

3 K-Nearest Neighbours

$$\|P - A\| = \|(17; 1; 4)\| = \sqrt{306}$$

$$\|P - B\| = \|(10; 2; 3)\| = \sqrt{113}$$

$$\|P - C\| = \|(13; 1; 3)\| = \sqrt{179}$$

$$\|P - D\| = \|(11; -1; 0)\| = \sqrt{122}$$

$$\|P - E\| = \|(14; -1; 1)\| = \sqrt{198}$$

$$\|P - F\| = \|(16; -1; 1)\| = \sqrt{258}$$

$\implies B$ is nearest neighbor and P is therefore in class 1.

4 K-Means Clustering

```
In [2]: library(tidyverse)
```

```
— Attaching packages —
tidyverse 1.3.2 —
✓ ggplot2 3.4.0    ✓ purrr  0.3.5
✓ tibble  3.1.8    ✓ dplyr  1.0.10
✓ tidyr   1.2.1    ✓ stringr 1.5.0
✓ readr   2.1.3    ✓ forcats 0.5.2

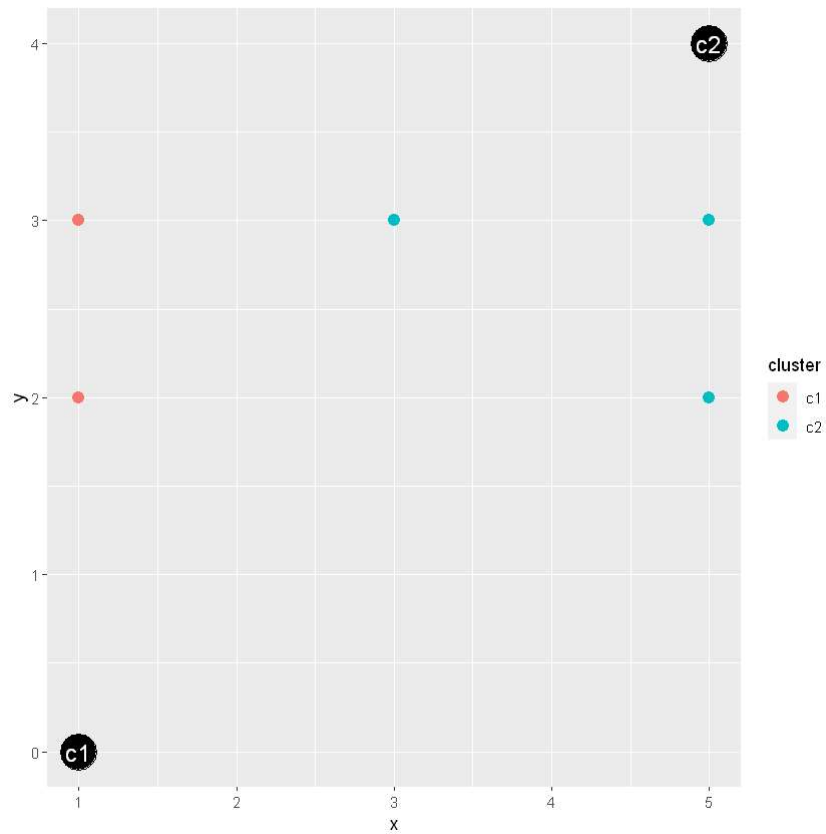
— Conflicts —
tidyverse_conflicts() —
✗ dplyr::filter() masks stats::filter()
✗ dplyr::lag()     masks stats::lag()
```

```
In [97]: data = as_tibble(data.frame(x = c(1,3,5,1,5), y=c(3,3,3,2,2)))
centers = as_tibble(data.frame(name=c('c1', 'c2'), x=c(1,5), y=c(0, 4)))
nearest_cluster <- Vectorize(function(xd,yd) {
  (centers %>% mutate(dist=((x-xd)^2 + (y-yd)^2))%>% slice(which.min(dist)))$name
})
data['cluster']=apply(data[,c('x', 'y')], 1, function(x) nearest_cluster(x[1], x[2])
head(data)
```

A tibble: 5 × 3

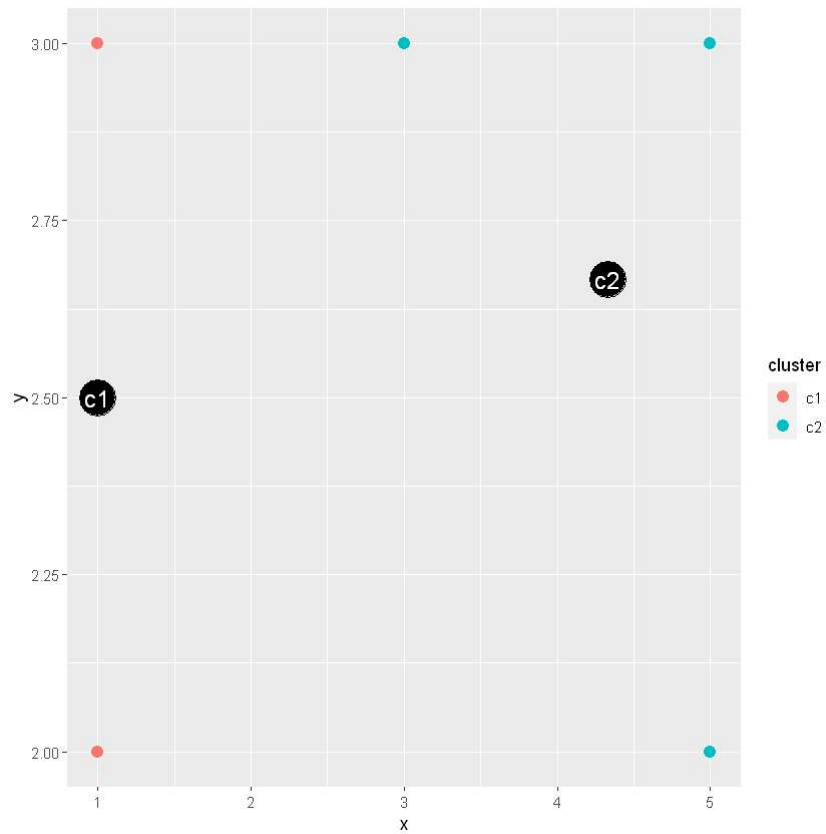
x	y	cluster
<dbl>	<dbl>	<chr>
1	3	c1
3	3	c2
5	3	c2
1	2	c1
5	2	c2

```
In [98]: ggplot() +
  geom_point(data = data, mapping = aes(x=x, y=y, colour=cluster), size=3) +
  geom_point(data = centers, mapping = aes(x=x, y=y), colour="black", size=10) +
  geom_text(data = centers, mapping = aes(x = x, y=y, label=name), color="white",
```



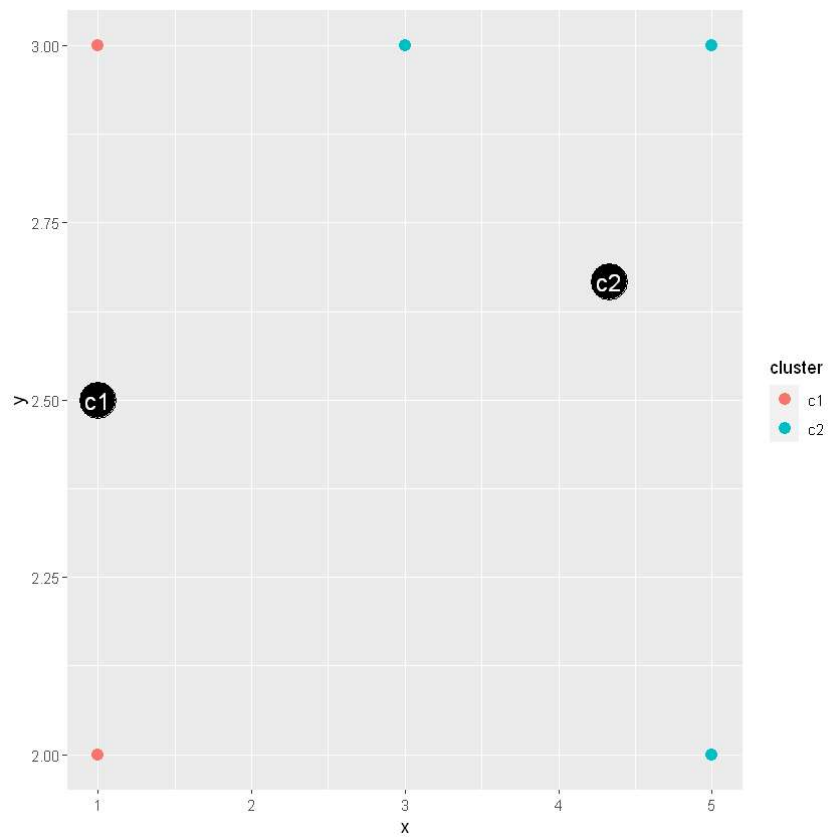
```
In [99]: for (x in 1:50) {
  centers$x = apply(centers["name"], 1, function(name) mean(filter(data, cluster=
  centers$y = apply(centers["name"], 1, function(name) mean(filter(data, cluster=
  data['cluster']=apply(data[,c('x', 'y')], 1, function(x) nearest_cluster(x[1],
  })
```

```
In [100... ggplot() +
  geom_point(data = data, mapping = aes(x=x, y=y, colour=cluster), size=3) +
  geom_point(data = centers, mapping = aes(x=x, y=y), colour="black", size=10) +
  geom_text(data = centers, mapping = aes(x = x, y=y, label=name), color="white",
```



```
In [101... for (x in 1:100) {
  centers$x = apply(centers["name"], 1, function(name) mean(filter(data, cluster=
  centers$y = apply(centers["name"], 1, function(name) mean(filter(data, cluster=
  data['cluster']=apply(data[,c('x', 'y')], 1, function(x) nearest_cluster(x[1],
})

ggplot() +
  geom_point(data = data, mapping = aes(x=x, y=y, colour=cluster), size=3) +
  geom_point(data = centers, mapping = aes(x=x, y=y), colour="black", size=10) +
  geom_text(data = centers, mapping = aes(x = x, y=y, label=name), color="white",
```



looks like we are stable