Tarea 4

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Contents

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1 Presentación del problema

Responder todas las preguntas presentadas por *Abastos Crema* usando los métodos *hcluster* o *kmeans*

2 Descripción del set de datos

Muestras de laboratorio provistas por el cliente.

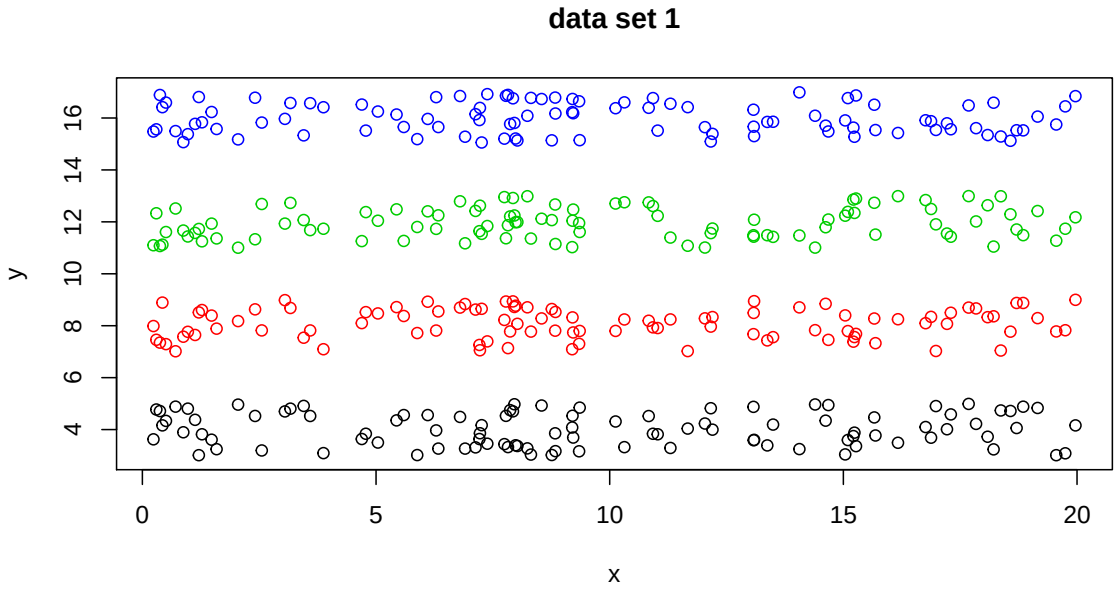
```
setwd("C:\\Users\\isys\\Documents\\DataMining\\clusterizacion_jerarquica\\tarea")

data1 <-  read.csv(file= "entrada_1.csv",header = T,sep = ",",dec = ".")
data2 <-  read.csv(file= "entrada_2.csv",header = T,sep = ",",dec = ".")
data3 <-  read.csv(file= "entrada_3.csv",header = T,sep = ",",dec = ".")
data4 <-  read.csv(file= "entrada_4.csv",header = T,sep = ",",dec = ".")
names(data1)<- c("index","x","y","class")
names(data2)<- c("index","x","y","class")
names(data3)<- c("index","x","y","class")
names(data4)<- c("index","x","y","class")
id1 <- rep(1,nrow(data1))
id2 <- rep(2,nrow(data2))
id3 <- rep(3,nrow(data3))
id4 <- rep(4,nrow(data4))

id<- c(id1,id2,id3,id4)
names(id) <- "id"
data <- rbind(data1,data2,data3,data4)
data <- cbind(id,data)
```

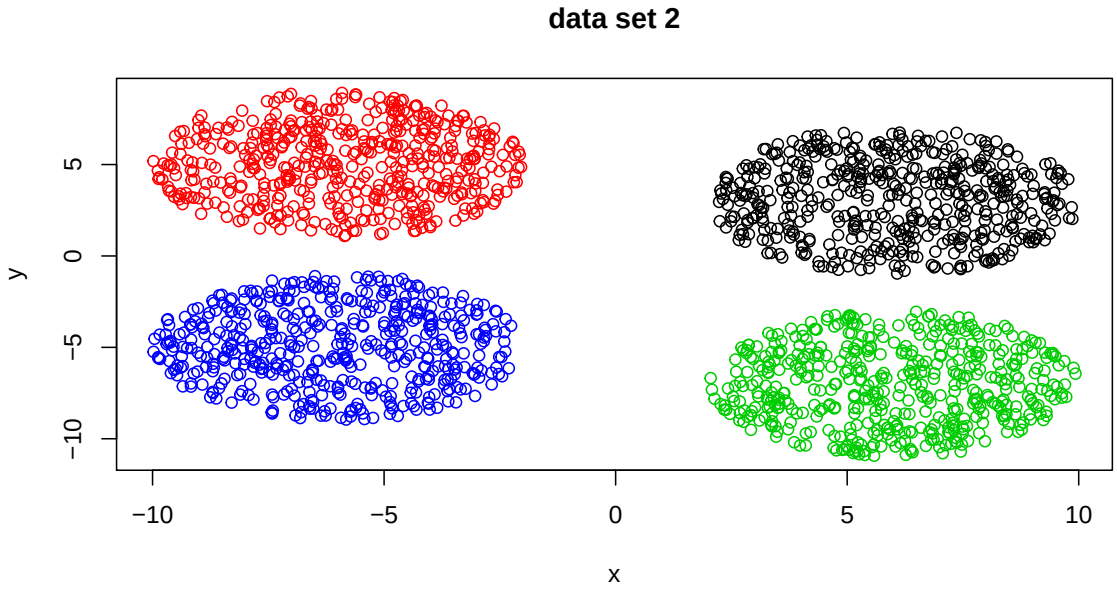
---

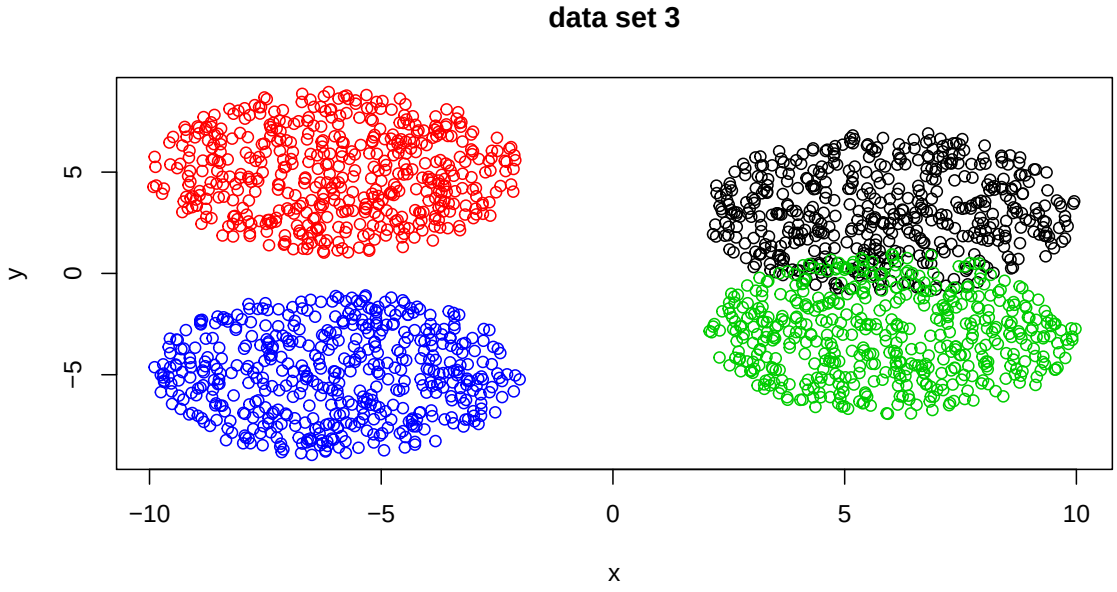
3 Respuestas

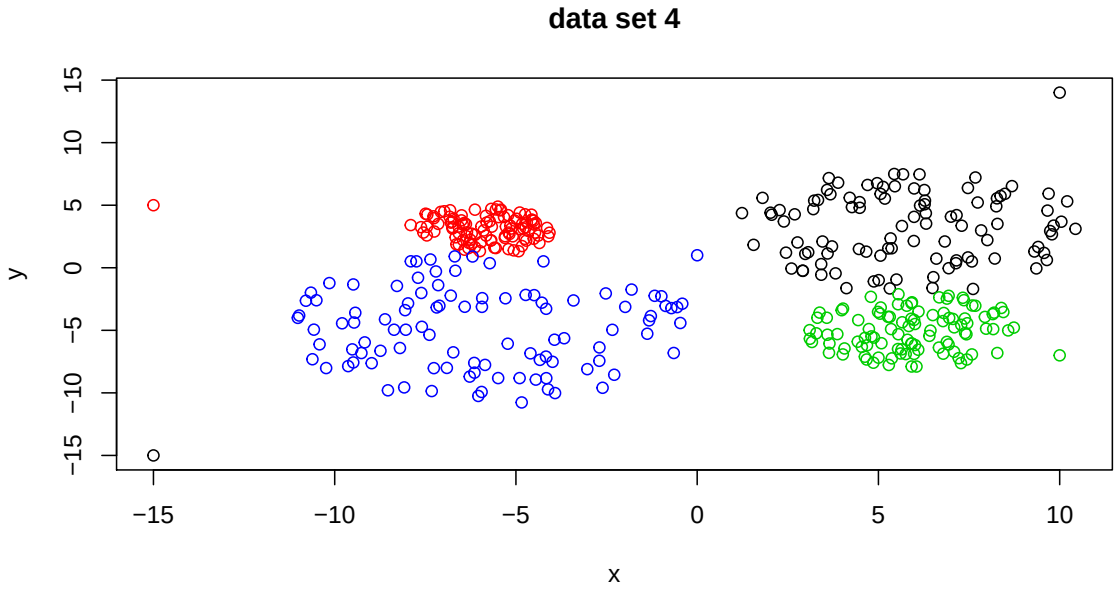
1. Grafica de los puntos contenidos en cada set de datos:

```
for(i in 1:4){
  subs<- subset(data,subset = data[1] == i)
  plot(subs[,c(3,4)],col =subs$class, xlab = "x",ylab = "y",main = paste("data set",i,sep= " "))
}
```









2. Sea una matriz de disimilaridades o distancias D_{n*n} es una matriz tal que su elemento i, j es una disimilaridad $d(ij)$ tal que $\forall i, j, k$:
   - $d(i, j) \geq 0$
   - $d(i, j) = 0$
   - $d(i, j) = d(j, i)$
   - $d(i, j) \leq d(i, k) + d(k, j)$

donde D es una matriz simetrica y su diagonal son 0.

Para la disimilaridad $d(i,j)$ representa una medida de la diferencia entre dos observaciones x_i y x_j en este caso usaremos la disimilaridad basada en distancia euclideana dado que no tenemos ninguna evidencia que la diferencia entre los individuos sea diferente de 0:

$d(i,j) = \sqrt{\sum_{i=1}^{p}(x_{ic} - x_{cj})^2}$

especificamente el criterio de vecino mas cercano expresado como :

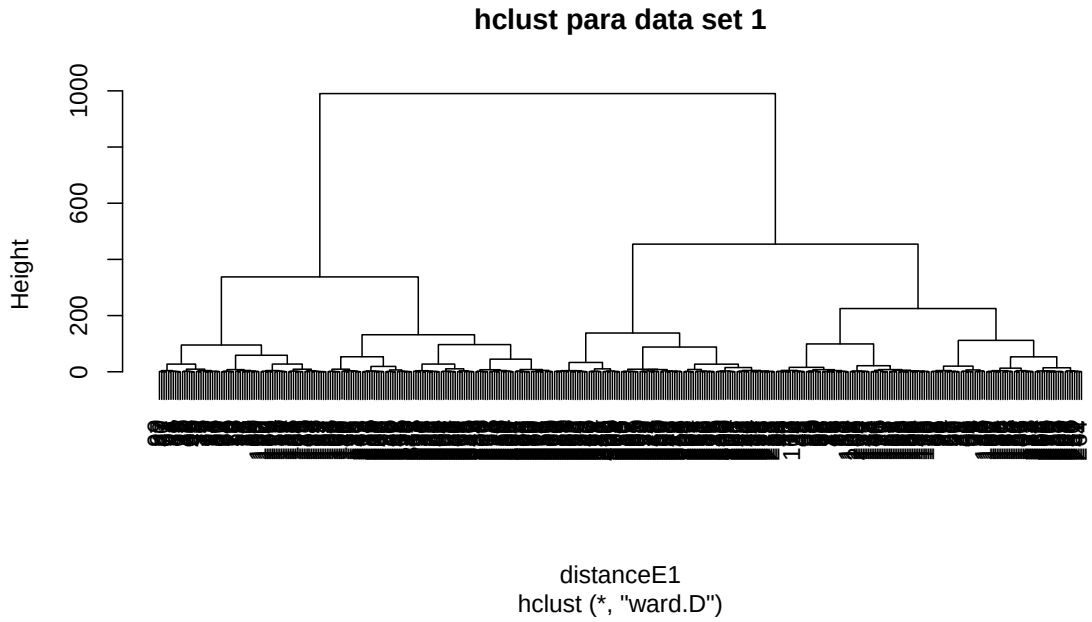
$d_{UV} = min(d_{ij}) : i \in U, j \in V$

ya que, los conglomerados formados por este data set no poseen formas estrictamente esfericas y por lo tanto se ajustarian mas (teoricamente) las comparaciones individuales de vecino mas cercano.

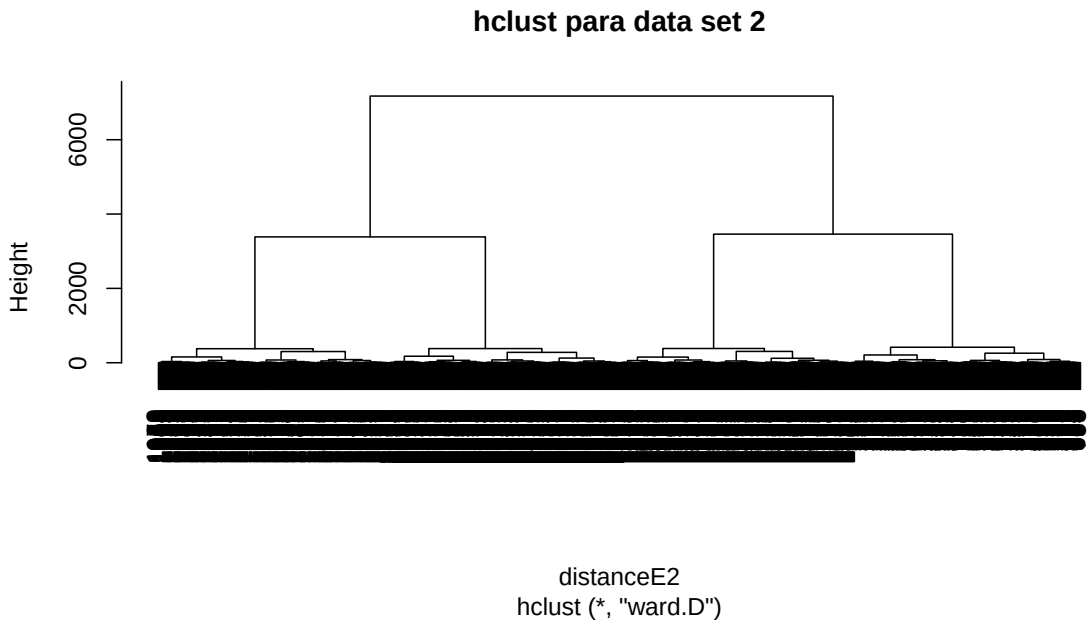
3. Para cada dataset se generaron los siguientes dendrogramas(uno por cada metodo):

```
metodos <- c("ward.D", "ward.D2", "single", "complete", "average", "mcquitty","median","centroid")
for(i in metodos){
  subs<- subset(data,subset = data$id == 1)
  distanceE1 <- dist(subs[-c(1,2,5)],method = "euclidean")
  clusterE1 <- hclust(distanceE1,method = i)
  plot(clusterE1, main= paste("hclust para data set 1"))
  corteE1 <- cutree(clusterE1,k=length(unique(subs$class)))
  print(table(corteE1,subs$class))
  if(sum(diag(table(corteE1,subs$class))) == nrow(subs)){
    mejor1 <-clusterE1
  }
  #-----------------------------------------------------
  subs<- subset(data,subset = data$id == 2)
  distanceE2 <- dist(subs[-c(1,2,5)],method = "euclidean")
  clusterE2 <- hclust(distanceE2,method = i)
  plot(clusterE2, main = paste("hclust para data set 2"))
  corteE2 <- cutree(clusterE2,k=length(unique(subs$class)))
  print(table(corteE2,subs$class))
  if(sum(diag(table(corteE2,subs$class))) == nrow(subs)){
    mejor2 <-clusterE2
  }
  #-----------------------------------------------------
  subs<- subset(data,subset = data$id == 3)
  distanceE3 <- dist(subs[-c(1,2,5)],method = "euclidean")
  clusterE3 <- hclust(distanceE3,method = i)
  plot(clusterE3, main = paste("hclust para data set 3"))
  corteE3 <- cutree(clusterE3,k=length(unique(subs$class)))
  print(table(corteE3,subs$class))
  if(i=="ward.D"){
    mejor3 <- clusterE3
    mejor3$precision <- sum(diag(table(corteE3,subs$class)))
  }
  if(sum(diag(table(corteE3,subs$class))) > mejor3$precision){
    mejor3 <- clusterE3
    mejor3$precision <- sum(diag(table(corteE3,subs$class)))
  }
  #-----------------------------------------------------
  subs<- subset(data,subset = data$id == 4)
```

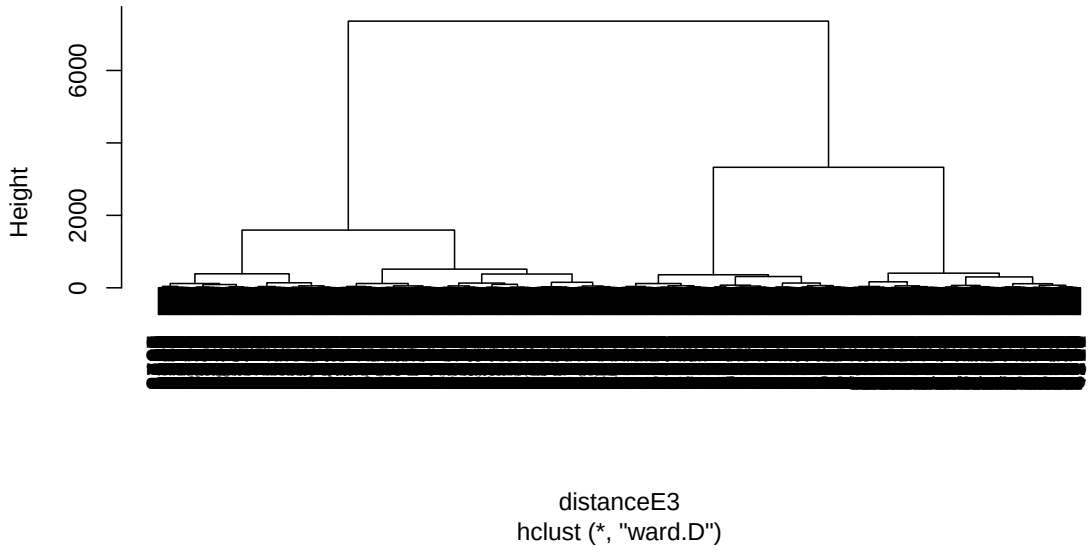
```
  distanceE4 <- dist(subs[-c(1,2,5)],method = "euclidean")
  clusterE4 <- hclust(distanceE4,method = i)
  plot(clusterE4, main = paste("hclust para data set 4"))
  corteE4 <- cutree(clusterE4,k=length(unique(subs$class)))
  print(table(corteE4,subs$class))
  if(i=="ward.D"){
    mejor4 <- clusterE4
    mejor4$precision <- sum(diag(table(corteE4,subs$class)))
  }
  if(sum(diag(table(corteE4,subs$class))) > mejor4$precision){
    mejor4 <- clusterE4
    mejor4$precision <- sum(diag(table(corteE4,subs$class)))
  }
}
```




```
##
## corteE1  1  2  3  4
##       1 56 56 21  0
##       2 44 29  0  0
##       3  0 15 39 44
##       4  0  0 40 56
```

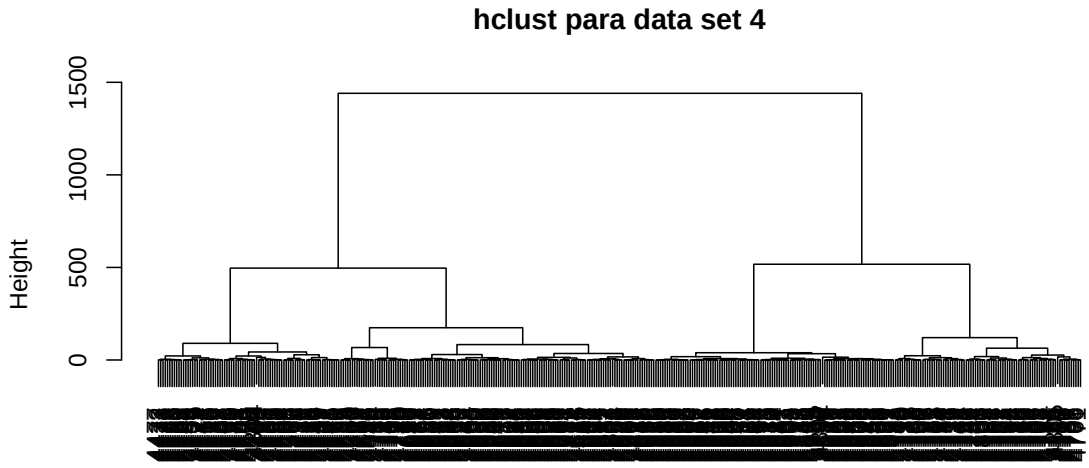



```
##
## corteE2   1   2   3   4
##       1 500   0   0   0
##       2   0 500   0   0
##       3   0   0 500   0
##       4   0   0   0 500
```

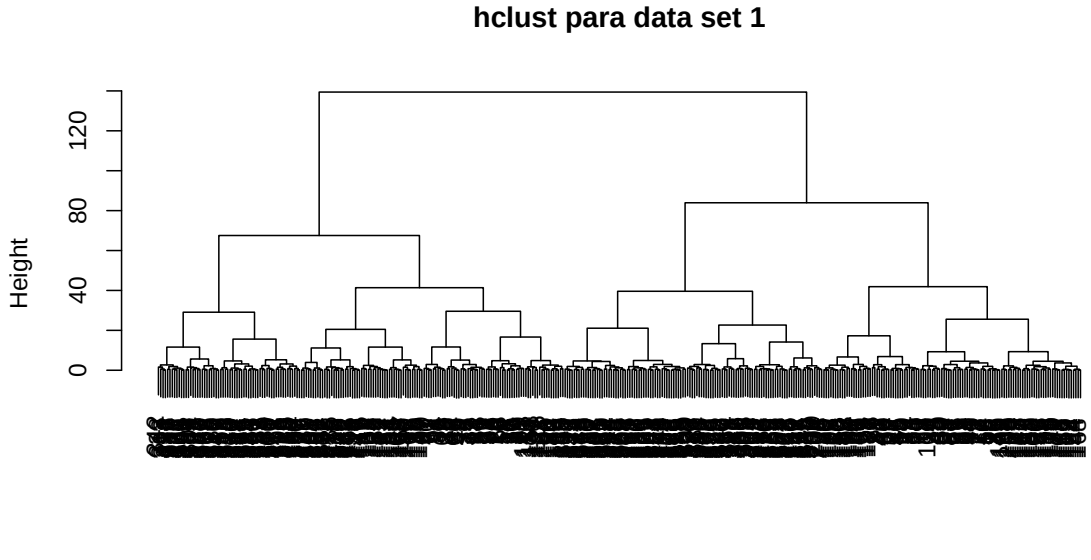



```
##
```

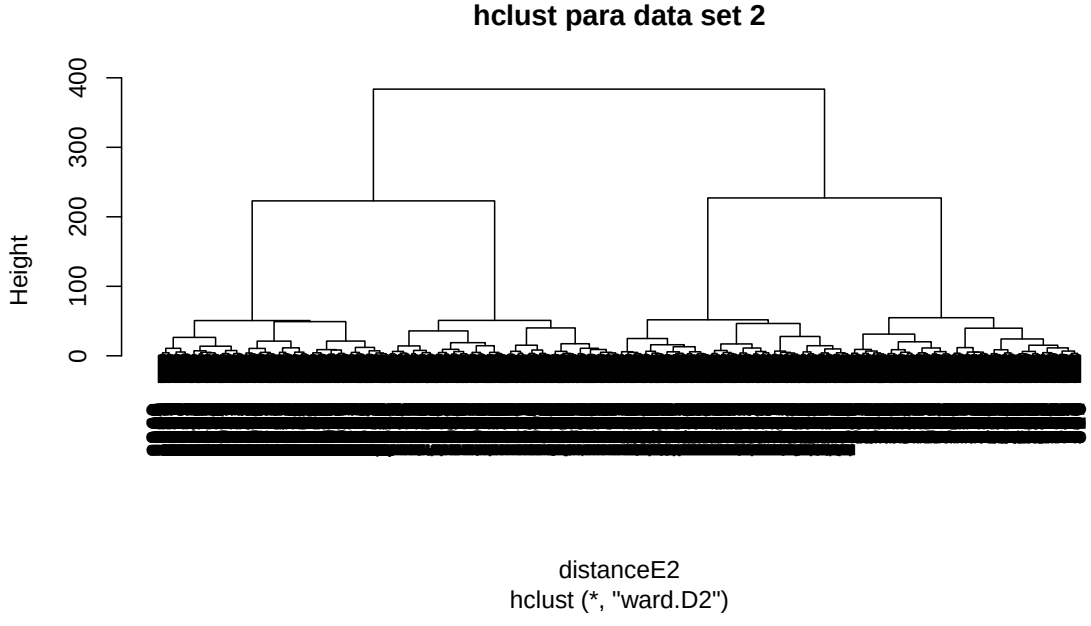
```
## corteE3   1   2   3   4
##        1 500   0 110   0
##        2   0 500   0   0
##        3   0   0 390   0
##        4   0   0   0 500
```




```
##
## corteE4   1   2   3   4
##        1  80   0   0   0
##        2  21   0 101  16
##        3   0 101   0   4
##        4   1   0   0  81
```

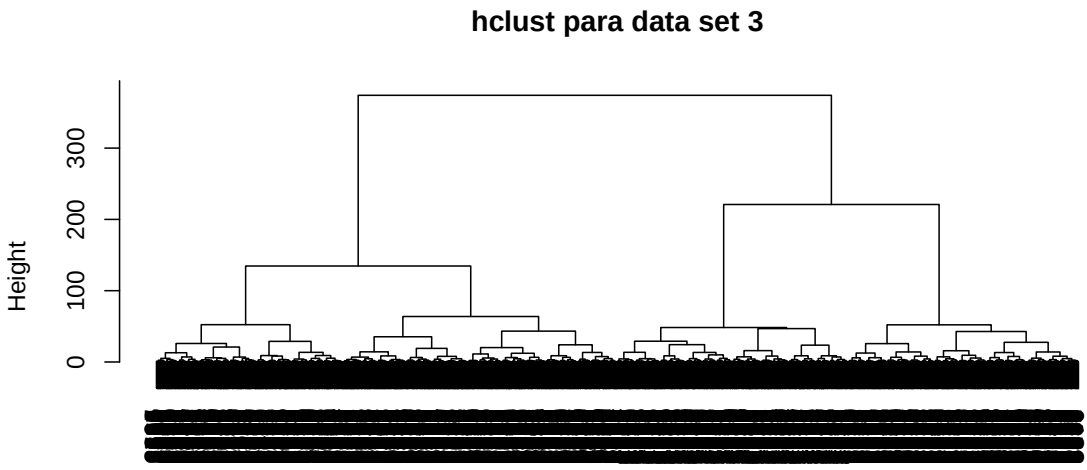



```
##
## corteE1  1  2  3  4
##       1 56 56  0  0
##       2 44 44 26  0
##       3  0  0 56 56
##       4  0  0 18 44
```

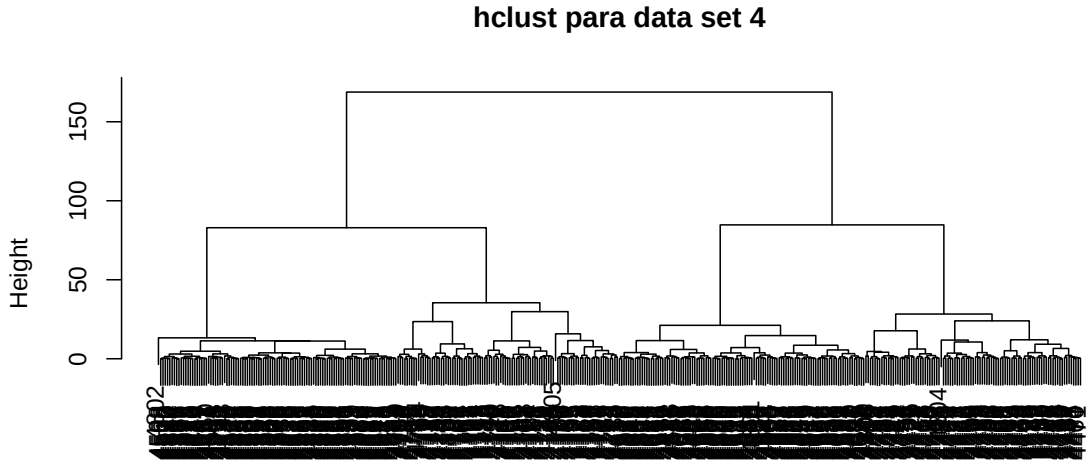



```
##
```

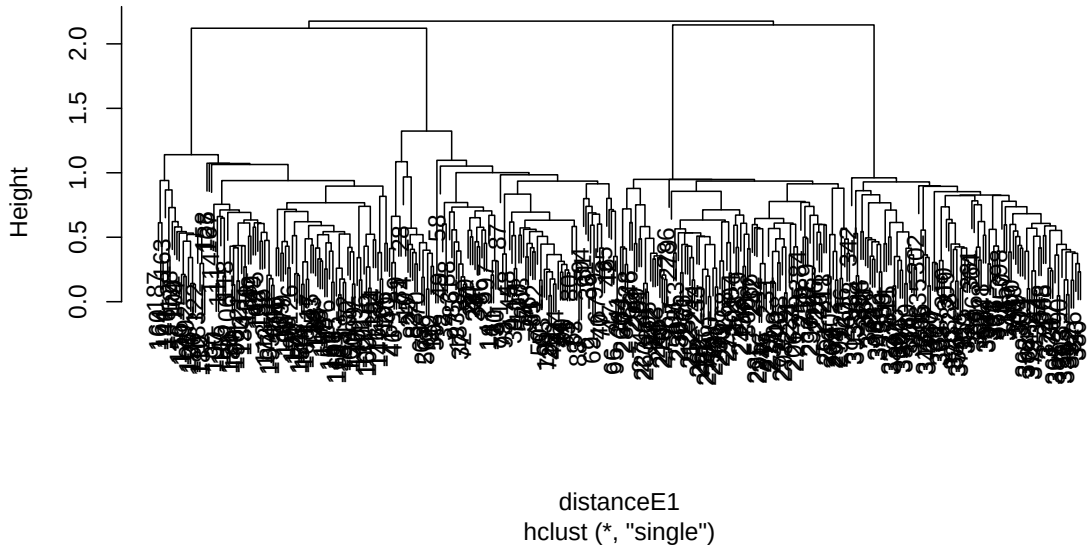
```
## corteE2   1   2   3   4
##        1 500   0   0   0
##        2   0 500   0   0
##        3   0   0 500   0
##        4   0   0   0 500
```




```
##
## corteE3   1   2   3   4
##        1  95   0 500   0
##        2 405   0   0   0
##        3   0 500   0   0
##        4   0   0   0 500
```

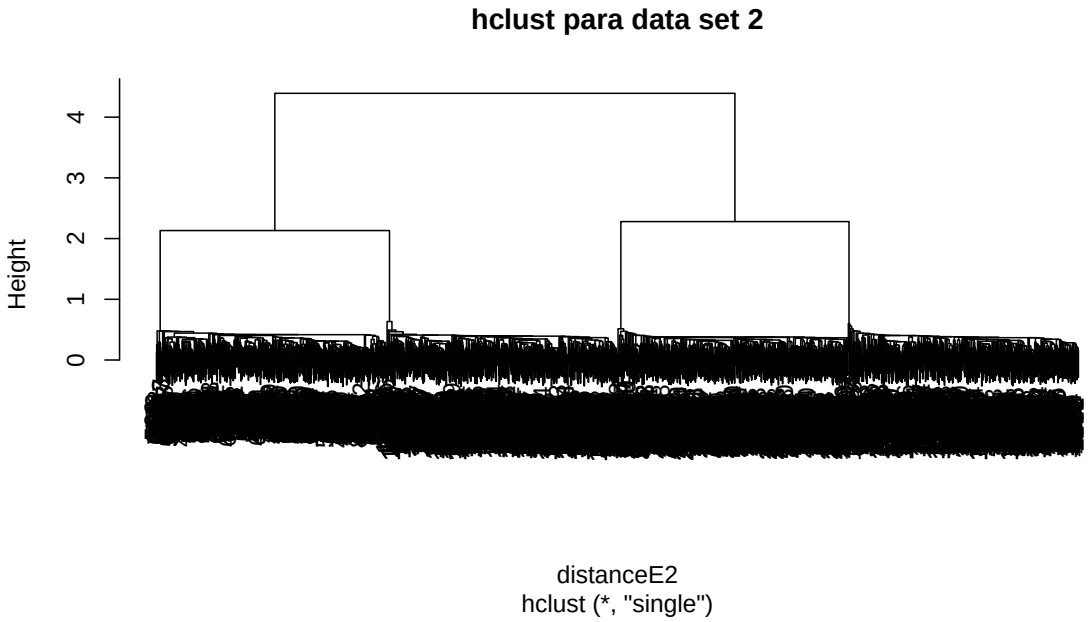



```
##
## corteE4   1   2   3   4
##       1  94   0   0   1
##       2   7   0 101   0
##       3   0 101   0   4
##       4   1   0   0  96
```

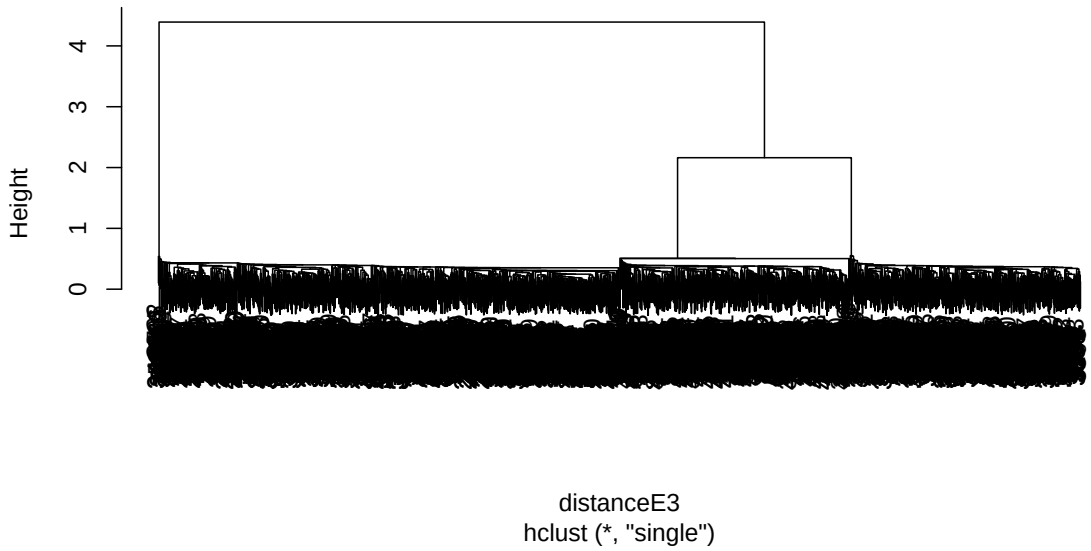



```
##
```

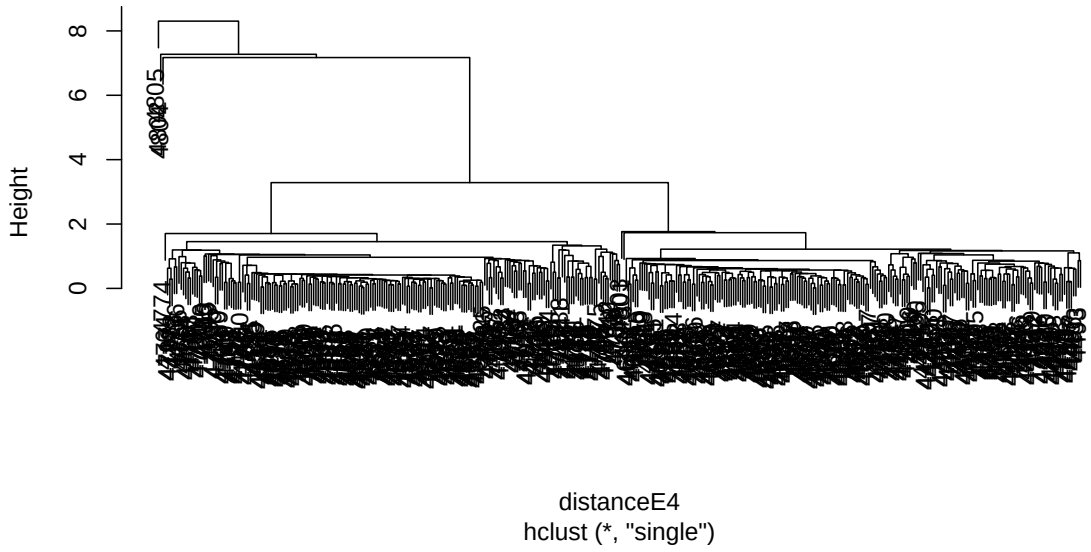
```
## corteE1   1   2   3   4
##        1 100   0   0   0
##        2   0 100   0   0
##        3   0   0 100   0
##        4   0   0   0 100
```




```
##
## corteE2   1   2   3   4
##        1 500   0   0   0
##        2   0 500   0   0
##        3   0   0 500   0
##        4   0   0   0 500
```

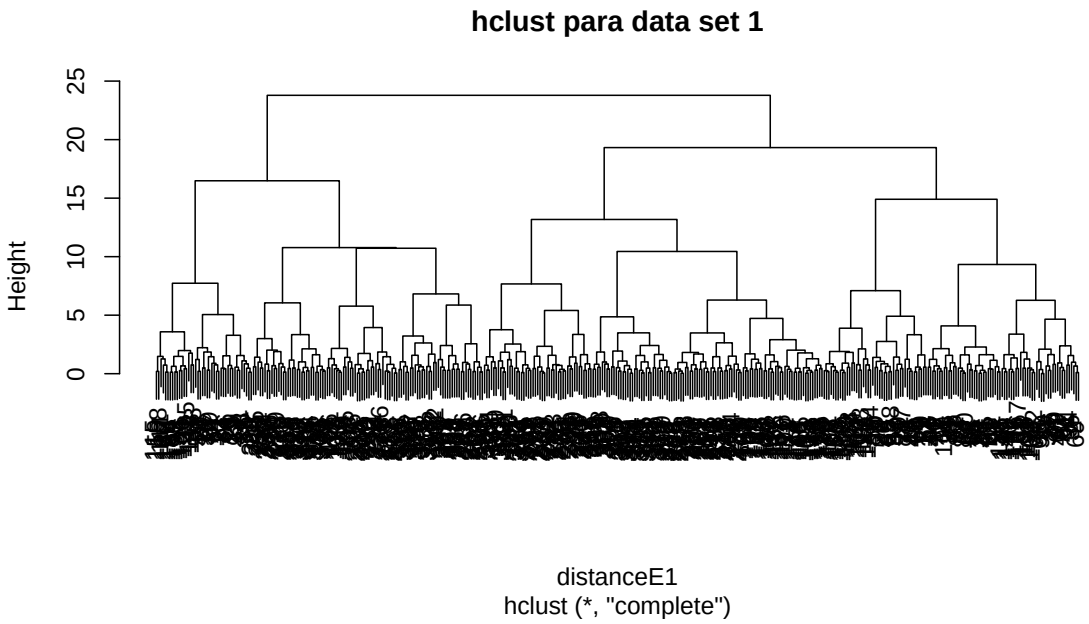



```
##
## corteE3   1   2   3   4
##       1 500   0 500   0
##       2   0 499   0   0
##       3   0   1   0   0
##       4   0   0   0 500
```

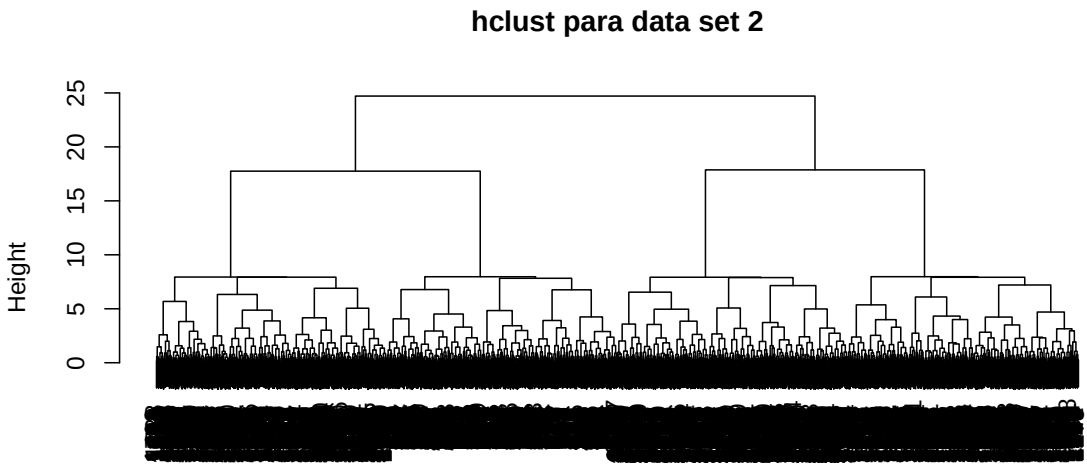



```
##
```

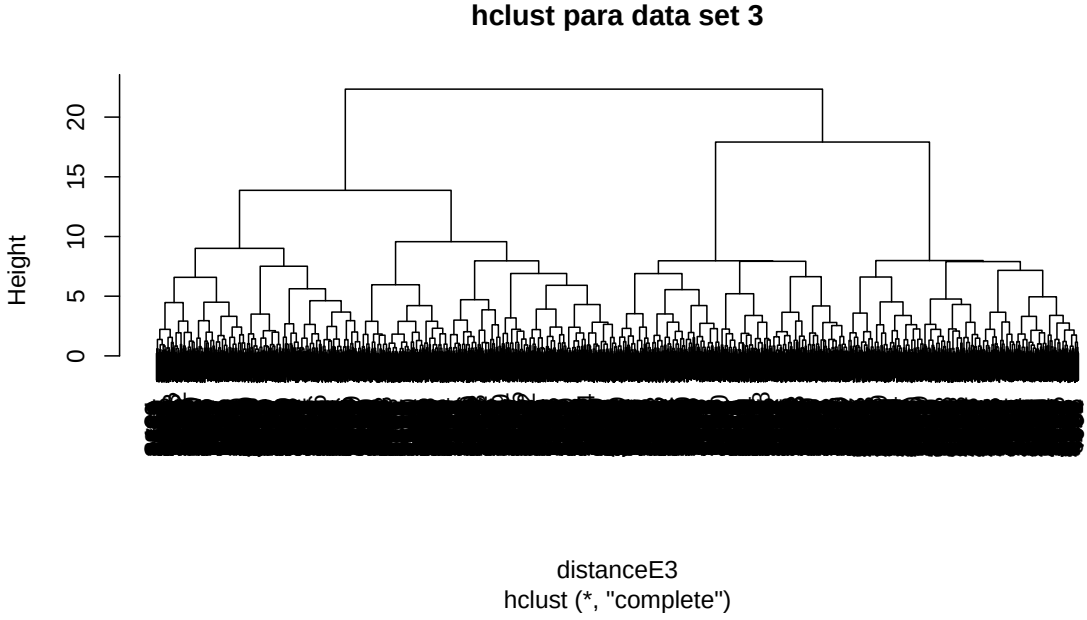
```
## corteE4   1   2   3   4
##        1 100 100 101 101
##        2   0   1   0   0
##        3   1   0   0   0
##        4   1   0   0   0
```




```
##
## corteE1  1  2  3  4
##        1 75 36  0  0
##        2 25 17  0  0
##        3  0 35 56 56
##        4  0 12 44 44
```

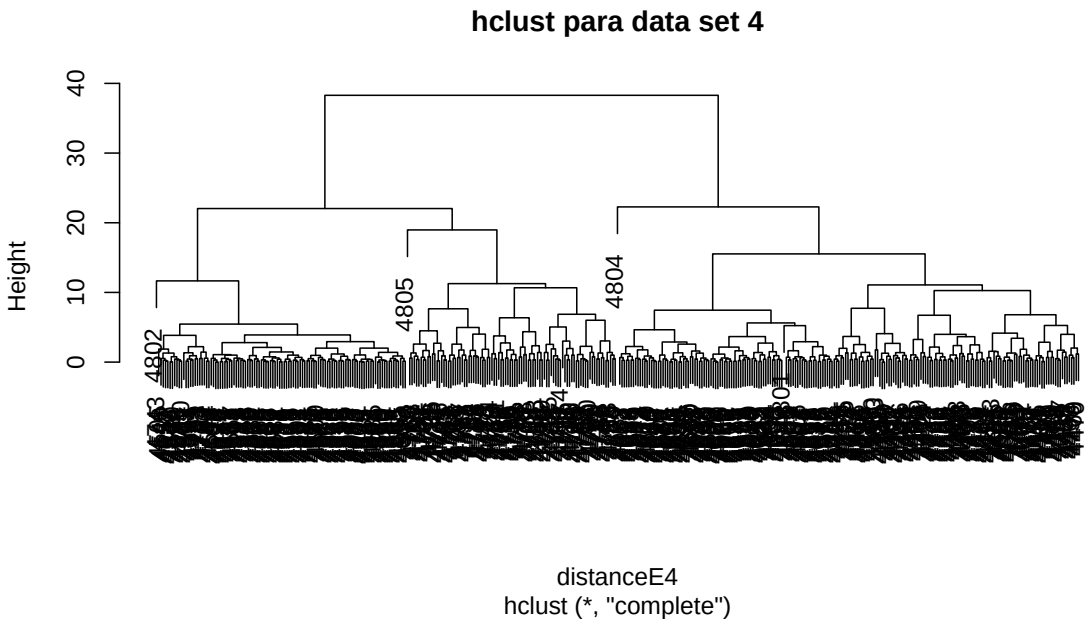



```
##
## corteE2   1   2   3   4
##       1 500   0   0   0
##       2   0 500   0   0
##       3   0   0 500   0
##       4   0   0   0 500
```

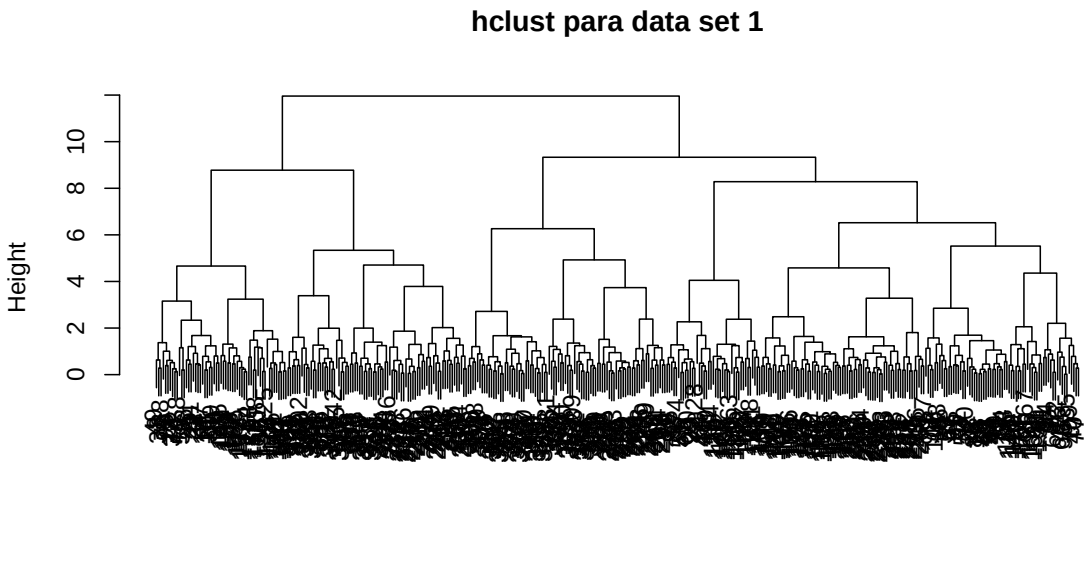



```
##
```

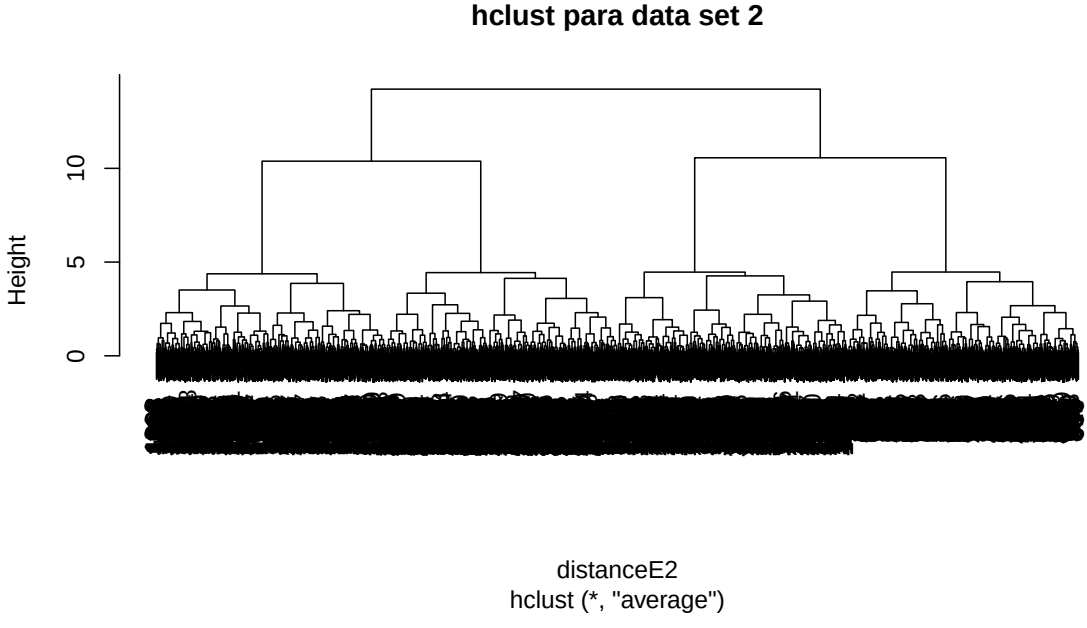
```
## corteE3   1   2   3   4
##        1 470   0  85   0
##        2  30   0 415   0
##        3   0 500   0   0
##        4   0   0   0 500
```




```
##
## corteE4   1   2   3   4
##        1 100   0 101   1
##        2   0 101   0   9
##        3   1   0   0  91
##        4   1   0   0   0
```

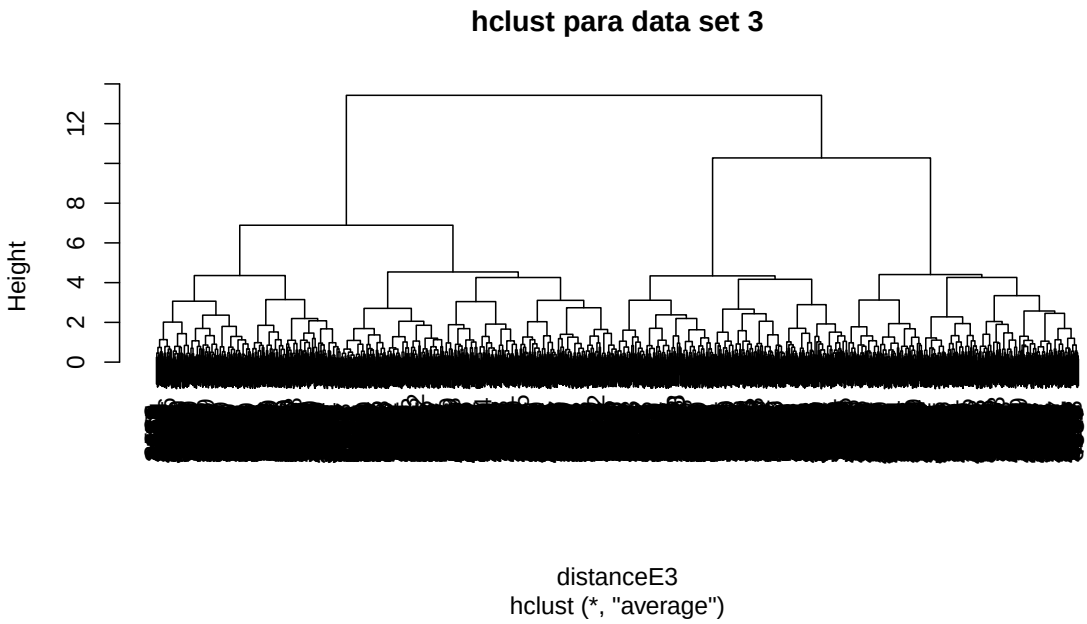



```
##
## corteE1  1  2  3  4
##       1 72 71 36  0
##       2 28 29  0  0
##       3  0  0 30 56
##       4  0  0 34 44
```

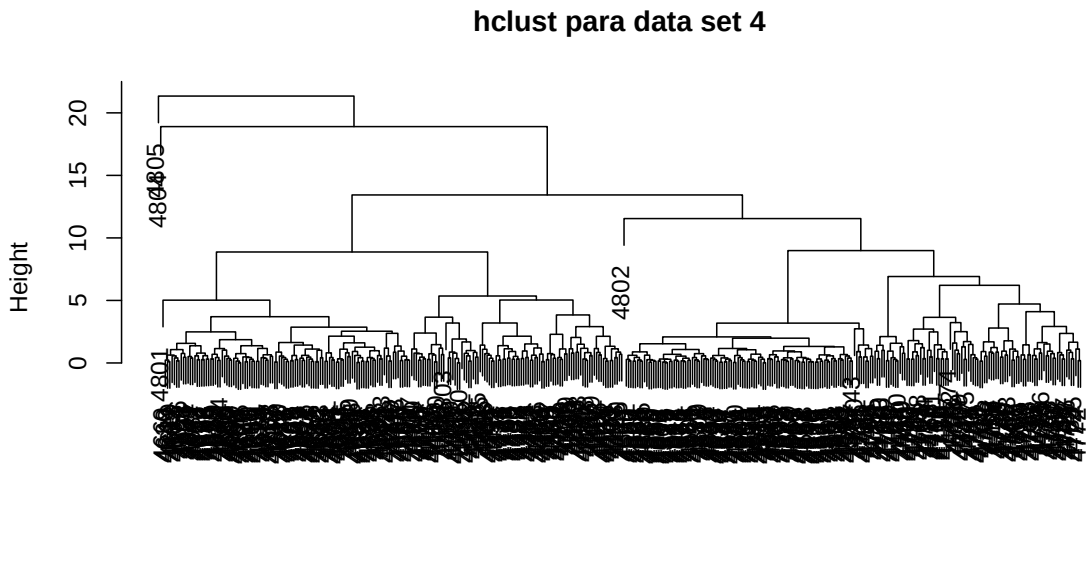



```
##
```

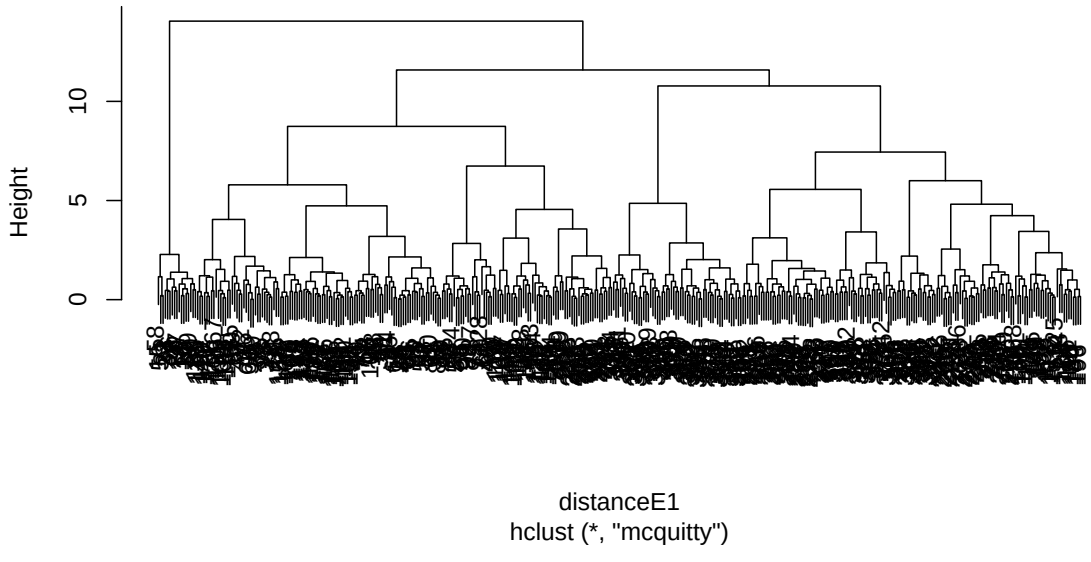
```
## corteE2   1   2   3   4
##        1 500   0   0   0
##        2   0 500   0   0
##        3   0   0 500   0
##        4   0   0   0 500
```




```
##
## corteE3   1   2   3   4
##        1 500   0  99   0
##        2   0 500   0   0
##        3   0   0 401   0
##        4   0   0   0 500
```

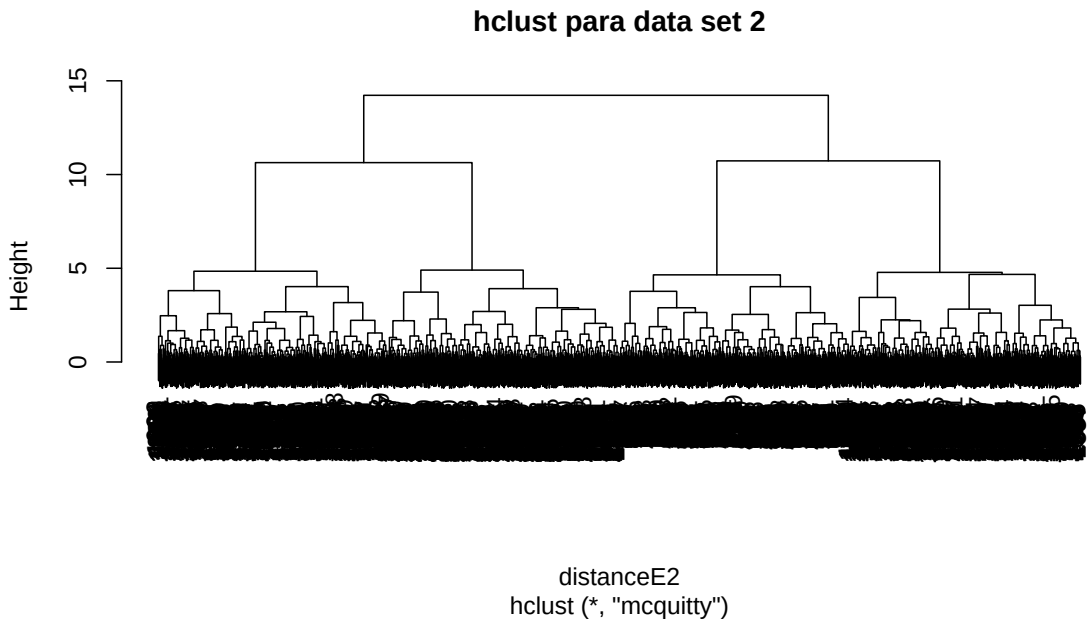



```
##
## corteE4   1   2   3   4
##       1 100   0 101   1
##       2   0 101   0 100
##       3   1   0   0   0
##       4   1   0   0   0
```

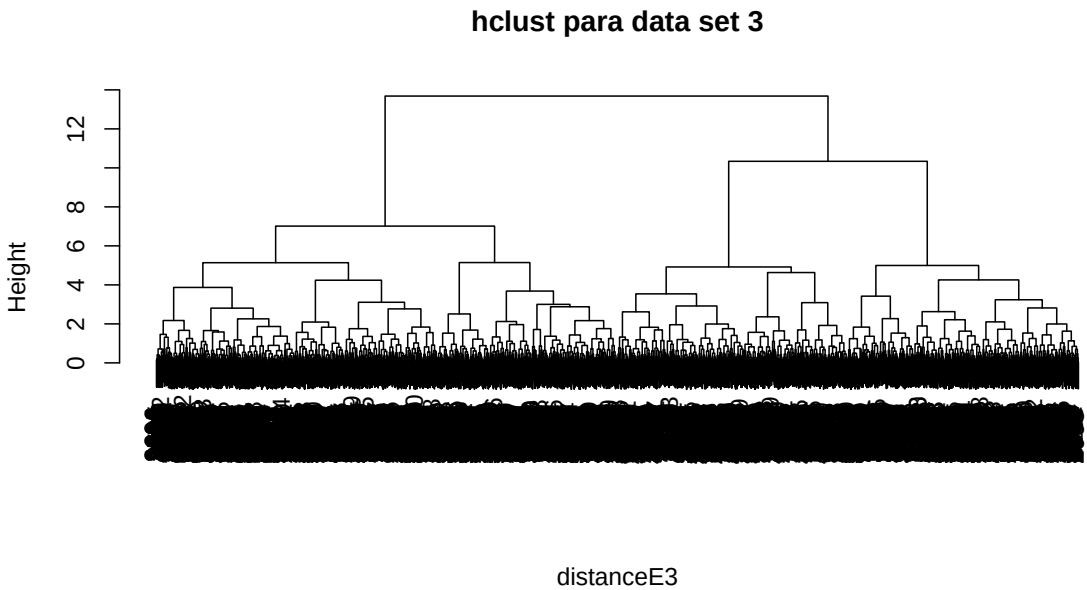



```
##
```

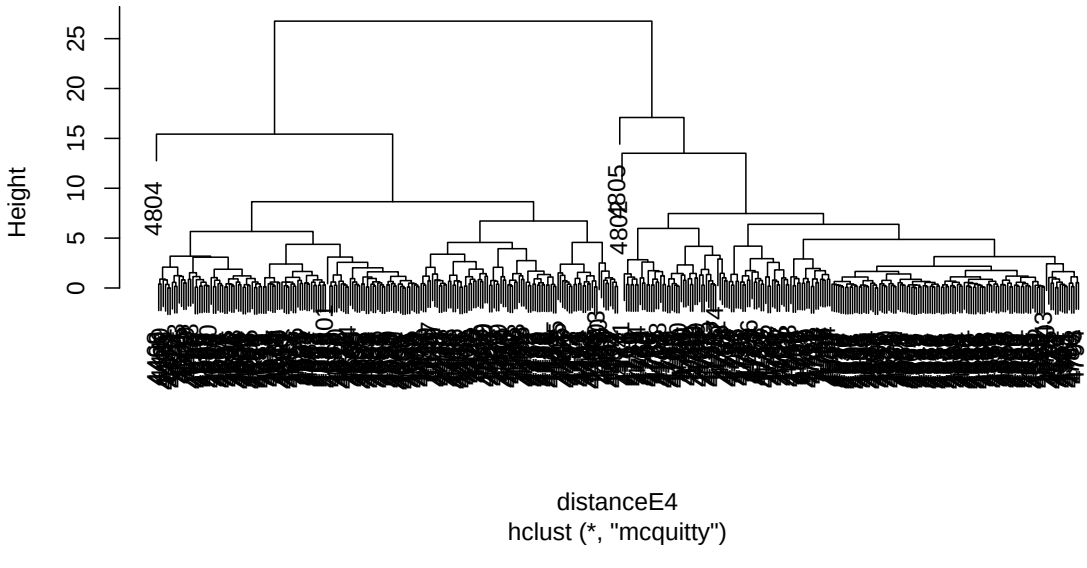
```
## corteE1  1  2  3  4
##       1 83 71 26  0
##       2 17  0  0  0
##       3  0 29 74 44
##       4  0  0  0 56
```




```
##
## corteE2   1   2   3   4
##       1 500   0   0   0
##       2   0 500   0   0
##       3   0   0 500   0
##       4   0   0   0 500
```

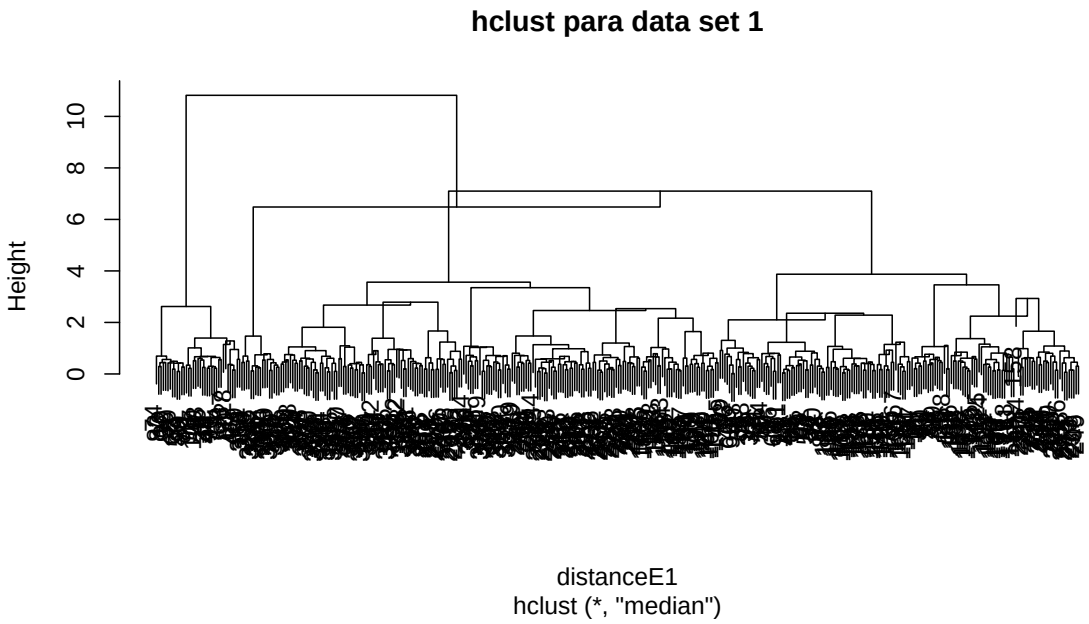



```
##
## corteE3   1   2   3   4
##       1 498   0 112   0
##       2   2   0 388   0
##       3   0 500   0   0
##       4   0   0   0 500
```

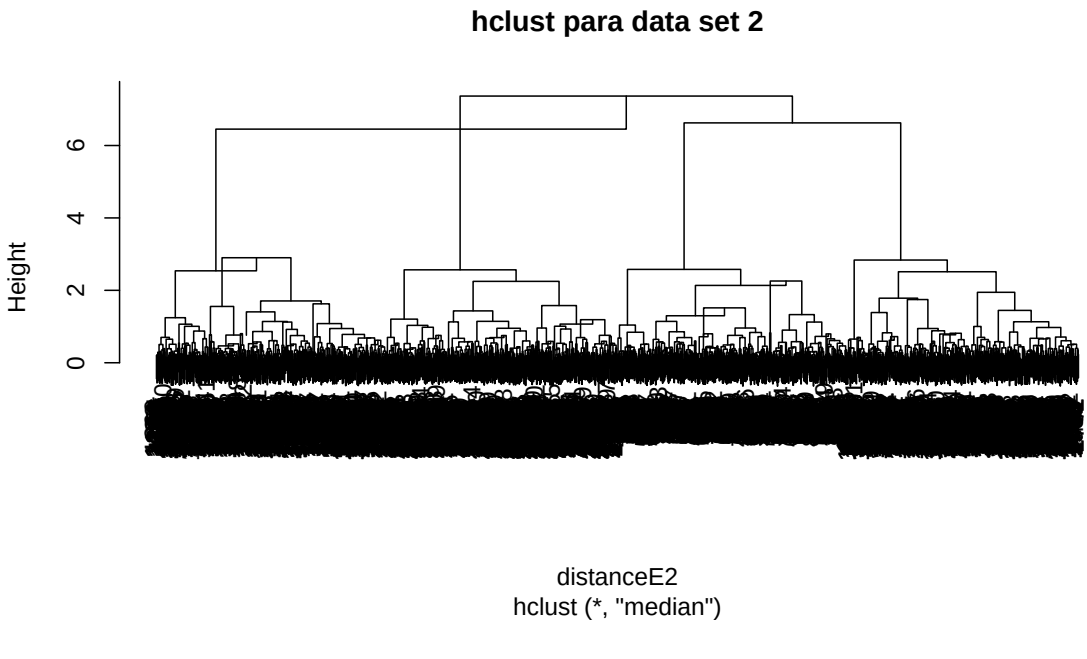



```
##
```

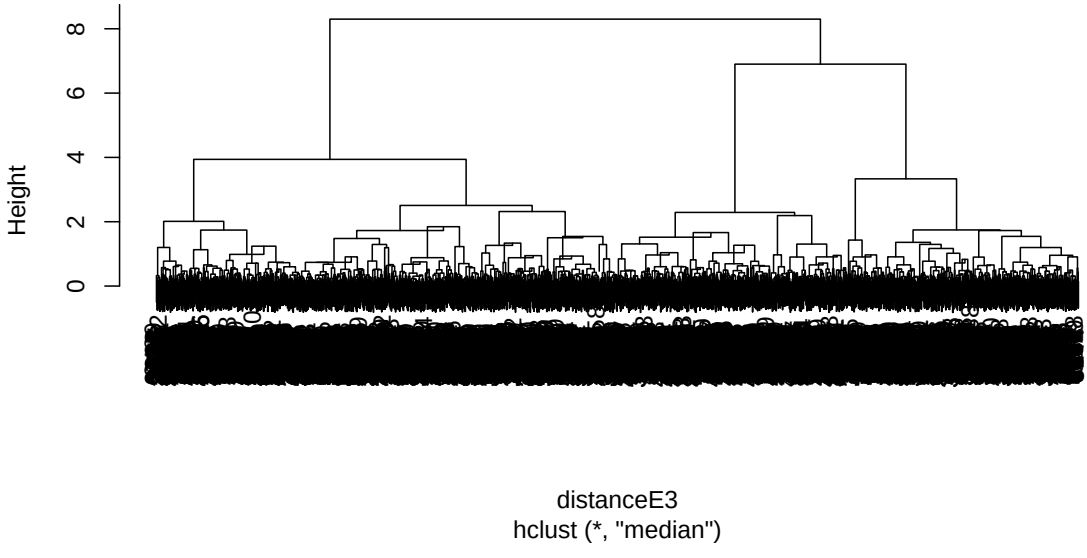
```
## corteE4   1   2   3   4
##        1 100   0 101   1
##        2   0 101   0 100
##        3   1   0   0   0
##        4   1   0   0   0
```




```
##
## corteE1  1  2  3  4
##        1 37  0  0  0
##        2 63 66 27  0
##        3  0 34 73 83
##        4  0  0  0 17
```

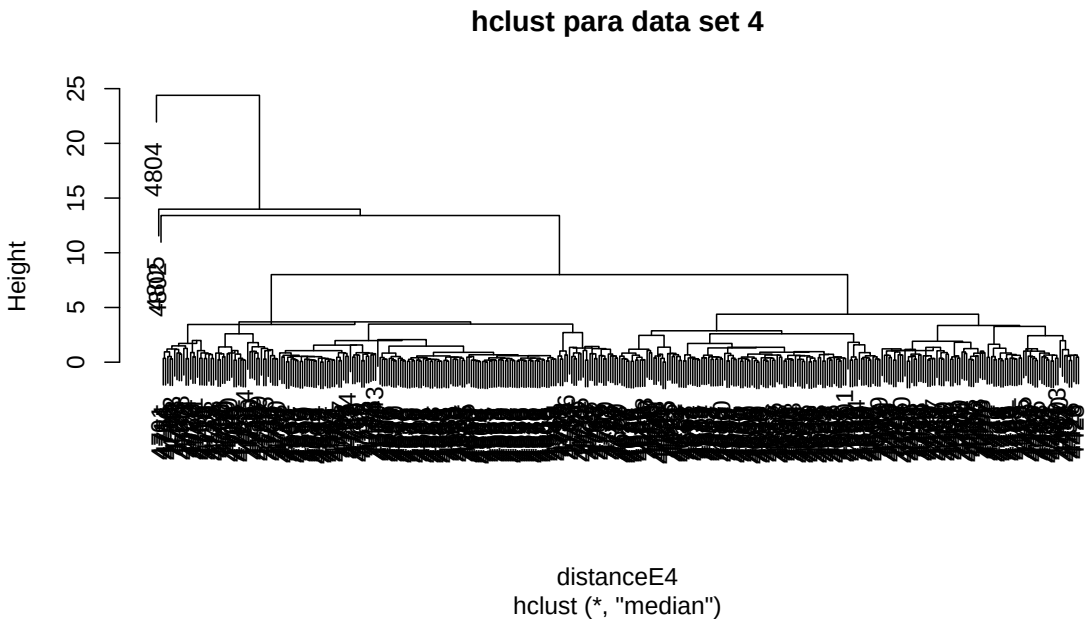



```
##
## corteE2   1   2   3   4
##       1 500   0   0   0
##       2   0 500   0   0
##       3   0   0 500   0
##       4   0   0   0 500
```

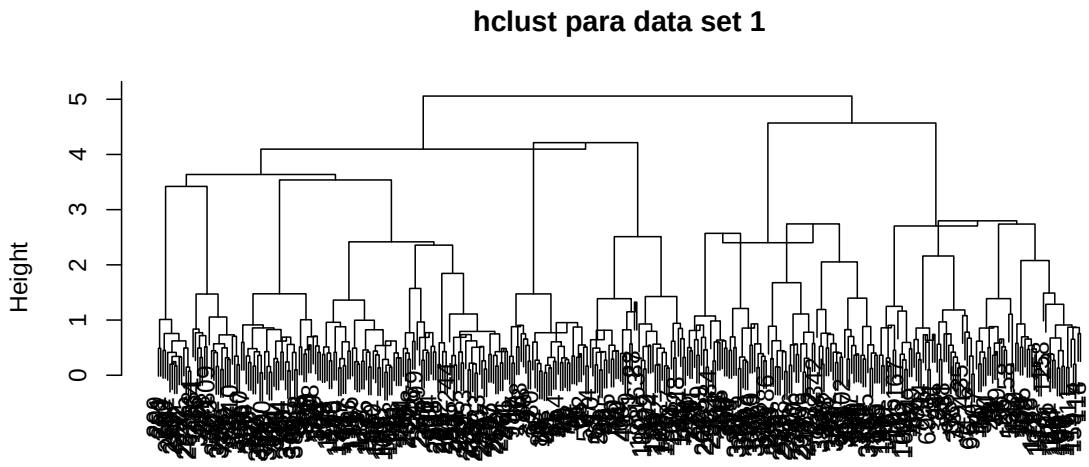



```
##
```

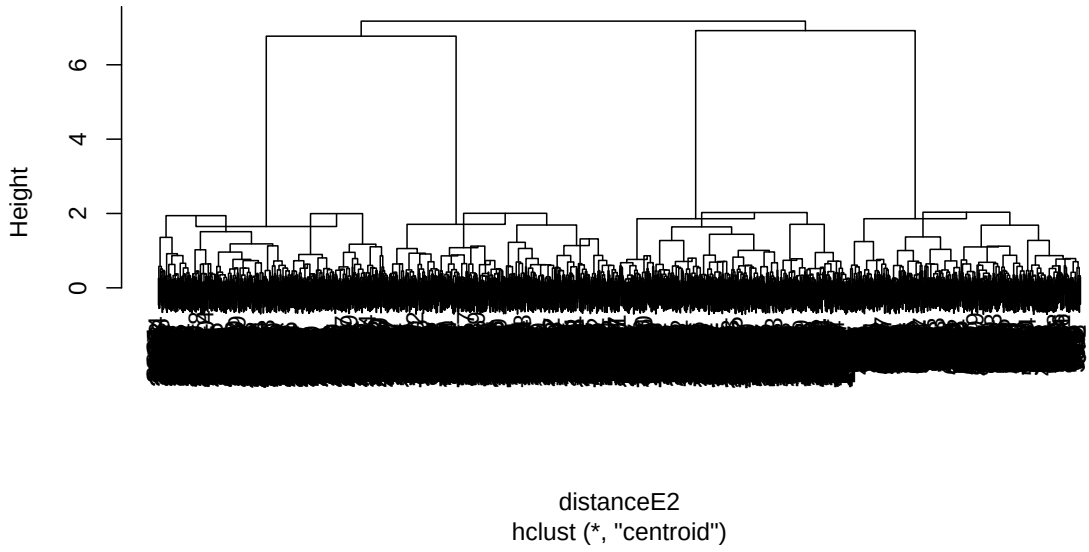
```
## corteE3   1   2   3   4
##        1 188   0 500   0
##        2 312   0   0   0
##        3   0 500   0   0
##        4   0   0   0 500
```




```
##
## corteE4   1   2   3   4
##        1 100 100 101 101
##        2   0   1   0   0
##        3   1   0   0   0
##        4   1   0   0   0
```

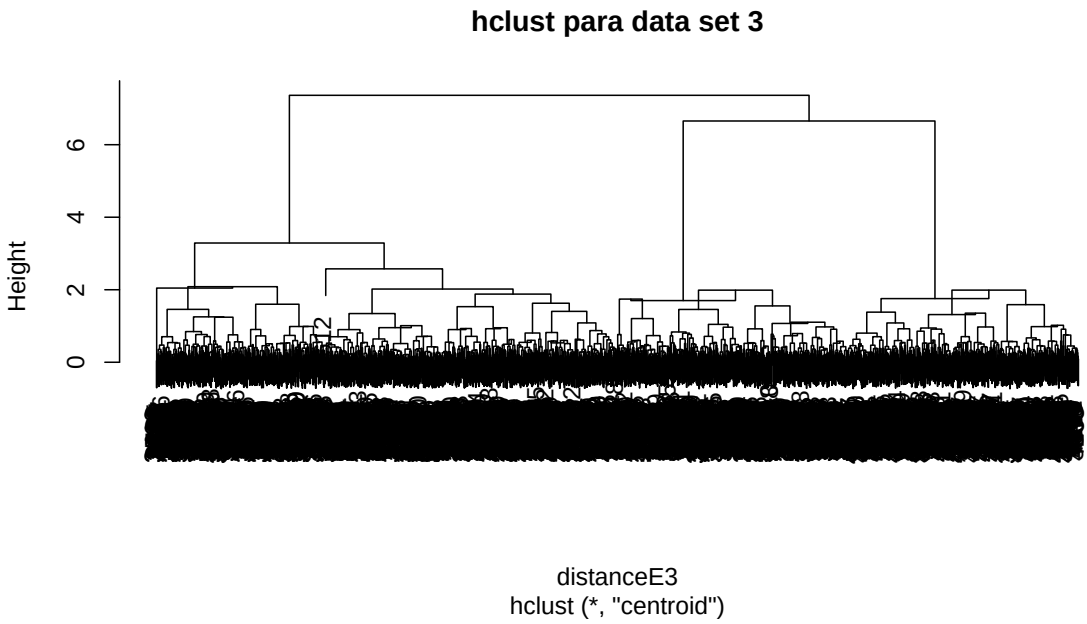



```
##
## corteE1  1  2  3  4
##       1 56 21  0  0
##       2 44 44  0  0
##       3  0 35 61 56
##       4  0  0 39 44
```

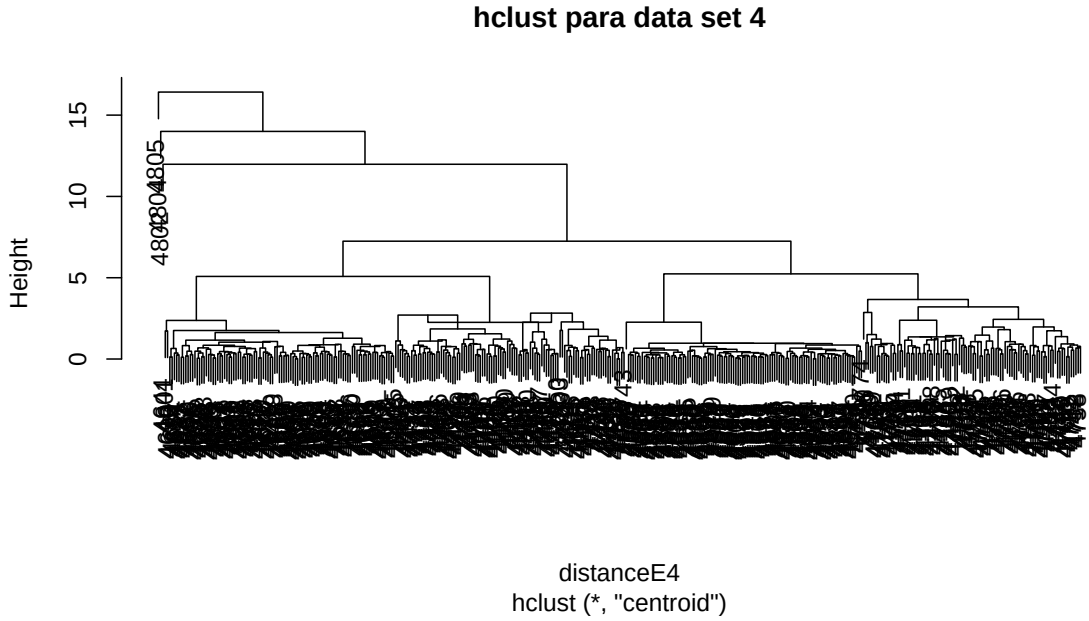



```
##
```

```
## corteE2   1   2   3   4
##        1 500   0   0   0
##        2   0 500   0   0
##        3   0   0 500   0
##        4   0   0   0 500
```




```
##
## corteE3   1   2   3   4
##        1 500   0 133   0
##        2   0 500   0   0
##        3   0   0 367   0
##        4   0   0   0 500
```




```
##
## corteE4   1   2   3   4
##       1 100 100 101 101
##       2   0   1   0   0
##       3   1   0   0   0
##       4   1   0   0   0
```

Cada matriz de confusión se hallo perfecta la precisión para el caso en que se utilizaba el metodo "single" o mas cercano.

4. Sea el dendrograma ganador

```
for(i in 2:5){
  print("para el set de datos 1 el dendrograma debe tener altura")
  print(sort(mejor1$height,decreasing = T)[i])
  print(paste("para i =",i," cluster"))
  print("para el set de datos 2 el dendrograma debe tener altura")
  print(sort(mejor2$height,decreasing = T)[i])
  print(paste("para i =",i," cluster"))
  print("para el set de datos 3 el dendrograma debe tener altura")
  print(sort(mejor3$height,decreasing = T)[i])
  print(paste("para i =",i," cluster"))
  print("para el set de datos 4 el dendrograma debe tener altura")
  print(sort(mejor4$height,decreasing = T)[i])
  print(paste("para i =",i," cluster"))
}
```

```
## [1] "para el set de datos 1 el dendrograma debe tener altura"
## [1] 2.147032
```

```
## [1] "para i = 2  cluster"
## [1] "para el set de datos 2 el dendrograma debe tener altura"
## [1] 6.919186
## [1] "para i = 2  cluster"
## [1] "para el set de datos 3 el dendrograma debe tener altura"
## [1] 10.27625
## [1] "para i = 2  cluster"
## [1] "para el set de datos 4 el dendrograma debe tener altura"
## [1] 22.27385
## [1] "para i = 2  cluster"
## [1] "para el set de datos 1 el dendrograma debe tener altura"
## [1] 2.121351
## [1] "para i = 3  cluster"
## [1] "para el set de datos 2 el dendrograma debe tener altura"
## [1] 6.769959
## [1] "para i = 3  cluster"
## [1] "para el set de datos 3 el dendrograma debe tener altura"
## [1] 6.888918
## [1] "para i = 3  cluster"
## [1] "para el set de datos 4 el dendrograma debe tener altura"
## [1] 22.04079
## [1] "para i = 3  cluster"
## [1] "para el set de datos 1 el dendrograma debe tener altura"
## [1] 1.323578
## [1] "para i = 4  cluster"
## [1] "para el set de datos 2 el dendrograma debe tener altura"
## [1] 2.033709
## [1] "para i = 4  cluster"
## [1] "para el set de datos 3 el dendrograma debe tener altura"
## [1] 4.537209
## [1] "para i = 4  cluster"
## [1] "para el set de datos 4 el dendrograma debe tener altura"
## [1] 18.97112
## [1] "para i = 4  cluster"
## [1] "para el set de datos 1 el dendrograma debe tener altura"
## [1] 1.140298
## [1] "para i = 5  cluster"
## [1] "para el set de datos 2 el dendrograma debe tener altura"
## [1] 2.02526
## [1] "para i = 5  cluster"
## [1] "para el set de datos 3 el dendrograma debe tener altura"
## [1] 4.406336
## [1] "para i = 5  cluster"
## [1] "para el set de datos 4 el dendrograma debe tener altura"
## [1] 15.53133
## [1] "para i = 5  cluster"
```

5. dado que las clases de los sets de datos de entrada poseen todos 4 clases, luego seleccionemos este valor como k para cortar el arbol

```r
sort(mejor1$height,decreasing = T)[4]
```

```
## [1] 1.323578
```

```r
sort(mejor2$height,decreasing = T)[4]
```

```
## [1] 2.033709
```

```r
sort(mejor3$height,decreasing = T)[4]
```

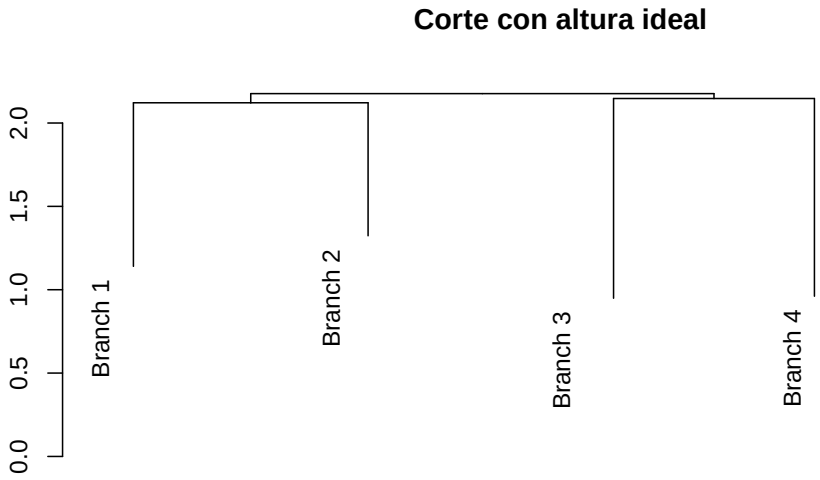
```
## [1] 4.537209
```

```r
sort(mejor4$height,decreasing = T)[4]
```

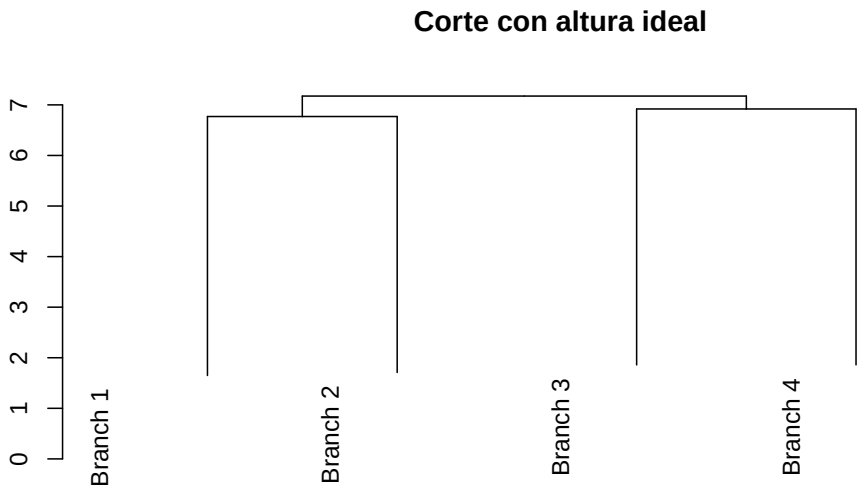
```
## [1] 18.97112
```

6. Grafica de los dendrogramas ganadores segun el mejor numero de altura:

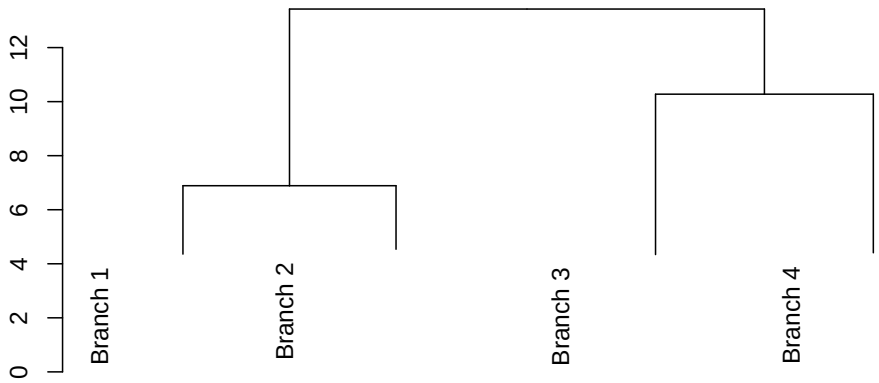
```r
mejor1$dendo <- as.dendrogram(mejor1)
mejorcorte1 <- cut(mejor1$dendo,h= sort(mejor1$height,decreasing = T)[4])$upper
plot(mejorcorte1, main = "Corte con altura ideal")
```



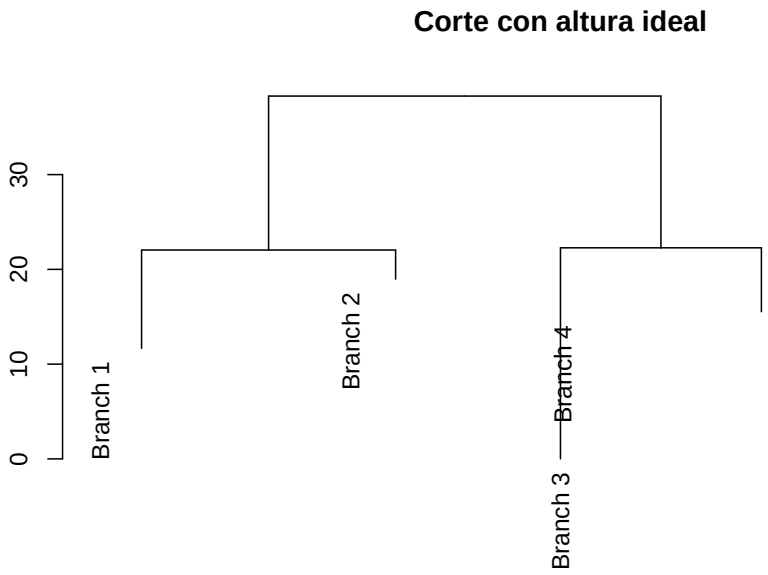

```r
mejor2$dendo <- as.dendrogram(mejor2)
mejorcorte2 <- cut(mejor2$dendo,h= sort(mejor2$height,decreasing = T)[4])$upper
plot(mejorcorte2, main = "Corte con altura ideal")
```




```
mejor3$dendo <- as.dendrogram(mejor3)
mejorcorte3 <- cut(mejor3$dendo,h= sort(mejor3$height,decreasing = T)[4])$upper
plot(mejorcorte3, main = "Corte con altura ideal")
```

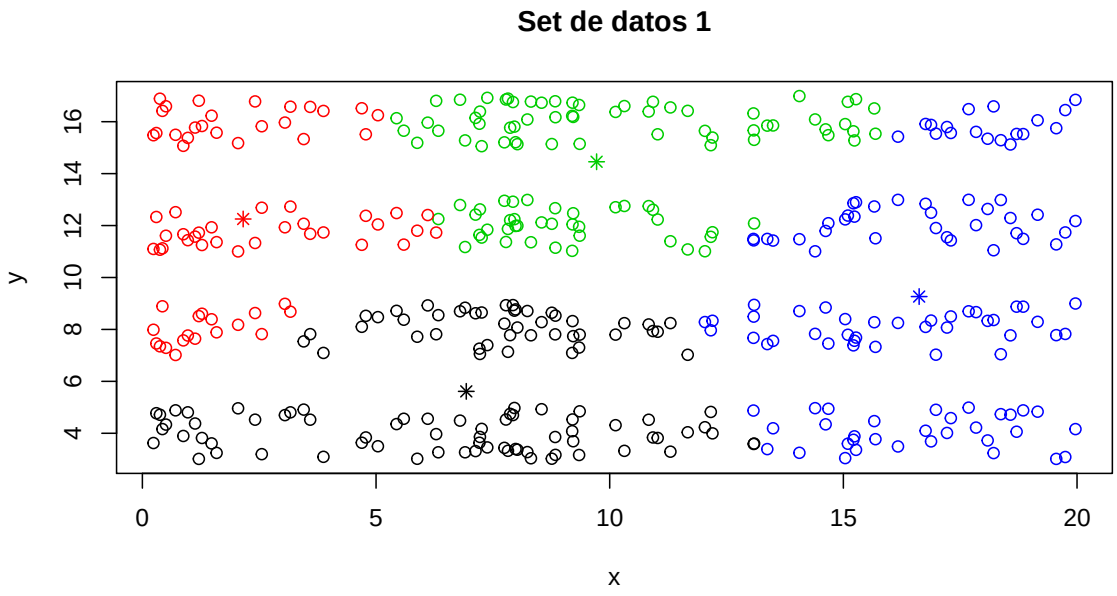


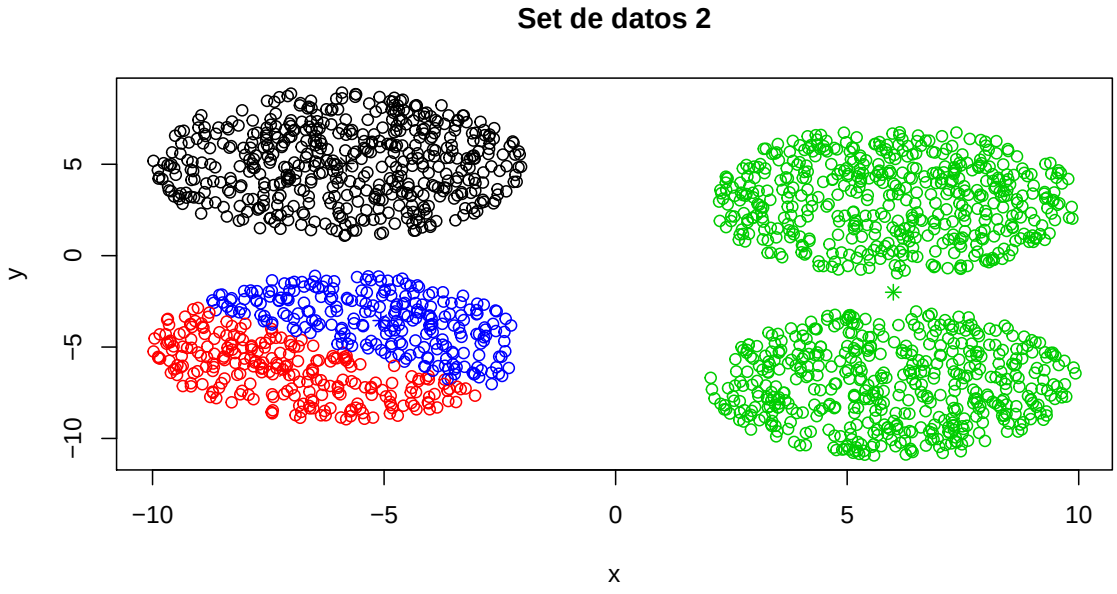

```
mejor4$dendo <- as.dendrogram(mejor4)
mejorcorte4 <- cut(mejor4$dendo,h= sort(mejor4$height,decreasing = T)[4])$upper
plot(mejorcorte4, main = "Corte con altura ideal")
```

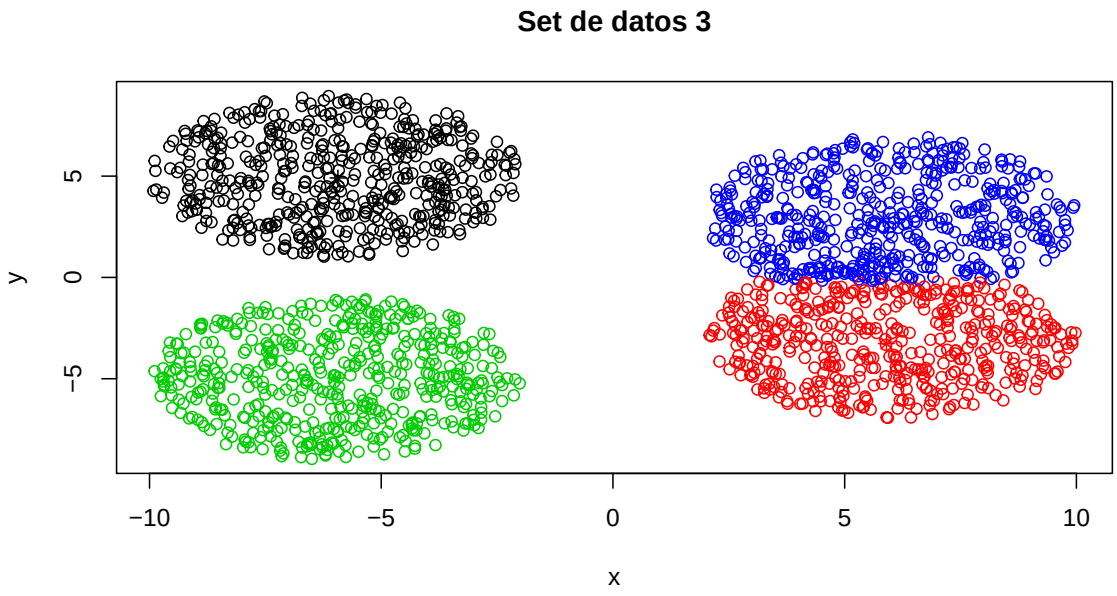


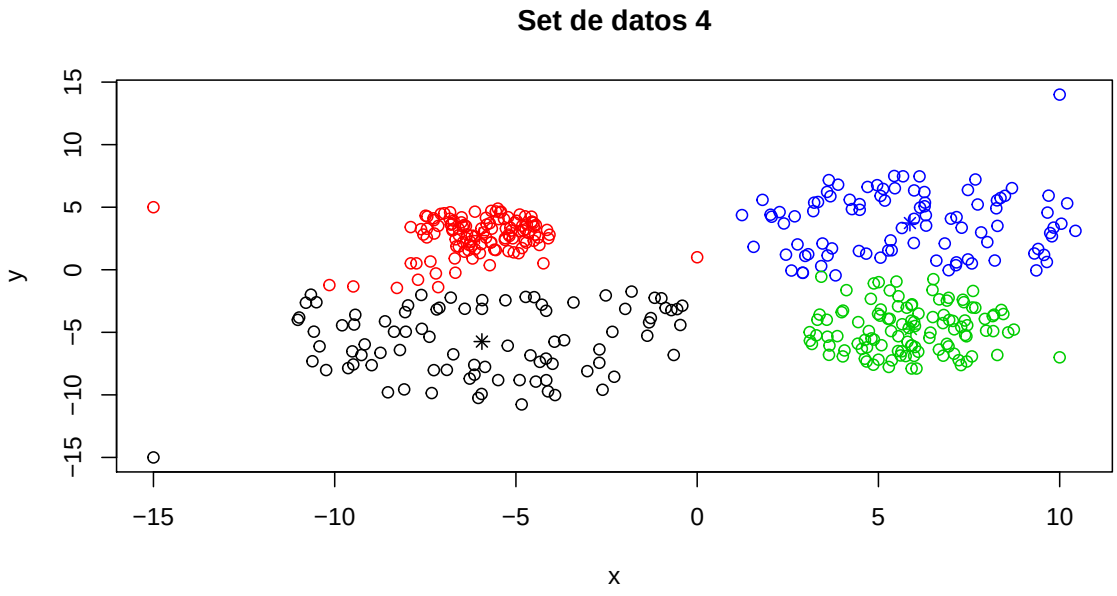
7. Dado que se conoce la clasificación en 4 diferentes conjuntos de la data se usara el k= 4
8. Grafica de la clusterizacion mediante k-medias y sus centros:

```
for(i in 1:4){
  subs<- subset(data,subset = data$id == i)
  kmd <- kmeans(subs[c(3,4)],4)
  plot(subs[c(3,4)], col = kmd$cluster, xlab = "x",ylab = "y",main = paste("Set de datos",i,sep=" "))
  points(kmd$centers, col = 1:4, pch = 8)
}
```


Set de datos 1
y
16
14
12
10
8
6
4
0
5
10
15
20
x


Set de datos 2
y
5
0
−5
−10
−10
−5
0
5
10
x





9. Para set de datos en los cuales la ubicación de los puntos o individuos posee una forma esferica puede ser conveniente el uso de k-medias, y para clusterizacion de formas no-esfericas proveen mayor precision los metodos de clasificación jerárquica por aglomeración(en este caso)

10. para calcular la clasificacion de la nueva instancia la agregamos a los sets y corremos los alogritmos de clusterizacion respectivos.

```
subs<- subset(data,subset = data$id == 1)
subs1 <- rbind(subs[,-c(1,2,5)],c(3,3))
```

```r
  distanceE1 <- dist(subs1,method = "euclidean")
  clusterE1 <- hclust(distanceE1,method = mejor1$method)
  corteE1 <- cutree(clusterE1,k=length(unique(subs$class)))
  print("en el Set 1")
```

```
## [1] "en el Set 1"
```

```r
  print(paste("en clasificacion jerarquica por aglomeracion",corteE1[length(corteE1)]))
```

```
## [1] "en clasificacion jerarquica por aglomeracion 1"
```

```r
  kmd <- kmeans(subs1,4)
  print(paste("en K-medias por otro lado reultaria en el cluster",unique(kmd$cluster)))
```

```
## [1] "en K-medias por otro lado reultaria en el cluster 3"
## [2] "en K-medias por otro lado reultaria en el cluster 2"
## [3] "en K-medias por otro lado reultaria en el cluster 1"
## [4] "en K-medias por otro lado reultaria en el cluster 4"
```

```r
  #-----------------------------------------------------------------
  subs<- subset(data,subset = data$id == 2)
  subs2 <- rbind(subs[,-c(1,2,5)],c(3,3))
  distanceE2 <- dist(subs2,method = "euclidean")
  clusterE2 <- hclust(distanceE2,method = mejor2$method)
  corteE2 <- cutree(clusterE2,k=length(unique(subs$class)))
  print("en el Set 2")
```

```
## [1] "en el Set 2"
```

```r
  print(paste("en clasificacion jerarquica por aglomeracion",corteE2[length(corteE2)]))
```

```
## [1] "en clasificacion jerarquica por aglomeracion 1"
```

```r
  kmd <- kmeans(subs2,4)
  print(paste("en K-medias por otro lado reultaria en el cluster",unique(kmd$cluster)))
```

```
## [1] "en K-medias por otro lado reultaria en el cluster 2"
## [2] "en K-medias por otro lado reultaria en el cluster 3"
## [3] "en K-medias por otro lado reultaria en el cluster 1"
## [4] "en K-medias por otro lado reultaria en el cluster 4"
```

```r
  #-----------------------------------------------------------------
  subs<- subset(data,subset = data$id == 3)
  subs3 <- rbind(subs[,-c(1,2,5)],c(3,3))
  distanceE3 <- dist(subs3,method = "euclidean")
  clusterE3 <- hclust(distanceE3,method = mejor3$method)
  corteE3 <- cutree(clusterE3,k=length(unique(subs$class)))
  print("en el Set 3")
```

```
## [1] "en el Set 3"
```

```
  print(paste("en clasificacion jerarquica por aglomeracion",corteE3[length(corteE3)]))
```

```
## [1] "en clasificacion jerarquica por aglomeracion 1"
```

```
  kmd <- kmeans(subs3,4)
  print(paste("en K-medias por otro lado reultaria en el cluster",unique(kmd$cluster)))
```

```
## [1] "en K-medias por otro lado reultaria en el cluster 3"
## [2] "en K-medias por otro lado reultaria en el cluster 1"
## [3] "en K-medias por otro lado reultaria en el cluster 2"
## [4] "en K-medias por otro lado reultaria en el cluster 4"
```

```
  #-----------------------------------------------------------------
  subs<- subset(data,subset = data$id == 4)
  subs4 <- rbind(subs[,-c(1,2,5)],c(3,3))
  distanceE4 <- dist(subs4,method = "euclidean")
  clusterE4 <- hclust(distanceE4,method = mejor4$method)
  corteE4 <- cutree(clusterE4,k=length(unique(subs$class)))
  print("en el Set 4")
```

```
## [1] "en el Set 4"
```

```
  print(paste("en clasificacion jerarquica por aglomeracion",corteE4[length(corteE4)]))
```

```
## [1] "en clasificacion jerarquica por aglomeracion 1"
```

```
  kmd <- kmeans(subs4,4)
  print(paste("en K-medias por otro lado reultaria en el cluster",unique(kmd$cluster)))
```

```
## [1] "en K-medias por otro lado reultaria en el cluster 2"
## [2] "en K-medias por otro lado reultaria en el cluster 1"
## [3] "en K-medias por otro lado reultaria en el cluster 3"
## [4] "en K-medias por otro lado reultaria en el cluster 4"
```

```
  #-----------------------------------------------------------------
```