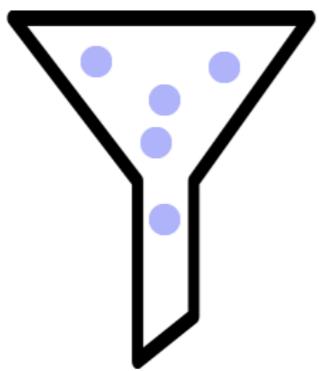
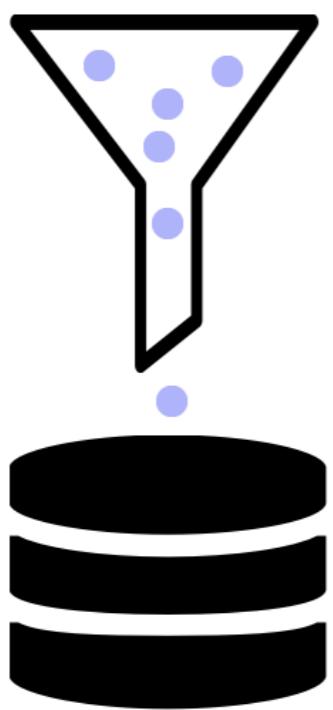


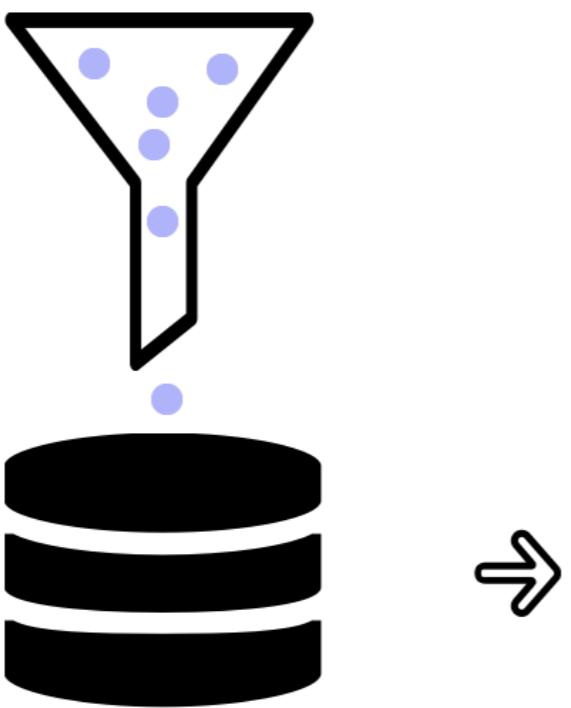
Visualization Principles

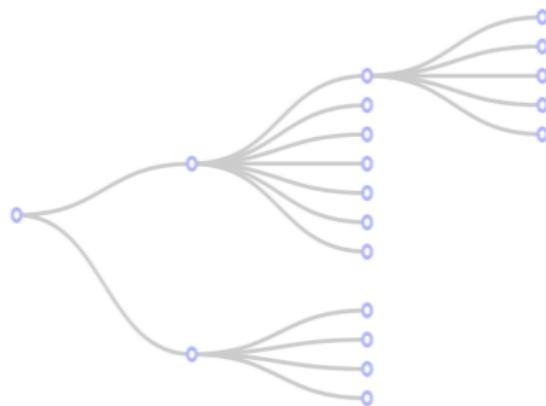
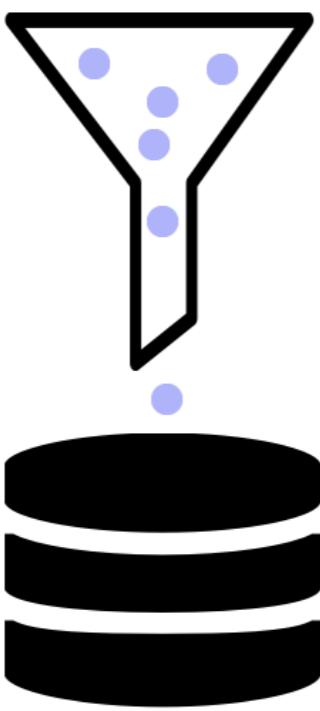
{context}

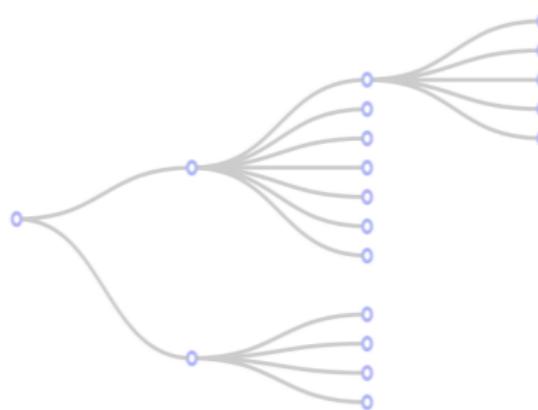
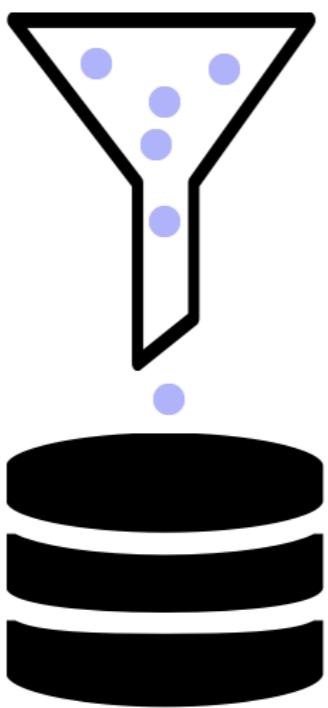


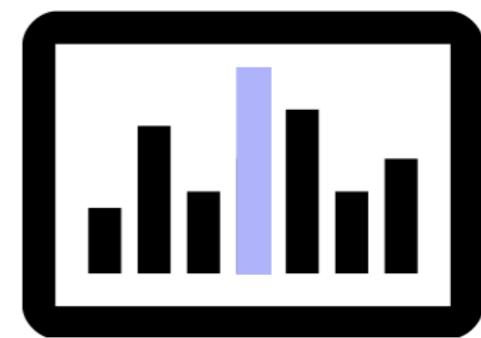
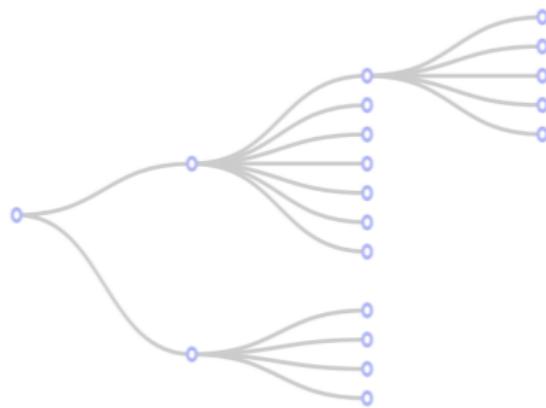
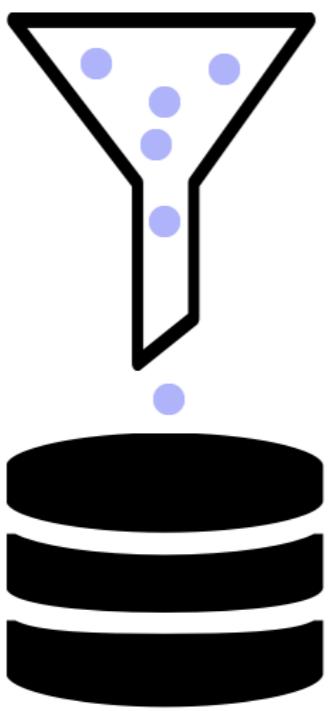


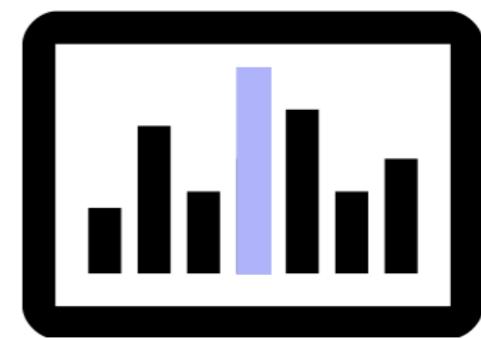
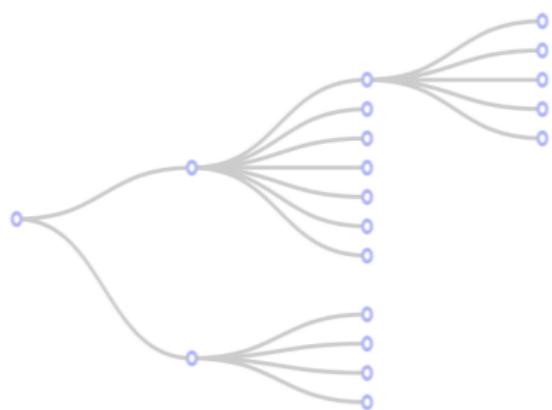
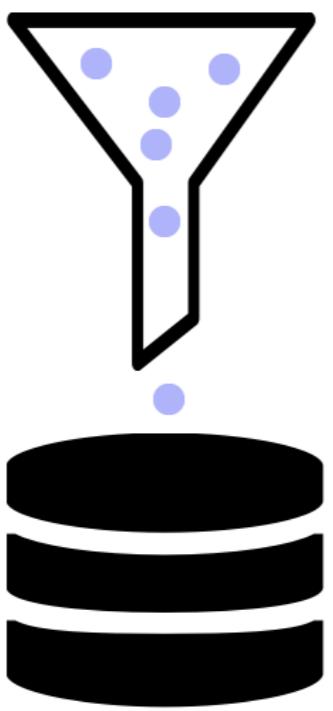


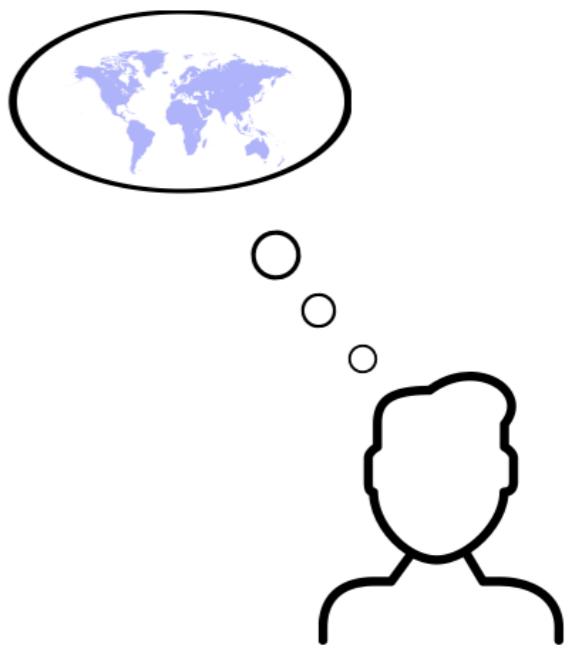
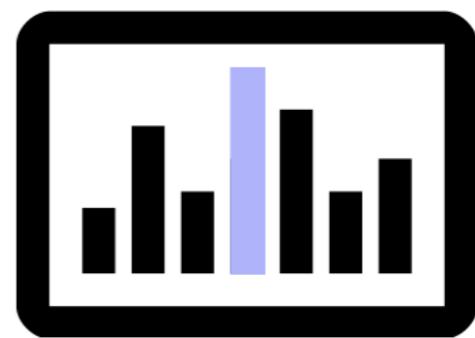
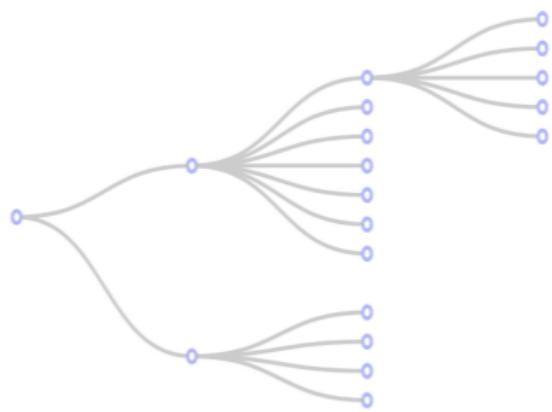
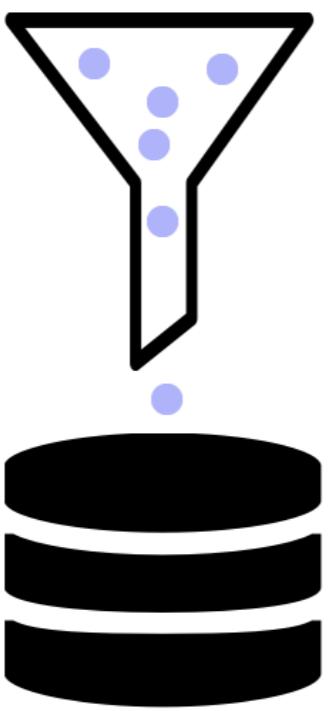


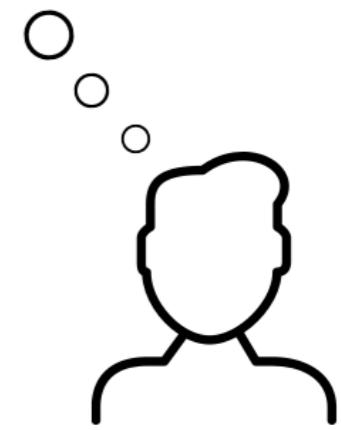
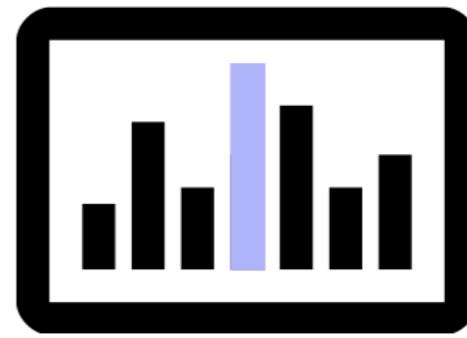
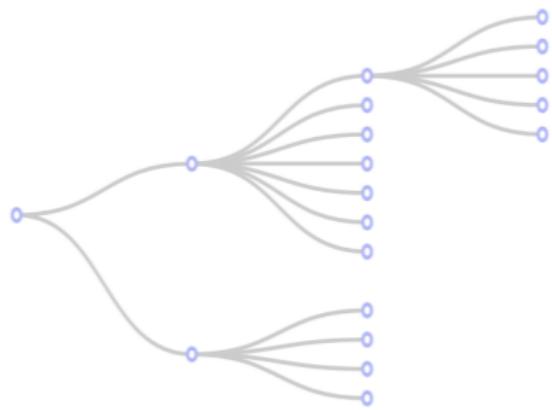
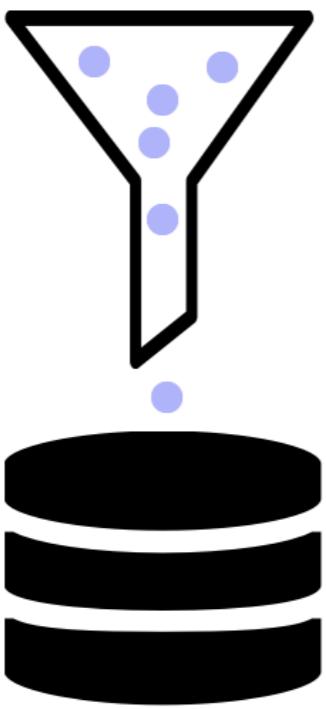


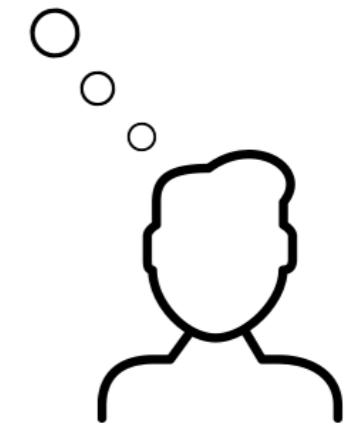
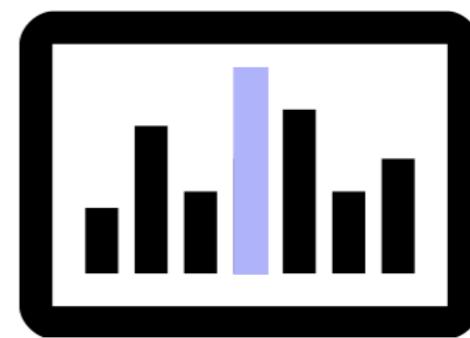
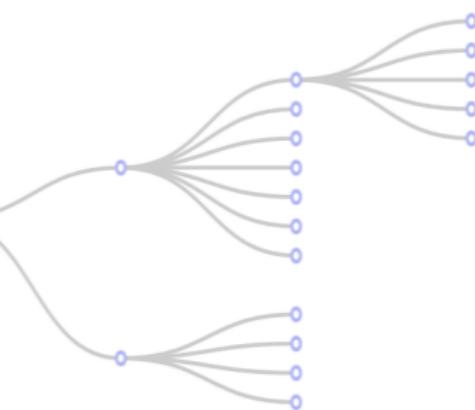
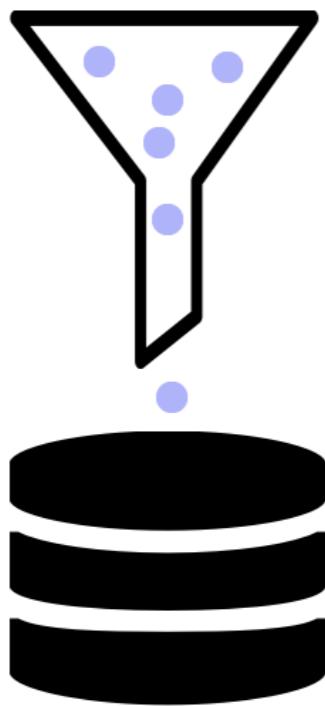


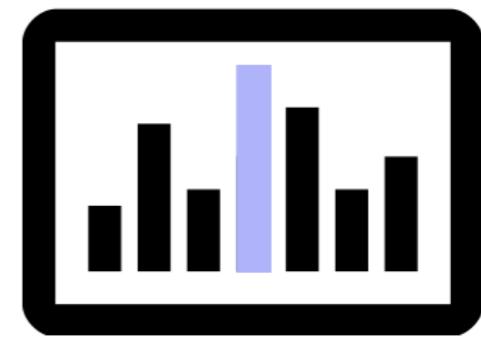
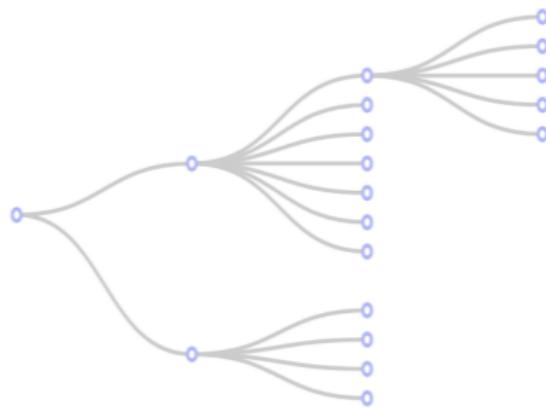
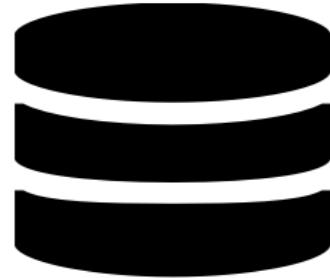
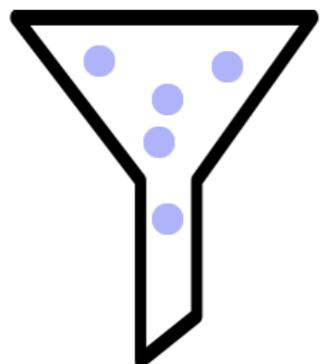
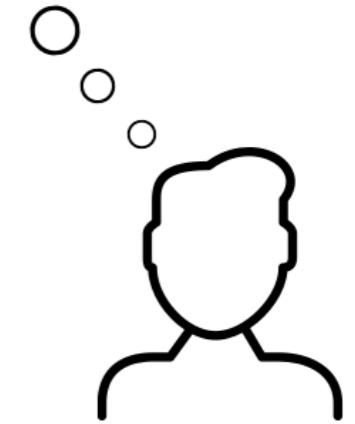


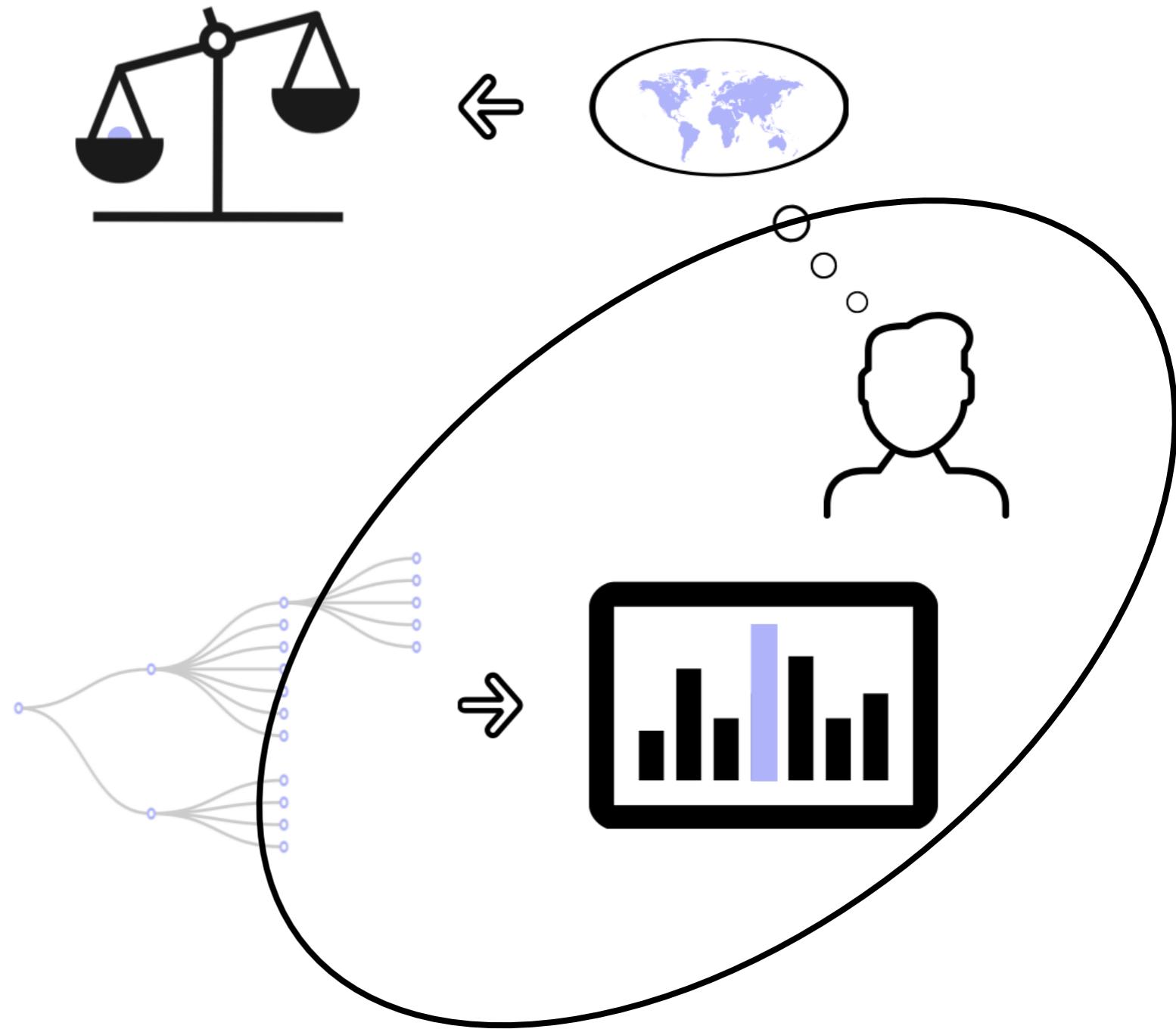
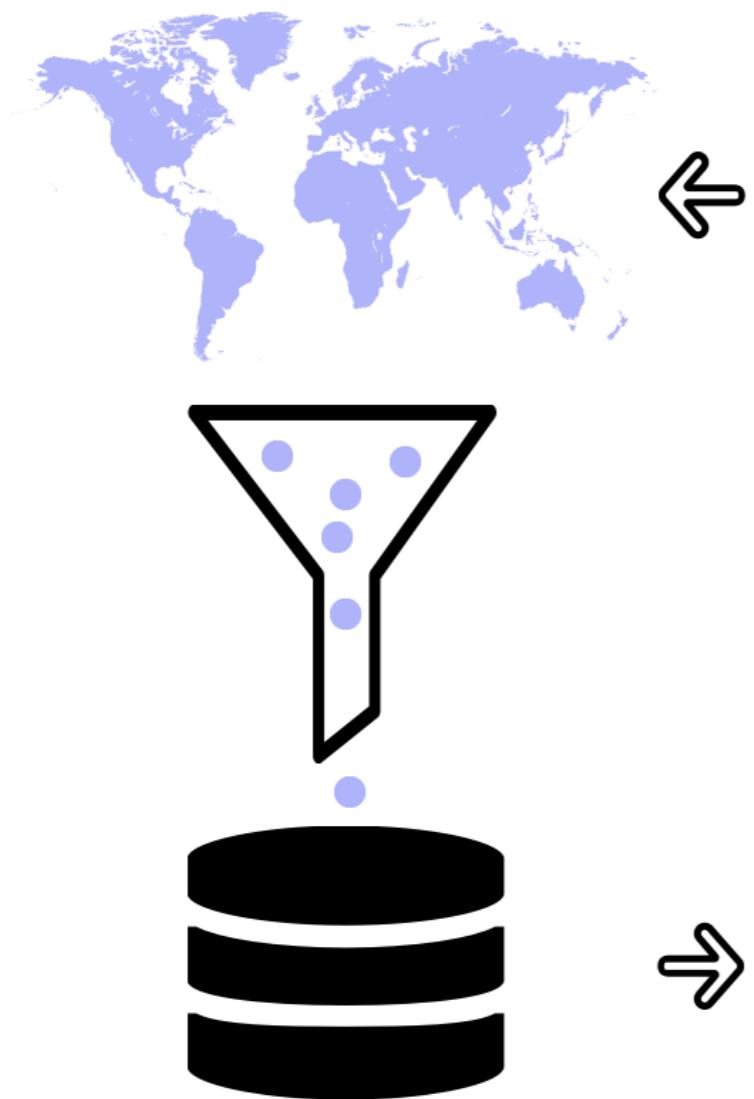












Maximize how quickly and accurately people decode information from graphics

*Maximize how **quickly** and **accurately** people
decode information from graphics*

{perceptual properties}

Quickly

Quickly

Preattentive cognition

Quickly

Preattentive cognition

How many 3's are there?

Quickly

Preattentive cognition

How many 3's are there?

28049385628406947862485
83922089486208947690187
85098834260928468724859
82382409852468749875220
89485202984850924853290
88452029884529028843528
92842589987458784958784
98597076764674153698742

Quickly

Preattentive cognition

How many 3's are there?

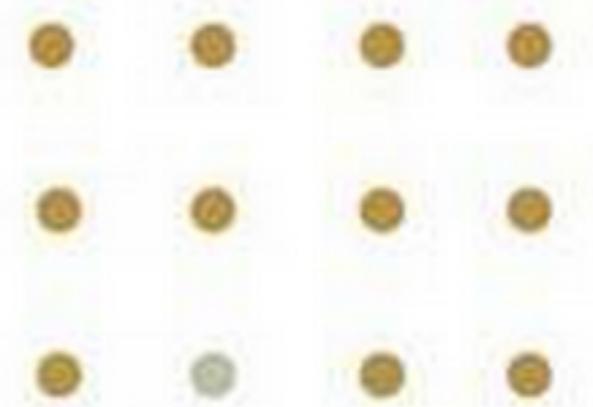
28049385628406947862485
83922089486208947690187
85098834260928468724859
82382409852468749875220
89485202984850924853290
88452029884529028843528
92842589987458784958784
98597076764674153698742

Quickly

Color (hue)



Color (intensity)

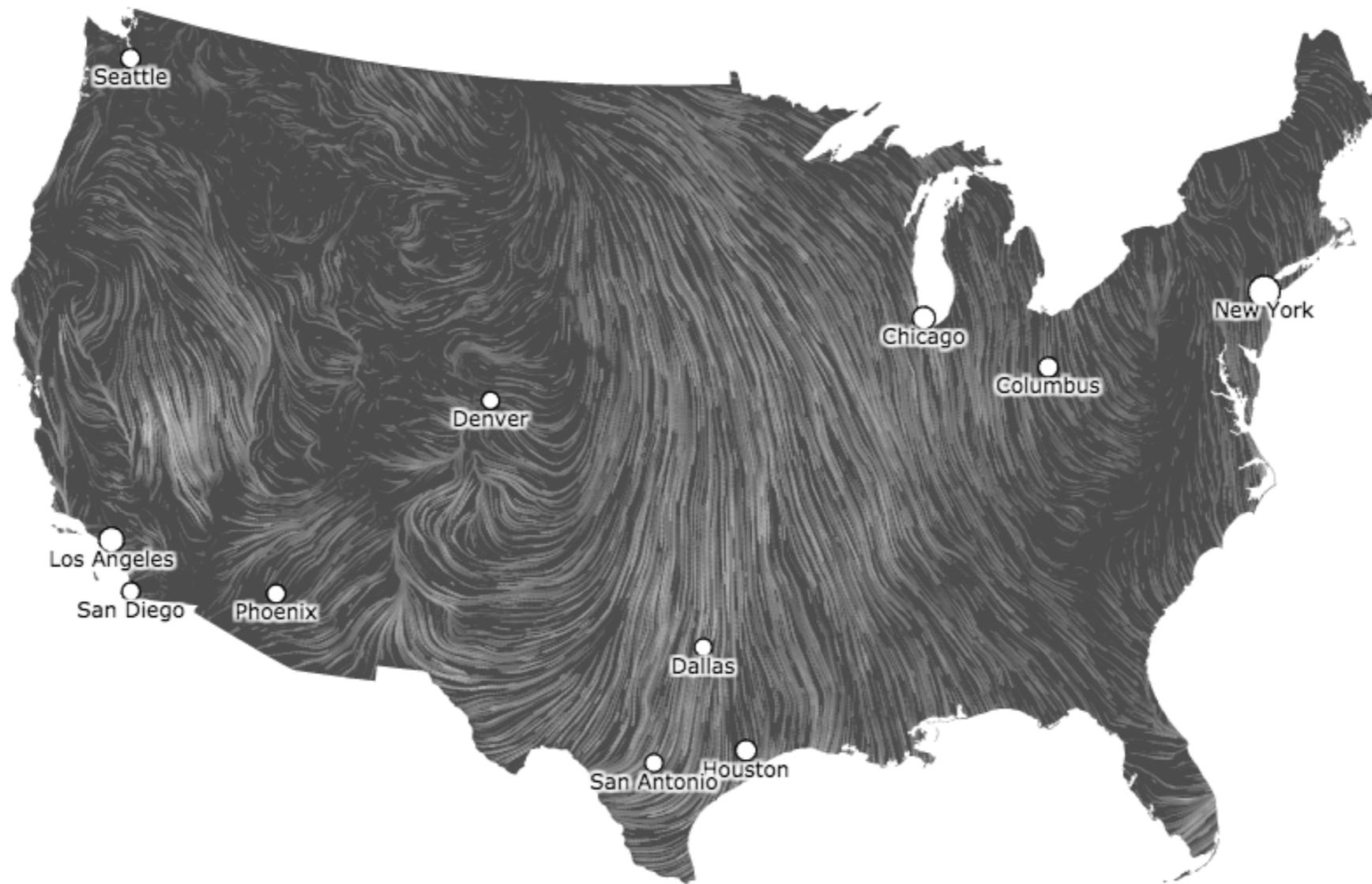
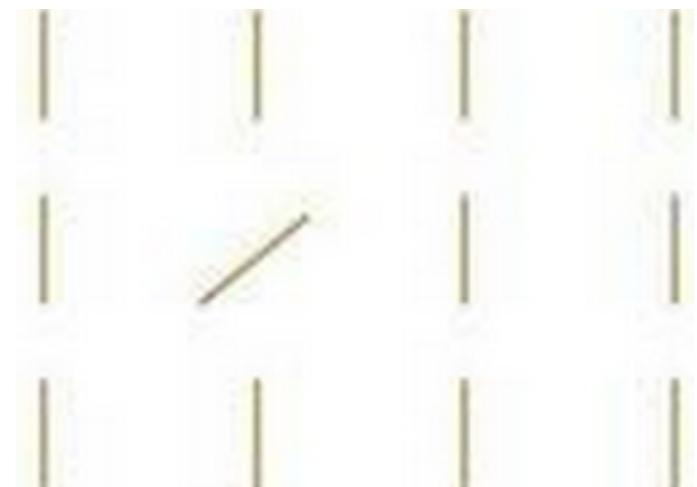


really fast

Credit: S. Few

Quickly

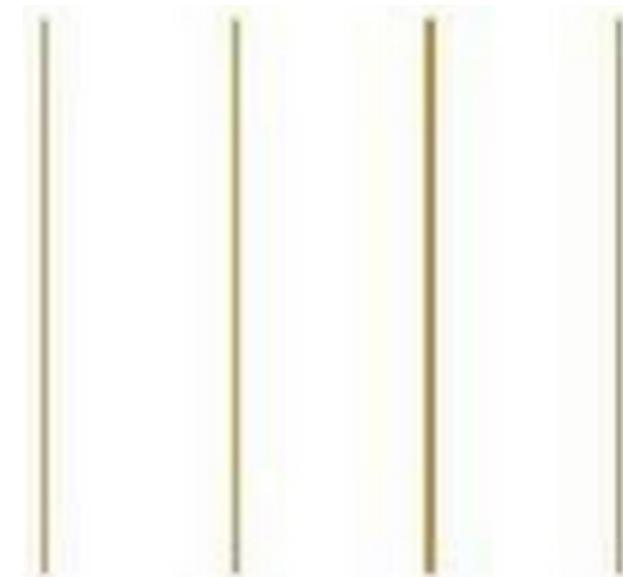
Form (orientation)



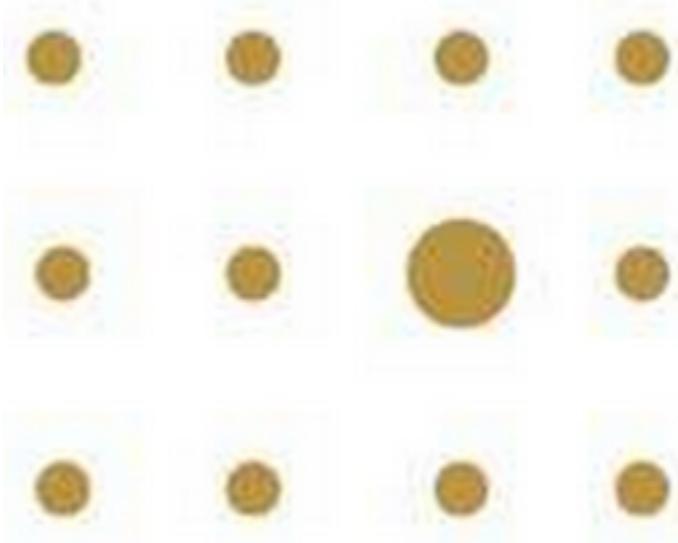
Quickly



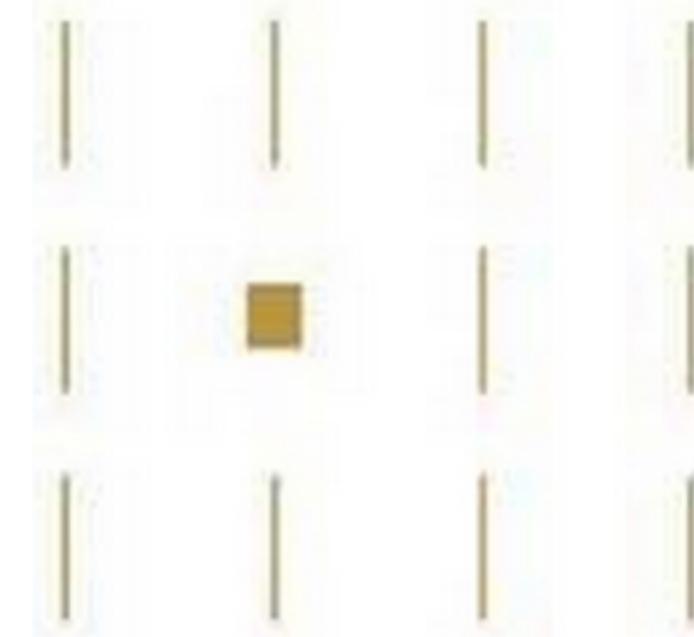
Form (length)



Form (width)



Form (size)



Form (shape)

{example application}

Website usage

“With so many users, sessions, and URLs, it is proving extremely difficult to present the data in such a way that it is visually comprehensible. Any sort of network graphs we try to implement end up looking like a ball of yarn.”

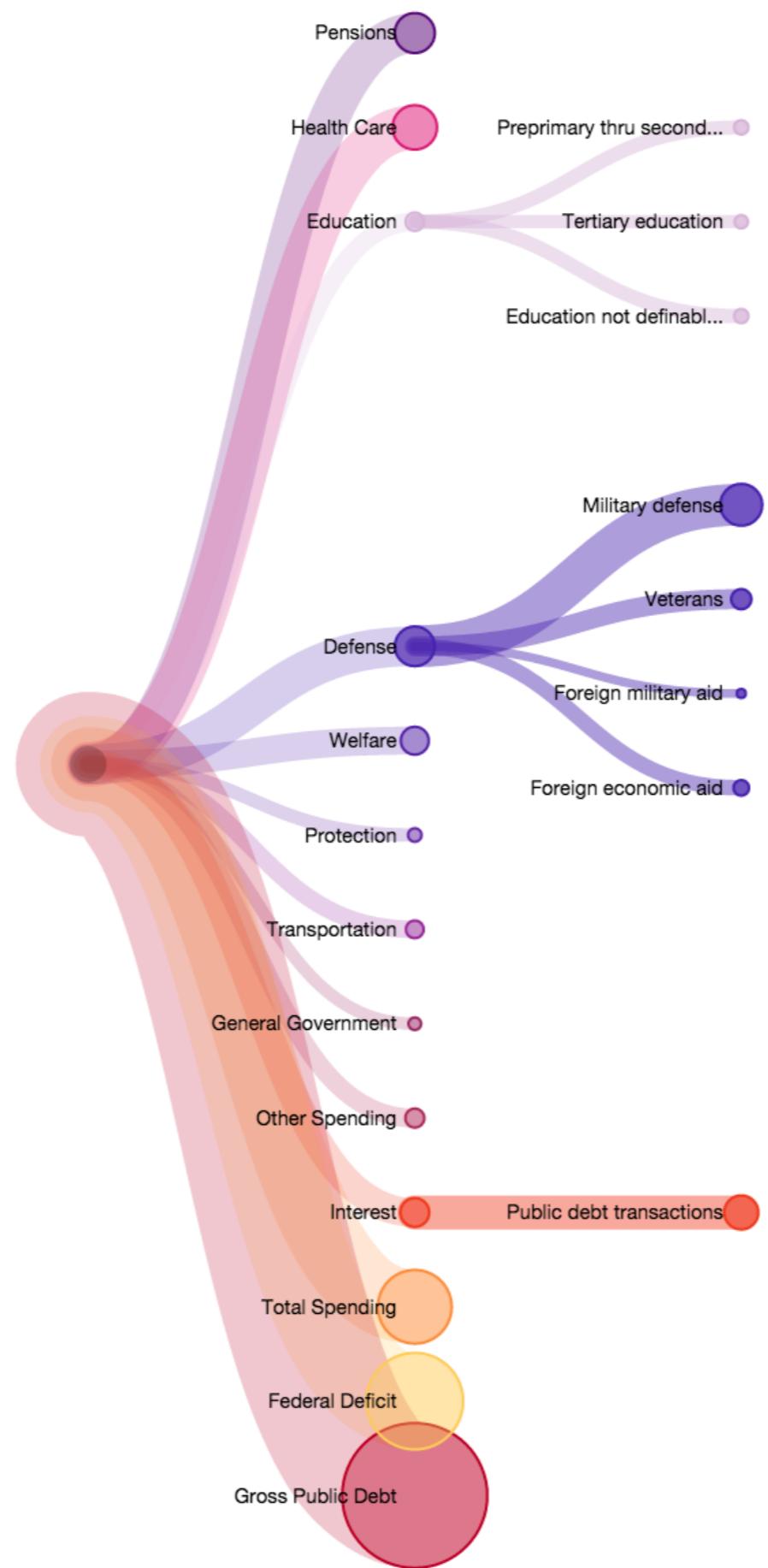
Wikitree

Search for a Wikipedia article...





Encode elements with visual properties to add information

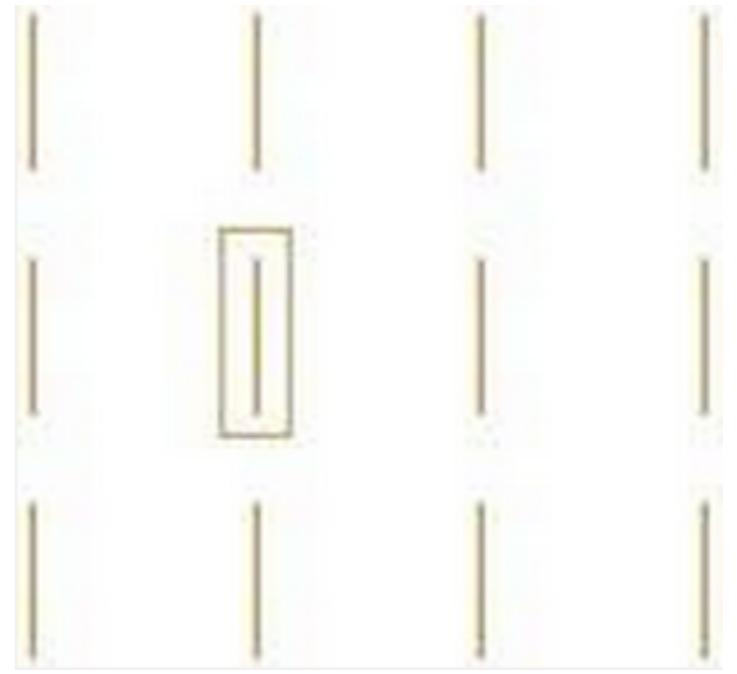
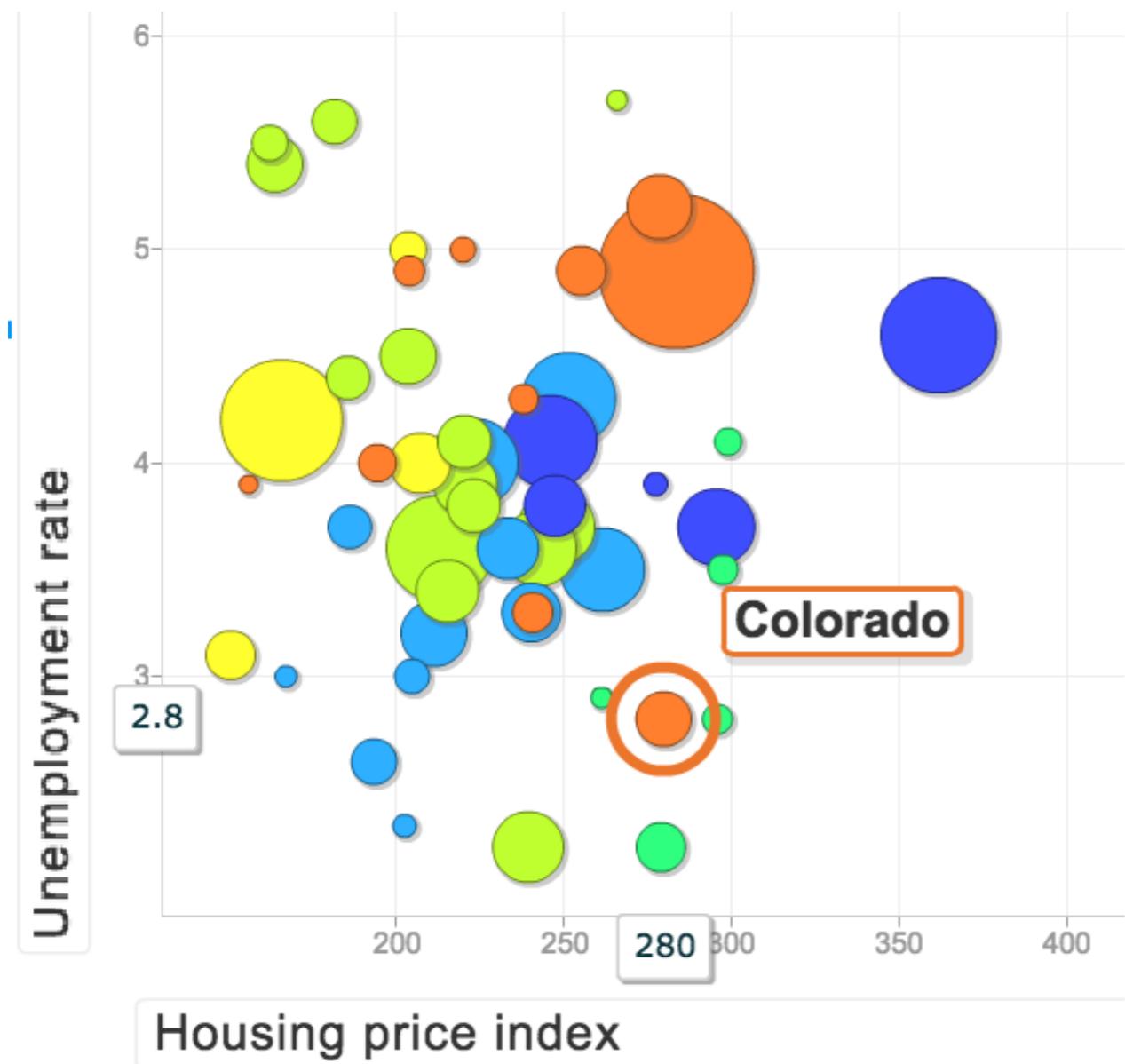


an alternative?

{back to the principles}

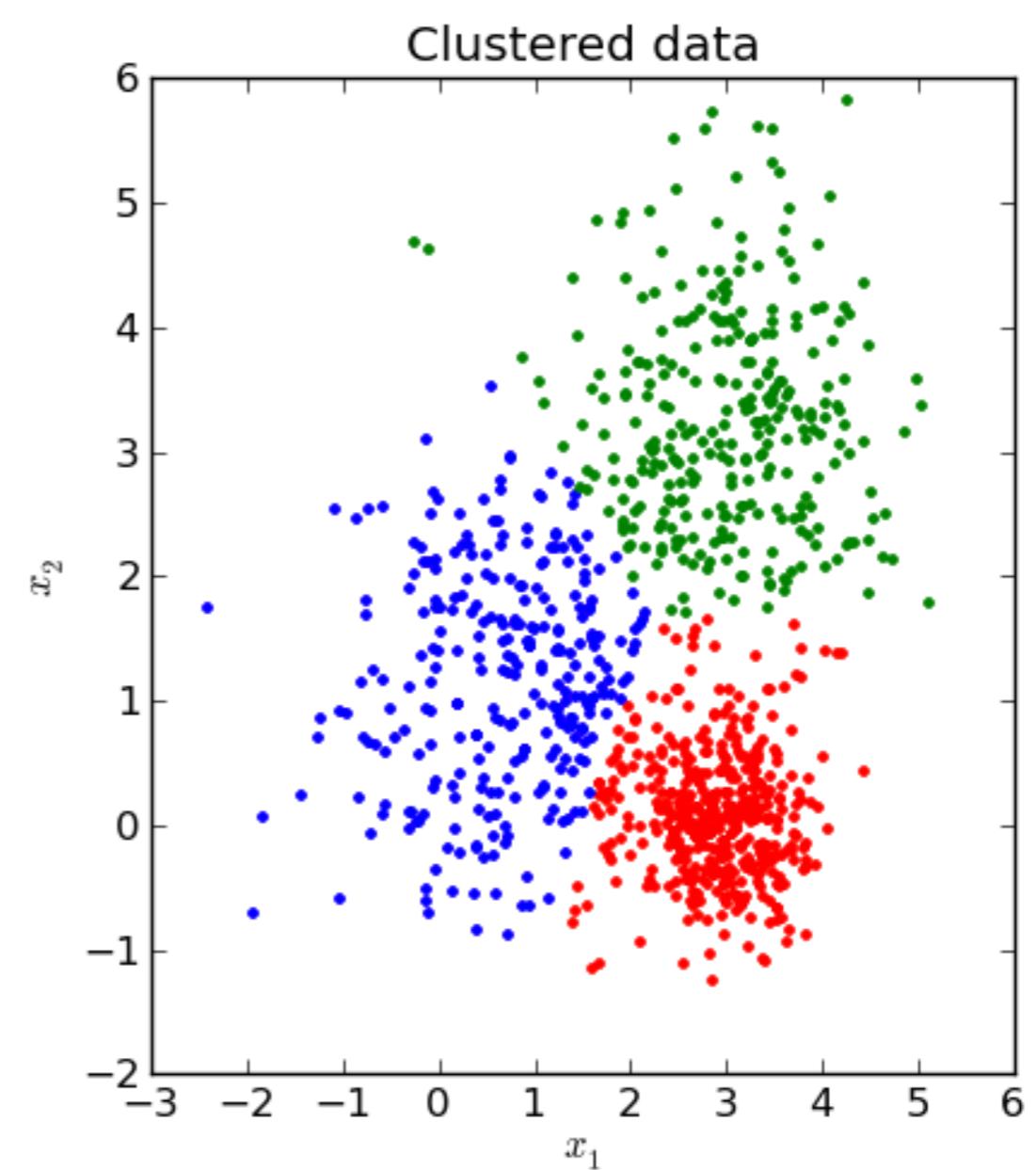
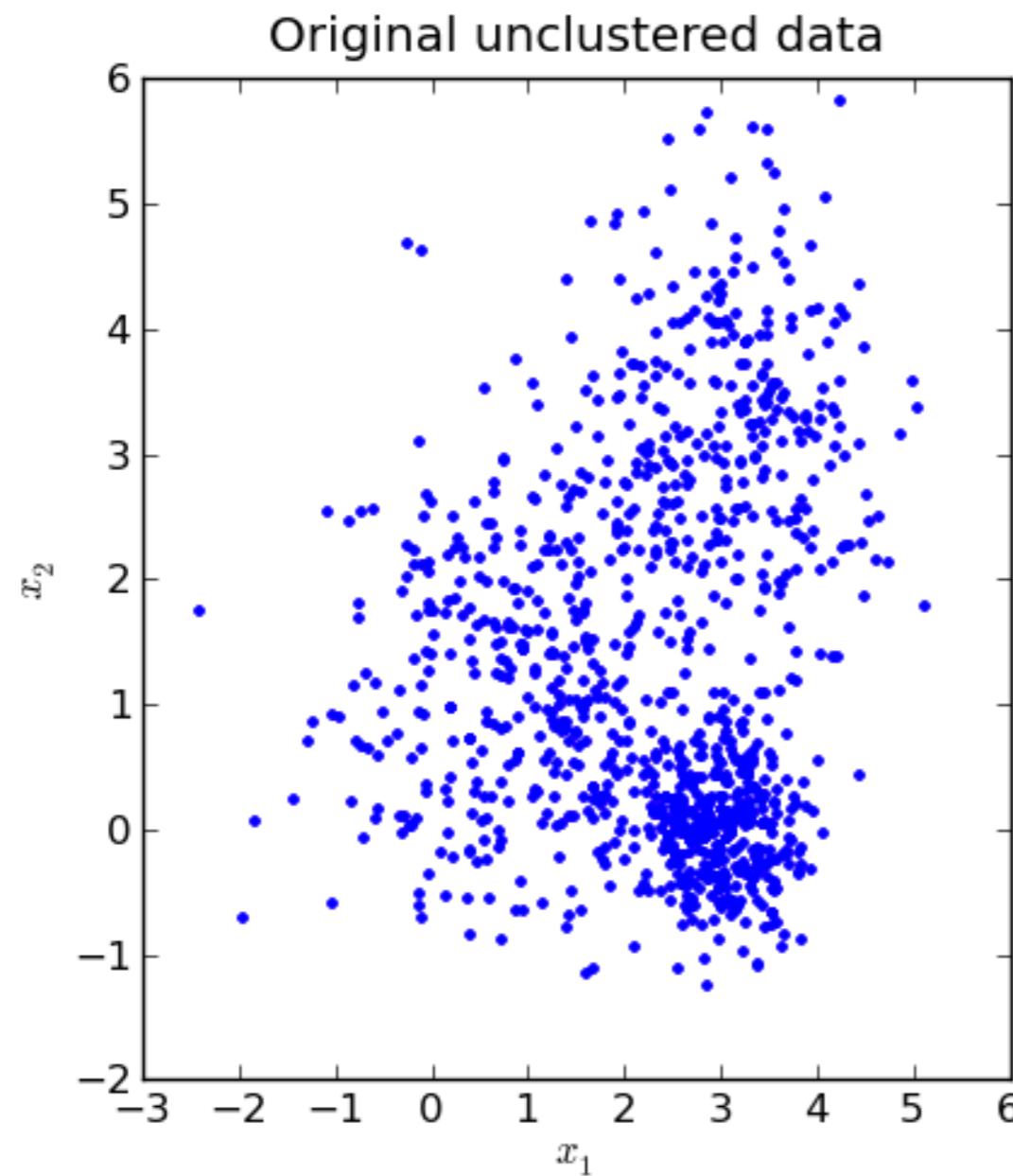
Quickly

Form (enclosure)

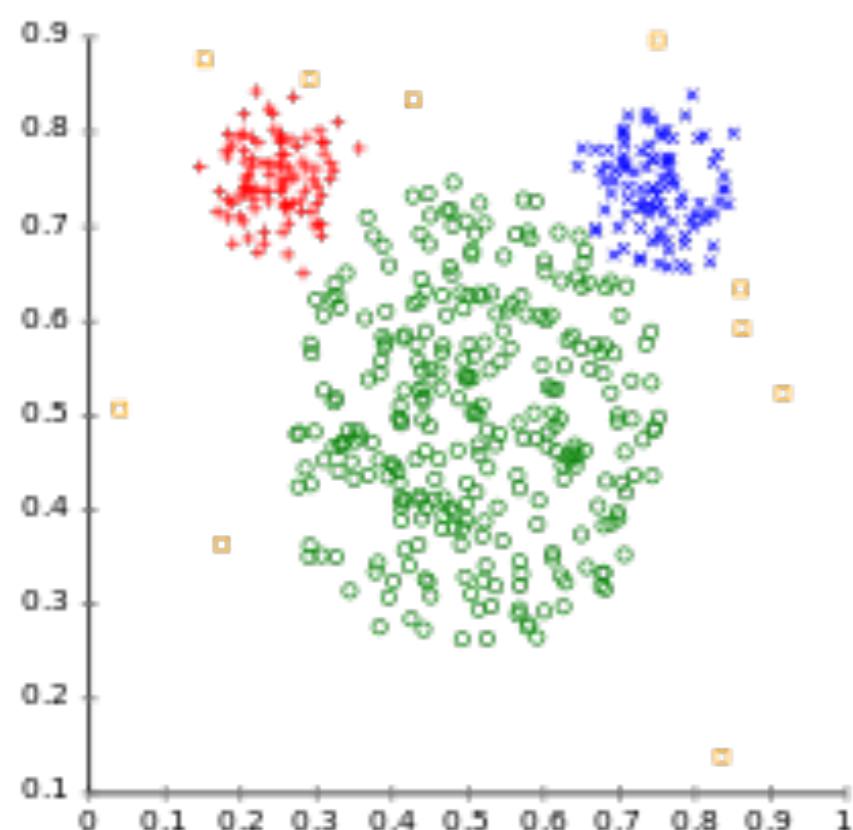


Groupings

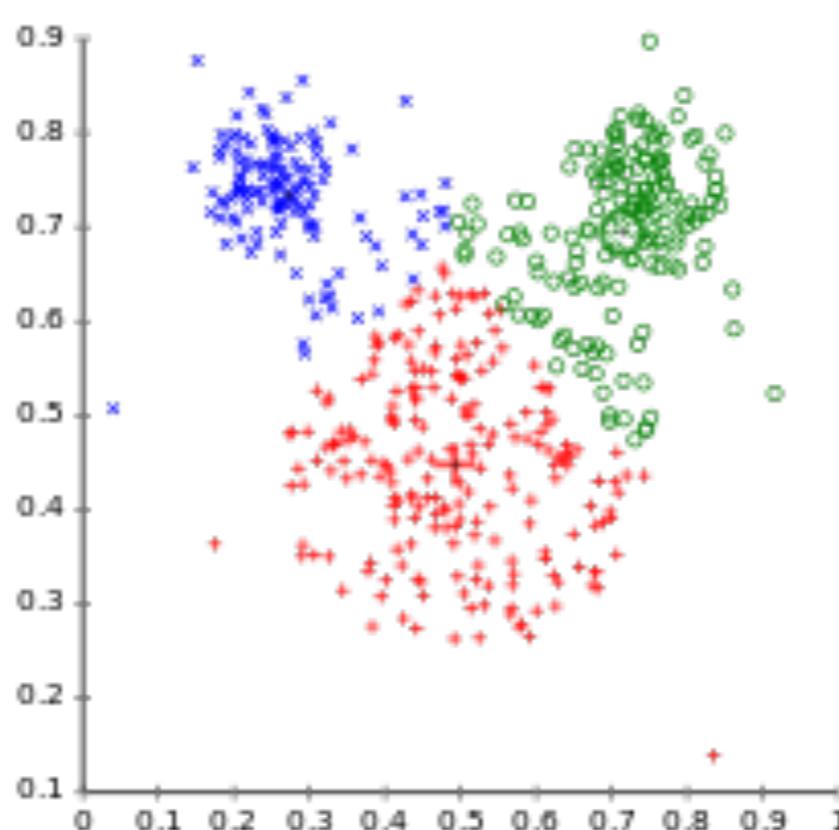
Proximity



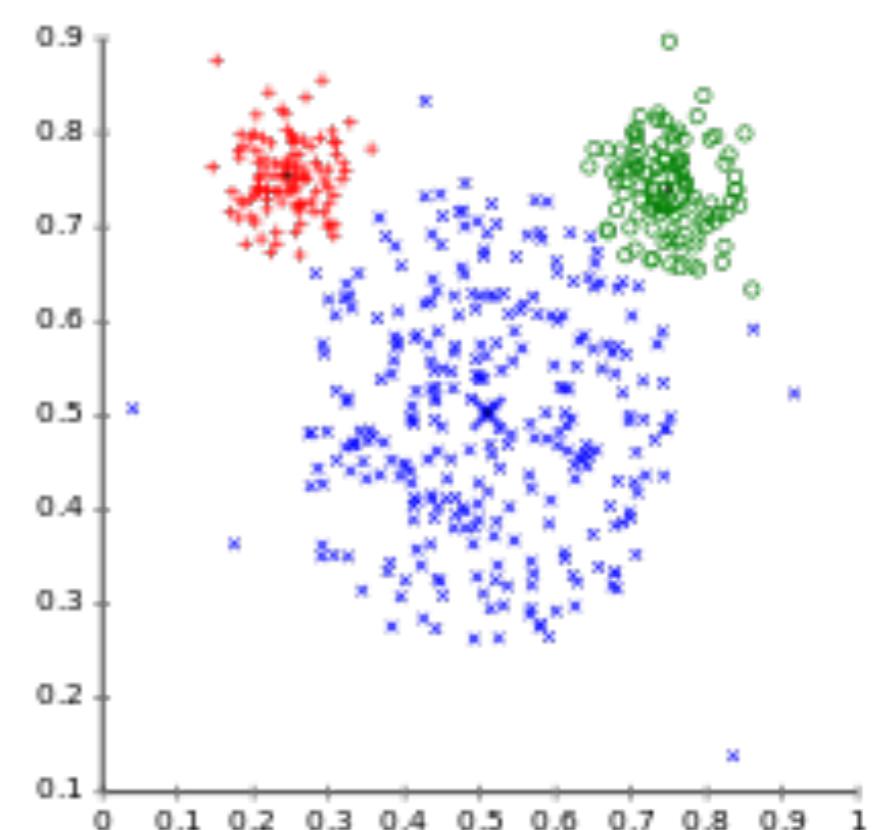
Original Data



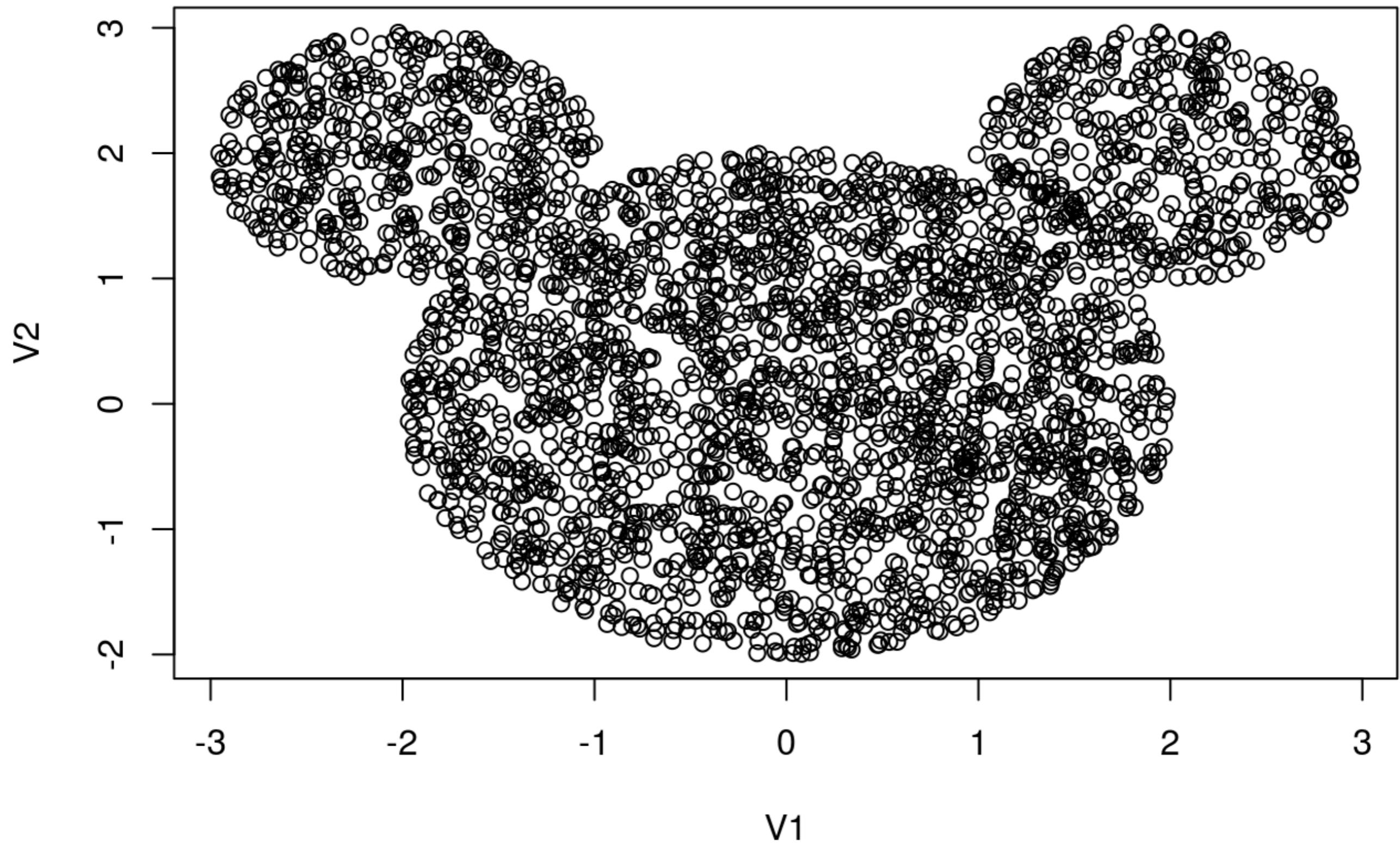
k-Means Clustering



EM Clustering

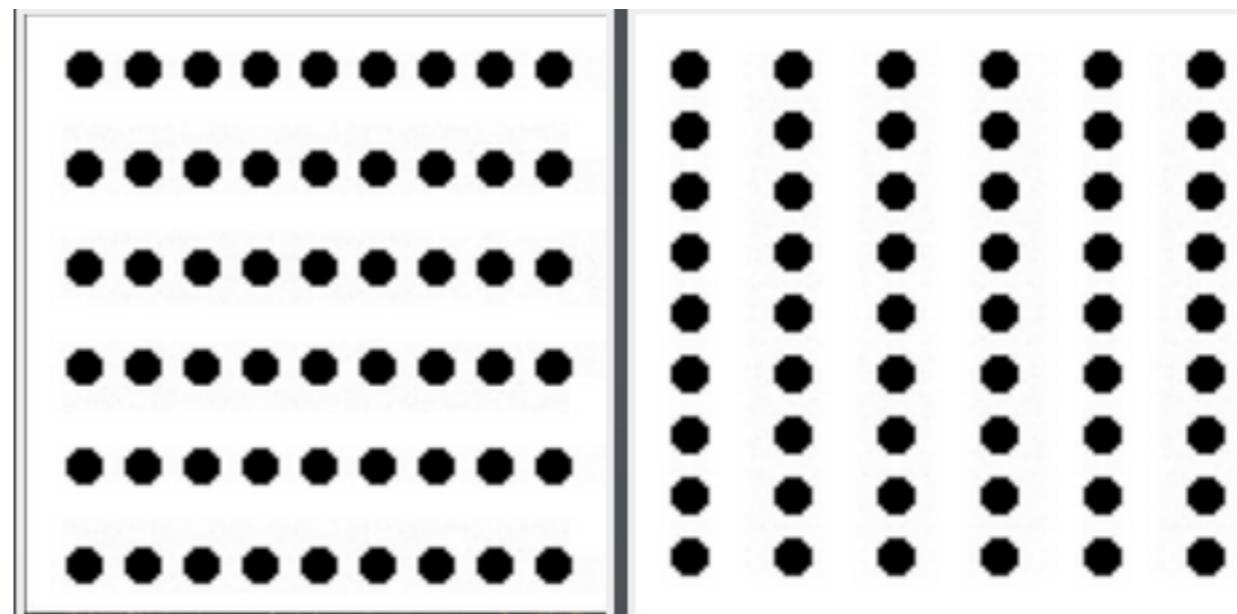


Mouse-like dataset

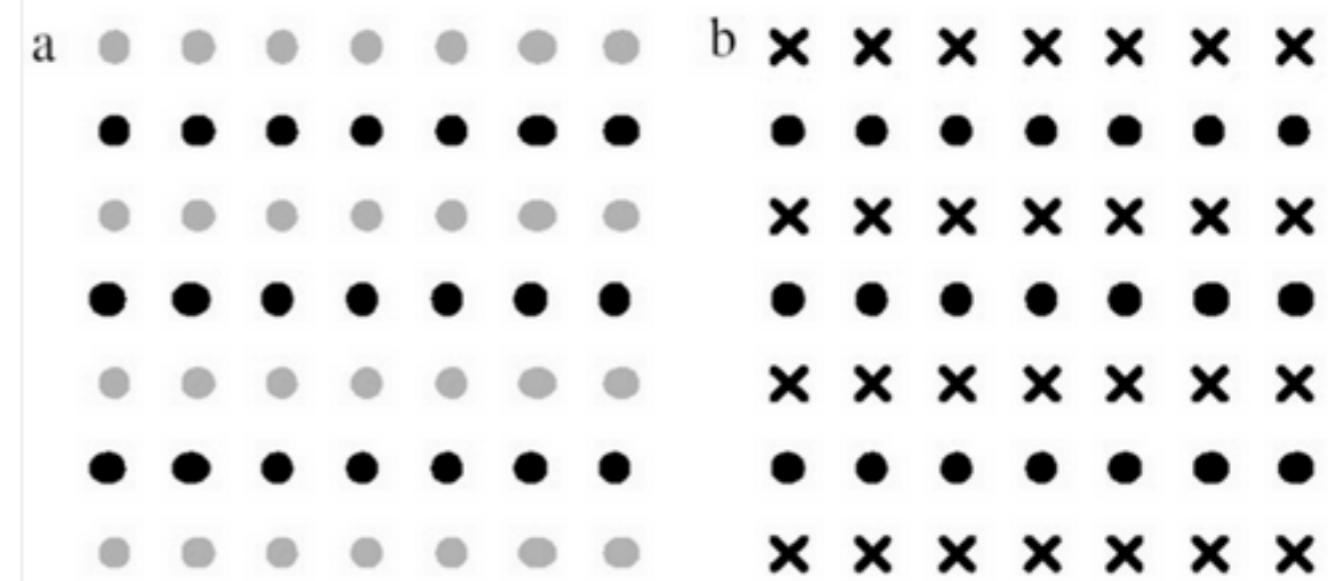


Groupings

Proximity

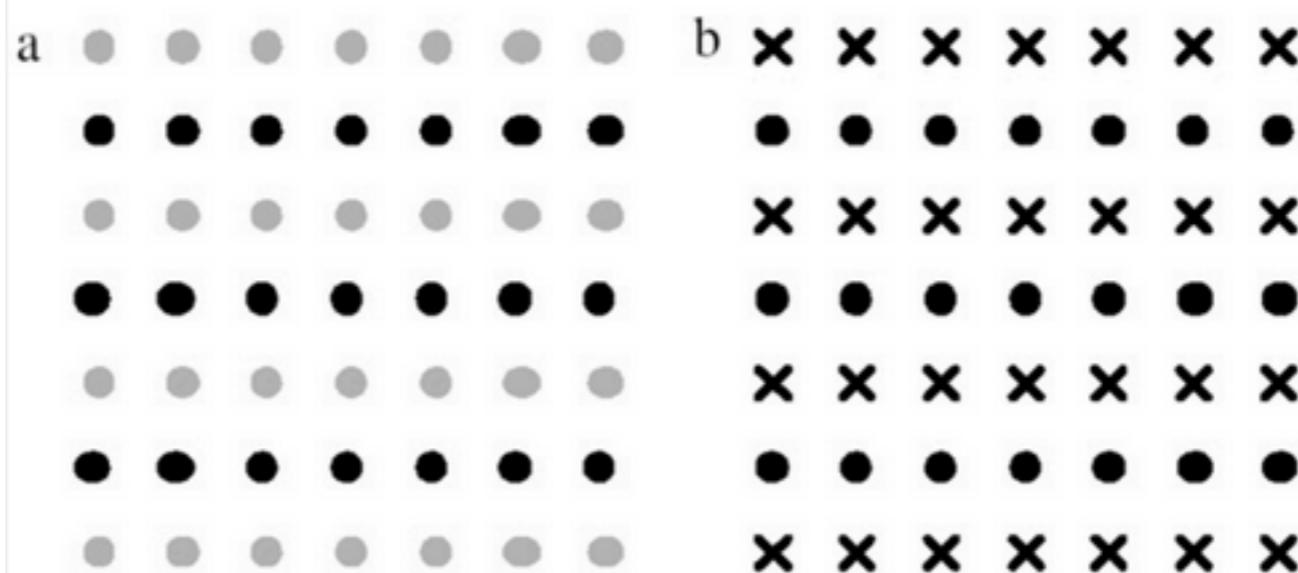


Similarity



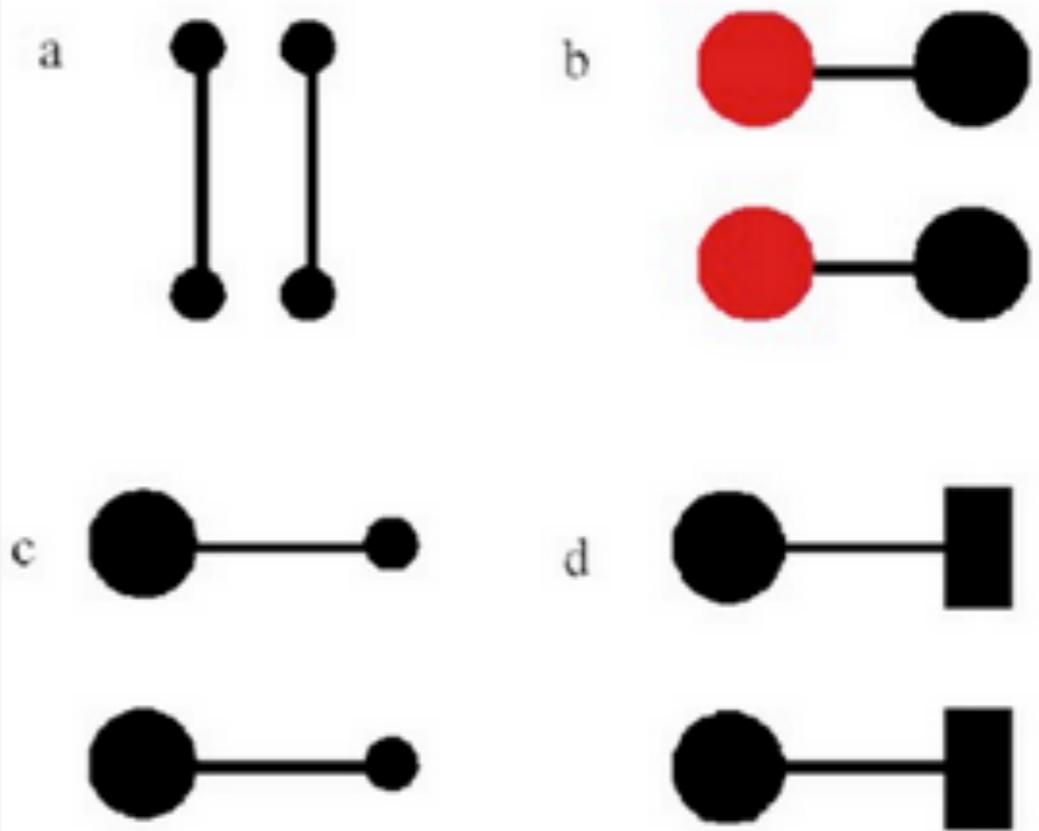
Groupings

Number	First Name	Last Name	Points
1	Eve	Jackson	94
2	John	Doe	80
3	Adam	Johnson	67
4	Jill	Smith	50



Groupings

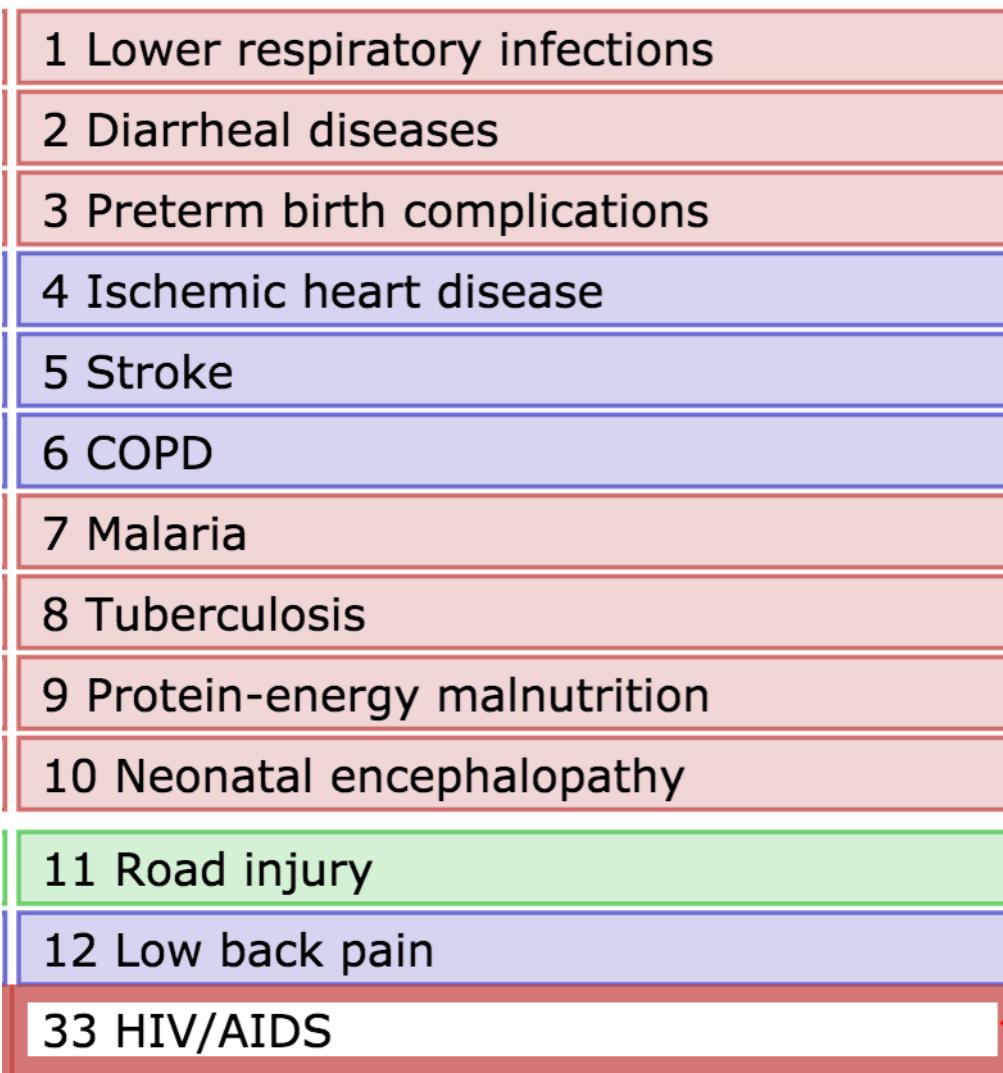
Connectedness



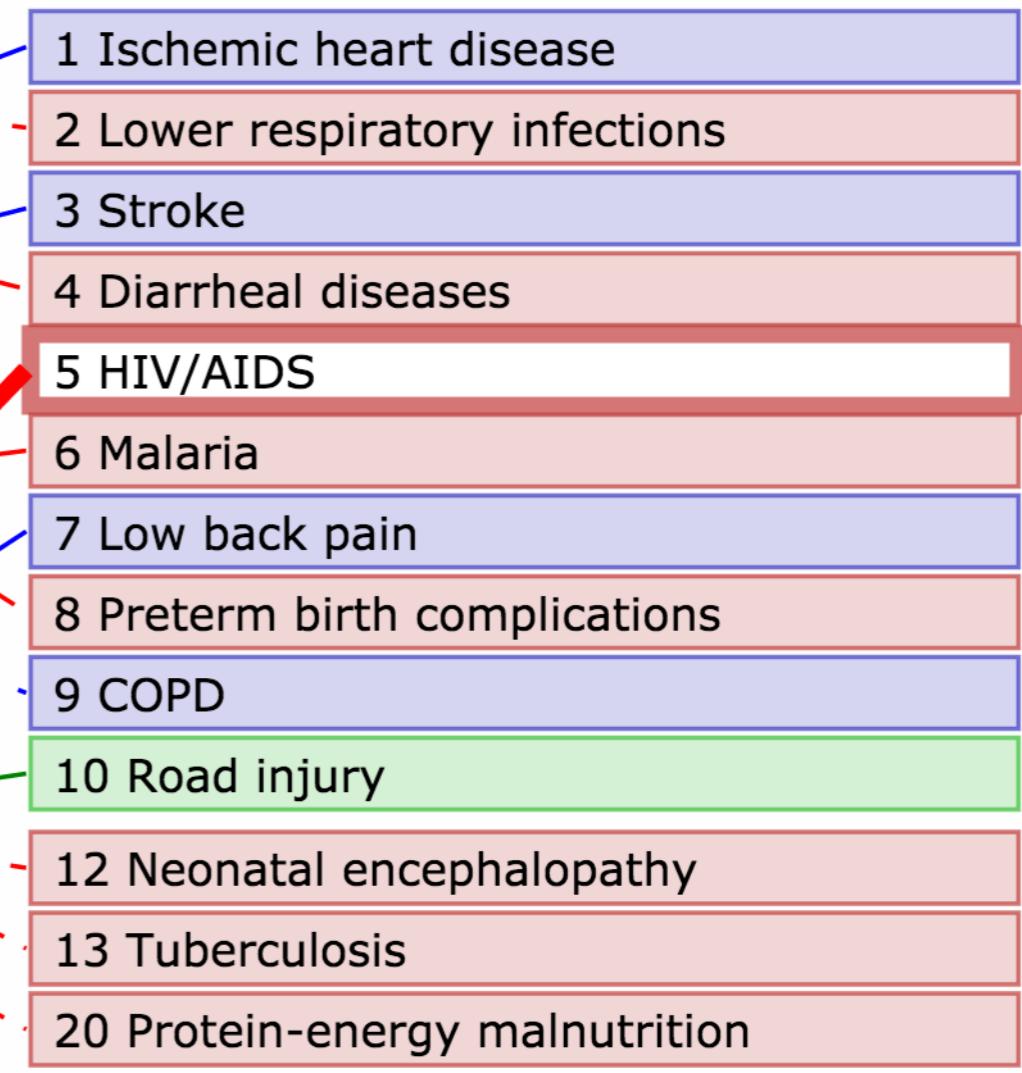
Groupings

Connectedness

1990 Mean rank (95% UI)

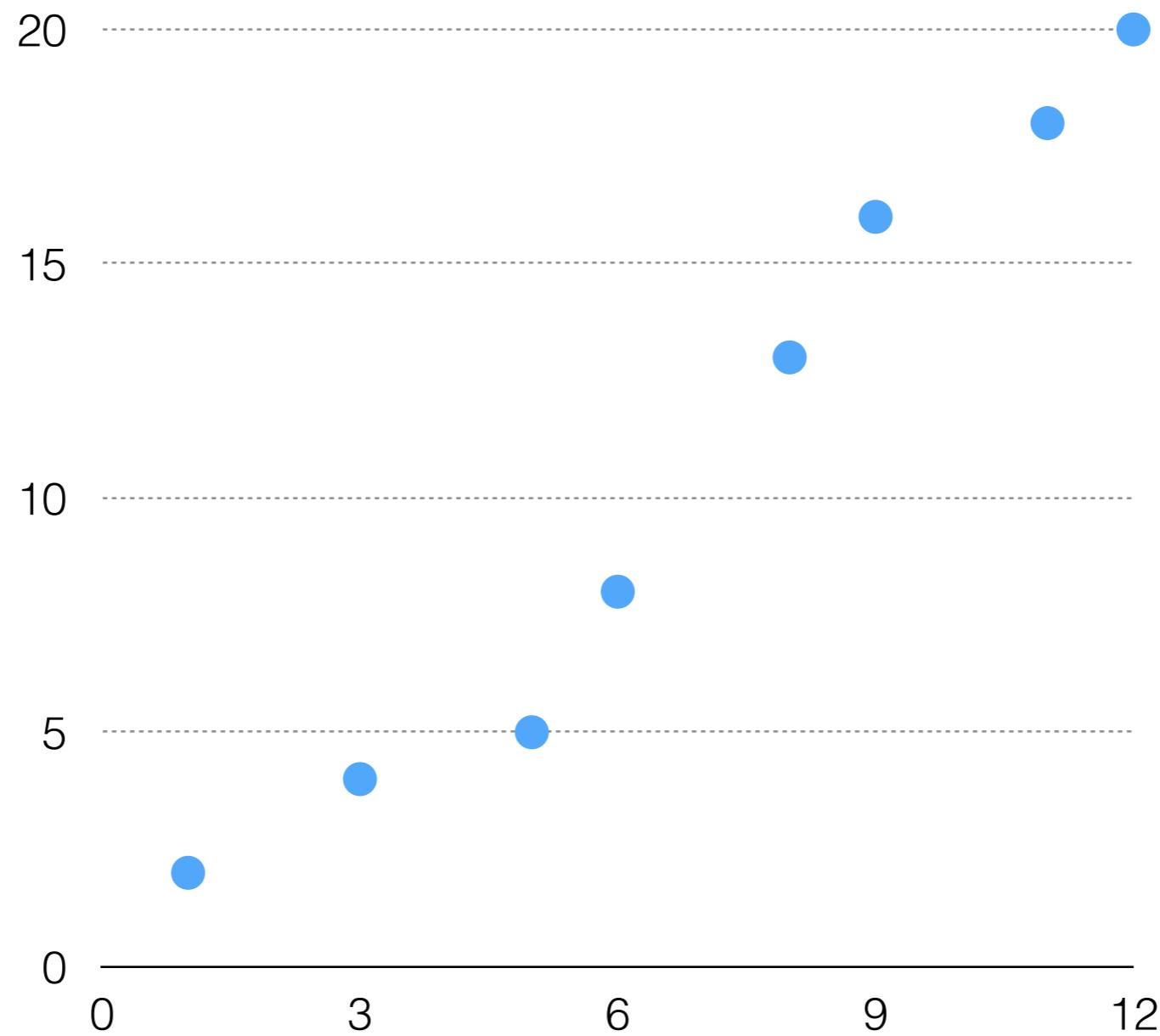


2010 Mean rank (95% UI)



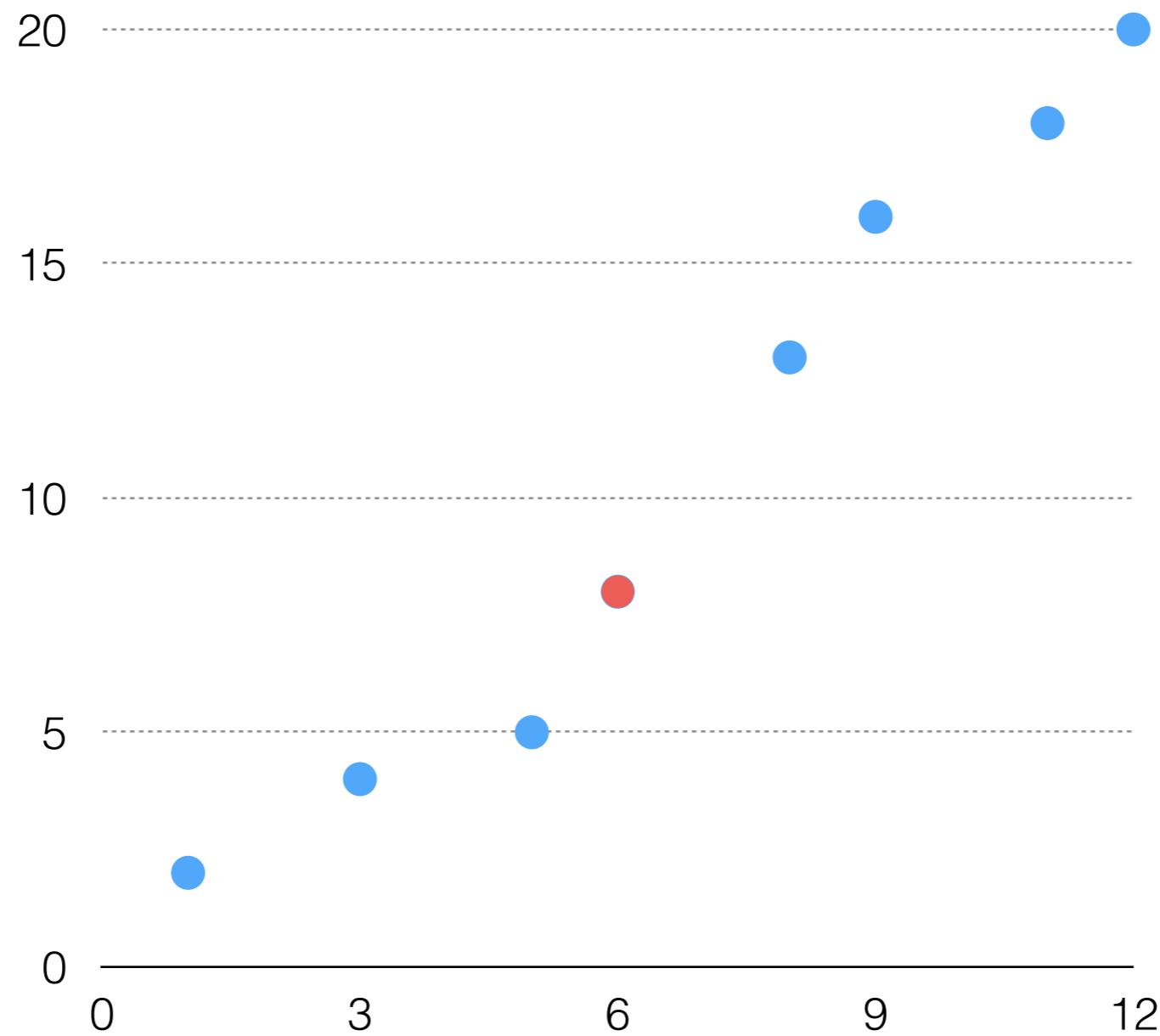
Examples

How could you indicate a selected point?



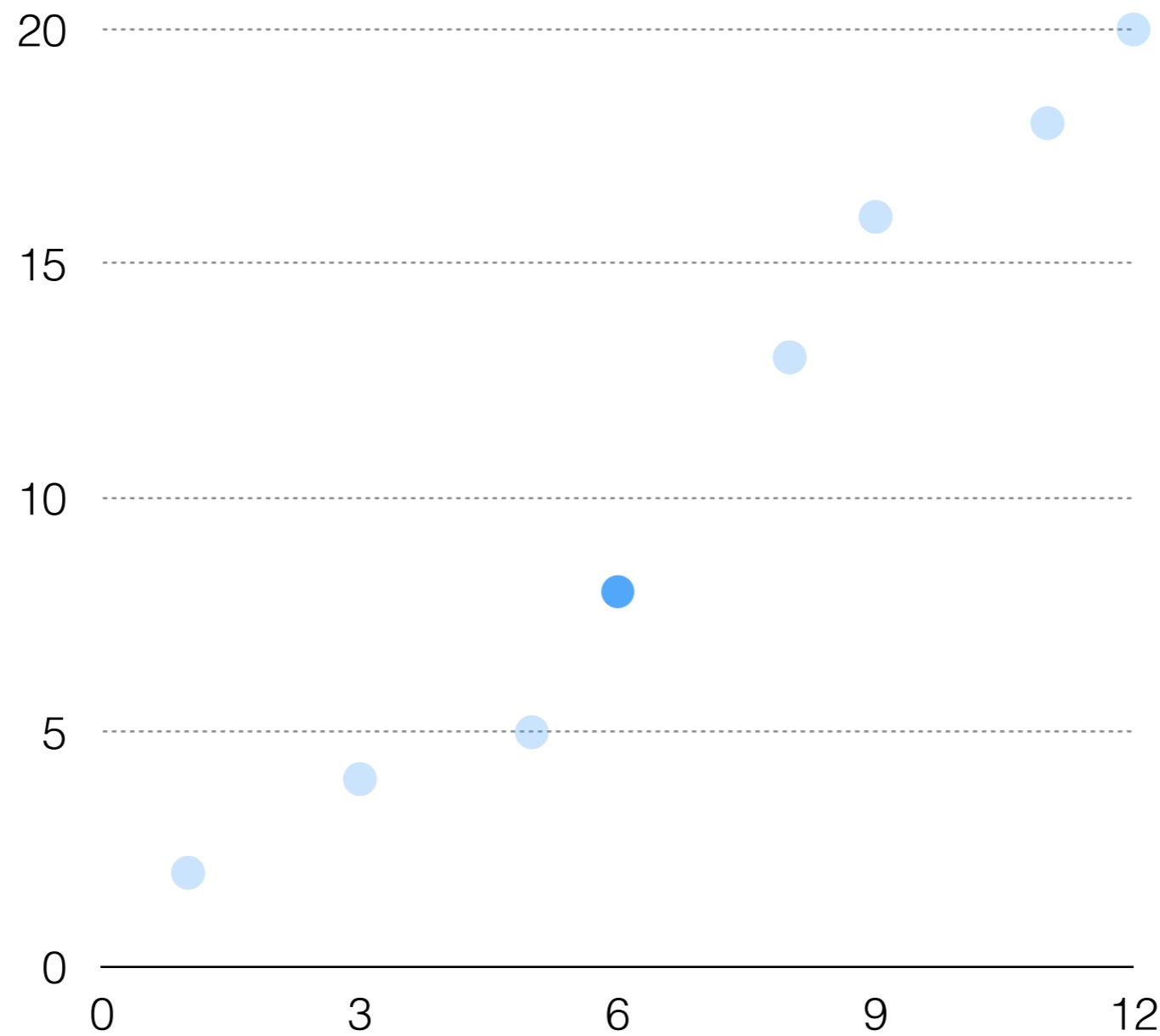
Examples

How could you indicate a selected point?



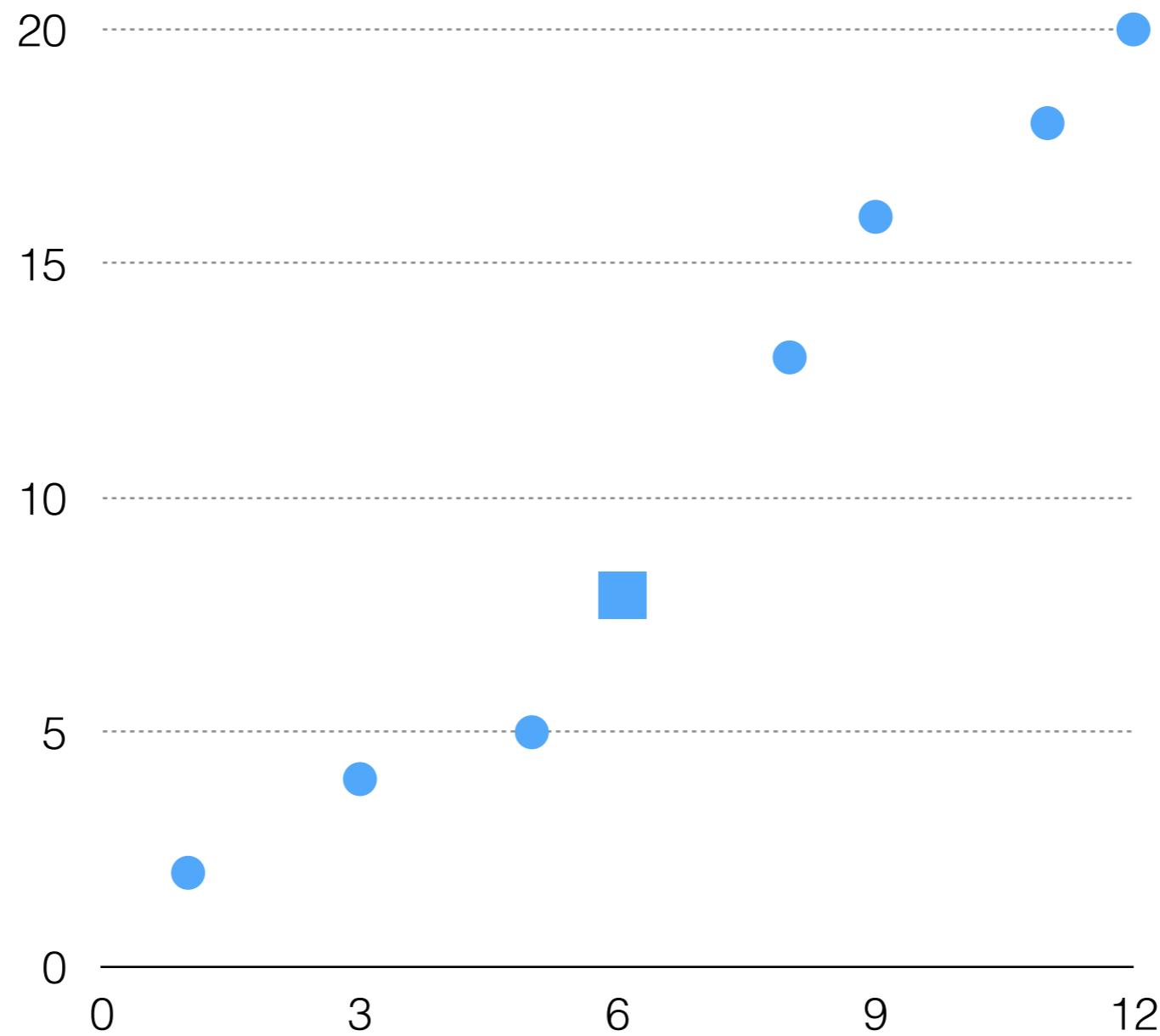
Examples

How could you indicate a selected point?



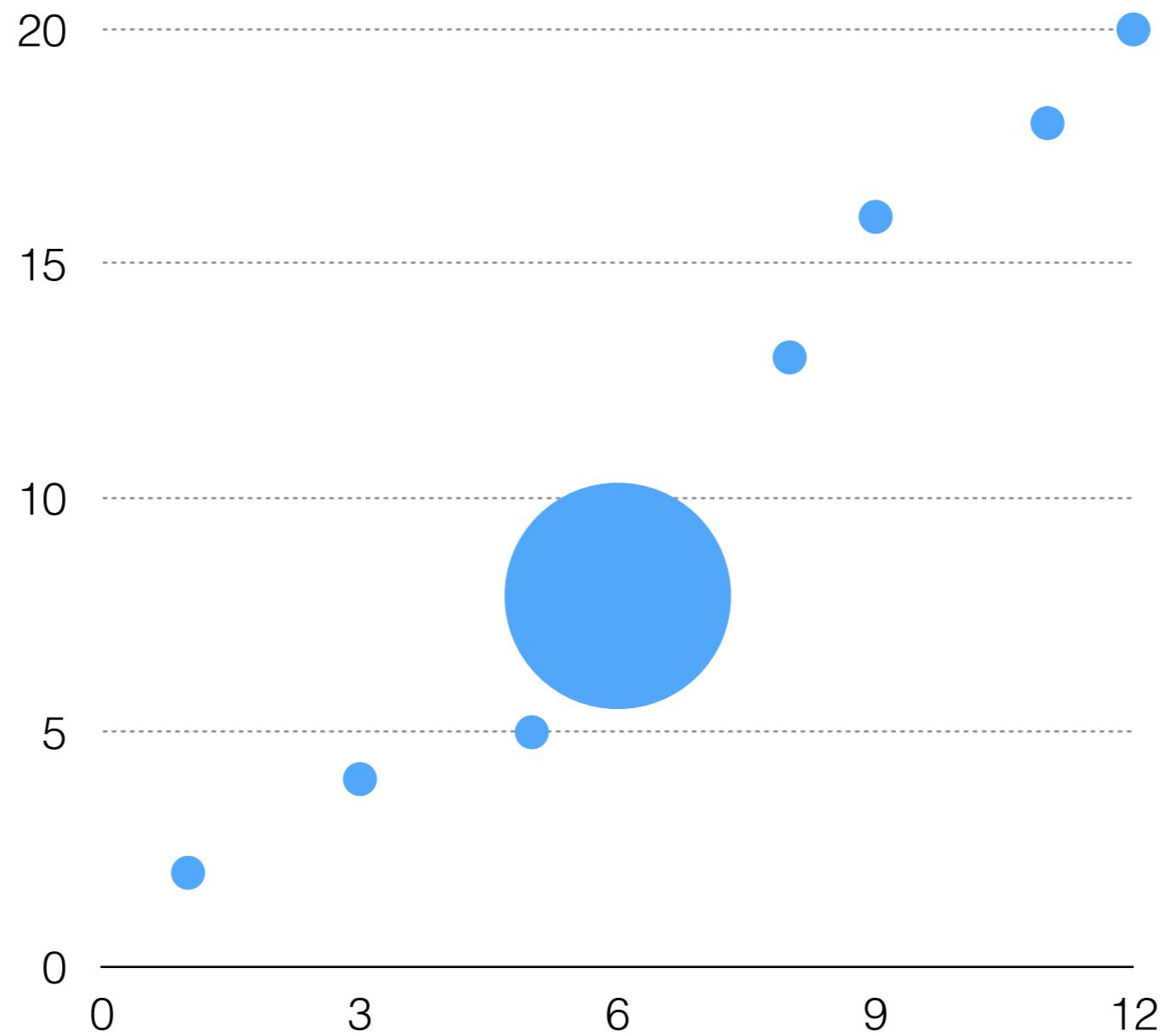
Examples

How could you indicate a selected point?



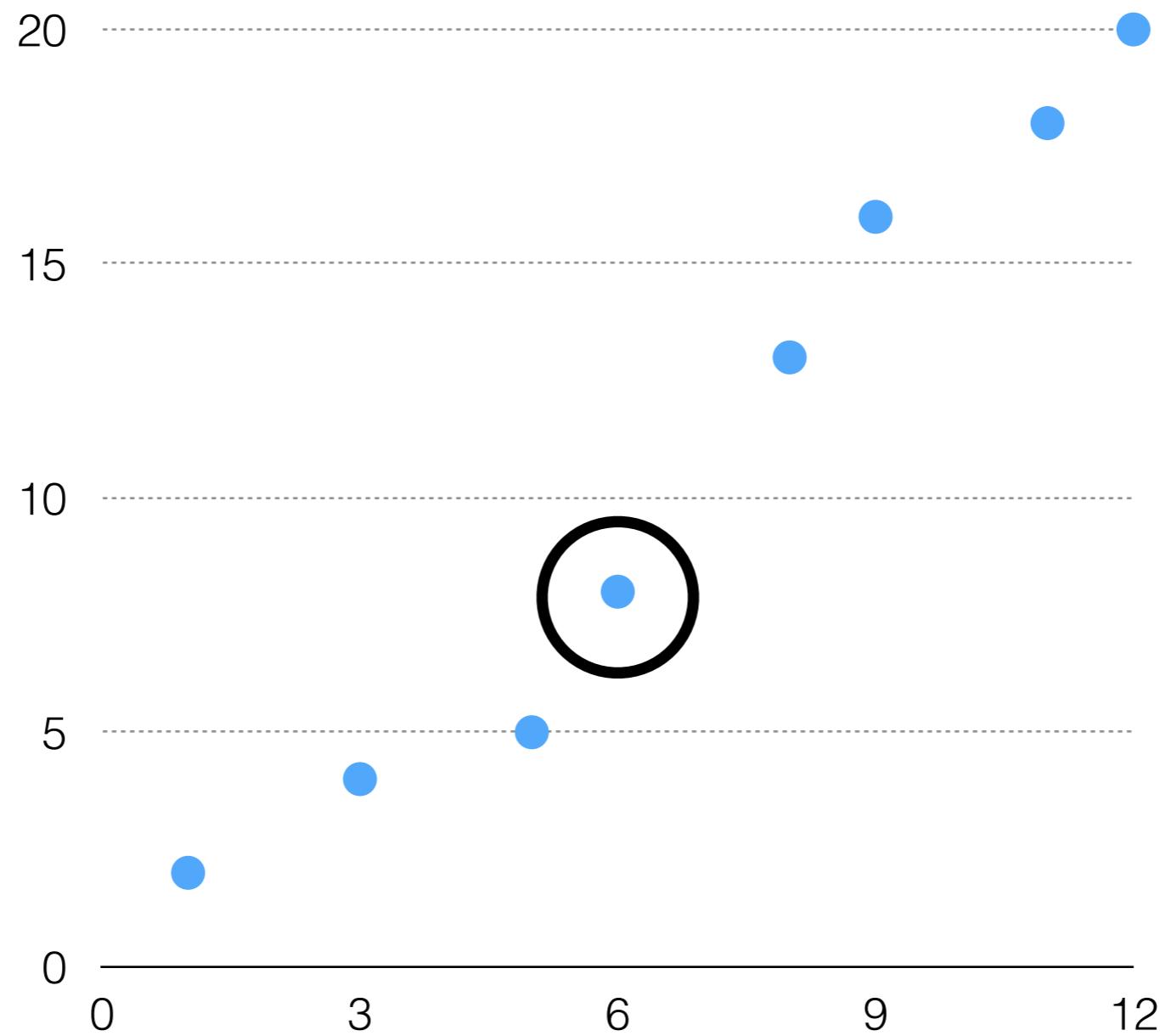
Examples

How could you indicate a selected point?



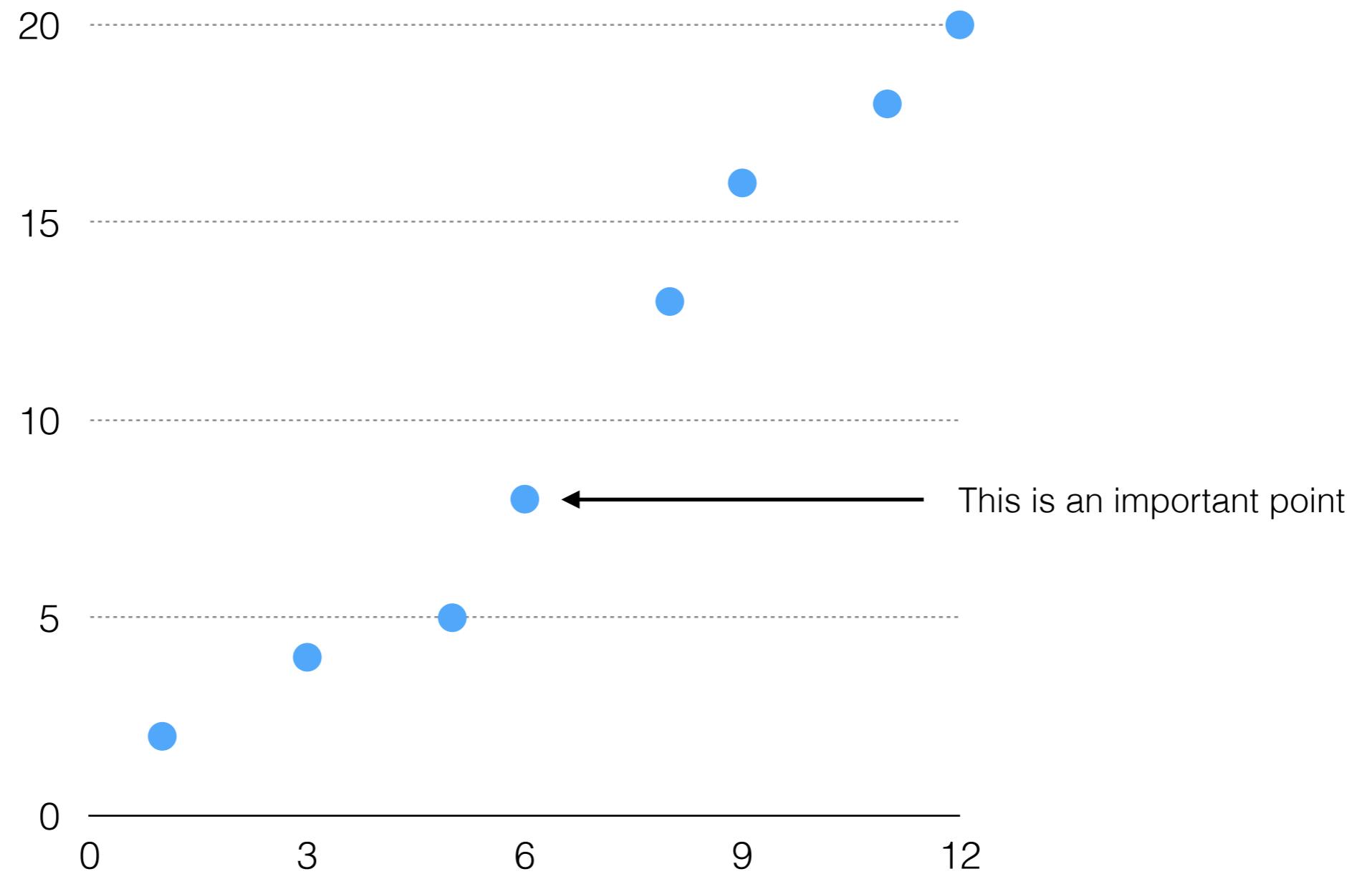
Examples

How could you indicate a selected point?



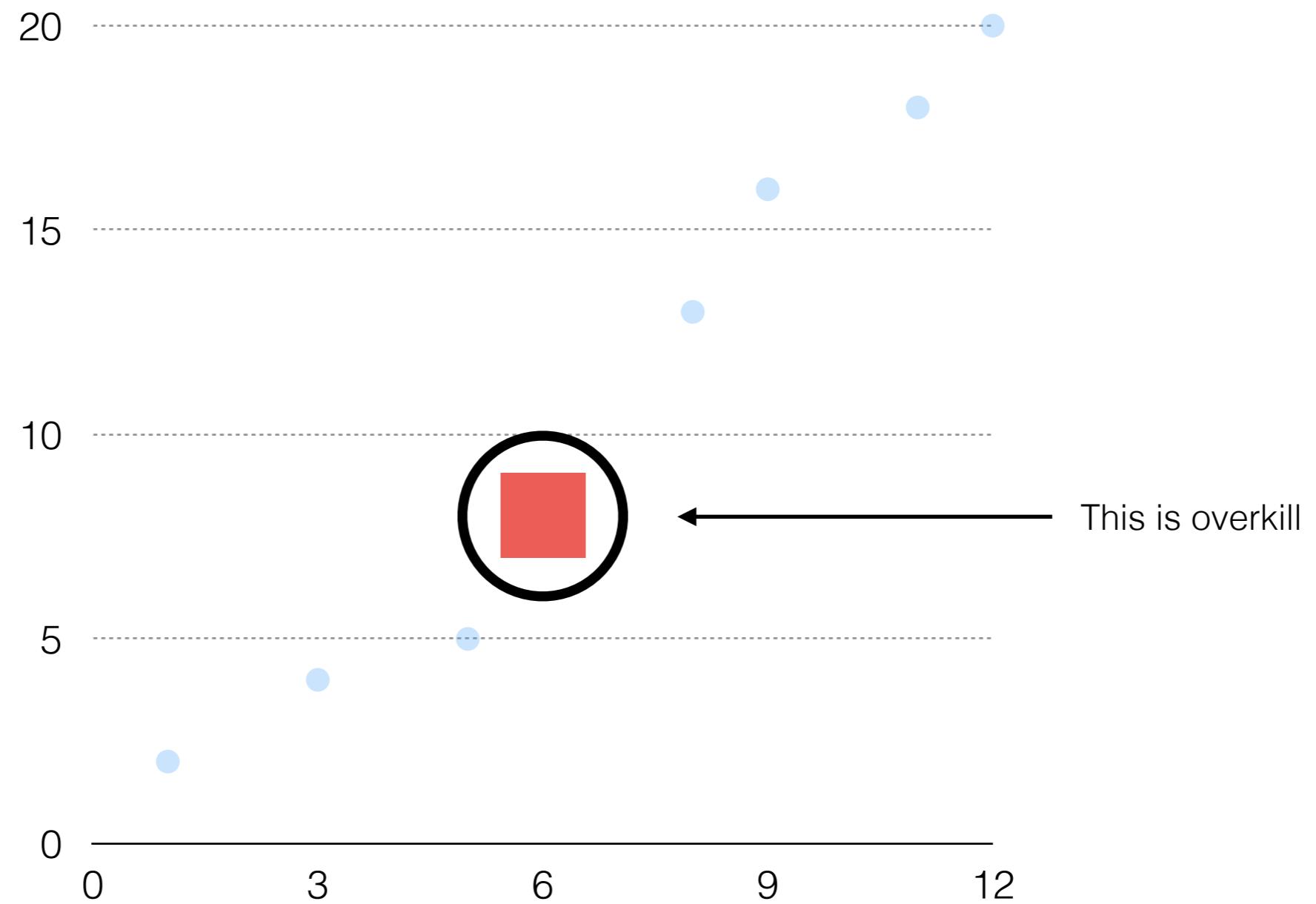
Examples

How could you indicate a selected point?



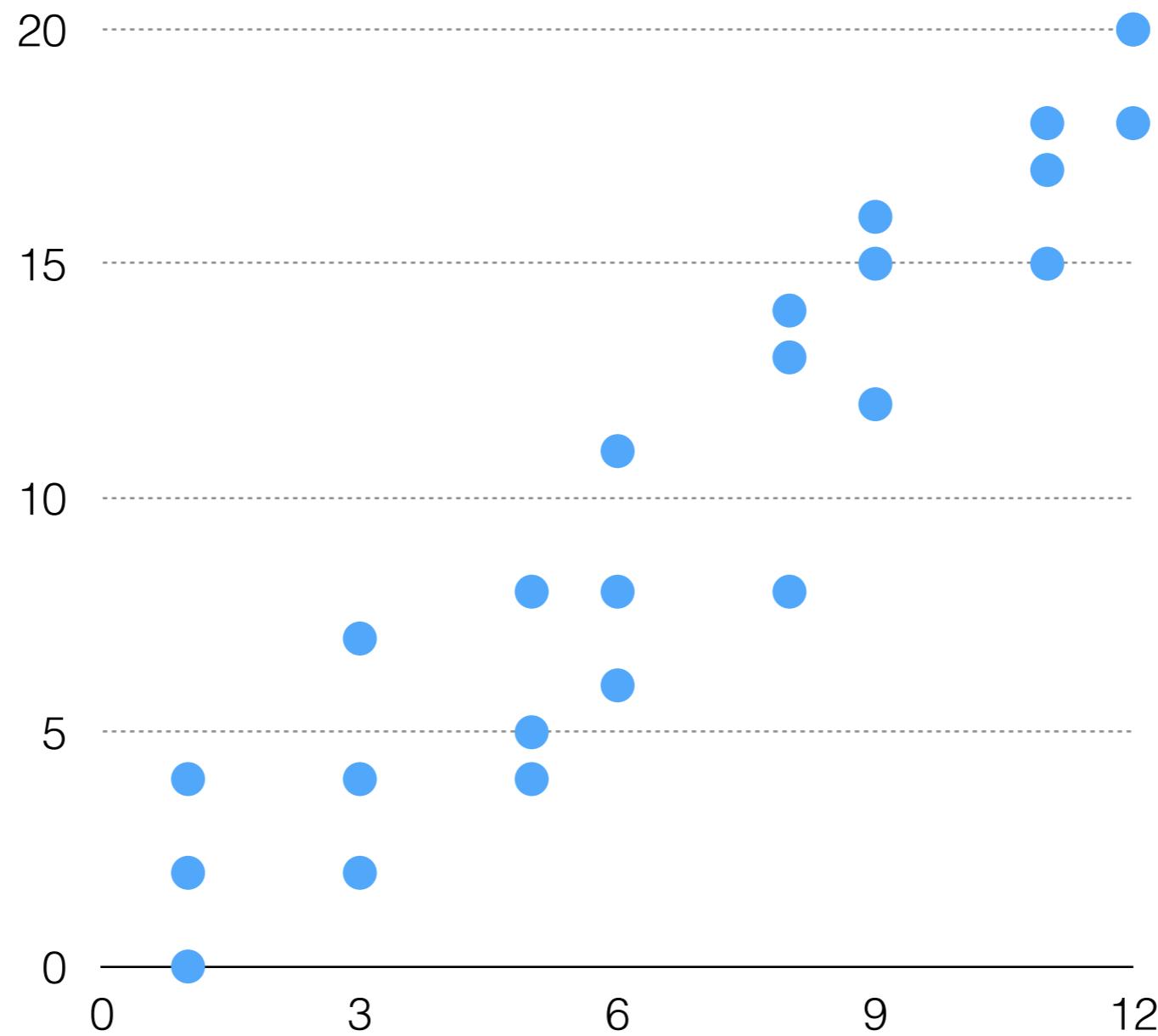
Examples

How could you indicate a selected point?



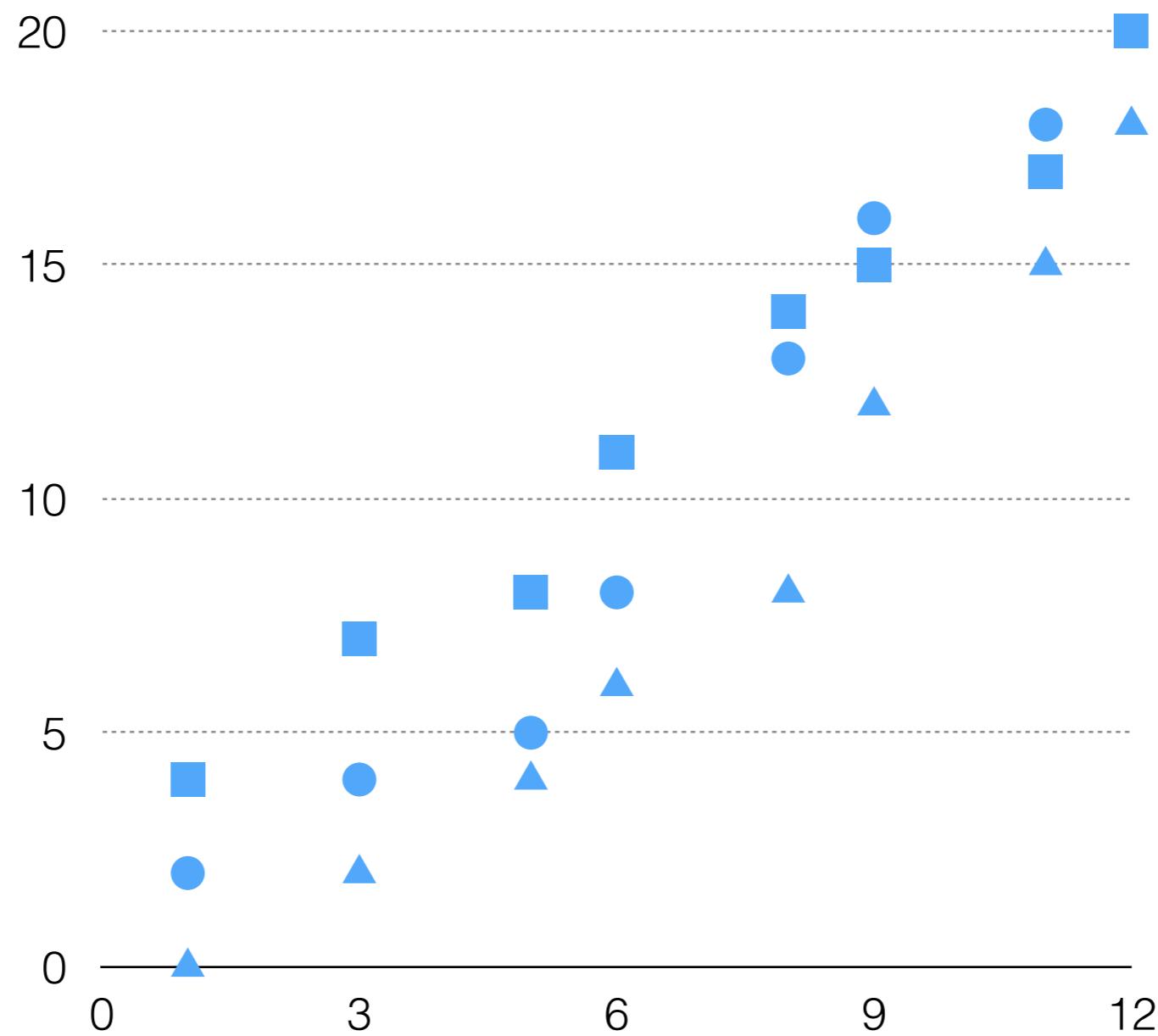
Examples

How could you distinguish between groups?



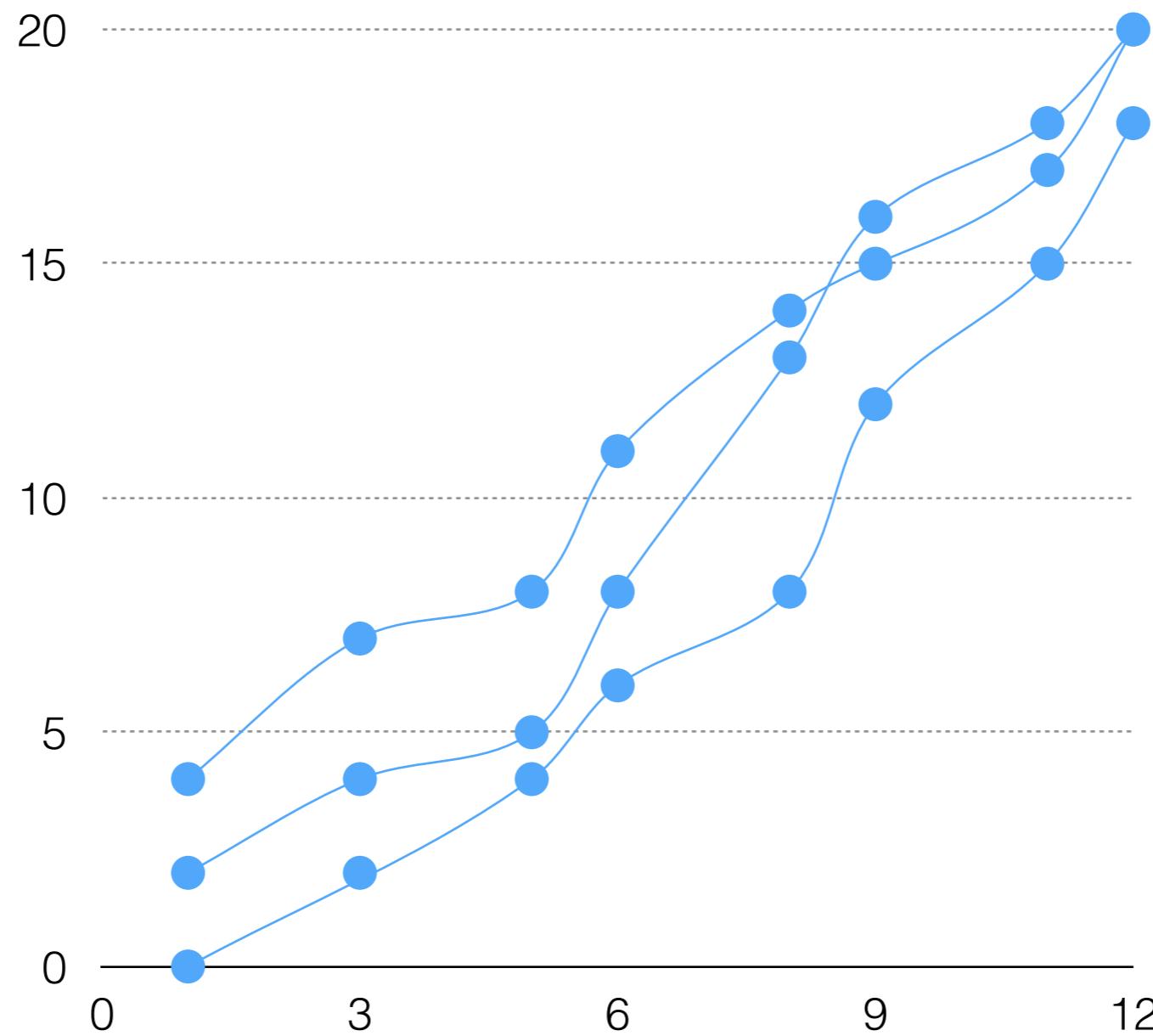
Examples

How could you distinguish between groups?



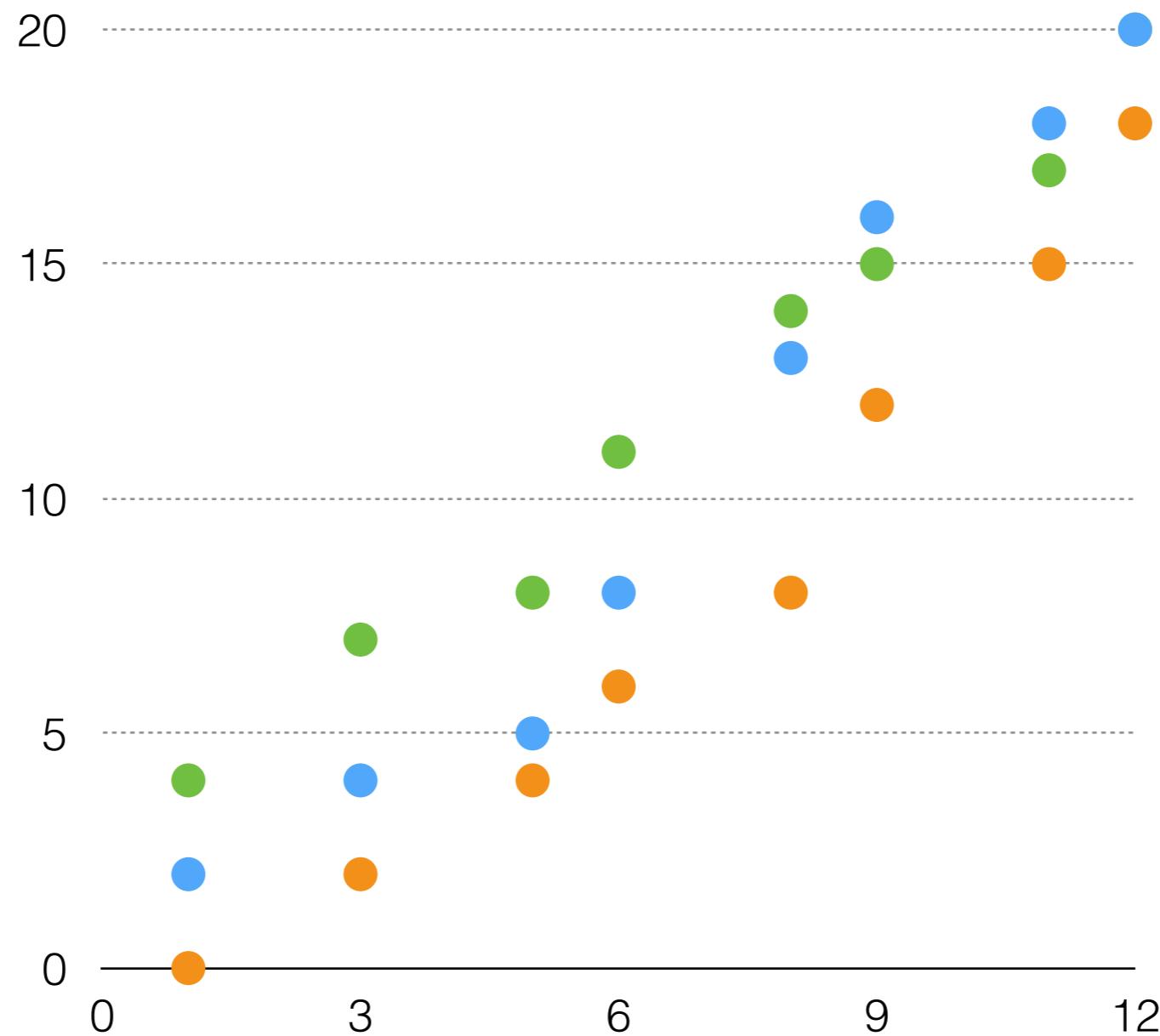
Examples

How could you distinguish between groups?



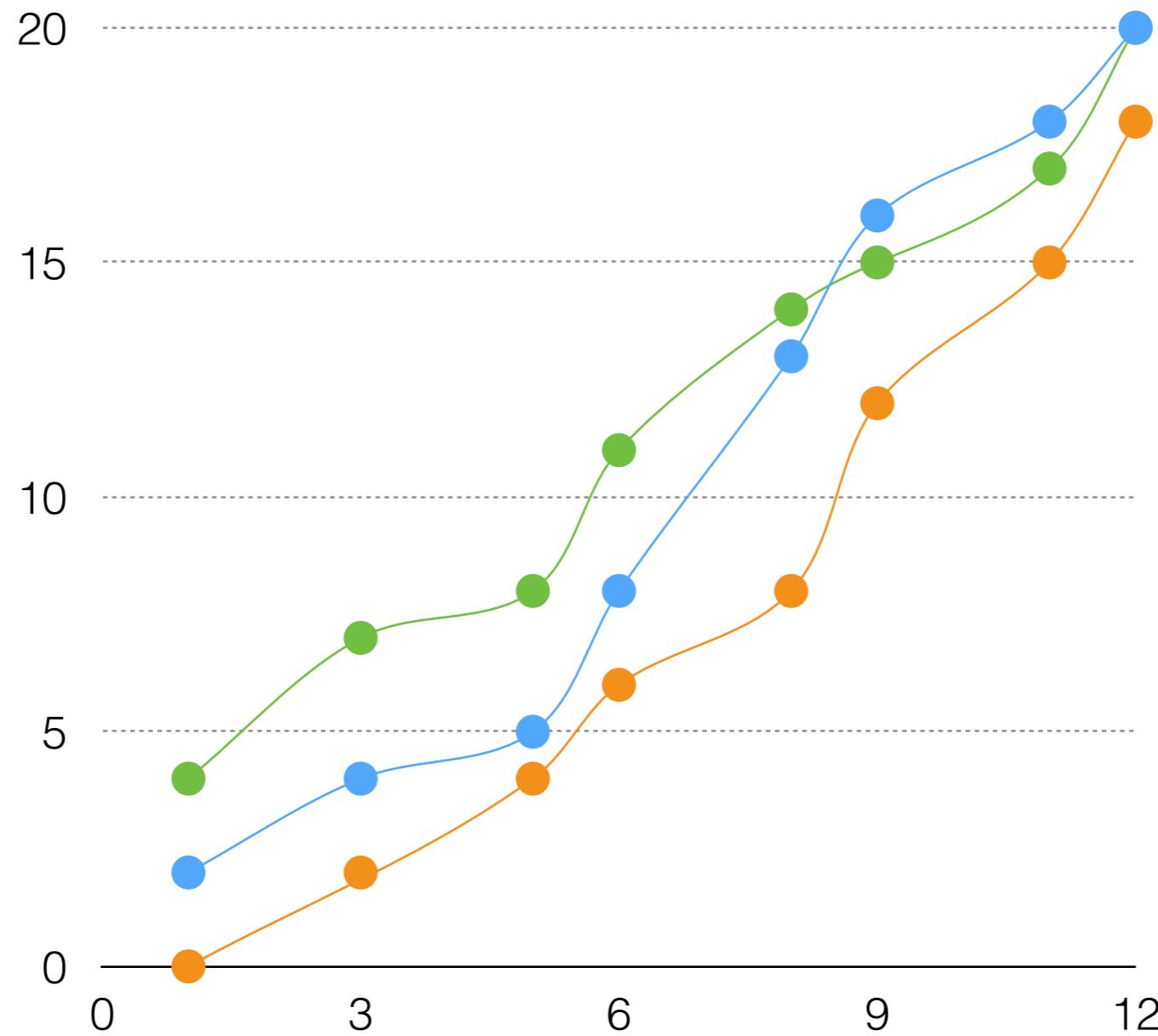
Examples

How could you distinguish between groups?



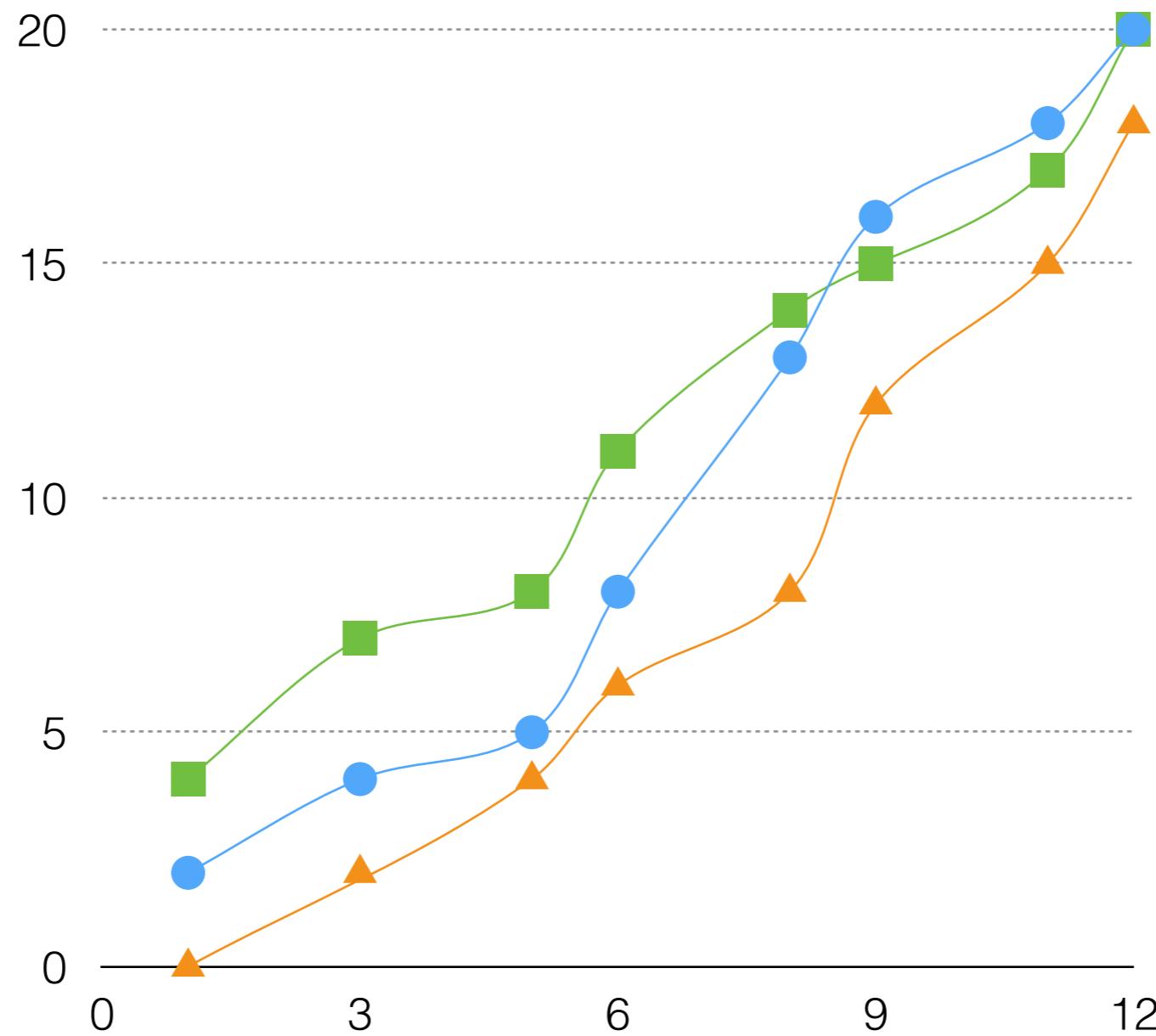
Examples

How could you distinguish between groups?



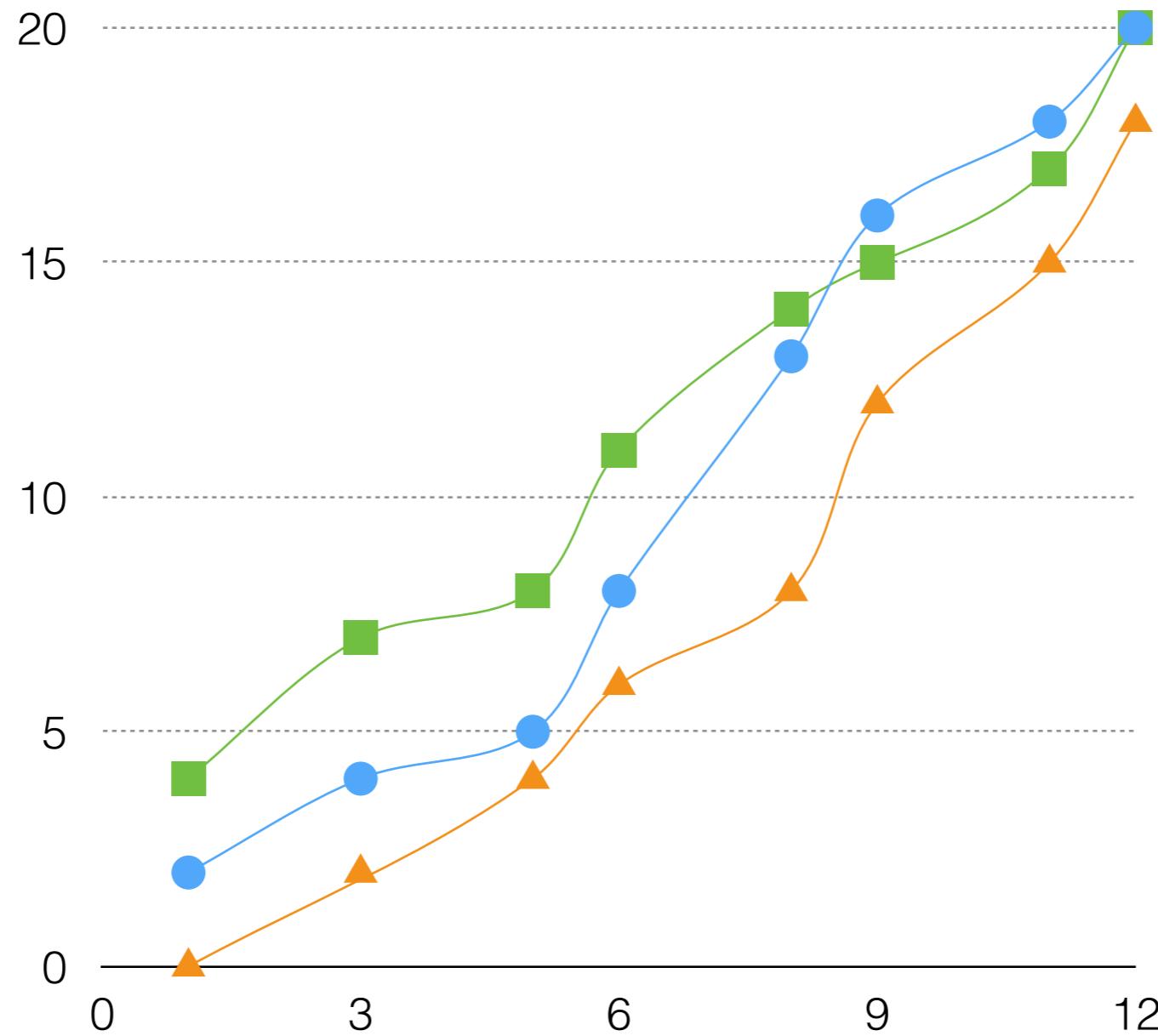
Examples

How could you distinguish between groups?



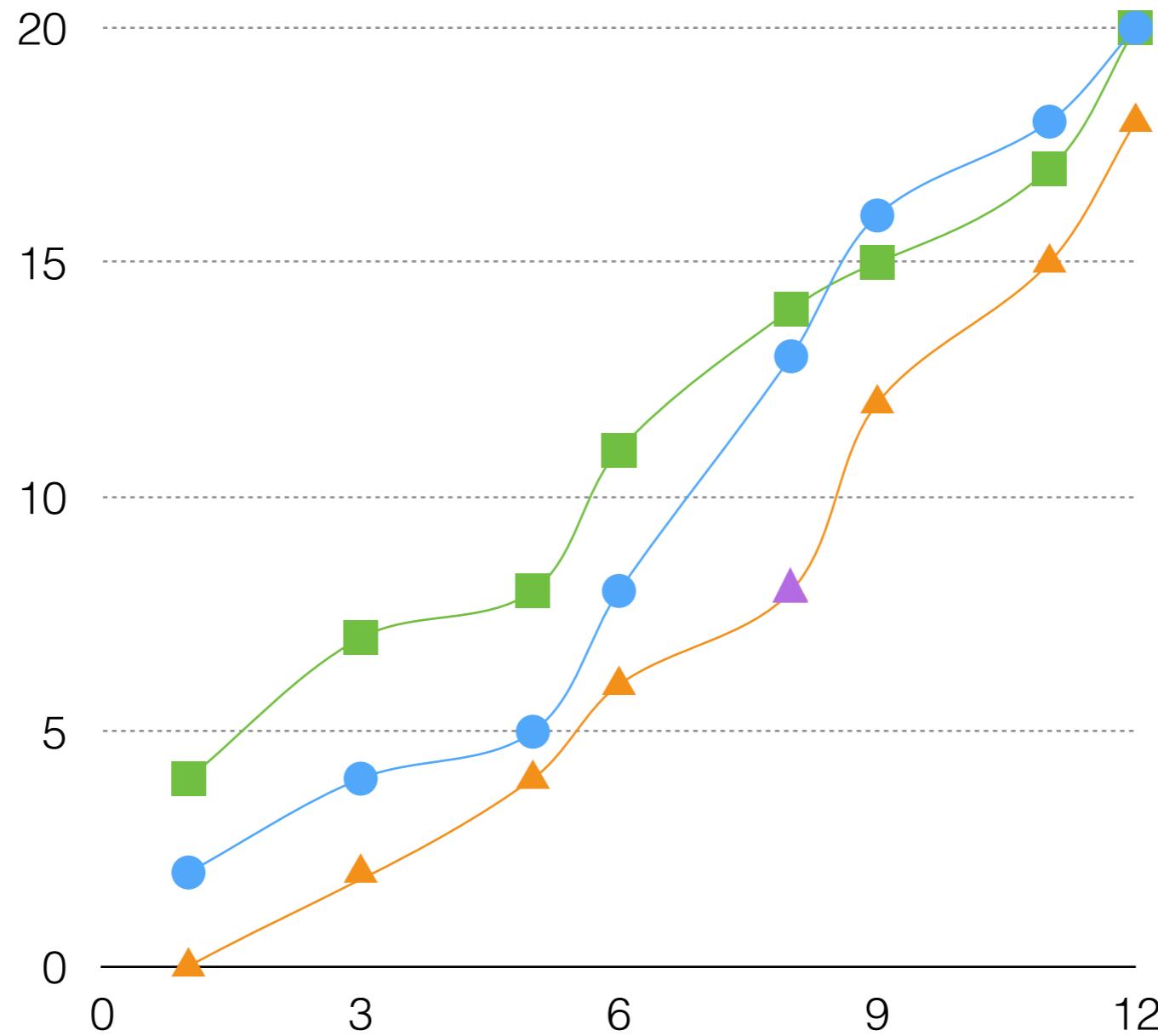
Examples

How do you highlight a single point?



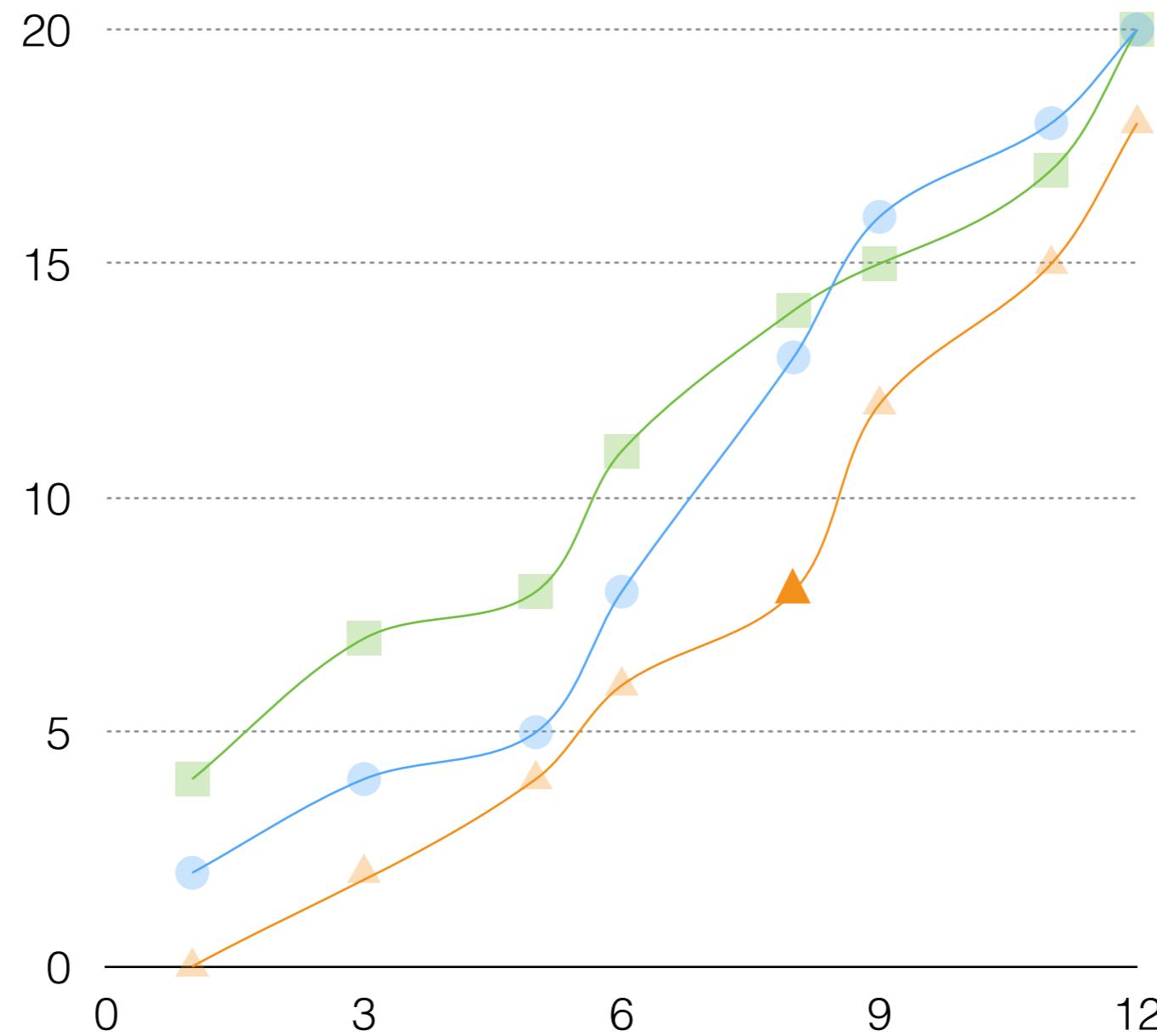
Examples

How do you highlight a single point?



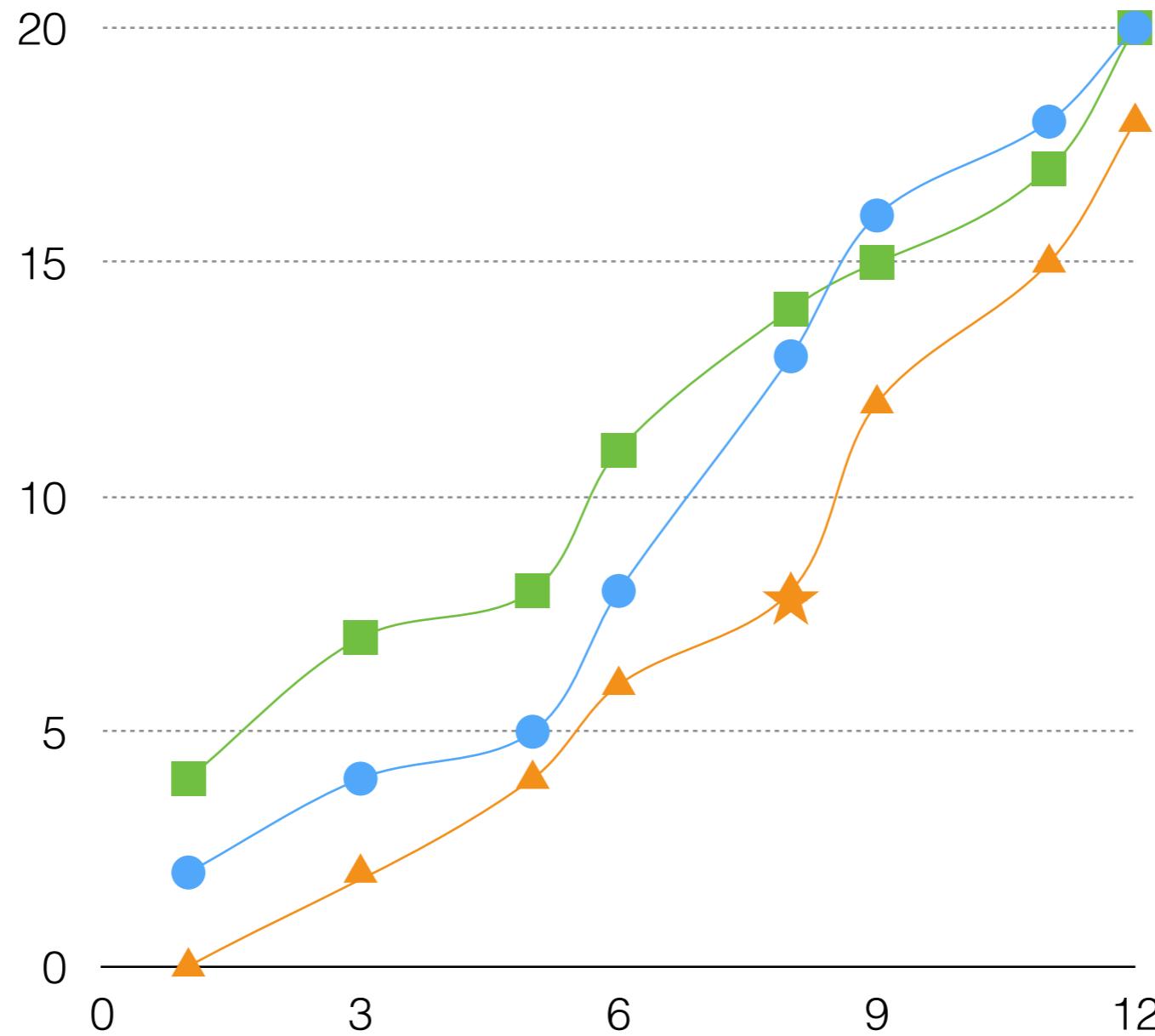
Examples

How do you highlight a single point?



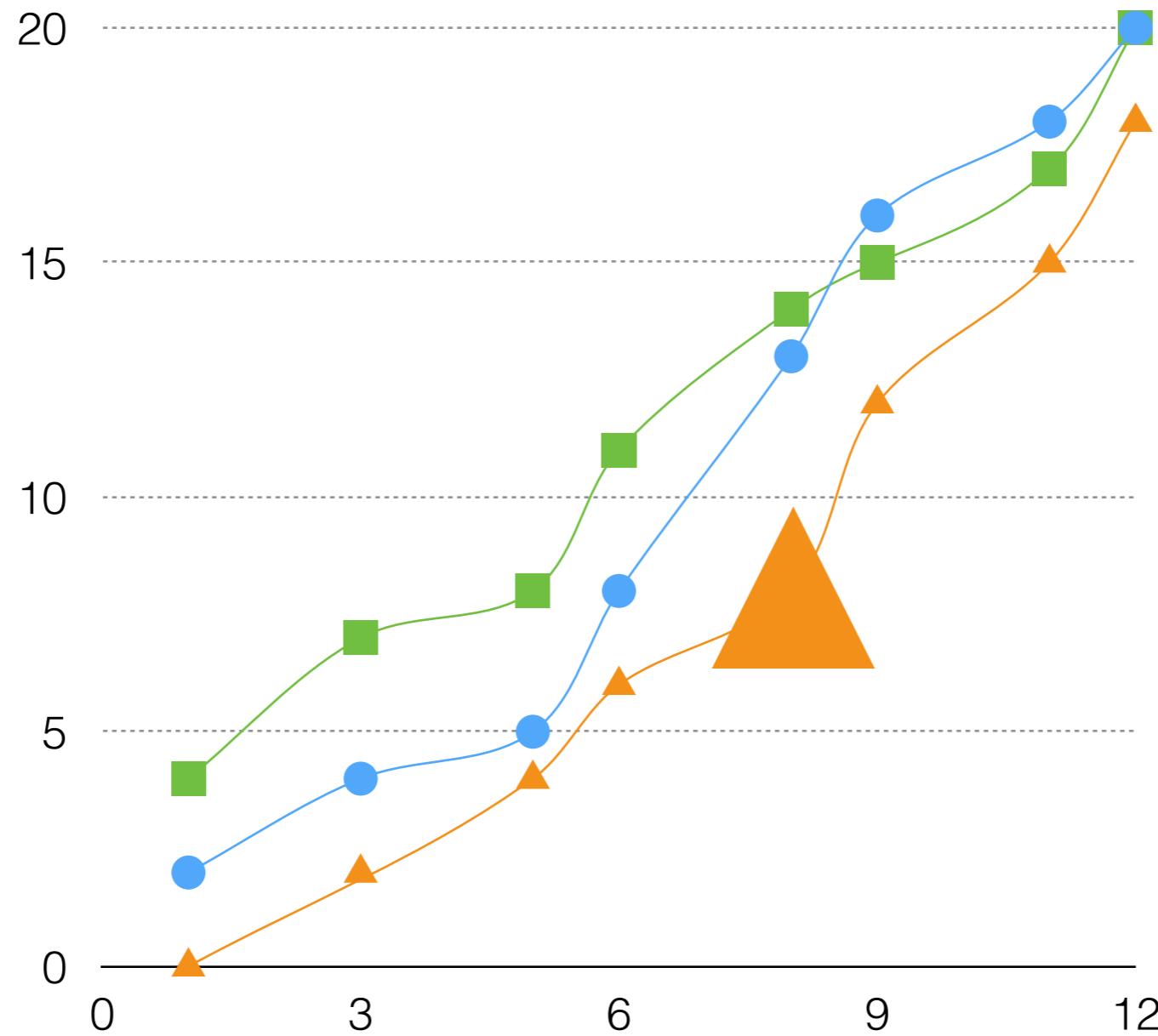
Examples

How do you highlight a single point?



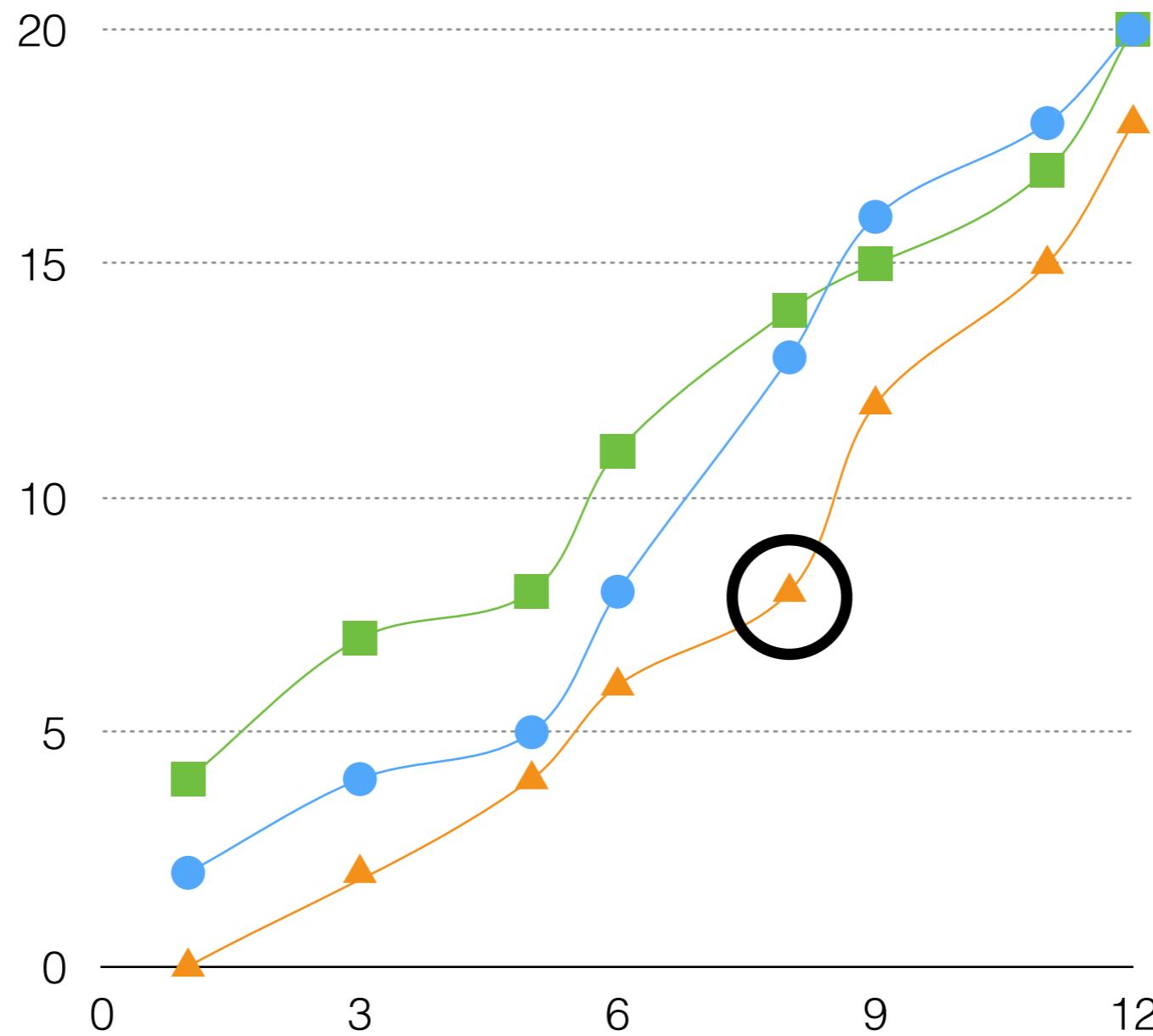
Examples

How do you highlight a single point?



Examples

How do you highlight a single point?



Maximize how quickly and accurately people decode information from graphics

*Maximize how **quickly** and **accurately** people
decode information from graphics*

{graphically encoding variables}

Graphically encoding variables



Graphically encoding variables



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81

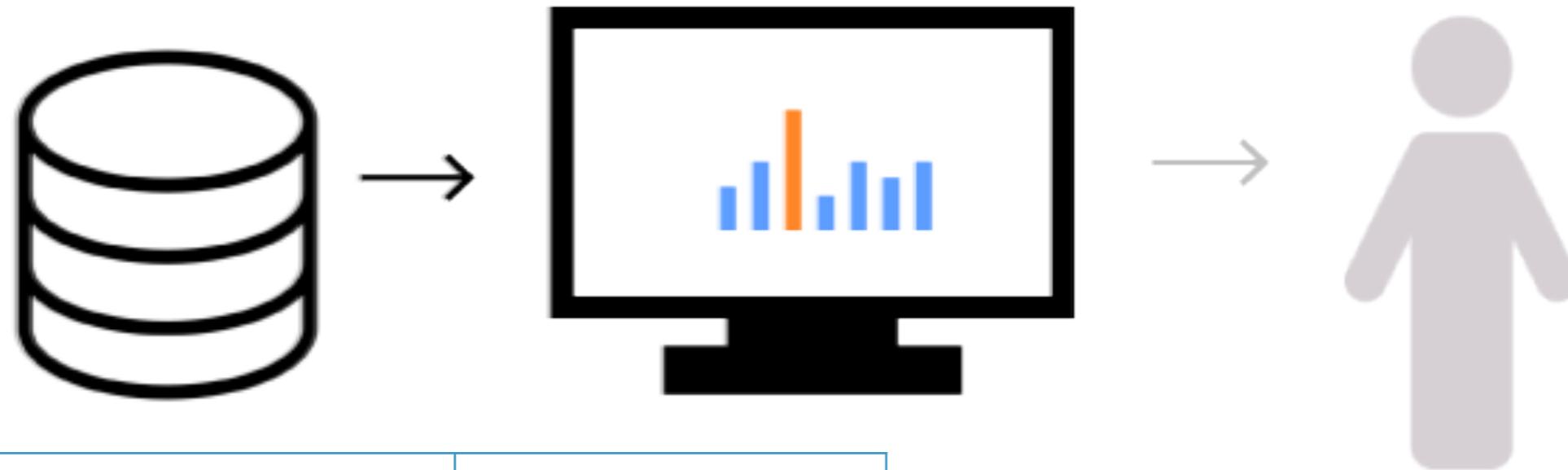
Graphically encoding variables



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81

Person

Graphically encoding variables



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81

Person → Horizontal position

Graphically encoding variables



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81

Person → Horizontal position
Score

Graphically encoding variables



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81

Person → Horizontal position
Score → Rectangle height

Visually decoding graphics



Person → Horizontal position
Score → Rectangle height

Visually decoding graphics



Person → Horizontal position → Person
Score → Rectangle height

Visually decoding graphics



Person → Horizontal position → Person
Score → Rectangle height → Score

Visually decoding graphics



Person → Horizontal position → Person
Score → Rectangle height → Score

Visually decoding graphics



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81



Person → Horizontal position → Person
Score → Rectangle height → Score

Visually decoding graphics



<u>Person</u>	<u>Score</u>
Jake	55
Jane	24
Jim	40
Jules	81



<u>Perceived Person</u>	<u>Perceived Score</u>
Jake	50
Jane	26
Jim	42
Jules	77

Person → Horizontal position → Person
Score → Rectangle height → Score

Visualization Accuracy



Choose the **graphical encodings**...

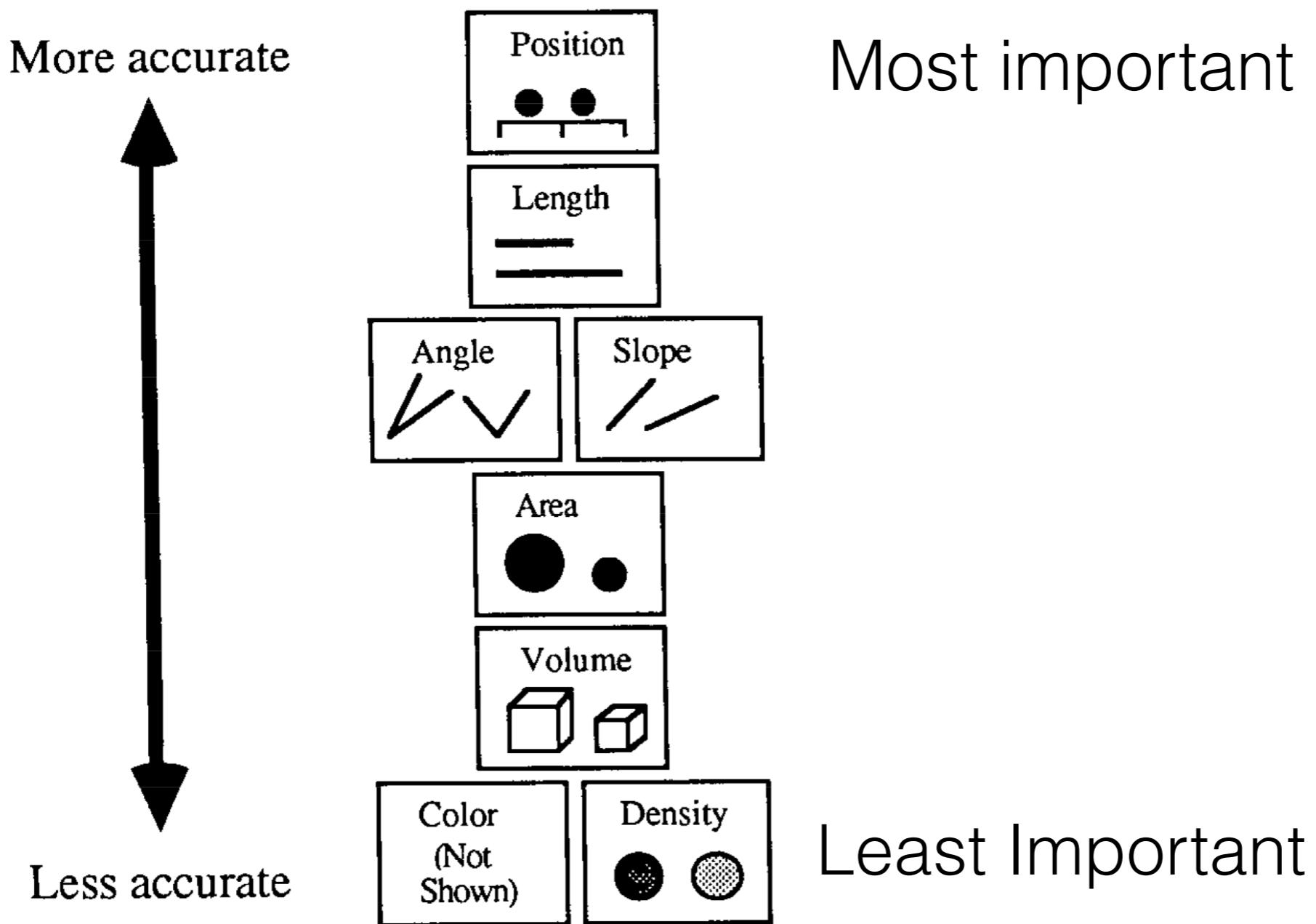
Visualization Accuracy



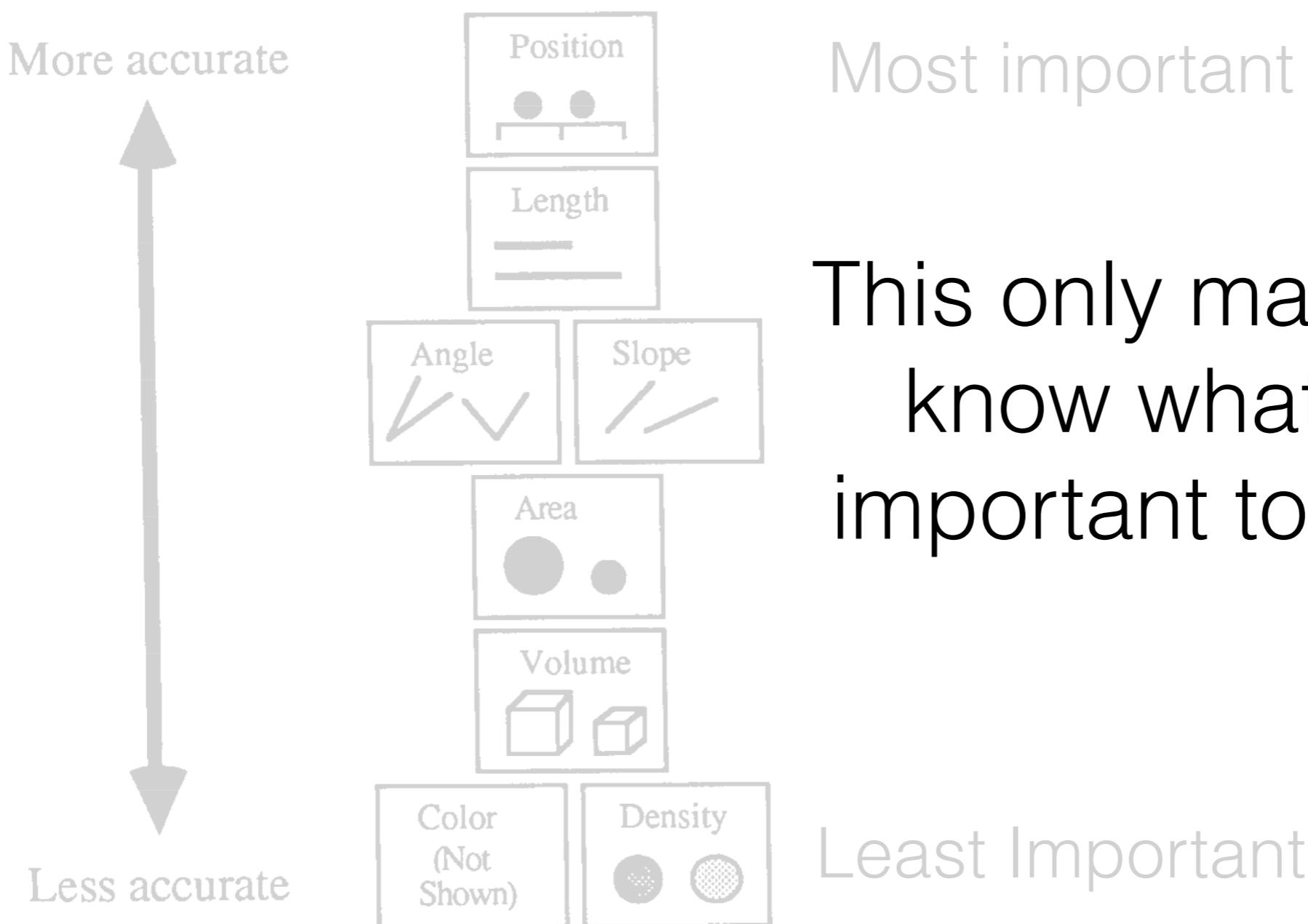
Choose the **graphical encodings**...

... that are best **visually decoded**.

Encoding ranking



Encoding ranking



This is what you're doing!

```
3 plot_ly(d,  
4     more      x = depth, position encoding  
5     important y = price, position encoding  
6     less       color = cut, color encoding  
7     important size = depth^2, area encoding  
8     mode = "markers"  
9 )
```

<https://github.com/INFO-498F/lecture-12-exercises>

Case study





*Where does money come from and
go to in global health?*

Some Definitions

Source

(where money comes from)

Governments

Gates foundation

Some Definitions

Source

(where money comes from)

Channel

(body that money is spent through)

Governments

United Nations

Gates foundation

Global Fund

Governments

Some Definitions

Source

(where money comes from)

Channel

(body that money is spent through)

Recipient

(who/what gets money)

Governments

United Nations

Health focus area

Gates foundation

Global Fund

Region

Governments

The data

- Money donated by each **source**
- Money received/spent by each **channel**
- Money received by each health focus area
- Money received by region
- Flow of money from source -> channel -> recipient
- Each year (1990 - 2014)

Who is interested in this data?

What questions do they want to ask
of the data?

How could you visually answer
those questions?

vizhub.healthdata.org/fgh