Comparing more than two observations

CLUSTER ANALYSIS IN R

Dmitriy Gorenshteyn
Lead Data Scientist, Memorial Sloan Kettering Cancer Center

The closest observation to a pair

	1	2	3
2	11.7		
3	16.8	18.0	
4	**10.0**	20.6	15.8

- Is 2 is closest to group 1,4?
- Is 3 is closest to group 1,4?

Linkage criteria: complete

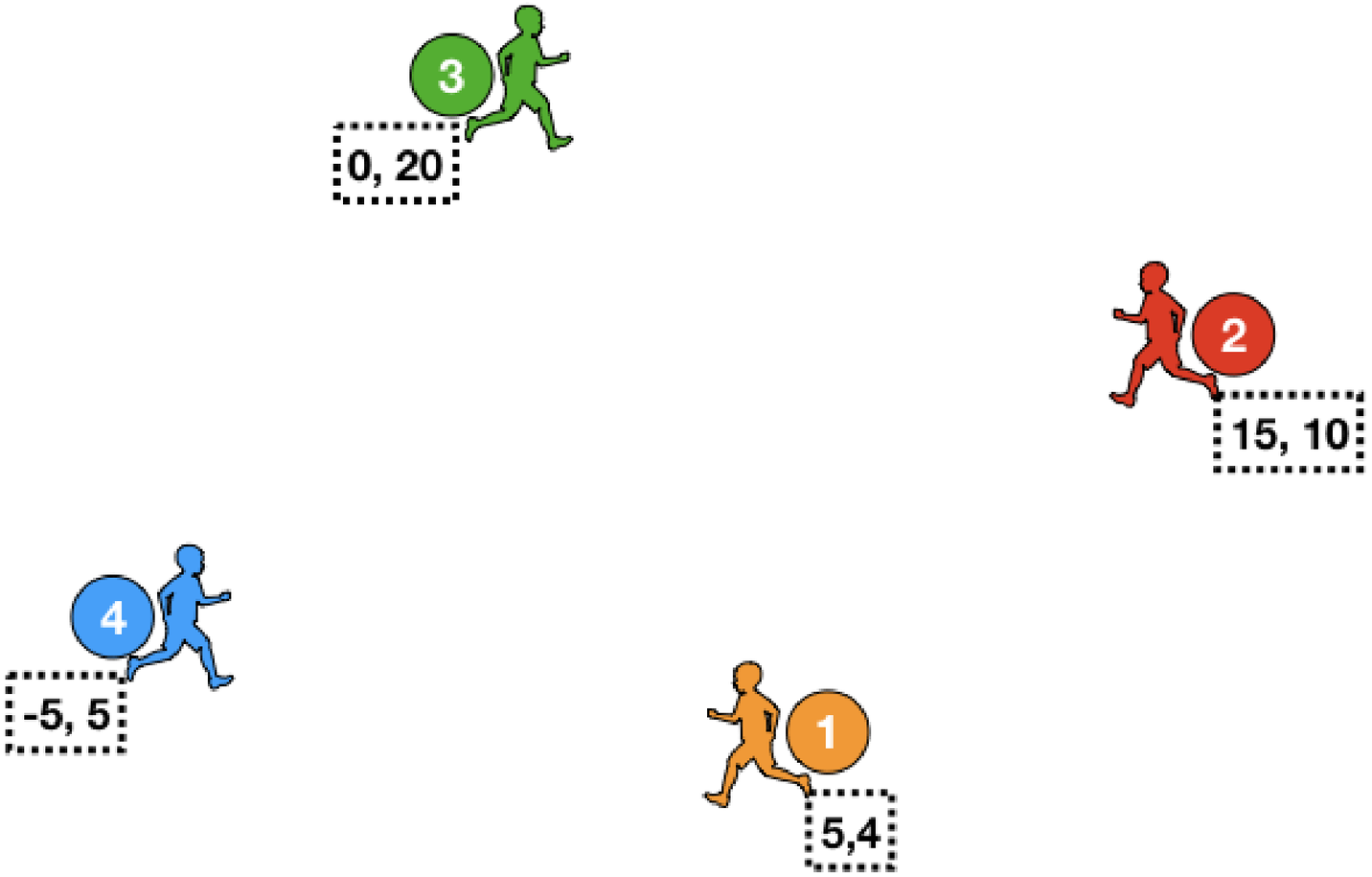
	1	2	3
2	11.7		
3	16.8	18.0	
4	**10.0**	20.6	15.8

- Is 2 is closest to group 1,4?
  - max(D(2,1), D(2,4)) = **20.6**
- Is 3 is closest to group 1,4?
  - max(D(3,1), D(3,4)) = **16.8**

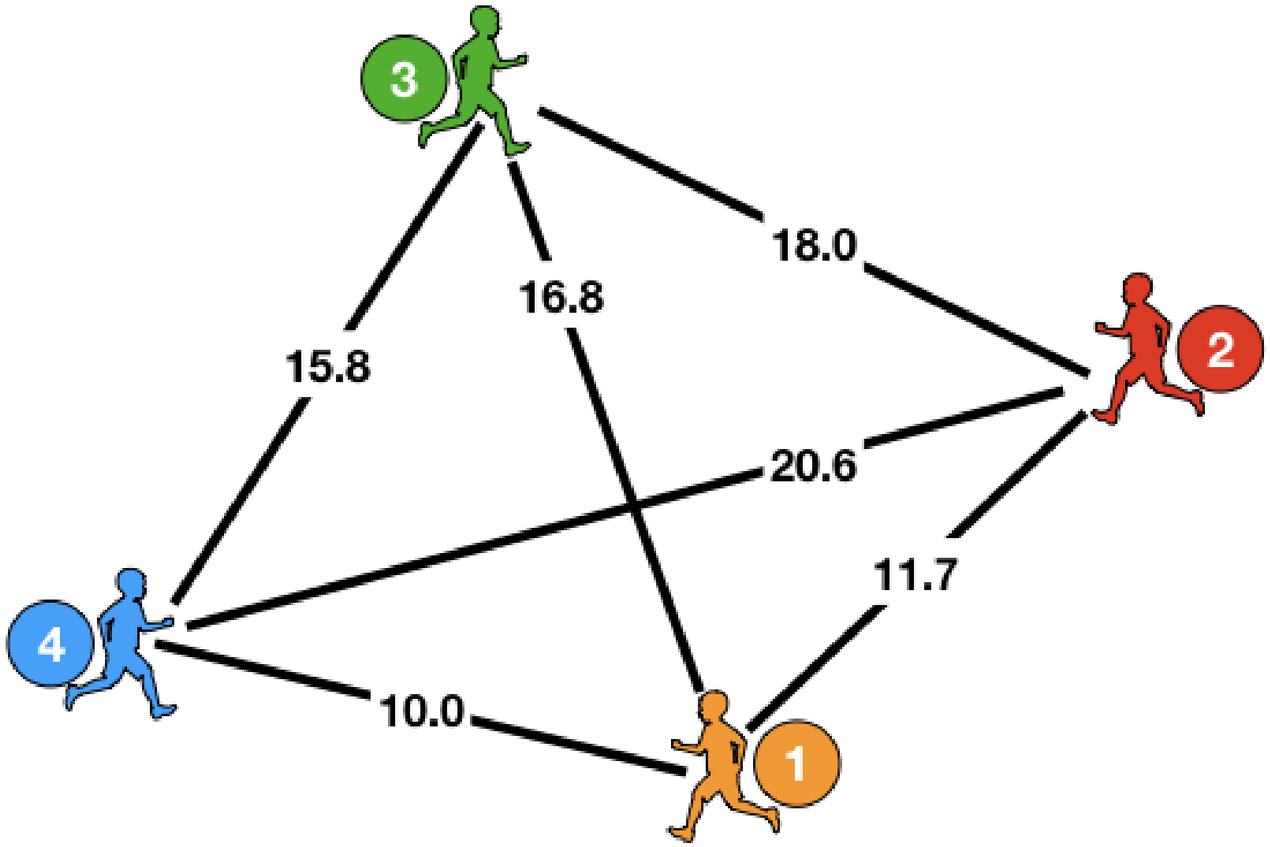
Hierarchical clustering

Complete Linkage: maximum distance between two sets

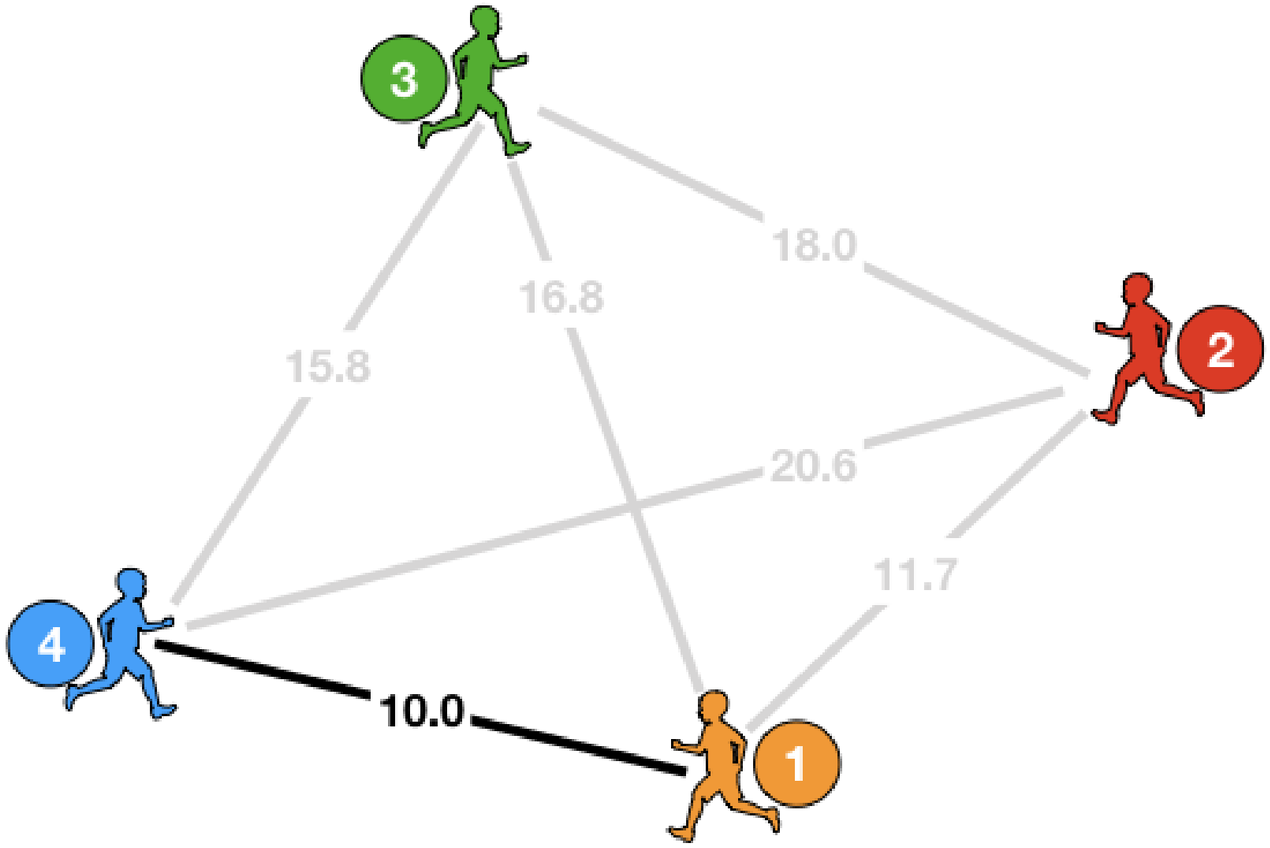
Grouping with linkage & distance



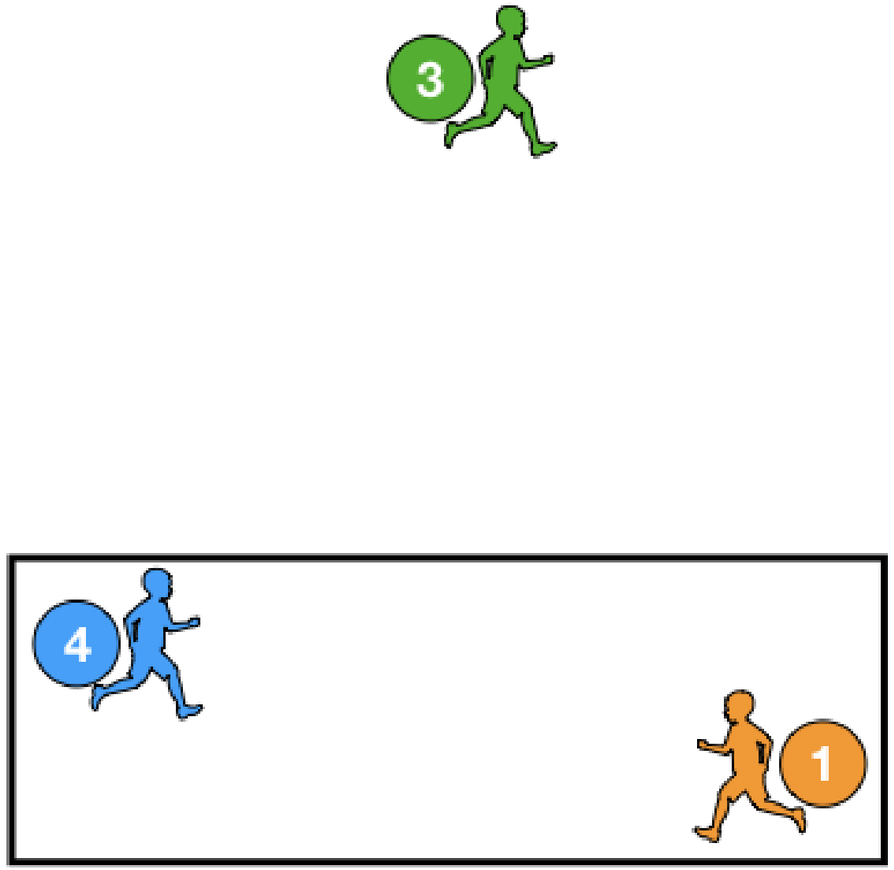
Grouping with linkage & distance



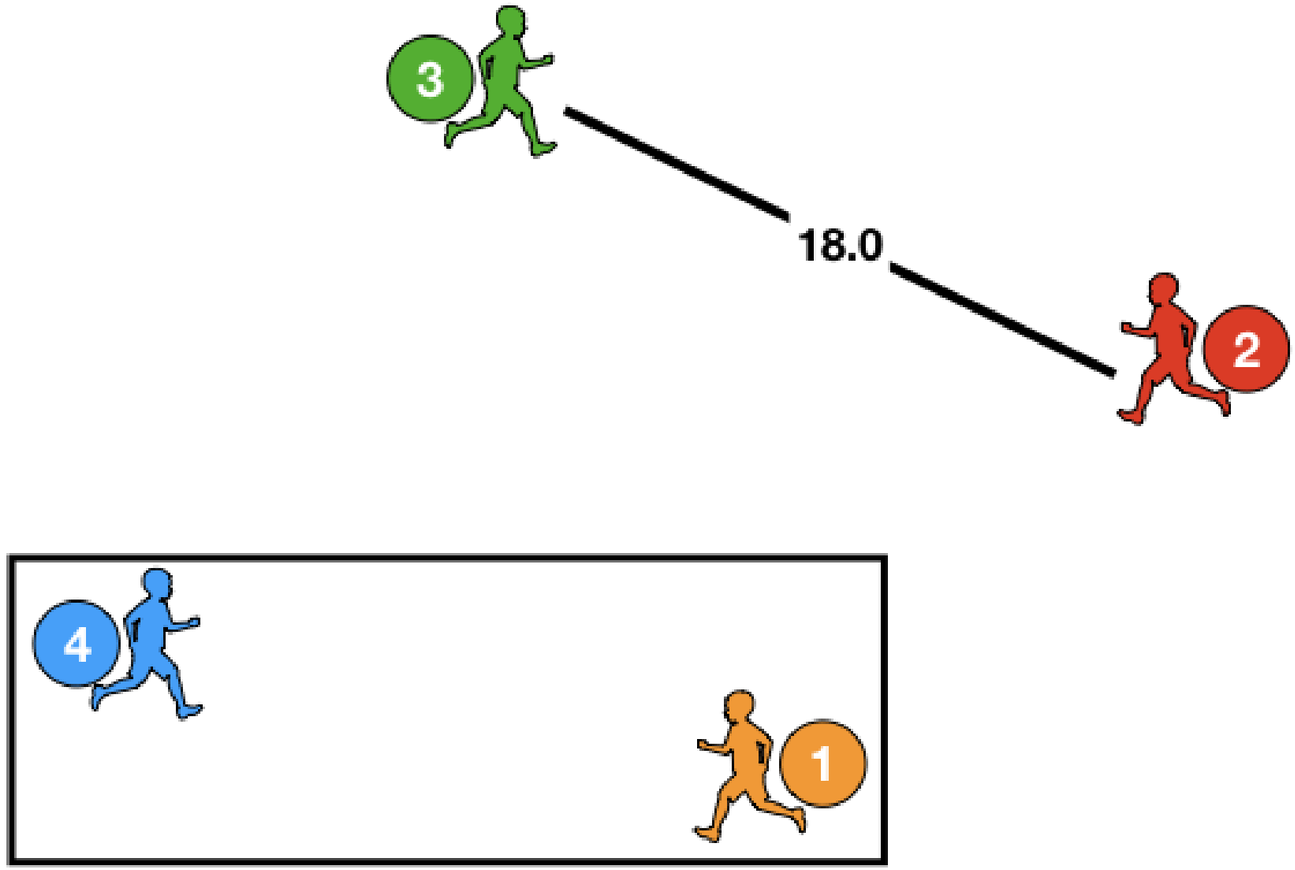
Grouping with linkage & distance



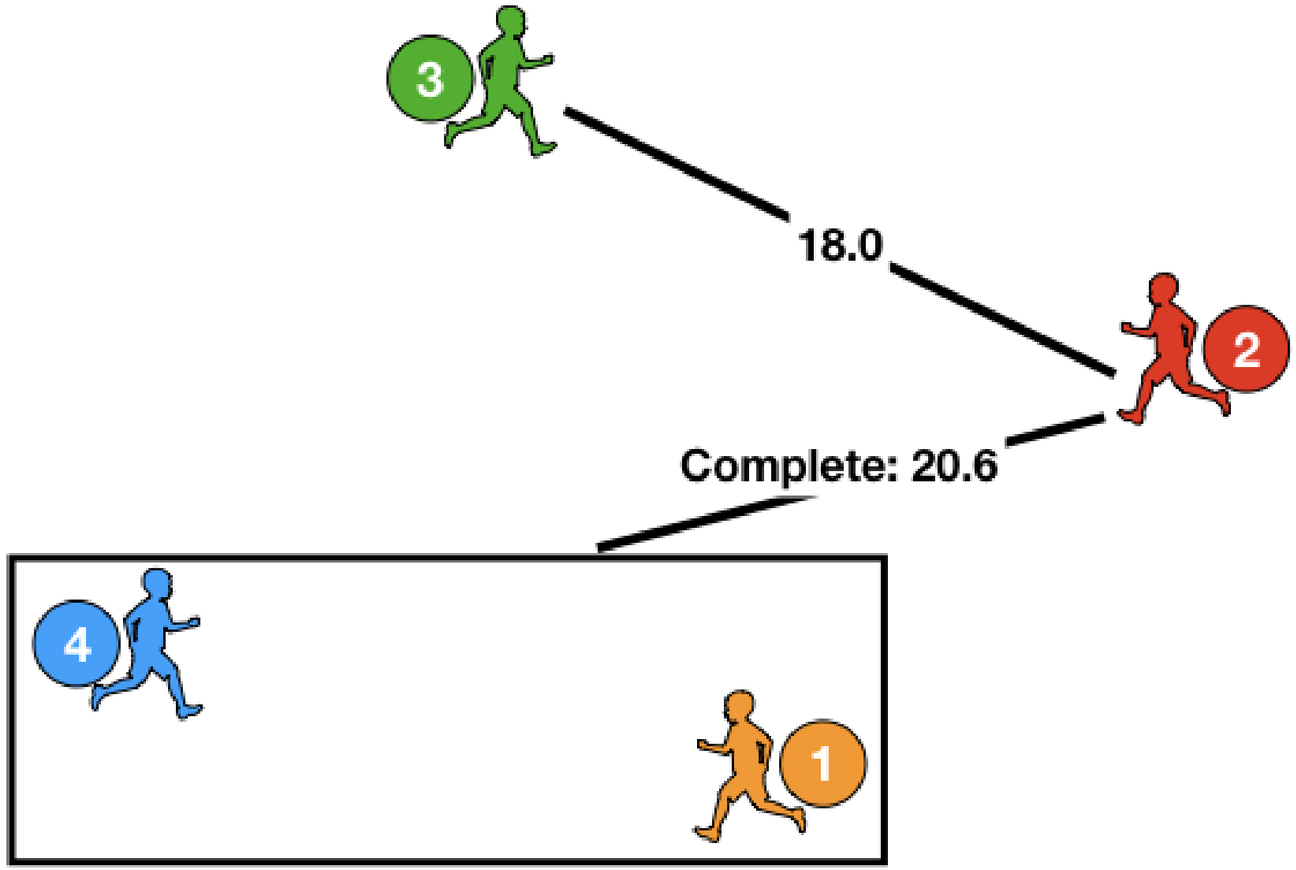
Grouping with linkage & distance



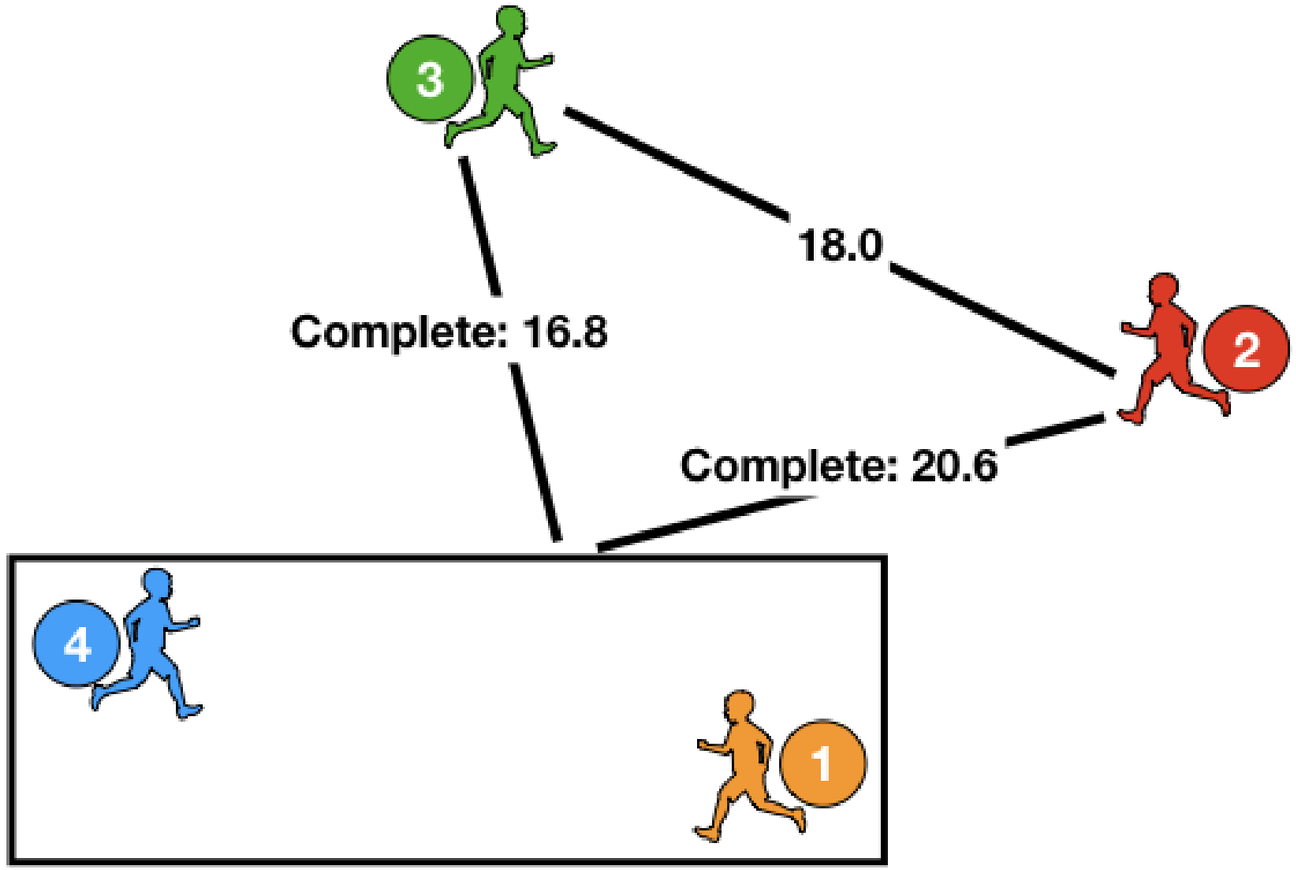
Grouping with linkage & distance



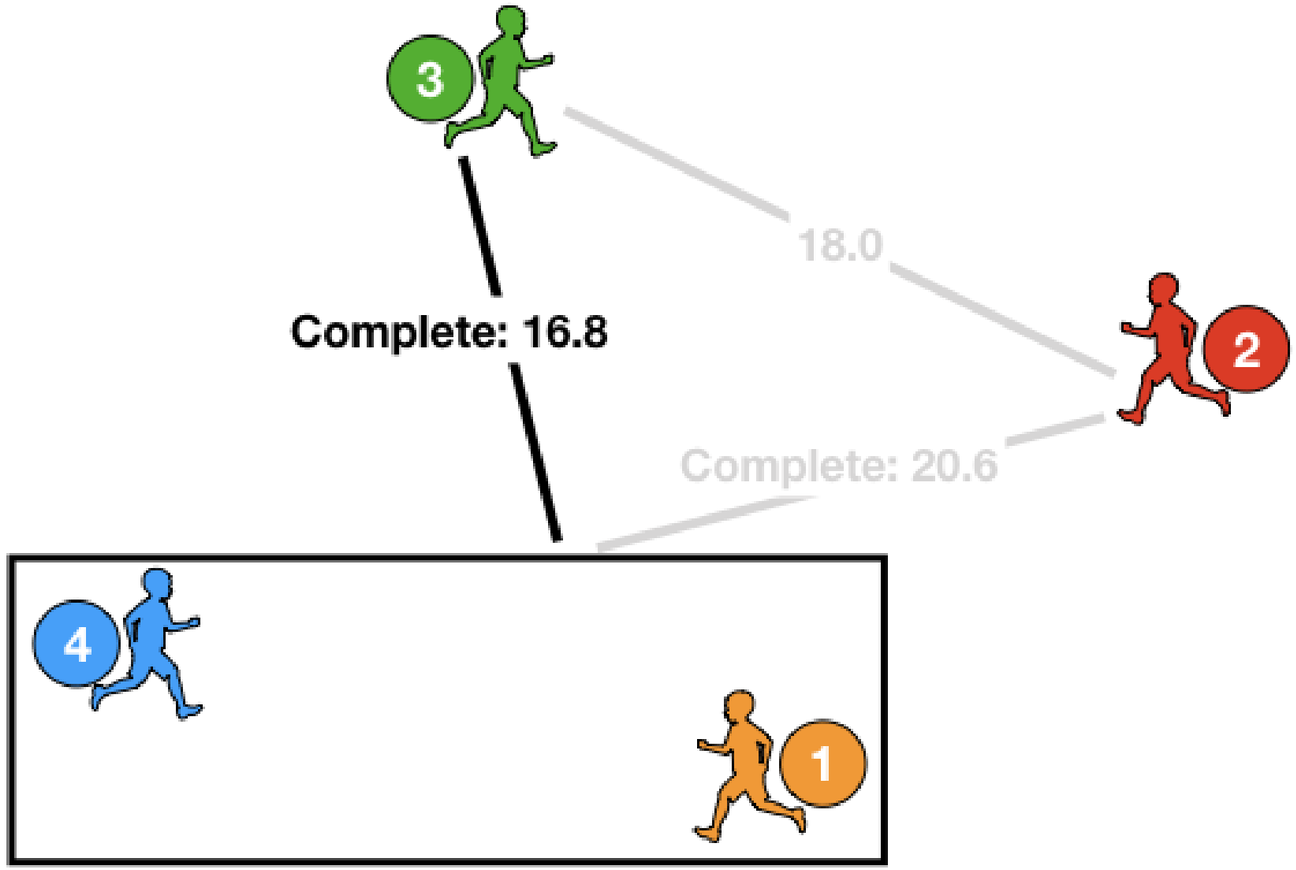
Grouping with linkage & distance



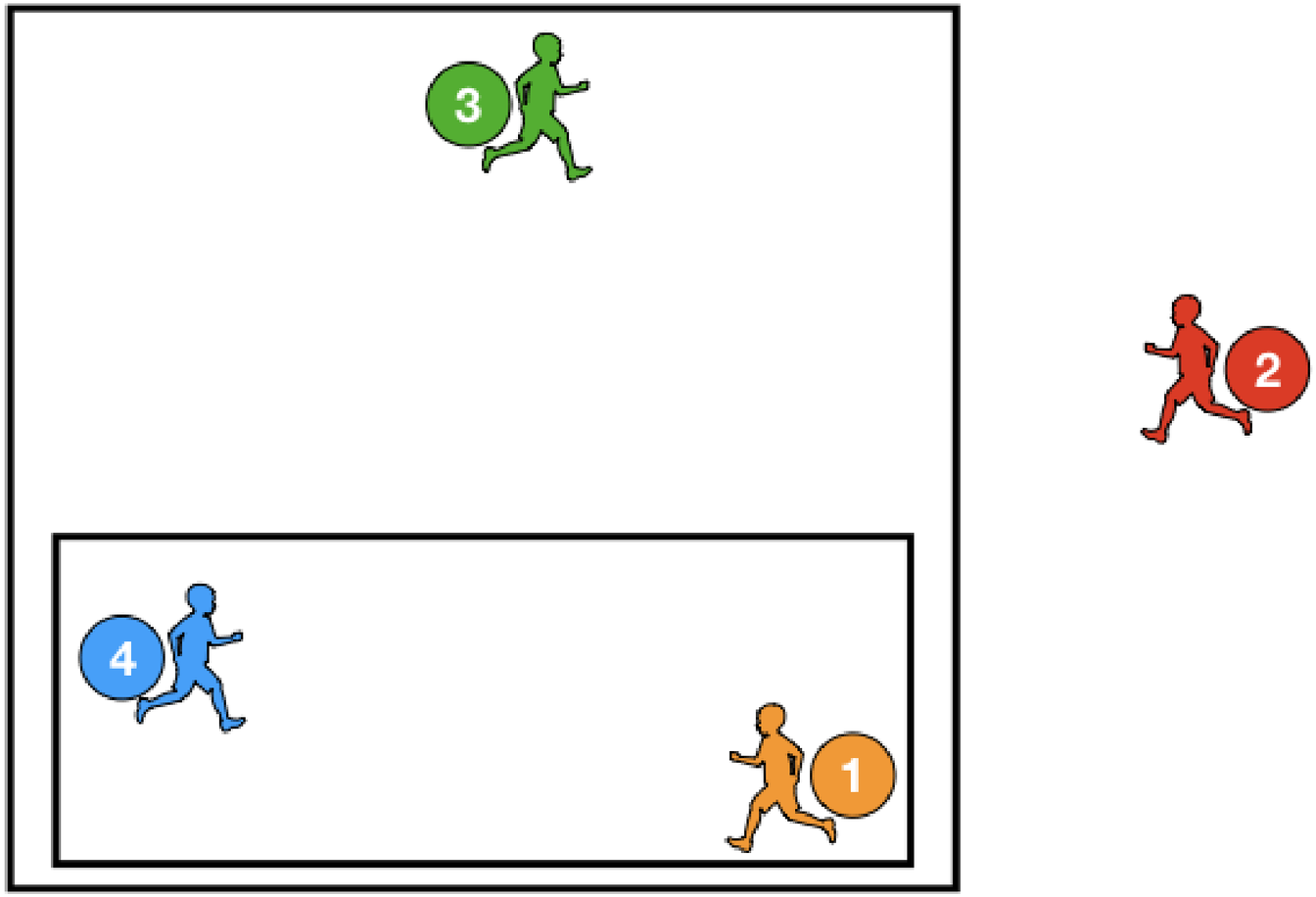
Grouping with linkage & distance



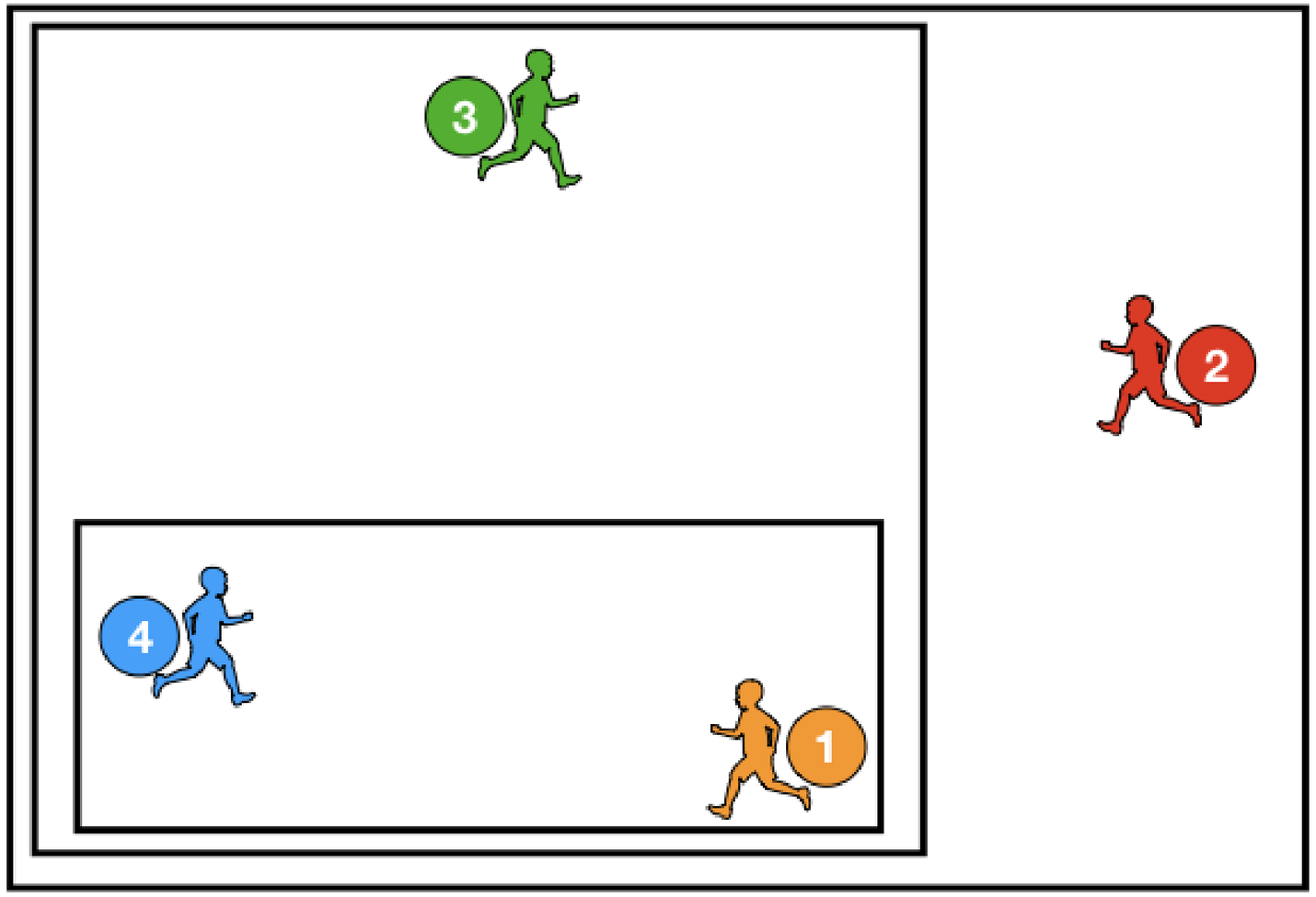
Grouping with linkage & distance



Grouping with linkage & distance



Grouping with linkage & distance



Linkage criteria

Complete Linkage: maximum distance between two sets

Single Linkage: minimum distance between two sets

Average Linkage: average distance between two sets

Let's practice!

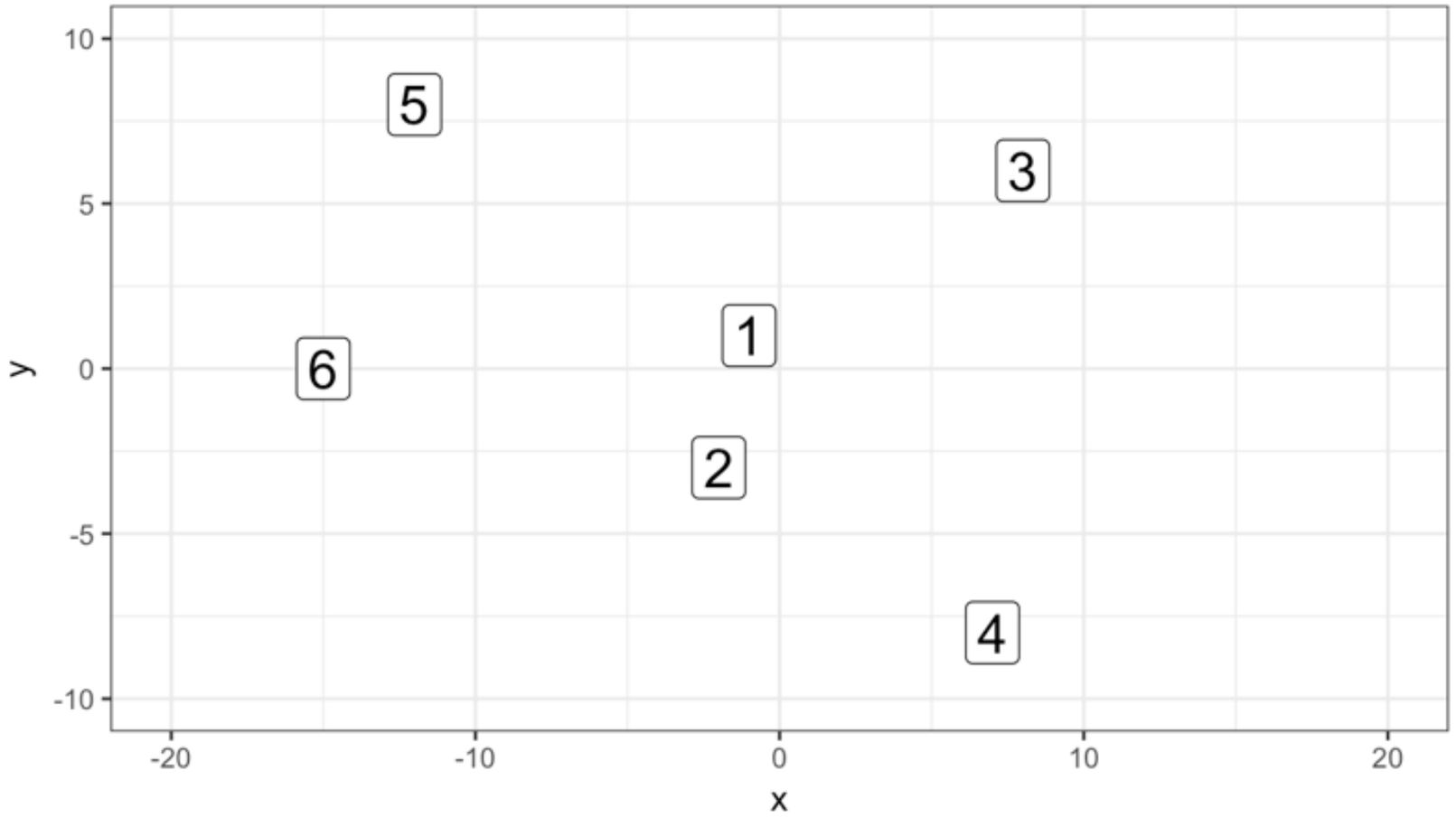
CLUSTER ANALYSIS IN R

Capturing K clusters

CLUSTER ANALYSIS IN R

Dmitriy Gorenshteyn

Lead Data Scientist, Memorial Sloan Kettering Cancer Center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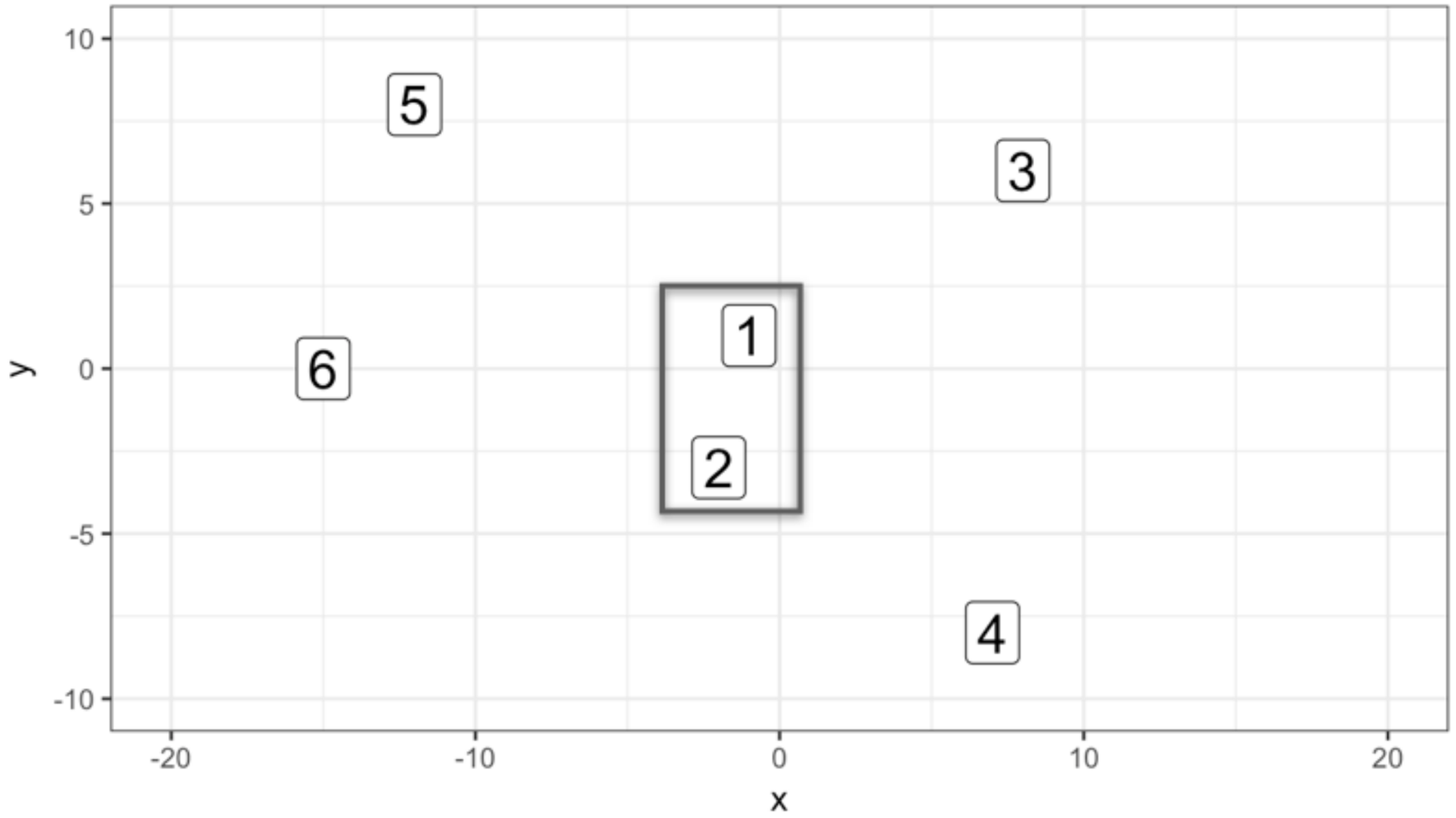
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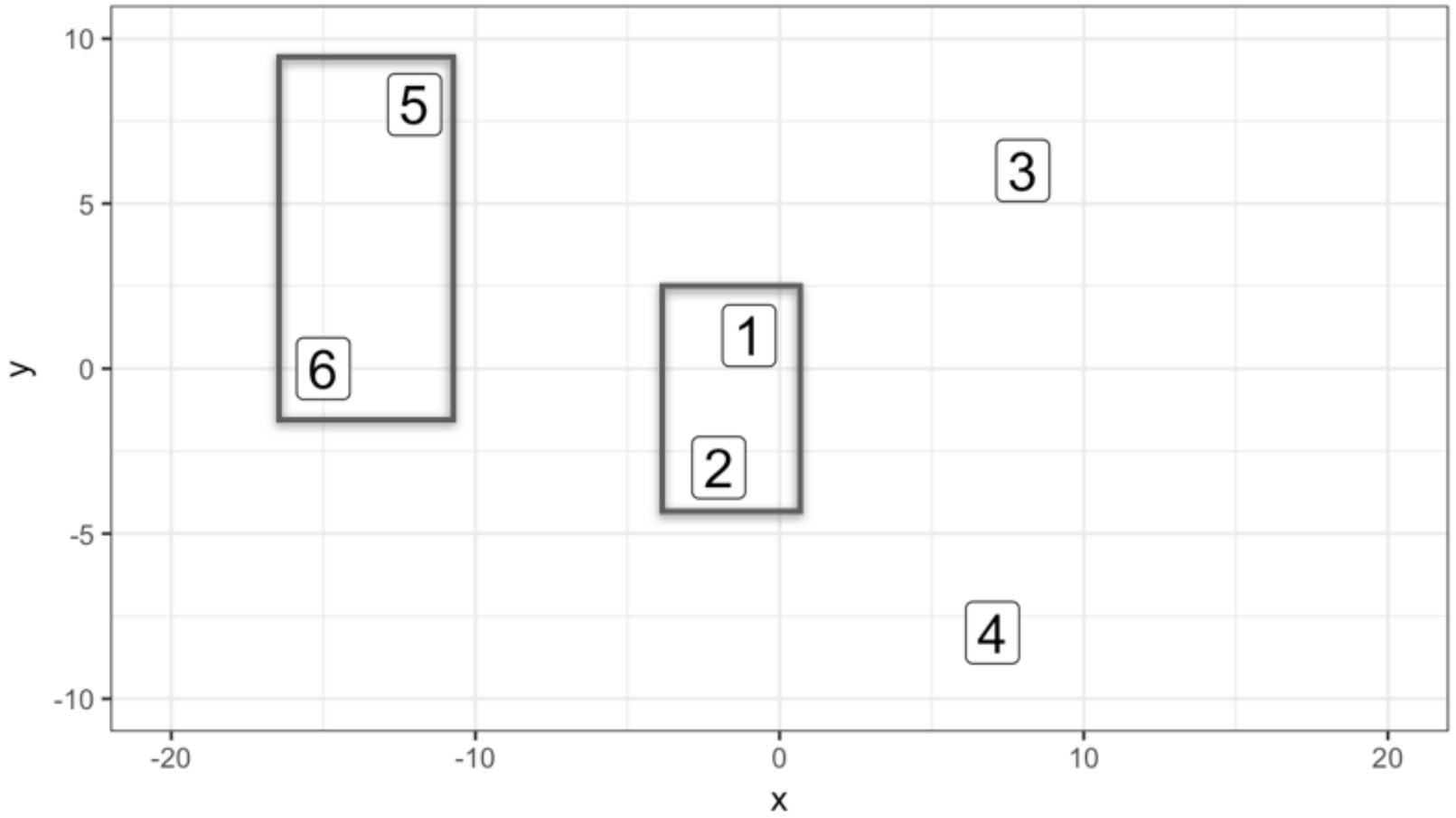
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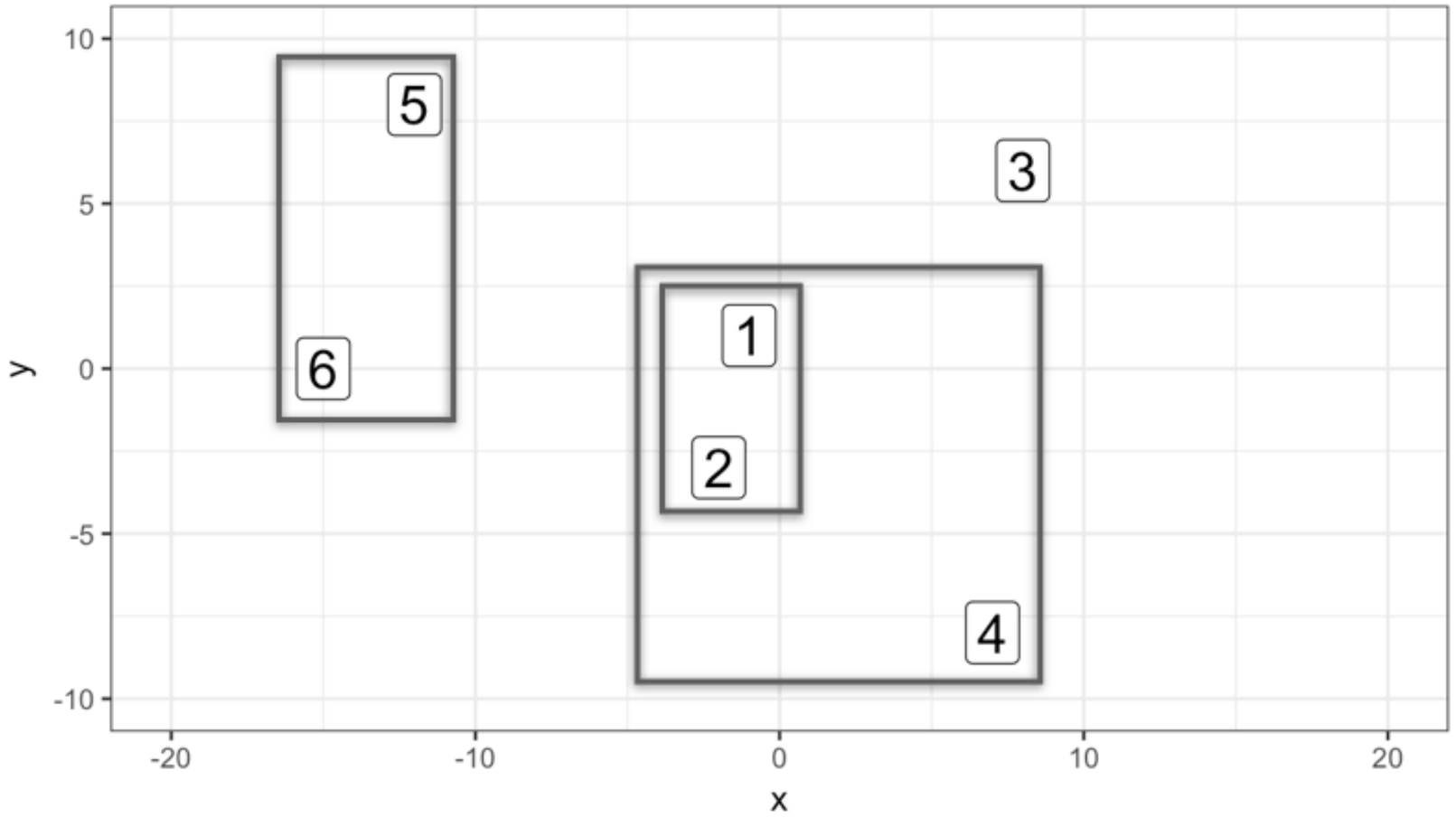
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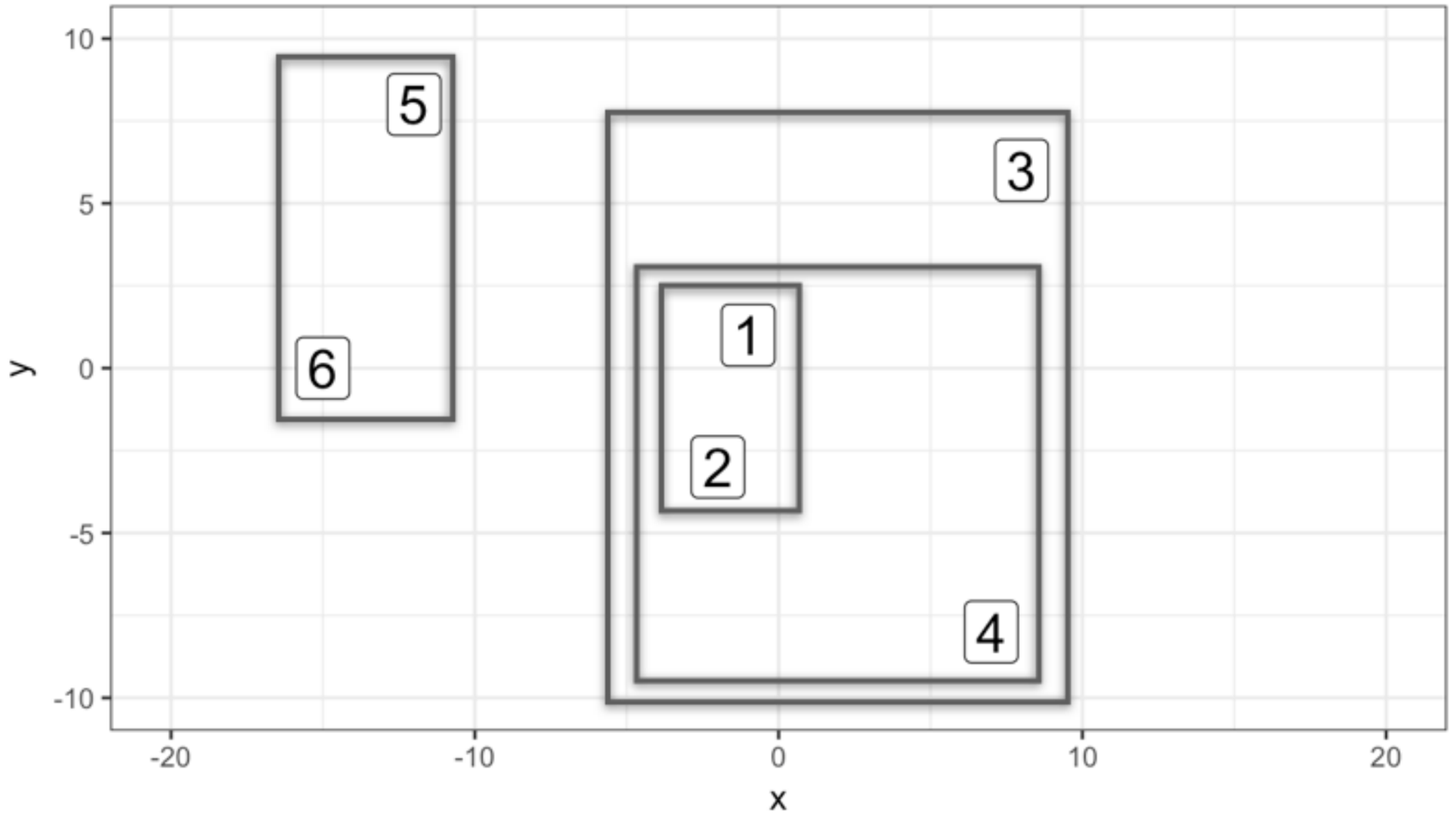
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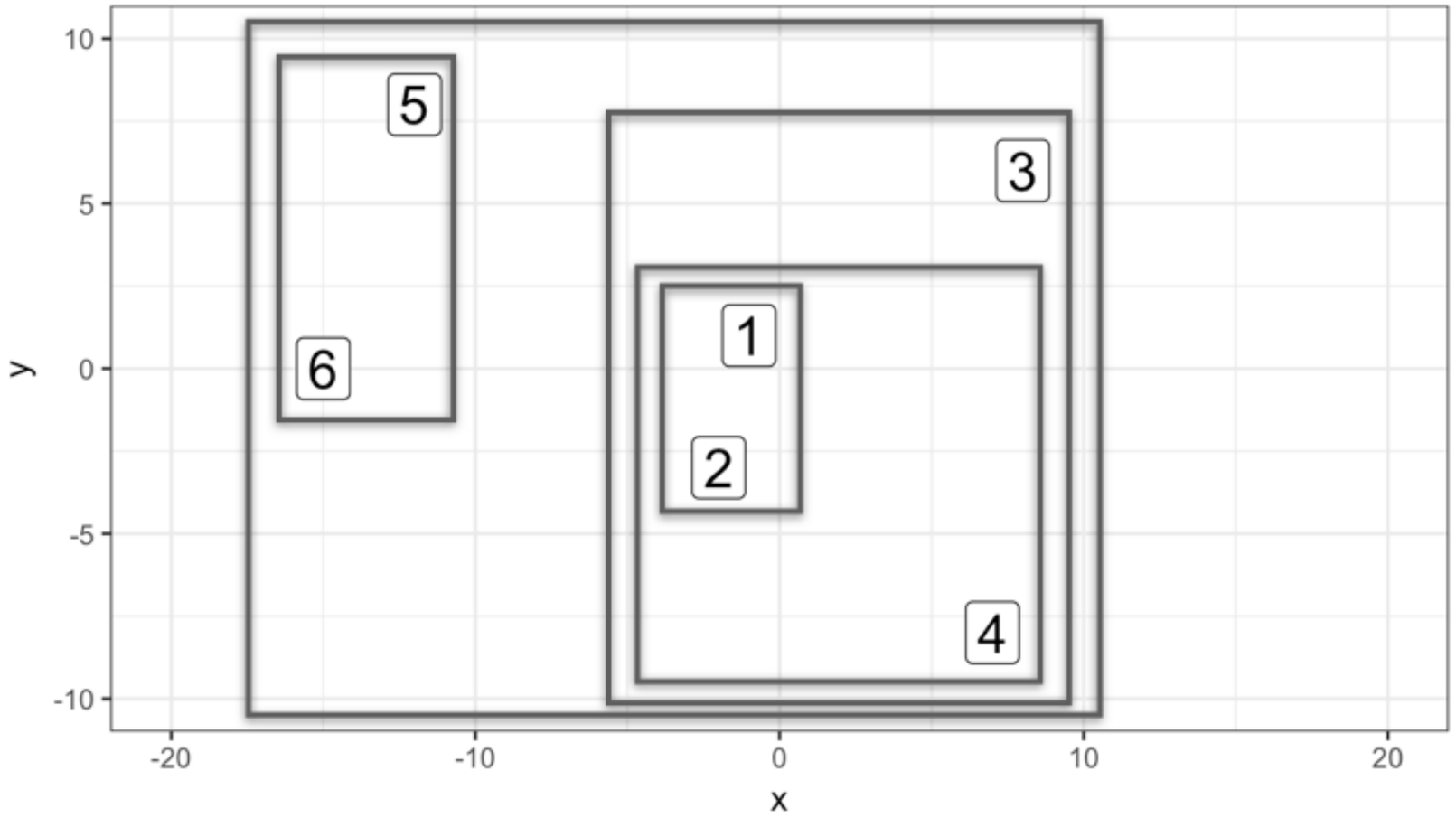
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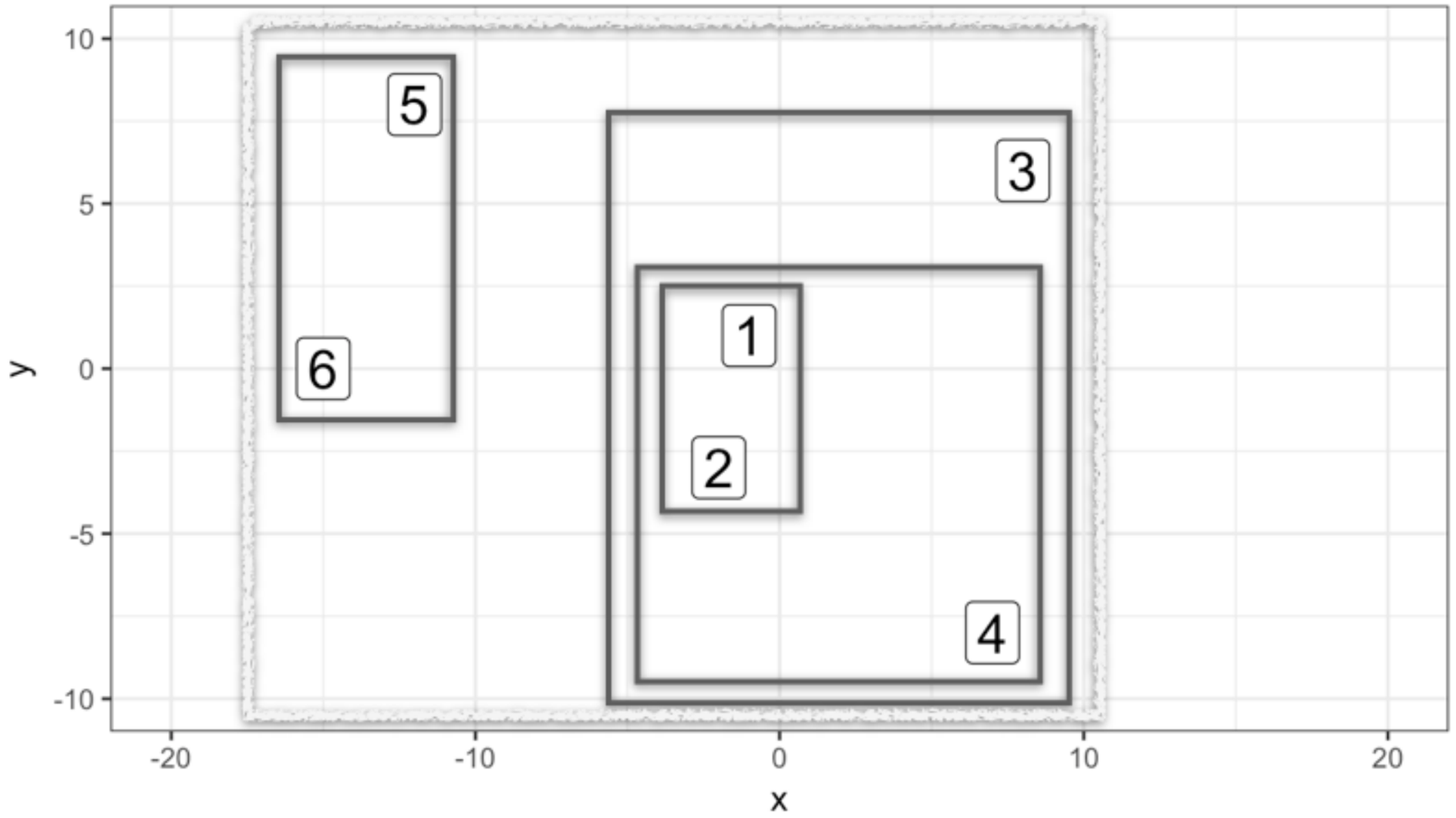
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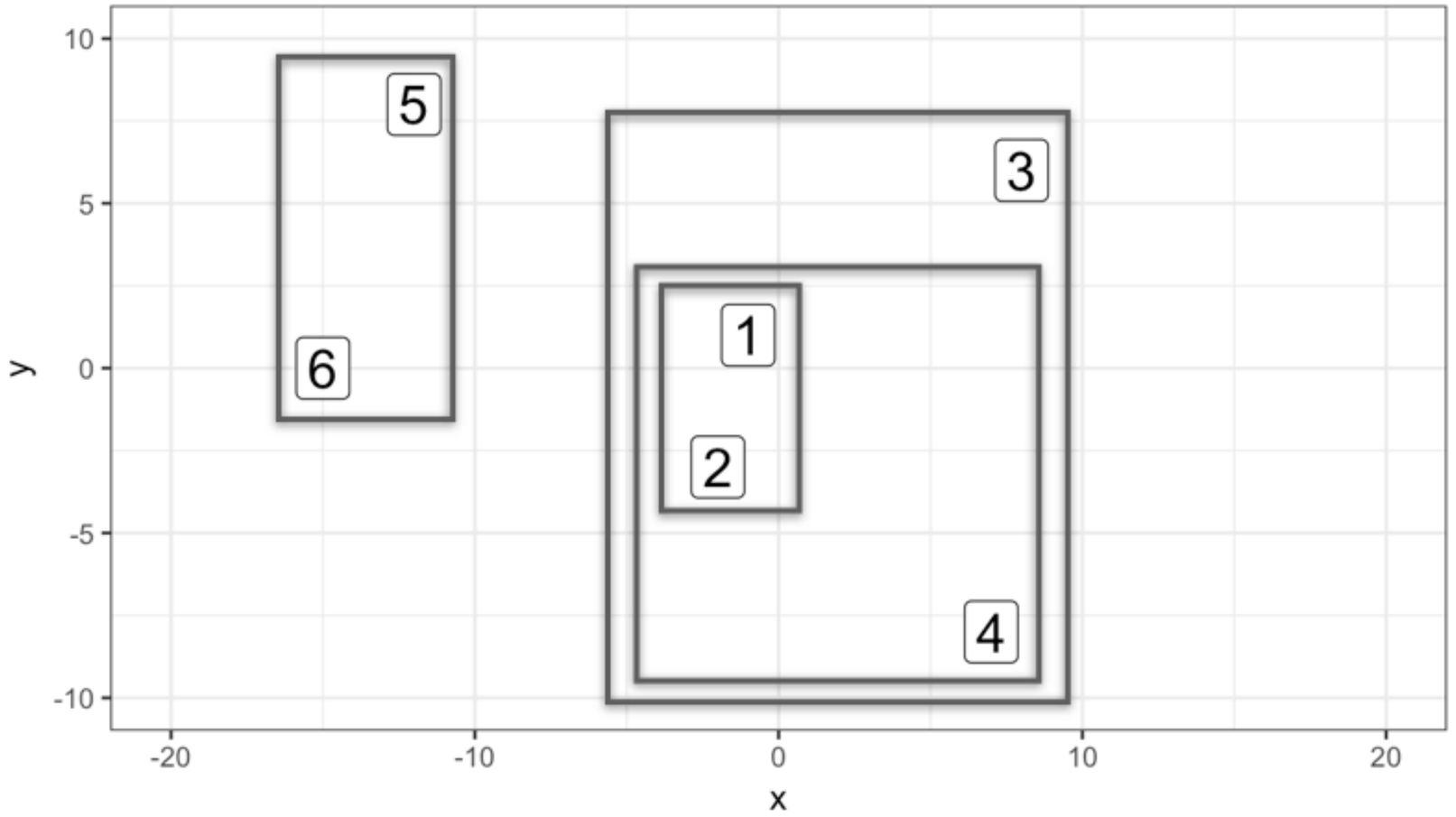
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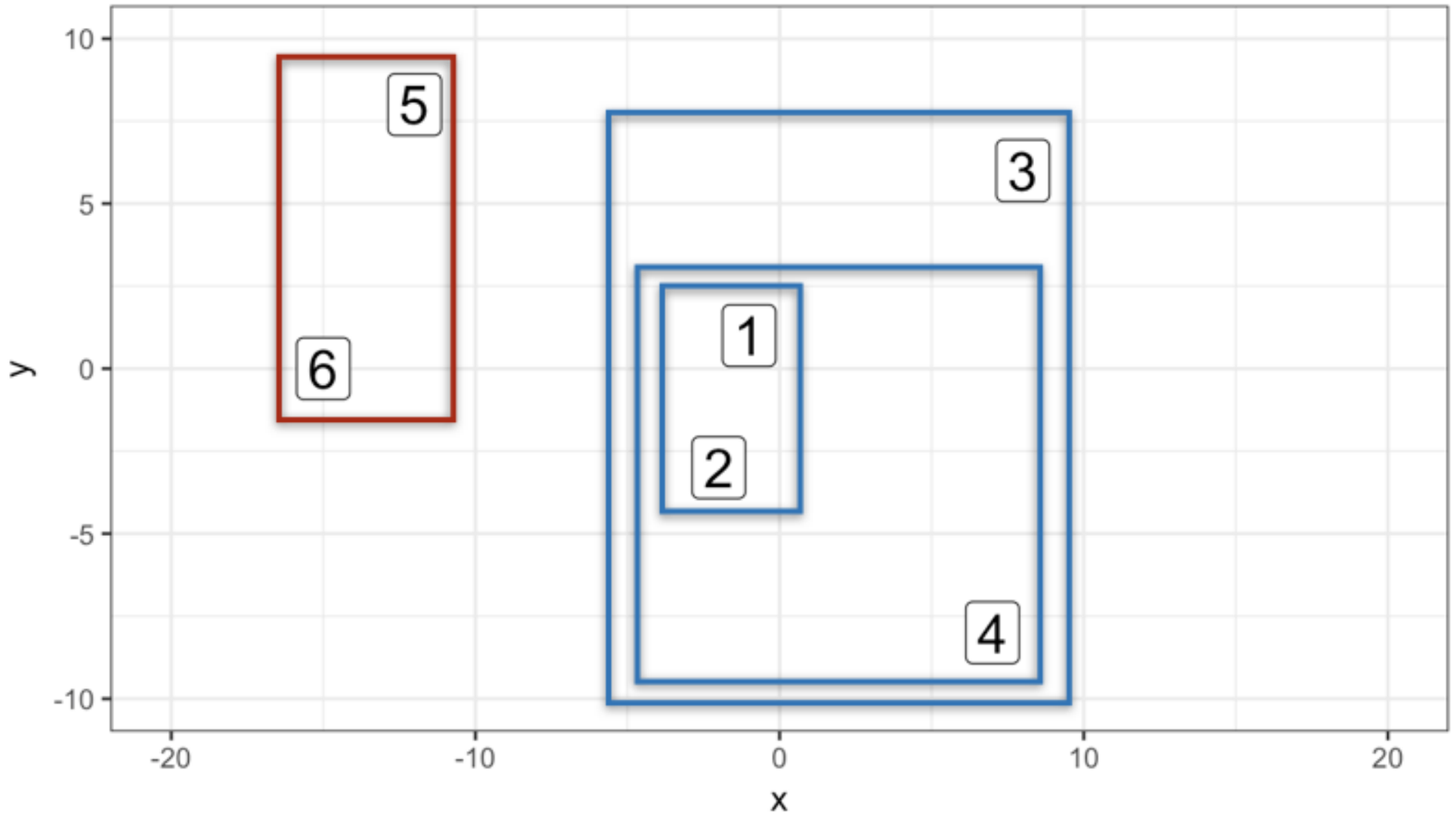
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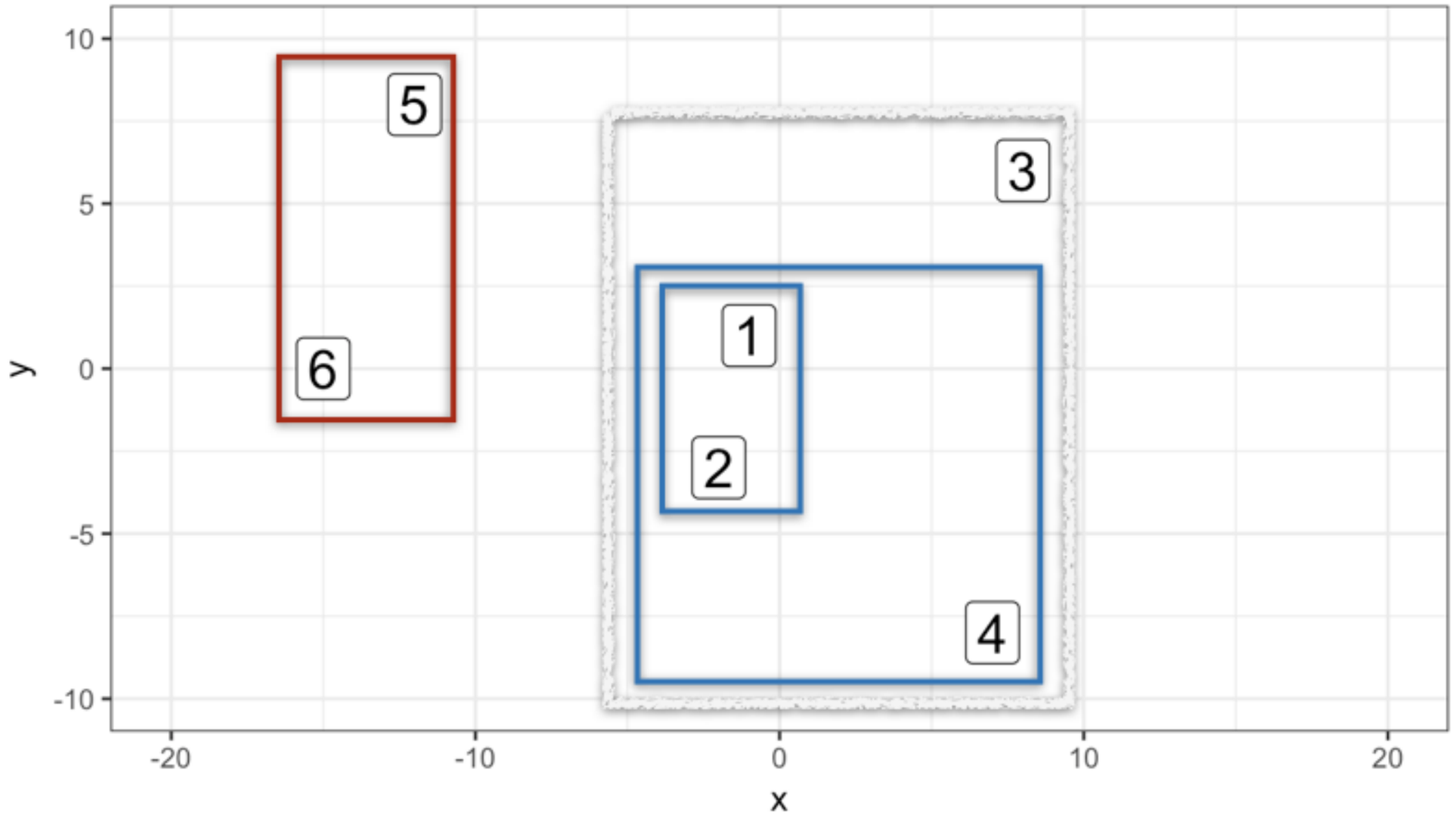
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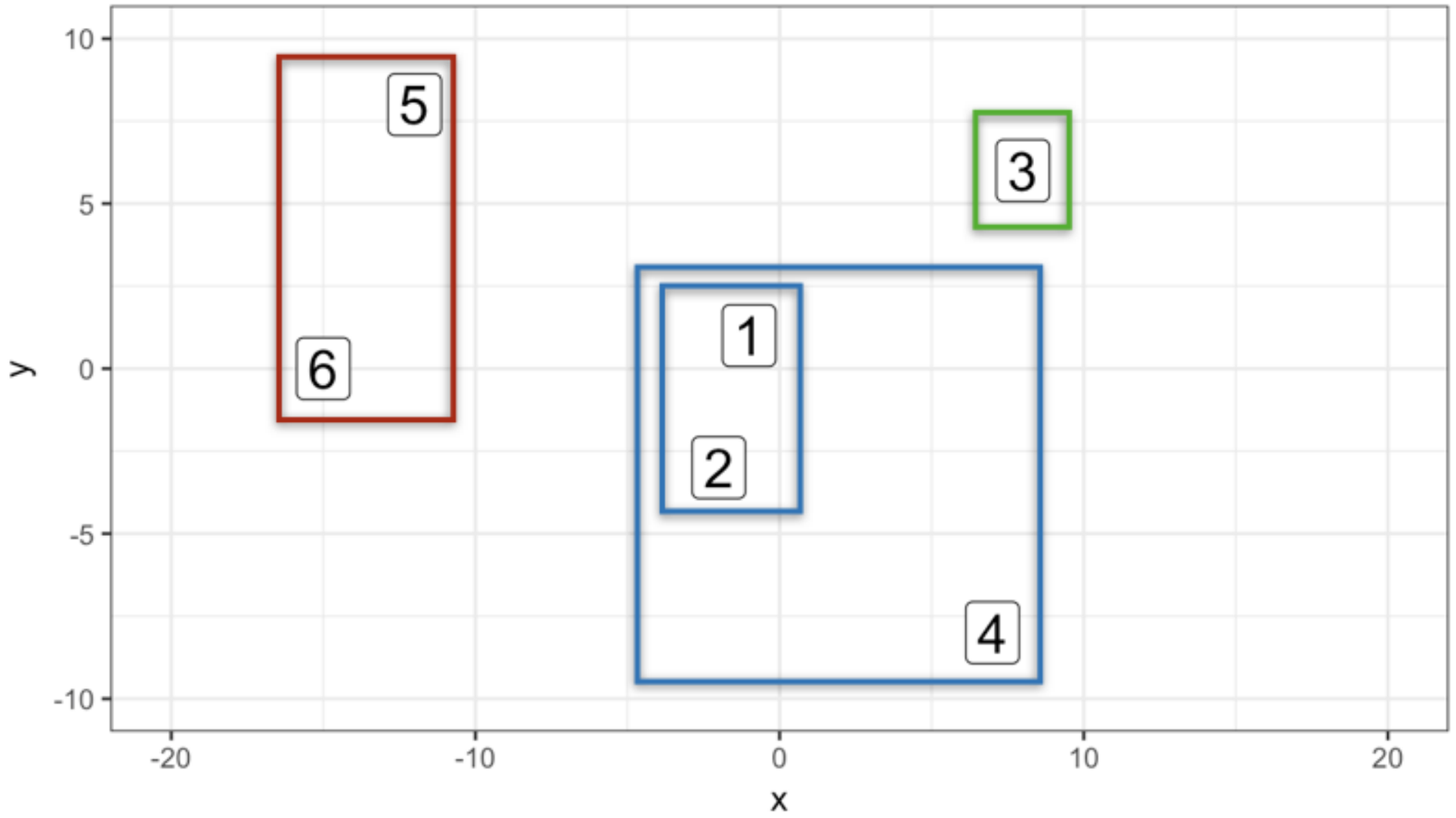
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-10
y
-20
-10
0
10
20
x
5
3
1
6
2
4

Hierarchical clustering in R

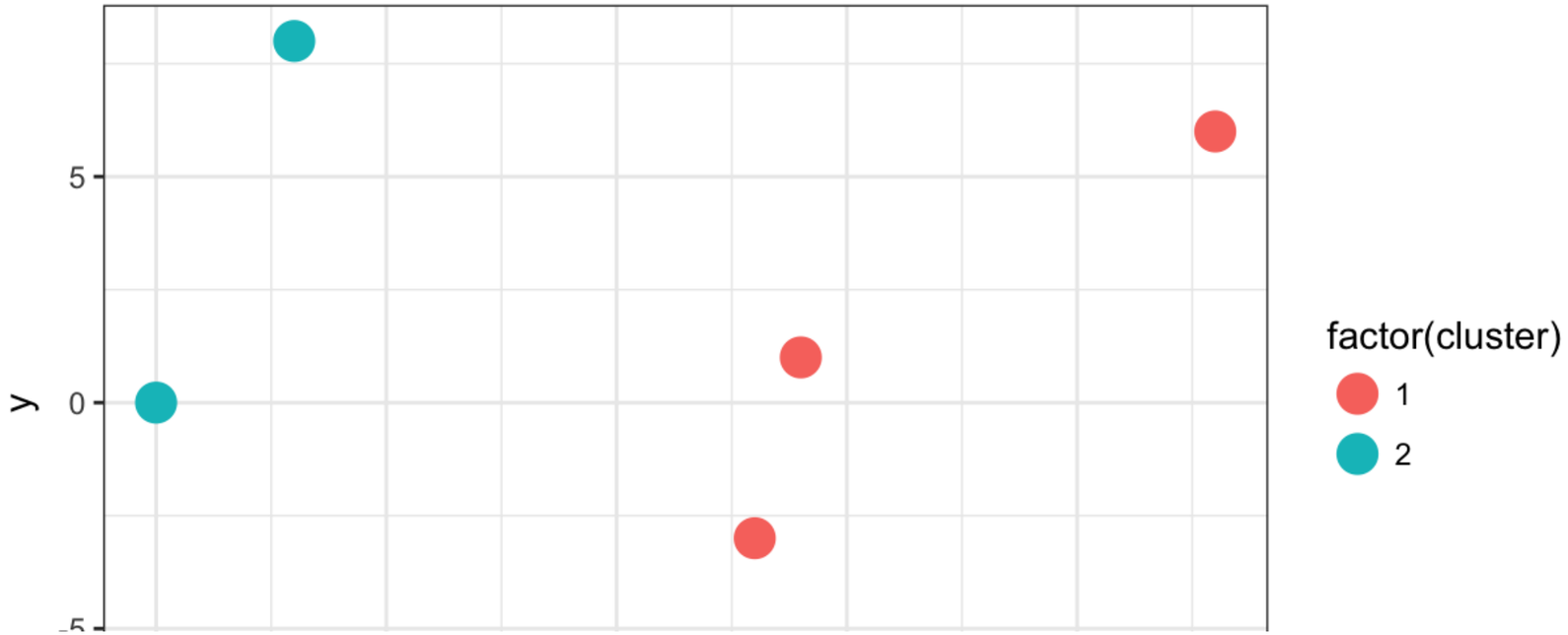
```
print(players)
      x     y
   <dbl> <dbl>
1    -1     1
2    -2    -3
3     8     6
4     7    -8
5   -12     8
6   -15     0

dist_players <- dist(players, method = 'euclidean')

hc_players <- hclust(dist_players, method = 'complete')
```

Extracting K clusters

```
cluster_assignments <- cutree(hc_players, k = 2)

print(cluster_assignments)
[1] 1 1 1 1 2 2

library(dplyr)
players_clustered <- mutate(players, cluster = cluster_assignments)

print(players_clustered)
      x     y cluster
  <dbl> <dbl>   <int>
1    -1     1       1
2    -2    -3       1
3     8     6       1
4     7    -8       1
5   -12     8       2
6   -15     0       2
```

Visualizing K Clusters

```
library(ggplot2)
ggplot(players_clustered, aes(x = x, y = y, color = factor(
  geom_point()
```



Let's practice!

CLUSTER ANALYSIS IN R

Visualizing the dendrogram

CLUSTER ANALYSIS IN R

Dmitriy Gorenshteyn

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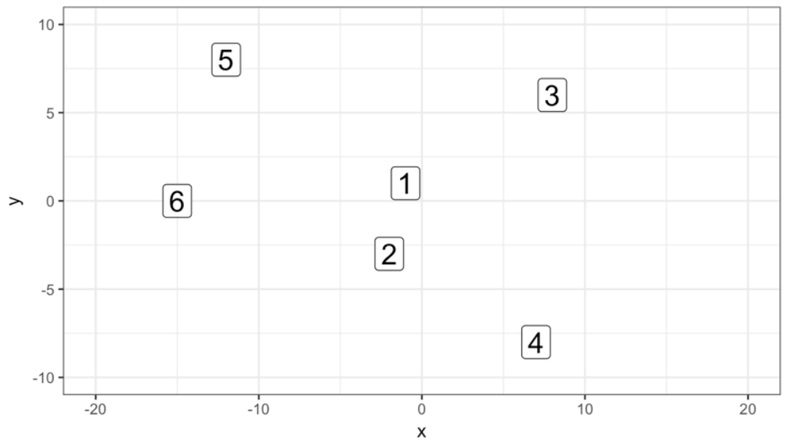
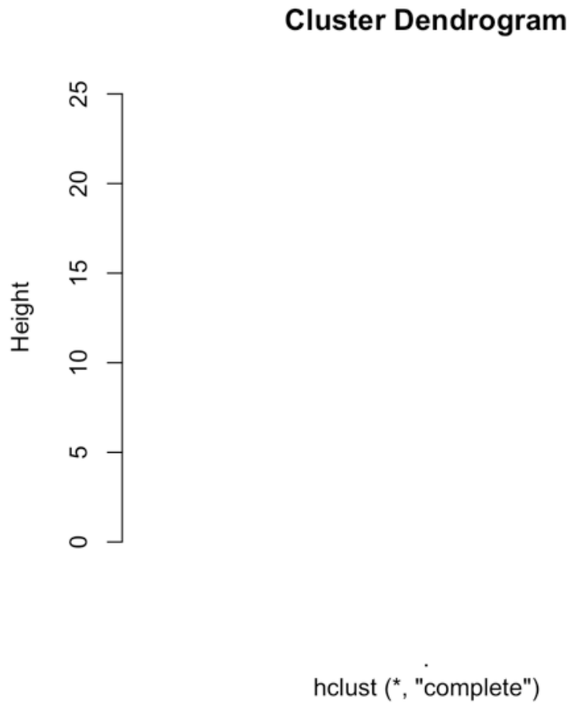
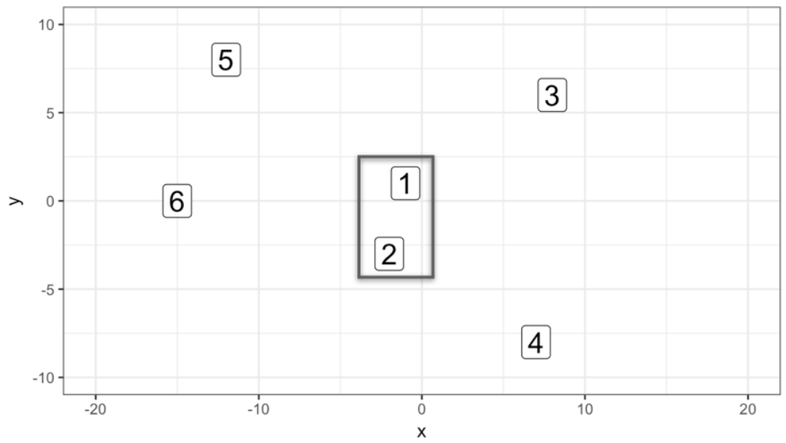
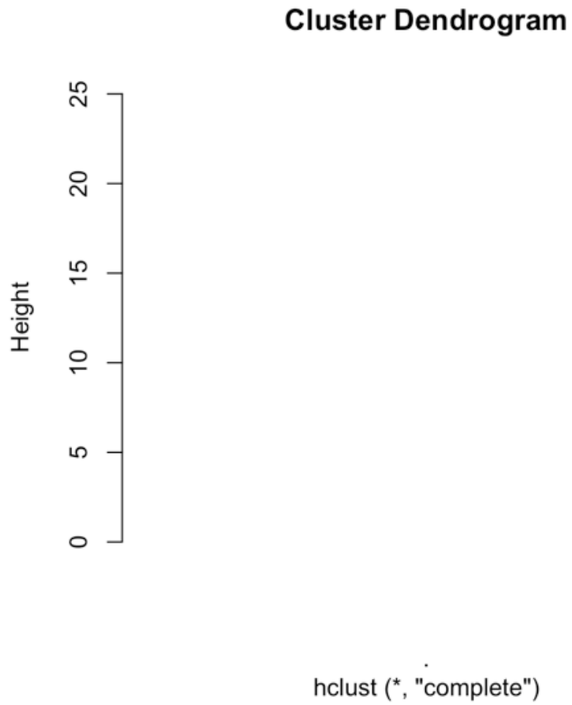
Building the dendrogram



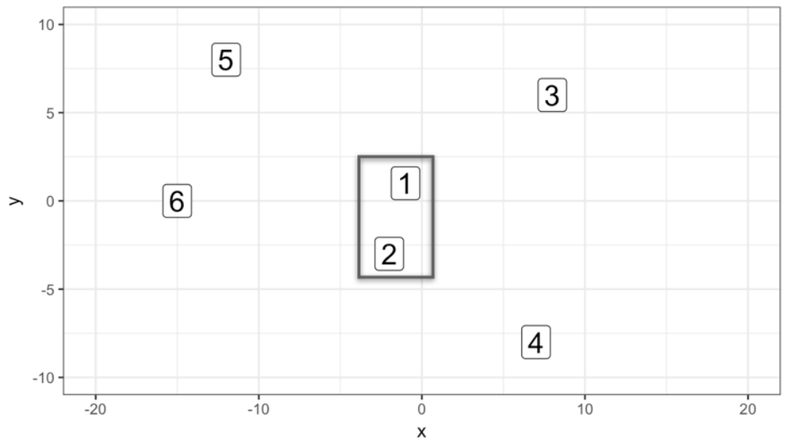


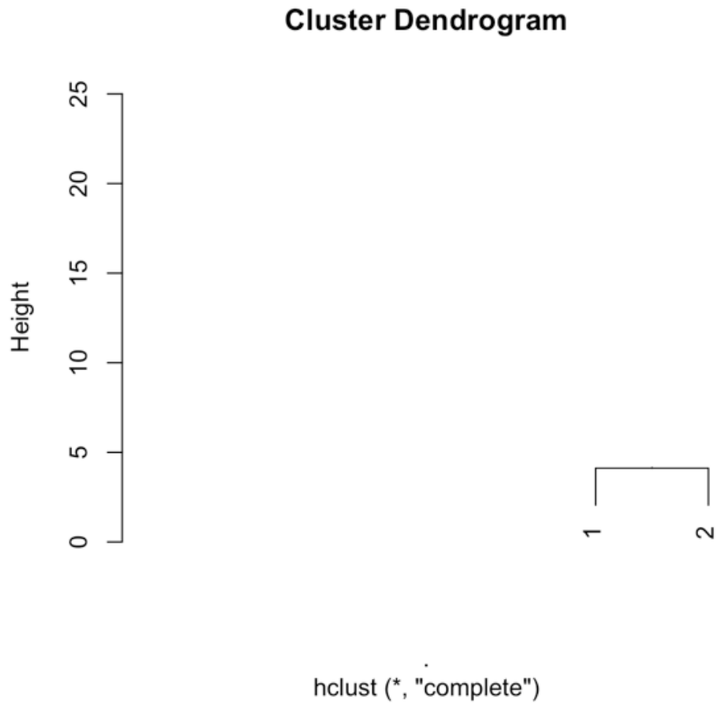
Building the dendrogram



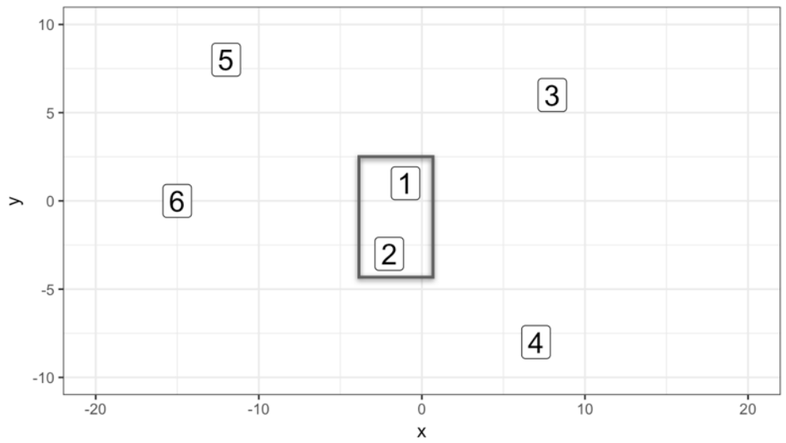


Building the dendrogram





Building the dendrogram



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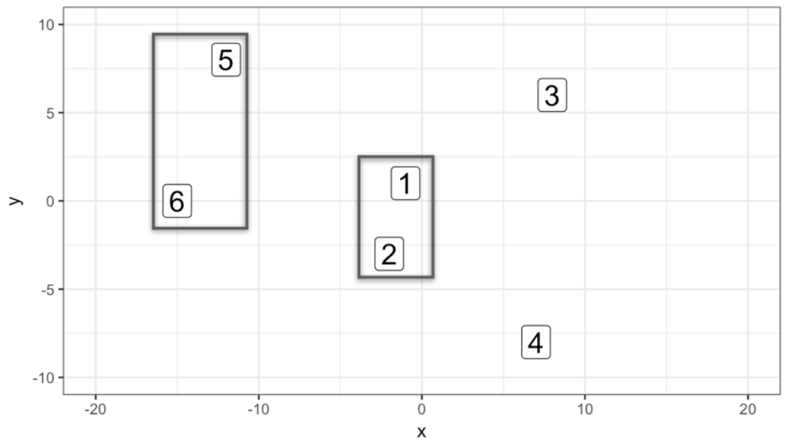
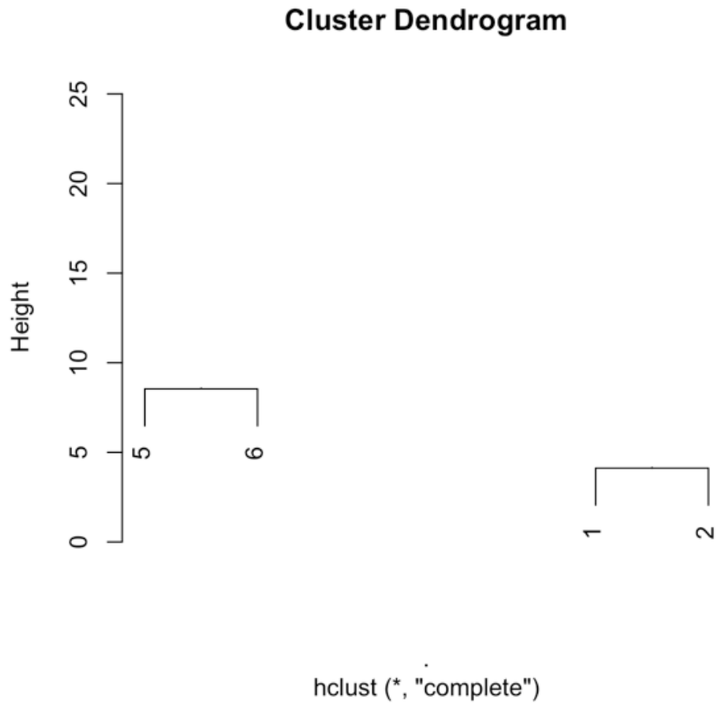
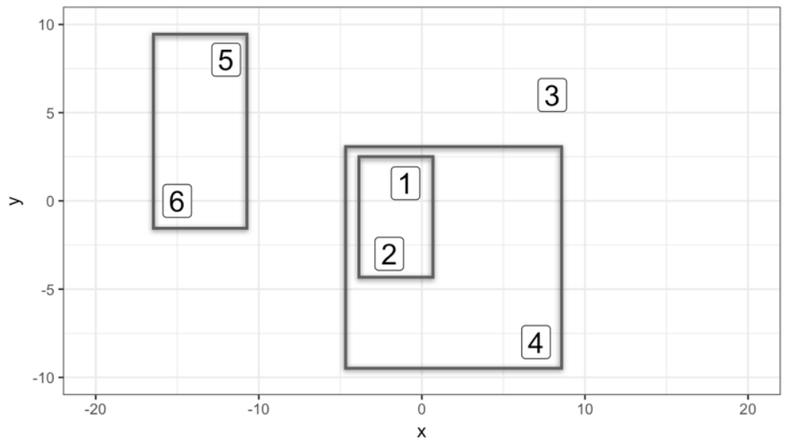
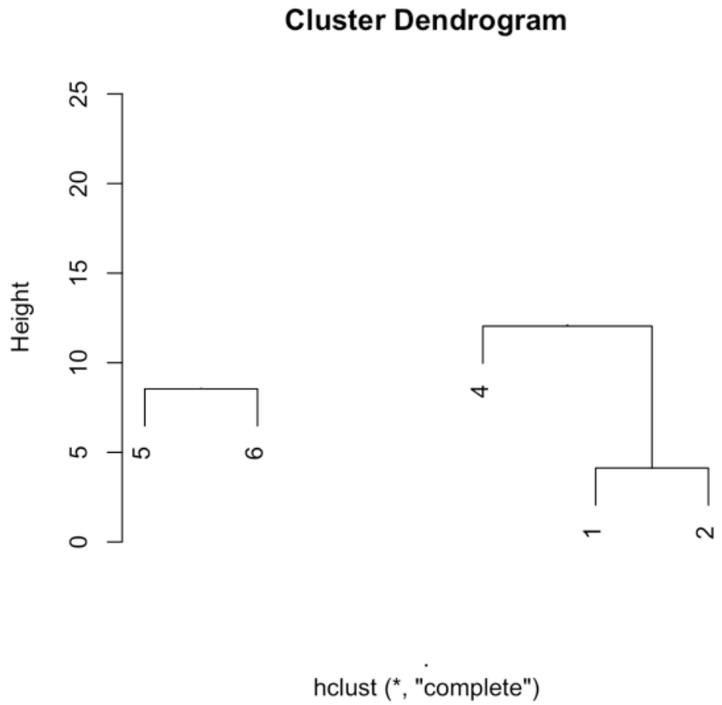


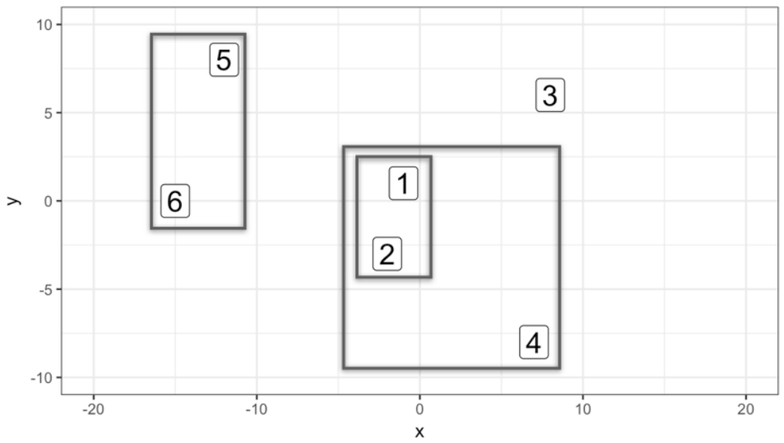


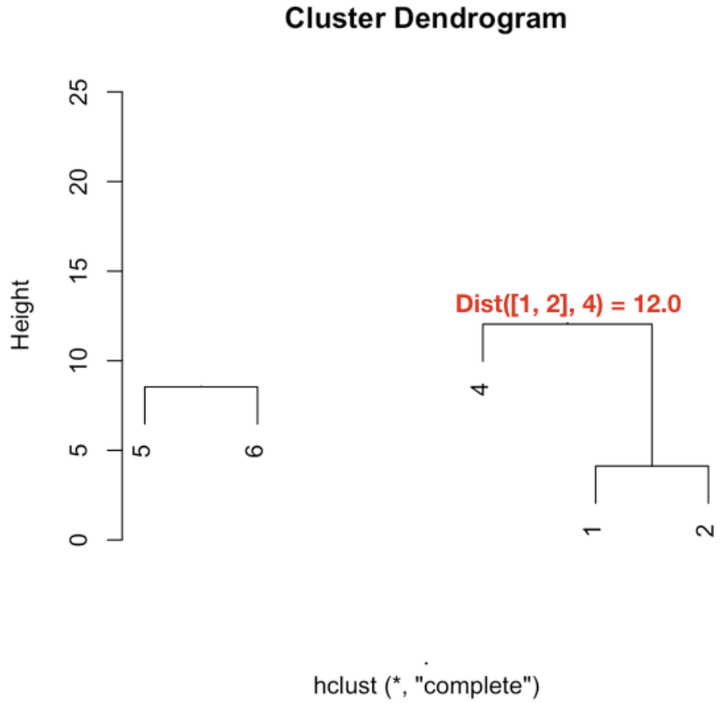
Building the dendrogram



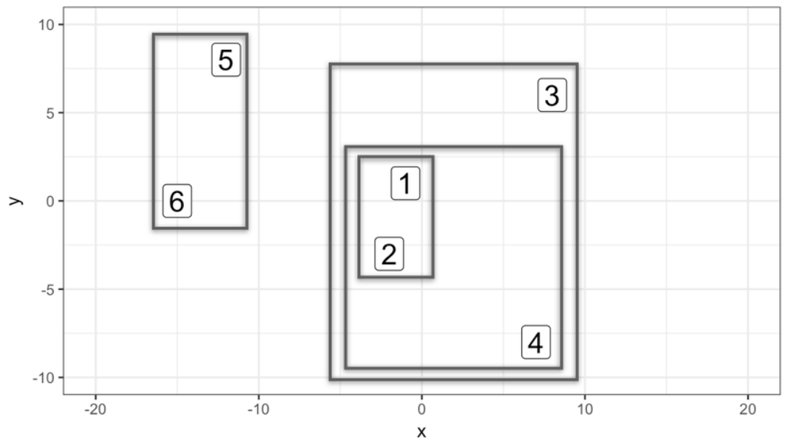


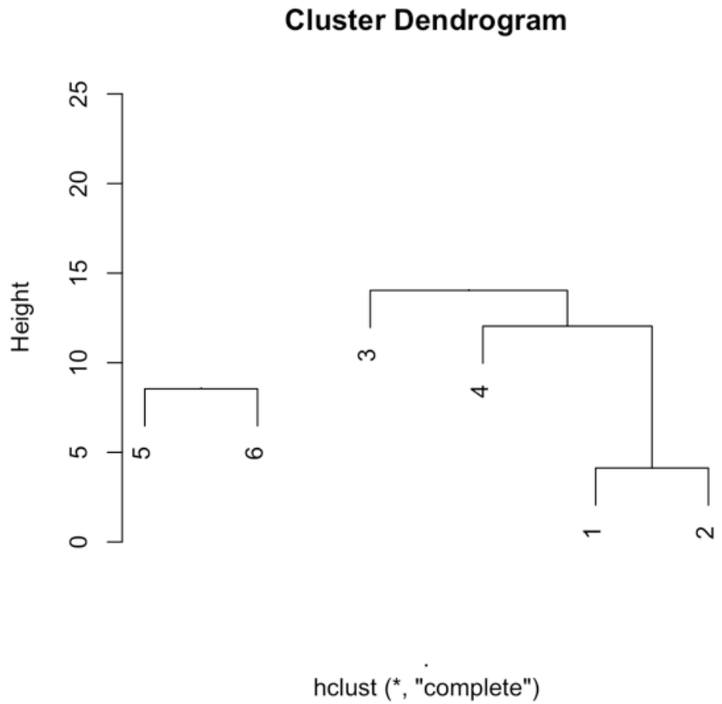
Building the dendrogram



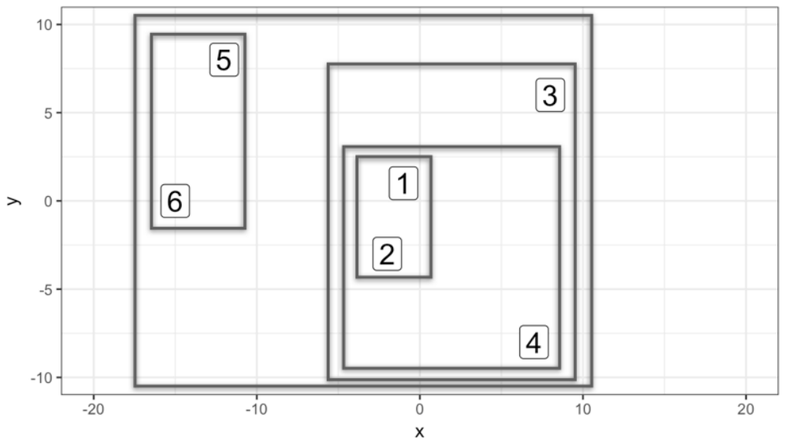


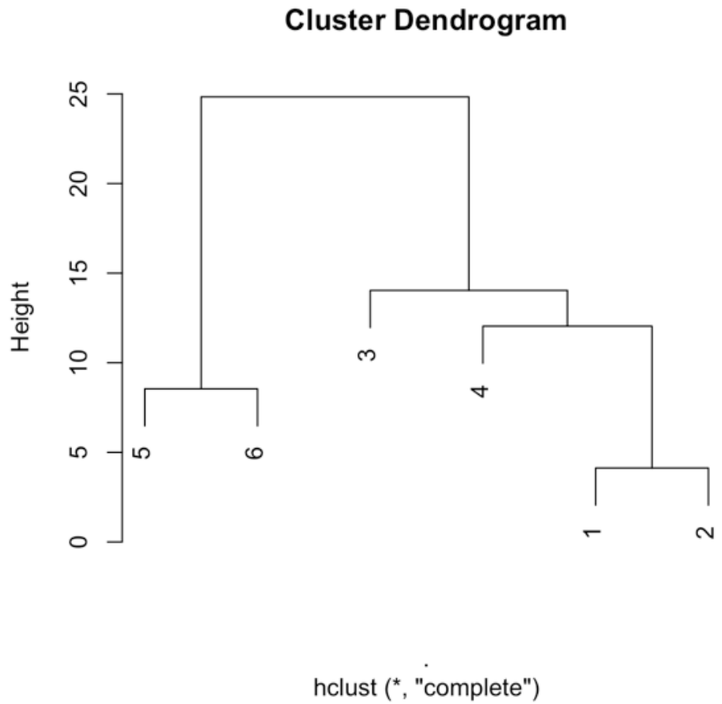
Building the dendrogram





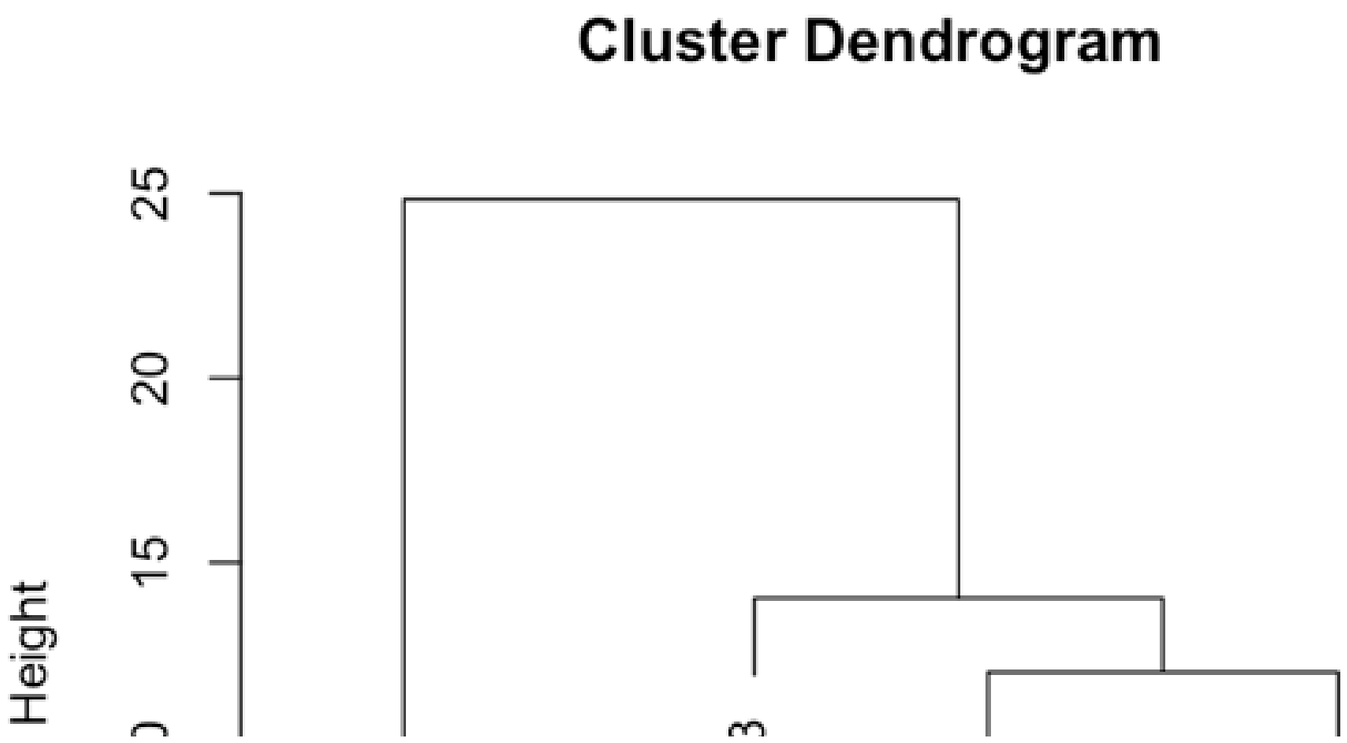
Building the dendrogram





Plotting the dendrogram

```
plot(hc_players)
```



Let's practice!

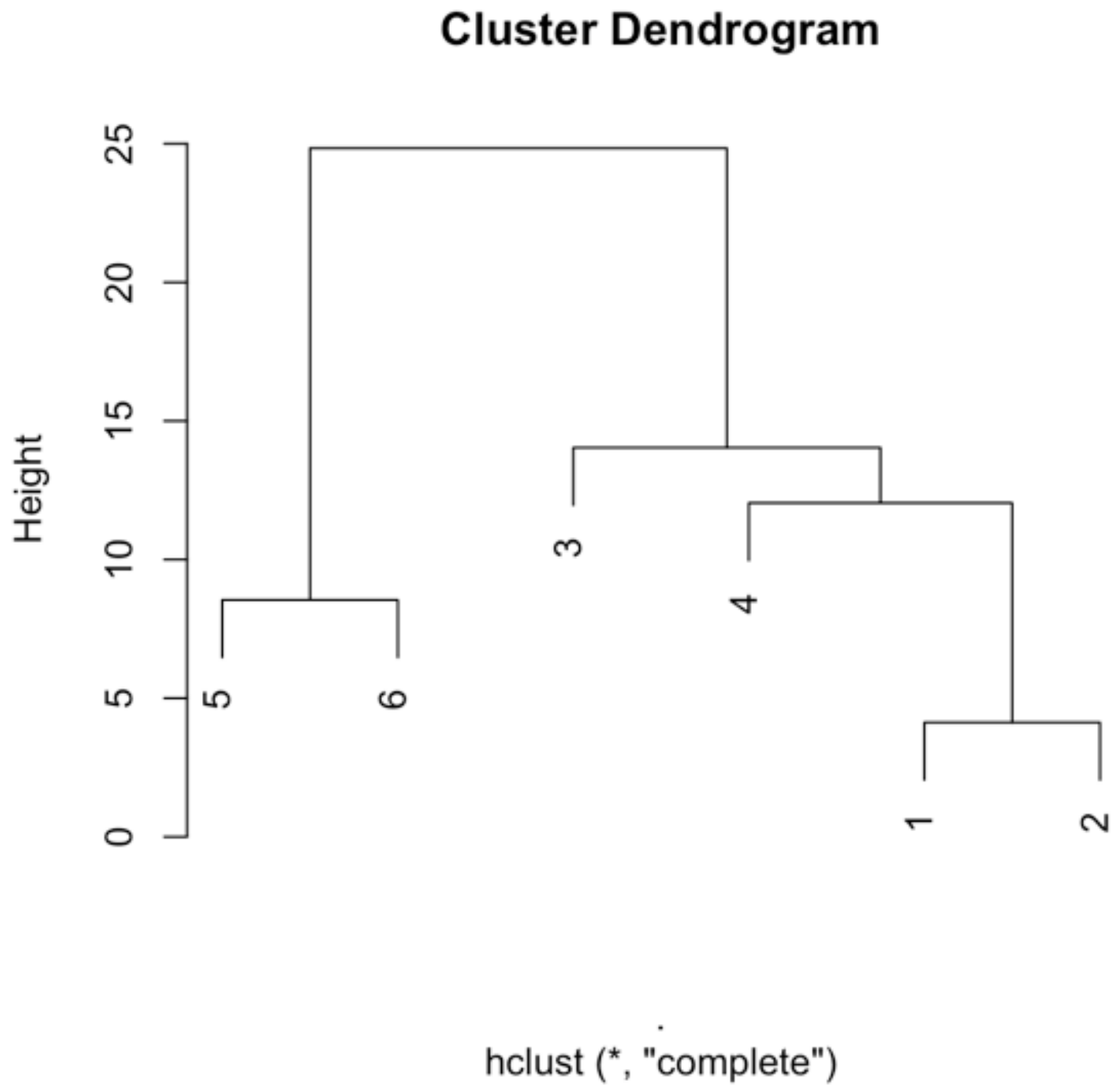
CLUSTER ANALYSIS IN R

Cutting the tree

CLUSTER ANALYSIS IN R

Dmitriy Gorenshteyn

Lead Data Scientist, Memorial Sloan Kettering Cancer Center


Cluster Dendrogram
Height
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25
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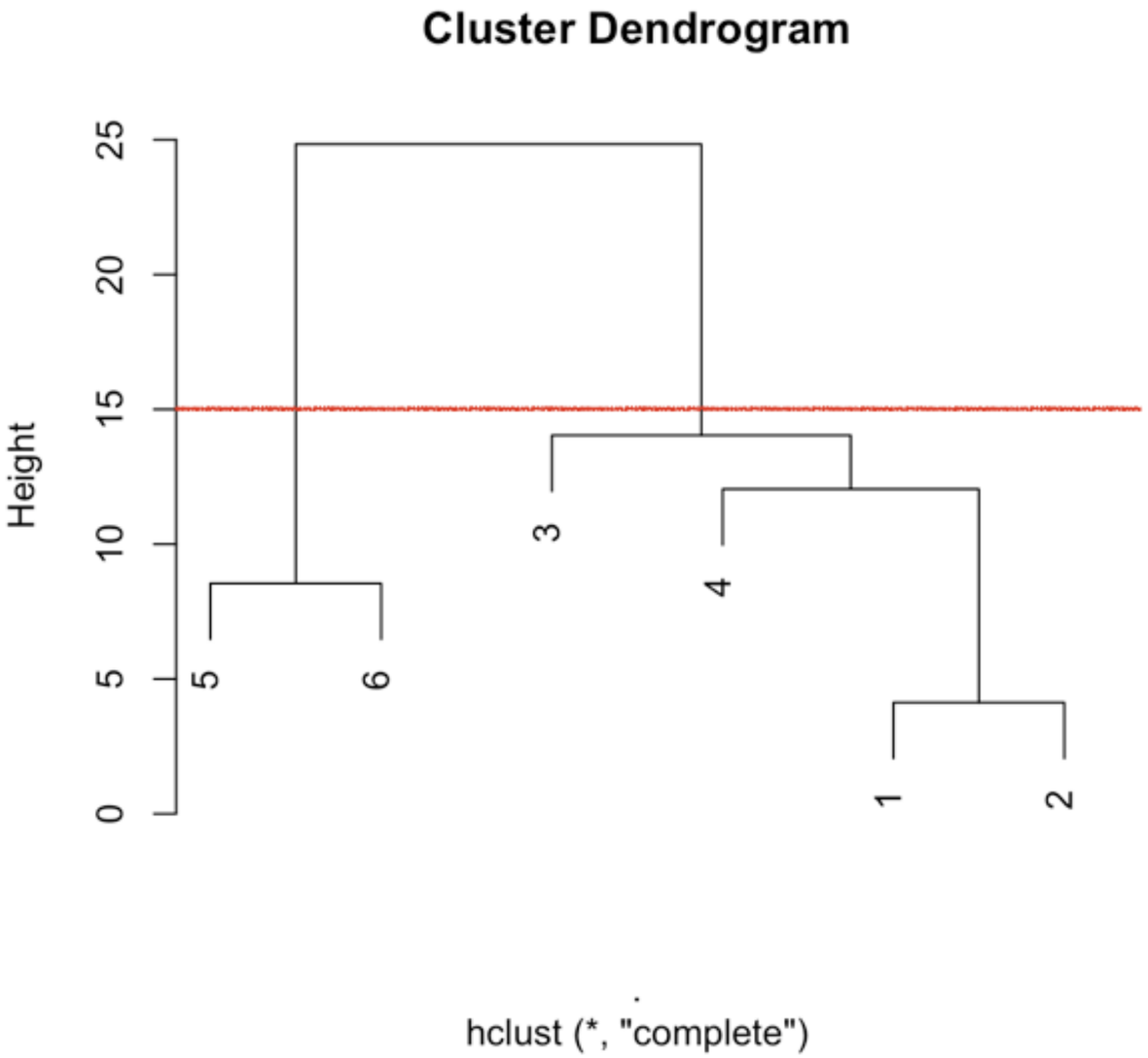
4
1
2
hclust (*, "complete")


Cluster Dendrogram
Height
0
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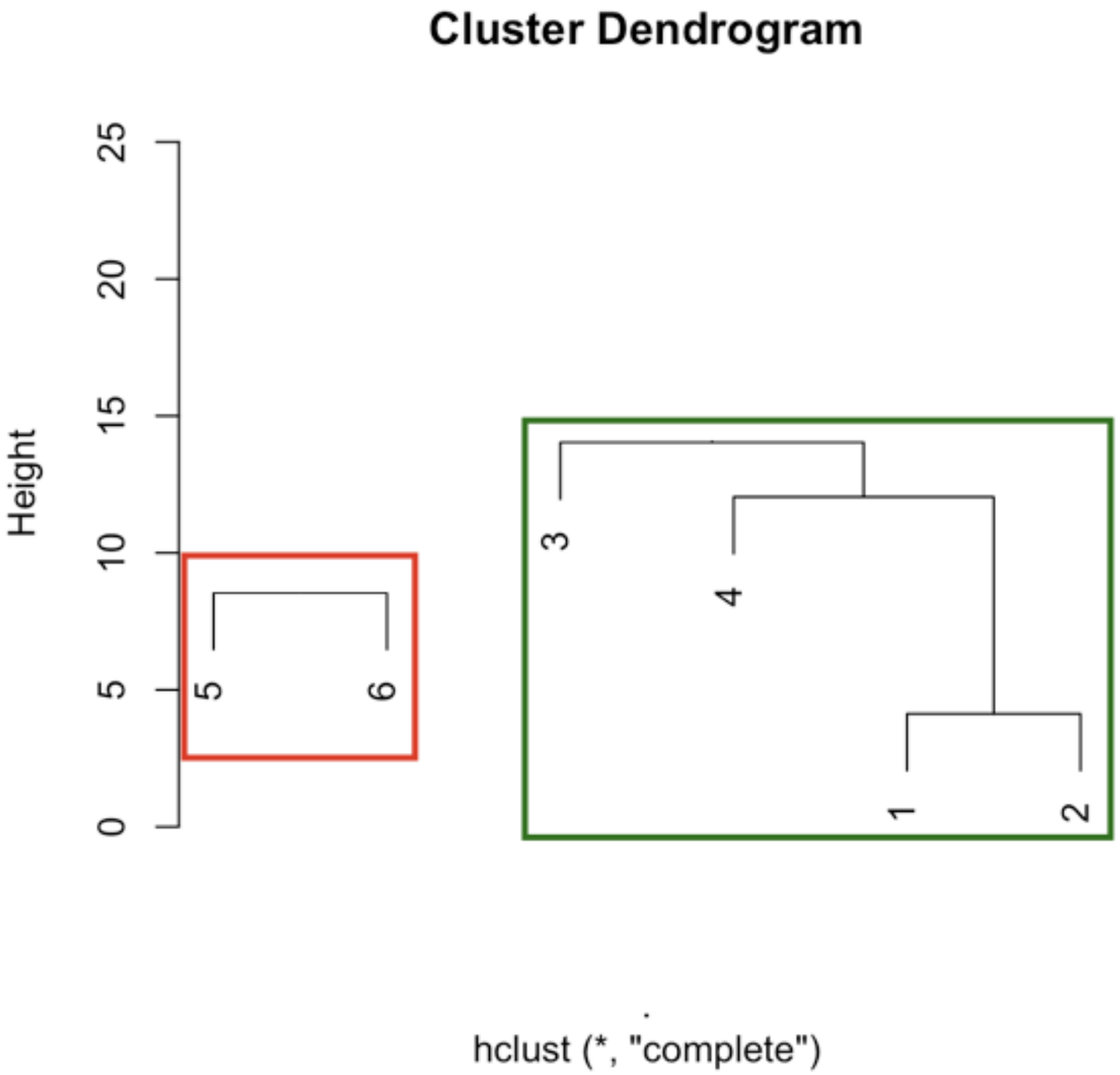
hclust (*, "complete")


Cluster Dendrogram
Height
0
5
10
15
20
25
5
6
3
4
1
2
hclust (*, "complete")

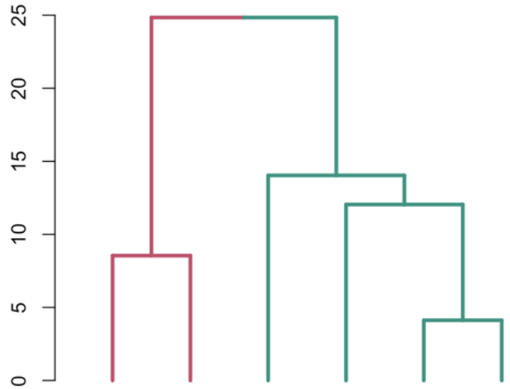
Coloring the dendrogram - height

```
library(dendextend)

dend_players <- as.dendrogram(hc_players)

dend_colored <- color_branches(dend_players, h = 15)

plot(dend_colored)
```



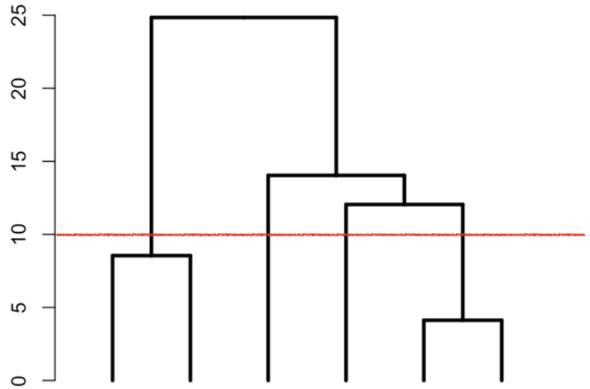
Coloring the dendrogram - height

```
library(dendextend)

dend_players <- as.dendrogram(hc_players)

dend_colored <- color_branches(dend_players, h = 15)

plot(dend_colored)
```



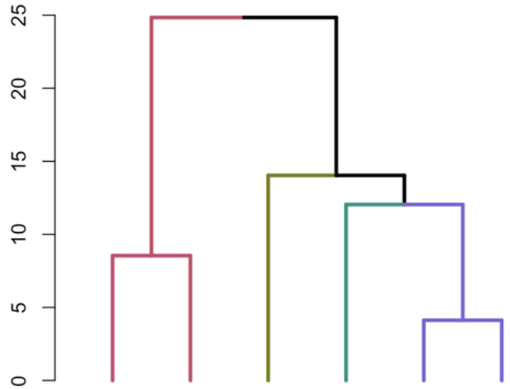
Coloring the dendrogram - height

```
library(dendextend)

dend_players <- as.dendrogram(hc_players)

dend_colored <- color_branches(dend_players, h = 10)

plot(dend_colored)
```



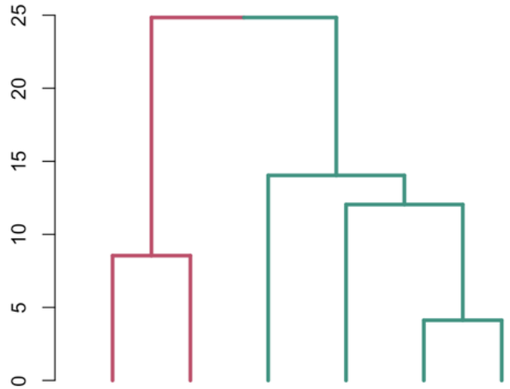
Coloring the dendrogram - K

```
library(dendextend)

dend_players <- as.dendrogram(hc_players)

dend_colored <- color_branches(dend_players, k = 2)

plot(dend_colored)
```



cutree() using height

```
cluster_assignments <- cutree(hc_players, h = 15)

print(cluster_assignments)
[1] 1 1 1 1 2 2

library(dplyr)
players_clustered <- mutate(players, cluster = cluster_assignments)

print(players_clustered)
      x     y cluster
  <dbl> <dbl>   <int>
1    -1     1       1
2    -2    -3       1
3     8     6       1
4     7    -8       1
5   -12     8       2
6   -15     0       2
```

Let's practice!

CLUSTER ANALYSIS IN R

Making sense of the clusters

CLUSTER ANALYSIS IN R

Dmitriy Gorenshteyn

Lead Data Scientist, Memorial Sloan Kettering Cancer Center

Wholesale dataset

- 45 observations
- 3 features:
  - Milk Spending
  - Grocery Spending
  - Frozen Food Spending

Wholesale dataset

```
print(customers_spend)
    Milk Grocery Frozen
1  11103   12469    902
2   2013    6550    909
3   1897    5234    417
4   1304    3643   3045
5   3199    6986   1455
...  ...     ...    ...
```

Exploring more than 2 dimensions

- Plot 2 dimensions at a time
- Visualize using PCA
- Summary statistics by feature

Segment the customers

CLUSTER ANALYSIS IN R