Lecture 4

Data Visualization

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RE 519 Real Estate Data Analytics and Visualization
Course Website: www.yuehaoyu.com/data-analytics-visualization/
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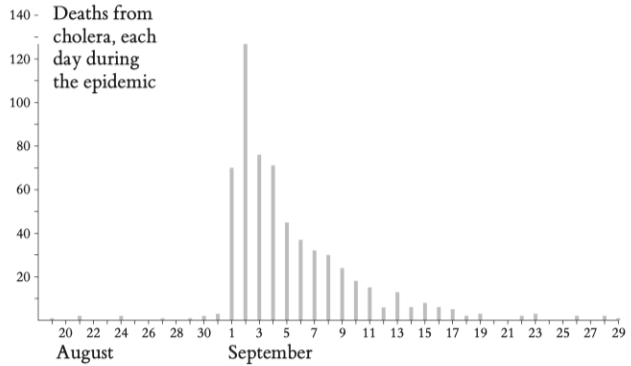
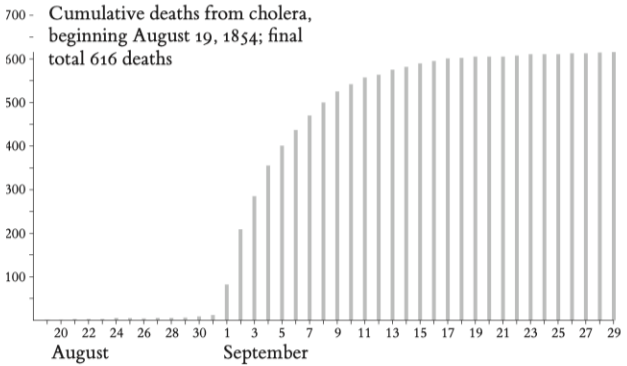
Purpose of Visualization

Cholera Map

Cholera broke out in the Broad Street area of central London on the evening of August 31, 1854. John Snow, who had investigated earlier epidemics, suspected that the water from a community pumpwell at Broad and Cambridge Streets was contaminated. Testing the water from the well on the evening of September 3, Snow saw no suspicious impurities, and thus he hesitated to come to a conclusion (Tufte, 1997) ……





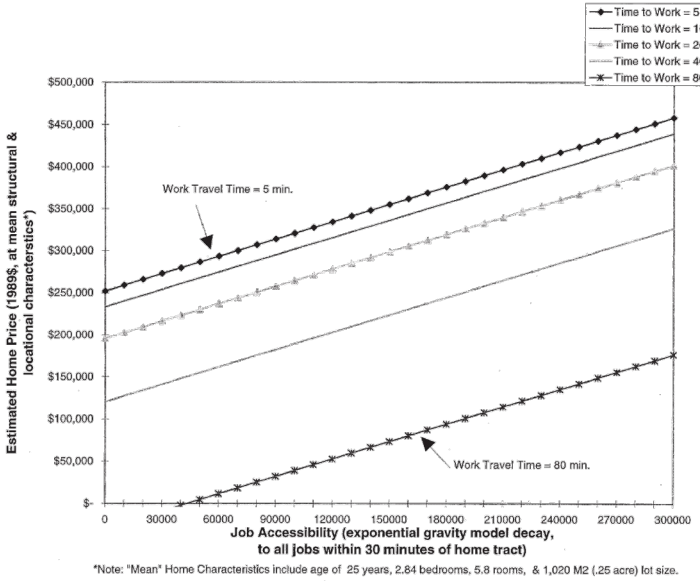
Purpose of Visualization

Cholera Map

This map of London was created by John Snow in the later 1854. The cholera cases are highlighted in black. Using this map, Snow and other scientists were able to trace the cholera outbreak to a single infected water pump.

Purpose of Visualization

What are the differences between these two figures?



House prices versus job accessibility, plotted at different work travel times. Kockelman, 1997

Infographic of SF Housing Price, Reddit: Original post by /u/surf2japan in r/bayarea

Purpose of Visualization

Explorative vs. Narrative

	EXPLORATIVE	NARRATIVE
CHARACTERISTICS		
	MINIMALIST	ILLUSTRATIVE
	ONLY INCLUDES ELEMENTS THAT REPRESENT DATA	DESIGN-FOCUSED
	SEEKS TO COMMUNICATE INFORMATION	SEEKS TO APPEAL TO VIEWER WITH ENGAGING VISUALS
	IN THE MOST CLEAR, CONCISE MANNER	INFORMS AND ENTERTAINS
APPLICATIONS		
	ACADEMIC RESEARCH	PUBLICATIONS
	SCIENCE	BLOGS
	BUSINESS INTELLIGENCE	CONTENT MARKETING
	DATA ANALYSIS	SALES AND MARKETING MATERIALS

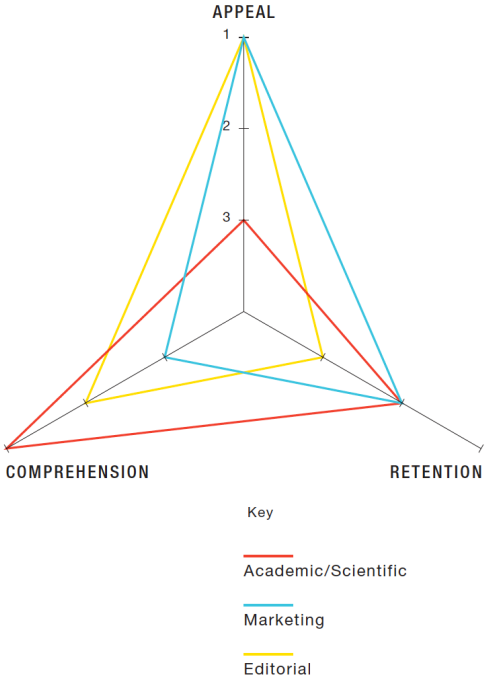
Lankow et al. 2012, Chapter 1, p. 34

Purpose of Visualization

Explorative vs. Narrative

- ***Appeal***
  - Communication should engage a voluntary audience.
- ***Comprehension***
  - Communication should effectively provide knowledge that enables a clear understanding of the information.
- ***Retention***
  - Communication should impart memorable knowledge.

- ***Academic/Scientific***
  - Comprehension, Retention, Appeal
- ***Marketing***
  - Appeal, Retention, Comprehension
- ***Editorial***
  - Appeal, Comprehension, Retention

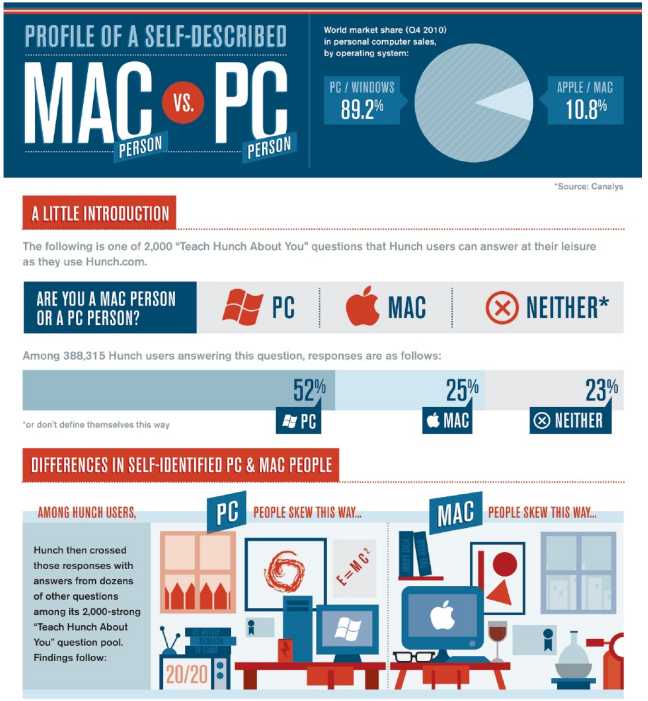


Lankow et al. 2012, Chapter 1, p38

Type of Data Visualization

Static

- User interaction consists of viewing and reading
- Display output is a still image
- Works best as a narrative, but can be explorative in some cases
- Internal reporting and presentation; Editorial or brand-centric content for blogging and social/PR distribution
- It can be outdated quickly
- Think about who should be involved in decision-making

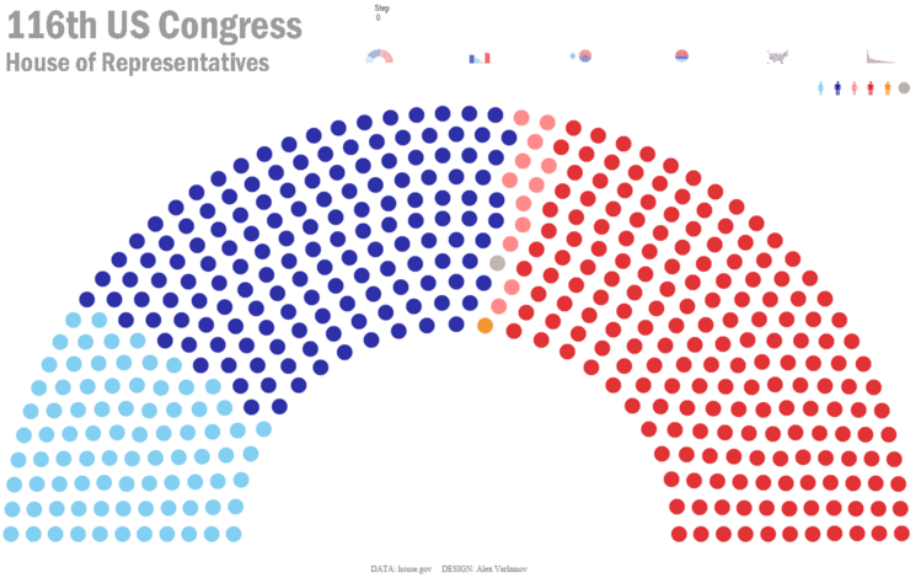


Source: Lankow, Jason, et al. Infographics: The Power of Visual Storytelling Chapter 2, page 67

Type of Data Visualization

Motion

- User interaction consists of viewing, listening to whether there is a voiceover, and reading.
- Display output is animated or moving
- Works best as a narrative, rarely explorative, without being used in combination with interactive content

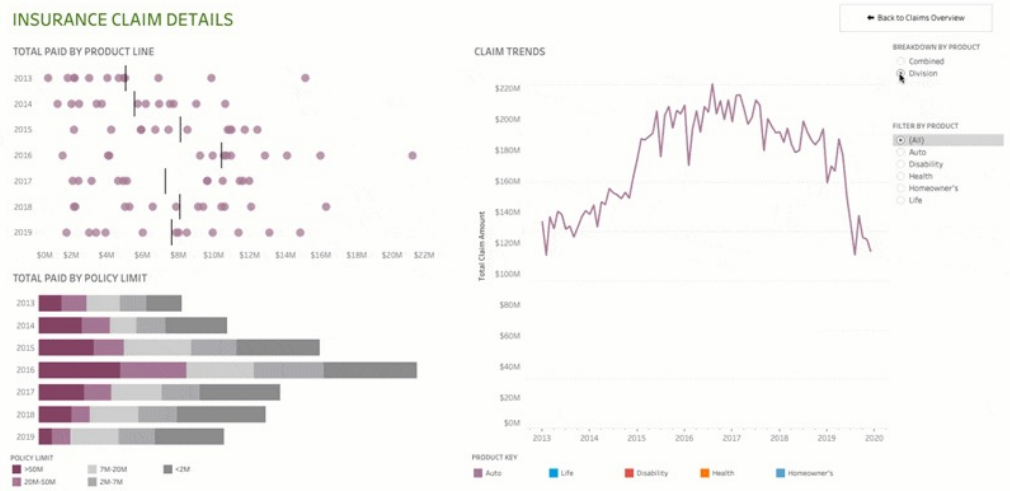


Source: https://www.flerlagetwins.com/2019/08/tableau-in-motion.html

Type of Data Visualization

Interactive

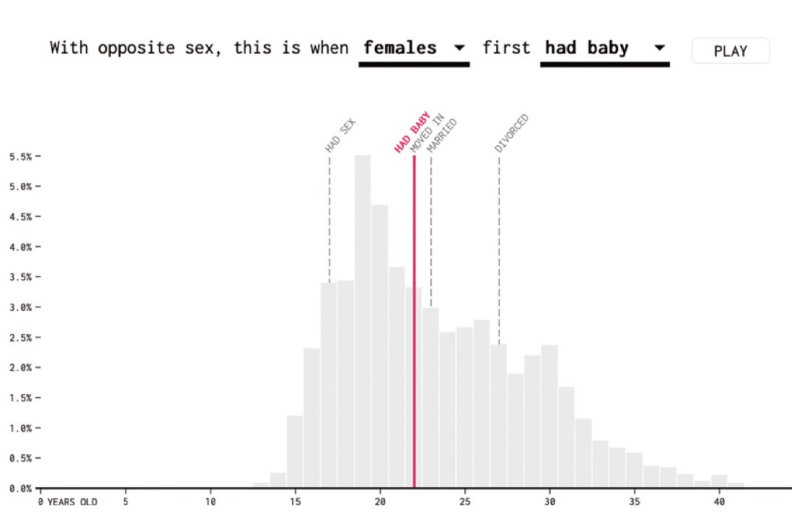
- User interaction consists of clicking, searching for specific data, actively shaping the content displayed, and choosing which information is accessed and visualized.
- Can be narrative, explorative, or both
- Often used in internal reports and presentations to public agencies
- Data security and privacy



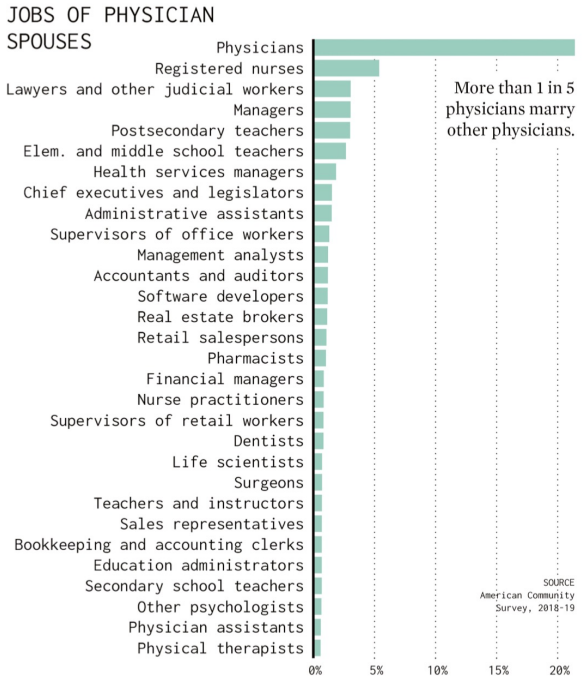
Source: https://help.tableau.com/current/pro/desktop/en-us/formatting_animations.htm

More Examples of Data Visualization

Bar Charts and Histogram

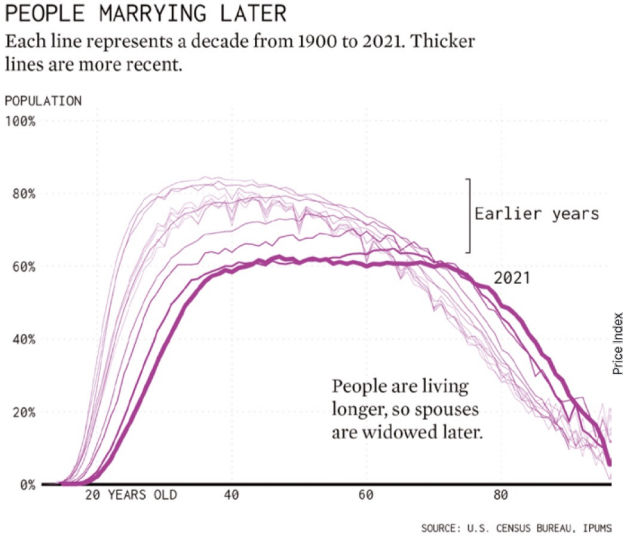


Source: Nathan Yau (2024). Visualize This



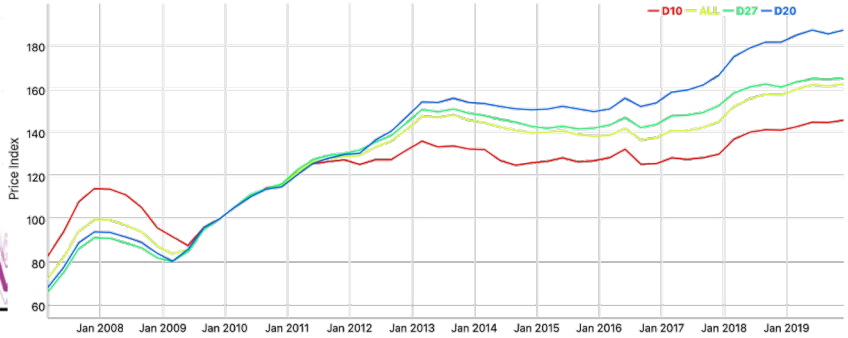
More Examples of Data Visualization

Line and Time Series Plots



Residential Property Price Index for selected districts, Singapore, 2008-2019

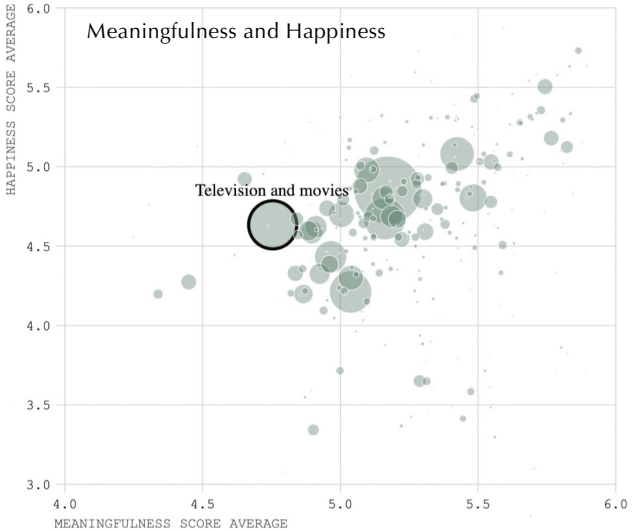
https://keith-tan.medium.com/real-estate-investing-and-development-data-visualization-as-a-tool-51b75dabb0ca

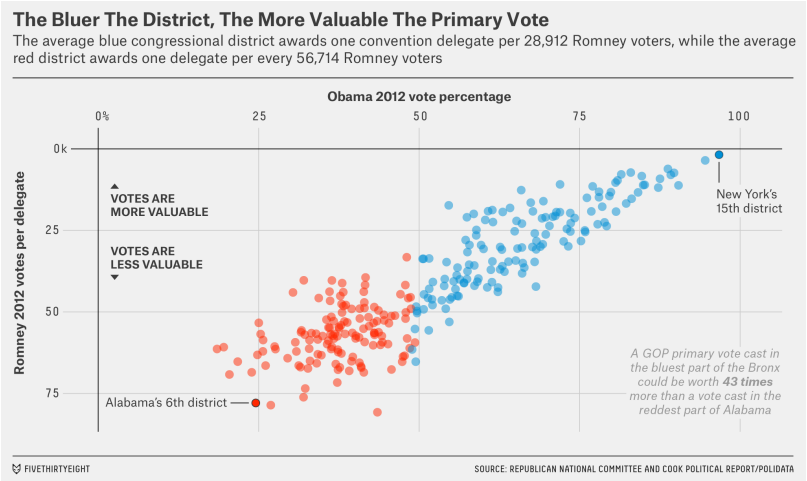


Source: Nathan Yau (2024). Visualize This

More Examples of Data Visualization

Scatter Plot Family



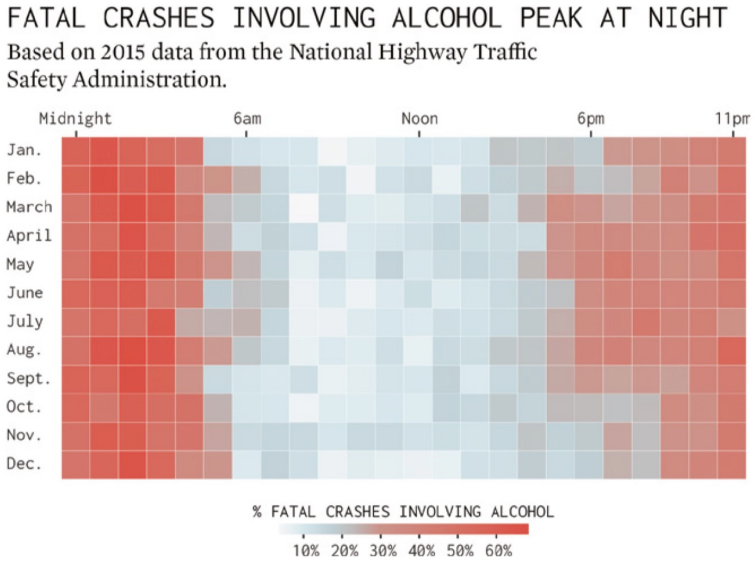


Source: https://fivethirtyeight.com/features/the-gops-primary-rules-might-doom-carson-and-cruz

Source: Nathan Yau (2024). Visualize This

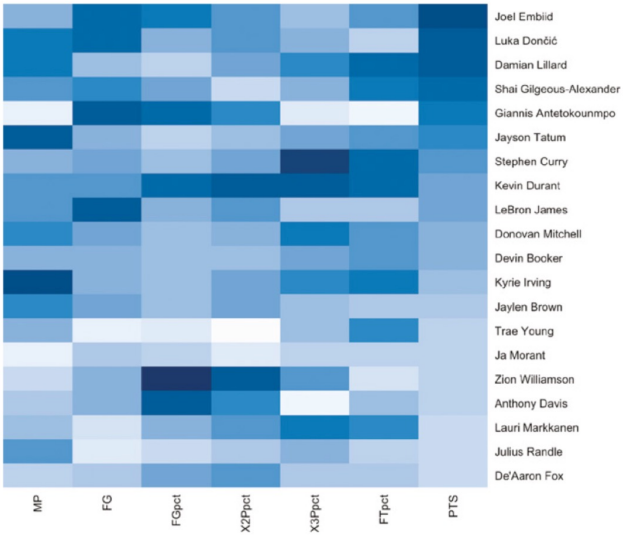
More Examples of Data Visualization

Heatmaps



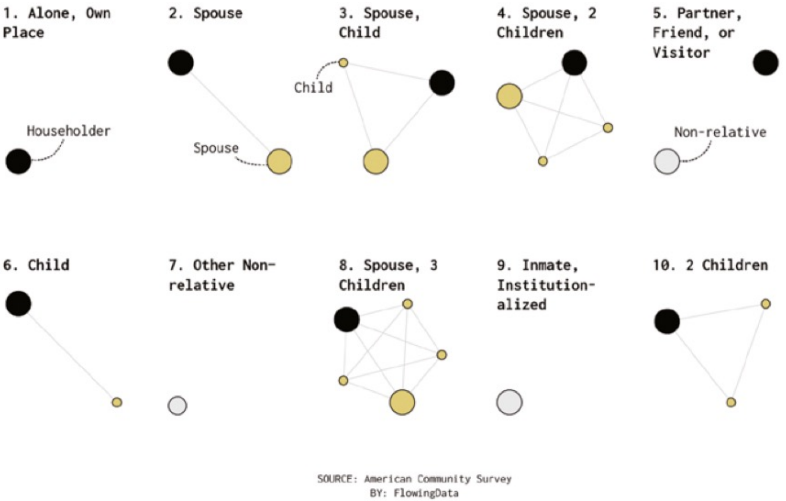
Source: Nathan Yau (2024). Visualize This

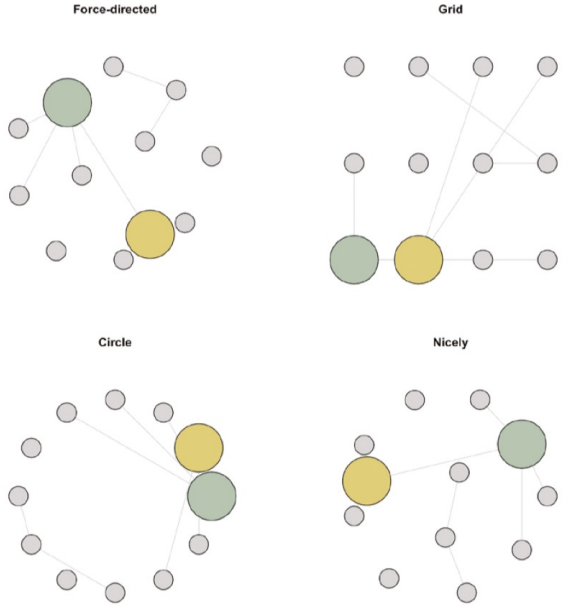
Correlation Matrix



More Examples of Data Visualization

Network Graphs

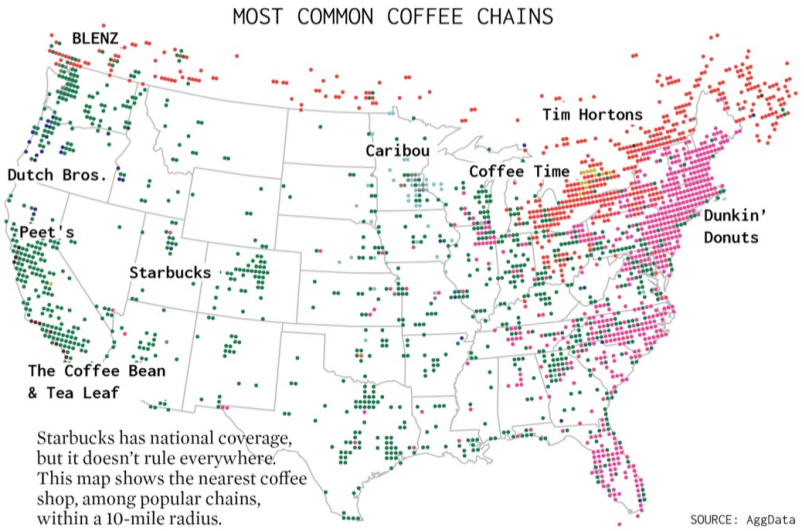




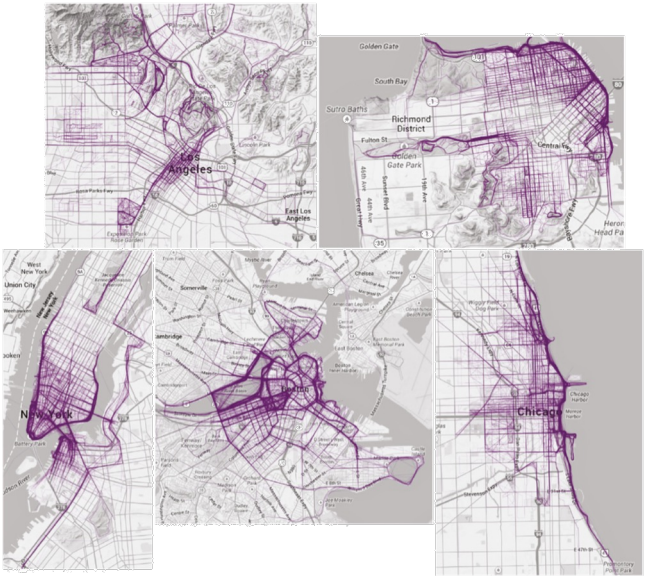
Source: Nathan Yau (2024). Visualize This

More Examples of Data Visualization

Maps



Source: Nathan Yau (2024). Visualize This



Where do People Run in Major Cities?

Data Visualization Principles

A Framework for Visualization from Tamara Munzner

Actions of Data Visualization	→ users' actions toward visualization
Target of Data Visualization	→ what part of data that users are focusing on
The Choice of Visualization **Idioms**	→ which form best present it
Marks and Channels	→ how to encode them visually
Expressiveness vs **Effectiveness**	→ key standards for good visualization
Elements of A Single Graph	→ components in a graph
User **Experience** and Organization	→ how people will use and understand the visualization
Graphic **Interaction**	→ how people can interact with the visualization

It represents a thinking flow — from understanding the goal of visualization, to selecting the right form, to ensuring clarity, usability, and interaction.

Actions of Visualization

Why are they looking at it? Three Levels of Actions

Analyze ——— Search ——— Query

[High level] From the perspective of users, why are they looking at the visualization?

➔ Consume

➔ *Discover* ➔ *Present* ➔ *Enjoy*

➔ Produce

➔ *Annotate* ➔ *Record* ➔ *Derive*

Consuming visualization rather than producing
- Discover: explore data
- Present: using visualization to understand (explain)
- Enjoy: casual and social

Aiming to produce visualizations
- Annotate: take notes and annotate key points
- Record: record discovery and analysis process
- Derive: derive new variable and produce new charts

Source: Tamara Munzner. Visualization Analysis and Design (2014).

Actions of Visualization

Why are they looking at it? Three Levels of Actions

Analyze — **Search** — Query

[Middle level] Users are trying to find a known/unknown item in the visualization.

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

Source: Tamara Munzner. Visualization Analysis and Design (2014).

Lookup
- ex: word in dictionary alphabetical order

Locate
- ex: keys in your house
- ex: node in network

Browse
- ex: books in a bookstore

Explore
- ex: find a cool neighborhood in a new city

Interaction and navigation are important to help users find the information.

Actions of Visualization

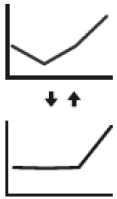
Why are they looking at it? Three Levels of Actions

Analyze —— Search —— **Query**

[Lower level] Users are trying to find out about the detailed characteristics of items.

➔ Identify

➔ Compare



➔ Summarize

How much of the data matters!

- One: identify
- Some: compare
- All: summarize

Source: Tamara Munzner. Visualization Analysis and Design (2014).

Visual encoding accuracy is important to help users find accurate information.

Targets of Data Visualization

Actions of Data Visualization
Target of Data Visualization
The Choice of Visualization Idioms
Marks and Channels
Expressiveness vs Effectiveness
Elements of A Single Graph
User Experience and Organization

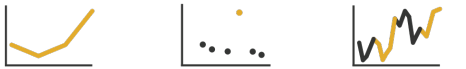
What will users look at?

A Target describes **which part of the data** users are examining, and this depends on the **data type.**

All Data

Overview-level tasks -- Thinking about the whole dataset.

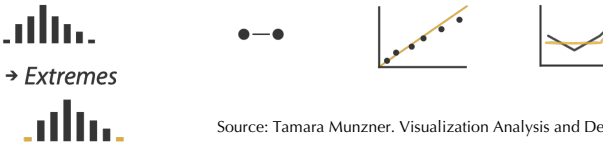
- Trends
- Outliers
- Features



Attributes

Attribute-level tasks -- Thinking about one or more attributes.

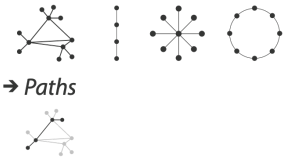
- One
  - *Distribution*
  - *Extremes*
- Many
  - *Dependency*
  - *Correlation*
  - *Similarity*



Source: Tamara Munzner. Visualization Analysis and Design (2014).

Network Data

- Topology
- *Paths*



Spatial Data

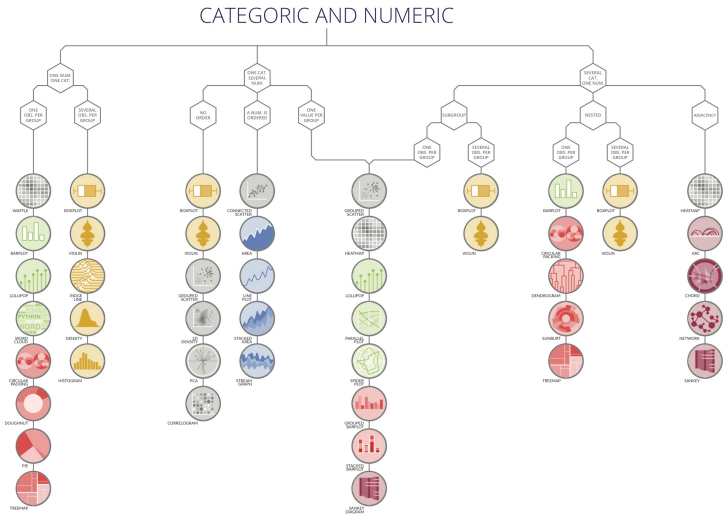
- Shape

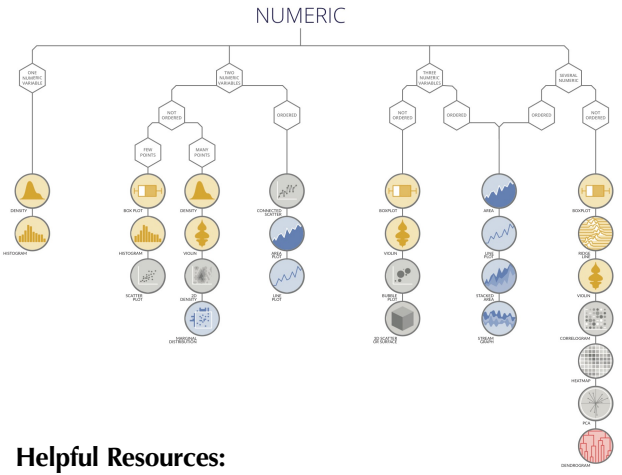
Note: In almost all datasets, we can decompose them into 3 parts: data set (all data), the data item, and the attribute.

The Choice of Visualization Idioms

How to visualize?

Actions of Data Visualization
Target of Data Visualization
The Choice of Visualization Idioms
Marks and Channels
Expressiveness vs Effectiveness
Elements of A Single Graph
User Experience and Organization



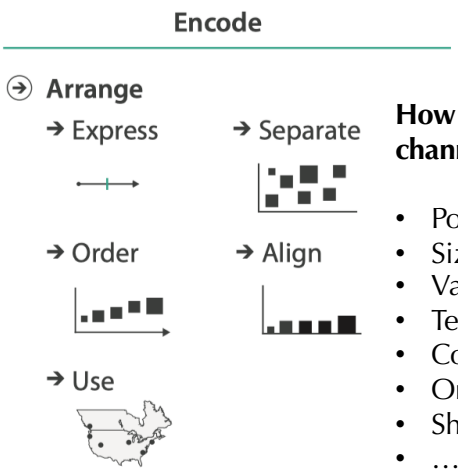


Helpful Resources:
Data Viz Project by ferdio.
From Data to Viz.

The Choice of Visualization Idioms

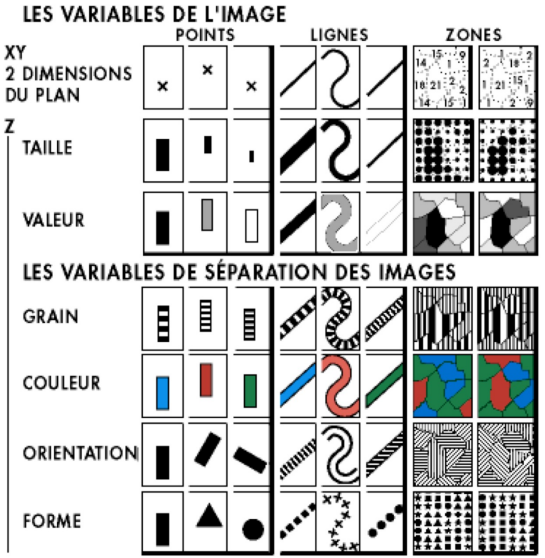
Actions of Data Visualization
Target of Data Visualization
The Choice of Visualization Idioms
Marks and Channels
Expressiveness vs Effectiveness
Elements of A Single Graph
User Experience and Organization

How to visualize? Choose idioms based on Action × Target.



How to convert attributes to visual channels? Such as:

- Position (X, Y)
- Size
- Value
- Texture
- Color
- Orientation
- Shape
- ……



Source: Tamara Munzner. Visualization Analysis and Design (2014).

Source: Jacques Bertin (1967) Sémiologie Graphique

The Choice of Visualization Idioms

Actions of Data Visualization
Target of Data Visualization
The Choice of Visualization Idioms
Marks and Channels
Expressiveness vs Effectiveness
Elements of A Single Graph
User Experience and Organization

How to visualize? Choose idioms based on Action × Target.

Facet

- Juxtapose

- Partition

- Superimpose

How to show multiple views, especially to compare?

Reduce

- Filter

- Aggregate

- Embed

How to simplify complex data?

Manipulate

- Change

- Select

- Navigate

How can users interact with the visualization?

Source: Tamara Munzner. Visualization Analysis and Design (2014).

Marks and Channels

Actions of Data Visualization
Target of Data Visualization
The Choice of Visualization Idioms
Marks and Channels
Expressiveness vs Effectiveness
Elements of A Single Graph
User Experience and Organization

Marks

Marks: represent **items** or **links**
Channels (aka Visual Variable): change **appearance** based on **attribute**

Marks as Items: Basic geometric elements

Points

0D

Lines

1D

Areas

2D

3D mark: Volume, but rarely used

Source: Tamara Munzner. Visualization Analysis and Design (2014).

Marks and Channels

Marks - Marks as Links

Actions of Data Visualization
Target of Data Visualization
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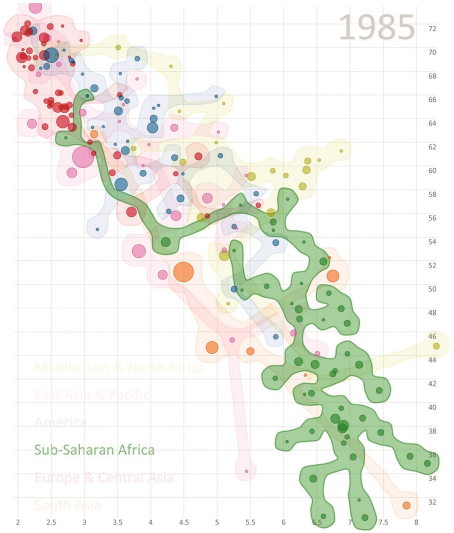
Containment



Source: vialab.science.uoit.ca/portfolio/bubblesets

Connection

Source: https://observablehq.com/@d3/force-directed-graph

Marks and Channels

Actions of Data Visualization
Target of Data Visualization
The Choice of Visualization Idioms
Marks and Channels
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User Experience and Organization

Channels

Marks: represent **items** or **links**
Channels (aka Visual Variable): change **appearance** based on **attribute**

- Position
  - Horizontal
  - Vertical
  - Both

- Color

- Size
  - Length

  - Area

  - Volume

- Shape

- Tilt

We will look at the rest of the steps later.

Source: Tamara Munzner. Visualization Analysis and Design (2014).

Reminders

- Practice is more important than theory! Look for more good or bad visualization examples!
- The deadline of Lab 2 is today, 11:59 PM PST.
- A few people do not form the final project group. You will not receive the point (1%) if you do not finish it by today.
- CoStar access.
- New anonymous suggestion box! https://freesuggestionbox.com/pub/qjyilmx

Thank you!

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RE 519 Real Estate Data Analysis and Visualization
Course Website: www.yuehaoyu.com/data-analytics-visualization/
Autumn 2025

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