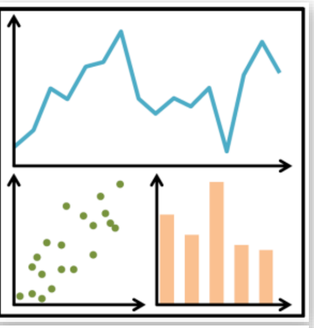
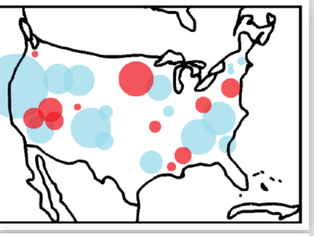
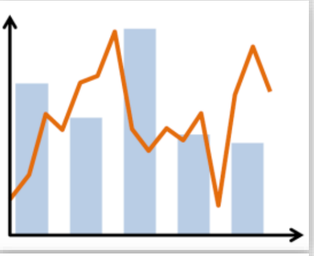
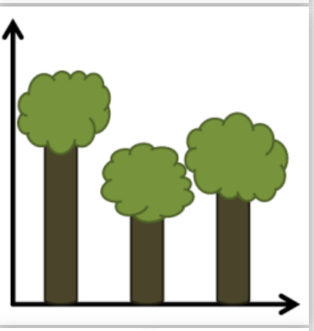
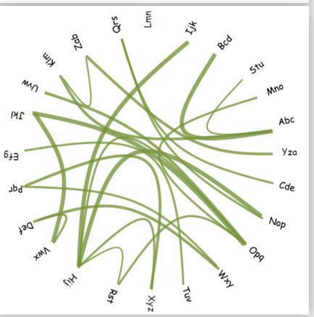






Visual Encodings

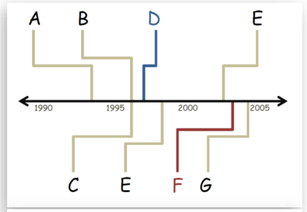
DS 4200

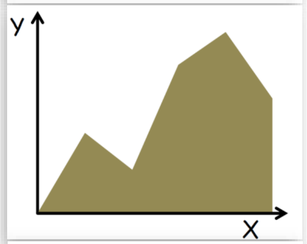
FALL 2020

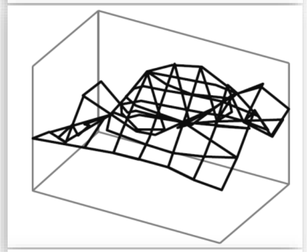
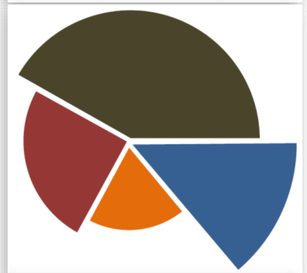
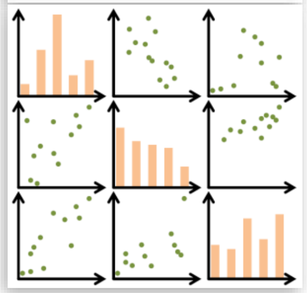
Prof. Cody Dunne

NORTHEASTERN UNIVERSITY

Slides and inspiration from Michelle Borkin, Krzysztof Gajos, Hanspeter Pfister, Miriah Meyer, Jonathan Schwabish, and David Sprague





Check-in

- Did anyone have a weird issue with GitHub Pages not being available?

READING QUIZ

Quiz — Facet into Multiple Views

Password: ????

PREVIOUSLY, ON DS 4200…

Visualization Building Blocks

Marks:

Marks as Items/Nodes

- Points

- Lines

- Areas

Marks as Links

- Containment

- Connection

Channels:

- Position
  - Horizontal
  - Vertical
  - Both

- Color

- Shape

- Tilt

- Size
  - Length
  - Area
  - Volume

Channels: Expressiveness Types and Effectiveness Ranks

Magnitude Channels: Ordered Attributes

- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)

Most ▲ Effectiveness ▼ Least

Same (Color luminance, Color saturation)

Same (Curvature, Volume)

Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

VAD

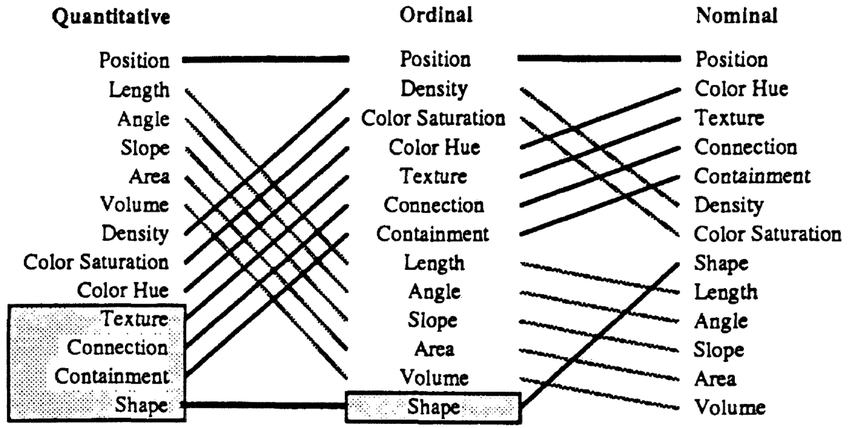


Figure 15: Ranking of Perceptual Tasks. *The tasks shown in the gray boxes are not relevant to that type of data.*

Mackinlay (1986)

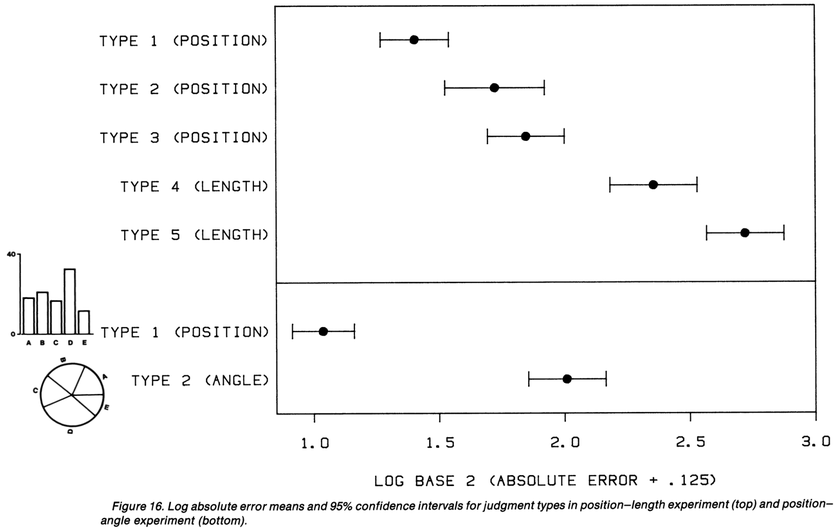
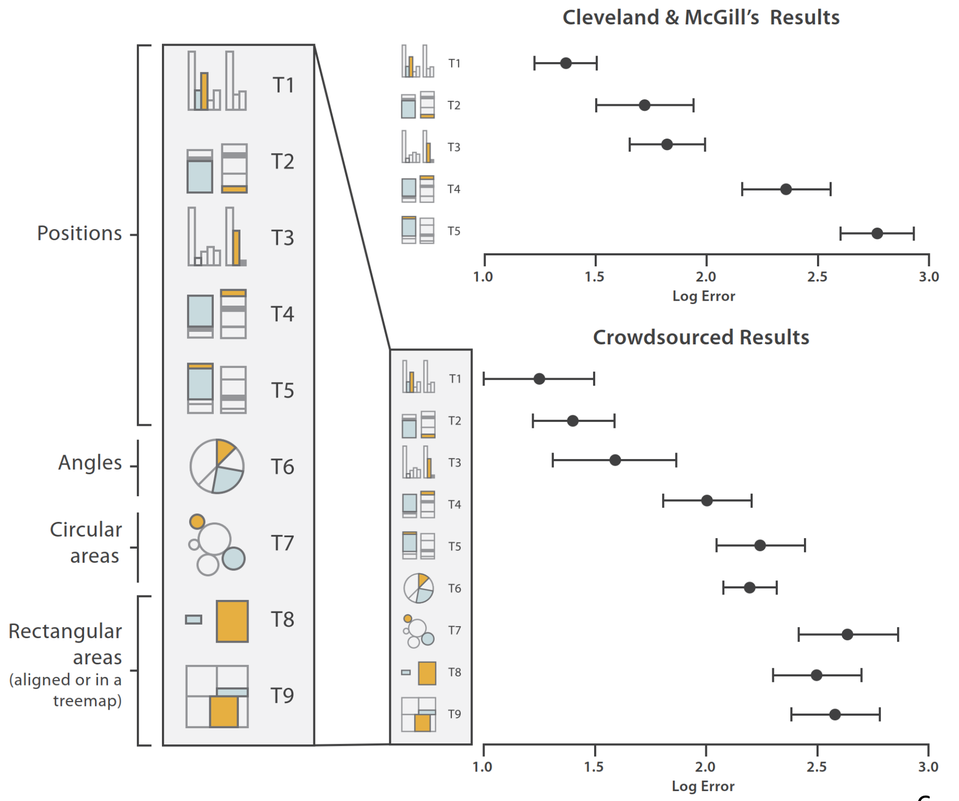


Figure 16. Log absolute error means and 95% confidence intervals for judgment types in position–length experiment (top) and position–angle experiment (bottom).

Cleveland & McGill (1984)



Heer & Bostock (2010)

Expressiveness and Effectiveness

Effectiveness principle: the importance of the attribute should match the salience of the channel; that is, its noticeability.
(i.e., encode most important attributes with highest ranked channels)

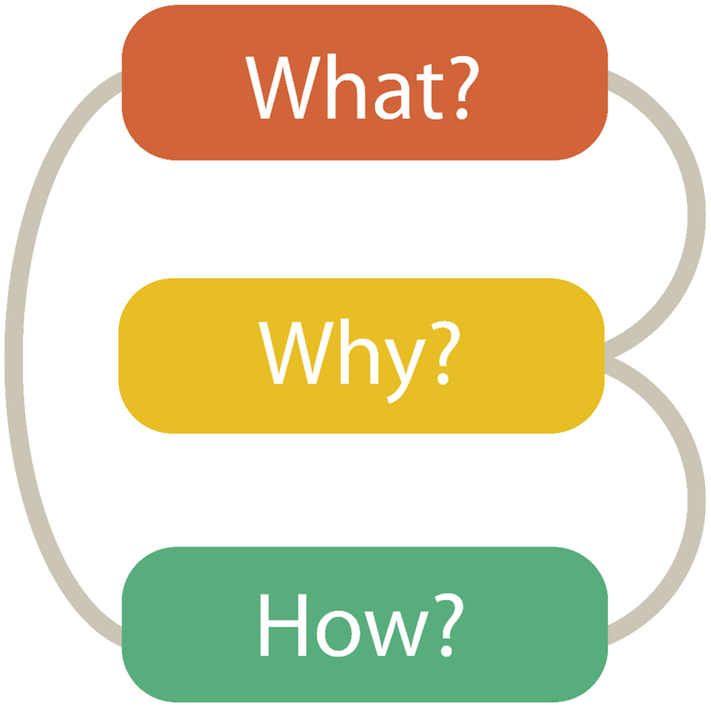
Expressiveness principle: the visual encoding should express all of, and only, the information in the dataset attributes.
(i.e., data characteristics should match the channel)

Mackinlay (1986)

Now, on DS 4200…

VISUAL ENCODING

Analysis

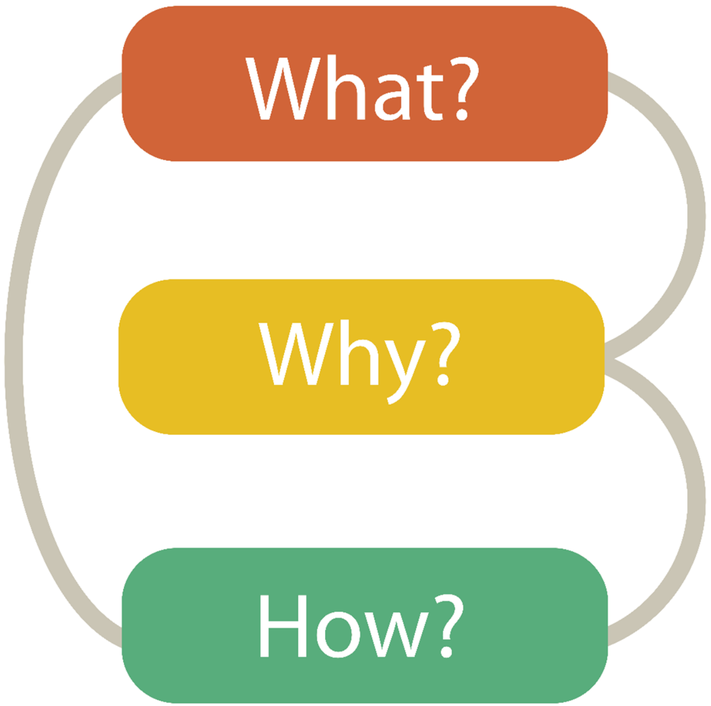


DATA ABSTRACTION

TASK ABSTRACTION

VISUAL ENCODING

Analysis



What data is shown?

Why is the user analyzing / viewing it?

How is the data presented?

Goals for Today

- Learn about visual encodings, esp. arranging tables
- Learn how to pick appropriate visual representations based on attribute type and perceptual properties

Visual Encoding

Now...

How?

Encode

Arrange

- Express
- Separate
- Order
- Align
- Use

Map
from categorical and ordered attributes

- Color
  - *Hue*
  - *Saturation*
  - *Luminance*
- Size, Angle, Curvature, ...
- Shape
- Motion
  Direction, Rate, Frequency, ...

Manipulate

Change

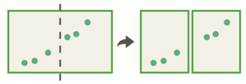
Select

Navigate

Facet

Juxtapose

Partition



Superimpose

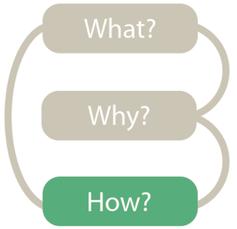
Reduce

Filter

Aggregate

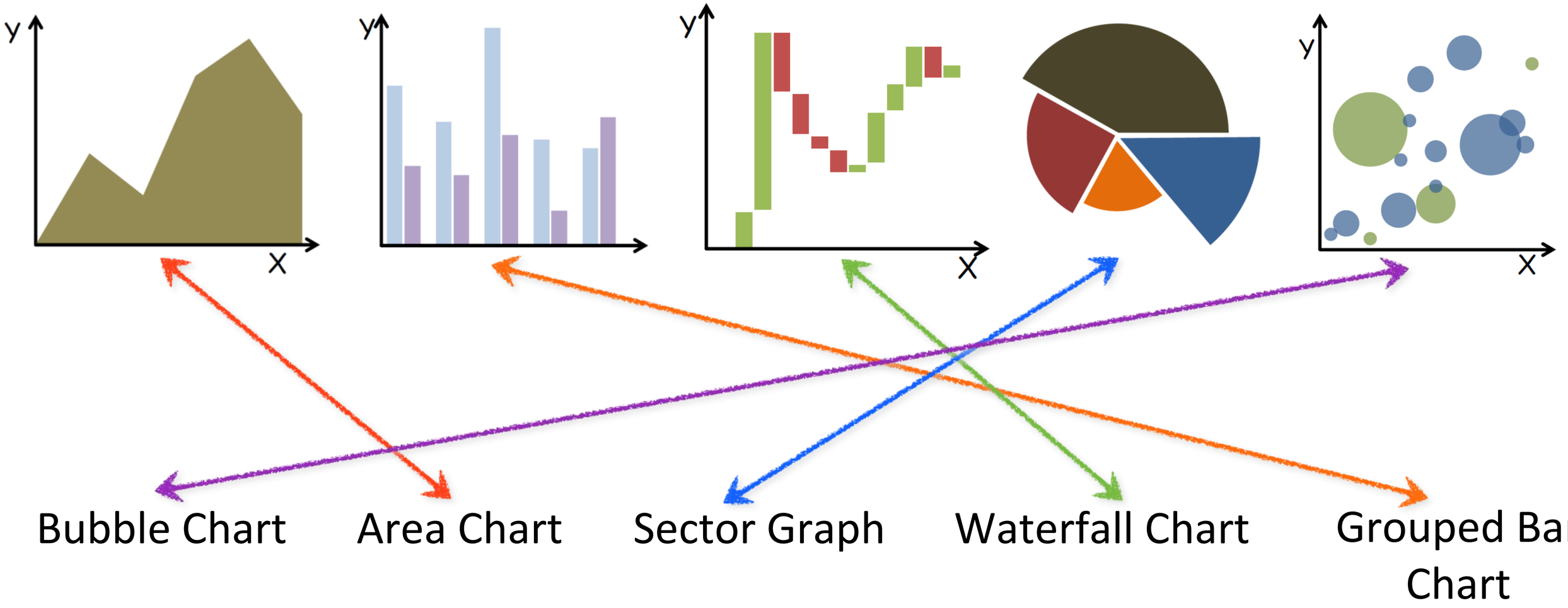
Embed

Later this semester...

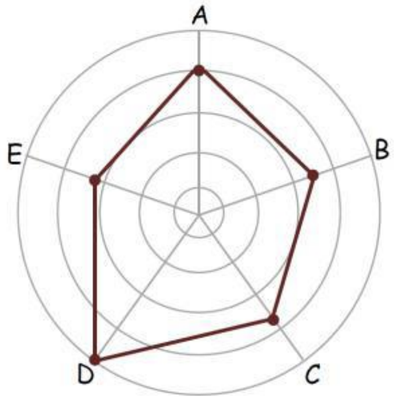


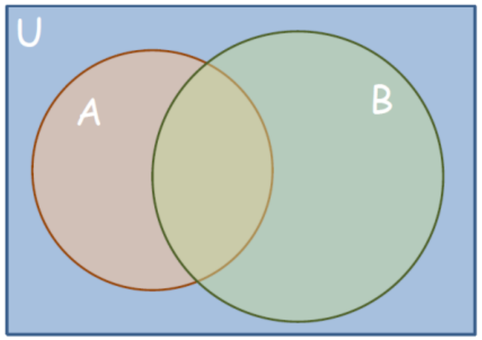
In-class exercise: Encodings Matchup

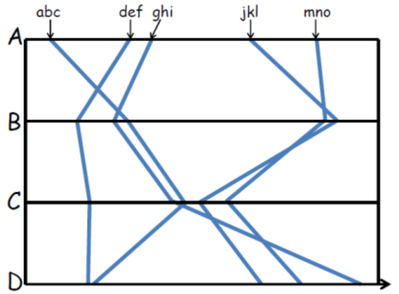
Encoding Match-up

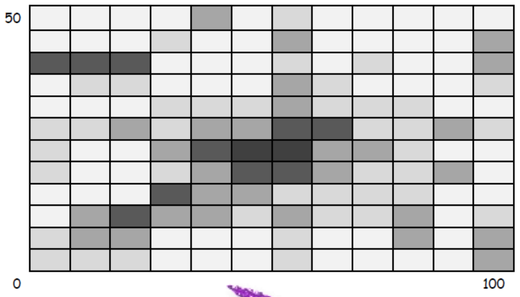


Encoding Match-up









Venn Diagram

Heat Map

Star Plot

Box & Whisker Plot

Parallel Coordinates

How?

Encode

Arrange

- Express
- Separate

- Order
- Align

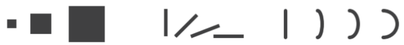
- Use

Map

from categorical and ordered attributes

- Color
  - *Hue*
  - *Saturation*
  - *Luminance*

- Size, Angle, Curvature, ...



- Shape

- Motion

  Direction, Rate, Frequency, ...

Manipulate

Change

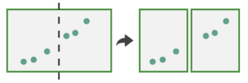
Select

Navigate

Facet

Juxtapose

Partition



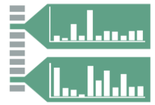
Superimpose

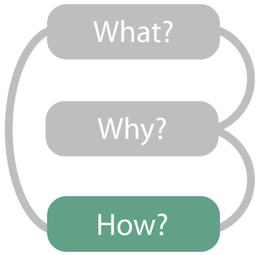
Reduce

Filter

Aggregate

Embed





Arrange Tables

- **Separate, Order, Align Regions**
  - Separate
  - Order
  - Align

  - *1 Key*
    List
  - *2 Keys*
    Matrix
  - *3 Keys*
    Volume
  - *Many Keys*
    Recursive Subdivision

Key: an independent attribute that can be used as a unique index (Tableau Dimension)

Categorical or Ordinal

Value: a dependent attribute (i.e., cell in a table) (Tableau Measures)

Categorical Ordinal, or Quantitative

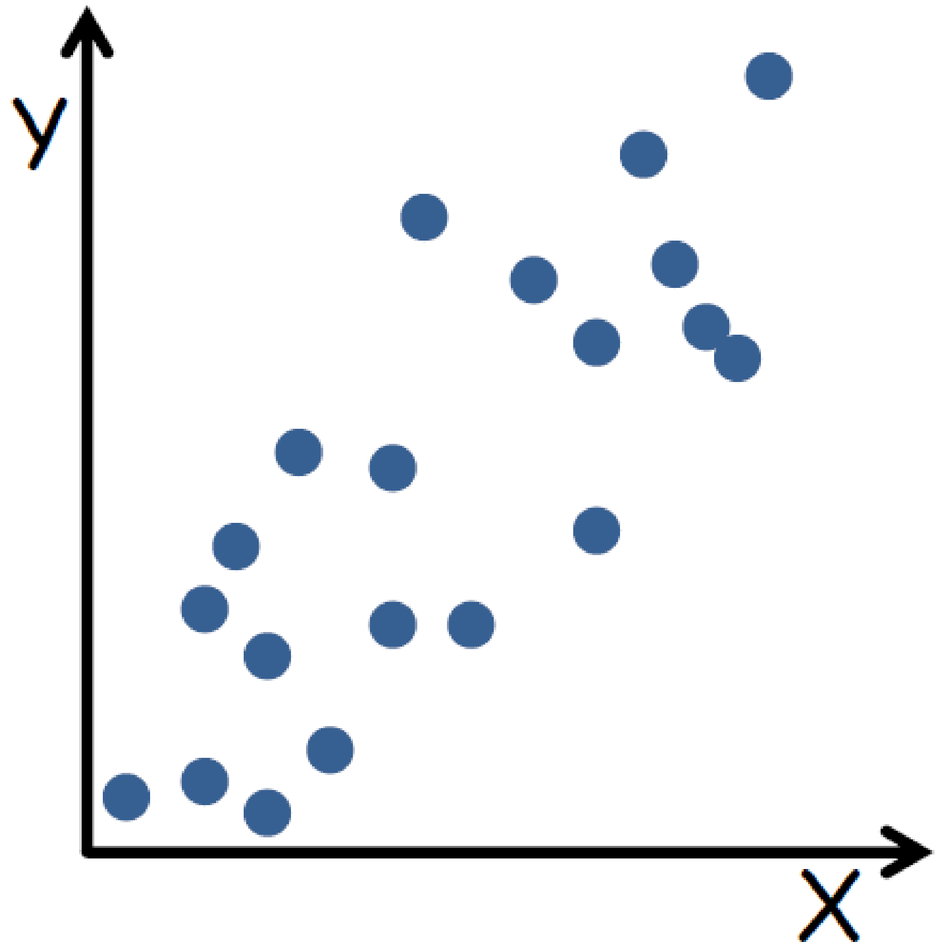
Example Keys

Key

Date	Precipitation	High Temperature
May 1, 2016	0”	60
May 2, 2016	0.3”	62
May 3, 2016	1”	55
May 4, 2016	0”	67

Student	College	HW1 grade (out of 10)
John	COS	9
Jane	Khoury	10
June	Khoury	8
Joe	Khoury	8

Arrange Tables — No Key

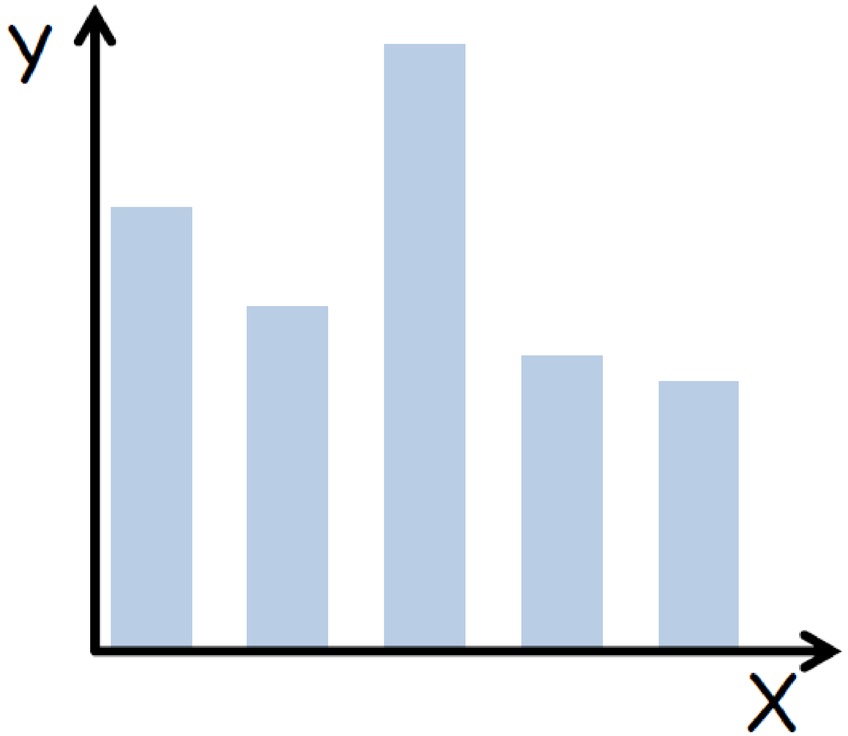


SCATTER PLOT

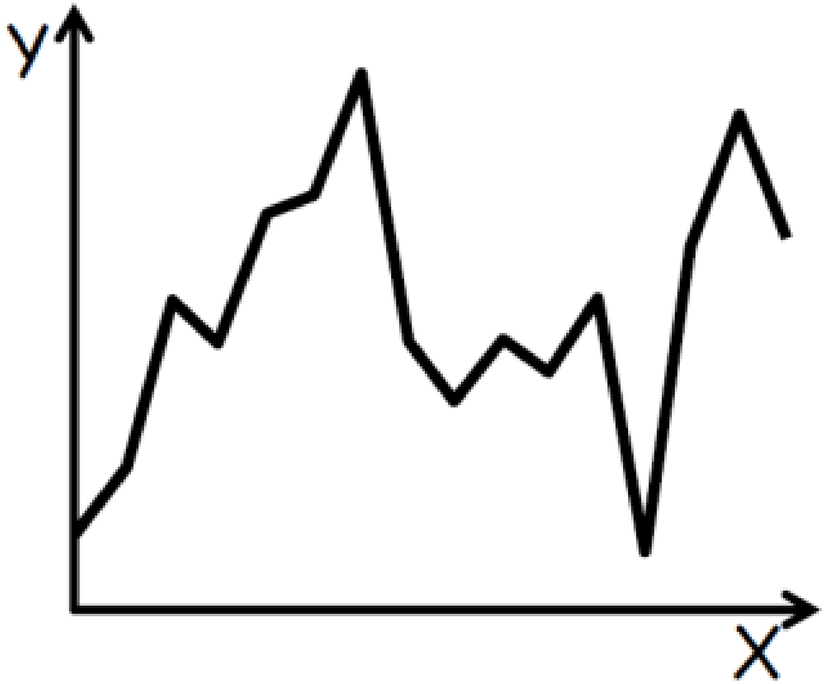
Arrange Tables — One Key

➔ *1 Key*

List



BAR CHART

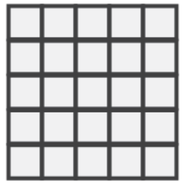


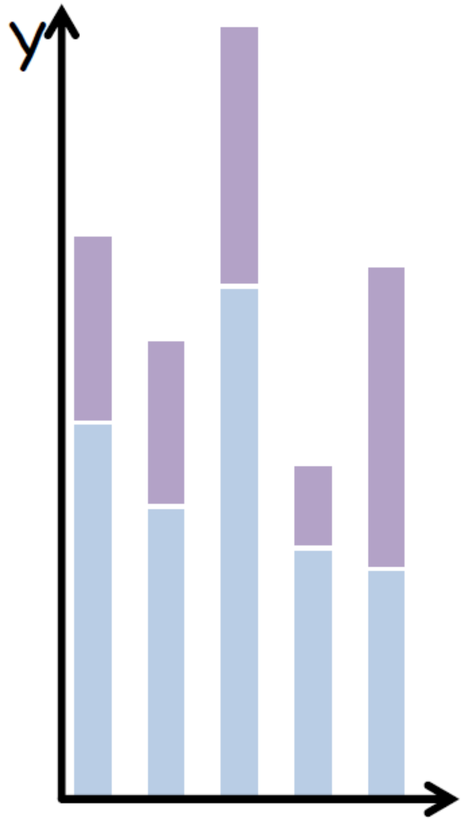
LINE GRAPH

Arrange Tables — Two Keys

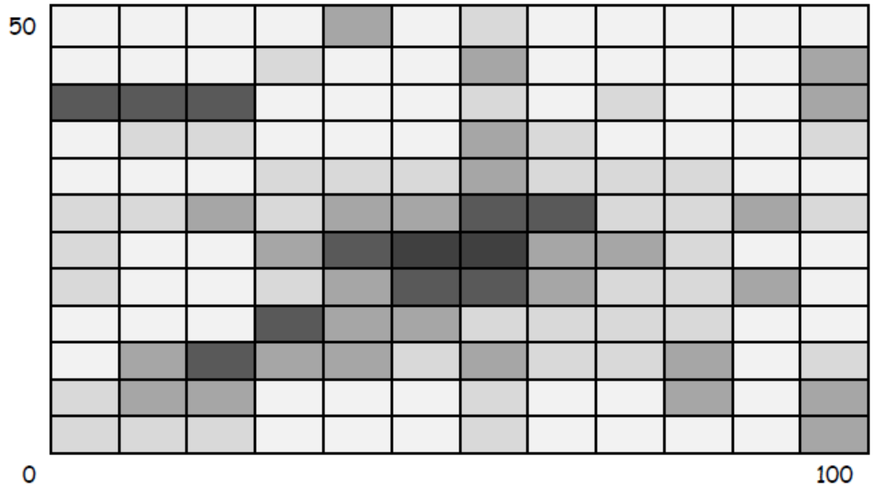
➔ *2 Keys*

Matrix





STACKED BAR CHART

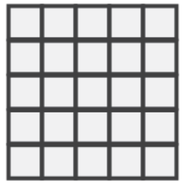


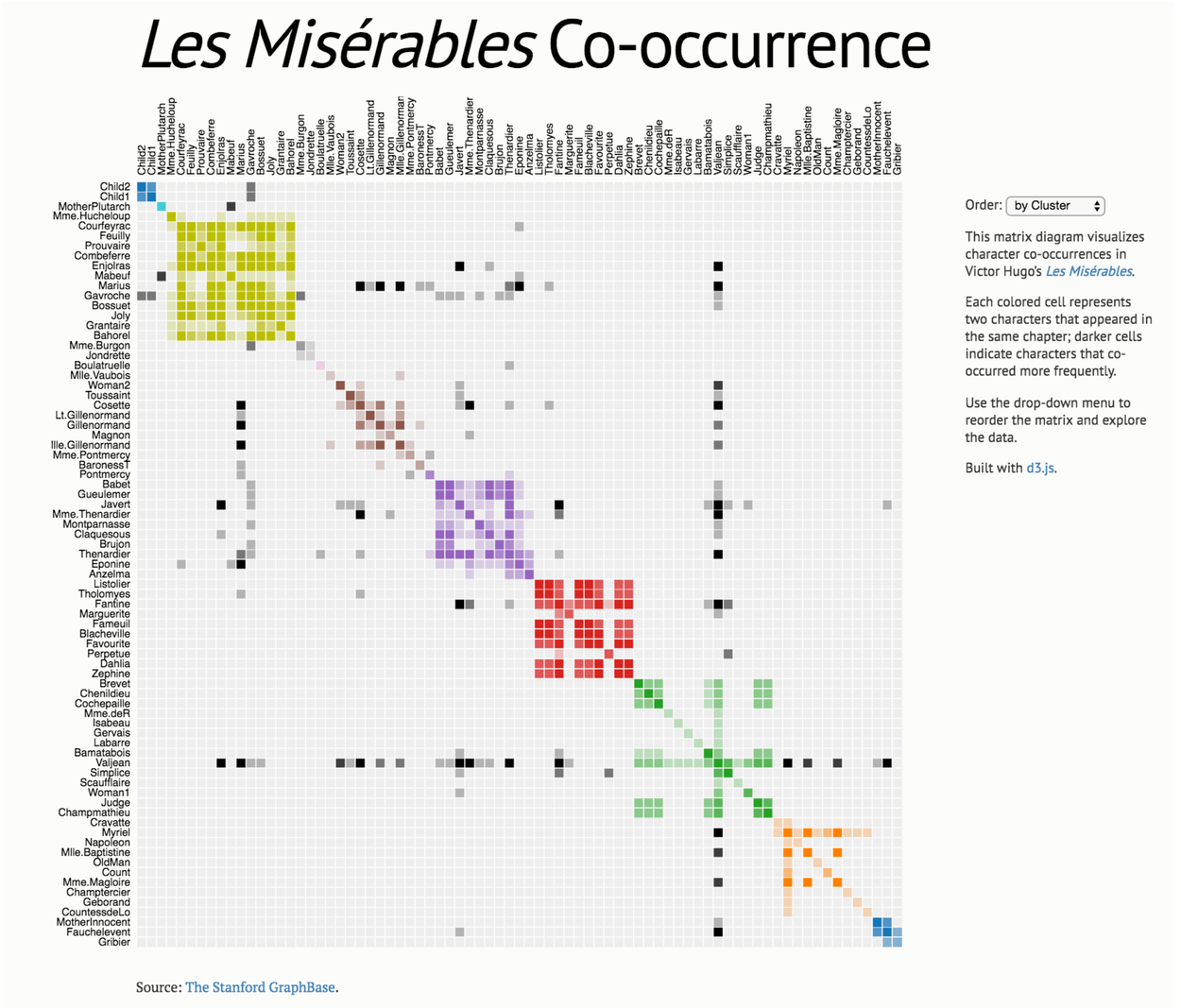
HEATMAP

Arrange Tables — Two Keys (Network)

➔ *2 Keys*

Matrix



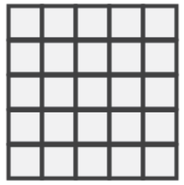


Bostock, 2012

Arrange Tables — Two Keys (Network)

➔ *2 Keys*

Matrix

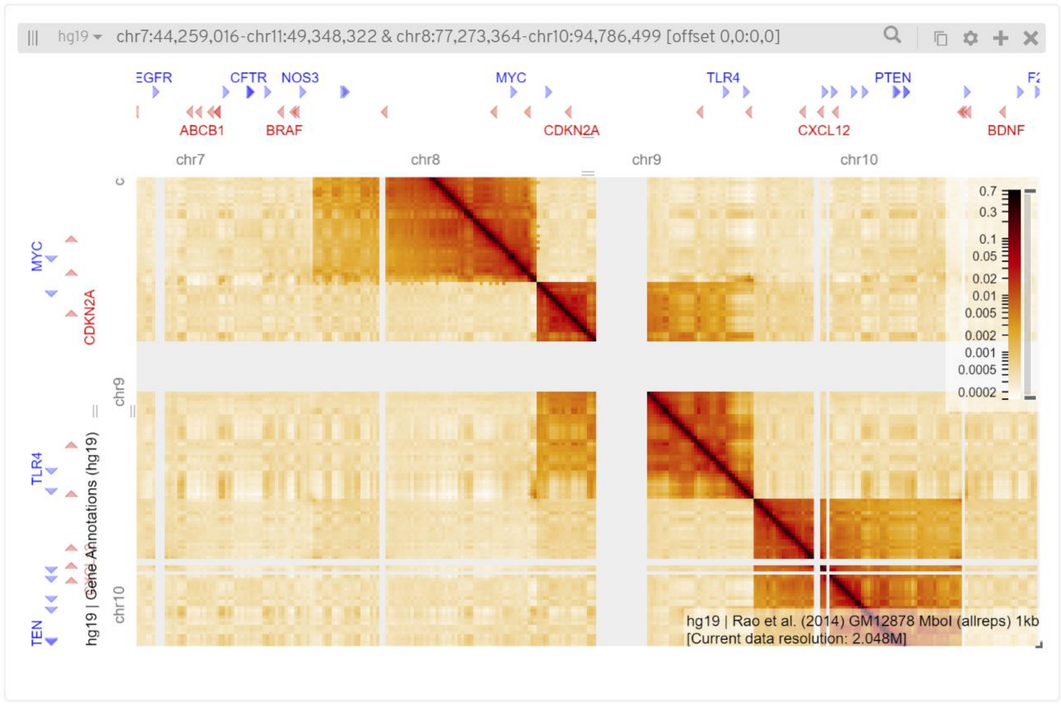


HiGlass About Examples Docs

HiGlass is a tool for exploring genomic contact matrices and tracks. Please take a look at the examples and documentation for a description of the ways that it can be configured to explore and compare contact matrices. To load private data, HiGlass can be run locally within a Docker container. The HiC data in the examples below is from Rao et al. (2014) [2].

A preprint of the paper describing HiGlass is available on bioRxiv [1].

Single View

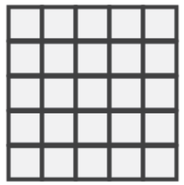


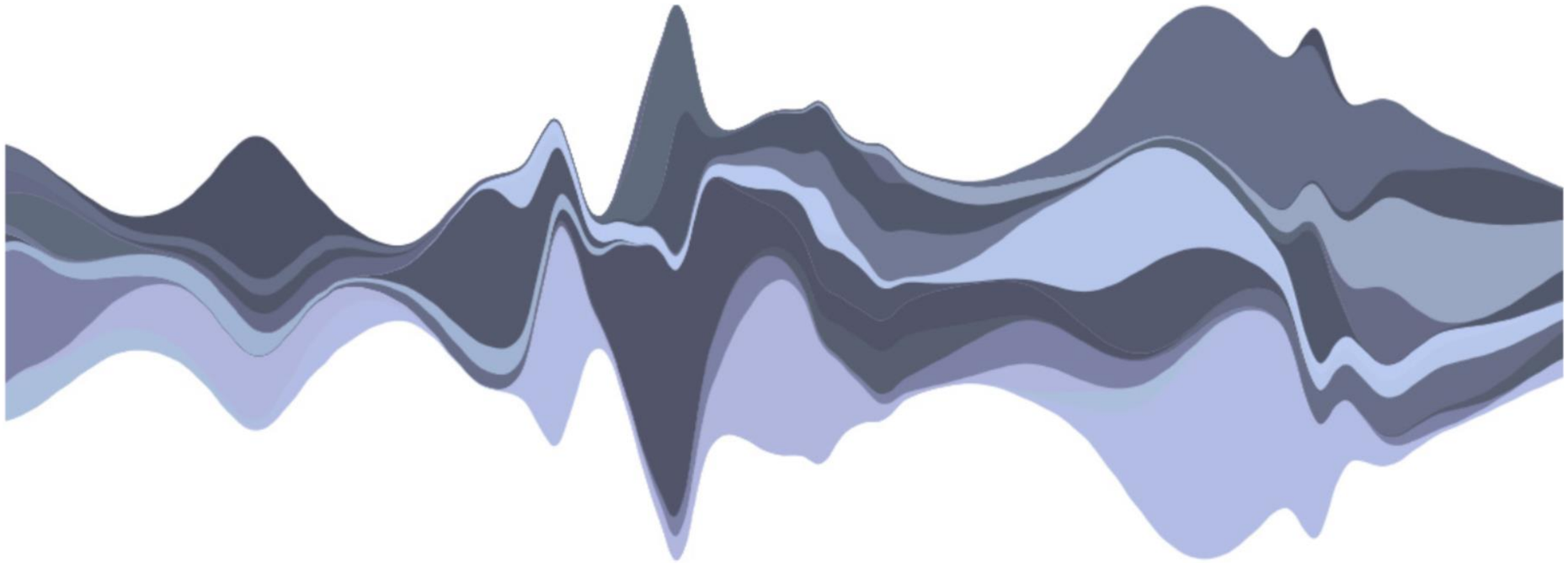
[Kerpedjiev et al., 2018]

Arrange Tables — Two Keys

➔ *2 Keys*

Matrix





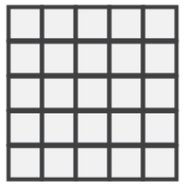
STREAMGRAPH

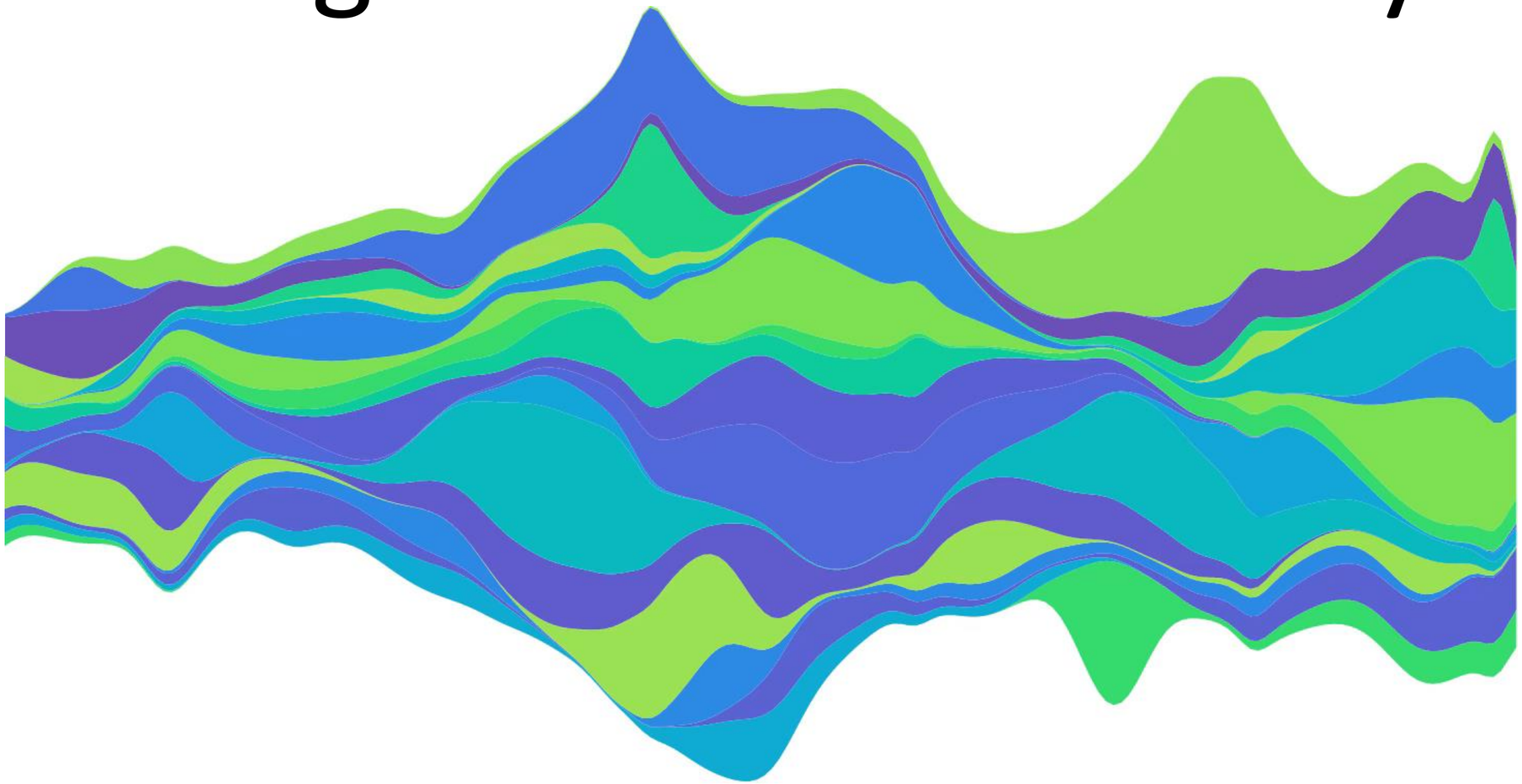
Byron & Wattenberg, 2008

Arrange Tables — Two Keys

➔ *2 Keys*

Matrix





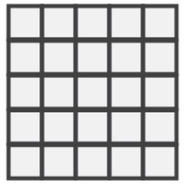
STREAMGRAPH

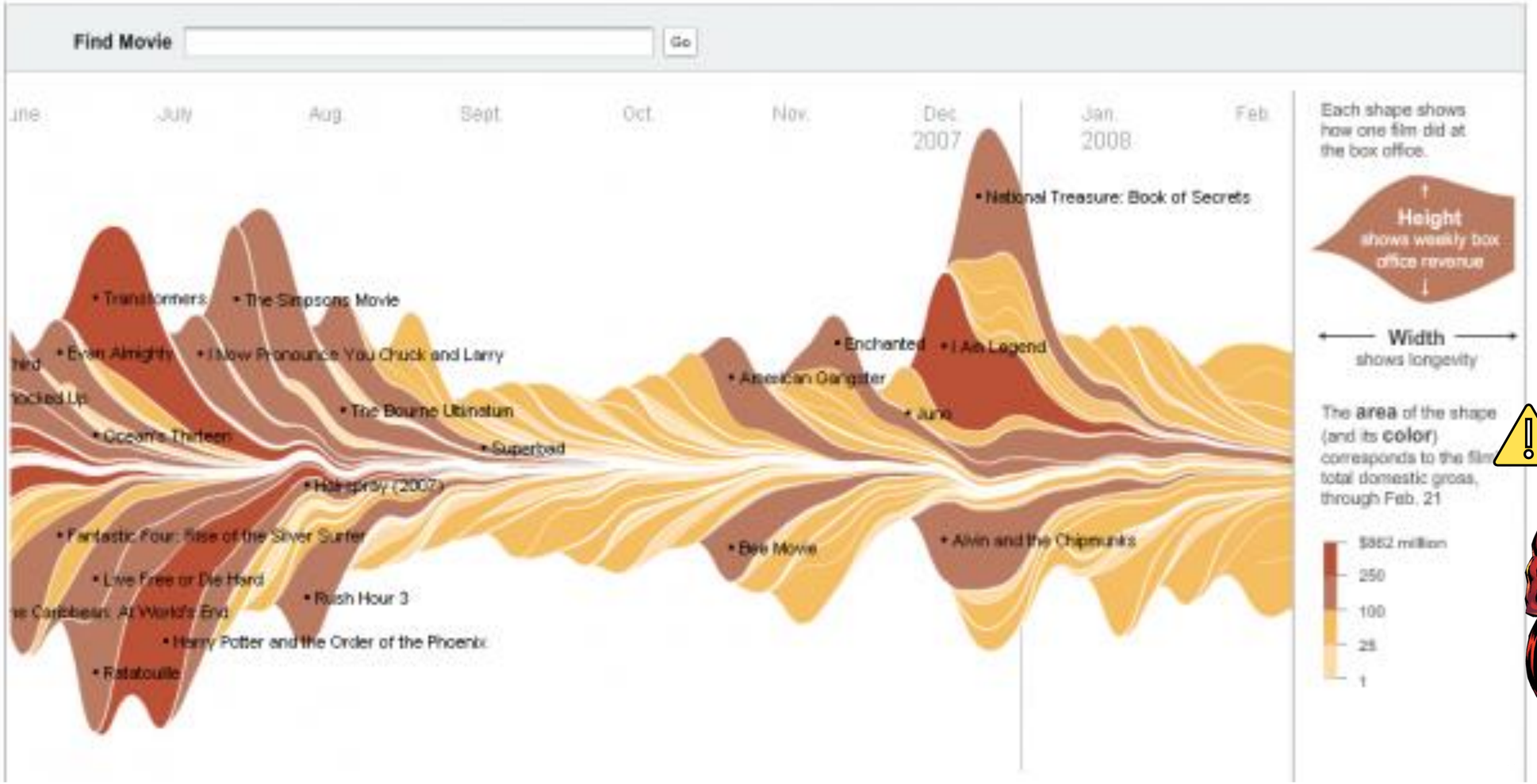
Bostock, 2018

Arrange Tables — Two Keys

➔ *2 Keys*

Matrix



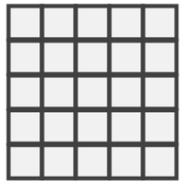


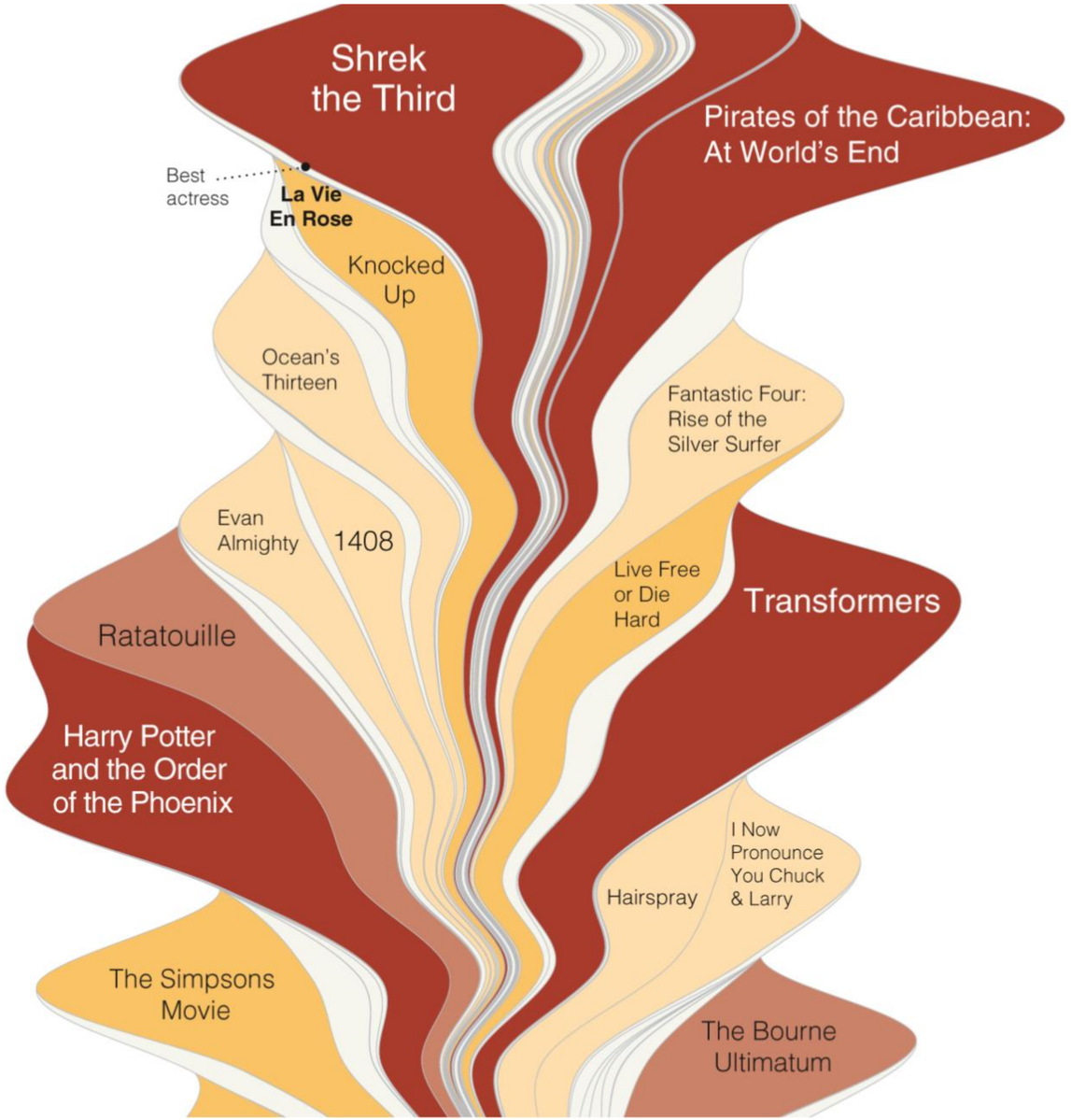
[NY Times, 2008]

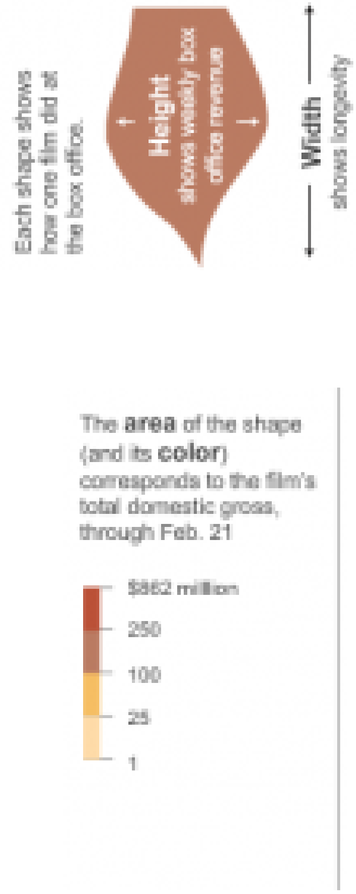
Arrange Tables — Two Keys

➔ *2 Keys*

Matrix





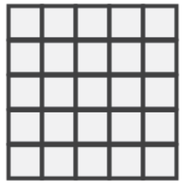


[Byron & Wattenberg, 2008]

Arrange Tables — Two Keys

➔ *2 Keys*

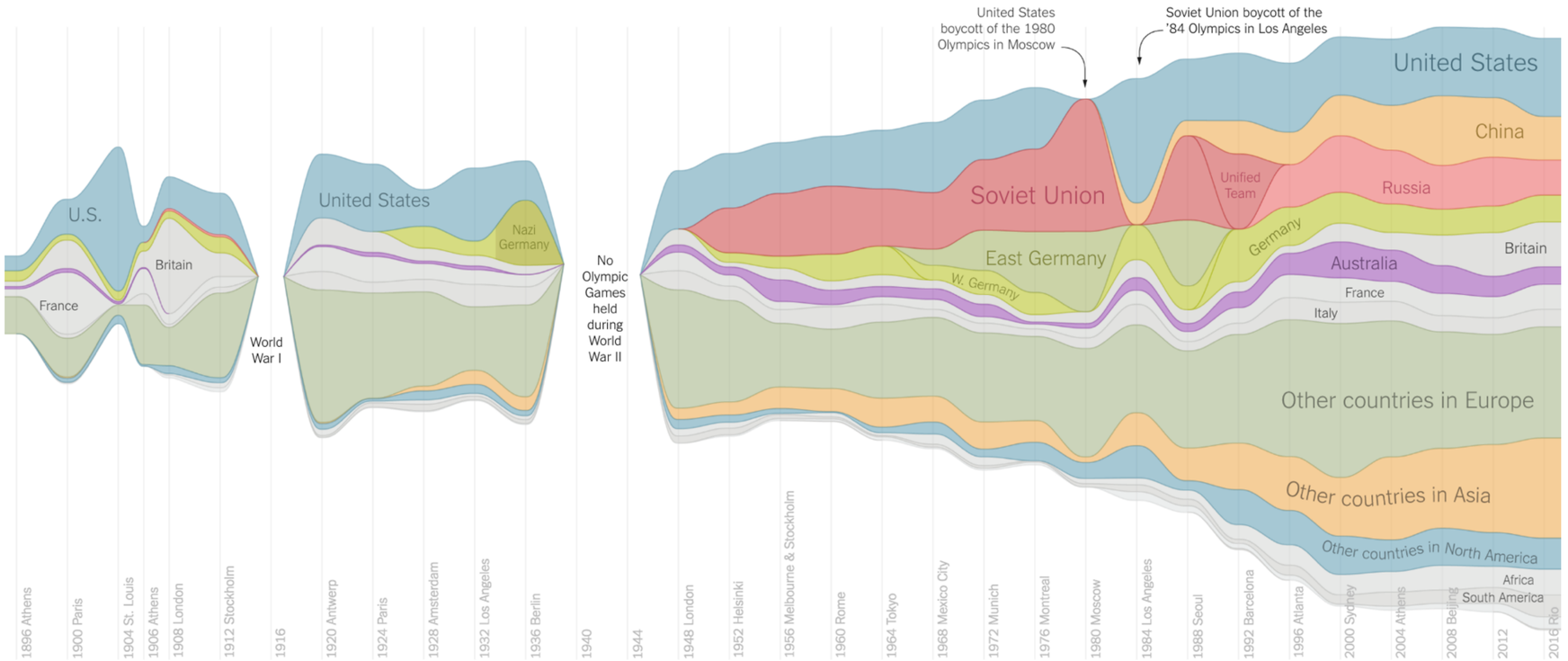
Matrix



Rio2016

A Visual History of Which Countries Have Dominated the Summer Olympics

By GREGOR AISCH and LARRY BUCHANAN UPDATED August 22, 2016



Just 10 countries — the United States, Australia and eight

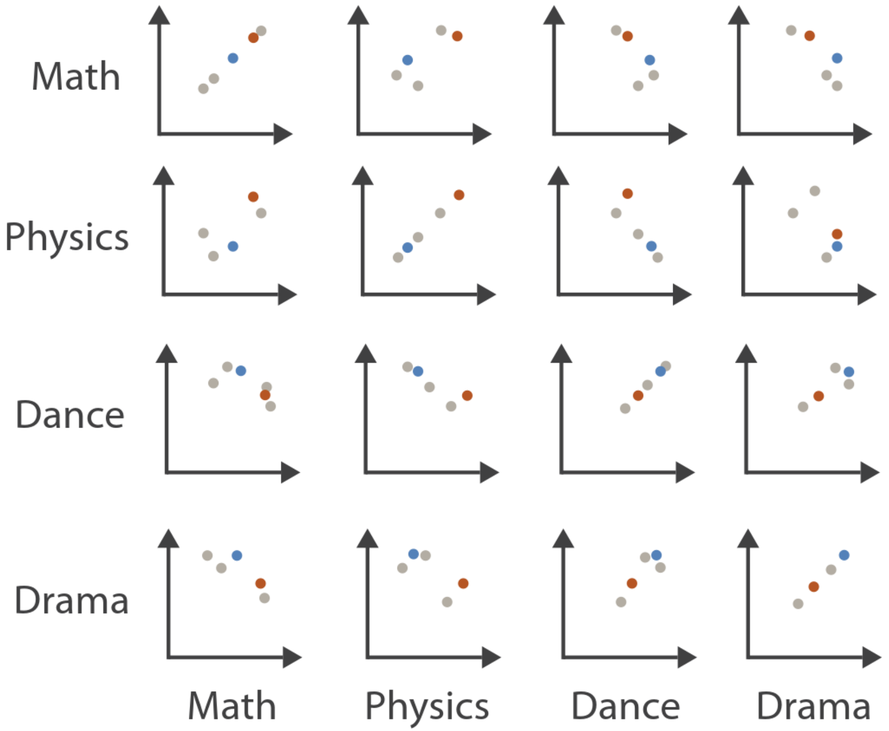
NY Times, 2016

Arrange Tables — Axes

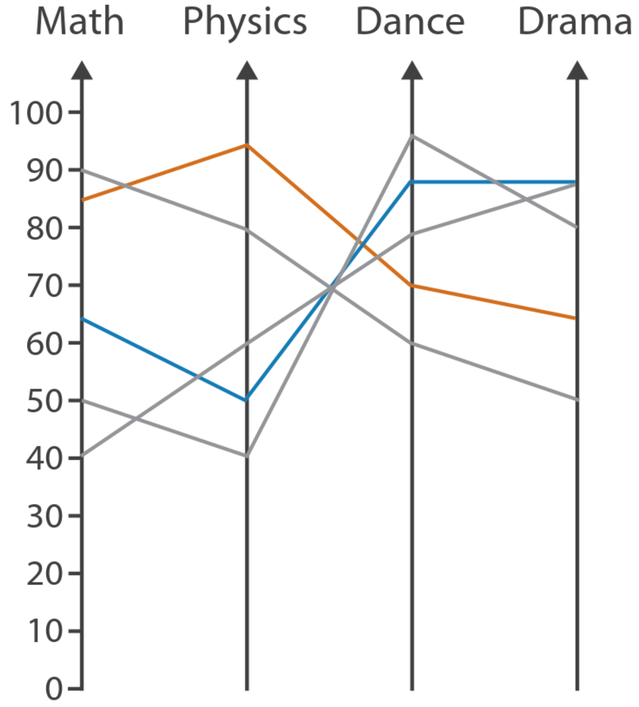
Table

Math	Physics	Dance	Drama
85	95	70	65
90	80	60	50
65	50	90	90
50	40	95	80
40	60	80	90

Scatterplot Matrix

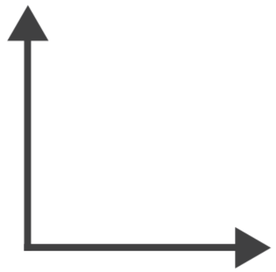


Parallel Coordinates

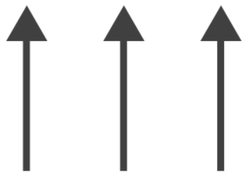


Arrange Tables — Axes

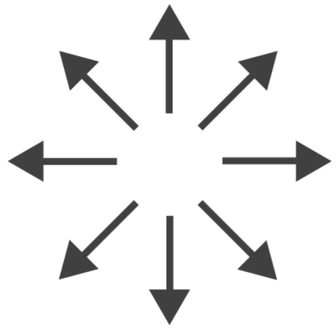
- **Axis Orientation**
  - Rectilinear



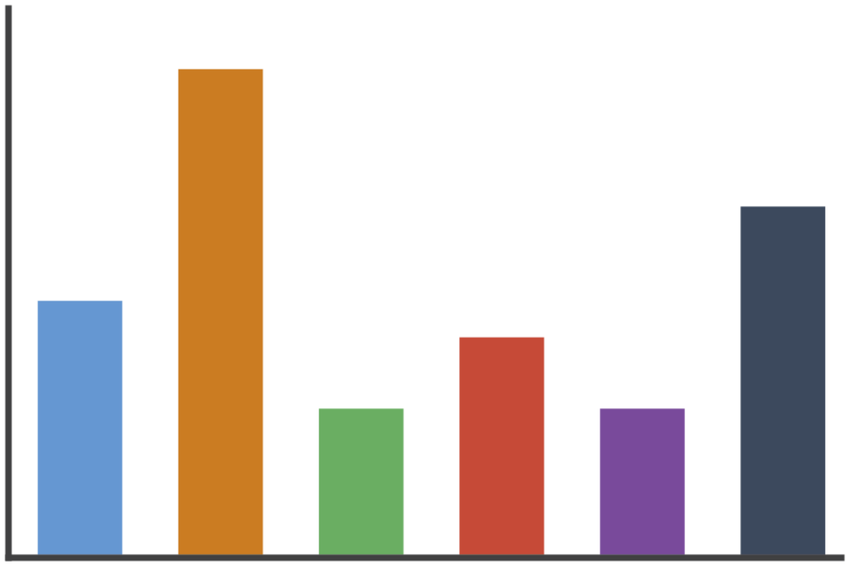
  - Parallel



  - Radial

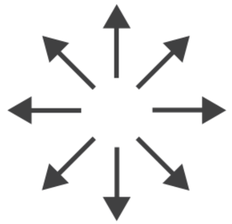


Arrange Tables



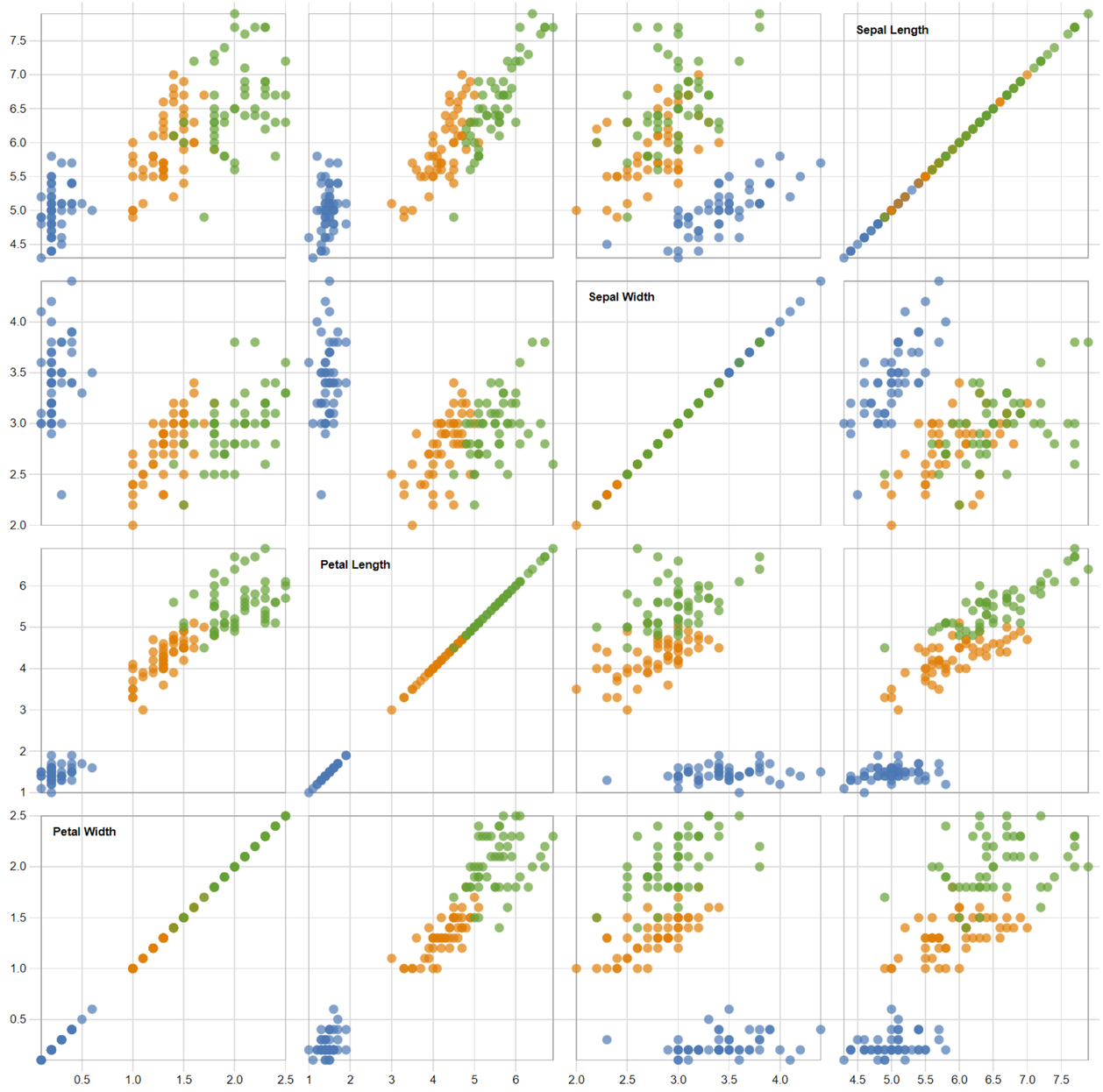
→ Rectilinear

→ Radial



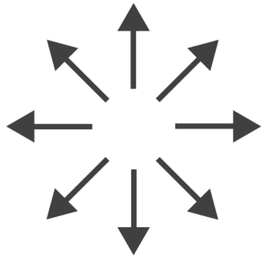
Scatterplot Matrix Brushing

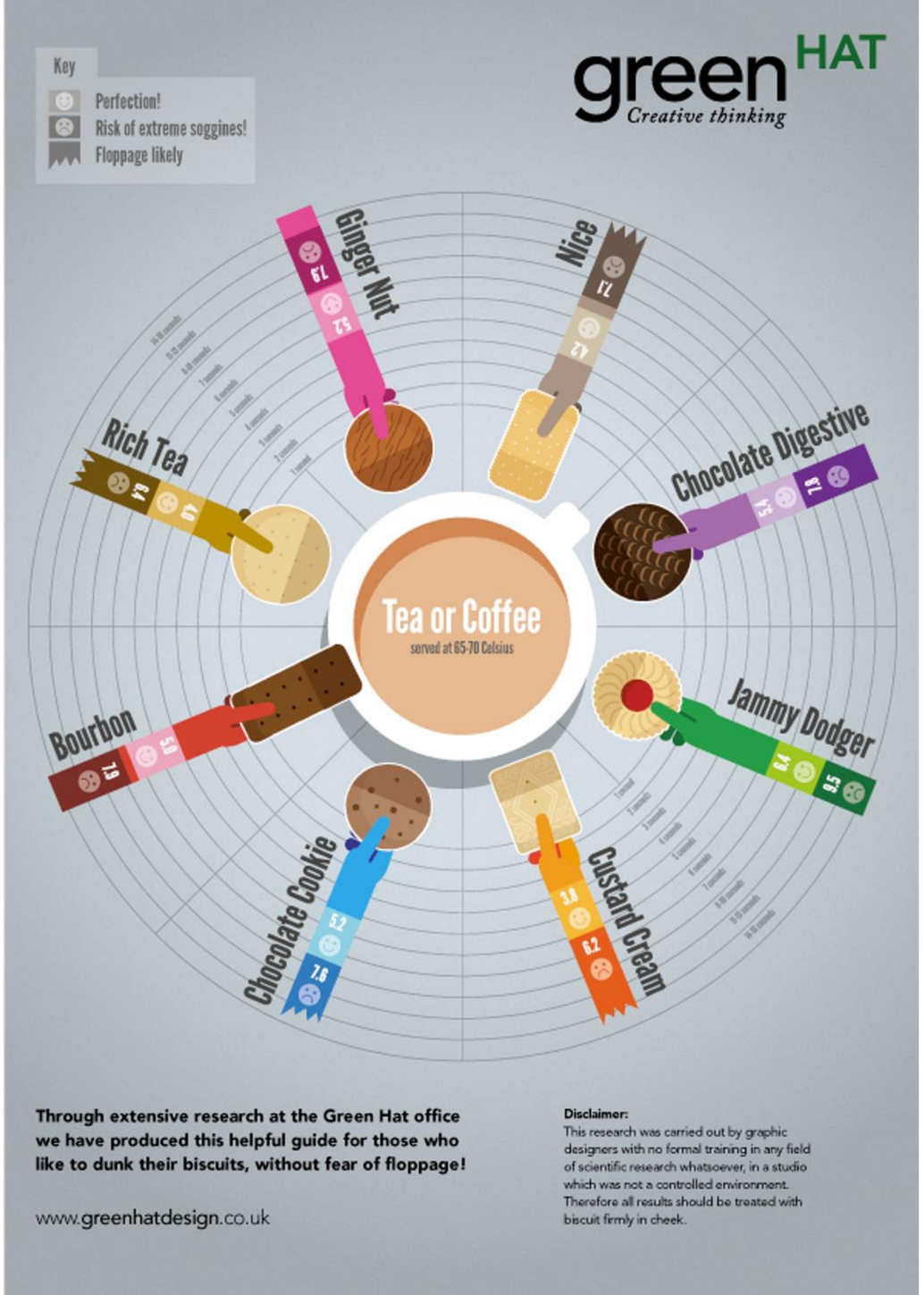
→ Rectilinear



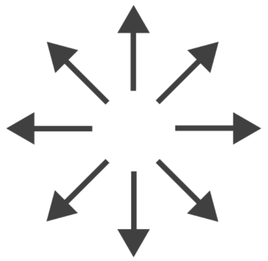
Bostock, Rivière' 2019

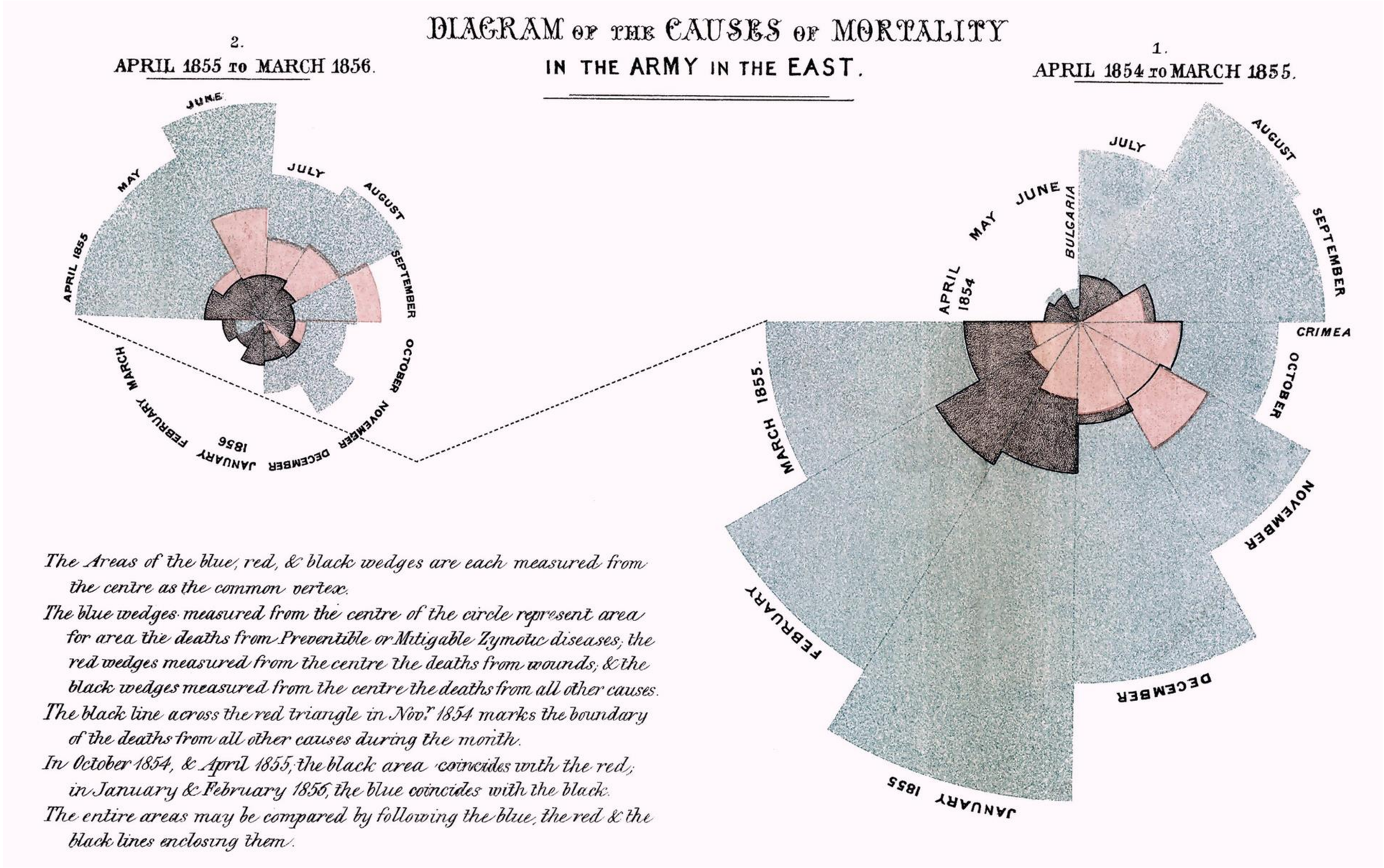
➔ Radial




Key
Perfection!
Risk of extreme soggines!
Floppage likely
green HAT
Creative thinking
Ginger Nut
7.3
5.2
Nice
7.3
4.2
Chocolate Digestive
7.5
7.9
Rich Tea
7.4
7.1
Tea or Coffee
served at 65-70 Celsius
Bourbon
7.1
6.5
Jammy Dodger
7.7
8.5
Chocolate Cookie
5.2
7.6
Custard Cream
3.5
6.2
Through extensive research at the Green Hat office we have produced this helpful guide for those who like to dunk their biscuits, without fear of floppage!
www.greenhatdesign.co.uk
Disclaimer:
This research was carried out by graphic designers with no formal training in any field of scientific research whatsoever, in a studio which was not a controlled environment. Therefore all results should be treated with biscuit firmly in cheek.

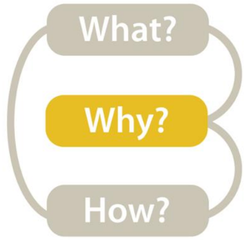
➔ Radial





FLORENCE NIGHTINGALE (C. 1858)

In-Class Exercise:
Design From Task Analysis



Task Analysis

Visualization for Public Transit Development

15m

Previous Class

INSTRUCTIONS:

- Break-out into groups of ~3 people in Teams.
- Pretend you are transportation engineers, e.g., for the MBTA, City of Boston.
- Discuss the user tasks and goals and abstract them using one of these taskonomies.
- Save your notes for a later exercise!!!

Low-level

Retrieve Value	*How long is the movie Gone with the Wind?*
Filter	*What comedies have won awards?*
Compute Derived Value	*How many awards have MGM studio won in total?*
Find Extremum	*What director/film has won the most awards?*
Sort	*Rank movies by most number of awards.*
Determine Range	*What is the range of film lengths?*
Characterize Distribution	*What is the age distribution of actors?*
Find Anomalies	*Are there exceptions to the relationship between number of awards won and total movies made by an actor?*
Cluster	*Is there a cluster of typical film lengths?*
Correlate	*Is there a trend of increasing film length over the years?*

Actions

High-level

→ *Present*

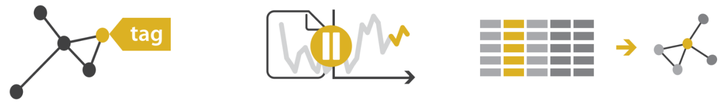
→ *Enjoy*

→ Produce

→ *Annotate*

→ *Record*

→ *Derive*



Mid-level

Search

	Target known	Target unknown
Location known	*Lookup*	*Browse*
Location unknown	*Locate*	*Explore*

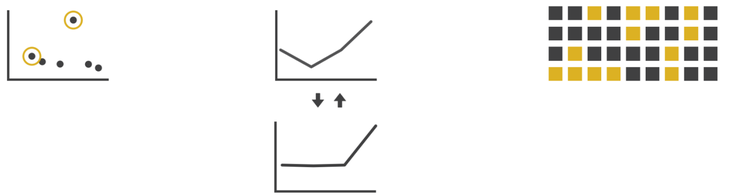
Low-level

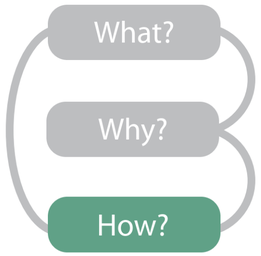
Query

→ Identify

→ Compare

→ Summarize





In-Class Design

Task Analysis→Visualization for Public Transit Development

38 min

INSTRUCTIONS:

- In-Class Design — Task Analysis→Visualization for Public Transit Development on Canvas