Assignment 5

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Loading required libraries

```
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.2.3
```

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 4.2.3
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library(dendextend)
```

```
## Warning: package 'dendextend' was built under R version 4.2.3
```

```
##
## ---------------------
## Welcome to dendextend version 1.17.1
## Type citation('dendextend') for how to cite the package.
##
## Type browseVignettes(package = 'dendextend') for the package vignette.
## The github page is: https://github.com/talgalili/dendextend/
##
## Suggestions and bug-reports can be submitted at: https://github.com/talgalili/dendextend/issues
## You may ask questions at stackoverflow, use the r and dendextend tags:
##   https://stackoverflow.com/questions/tagged/dendextend
##
##  To suppress this message use:  suppressPackageStartupMessages(library(dendextend))
## ---------------------
```

```
##
## Attaching package: 'dendextend'
```

```
## The following object is masked from 'package:stats':
##
##     cutree
```

```
library(cluster)
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.2.3
```

```
## Warning: package 'tibble' was built under R version 4.2.3
```

```
## Warning: package 'tidyr' was built under R version 4.2.3
```

```
## Warning: package 'readr' was built under R version 4.2.3
```

```
## Warning: package 'purrr' was built under R version 4.2.3
```

```
## Warning: package 'dplyr' was built under R version 4.2.3
```

```
## Warning: package 'stringr' was built under R version 4.2.3
```

```
## Warning: package 'forcats' was built under R version 4.2.3
```

```
## Warning: package 'lubridate' was built under R version 4.2.3
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.3     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v lubridate 1.9.2     v tibble    3.2.1
## v purrr     1.0.2     v tidyr     1.3.0
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(knitr)
```

```
## Warning: package 'knitr' was built under R version 4.2.3
```

Here i am importing the data

```
cereals_Data<-read.csv("C:\\Users\\CherRyY\\Desktop\\BOYAPATI\\Cereals.csv")
numericData<-data.frame(cereals_Data[,4:16])
```

Here i am removing the missing values

```
miss_ceralas_data<-na.omit(numericData)
```

Standardizing above data

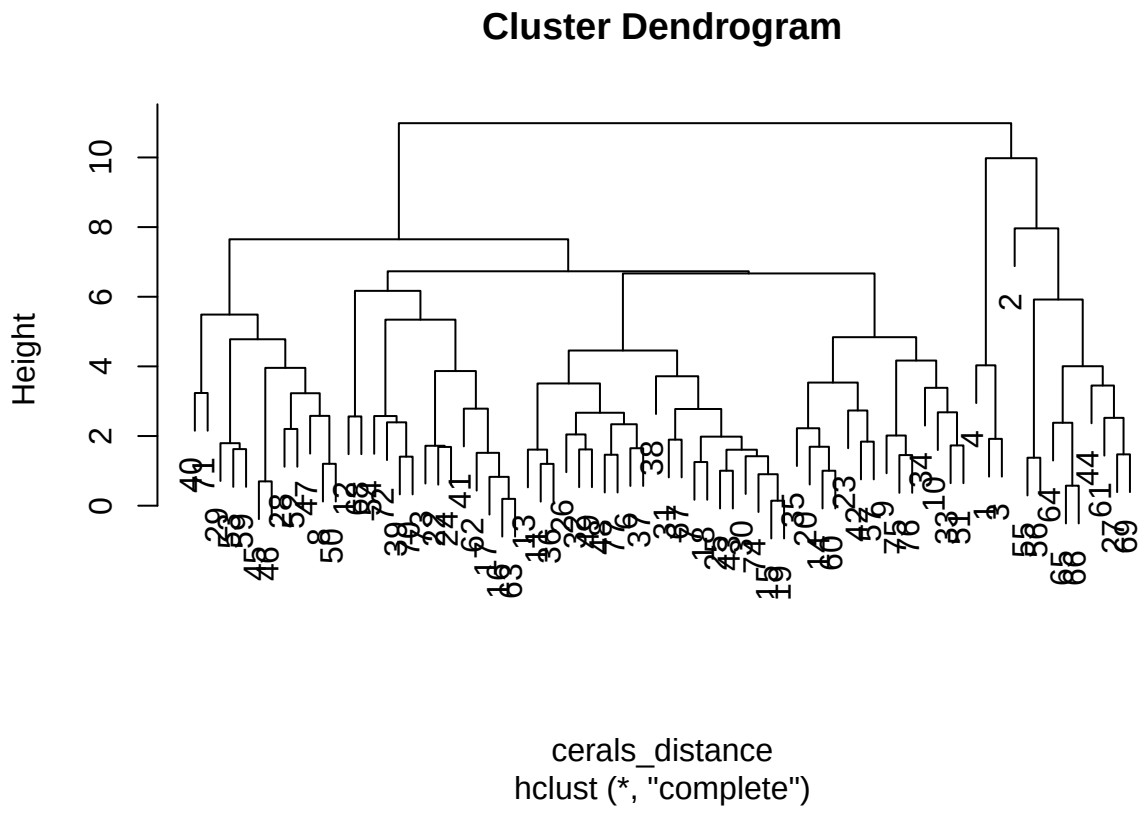
```
normalise_cerals<-scale(miss_ceralas_data)
```

Here i am using Euclidean distance to calculate the distance

```
cerals_distance<-dist(normalise_cerals, method = "euclidian")
```

Hierarchical Clustering is carried out, employing complete linkage

```
hierarchial_CClustering<-hclust(cerals_distance,method = "complete")
plot(hierarchial_CClustering)
```



Rounding the numbers to the nearest decimals

```
round(hierarchial_CClustering$height, 3)
```

```
##  [1]  0.143  0.196  0.575  0.698  0.828  0.904  1.003  1.004  1.201  1.203
## [11]  1.254  1.378  1.408  1.421  1.454  1.463  1.474  1.517  1.608  1.611
## [21]  1.616  1.625  1.650  1.687  1.692  1.720  1.730  1.795  1.839  1.897
## [31]  1.919  1.982  2.015  2.046  2.203  2.224  2.339  2.381  2.394  2.522
## [41]  2.563  2.574  2.579  2.668  2.682  2.734  2.776  2.787  3.229  3.236
## [51]  3.385  3.451  3.510  3.535  3.717  3.866  3.957  4.005  4.031  4.168
## [61]  4.456  4.779  4.839  5.342  5.488  5.920  6.169  6.669  6.731  7.650
## [71]  7.964  9.979 10.984
```

Applying AGNES algorithm for CClustering

```
library(dendextend)

HC_Single<-agnes(normalise_cerals, method = "single")
HC_Complete<-agnes(normalise_cerals, method = "complete")
HC_Average<-agnes(normalise_cerals, method = "average")
HC_Ward<-agnes(normalise_cerals, method = "ward")
```

We will now contrast the agglomerative coefficients for average, single, and complete linkage methods.

```
print(HC_Single$ac)
```

```
## [1] 0.6067859
```

```
print(HC_Complete$ac)
```

```
## [1] 0.8353712
```

```
print(HC_Average$ac)
```

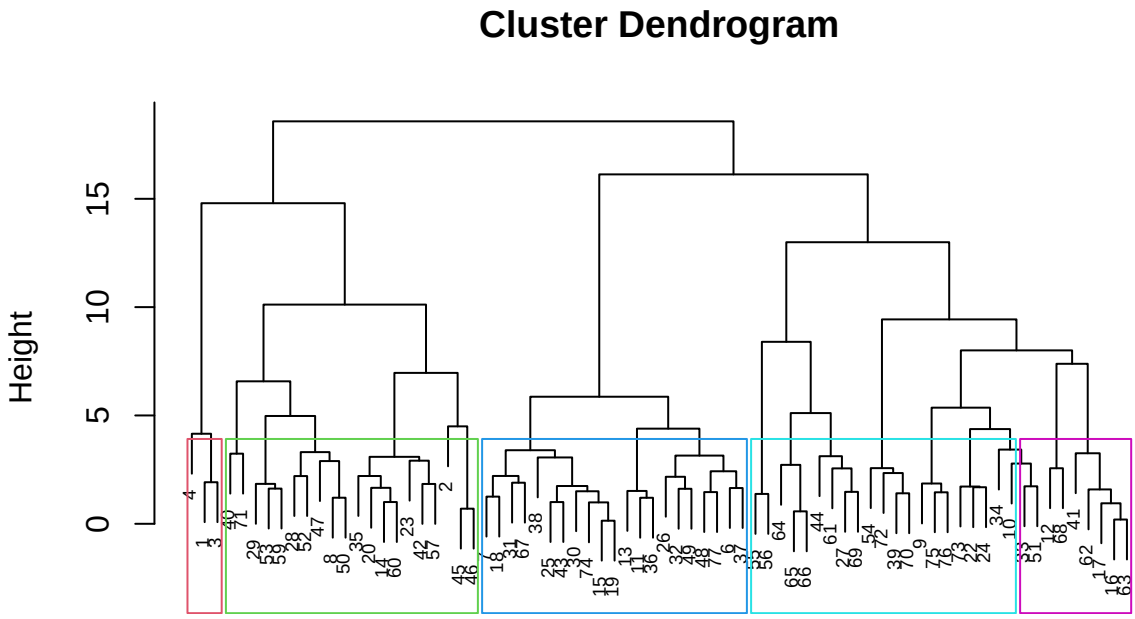
```
## [1] 0.7766075
```

```
print(HC_Ward$ac)
```

```
## [1] 0.9046042
```

The ward method exhibits the highest effectiveness with an agglomerative coefficient value of 0.904 among the mentioned approaches. Let's proceed to identify the best CClusters.

```
#here i AM using the ward method for hierarchial Clustering
HC_01<-hclust(cerals_distance, method = "ward.D2" )
plot(HC_01,cex=0.6)
rect.hclust(HC_Ward,k=5, border=2:10)
```



From the conclusions drawn from the ward method graphs, it is evident that the optimal k value is 5. Therefore, we will choose five CClusters. Next, let's utilize the ward approach to map AGNES

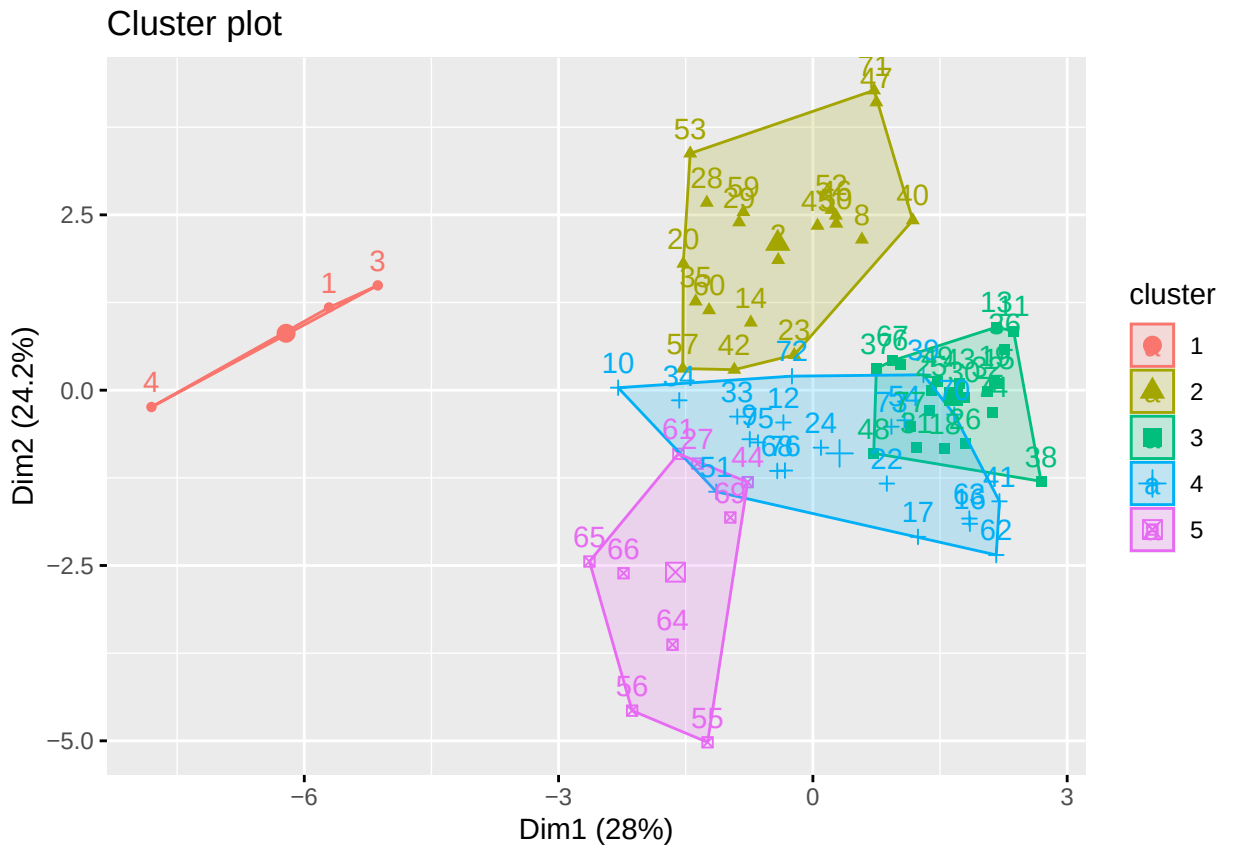
```
sub_grouping <- cutree(HC_01,k=5)
table(sub_grouping)
```

```
## sub_grouping
##  1  2  3  4  5
##  3 20 21 21  9
```

```
cereals_groupings <- as.data.frame(cbind(normalise_cerals,sub_grouping))
```

Let's represent the results on a scatter plot.

```
fviz_cluster(list(data = normalise_cerals, cluster = sub_grouping))
```



Let's identify the top Cluster of breakfast cereals that are low in sugar and sodium, high in protein, and high in fiber.

Choosing the Cluster of nutritious cereals.

```
New_Cereals <- numericData
Ncereal_omit <- na.omit(New_Cereals)
CCluster <- cbind(Ncereal_omit, sub_grouping)
CCluster[CCluster$sub_grouping==1,]
```

```
##   calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 1       70       4   1    130    10     5      6    280       25     3      1
## 3       70       4   1    260     9     7      5    320       25     3      1
## 4       50       4   0    140    14     8      0    330       25     3      1
##   cups    rating sub_grouping
## 1 0.33 68.40297            1
## 3 0.33 59.42551            1
## 4 0.50 93.70491            1
```

```
CCluster[CCluster$sub_grouping==2,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 2       120       3   5     15   2.0   8.0      8    135        0     3   1.00
## 8       130       3   2    210   2.0  18.0      8    100       25     3   1.33
## 14      110       3   2    140   2.0  13.0      7    105       25     3   1.00
## 20      110       3   3    140   4.0  10.0      7    160       25     3   1.00
```

```
## 23      100       2   1    140   2.0  11.0     10    120       25     3   1.00
## 28      120       3   2    160   5.0  12.0     10    200       25     3   1.25
## 29      120       3   0    240   5.0  14.0     12    190       25     3   1.33
## 35      120       3   3     75   3.0  13.0      4    100       25     3   1.00
## 40      140       3   1    170   2.0  20.0      9     95      100     3   1.30
## 42      100       4   2    150   2.0  12.0      6     95       25     2   1.00
## 45      150       4   3     95   3.0  16.0     11    170       25     3   1.00
## 46      150       4   3    150   3.0  16.0     11    170       25     3   1.00
## 47      160       3   2    150   3.0  17.0     13    160       25     3   1.50
## 50      140       3   2    220   3.0  21.0      7    130       25     3   1.33
## 52      130       3   2    170   1.5  13.5     10    120       25     3   1.25
## 53      120       3   1    200   6.0  11.0     14    260       25     3   1.33
## 57      100       4   1    135   2.0  14.0      6    110       25     3   1.00
## 59      120       3   1    210   5.0  14.0     12    240       25     2   1.33
## 60      100       3   2    140   2.5  10.5      8    140       25     3   1.00
## 71      140       3   1    190   4.0  15.0     14    230      100     3   1.50
##    cups   rating sub_grouping
## 2  1.00 33.98368            2
## 8  0.75 37.03856            2
## 14 0.50 40.40021            2
## 20 0.50 40.44877            2
## 23 0.75 36.17620            2
## 28 0.67 40.91705            2
## 29 0.67 41.01549            2
## 35 0.33 45.81172            2
## 40 0.75 36.47151            2
## 42 0.67 45.32807            2
## 45 1.00 37.13686            2
## 46 1.00 34.13976            2
## 47 0.67 30.31335            2
## 50 0.67 40.69232            2
## 52 0.50 30.45084            2
## 53 0.67 37.84059            2
## 57 0.50 49.51187            2
## 59 0.75 39.25920            2
## 60 0.50 39.70340            2
## 71 1.00 28.59278            2
```

```
CCluster[CCluster$sub_grouping==3,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 6       110       2   2    180   1.5  10.5     10     70       25     1      1
## 7       110       2   0    125   1.0  11.0     14     30       25     2      1
## 11      120       1   2    220   0.0  12.0     12     35       25     2      1
## 13      120       1   3    210   0.0  13.0      9     45       25     2      1
## 15      110       1   1    180   0.0  12.0     13     55       25     2      1
## 18      110       1   0     90   1.0  13.0     12     20       25     2      1
## 19      110       1   1    180   0.0  12.0     13     65       25     2      1
## 25      110       2   1    125   1.0  11.0     13     30       25     2      1
## 26      110       1   0    200   1.0  14.0     11     25       25     1      1
## 30      110       1   1    135   0.0  13.0     12     25       25     2      1
## 31      100       2   0     45   0.0  11.0     15     40       25     1      1
## 32      110       1   1    280   0.0  15.0      9     45       25     2      1
## 36      120       1   2    220   1.0  12.0     11     45       25     2      1
```

```
## 37      110       3   1    250   1.5  11.5     10     90       25     1      1
## 38      110       1   0    180   0.0  14.0     11     35       25     1      1
## 43      110       2   1    180   0.0  12.0     12     55       25     2      1
## 48      100       2   1    220   2.0  15.0      6     90       25     1      1
## 49      120       2   1    190   0.0  15.0      9     40       25     2      1
## 67      110       2   1     70   1.0   9.0     15     40       25     2      1
## 74      110       1   1    140   0.0  13.0     12     25       25     2      1
## 77      110       2   1    200   1.0  16.0      8     60       25     1      1
##    cups   rating sub_grouping
## 6  0.75 29.50954            3
## 7  1.00 33.17409            3
## 11 0.75 18.04285            3
## 13 0.75 19.82357            3
## 15 1.00 22.73645            3
## 18 1.00 35.78279            3
## 19 1.00 22.39651            3
## 25 1.00 32.20758            3
## 26 0.75 31.43597            3
## 30 0.75 28.02576            3
## 31 0.88 35.25244            3
## 32 0.75 23.80404            3
## 36 1.00 21.87129            3
## 37 0.75 31.07222            3
## 38 1.33 28.74241            3
## 43 1.00 26.73451            3
## 48 1.00 40.10596            3
## 49 0.67 29.92429            3
## 67 0.75 31.23005            3
## 74 1.00 27.75330            3
## 77 0.75 36.18756            3
```

```
CCluster[CCluster$sub_grouping==4,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 9        90       2   1    200     4    15       6    125       25     1      1
## 10       90       3   0    210     5    13       5    190       25     3      1
## 12      110       6   2    290     2    17       1    105       25     1      1
## 16      110       2   0    280     0    22       3     25       25     1      1
## 17      100       2   0    290     1    21       2     35       25     1      1
## 22      110       2   0    220     1    21       3     30       25     3      1
## 24      100       2   0    190     1    18       5     80       25     3      1
## 33      100       3   1    140     3    15       5     85       25     3      1
## 34      110       3   0    170     3    17       3     90       25     3      1
## 39      110       2   1    170     1    17       6     60      100     3      1
## 41      110       2   1    260     0    21       3     40       25     2      1
## 51       90       3   0    170     3    18       2     90       25     3      1
## 54      100       3   0    320     1    20       3     45      100     3      1
## 62      110       1   0    240     0    23       2     30       25     1      1
## 63      110       2   0    290     0    22       3     35       25     1      1
## 68      110       6   0    230     1    16       3     55       25     1      1
## 70      110       2   1    200     0    21       3     35      100     3      1
## 72      100       3   1    200     3    16       3    110      100     3      1
## 73      110       2   1    250     0    21       3     60       25     3      1
## 75      100       3   1    230     3    17       3    115       25     1      1
```

```
## 76      100       3   1    200     3    17      3    110       25     1      1
##    cups   rating sub_grouping
## 9  0.67 49.12025            4
## 10 0.67 53.31381            4
## 12 1.25 50.76500            4
## 16 1.00 41.44502            4
## 17 1.00 45.86332            4
## 22 1.00 46.89564            4
## 24 0.75 44.33086            4
## 33 0.88 52.07690            4
## 34 0.25 53.37101            4
## 39 1.00 36.52368            4
## 41 1.50 39.24111            4
## 51 1.00 59.64284            4
## 54 1.00 41.50354            4
## 62 1.13 41.99893            4
## 63 1.00 40.56016            4
## 68 1.00 53.13132            4
## 70 1.00 38.83975            4
## 72 1.00 46.65884            4
## 73 0.75 39.10617            4
## 75 0.67 49.78744            4
## 76 1.00 51.59219            4
```

```
CCluster[CCluster$sub_grouping==5,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 27      100       3   0      0     3    14      7    100       25     2   1.00
## 44      100       4   1      0     0    16      3     95       25     2   1.00
## 55       50       1   0      0     0    13      0     15        0     3   0.50
## 56       50       2   0      0     1    10      0     50        0     3   0.50
## 61       90       2   0      0     2    15      6    110       25     3   1.00
## 64       80       2   0      0     3    16      0     95        0     1   0.83
## 65       90       3   0      0     4    19      0    140        0     1   1.00
## 66       90       3   0      0     3    20      0    120        0     1   1.00
## 69       90       2   0     15     3    15      5     90       25     2   1.00
##    cups   rating sub_grouping
## 27 0.80 58.34514            5
## 44 1.00 54.85092            5
## 55 1.00 60.75611            5
## 56 1.00 63.00565            5
## 61 0.50 55.33314            5
## 64 1.00 68.23588            5
## 65 0.67 74.47295            5
## 66 0.67 72.80179            5
## 69 1.00 59.36399            5
```

Let's calculate the average rating to determine the healthiest cluster of grain cereals.

```
mean(CCluster[CCluster$sub_grouping==1,"rating"])
```

```
## [1] 73.84446
```

```r
mean(CCluster[CCluster$sub_grouping==2,"rating"])
```

```
## [1] 38.26161
```

```r
mean(CCluster[CCluster$sub_grouping==3,"rating"])
```

```
## [1] 28.84825
```

```r
mean(CCluster[CCluster$sub_grouping==4,"rating"])
```

```
## [1] 46.46513
```

```r
mean(CCluster[CCluster$sub_grouping==5,"rating"])
```

```
## [1] 63.0184
```

Subgroup 1 has the highest mean rating of 73.84446, as indicated by the statistics above. Therefore, the healthy diet CCluster should be selected from subgroup 1.