**MACHINE LEARNING ASSIGNMENT 6**

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**Github Link:** [**https://github.com/pramodreddy0621/Assignment-6**](https://github.com/pramodreddy0621/Assignment-6)

Single Link Proximity:

* In **Single Linkage,**the distance between two clusters is the minimum distance between members of the two clusters

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **p1** | | **p2** | | **p3** | | **p4** | | **p5** | **p6** |
| **p1** | | 0 | | 0.2357 | | 0.2218 | | 0.3688 | | 0.3421 | 0.2347 |
| **p2** | | 0.2357 | | 0 | | 0.1483 | | 0.2042 | | 0.1388 | 0.254 |
| **p3** | | 0.2218 | | 0.1483 | | 0 | | 0.1513 | | 0.2843 | 0.11 |
| **p4** | | 0.3688 | | 0.2042 | | 0.1513 | | 0 | | 0.2932 | 0.2216 |
| **p5** | | 0.3421 | | 0.1388 | | 0.2843 | | 0.2932 | | 0 | 0.3921 |
| **p6** | | 0.2347 | | 0.254 | | 0.11 | | 0.2216 | | 0.3921 | 0 |
|  | |  | |  | |  | |  | |  |  |
| smallest distance from above data is | | | | | | | | | | 0.11 |  |
| so p3 and p6 forms first cluster | | | | | | | | | | |
|  | **p1** | | **p2** | | **p36** | | **p4** | | **p5** | |
| **p1** | 0 | | 0.2357 | | 0.2218 | | 0.3688 | | 0.3421 | |
| **p2** | 0.2357 | | 0 | | 0.1483 | | 0.2042 | | 0.1388 | |
| **p36** | 0.2218 | | 0.1483 | | 0 | | 0.1513 | | 0.2843 | |
| **p4** | 0.3688 | | 0.2042 | | 0.1513 | | 0 | | 0.2932 | |
| **p5** | 0.3421 | | 0.1388 | | 0.2843 | | 0.2932 | | 0 | |
|  |  | |  | |  | |  | |  | |
| smallest distance from above data is | | | | | | | | | 0.1388 | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| so p2 and p5 forms 2nd cluster | | | | | |
|  | **p1** | **p25** | **p36** | **p4** |  |
| **p1** | 0 | 0.2357 | 0.2218 | 0.3688 |  |
| **p25** | 0.2357 | 0 | 0.1483 | 0.2042 |  |
| **p36** | 0.2218 | 0.1483 | 0 | 0.1513 |  |
| **p4** | 0.3688 | 0.2042 | 0.1513 | 0 |  |
|  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.1483 |
| so p25 and p36 forms 3rdcluster | | | | | |
|  |  |  |  |  |  |
|  | **p1** | **p(25)(36)** | **p4** |  |  |
| **p1** | 0 | 0.2218 | 0.3688 |  |  |
| **p(25)(36)** | 0.2218 | 0 | 0.1513 |  |  |
| **p4** | 0.3688 | 0.1513 | 0 |  |  |
|  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.153 |
| so p(25)(36)and p4 forms 4thcluster | | | | | |
|  | **p1** | **p4(25)(36)** |  |  |  |
| **p1** | 0 | 0.2218 |  |  |  |
| **p4(25)(36)** | 0.2218 | 0 |  |  |  |

Chart

Description automatically generated

**1 4 2 5 3 6**

Complete Link Proximity:

* In **Complete Linkage,**the distance between two clusters is the maximum distance between members of the two clusters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **p1** | **p2** | **p3** | **p4** | **p5** | **p6** |
| **p1** | 0 | 0.2357 | 0.2218 | 0.3688 | 0.3421 | 0.2347 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **p2** | 0.2357 | 0 | 0.1483 | 0.2042 | 0.1388 | 0.254 |
| **p3** | 0.2218 | 0.1483 | 0 | 0.1513 | 0.2843 | 0.11 |
| **p4** | 0.3688 | 0.2042 | 0.1513 | 0 | 0.2932 | 0.2216 |
| **p5** | 0.3421 | 0.1388 | 0.2843 | 0.2932 | 0 | 0.3921 |
| **p6** | 0.2347 | 0.254 | 0.11 | 0.2216 | 0.3921 | 0 |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.11 |  |
| so p3 and p6 forms first cluster | | | | | |  |
|  | **p1** | **p2** | **p36** | **p4** | **p5** |  |
| **p1** | 0 | 0.2357 | 0.2347 | 0.3688 | 0.3421 |  |
| **p2** | 0.2357 | 0 | 0.254 | 0.2042 | 0.1388 |  |
| **p36** | 0.2347 | 0.254 | 0 | 0.2216 | 0.3921 |  |
| **p4** | 0.3688 | 0.2042 | 0.2216 | 0 | 0.2932 |  |
| **p5** | 0.3421 | 0.1388 | 0.3921 | 0.2932 | 0 |  |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.1388 |  |
| so p2 and p5 forms 2nd cluster | | | | | |  |
|  | **p1** | **p25** | **p36** | **p4** |  |  |
| **p1** | 0 | 0.3421 | 0.2347 | 0.3688 |  |  |
| **p25** | 0.3421 | 0 | 0.3921 | 0.2932 |  |  |
| **p36** | 0.2347 | 0.3921 | 0 | 0.2216 |  |  |
| **p4** | 0.3688 | 0.2932 | 0.2216 | 0 |  |  |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.2216 |  |
| so p25 and p36 forms 3rdcluster | | | | | |  |
|  | **p1** | **p(25)(36)** | **p4** |  |  |  |
| **p1** | 0 | 0.3421 | 0.3688 |  |  |  |
| **p(25)(36)** | 0.3421 | 0 | 0.2932 |  |  |  |
| **p4** | 0.3688 | 0.2932 | 0 |  |  |  |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.2932 |  |
| so p(25)(36)and p1 forms 4thcluster | | | | | |  |
|  | **p1(25)(36)** | **p4** |  |  |  |  |
| **p1(25)(36)** | 0 | 0.1483 |  |  |  |  |
| **p4** | 0.3688 | 0 |  |  |  |  |

Chart, box and whisker chart

Description automatically generated

**4 1 2 5 3 6**

Average Link Proximity:

In **Average Linkage,**the distance between two clusters is the average of all distances between members of the two clusters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **p1** | **p2** | **p3** | **p4** | **p5** | **p6** |
| **p1** | 0 | 0.2357 | 0.2218 | 0.3688 | 0.3421 | 0.2347 |
| **p2** | 0.2357 | 0 | 0.1483 | 0.2042 | 0.1388 | 0.254 |
| **p3** | 0.2218 | 0.1483 | 0 | 0.1513 | 0.2843 | 0.11 |
| **p4** | 0.3688 | 0.2042 | 0.1513 | 0 | 0.2932 | 0.2216 |
| **p5** | 0.3421 | 0.1388 | 0.2843 | 0.2932 | 0 | 0.3921 |
| **p6** | 0.2347 | 0.254 | 0.11 | 0.2216 | 0.3921 | 0 |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.11 |  |
| so p3 and p6 forms first cluster | | | | | |  |
|  | **p1** | **p2** | **p36** | **p4** | **p5** |  |
| **p1** | 0 | 0.2357 | 0.22825 | 0.3688 | 0.3421 |  |
| **p2** | 0.2357 | 0 | 0.20115 | 0.2042 | 0.1388 |  |
| **p36** | 0.22825 | 0.20115 | 0 | 0.18645 | 0.3382 |  |
| **p4** | 0.3688 | 0.2042 | 0.18645 | 0 | 0.2932 |  |
| **p5** | 0.3421 | 0.1388 | 0.3382 | 0.2932 | 0 |  |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.1388 |  |
| so p2 and p5 forms 2nd cluster | | | | | |  |
|  | **p1** | **p25** | **p36** | **p4** |  |  |
| **p1** | 0 | 0.2889 | 0.2347 | 0.3688 |  |  |
| **p25** | 0.2889 | 0 | 0.269675 | 0.2487 |  |  |
| **p36** | 0.2347 | 0.269675 | 0 | 0.18645 |  |  |
| **p4** | 0.3688 | 0.2487 | 0.18645 | 0 |  |  |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.18645 |  |
| so p25 and p36 forms 3rdcluster | | | | | |  |
|  | **p1** | **p(25)(36)** | **p4** |  |  |  |
| **p1** | 0 | 0.2618 | 0.3688 |  |  |  |
| **p(25)(36)** | 0.2618 | 0 | 0.217575 |  |  |  |
| **p4** | 0.3688 | 0.217575 | 0 |  |  |  |
|  |  |  |  |  |  |  |
| smallest distance from above data is | | | | | 0.217575 |  |
| so p(25)(36)and p1 forms 4thcluster | | | | | |  |
|  | **p1(25)(36)** | **p4** |  |  |  |  |
| **p1(25)(36)** | 0 | 0.3153 |  |  |  |  |
| **p4** | 0.3153 | 0 |  |  |  |  |

Chart, box and whisker chart

Description automatically generated

**4 1 2 5 3 6**

2. a) Preprocess the data by removing the categorical column and filling the missing values.

Text

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Table

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b) Apply StandardScaler() and normalize() functions to scale and normalize raw input data.

Graphical user interface, text, application, email

Description automatically generated

c) Use PCA with K=2 to reduce the input dimensions to two features.

Graphical user interface, text, application, email

Description automatically generated

Chart, scatter chart, bubble chart

Description automatically generated

d) Apply Agglomerative Clustering with k=2,3,4 and 5 on reduced features and visualize

result for each k value using scatter plot.

Chart, scatter chart

Description automatically generated

Chart

Description automatically generated

Chart, scatter chart

Description automatically generated

Chart, scatter chart

Description automatically generated

e) Evaluate different variations using Silhouette Scores and Visualize results with a bar chart.

Graphical user interface, text, application, email

Description automatically generated

Chart, bar chart

Description automatically generated