CS2034B / DH2144B

Data Analytics: Principles and Tools

Week 10

Visualization

Visualization

Case Study: Measles in Canada

- The Government of Canada collects data on the spread of a number of diseases and conditions and provides this data to the public and researchers in weekly reports.
- We will take a look at a few different ways this data has been presented for measles and rubella.
- I will show 5 different summaries and visualizations used in these reports.

Case Study: Measles in Canada

Key Points

- In Canada, eleven new cases of measles and no new cases of rubella were reported in week 8, 2019.
- Currently, there are twelve active cases of measles in Canada.
- Nineteen (19) cases of measles and no cases of rubella have been reported in Canada in 2019. These cases were reported by Québec, British Columbia, and the Northwest Territories.
- Globally, there are large measles outbreaks which have affected a large number of countries. Canadians travelling outside of Canada are invited to consult the travel health notices for more information.

Case Study: Measles in Canada

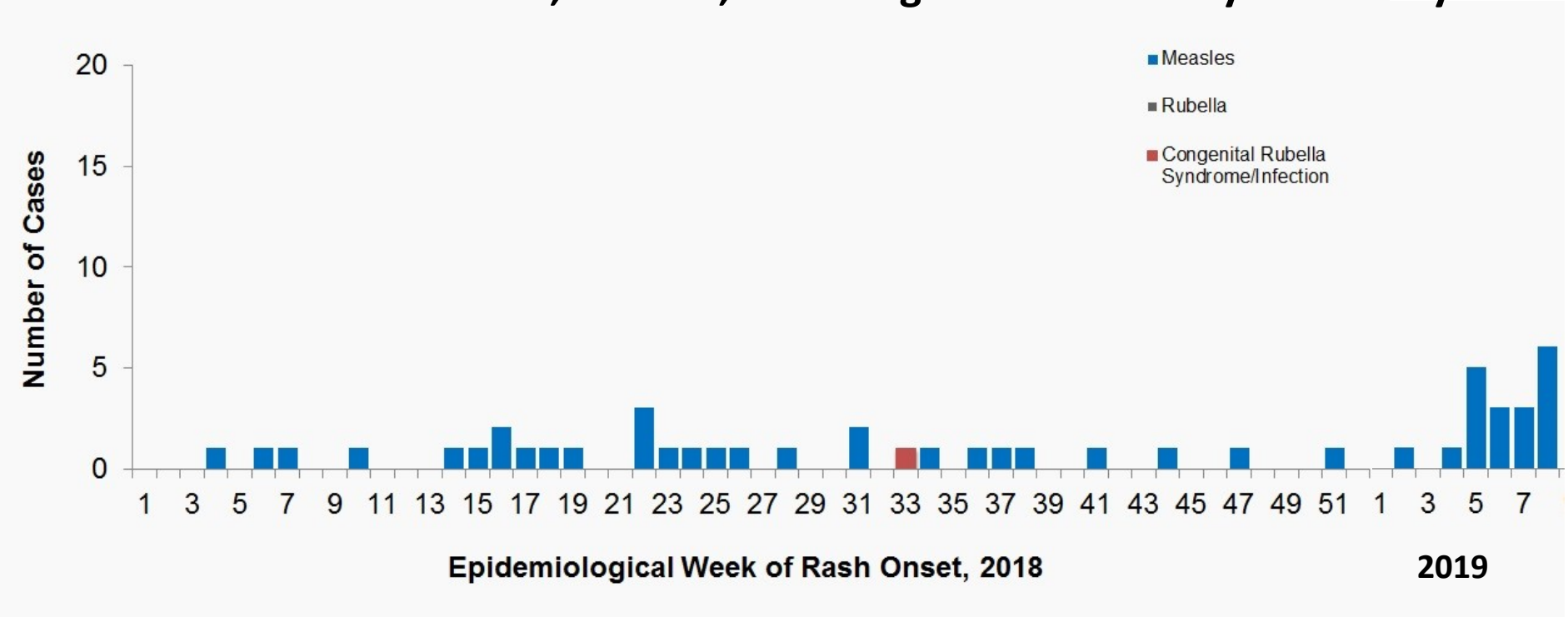
Epidemiological summary

During **epidemiological week 8, 2019** eleven new laboratory-confirmed cases of measles and no new cases of rubella were reported in Canada. Nine cases were reported by the province of British Columbia: seven cases were related to the outbreak among the French language schools; one case was exposed in Canada to an unknown source; and one case was in a traveller returning from the Philippines. One case was reported by the Northwest Territories in a traveller returning from the Philippines. The last case was reported by the province of Québec and may have been exposed in Canada to an unknown source or while travelling to France.

To date in 2019, nineteen cases of measles and no cases of rubella have been reported. The last case of rubella was reported in 2016 and the last case of congenital rubella syndrome/infection was reported in September 2018.

Case Study: Measles in Canada

Number of Cases of Measles, Rubella, and Congenital Rubella Syndrome by Week



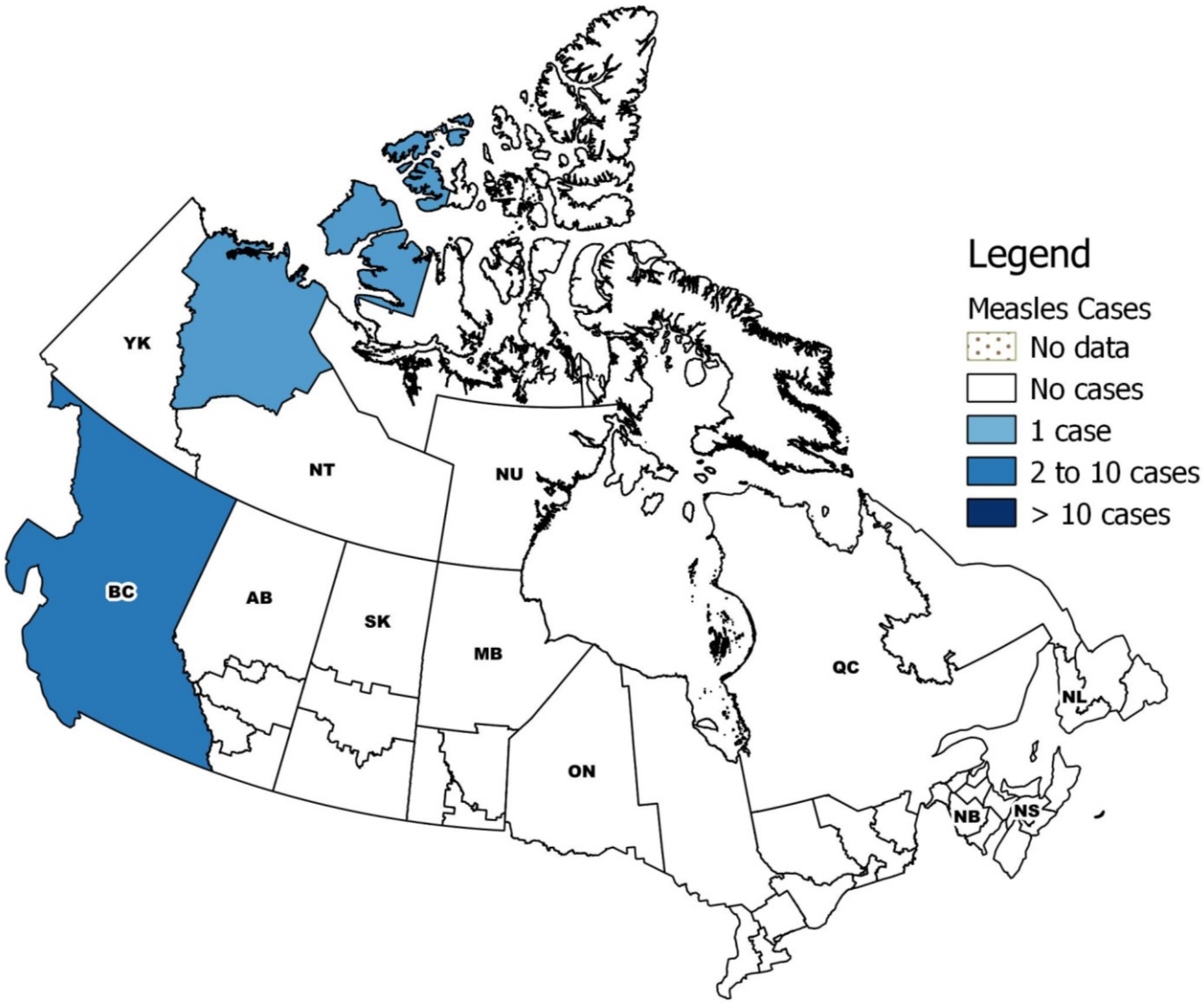
Week of Rash Onset, 2018	Number of measles cases	Number of rubella cases	Number of congenital rubella syndrome/infection cases
1	0	0	0
2	0	0	0
3	0	0	0
4	1	0	0
5	0	0	0
6	1	0	0
7	1	0	0
8	0	0	0
9	0	0	0
10	1	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	1	0	0
15	1	0	0
16	2	0	0
17	1	0	0
18	1	0	0
19	1	0	0
20	0	0	0
21	0	0	0
22	3	0	0
23	1	0	0
24	1	0	0
25	1	0	0
26	1	0	0
27	0	0	0
28	1	0	0
29	0	0	0
30	0	0	0
31	2	0	0

Week of Rash Onset, 2019	Number of measles cases	Number of rubella cases	Number of congenital rubella syndrome/infection cases
1	0	0	0
2	0	0	0
3	0	0	0
4	1	0	0
5	0	0	0
6	1	0	0
7	1	0	0
8	0	0	0
Total Cases (2019 to date)	**19**	**0**	**0**

Case Study: Measles in Canada

Case Study: Measles in Canada

Geographic Distribution of Currently Active Cases of Measles



Case Study: Measles in Canada

- Some questions to think about
  - Which representations did the best job of quickly conveying the data?
  - Which representations would be most useful for obtaining exact figures for further analysis?
  - Which representations are ideal for conveying a message to a general audience with little background in the subject?
  - What other advantages/disadvantages did you notice between these representations?

Visual Perception & Cognition

- It has been estimated that almost **50% of your brain is involved in visual processing** and **70% of all your sensory receptors are in your eyes** [*1*].
- Visualizations and visual representations allow us to **maximize cognition** of information by enabling visual processing.

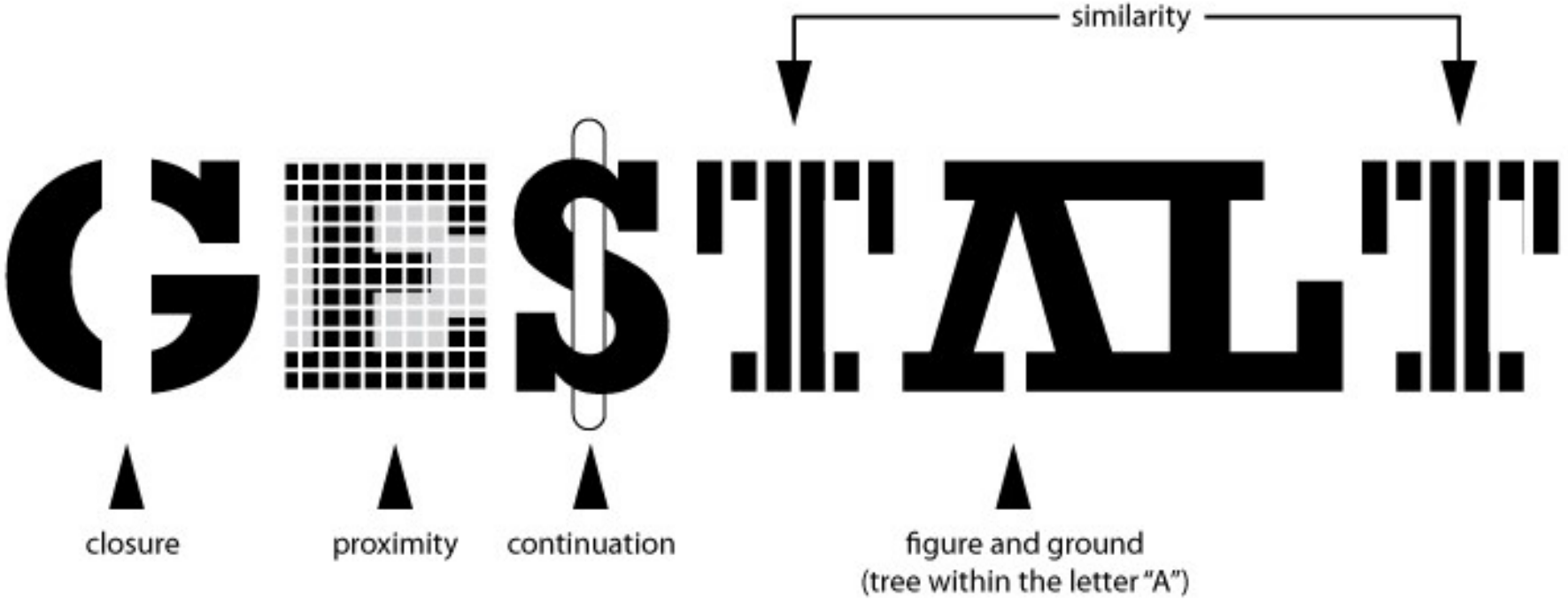
[1] Merieb, E. N. & Hoehn, K. (2007). Human Anatomy & Physiology 7th Edition, Pearson International Edition.

Visual Perception & Cognition

Visualizations help us:

- Communicate information **clearly** and **effectively**.
- Tell the *"story"* of the data.
- Illustrate relations, discover trends, patterns and outliers.
- Get and keep the attention of viewers.
- **Bring out** or **obscure** the main points.

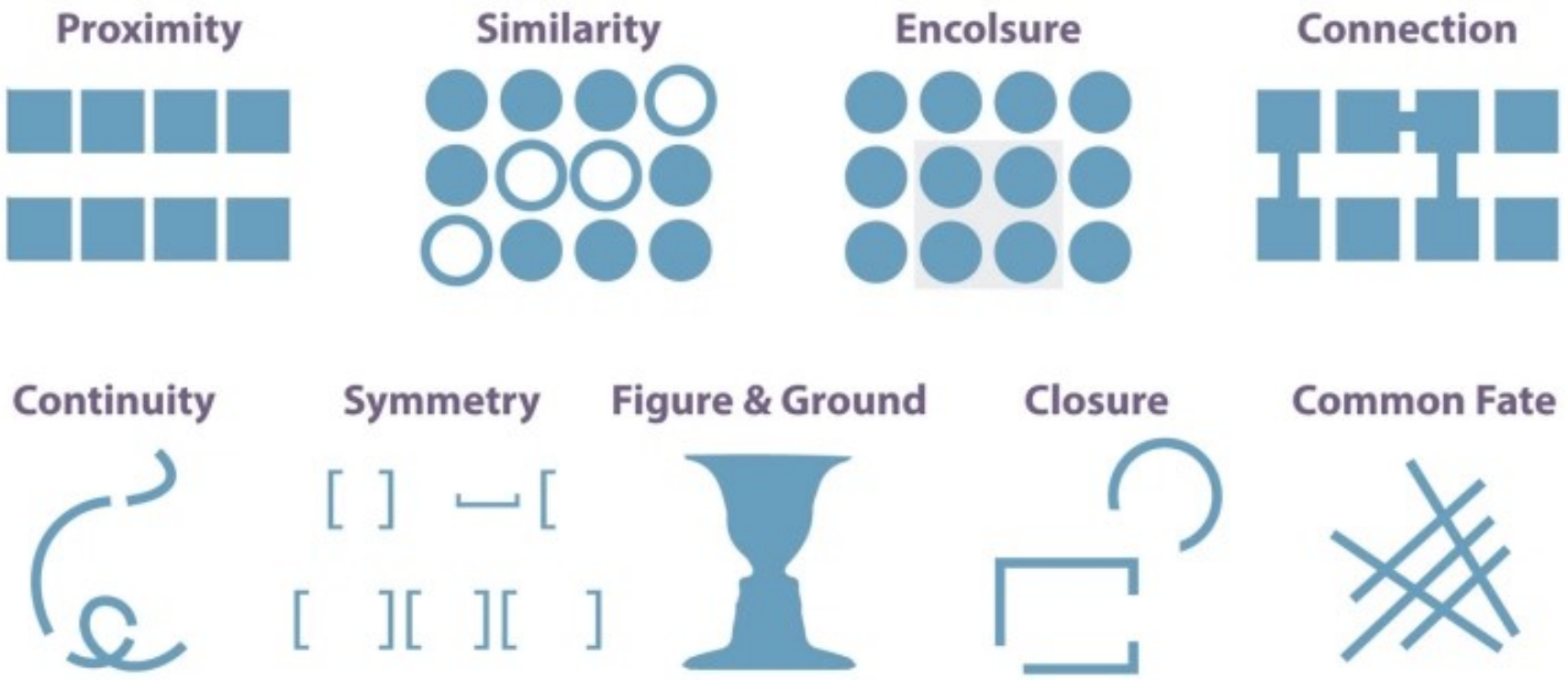
Gestalt Principles



Gestalt Principles

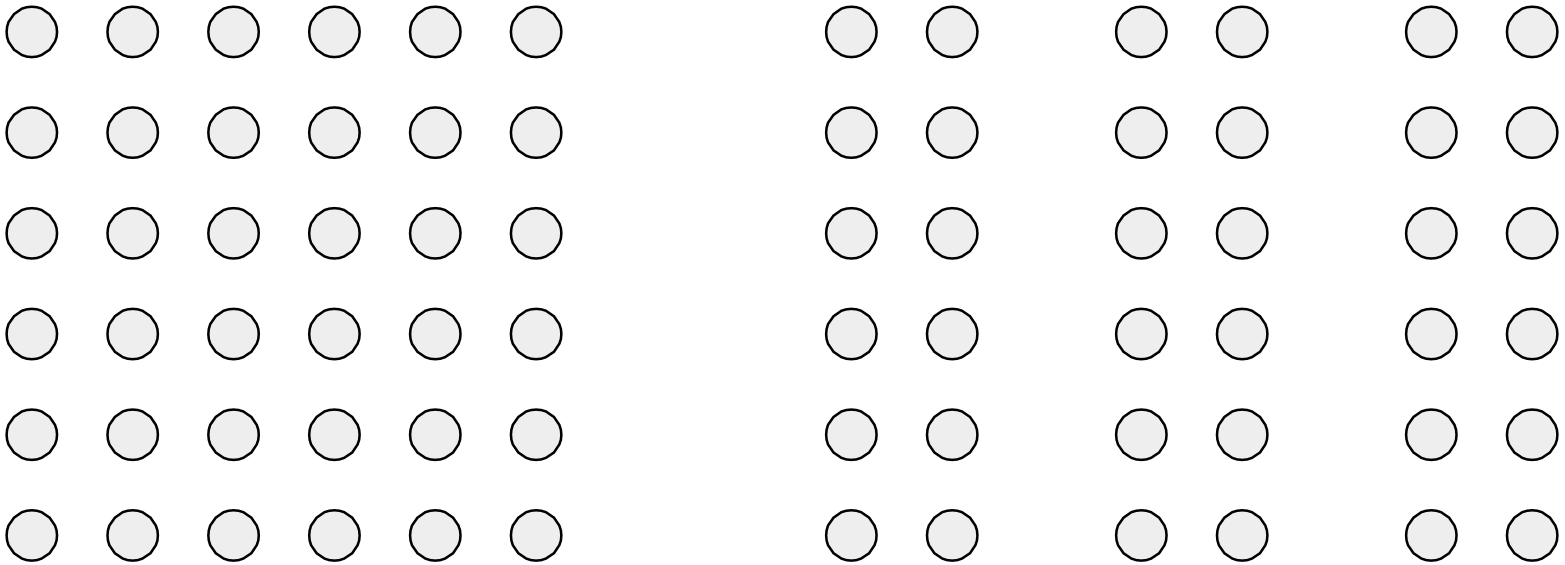
- Observations about visual perceptions arising from 1920s' psychology.
- Set of laws that describe how humans see and group objects visually.
- Used as best practices for visual design.

Gestalt Principles

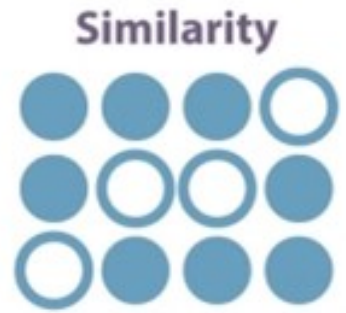


Gestalt Principles

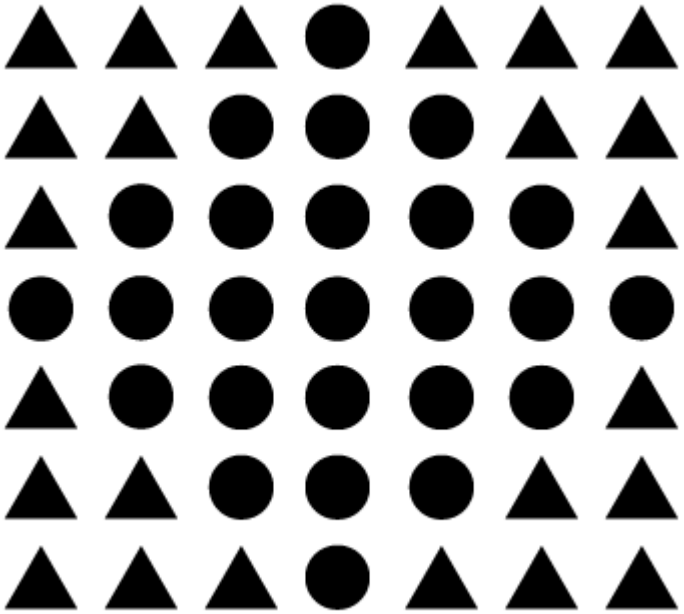
The principle of **proximity** states that **things that are close together appear to be more related than things that are spaced further apart**.



Gestalt Principles



The principle of **similarity** states that **when things appear to be similar to each other we group them together. We also tend to think they have the same function.**



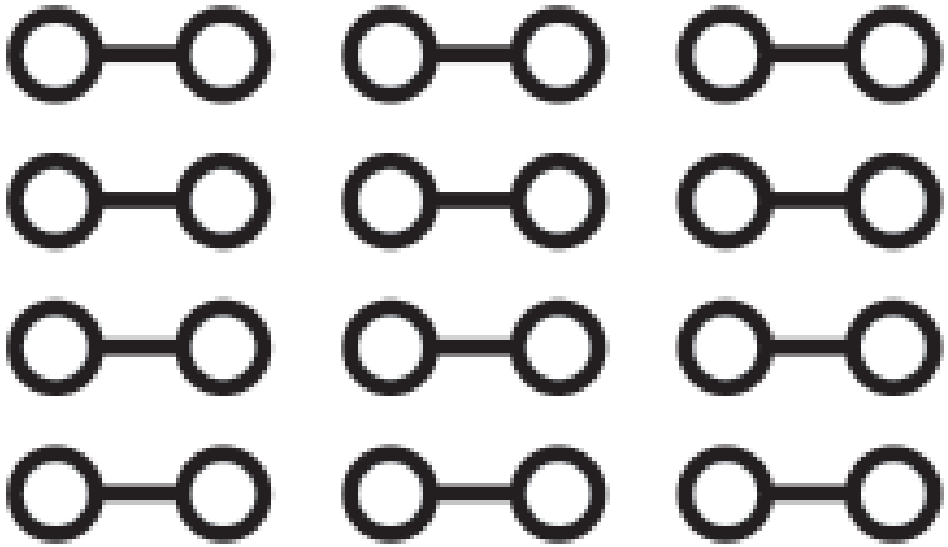
Gestalt Principles

The principle of **enclosure** states that **when objects are located within the same closed region, we perceive them as being grouped together.**

Also know as Common Region

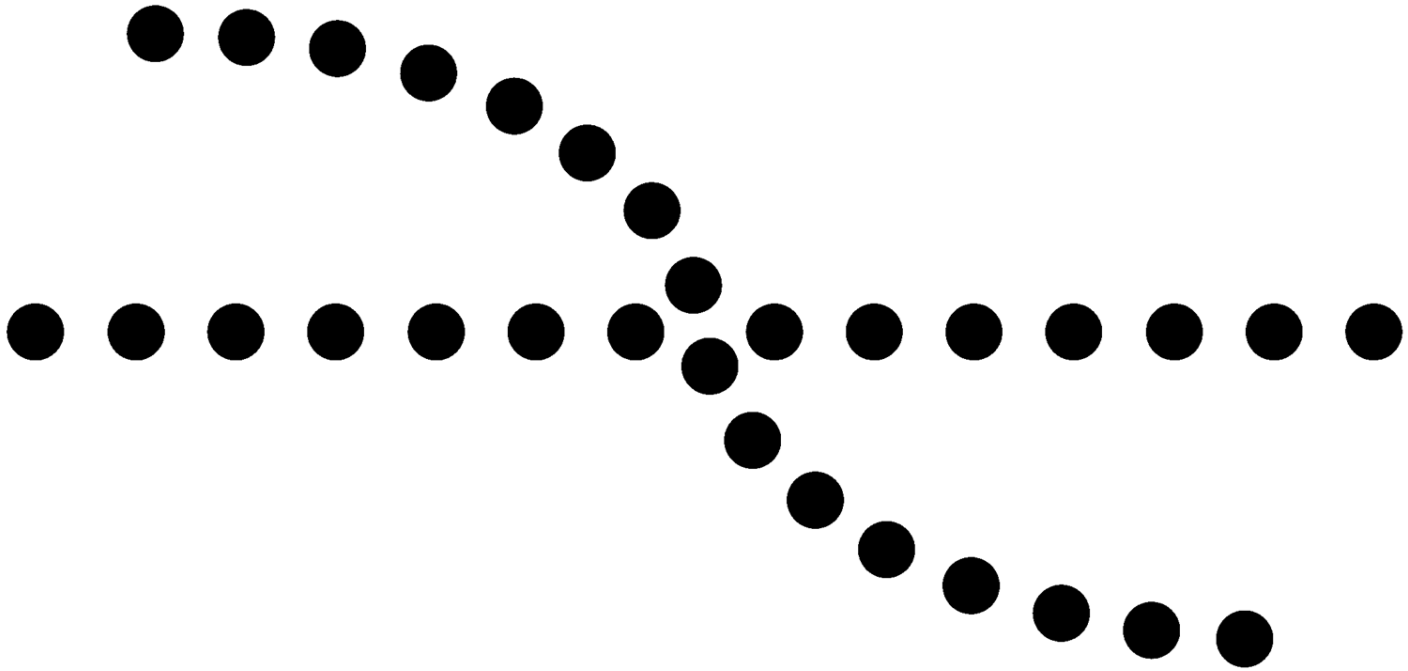
Gestalt Principles

The principle of **connectedness** states that **elements that are visually connected are perceived as more related than elements with no connection.**



Gestalt Principles

The principle of **continuity** states that **elements that are arranged on a line or curve are perceived to be more related than elements not on the line or curve.**



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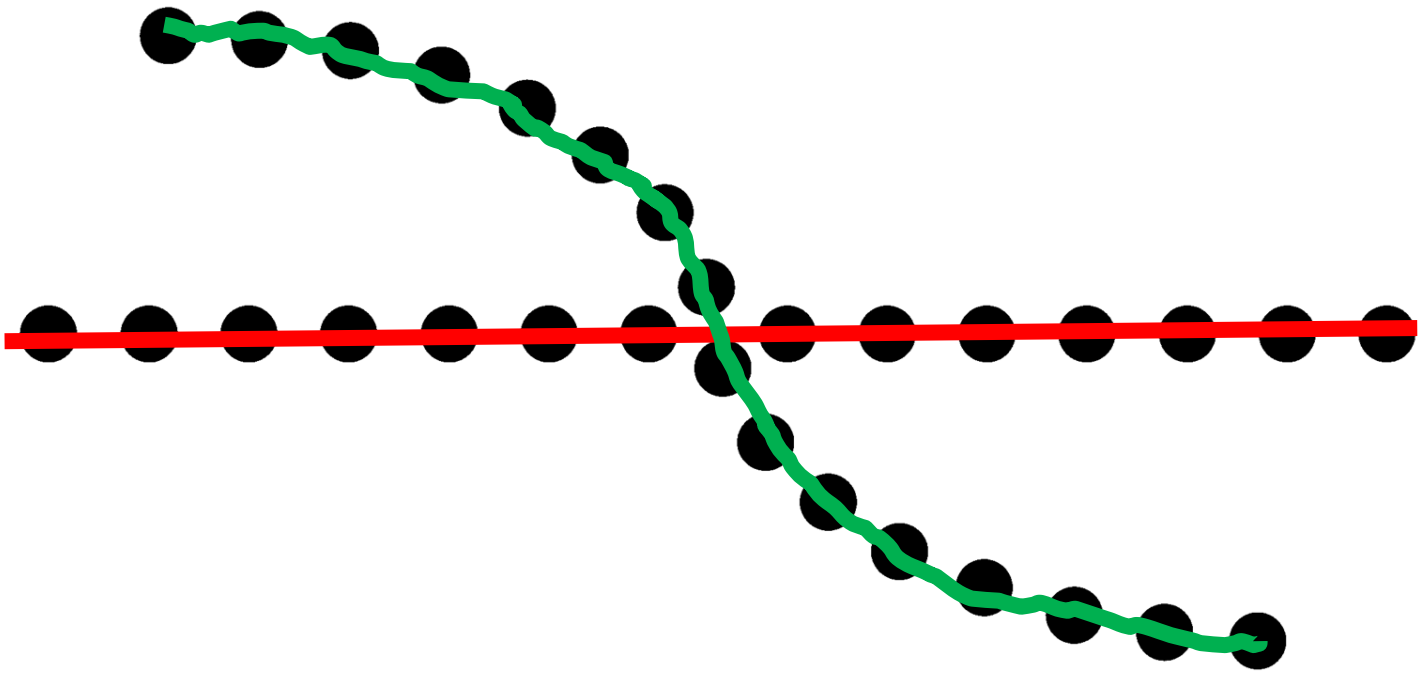
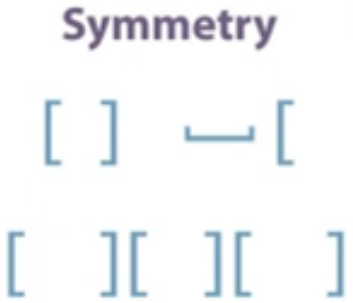
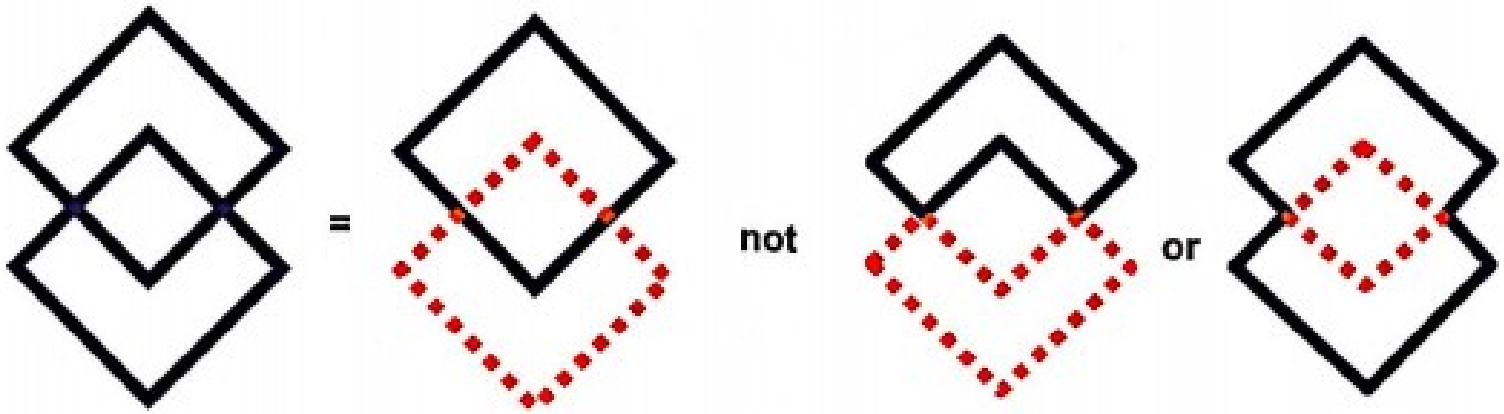


Gestalt Principles



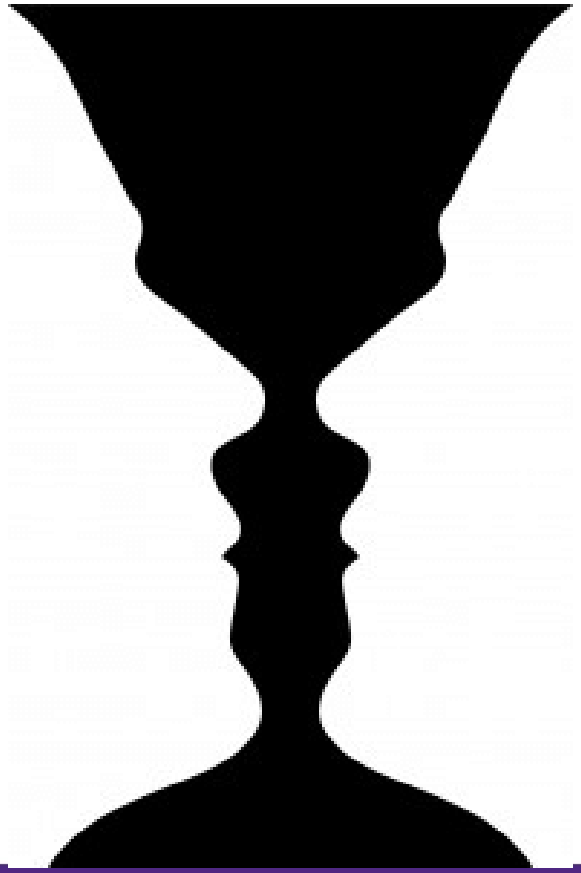
The principle of **symmetry** states that **we seek balance and order in designs, struggling to do so if they aren't readily apparent.**



Symmetry: the human visual system tries to resolve complex scenes into combinations of simple, symmetrical shapes.

Gestalt Principles

The **figure & ground** principle states that **people instinctively perceive objects as either being in the foreground or the background.**



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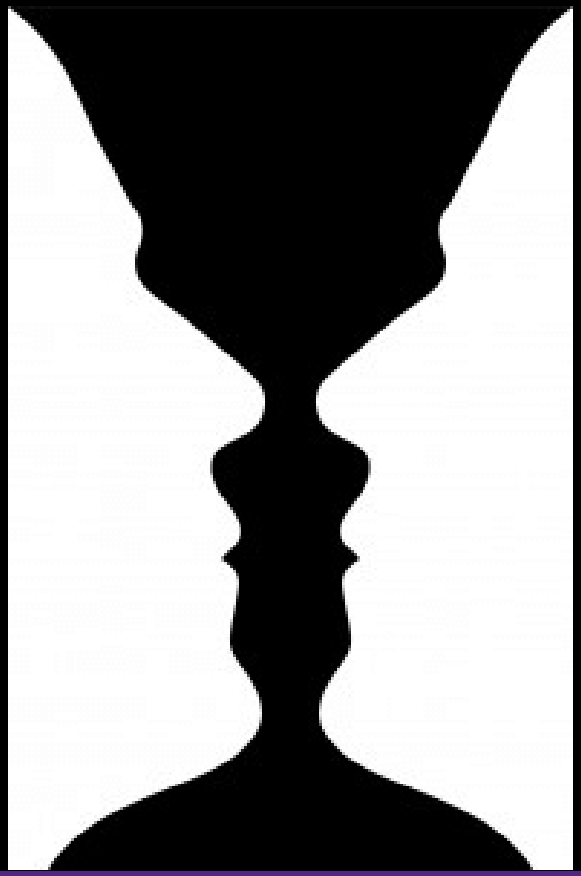
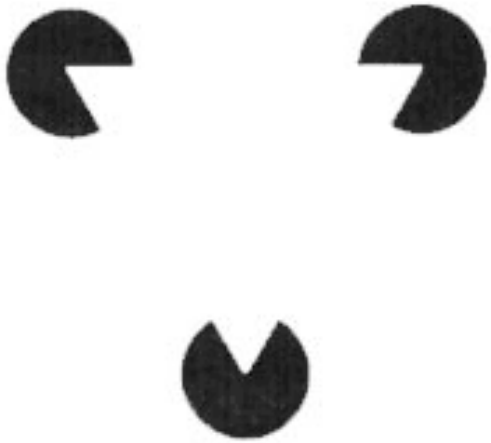


Gestalt Principles

The principle of **closure** states that **when we look at a complex arrangement of visual elements, we tend to look for a single, recognizable pattern.**



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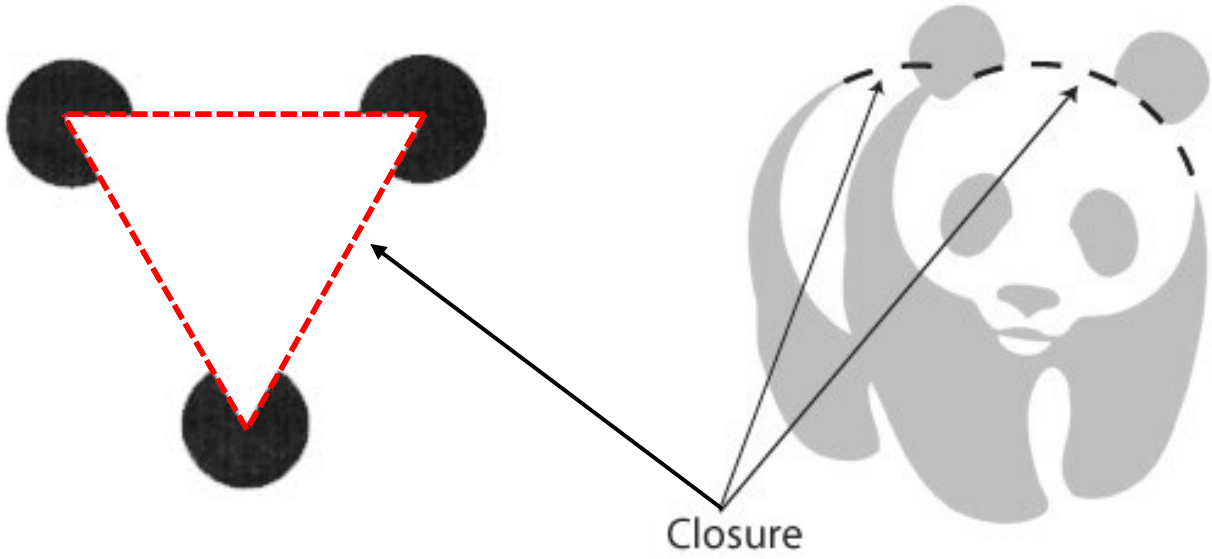

Gestalt Principles

Common Fate

The principle of **common fate** states that **objects that move together are perceived as grouped or related.**

Gestalt Principles

Common Fate

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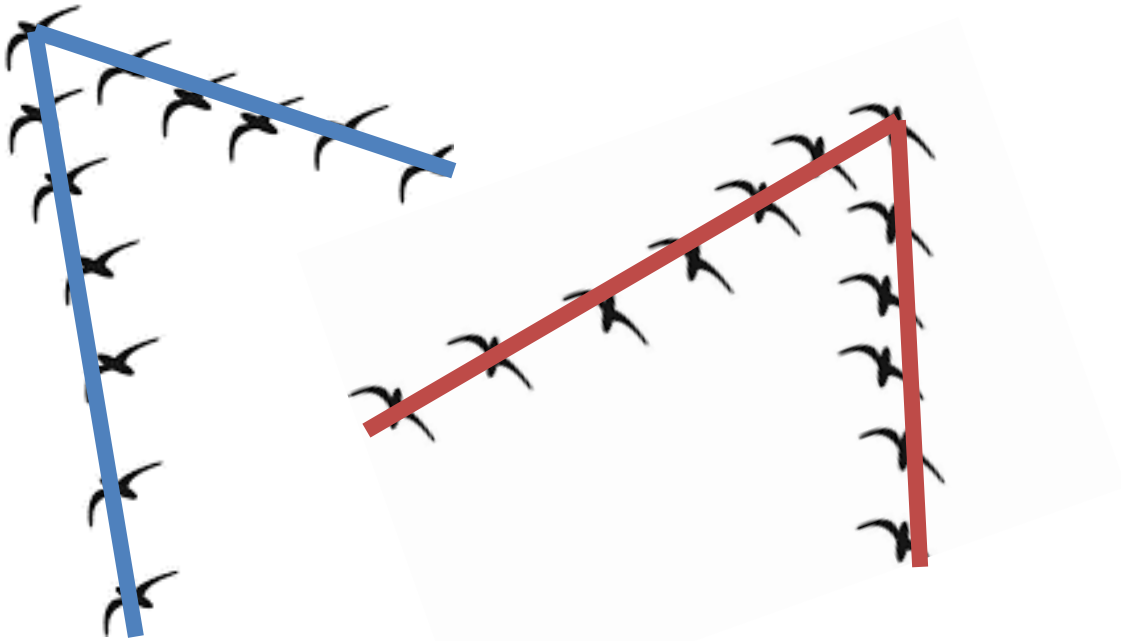

Types of Visualizations

- Dozens, if not hundreds more types.
- Use color, labels, spatial layout and other Gestalt Principles to help convey information.

Types of Visualizations

Visualizations can be categorized into a number of groups by the feature or point of the data they **bring out**.

Numerical values

- As lengths (1D)
- As areas (2D)
- As volumes (3D in 2D)

Relationships

- By connecting lines
- By proximity
- By hierarchy

Based on characteristics of the data being emphasized

- Geography/maps
- Graphs, Trees and Networks
- Plots and Charts
- Glyphs and Multidimensional Icons
- Enclosure Diagrams

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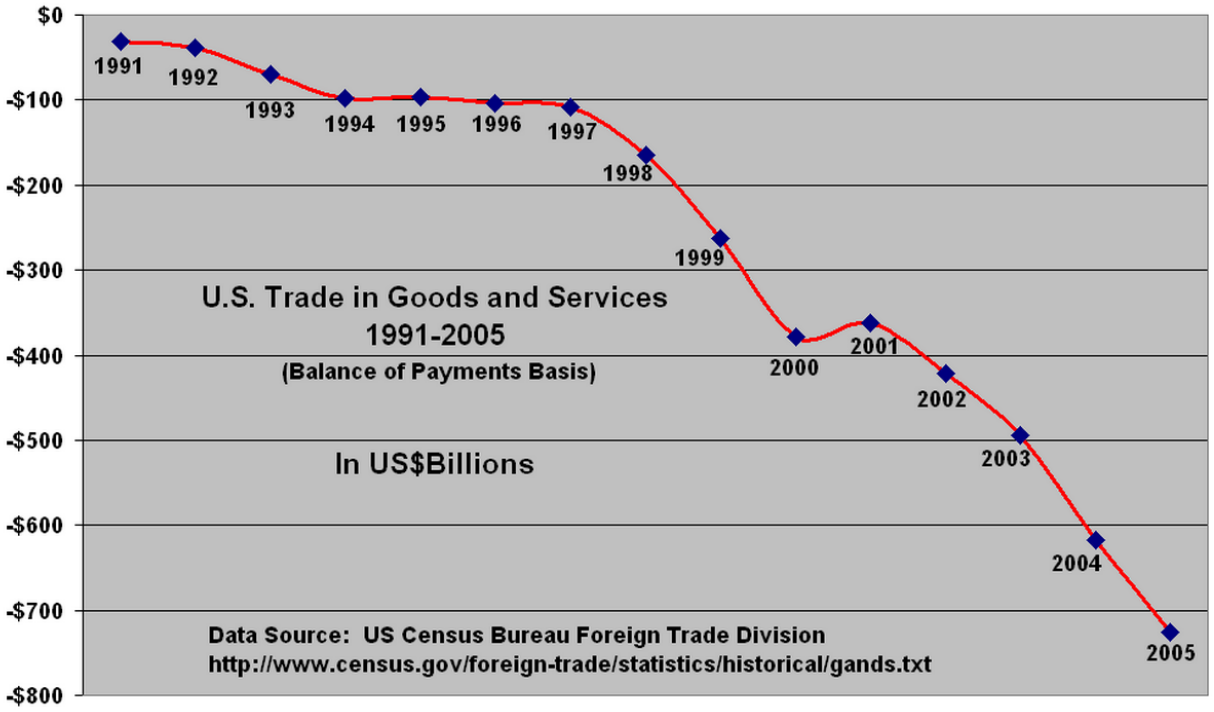
Visualizations Showing Numbers

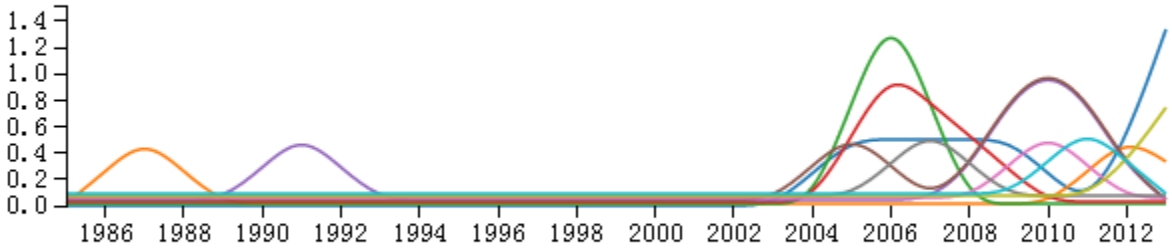
Line Graph



Visualizations Showing Numbers

Multi-Line Graph

Publication Statistics Line Chart:

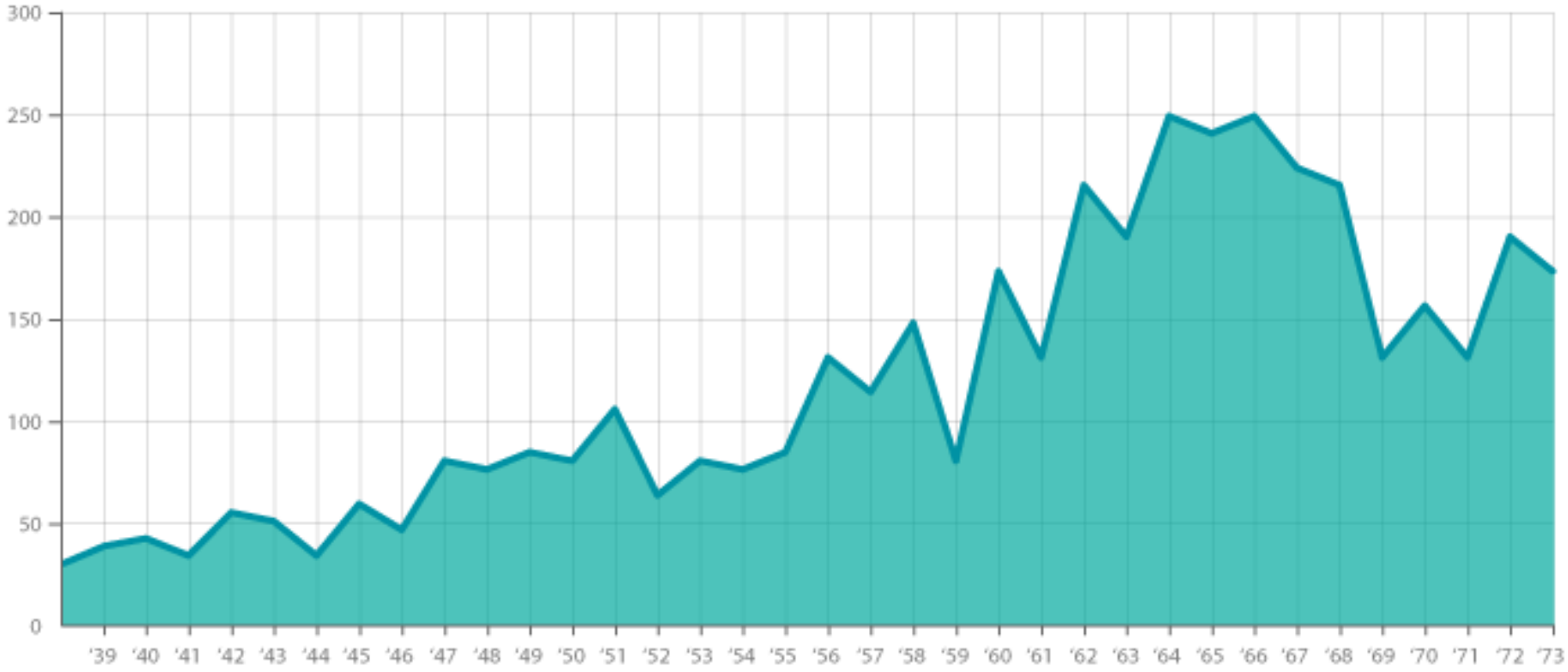


Key Terms:

All
handwritten mathematical symbol
mathematical computation
symbolic computation software
symbolic polynomial
international symposium
scientific computing
handwritten mathematical character
hybrid mathematical symbol recognition
mathematical character recognition
mathematical collaboration

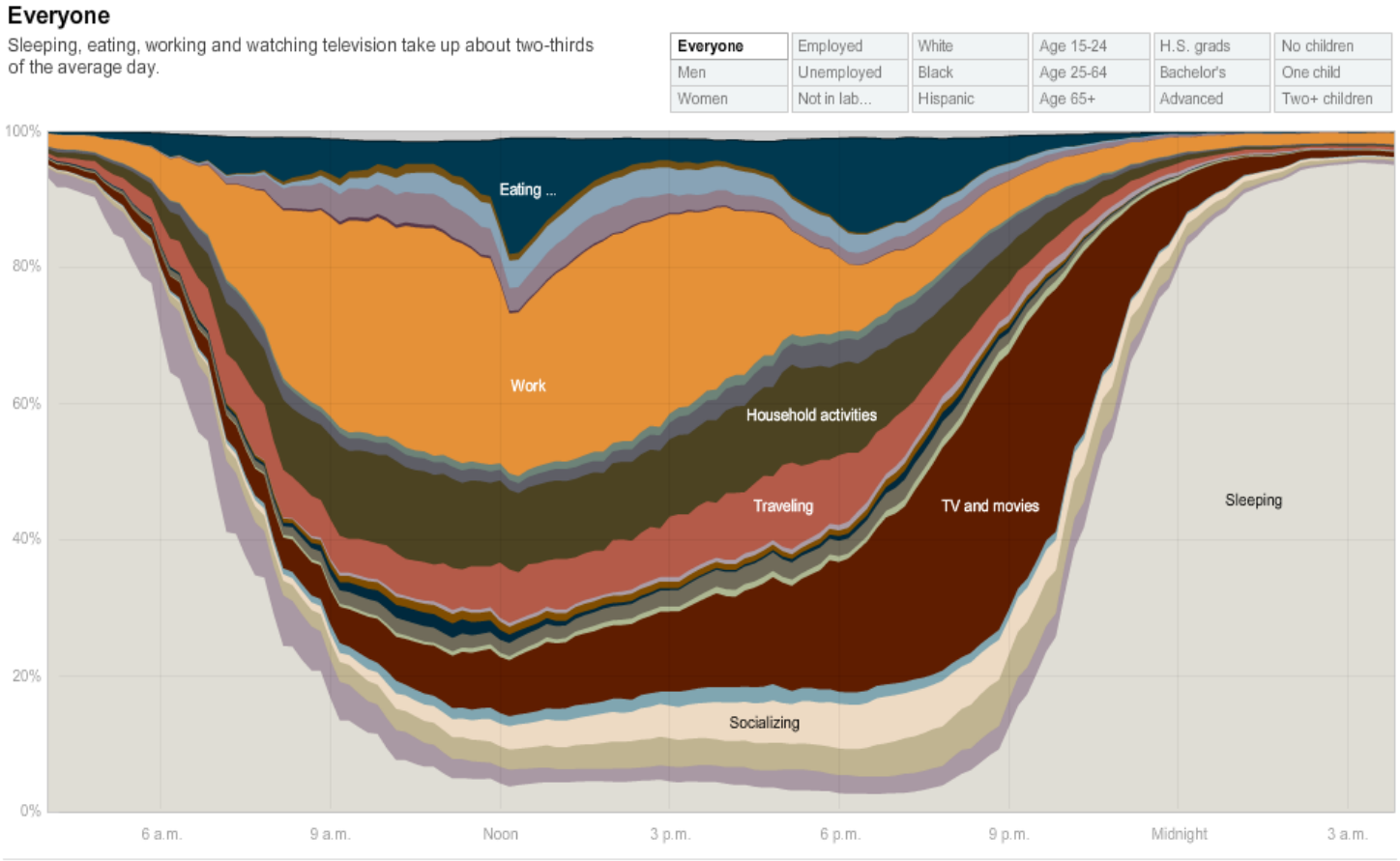
Visualizations Showing Numbers

Area Graph



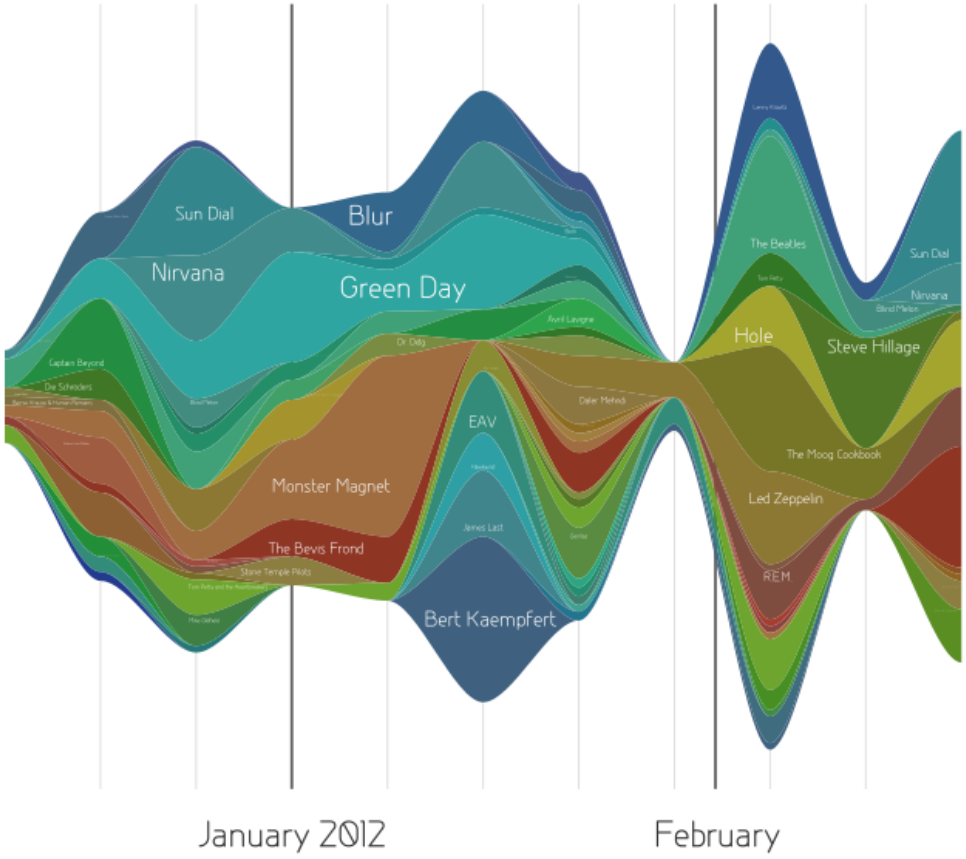
Visualizations Showing Numbers

Stacked Area Graph



Visualizations Showing Numbers

Stream Graph



Visualizations Showing Numbers

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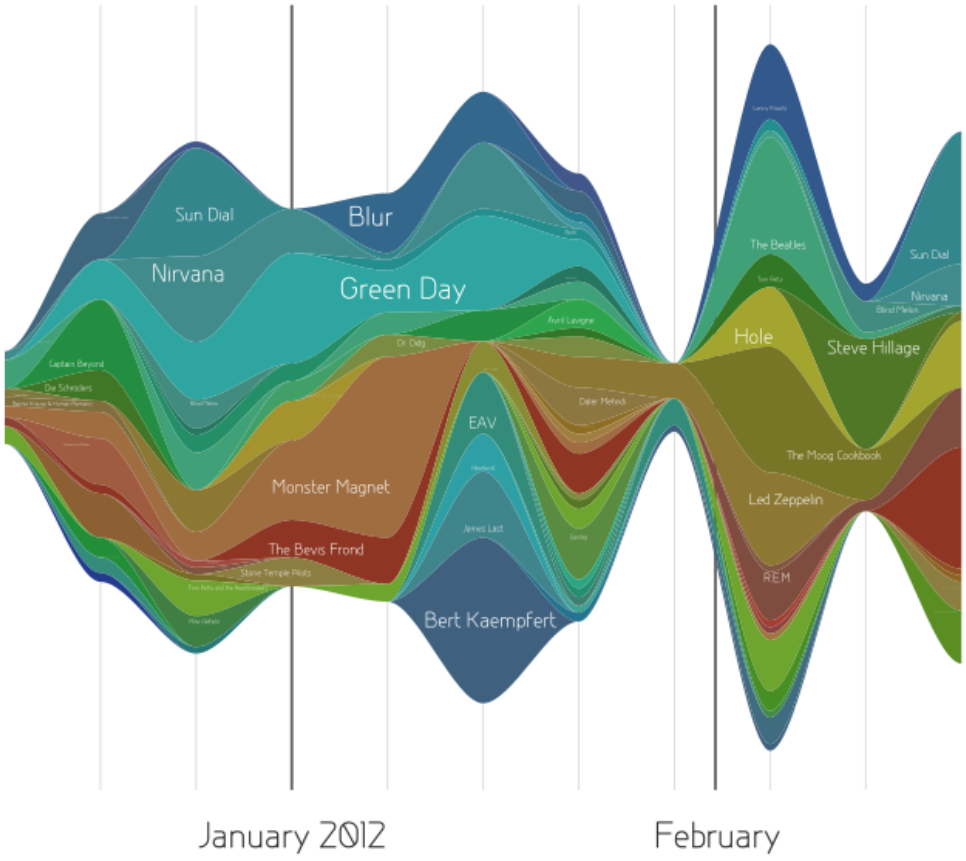
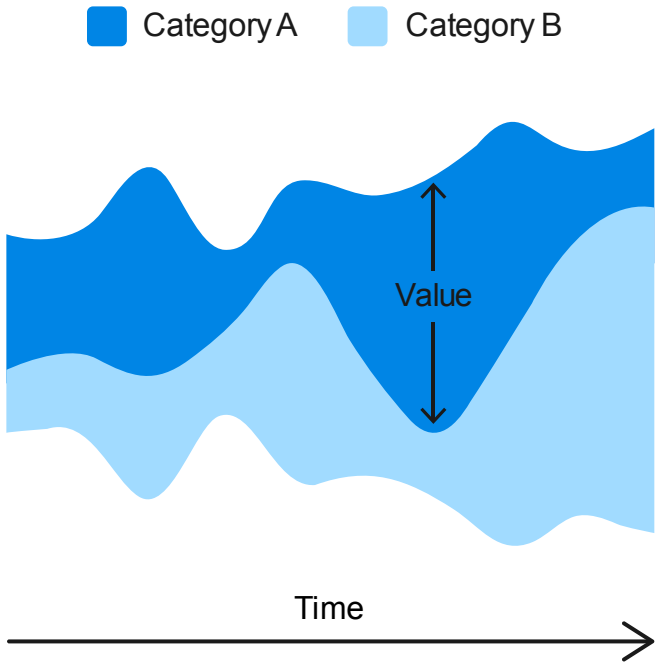
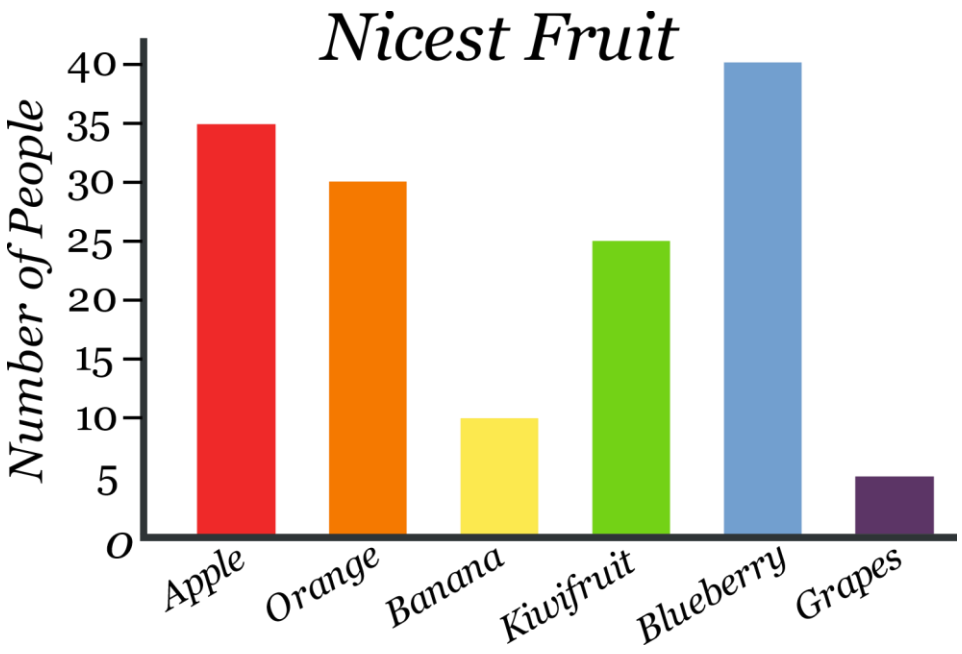


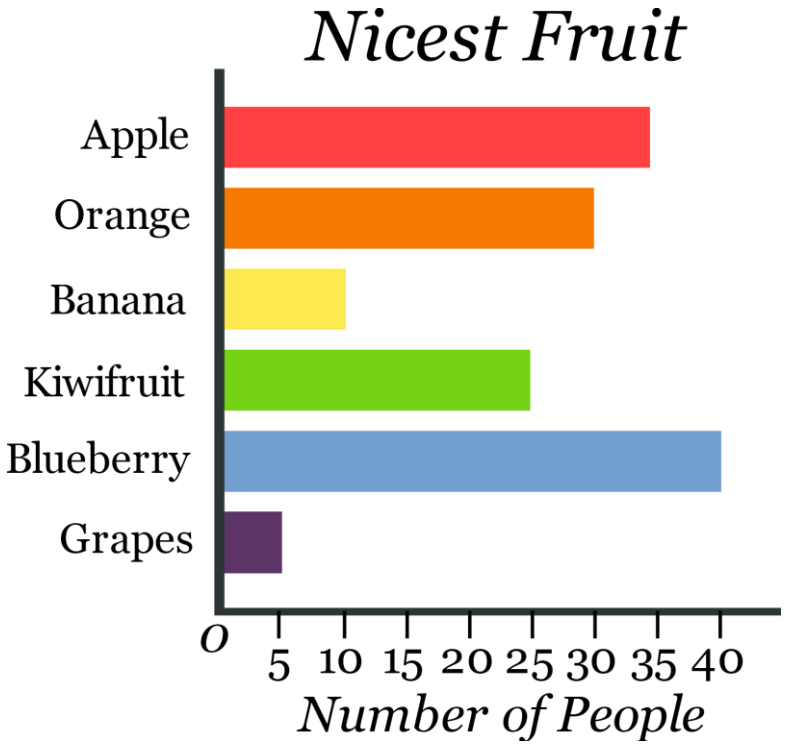


Visualizations Showing Numbers

Bar Graph



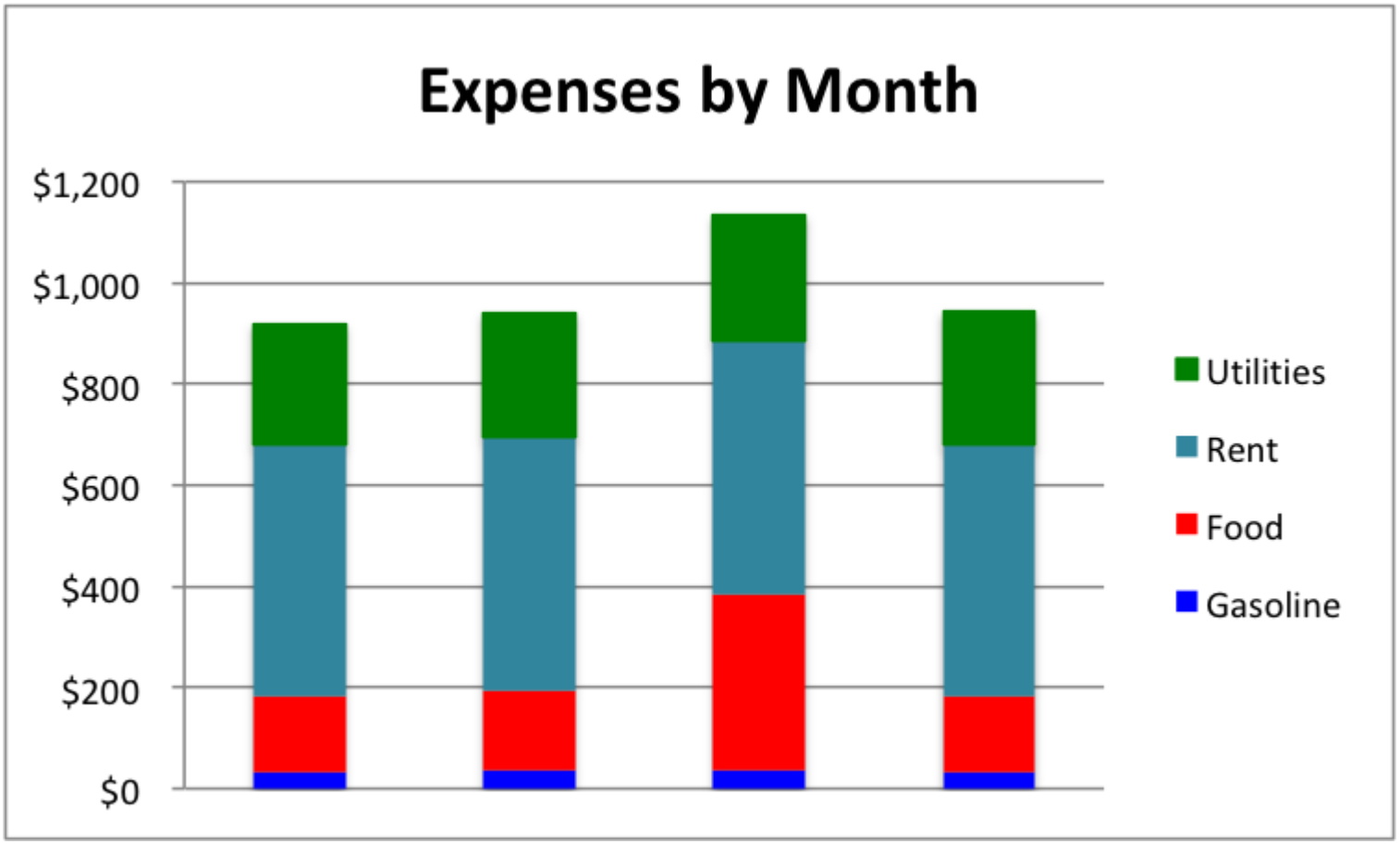
Vertical



Horizontal

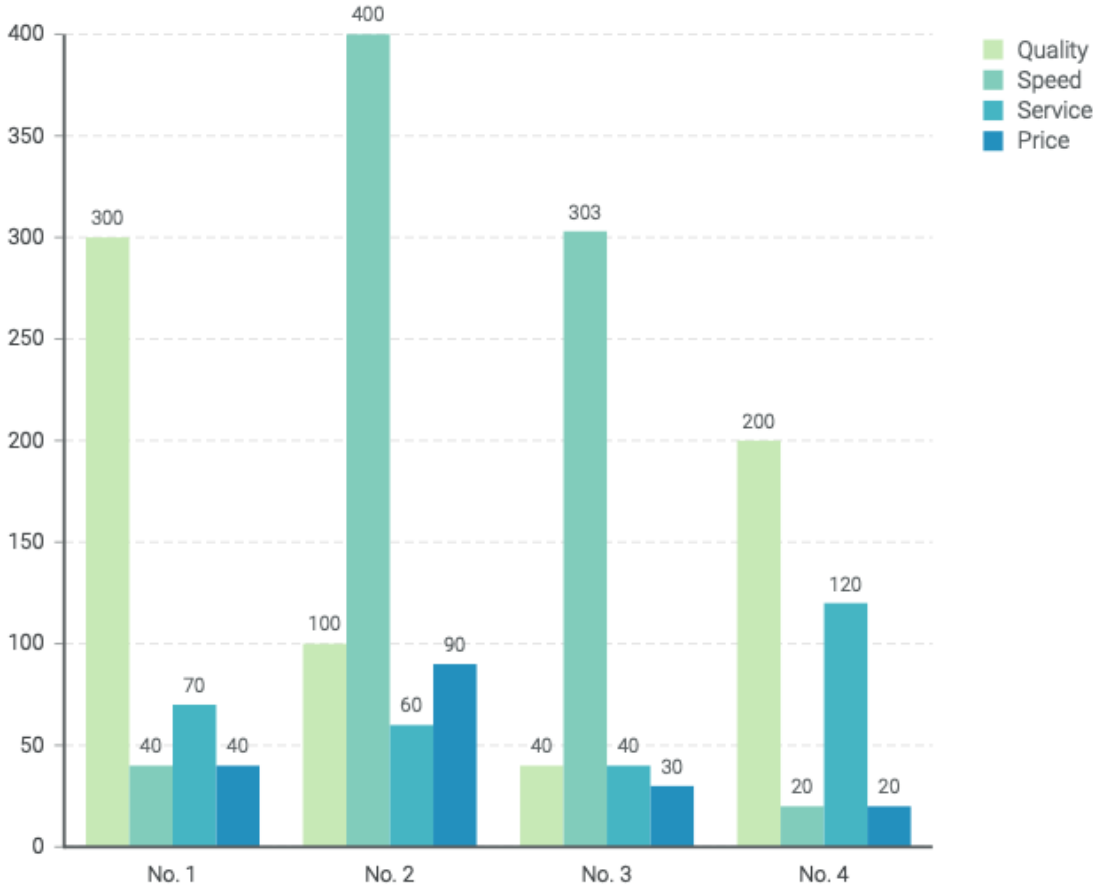
Visualizations Showing Numbers

Stacked Bar Graph



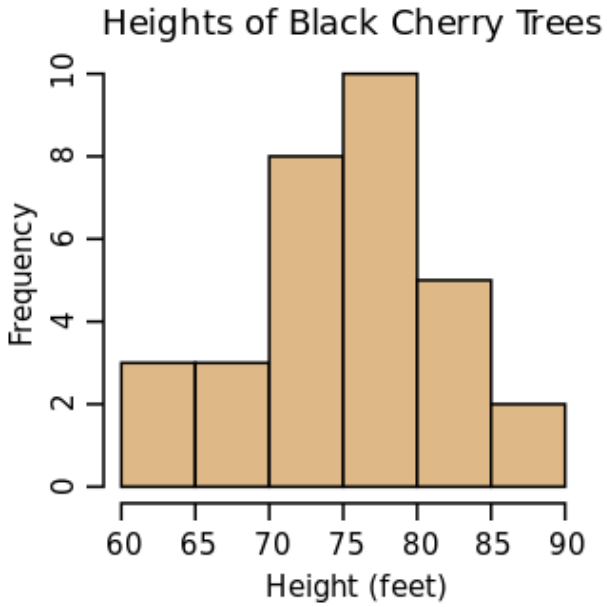
Visualizations Showing Numbers

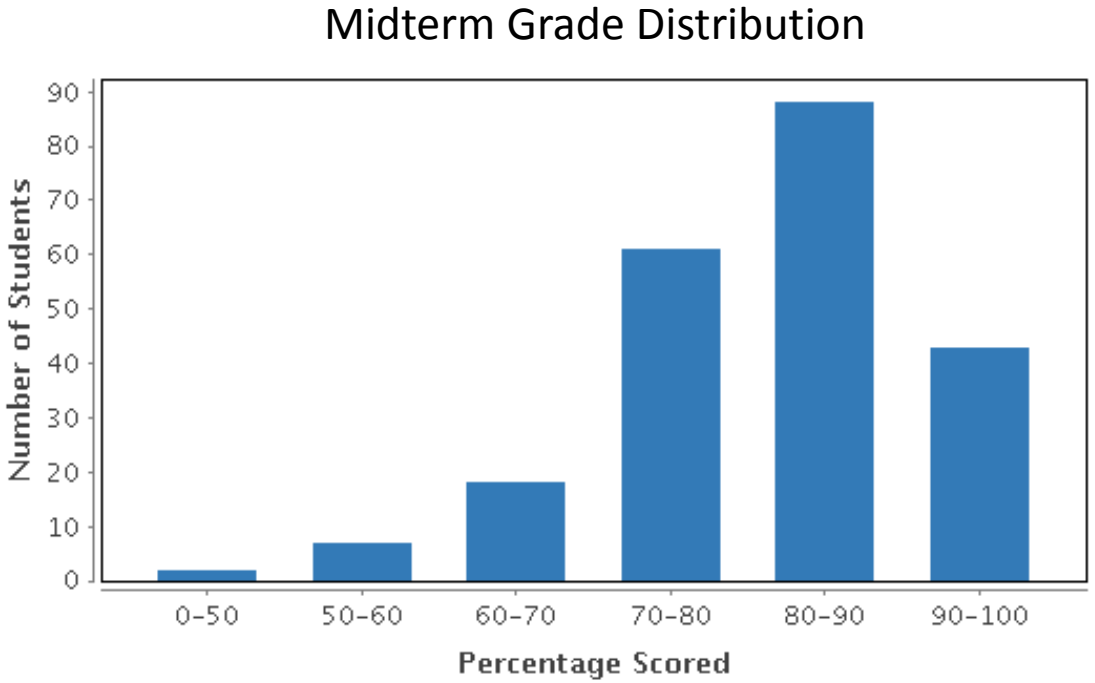
Multi-set Bar Graph



Visualizations Showing Numbers

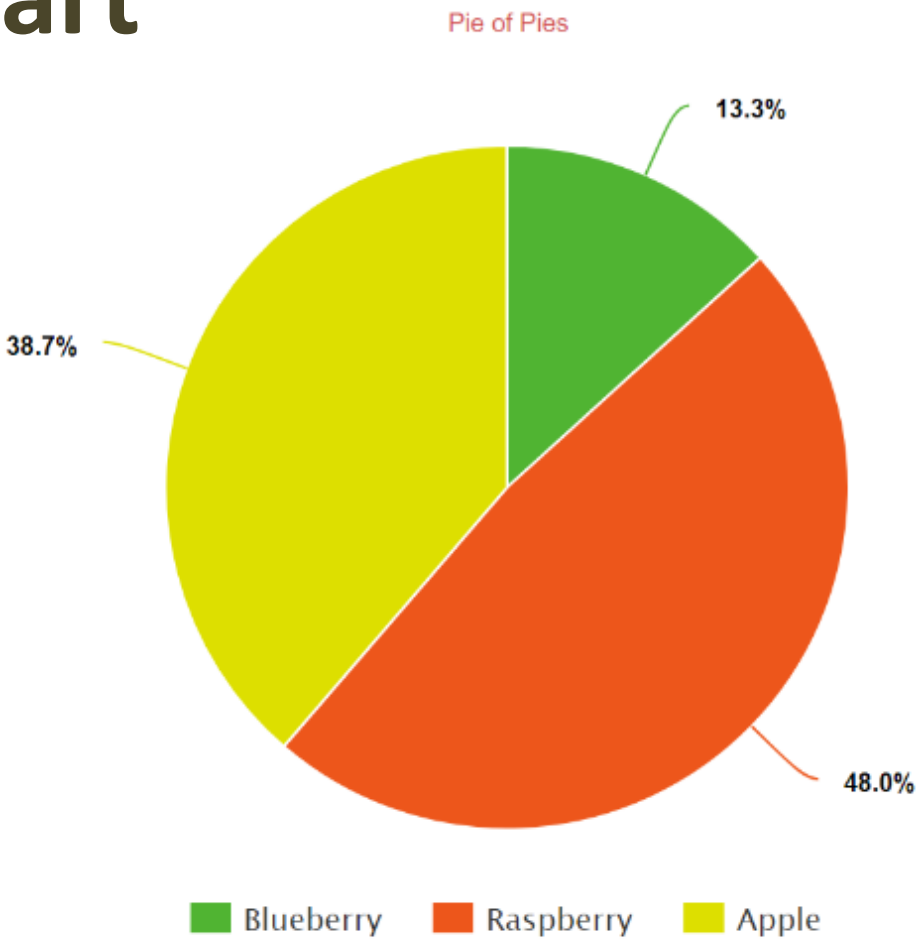
Histograms





Visualizations Showing Numbers

Pie Chart



Visualizations Showing Numbers

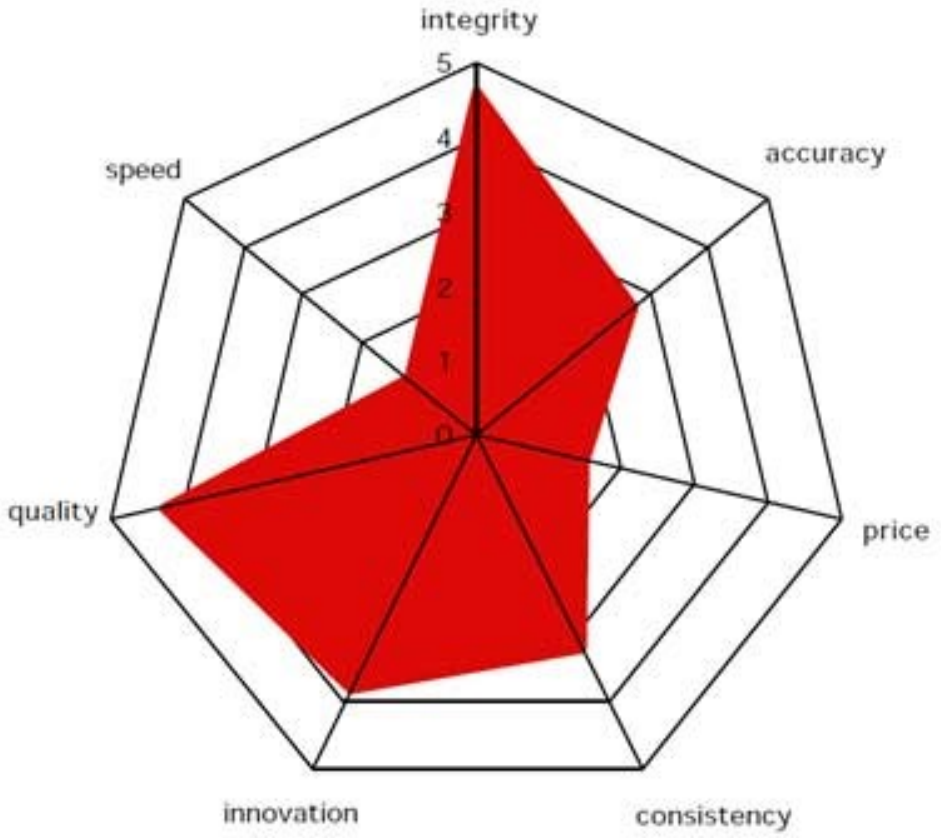
Pie Chart

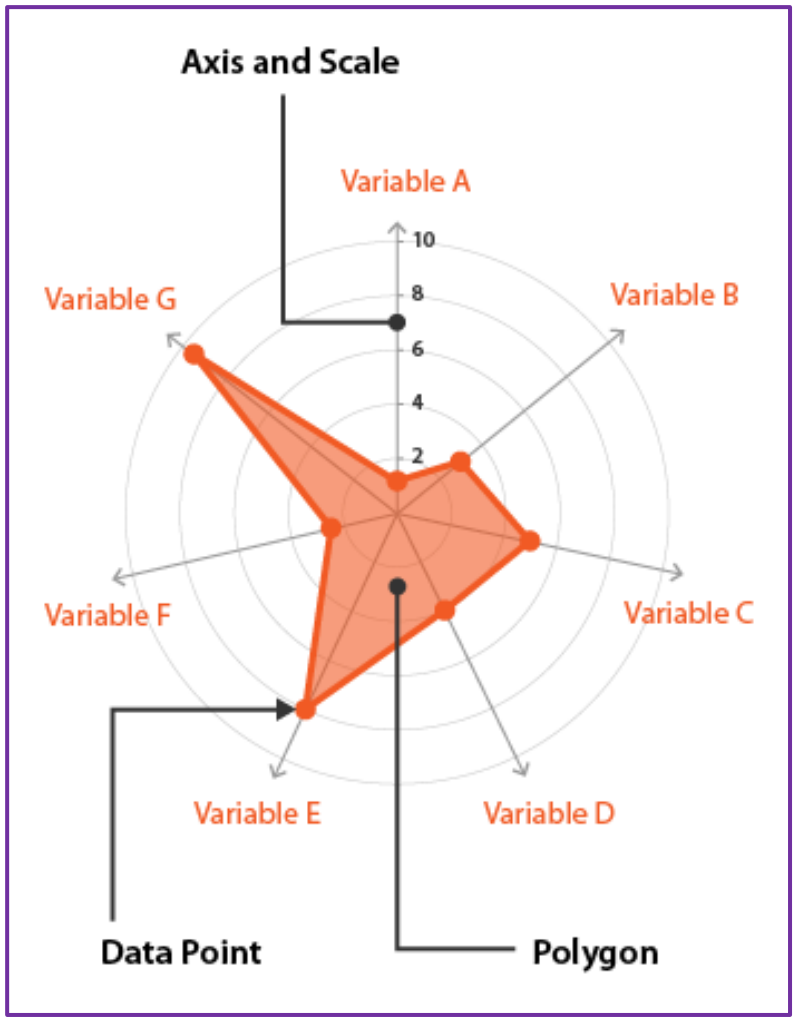
Major Downsides

- Cannot show more than a few values.
- Take up more space than their alternatives.
- Not great for making accurate comparisons between groups of Pie Charts.
- Legends and Labels are Hard to Align and Read.
- 3D and stylized pie charts can add distortions and errors.

Visualizations Showing Numbers

Radar Chart





Types of Visualizations

- Many, many, many more types and combinations.
- You can explore more types with the following resources:
  - The Data Visualisation Catalogue (https://datavizcatalogue.com/)
  - RAWGraphs (https://old.rawgraphs.io/)

Types of Visualizations

- The Data Visualisation Catalogue (https://datavizcatalogue.com/)
  - Take a look at the following Visualizations:
    - Tree Map
    - Heat Map
    - Choropleth
    - Dot Map
    - Bubble Map

Tools for Creating Visualizations

Excel

Many visualization options on insert tab.