6,6.9,2.3,
 6.9,3.2,5.7,2.3,
 7.7,2.8,6.7,2.0,
 6.7,3.3,5.7,2.1,
 7.2,3.2,6.0,1.8,
 7.2,3.0,5.8,1.6,
 7.4,2.8,6.1,1.9,
 7.9,3.8,6.4,2.0,
 7.7,3.0,6.1,2.3,
 6.7,3.1,5.6,2.4,
 6.8,3.2,5.9,2.3,
 6.7,3.3,5.7,2.5,

VI.C.1. Iris Agglomerative Hierarchical Clustering Results (threshold = 2.2)

Cluster 0:
 Center:
 6.459999999999998,2.9533333333333336,5.2120000000000015,1.818666
 6666666664,
 Max Dist. to Center: 2.1779509228222347
 Min Dist. to Center: 0.19184252801596366
 Avg Dist. to Center: 0.8763186026484493
 SSE: 71.05973333333333
 75 Points:
 7.2,3.6,6.1,2.5,
 7.7,3.8,6.7,2.2,
 7.9,3.8,6.4,2.0,

7.7,2.6,6.9,2.3,
7.6,3.0,6.6,2.1,
7.7,2.8,6.7,2.0,
7.3,2.9,6.3,1.8,
7.4,2.8,6.1,1.9,
7.1,3.0,5.9,2.1,
7.2,3.2,6.0,1.8,
7.2,3.0,5.8,1.6,
6.8,2.8,4.8,1.4,
6.5,2.8,4.6,1.5,
6.6,2.9,4.6,1.3,
6.7,3.0,5.0,1.7,
6.7,3.1,4.7,1.5,
7.0,3.2,4.7,1.4,
6.9,3.1,4.9,1.5,
6.0,2.2,5.0,1.5,
6.2,2.2,4.5,1.5,
6.3,2.3,4.4,1.3,
5.8,2.8,5.1,2.4,
5.6,2.8,4.9,2.0,
5.7,2.5,5.0,2.0,
5.8,2.7,5.1,1.9,
5.8,2.7,5.1,1.9,
5.9,3.0,5.1,1.8,
5.9,3.2,4.8,1.8,
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Cluster 1:

Center: 5.04,3.02,2.2399999999999998,0.6,

Max Dist. to Center: 4.98654188792193

Min Dist. to Center: 1.1356055653262709

Avg Dist. to Center: 1.9989924162260528

SSE: 31.192

5 Points:

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Cluster 2:

Center:

5.239999999999999,3.1642857142857146,2.31,0.5771428571428575,

Max Dist. to Center: 2.67972508489439

Min Dist. to Center: 0.6450344081947117

Avg Dist. to Center: 1.3553012415510313

SSE: 145.21514285714284

70 Points:

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VI.C.2. Iris Agglomerative Hierarchical Clustering Dendrogram

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  }  
]
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  {  
  
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}

]

}
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  {  
  
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    ]  
  }  
]
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]
}
]
}
]
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  "height": 0.14142135623730995,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "6.7,3.1,4.4,1.4"
    },
    {
      "type": "leaf",
      "height": 0,
      "data": "6.6,3.0,4.4,1.4"
    }
  ]
}
```

```
]
}
]
}
]
},
{
  "type": "node",
  "height": 0.7874557531213177,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "4.6,3.6,1.0,0.2"
    },
    {
      "type": "node",
      "height": 0.2579439412334876,
      "nodes": [
        {
```

```
"type": "node",  
  
"height": 0.1414213562373093,  
  
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "4.7,3.2,1.6,0.2"  
  
  },  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "4.8,3.1,1.6,0.2"  
  
  }  
  
],  
  
  },  
  
  {  
  
    "type": "node",  
  
    "height": 0.2213802229675571,  
  
    "nodes": [  
  
      {
```

```
"type": "node",  
  
"height": 0.17071067811865492,  
  
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "4.8,3.0,1.4,0.1"  
  
  },  
  
  {  
  
    "type": "node",  
  
    "height": 0.14142135623730986,  
  
    "nodes": [  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,  
  
        "data": "4.9,3.0,1.4,0.2"  
  
      },  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,
```

```
"data": "4.8,3.0,1.4,0.3"

}

]

}

]

},

{

"type": "node",

"height": 0.19999999999999993,

"nodes": [

{

"type": "leaf",

"height": 0,

"data": "5.0,3.0,1.6,0.2"

},

{

"type": "node",

"height": 0.0,

"nodes": [

{
```

```
"type": "leaf",  
  
"height": 0,  
  
"data": "4.9,3.1,1.5,0.1"  
  
},  
  
{  
  
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
{  
  
"type": "leaf",  
  
"height": 0,  
  
"data": "4.9,3.1,1.5,0.1"  
  
},  
  
{  
  
"type": "leaf",  
  
"height": 0,  
  
"data": "4.9,3.1,1.5,0.1"  
  
}  
  
]  
  
}
```

]

}

]

}

]

}

]

}

]

}

]

}

]

 $\},$ $\{$

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "4.9,2.5,4.5,1.7"
```

}

]

}

]

}

]

}

]

```

    }
  ]
}
]
}
]
}

```

VI.D. Iris DBSCAN Results (epsilon = 0.5 & NumPoints = 10)

Cluster 1:

Center:

4.9739130434782615, 3.391304347826087, 1.4739130434782608, 0.24130434782608692,

Max Dist. to Center: 0.8758171987323976

Min Dist. to Center: 0.05605998677490244

Avg Dist. to Center: 0.42983617541186725

SSE: 10.245434782608696

46 Points:

5.1, 3.5, 1.4, 0.2,
 4.9, 3.0, 1.4, 0.2,
 4.7, 3.2, 1.3, 0.2,
 4.6, 3.1, 1.5, 0.2,
 5.0, 3.6, 1.4, 0.2,
 5.4, 3.9, 1.7, 0.4,
 4.6, 3.4, 1.4, 0.3,
 5.0, 3.4, 1.5, 0.2,
 4.4, 2.9, 1.4, 0.2,
 4.9, 3.1, 1.5, 0.1,
 5.4, 3.7, 1.5, 0.2,
 4.8, 3.4, 1.6, 0.2,
 4.8, 3.0, 1.4, 0.1,
 4.3, 3.0, 1.1, 0.1,
 5.4, 3.9, 1.3, 0.4,
 5.1, 3.5, 1.4, 0.3,
 5.7, 3.8, 1.7, 0.3,
 5.1, 3.8, 1.5, 0.3,
 5.4, 3.4, 1.7, 0.2,
 5.1, 3.7, 1.5, 0.4,
 4.6, 3.6, 1.0, 0.2,
 5.1, 3.3, 1.7, 0.5,
 4.8, 3.4, 1.9, 0.2,

5.0,3.0,1.6,0.2,
 5.0,3.4,1.6,0.4,
 5.2,3.5,1.5,0.2,
 5.2,3.4,1.4,0.2,
 4.7,3.2,1.6,0.2,
 4.8,3.1,1.6,0.2,
 5.4,3.4,1.5,0.4,
 5.2,4.1,1.5,0.1,
 4.9,3.1,1.5,0.1,
 5.0,3.2,1.2,0.2,
 5.5,3.5,1.3,0.2,
 4.9,3.1,1.5,0.1,
 4.4,3.0,1.3,0.2,
 5.1,3.4,1.5,0.2,
 5.0,3.5,1.3,0.3,
 4.4,3.2,1.3,0.2,
 5.0,3.5,1.6,0.6,
 5.1,3.8,1.9,0.4,
 4.8,3.0,1.4,0.3,
 5.1,3.8,1.6,0.2,
 4.6,3.2,1.4,0.2,
 5.3,3.7,1.5,0.2,
 5.0,3.3,1.4,0.2,

Cluster 2:

Center:

5.968000000000001,2.8139999999999996,4.4239999999999995,1.42,

Max Dist. to Center: 1.0713524163411399

Min Dist. to Center: 0.1435130656072822

Avg Dist. to Center: 0.6329045990753659

SSE: 22.280200000000004

50 Points:

6.4,3.2,4.5,1.5,
 5.5,2.3,4.0,1.3,
 6.5,2.8,4.6,1.5,
 5.7,2.8,4.5,1.3,
 6.3,3.3,4.7,1.6,
 6.6,2.9,4.6,1.3,
 5.2,2.7,3.9,1.4,
 5.9,3.0,4.2,1.5,
 6.0,2.2,4.0,1.0,

6.1, 2.9, 4.7, 1.4,
5.6, 2.9, 3.6, 1.3,
6.7, 3.1, 4.4, 1.4,
5.6, 3.0, 4.5, 1.5,
5.8, 2.7, 4.1, 1.0,
5.6, 2.5, 3.9, 1.1,
5.9, 3.2, 4.8, 1.8,
6.1, 2.8, 4.0, 1.3,
6.3, 2.5, 4.9, 1.5,
6.1, 2.8, 4.7, 1.2,
6.4, 2.9, 4.3, 1.3,
6.6, 3.0, 4.4, 1.4,
6.8, 2.8, 4.8, 1.4,
6.0, 2.9, 4.5, 1.5,
5.7, 2.6, 3.5, 1.0,
5.5, 2.4, 3.8, 1.1,
5.5, 2.4, 3.7, 1.0,
5.8, 2.7, 3.9, 1.2,
6.0, 2.7, 5.1, 1.6,
5.4, 3.0, 4.5, 1.5,
6.0, 3.4, 4.5, 1.6,
6.7, 3.1, 4.7, 1.5,
5.6, 3.0, 4.1, 1.3,
5.5, 2.5, 4.0, 1.3,
5.5, 2.6, 4.4, 1.2,
6.1, 3.0, 4.6, 1.4,
5.8, 2.6, 4.0, 1.2,
5.6, 2.7, 4.2, 1.3,
5.7, 3.0, 4.2, 1.2,
5.7, 2.9, 4.2, 1.3,
6.2, 2.9, 4.3, 1.3,
5.7, 2.8, 4.1, 1.3,
5.8, 2.7, 5.1, 1.9,
6.3, 2.7, 4.9, 1.8,
6.2, 2.8, 4.8, 1.8,
6.1, 3.0, 4.9, 1.8,
6.3, 2.8, 5.1, 1.5,
6.0, 3.0, 4.8, 1.8,
5.8, 2.7, 5.1, 1.9,
6.3, 2.5, 5.0, 1.9,
5.9, 3.0, 5.1, 1.8,

Cluster 3:

Center:

6.6000000000000005,3.0368421052631582,5.4526315789473685,2.089473684210526,

Max Dist. to Center: 0.6065661033004811

Min Dist. to Center: 0.2090739375372752

Avg Dist. to Center: 0.39467730529874534

SSE: 3.129473684210527

19 Points:

6.7,3.0,5.0,1.7,

6.3,2.9,5.6,1.8,

6.5,3.0,5.8,2.2,

6.5,3.2,5.1,2.0,

6.4,2.7,5.3,1.9,

6.8,3.0,5.5,2.1,

6.4,3.2,5.3,2.3,

6.5,3.0,5.5,1.8,

6.9,3.2,5.7,2.3,

6.7,3.3,5.7,2.1,

6.4,2.8,5.6,2.1,

6.4,2.8,5.6,2.2,

6.4,3.1,5.5,1.8,

6.9,3.1,5.4,2.1,

6.7,3.1,5.6,2.4,

6.9,3.1,5.1,2.3,

6.8,3.2,5.9,2.3,

6.7,3.0,5.2,2.3,

6.5,3.0,5.2,2.0,

Total Number of Outliers: 35

Percentage of Outliers: 23.333333333333332%

Outliers:

5.8,4.0,1.2,0.2,

5.7,4.4,1.5,0.4,

5.5,4.2,1.4,0.2,

4.5,2.3,1.3,0.3,

7.0,3.2,4.7,1.4,

6.9,3.1,4.9,1.5,

4.9,2.4,3.3,1.0,

5.0,2.0,3.5,1.0,

6.2,2.2,4.5,1.5,
 6.3,2.3,4.4,1.3,
 5.0,2.3,3.3,1.0,
 5.1,2.5,3.0,1.1,
 6.3,3.3,6.0,2.5,
 7.1,3.0,5.9,2.1,
 7.6,3.0,6.6,2.1,
 4.9,2.5,4.5,1.7,
 7.3,2.9,6.3,1.8,
 6.7,2.5,5.8,1.8,
 7.2,3.6,6.1,2.5,
 5.7,2.5,5.0,2.0,
 5.8,2.8,5.1,2.4,
 7.7,3.8,6.7,2.2,
 7.7,2.6,6.9,2.3,
 6.0,2.2,5.0,1.5,
 5.6,2.8,4.9,2.0,
 7.7,2.8,6.7,2.0,
 7.2,3.2,6.0,1.8,
 7.2,3.0,5.8,1.6,
 7.4,2.8,6.1,1.9,
 7.9,3.8,6.4,2.0,
 6.1,2.6,5.6,1.4,
 7.7,3.0,6.1,2.3,
 6.3,3.4,5.6,2.4,
 6.7,3.3,5.7,2.5,
 6.2,3.4,5.4,2.3,

VII.B. Accidents K-Means Clustering Results (k = 3)

Cluster 0:

Center:

1.6666666666666667,0.3333333333333333,2.0,1.0740740740740742,0.7037037037037037,

Max Dist. to Center: 2.4609431985748462

Min Dist. to Center: 0.8055023396641313

Avg Dist. to Center: 1.17889171044148

SSE: 43.48148148148147

27 Points:

3.0,0.0,2.0,1.0,0.0,
 2.0,0.0,2.0,1.0,0.0,
 3.0,0.0,2.0,1.0,1.0,

4.0,0.0,2.0,1.0,0.0,
 2.0,0.0,2.0,1.0,0.0,
 3.0,1.0,2.0,1.0,0.0,
 3.0,1.0,2.0,1.0,1.0,
 4.0,0.0,2.0,1.0,0.0,
 1.0,0.0,2.0,1.0,0.0,
 1.0,1.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,2.0,2.0,
 2.0,1.0,2.0,1.0,2.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 2.0,1.0,2.0,1.0,1.0,
 1.0,0.0,2.0,2.0,1.0,
 1.0,1.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,0.0,2.0,1.0,1.0,
 1.0,1.0,2.0,1.0,0.0,
 1.0,1.0,2.0,1.0,0.0,
 1.0,1.0,2.0,1.0,0.0,

Cluster 1:

Center: 1.04,0.88,4.0,1.16,0.76,
 Max Dist. to Center: 3.029719458959856
 Min Dist. to Center: 0.3149603149604724
 Avg Dist. to Center: 0.8490690147393721
 SSE: 27.519999999999996

25 Points:

1.0,0.0,4.0,2.0,0.0,
 2.0,0.0,4.0,2.0,0.0,
 1.0,0.0,4.0,1.0,1.0,
 1.0,0.0,4.0,3.0,3.0,
 1.0,1.0,4.0,1.0,0.0,
 1.0,1.0,4.0,1.0,1.0,
 1.0,1.0,4.0,1.0,2.0,
 1.0,1.0,4.0,1.0,2.0,
 1.0,1.0,4.0,1.0,0.0,

```

1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,0.0,
1.0,2.0,4.0,1.0,2.0,
1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,0.0,
1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,0.0,
1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,0.0,
1.0,1.0,4.0,1.0,0.0,
1.0,1.0,4.0,1.0,0.0,
1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,0.0,
1.0,1.0,4.0,1.0,1.0,

```

Cluster 2:

```

Center: 4.2,0.0,4.0,1.0,0.6,
Max Dist. to Center: 5.813776741499453
Min Dist. to Center: 0.6324555320336759
Avg Dist. to Center: 1.6739312843625946
SSE: 47.999999999999999

```

10 Points:

```

5.0,0.0,4.0,1.0,1.0,
5.0,0.0,4.0,1.0,0.0,
4.0,0.0,4.0,1.0,0.0,
10.0,0.0,4.0,1.0,1.0,
3.0,0.0,4.0,1.0,1.0,
3.0,0.0,4.0,1.0,0.0,
3.0,0.0,4.0,1.0,0.0,
3.0,0.0,4.0,1.0,1.0,
3.0,0.0,4.0,1.0,0.0,
3.0,0.0,4.0,1.0,2.0,

```

VII.C.1. Accidents Agglomerative Hierarchical Clustering Results (threshold = 2.5)

Cluster 0:

```

Center: 10.0,0.0,4.0,1.0,1.0,
Max Dist. to Center: 0.0
Min Dist. to Center: 0.0
Avg Dist. to Center: 0.0

```

SSE: 0.0

1 Points:

10.0,0.0,4.0,1.0,1.0,

Cluster 1:

Center: 1.0,0.0,4.0,3.0,3.0,

Max Dist. to Center: 0.0

Min Dist. to Center: 0.0

Avg Dist. to Center: 0.0

SSE: 0.0

1 Points:

1.0,0.0,4.0,3.0,3.0,

Cluster 2:

Center: 3.5555555555555554,0.0,4.0,1.0,0.5555555555555556,

Max Dist. to Center: 1.5475986974649023

Min Dist. to Center: 0.7114582486036497

Avg Dist. to Center: 1.0108743606296131

SSE: 10.444444444444445

9 Points:

5.0,0.0,4.0,1.0,1.0,

5.0,0.0,4.0,1.0,0.0,

4.0,0.0,4.0,1.0,0.0,

3.0,0.0,4.0,1.0,0.0,

3.0,0.0,4.0,1.0,0.0,

3.0,0.0,4.0,1.0,0.0,

3.0,0.0,4.0,1.0,2.0,

3.0,0.0,4.0,1.0,1.0,

3.0,0.0,4.0,1.0,1.0,

Cluster 3:

Center:

1.3725490196078431,0.6078431372549019,2.9411764705882355,1.07843

13725490196,0.6862745098039216,

Max Dist. to Center: 2.938691760914549

Min Dist. to Center: 1.132681812865583

Avg Dist. to Center: 1.489946801700313

SSE: 121.56862745098033

51 Points:

2.0,1.0,2.0,1.0,2.0,

2.0,1.0,2.0,1.0,1.0,

[illegible]


```

1.0,1.0,4.0,1.0,1.0,
1.0,1.0,4.0,1.0,1.0,
3.0,1.0,2.0,1.0,0.0,
3.0,1.0,2.0,1.0,1.0,
4.0,0.0,2.0,1.0,0.0,
4.0,0.0,2.0,1.0,0.0,
3.0,0.0,2.0,1.0,0.0,
3.0,0.0,2.0,1.0,1.0,

```

VII.C.2. Accidents Agglomerative Hierarchical Clustering Dendrogram

```

{
  "type": "root",
  "height": 8.49159373751671,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "10.0,0.0,4.0,1.0,1.0"
    },
    {
      "type": "node",
      "height": 3.6496589979555236,
      "nodes": [
        {
          "type": "leaf",
          "height": 0,
          "data": "1.0,0.0,4.0,3.0,3.0"
        },
        {
          "type": "node",
          "height": 3.0380831175274485,
          "nodes": [
            {
              "type": "node",
              "height": 2.047074896579859,
              "nodes": [
                {
                  "type": "node",
                  "height": 1.0,
                  "nodes": [
                    {

```

```

"5.0,0.0,4.0,1.0,1.0"
"5.0,0.0,4.0,1.0,0.0"
1.4220412585204982,
"leaf",
"4.0,0.0,4.0,1.0,0.0"
"node",
0.0,
"type": "leaf",
"height": 0,
"nodes": [
  {
    "type": "leaf",
    "height": 0,
    "data":
  },
  {
    "type": "node",
    "height":
      "nodes": [
        {
          "type":
            "height": 0,
            "data":
        },
        {
          "type":
            "height":
              "nodes": [
                {

```

```

"data": "3.0,0.0,4.0,1.0,0.0"
                                },
                                {

"type": "node",

"height": 0.0,

"nodes": [

{

"type": "leaf",

"height": 0,

"data": "3.0,0.0,4.0,1.0,0.0"

},

{

"type": "leaf",

"height": 0,

"data": "3.0,0.0,4.0,1.0,0.0"

}

]

}

]

},

{

"type": "node",

"height": 1.0,

"nodes": [

{

```

```
"leaf",
"3.0,0.0,4.0,1.0,2.0"
```

```
"node",
0.0,
```

```
"type": "leaf",
"height": 0,
"data": "3.0,0.0,4.0,1.0,1.0"
```

```
"type": "leaf",
"height": 0,
"data": "3.0,0.0,4.0,1.0,1.0"
```

```

    "type":
    "height": 0,
    "data":
  },
  {
    "type":
    "height":
    "nodes": [
      {
        "type": "leaf",
        "height": 0,
        "data": "3.0,0.0,4.0,1.0,1.0"
      }
    ]
  }
]
},
{
  "type": "node",
  "height": 2.424340660756501,
  "nodes": [
    {

```

```

1.6589962189231093,
"leaf",
"2.0,1.0,2.0,1.0,2.0"
"leaf",
"2.0,1.0,2.0,1.0,1.0"
1.4106483019281868,
"node",
1.0,
"type": "leaf",
"height": 0,
"type": "node",
"height":
"nodes": [
  {
    "type": "node",
    "height": 1.0,
    "nodes": [
      {
        "type":
          "height": 0,
          "data":
      },
      {
        "type":
          "height": 0,
          "data":
      }
    ]
  },
  {
    "type": "node",
    "height":
    "nodes": [
      {
        "type":
          "height":
          "nodes": [
            {

```

```
"data": "1.0,0.0,2.0,1.0,0.0"
```

```
},
{
```

```
"type": "node",
```

```
"height": 0.0,
```

```
"nodes": [
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "2.0,0.0,2.0,1.0,0.0"
```

```
},
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "2.0,0.0,2.0,1.0,0.0"
```

```
}
```

```
]
```

```
}
```

```
]
```

```
},
```

```
{
```

```
"type":
```

```
"height":
```

```
"nodes": [
```

```
{
```

```
"node",
```

```
1.3640166650002483,
```

```
"type": "node",  
  
"height": 1.0,  
  
"nodes": [  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,  
  
        "data": "1.0,1.0,2.0,1.0,1.0"  
  
      },  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,  
  
        "data": "1.0,1.0,2.0,1.0,1.0"  
  
      }  
  
    ]  
  
  },  
  
  {
```

```
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,2.0,1.0,0.0"  
  
  },  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,  
  
        "data": "1.0,1.0,2.0,1.0,0.0"  
  
      },  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,
```



```
"data": "1.0,1.0,2.0,1.0,0.0"
```

```
}
```

```
]
```

```
}
```

```
]
```

```
}
```

```
]
```

```
},
```

```
{
```

```
"type": "node",
```

```
"height": 1.2071067811865475,
```

```
"nodes": [
```

```
{
```

```
"type": "node",
```

```
"height": 0.0,
```

```
"nodes": [
```

```
{
```

```
"type": "node",
```

```
"height": 0.0,
```

```
"nodes": [
```

```
{
```

```
"type": "node",
```

```
"height": 0.0,  
  
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,0.0,2.0,1.0,1.0"  
  
  },  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,0.0,2.0,1.0,1.0"  
  
  }  
  
],  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {  
  
        "type": "leaf",
```

```
"height": 0,  
  
"data": "1.0,0.0,2.0,1.0,1.0"  
  
},  
  
{  
  
"type": "leaf",  
  
"height": 0,  
  
"data": "1.0,0.0,2.0,1.0,1.0"  
  
}  
  
]  
  
}  
  
]  
  
},  
  
{  
  
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
{  
  
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  

```

```
{  
  
  "type": "leaf",  
  
  "height": 0,  
  
  "data": "1.0,0.0,2.0,1.0,1.0"  
  
},  
  
{  
  
  "type": "leaf",  
  
  "height": 0,  
  
  "data": "1.0,0.0,2.0,1.0,1.0"  
  
}  
  
]  
  
},  
  
{  
  
  "type": "node",  
  
  "height": 0.0,  
  
  "nodes": [  
  
    {  
  
      "type": "leaf",  
  
      "height": 0,  
  
      "data": "1.0,0.0,2.0,1.0,1.0"
```

```
},  
  
{  
  
  "type": "node",  
  
  "height": 0.0,  
  
  "nodes": [  
  
    {  
  
      "type": "leaf",  
  
      "height": 0,  
  
      "data": "1.0,0.0,2.0,1.0,1.0"  
  
    },  
  
    {  
  
      "type": "leaf",  
  
      "height": 0,  
  
      "data": "1.0,0.0,2.0,1.0,1.0"  
  
    }  
  
  ]  
  
}  
  
]
```

```
}  
  
]  
  
,  
  
{  
  
  "type": "node",  
  
  "height": 1.0,  
  
  "nodes": [  
  
    {  
  
      "type": "leaf",  
  
      "height": 0,  
  
      "data": "1.0,0.0,2.0,2.0,2.0"  
  
    },  
  
    {  
  
      "type": "leaf",  
  
      "height": 0,  
  
      "data": "1.0,0.0,2.0,2.0,1.0"  
  
    }  
  
  ]  
  
}  
  
]  
  
]  
  
}  
  
]
```

```

    }
  ]
}
]
},
{
  "type": "node",
  "height":
2.4202022829151777,

  "nodes": [
    {
      "type": "node",
      "height":
1.850087743986444,

      "nodes": [
        {
          "type":
"node",

          "height":
1.0,

          "nodes": [
            {
              "type": "leaf",
              "height": 0,
              "data": "1.0,0.0,4.0,2.0,0.0"
            },
            {
              "type": "leaf",
              "height": 0,
              "data": "2.0,0.0,4.0,2.0,0.0"
            }
          ]
        },
        {

```

```
"node",
1.612579455457929,
```

```
"type": "node",
```

```
"height": 1.0,
```

```
"nodes": [
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "1.0,2.0,4.0,1.0,2.0"
```

```
},
```

```
{
```

```
"type": "node",
```

```
"height": 0.0,
```

```
"nodes": [
```

```
{
```

```
"type": "leaf",
```

```
"height": 0,
```

```
"data": "1.0,1.0,4.0,1.0,2.0"
```

```
},
```

```
"type":
```

```
"height":
```

```
"nodes": [
    {
```



```

{
  "type": "leaf",
  "height": 0,
  "data": "1.0,1.0,4.0,1.0,2.0"
}

]

}

    ]
    },
    {

    "type": "node",
    "height": 1.0414213562373096,
    "nodes": [

    {

    "type": "node",
    "height": 0.0,
    "nodes": [

    {

    "type": "node",
    "height": 0.0,
    "nodes": [

    {

```

```
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,0.0"  
  
  },  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,0.0"  
  
  }  
  
],  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {
```

```
"type": "leaf",  
  
"height": 0,  
  
"data": "1.0,1.0,4.0,1.0,0.0"  
  
},  
  
{  
  
"type": "leaf",  
  
"height": 0,  
  
"data": "1.0,1.0,4.0,1.0,0.0"  
  
}  
  
]  
  
}  
  
]  
  
},  
  
{  
  
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
{  
  
"type": "node",  
  
"height": 0.0,
```

```
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,0.0"  
  
  },  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,0.0"  
  
  }  
  
],  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,
```

```
"data": "1.0,1.0,4.0,1.0,0.0"

},

{

"type": "node",

"height": 0.0,

"nodes": [

{

"type": "leaf",

"height": 0,

"data": "1.0,1.0,4.0,1.0,0.0"

},

{

"type": "leaf",

"height": 0,

"data": "1.0,1.0,4.0,1.0,0.0"

}

]

}

]
```

```
]
}
]
},
{
  "type": "node",
  "height": 1.0,
  "nodes": [
    {
      "type": "leaf",
      "height": 0,
      "data": "1.0,0.0,4.0,1.0,1.0"
    },
    {
      "type": "node",
      "height": 0.0,
      "nodes": [
        {
          "type": "node",
          "height": 0.0,
```

```
"nodes": [  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,  
  
        "data": "1.0,1.0,4.0,1.0,1.0"  
  
      },  
  
      {  
  
        "type": "leaf",  
  
        "height": 0,  
  
        "data": "1.0,1.0,4.0,1.0,1.0"  
  
      }  
  
    ]  
  
  },  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,
```

```
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,1.0"  
  
  },  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,1.0"  
  
  }  
  
]  
  
}  
  
]  
  
},  
  
{  
  
  "type": "node",  
  
  "height": 0.0,  
  
  "nodes": [  
  
    {
```



```
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,1.0"  
  
  },  
  
  {  
  
    "type": "leaf",  
  
    "height": 0,  
  
    "data": "1.0,1.0,4.0,1.0,1.0"  
  
  }  
  
],  
  
  },  
  
  {  
  
    "type": "node",  
  
    "height": 0.0,  
  
    "nodes": [  
  
      {
```

```
"type": "leaf",  
  
"height": 0,  
  
"data": "1.0,1.0,4.0,1.0,1.0"  
  
},  
  
{  
  
"type": "node",  
  
"height": 0.0,  
  
"nodes": [  
  
{  
  
"type": "leaf",  
  
"height": 0,  
  
"data": "1.0,1.0,4.0,1.0,1.0"  
  
},  
  
{  
  
"type": "leaf",  
  
"height": 0,  
  
"data": "1.0,1.0,4.0,1.0,1.0"  
  
}  
  
]  
  
}
```

```

]
}
]
}
]
}
]
}

]
}
]
}
]
}
]
}

1.3901194830787669,

"node",
1.0,

"type": "leaf",
"height": 0,
"data": "3.0,1.0,2.0,1.0,0.0"

},
{
  "type": "node",
  "height":
  "nodes": [
    {
      "type":
      "height":
      "nodes": [
        {

```

```

"type": "leaf",

"height": 0,

"data": "3.0,1.0,2.0,1.0,1.0"

```

```

        {
    ]
},
{
    "type":
    "height":
    "nodes": [
        {

```

```

"node",

1.2071067811865475,

```

```

"type": "node",

"height": 0.0,

"nodes": [

{

"type": "leaf",

"height": 0,

"data": "4.0,0.0,2.0,1.0,0.0"

},

{

"type": "leaf",

"height": 0,

"data": "4.0,0.0,2.0,1.0,0.0"

```



```

    ]
  }
]
}

```

VII.D. Accidents DBSCAN Results (epsilon = 0.25 & NumPoints = 5)

Cluster 1:

Center: 1.0,0.0,2.0,1.0,1.0,

Max Dist. to Center: 0.0

Min Dist. to Center: 0.0

Avg Dist. to Center: 0.0

SSE: 0.0

9 Points:

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

1.0,0.0,2.0,1.0,1.0,

Cluster 2:

Center: 1.0,1.0,4.0,1.0,0.0,

Max Dist. to Center: 0.0

Min Dist. to Center: 0.0

Avg Dist. to Center: 0.0

SSE: 0.0

9 Points:

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

1.0,1.0,4.0,1.0,0.0,

Cluster 3:

Center: 1.0,1.0,4.0,1.0,1.0,

Max Dist. to Center: 0.0

Min Dist. to Center: 0.0

Avg Dist. to Center: 0.0

SSE: 0.0

9 Points:

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

1.0,1.0,4.0,1.0,1.0,

Total Number of Outliers: 35

Percentage of Outliers: 56.451612903225815%

Outliers:

3.0,0.0,2.0,1.0,0.0,

5.0,0.0,4.0,1.0,1.0,

5.0,0.0,4.0,1.0,0.0,

2.0,0.0,2.0,1.0,0.0,

3.0,0.0,2.0,1.0,1.0,

4.0,0.0,4.0,1.0,0.0,

10.0,0.0,4.0,1.0,1.0,

4.0,0.0,2.0,1.0,0.0,

2.0,0.0,2.0,1.0,0.0,

3.0,1.0,2.0,1.0,0.0,

3.0,1.0,2.0,1.0,1.0,

4.0,0.0,2.0,1.0,0.0,

1.0,0.0,4.0,2.0,0.0,

3.0,0.0,4.0,1.0,1.0,

3.0,0.0,4.0,1.0,0.0,

1.0,0.0,2.0,1.0,0.0,

2.0,0.0,4.0,2.0,0.0,

3.0,0.0,4.0,1.0,0.0,

3.0,0.0,4.0,1.0,1.0,

1.0,0.0,4.0,1.0,1.0,

3.0,0.0,4.0,1.0,0.0,
3.0,0.0,4.0,1.0,2.0,
1.0,0.0,4.0,3.0,3.0,
1.0,1.0,2.0,1.0,1.0,
1.0,0.0,2.0,2.0,2.0,
2.0,1.0,2.0,1.0,2.0,
2.0,1.0,2.0,1.0,1.0,
1.0,0.0,2.0,2.0,1.0,
1.0,1.0,2.0,1.0,1.0,
1.0,1.0,2.0,1.0,0.0,
1.0,1.0,2.0,1.0,0.0,
1.0,1.0,2.0,1.0,0.0,
1.0,1.0,4.0,1.0,2.0,
1.0,1.0,4.0,1.0,2.0,
1.0,2.0,4.0,1.0,2.0,