What is cluster analysis?

CLUSTER ANALYSIS IN R

Dmitriy (Dima) Gorenshteyn
Lead Data Scientist,

What is clustering?

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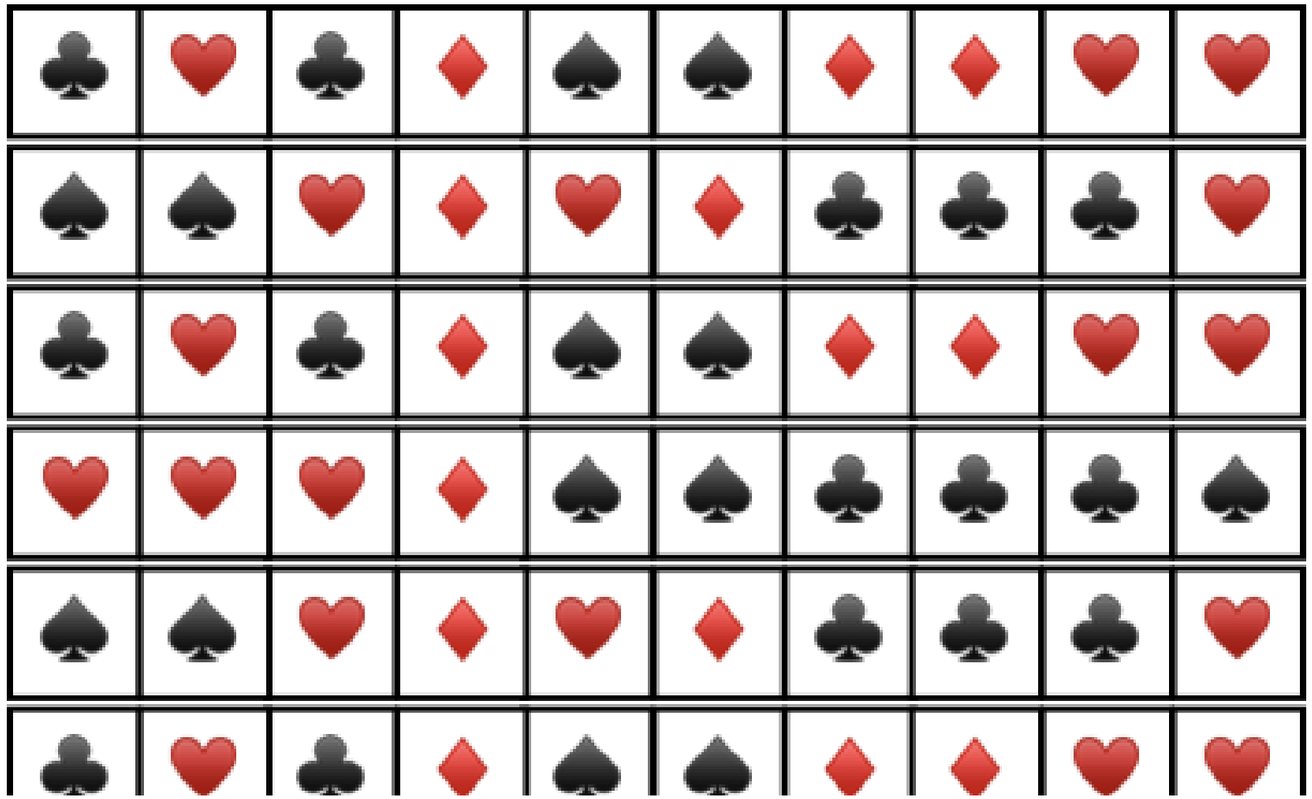

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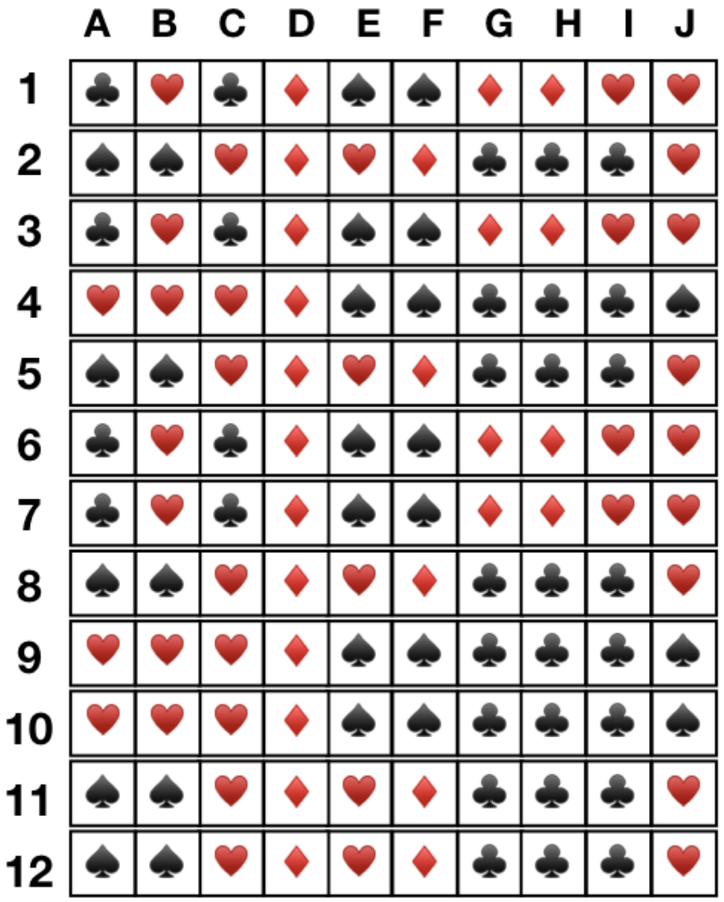

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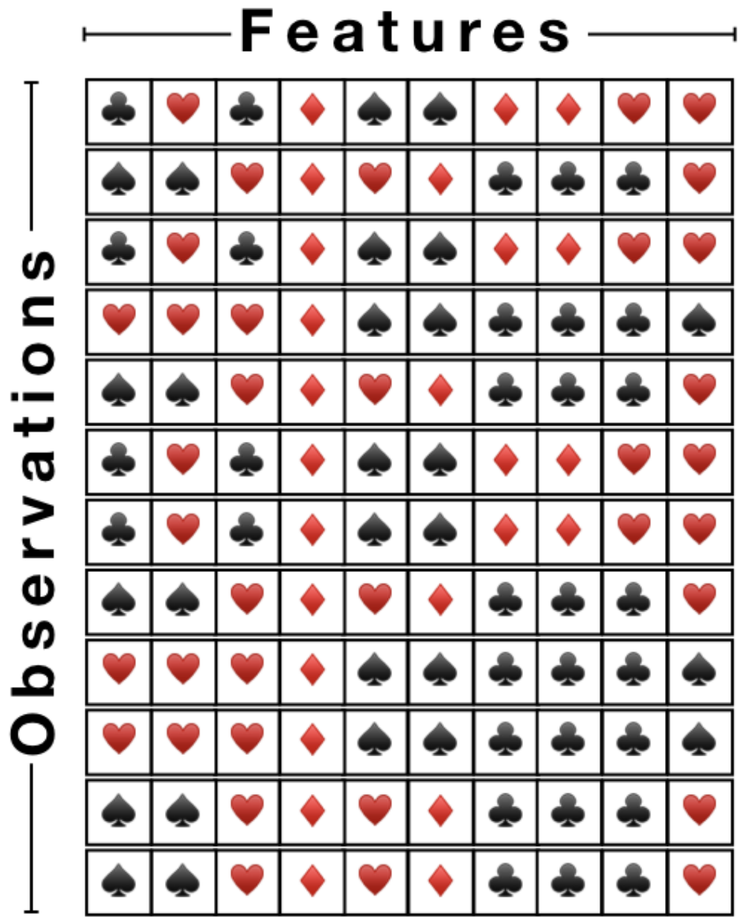

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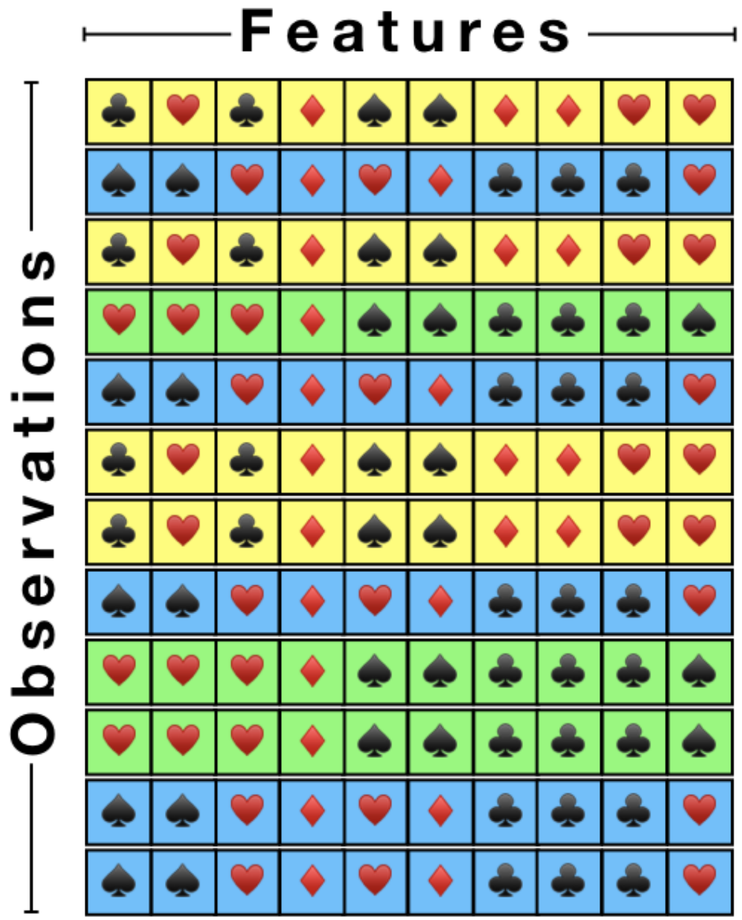
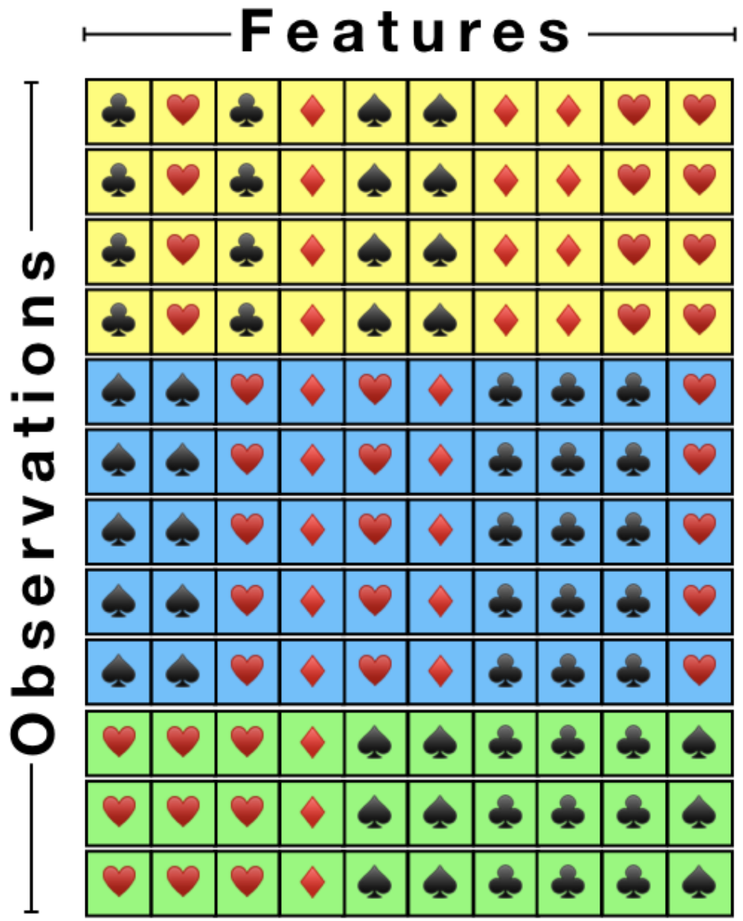


What is clustering?

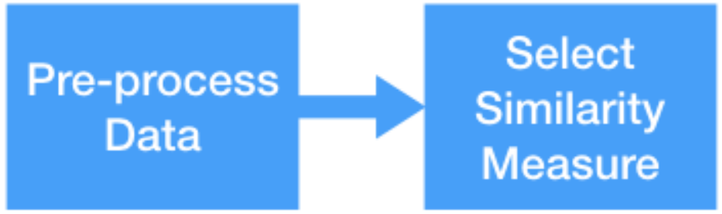


What is clustering?

> A form of exploratory data analysis (**EDA**) where **observations** are divided into meaningful groups that share common characteristics (**features**).

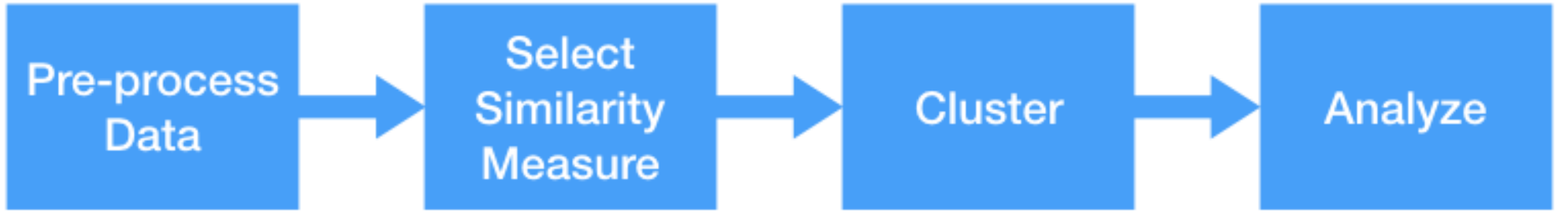
The flow of cluster analysis

The flow of cluster analysis

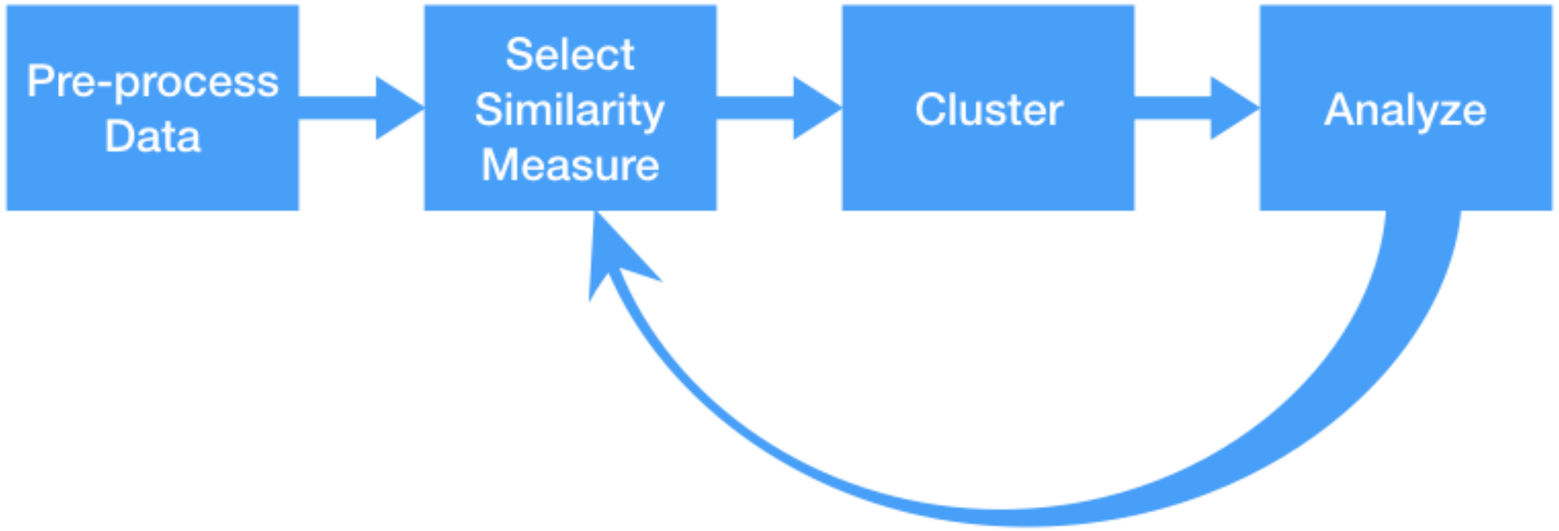


The flow of cluster analysis

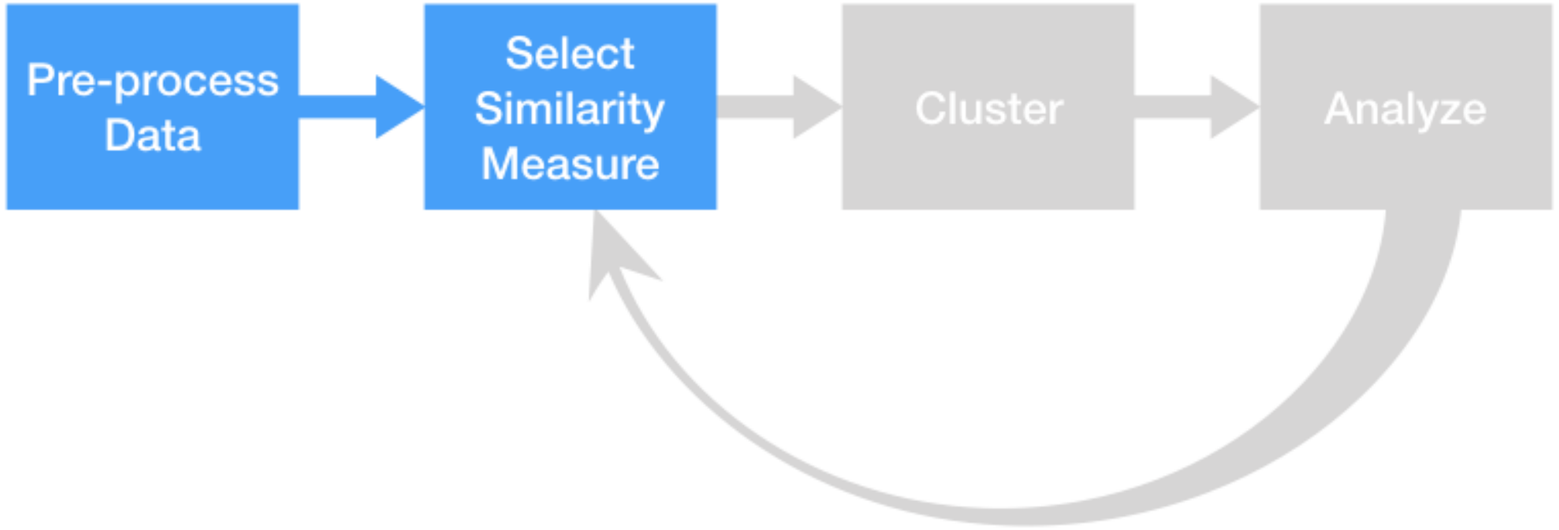
The flow of cluster analysis



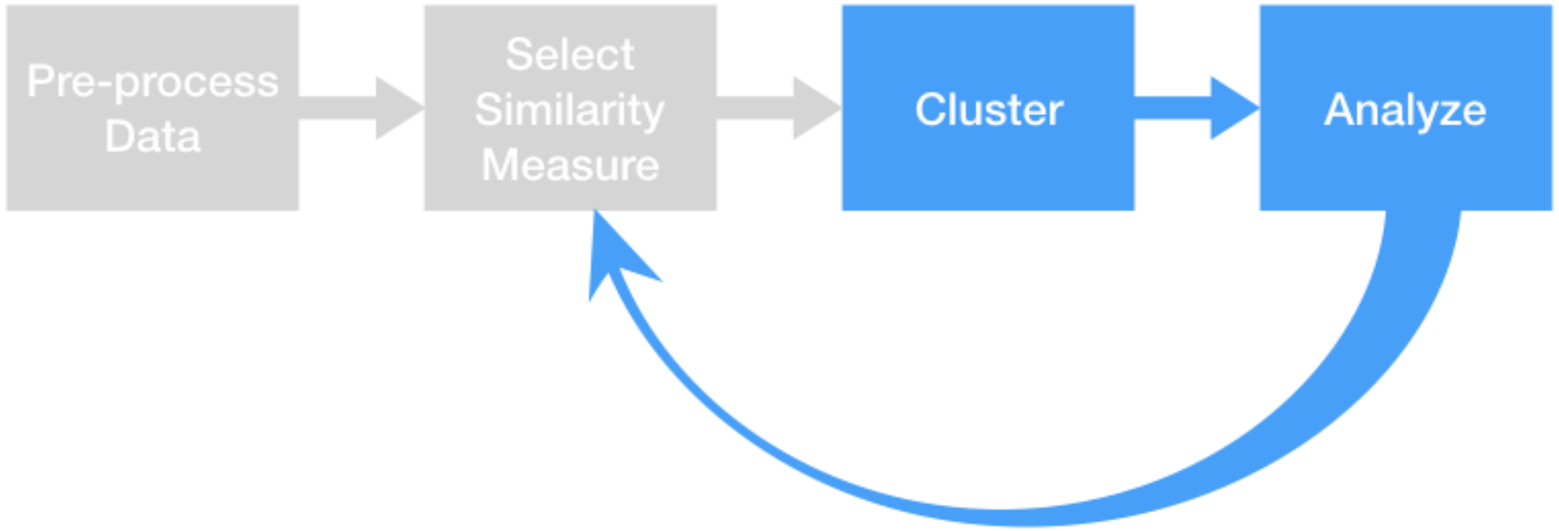
The flow of cluster analysis



Structure of this course



Structure of this course



Let's learn!

CLUSTER ANALYSIS IN R

Distance between two observations

CLUSTER ANALYSIS IN R

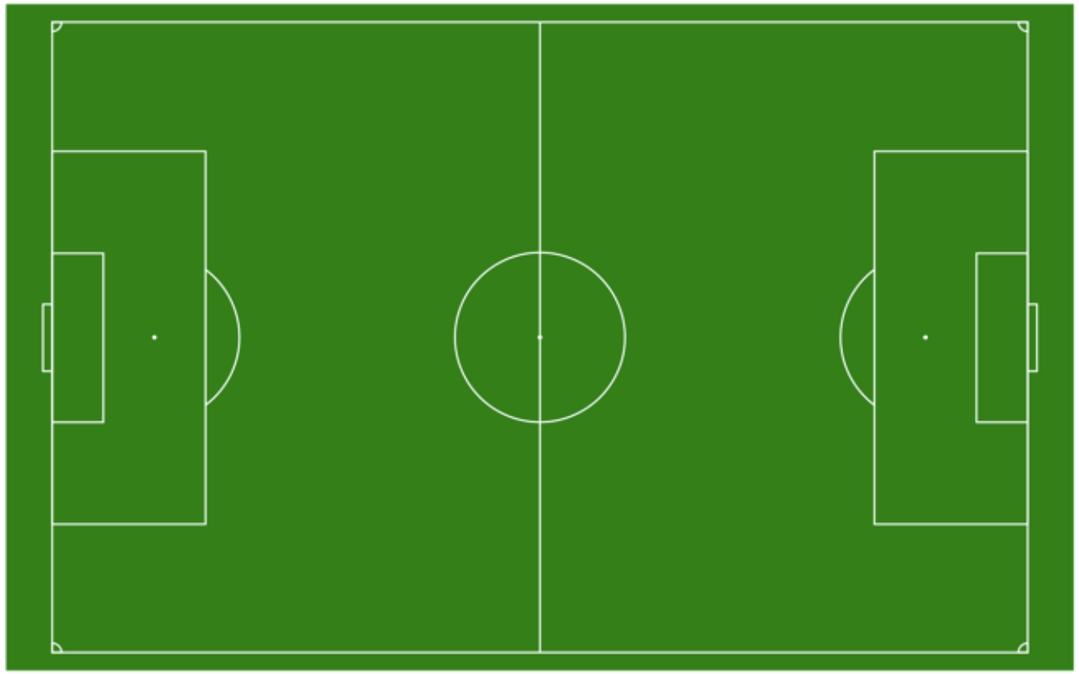
Dmitriy (Dima) Gorenshteyn
Lead Data Scientist, Memorial Sloan Kettering Cancer Center

Distance vs Similarity

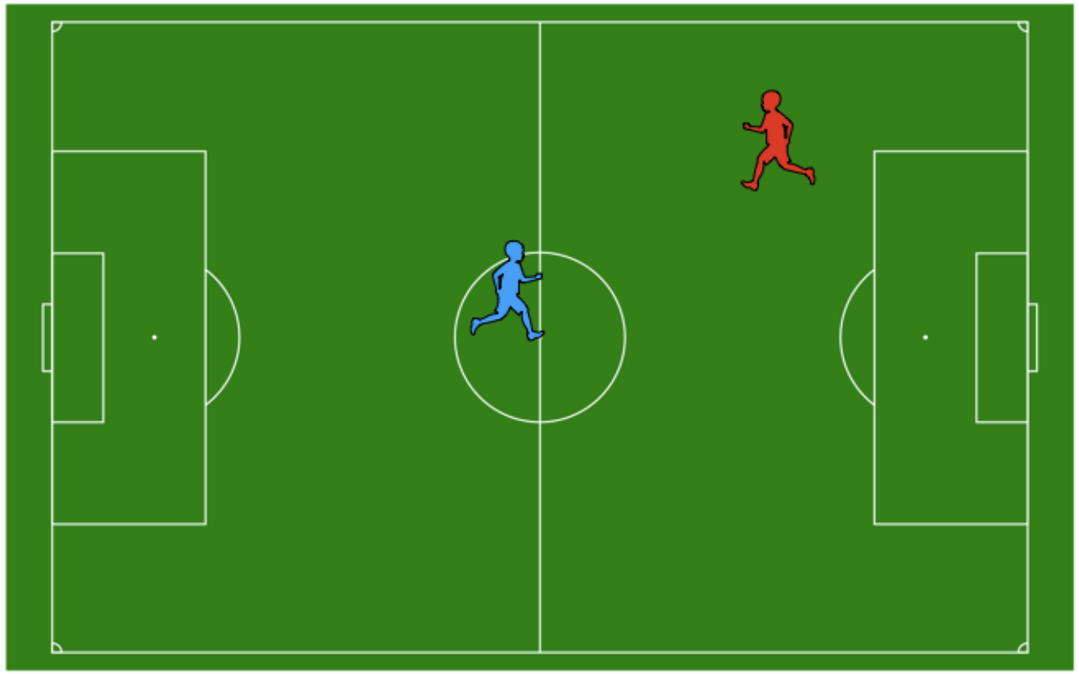
Distance vs Similarity

$$Distance = 1 - Similarity$$

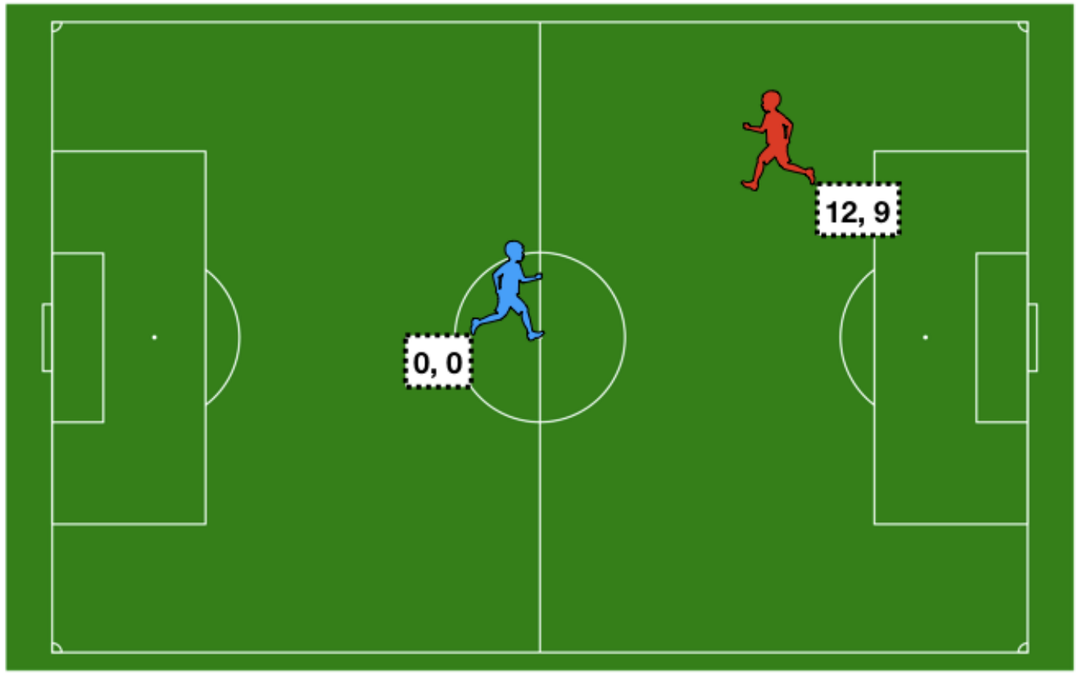
Distance between two players



Distance between two players

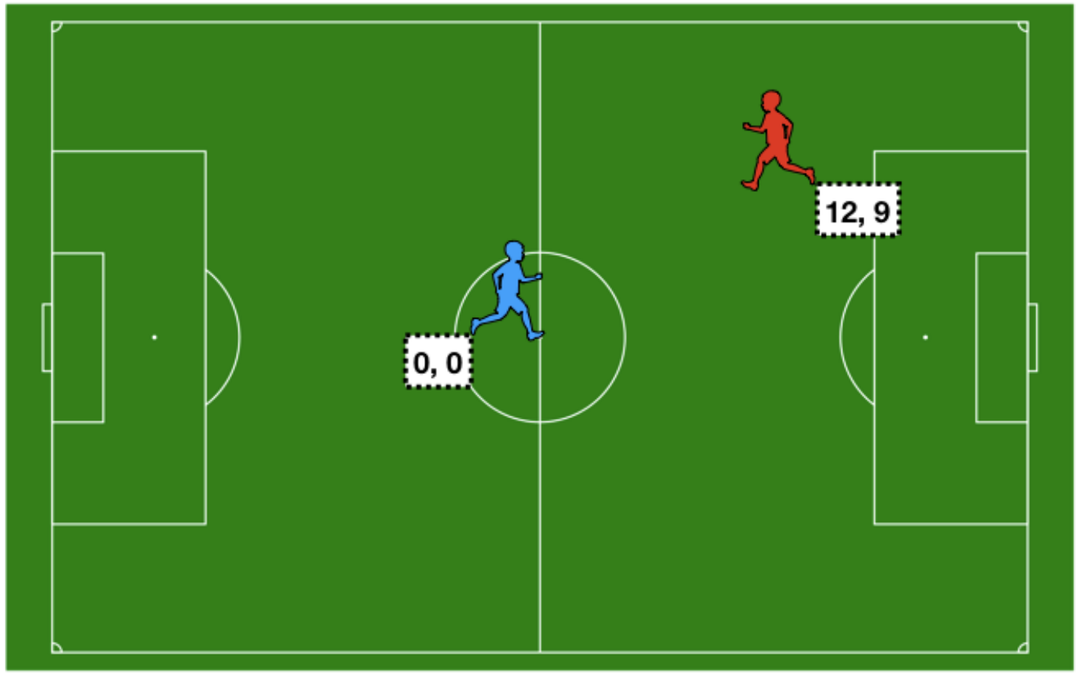


Distance between two players



Distance between two players

	X	Y
Blue	0	0
Red	12	9



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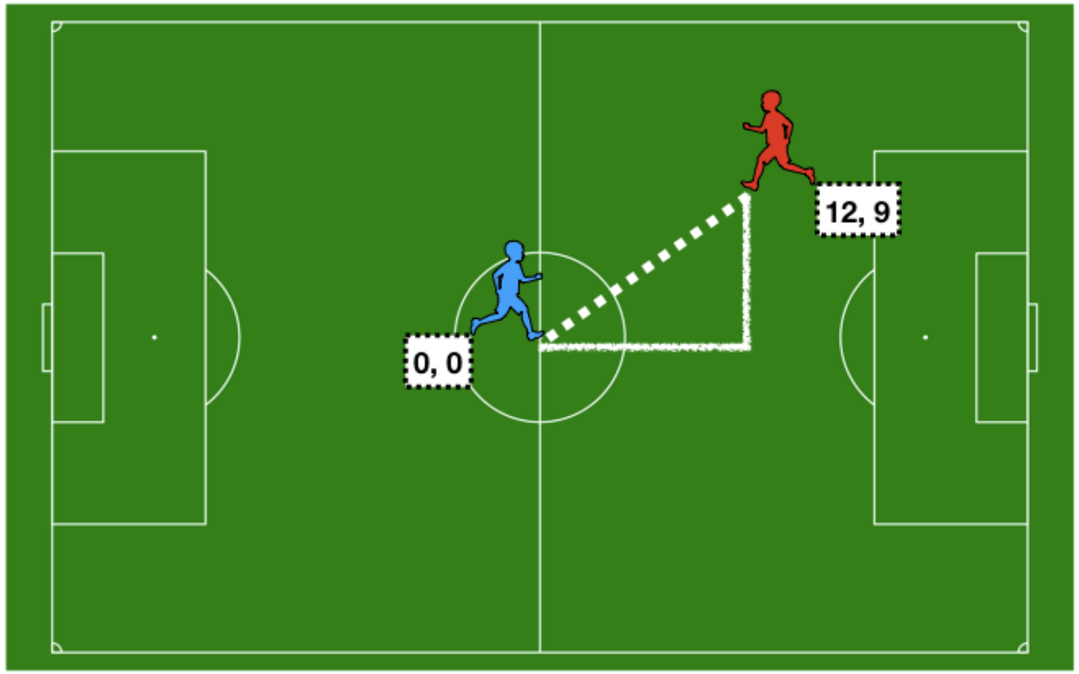

Distance between two players

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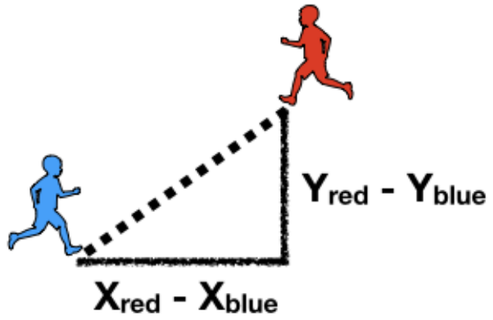

Distance between two players

	X	Y
Blue	0	0
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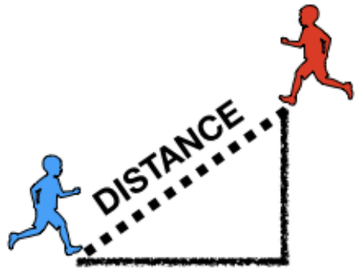
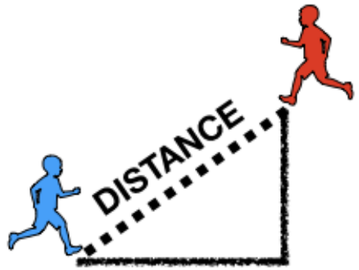


$$= \sqrt{(X_{red} - X_{blue})^2 + (Y_{red} - Y_{blue})^2}$$

Distance between two players

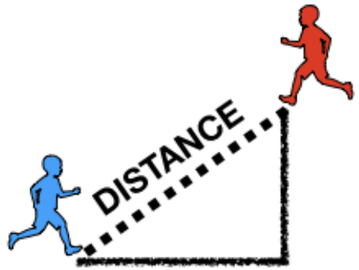
	X	Y
Blue	0	0
Red	12	9



$$= \sqrt{(12 - 0)^2 + (9 - 0)^2}$$

Distance between two players

	X	Y
Blue	0	0
Red	12	9



= 15

dist() function

```
print(two_players)
     X  Y
BLUE 0  0
RED  9 12
```

```
dist(two_players, method = 'euclidean')


     BLUE
RED    15
```

More than 2 observations

```
print(three_players)
       X  Y
BLUE   0  0
RED    9 12
GREEN -2 19
```

```
dist(three_players)

          BLUE      RED
RED   15.00000
GREEN 19.10497 13.03840
```

Let's practice!

CLUSTER ANALYSIS IN R

The importance of scale

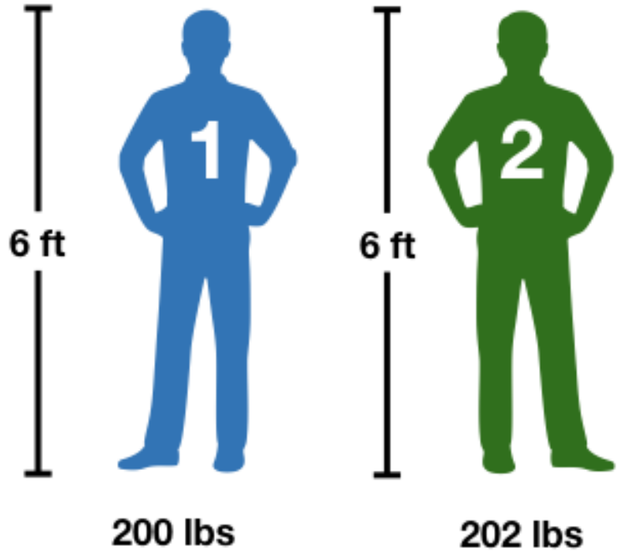
CLUSTER ANALYSIS IN R

Dmitriy (Dima) Gorenshteyn
Lead Data Scientist, Memorial Sloan Kettering Cancer Center

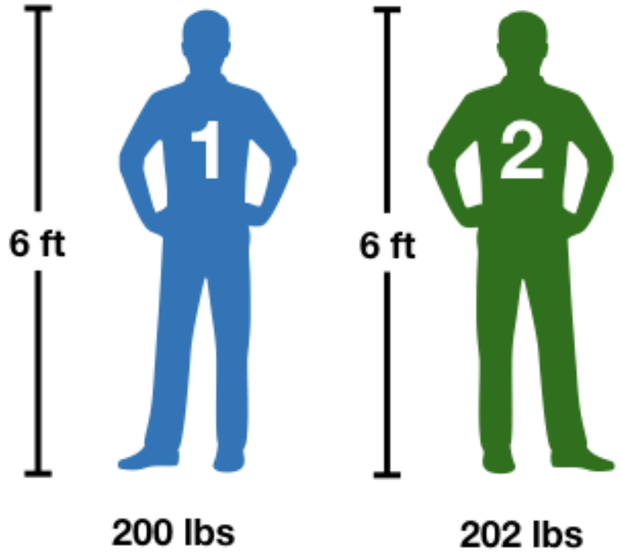
Distance between individuals

Observation	Height (feet)	Weight (lbs)
1	6.0	200
2	6.0	202
3	8.0	200
...	...	...
...	...	...

Distance between individuals

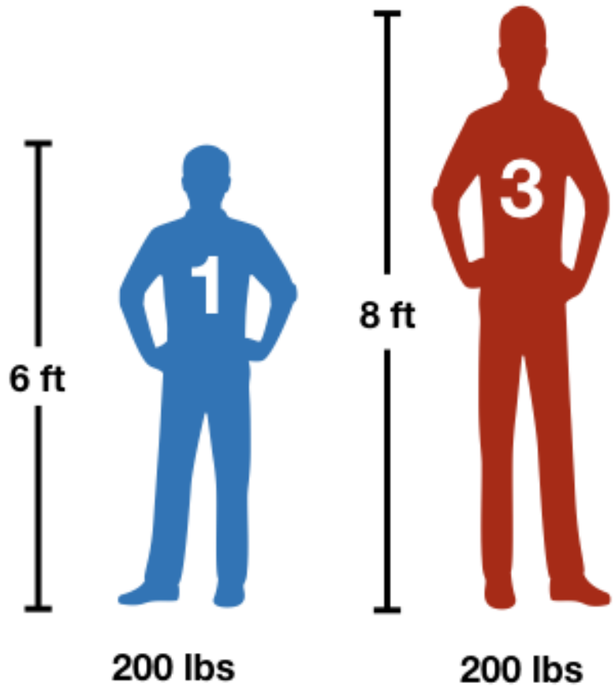


Distance between individuals

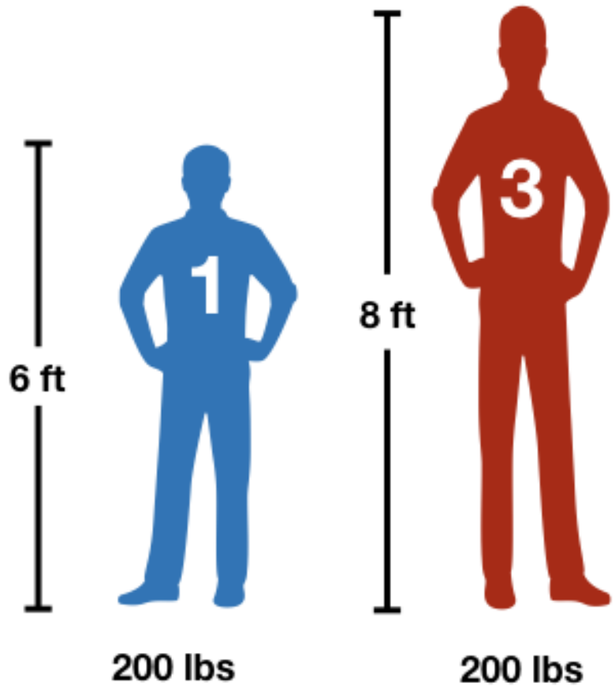


DISTANCE: **2**

Distance between individuals

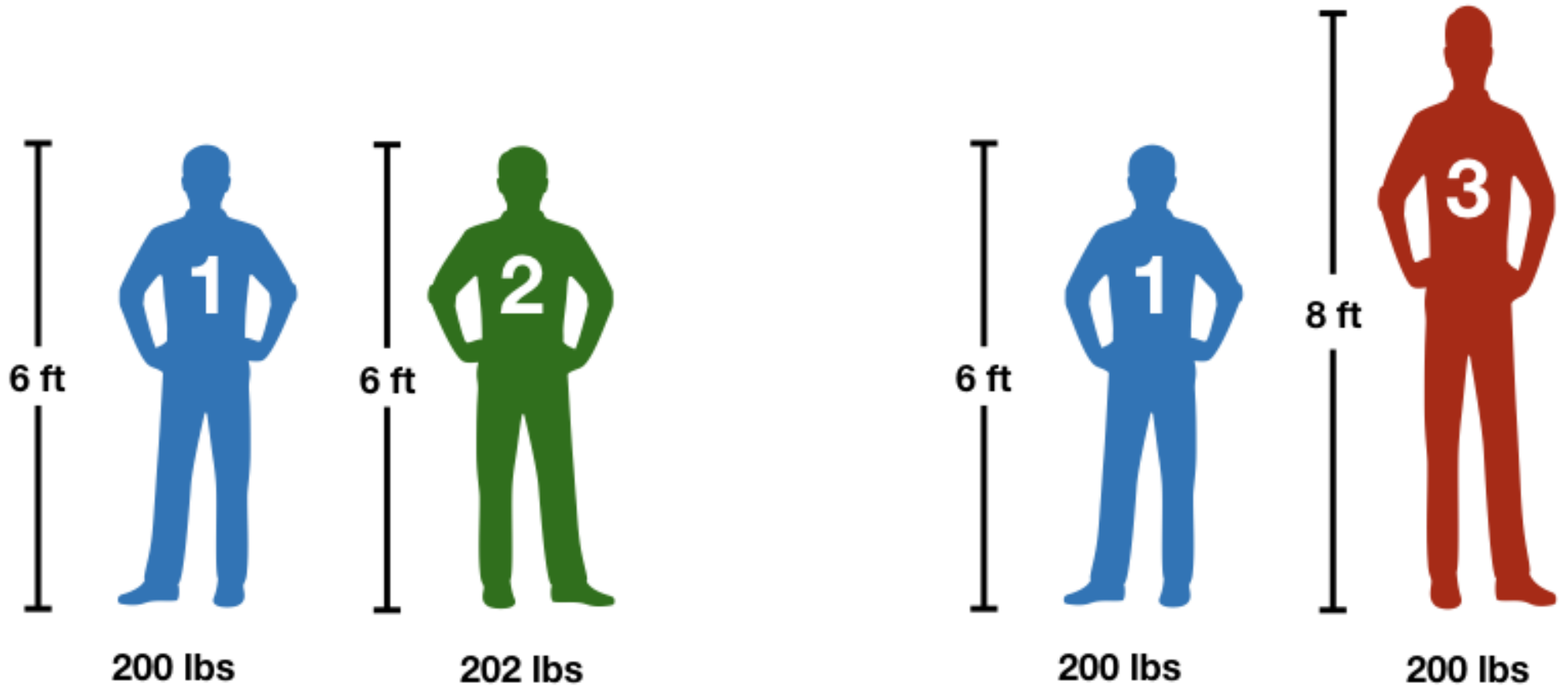


Distance between individuals



DISTANCE: **2**

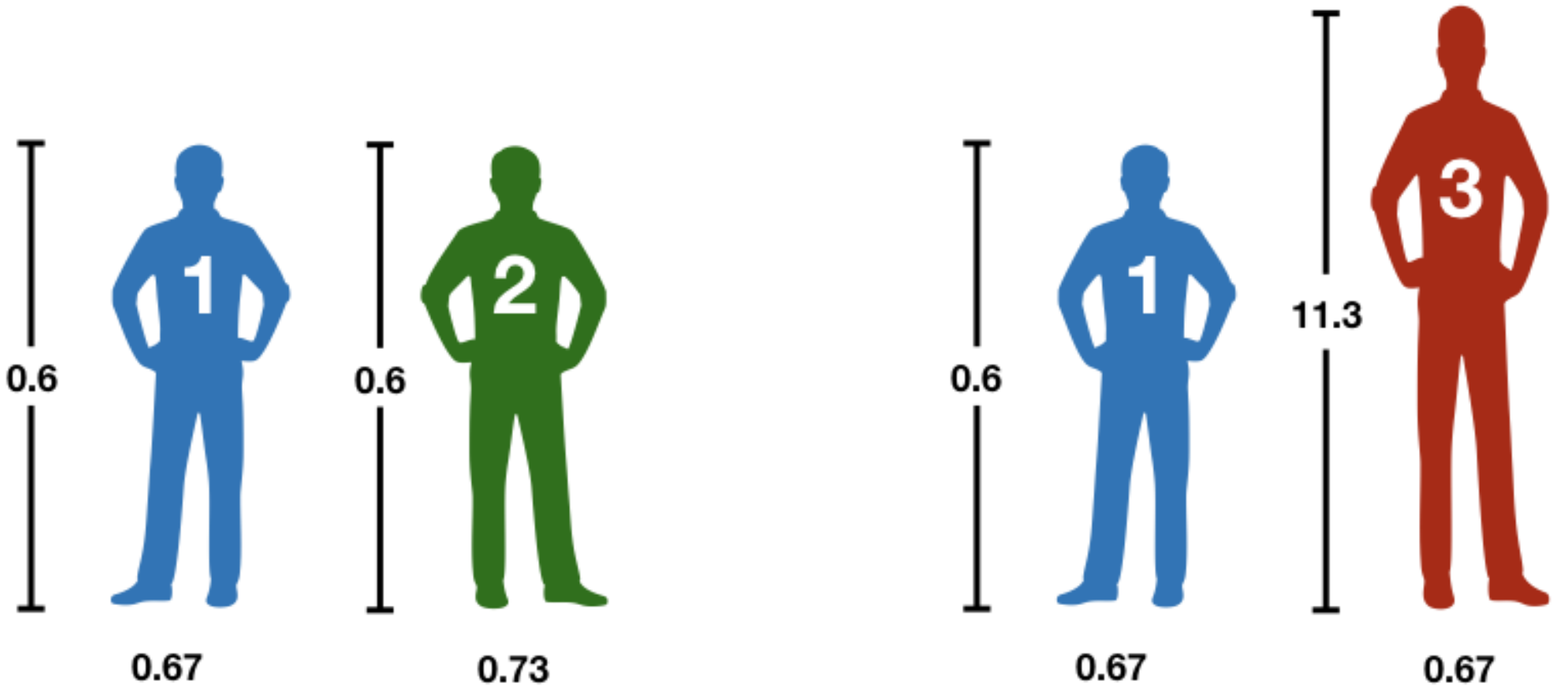
Distance between individuals



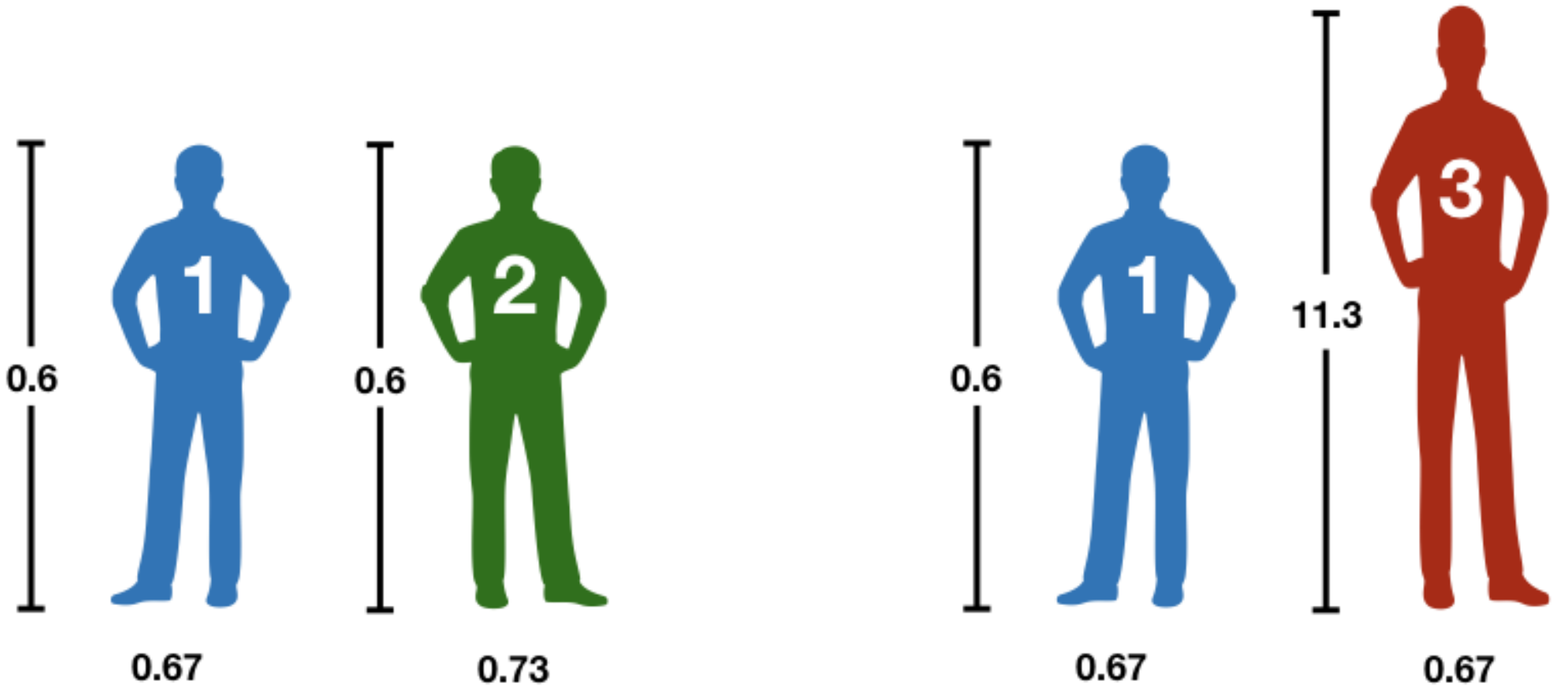
Scaling our features

$$height_{scaled} = \frac{height - mean(height)}{sd(height)}$$

Distance between individuals



Distance between individuals



DISTANCE: **0.06**

DISTANCE: **10.7**

scale() function

```
print(height_weight)

  Height Weight
1      6    200
2      6    202
3      8    200
...  ...    ...
scale(height_weight)

   Height   Weight
1    0.60    0.67
2    0.60    0.73
```

Let's practice!

CLUSTER ANALYSIS IN R

Measuring distance for categorical data

CLUSTER ANALYSIS IN R

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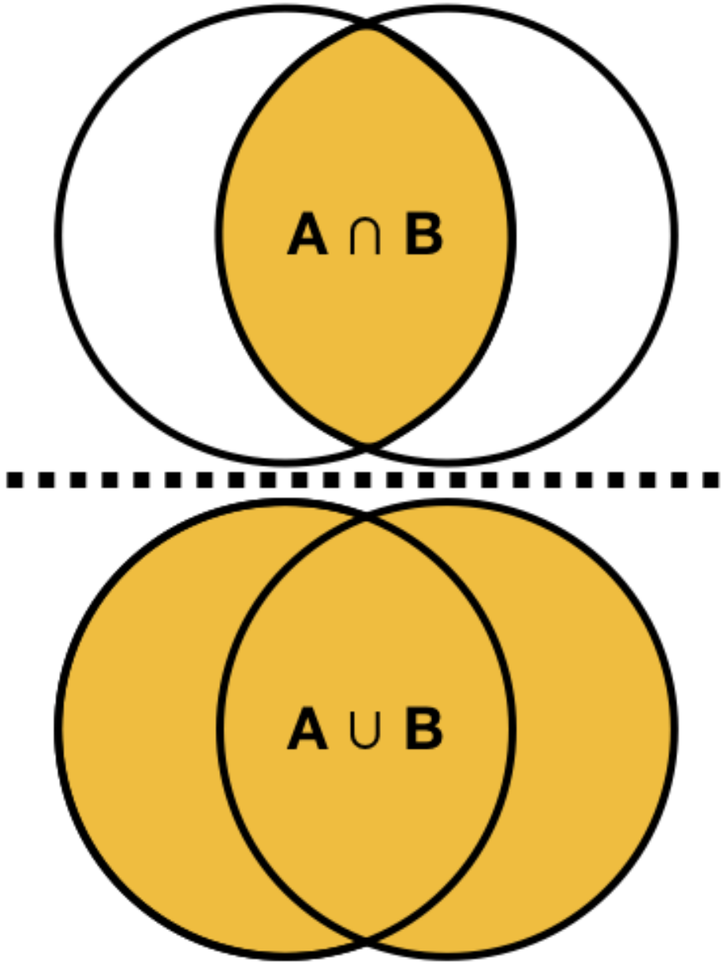
Lead Data Scientist, Memorial Sloan Kettering Cancer Center

Binary data

	wine	beer	whiskey	vodka
1	**TRUE**	**TRUE**	FALSE	FALSE
2	FALSE	**TRUE**	**TRUE**	**TRUE**
...	...	...	...	...

Jaccard index

$$J(A,B) = \frac{A \cap B}{A \cup B}$$



Calculating Jaccard distance

	wine	beer	whiskey	vodka
1	**TRUE**	**TRUE**	FALSE	FALSE
2	FALSE	**TRUE**	**TRUE**	**TRUE**

$$J(1,2) = \frac{1 \cap 2}{1 \cup 2} = \frac{1}{4} = 0.25$$

$$Distance(1,2) = 1 - J(1,2) = 0.75$$

Calculating Jaccard distance in R

```
print(survey_a)
```

```
   wine  beer whiskey vodka
  <lgl> <lgl>   <lgl> <lgl>
1  TRUE  TRUE    FALSE FALSE
2 FALSE  TRUE    TRUE  TRUE
3  TRUE FALSE    TRUE FALSE
```

```
dist(survey_a, method = "binary")
```

```
          1         2
2 0.7500000
3 0.6666667 0.7500000
```

More than two categories

	color	sport
1	red	soccer
2	green	hockey
3	blue	hockey

	colorblue	colorgreen	colorred	sporthockey	sportsoccer
1	0	0	1	0	1
2	0	1	0	1	0
3	1	0	0	1	0

Dummification in R

```
print(survey_b)

  color  sport
1   red soccer
2 green hockey
3  blue hockey
4  blue soccer
```

```
library(dummies)

dummy.data.frame(survey_b)

  colorblue colorgreen colorred sporthockey sportsoccer
1         0          0        1           0           1
2         0          1        0           1           0
3         1          0        0           1           0
4         1          0        0           0           1
```

Generalizing categorical distance in R

```
print(survey_b)

  color  sport
1   red soccer
2 green hockey
3  blue hockey
4  blue soccer
```

```
dummy_survey_b <- dummy.data.frame(survey_b)

dist(dummy_survey_b, method = 'binary')

          1         2         3
2 1.0000000
3 1.0000000 0.6666667
4 0.6666667 1.0000000 0.6666667
```

Let's practice!

CLUSTER ANALYSIS IN R