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Outline

- What is Data Visualization?
- Why do we need Data Visualization?
- Goals of Data Visualization
- Characteristics of effective graphical displays
- Different Types of Data
- Gestalt Principles of Visual Perception

?

02:54

What is Data Visualization?

- Data visualization is a general term that describes any effort to help people understand the significance of data by placing it in a visual context.
- Patterns, trends and correlations that might go undetected in text-based data can be exposed and recognized easier with data visualization software.

Why Data Visualization?

- Did you know that 25% of your brain power is connected to visual stimulus, and 70% of our sensory receptors are in our eyes?
- No wonder we "get the picture" faster when presenting information visually

Why Data Visualization?

- A picture is worth 1000 words.
- A picture can also be worth 1000 data points.
  - In 1973, the statistician Francis Anscombe demonstrated the importance of graphing data.
  - The Anscombe's Quartet shows how four sets of data with identical simple summary statistics can vary considerably when graphed.

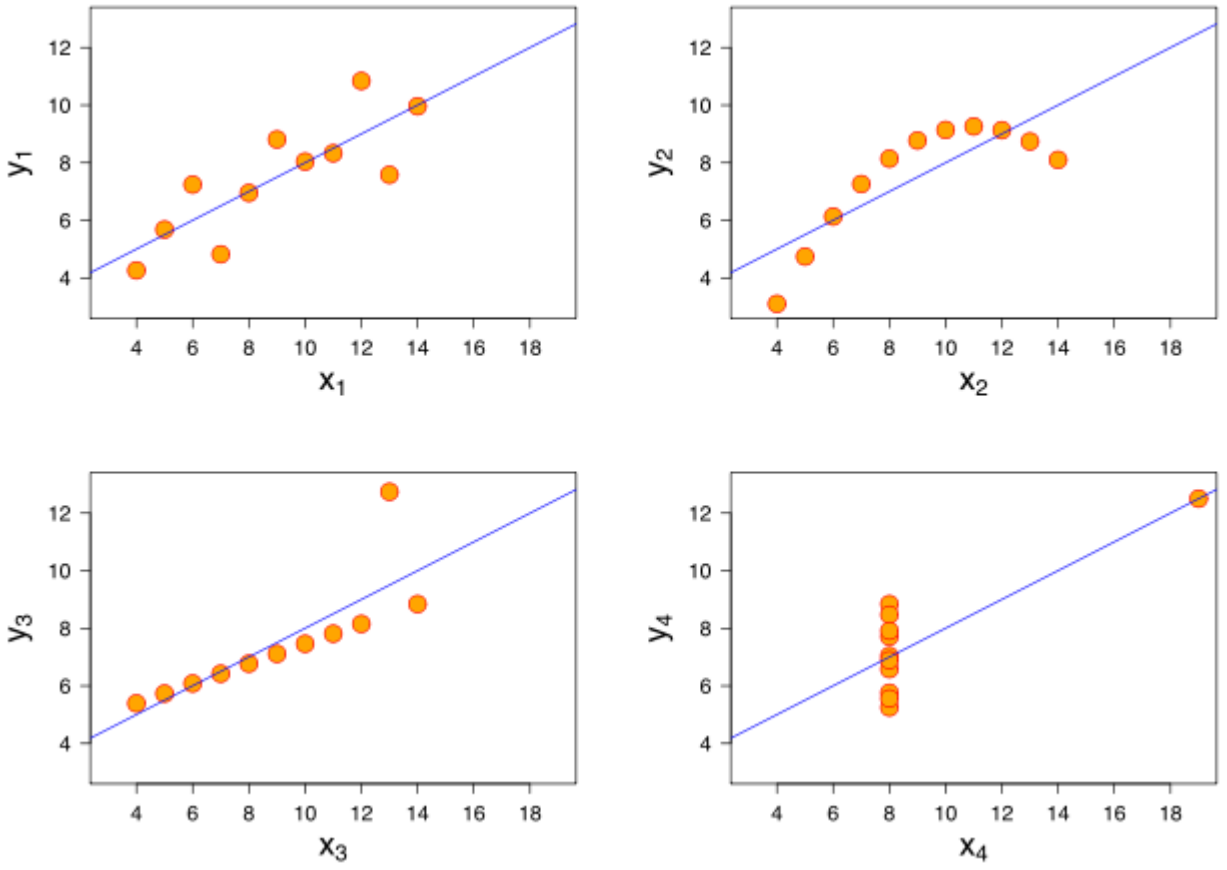
Why Data Visualization?

- Simple Summary Statistics of Anscombe's Quartet Data Table

Property	Value
Mean of x of each data set	9 (exact)
Variance of x in each data set	11 (exact)
Mean of y in each data set	7.50 (to 2 decimal places)
Variance of y in each data set	4.122 or 4.127 (to 3 decimal places)
Correlation between x and y in each data set	0.816 (to 3 decimal places)
Linear regression line for each data set	y = 3.00 + 0.500x (to 2 and 3 decimal places, respectively)

Why Data Visualization?

- Graph of Anscombe's Quartet Data Table



Goals of Data Visualization

- A primary goal of data visualization is to communicate information clearly and efficiently via statistical graphics, plots and information graphics.
- Numerical data may be encoded using dots, lines, or bars, to visually communicate a quantitative message.

Goals of Data Visualization

- Effective visualization helps users analyze and reason about data and evidence. It makes complex data more accessible, understandable and usable.
- Users may have particular analytical tasks, such as making comparisons or understanding causality, and the design principle of the graphic follows the task.
- Tables are generally used where users will look up a specific measurement, while charts of various types are used to show patterns or relationships in the data for one or more variables

Characteristics of effective graphical displays

- show the data
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production or something else
- avoid distorting what the data has to say
- present many numbers in a small space

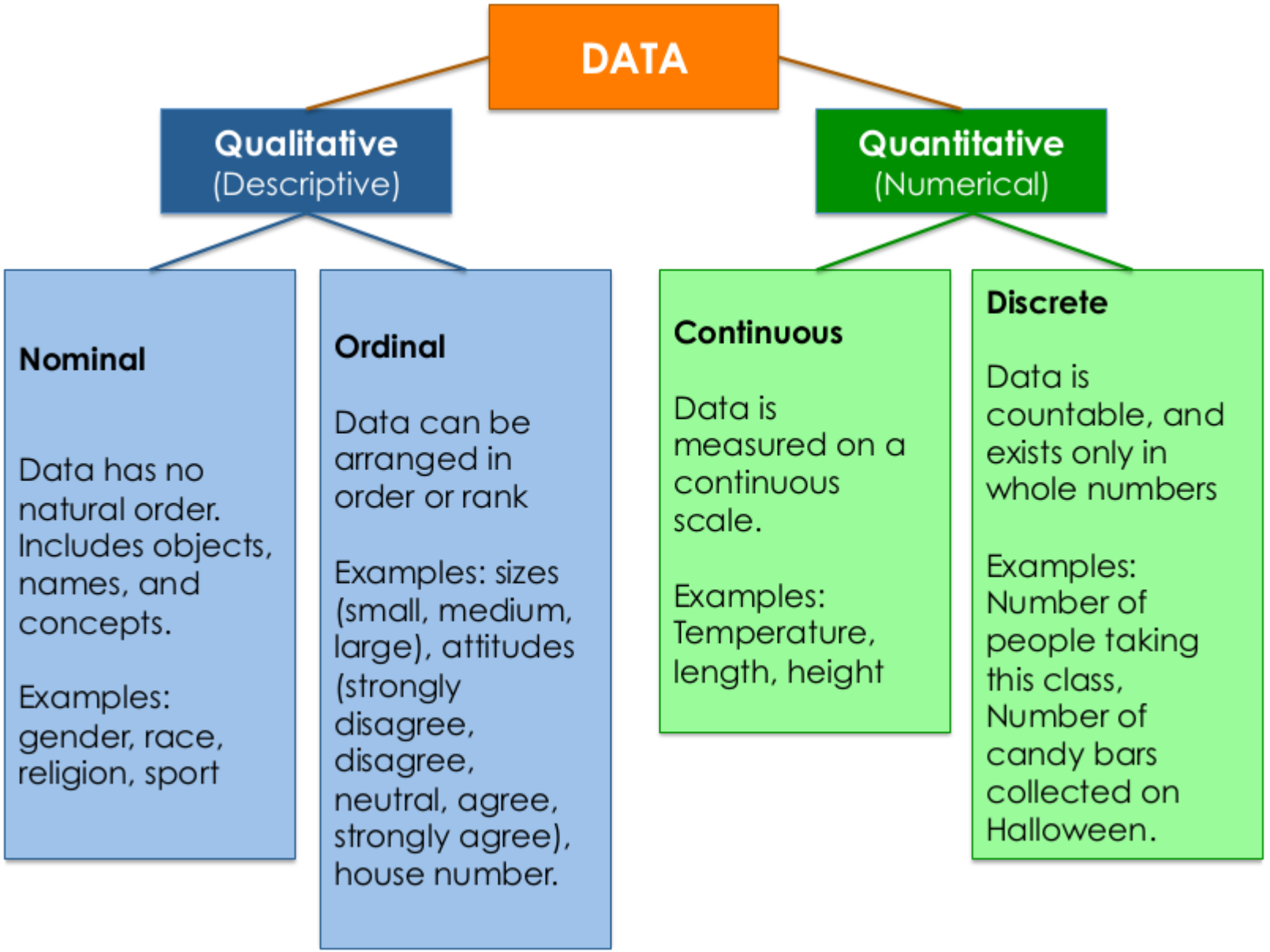
Characteristics of effective graphical displays

- make large data sets coherent
- encourage the eye to compare different pieces of data
- reveal the data at several levels of detail, from a broad overview to the fine structure
- serve a reasonably clear purpose: description, exploration, tabulation or decoration
- be closely integrated with the statistical and verbal descriptions of a data set

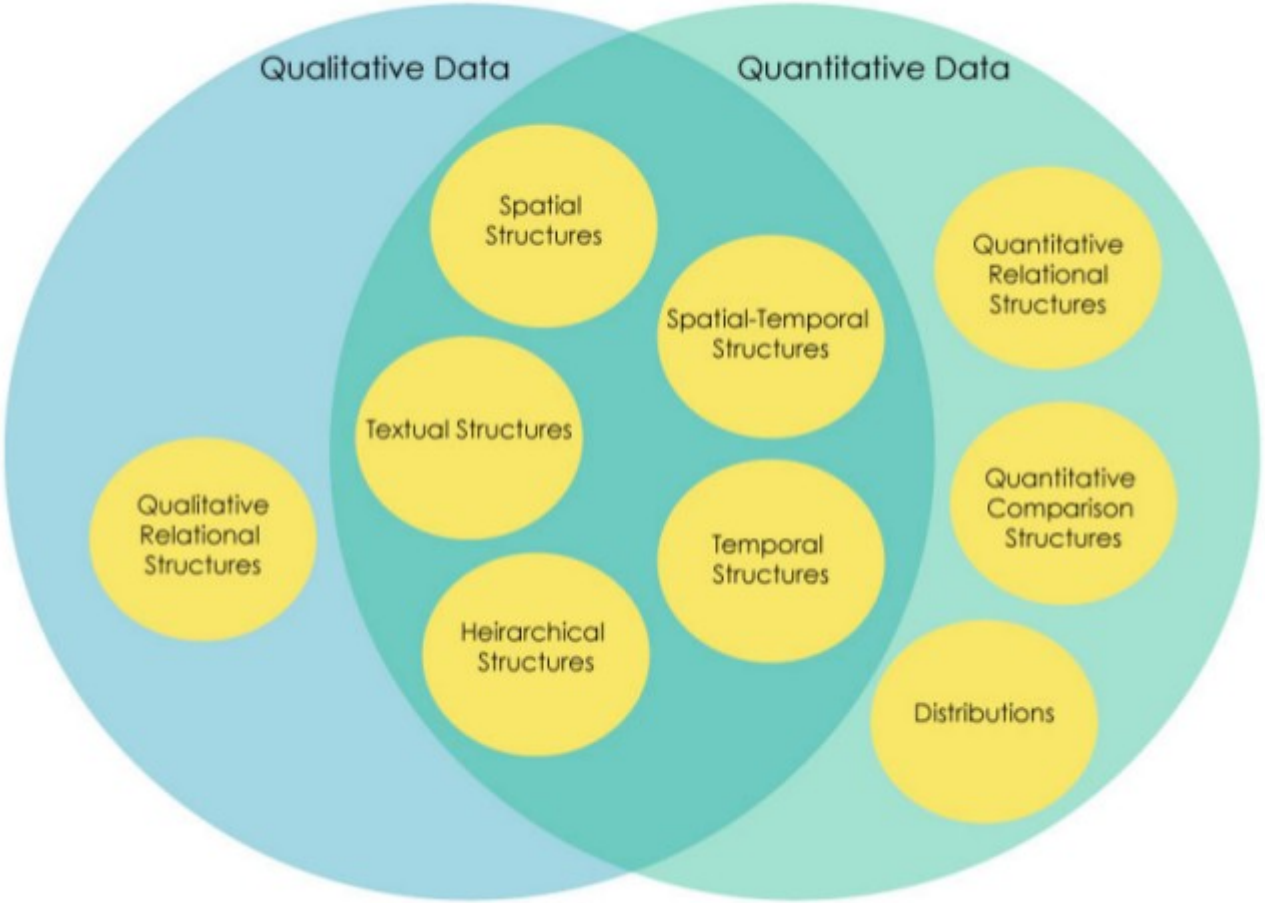
Characteristics of effective graphical displays

- The greatest value of a picture is when it forces us to notice what we never expected to see. - John Tukey

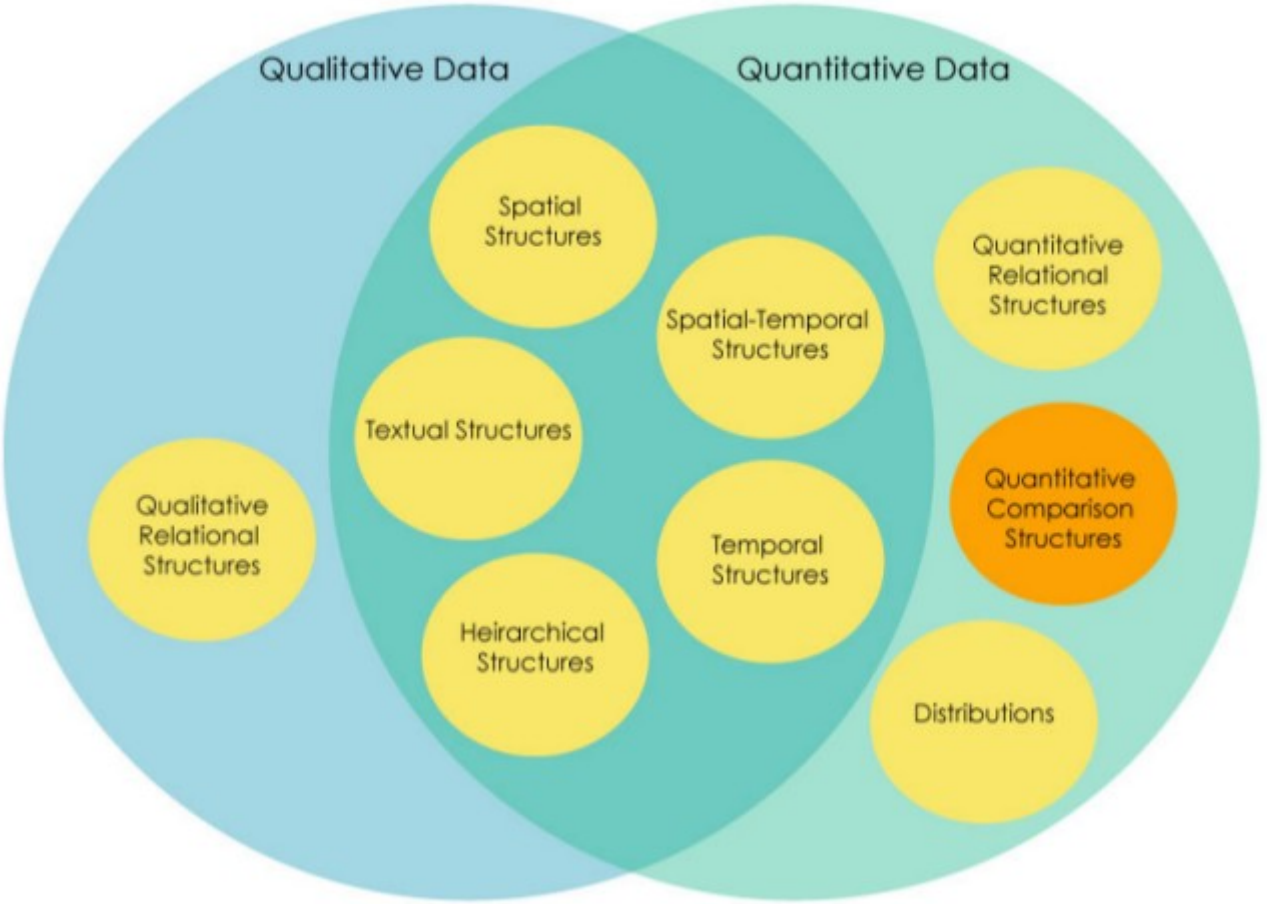
Different Types of Data



Different Types of Data

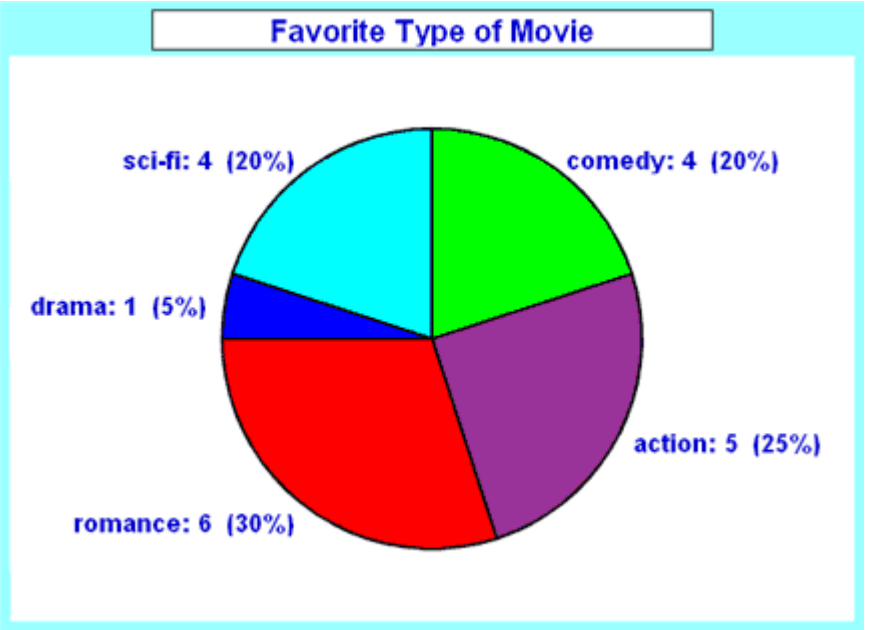


Different Types of Data

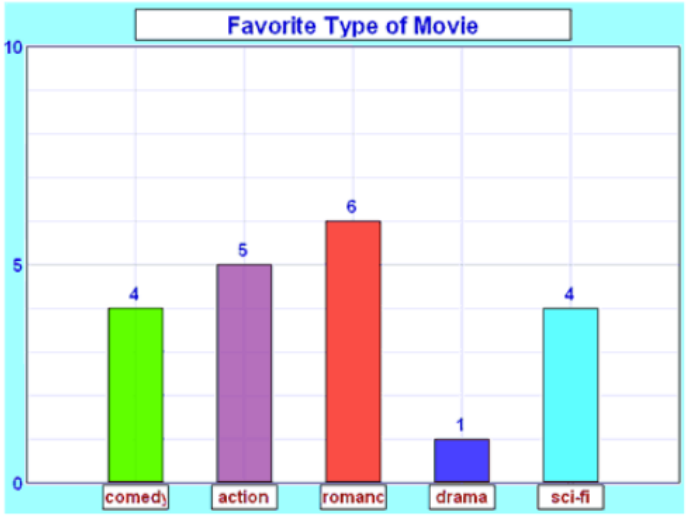


Quantitative Comparison

- Use sparingly
- No more than six components.
- Not useful when values of each component are similar



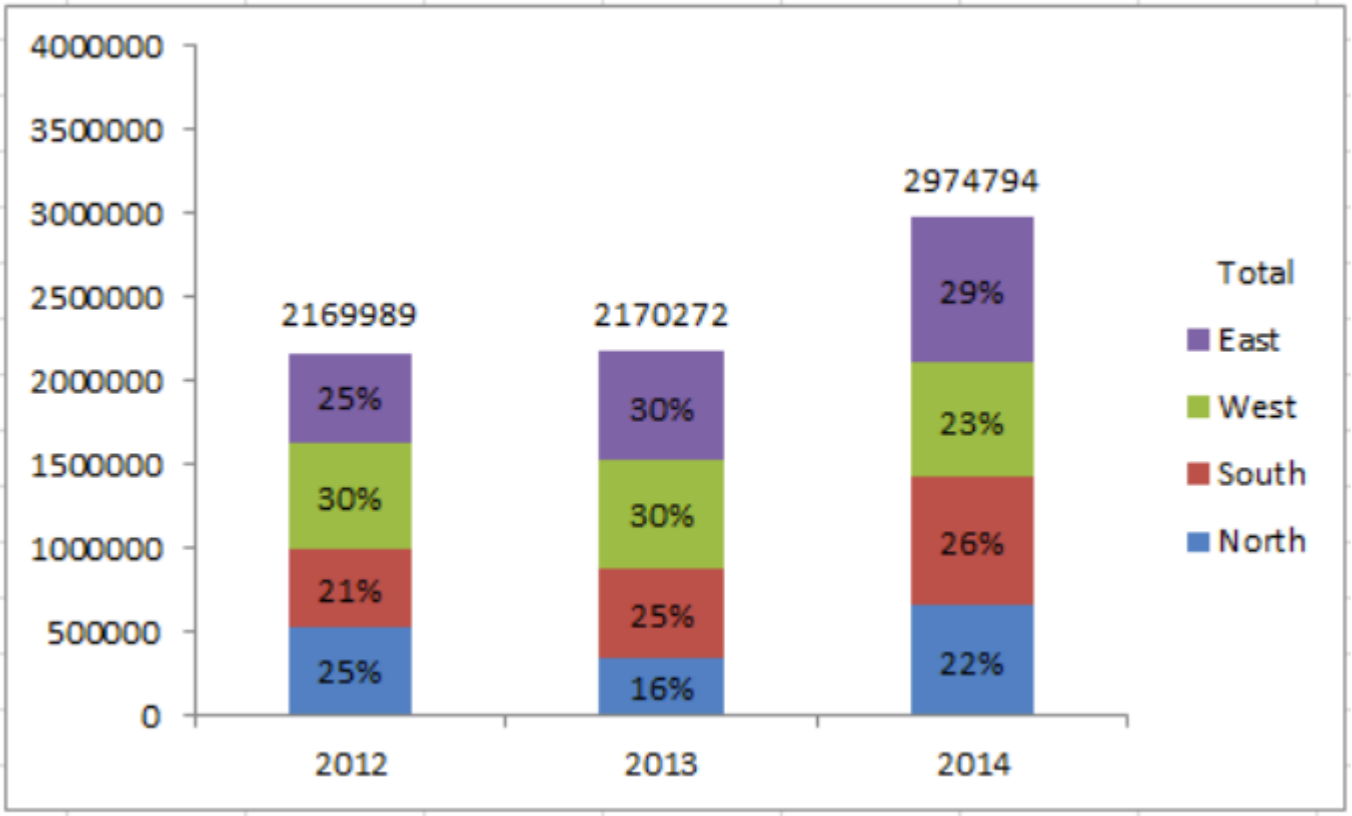
Quantitative Comparison



- Bar graph
- Best for comparing categories.
- Best Practices
  - Make bars and columns wider than the space between them.
  - Do not allow grid lines to pass through columns or bars.
  - Use a single font type on a graph.

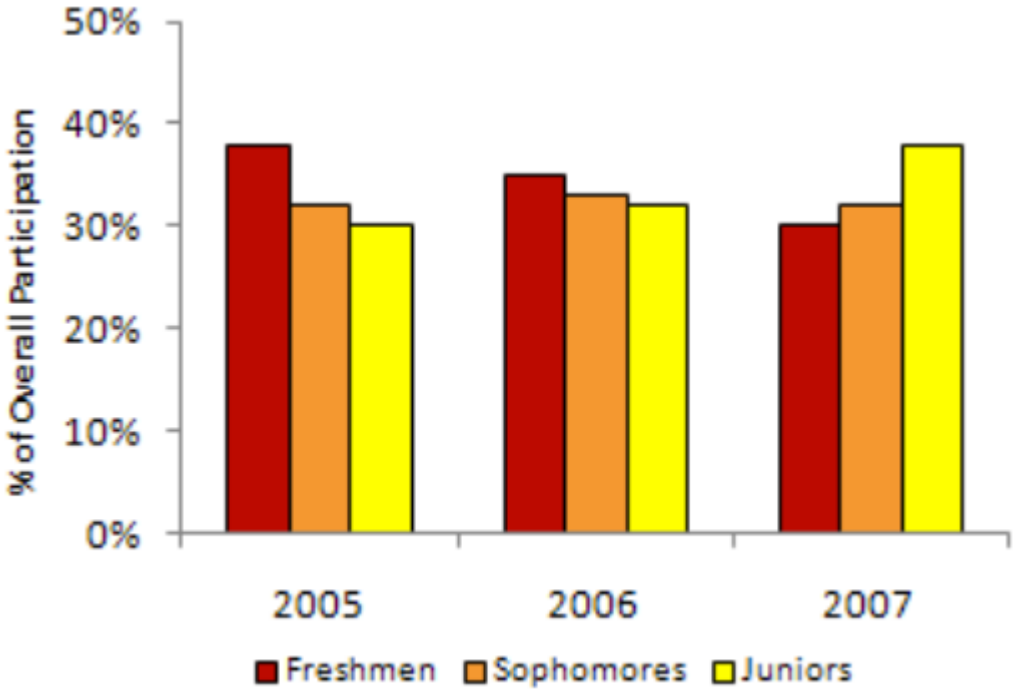
Quantitative Comparison

- Stacked bar graph



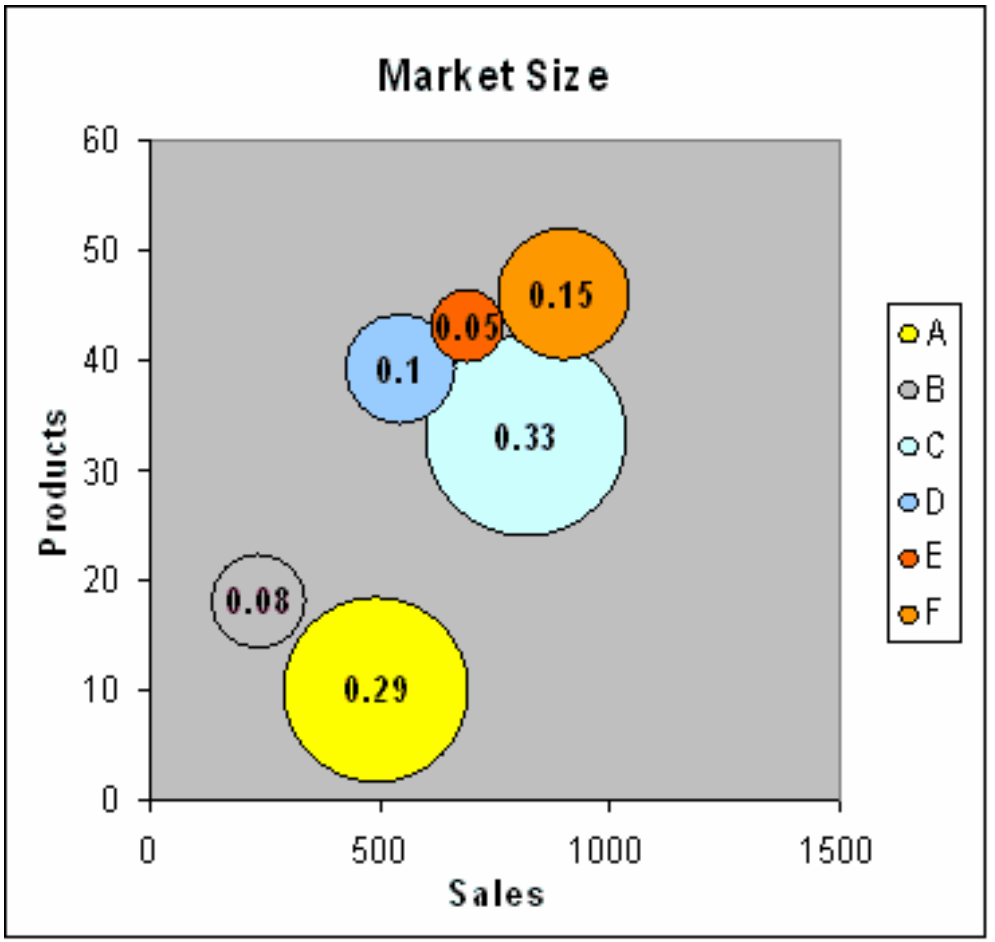
Quantitative Comparison

- Group Bar Plot or Clustered bar graph



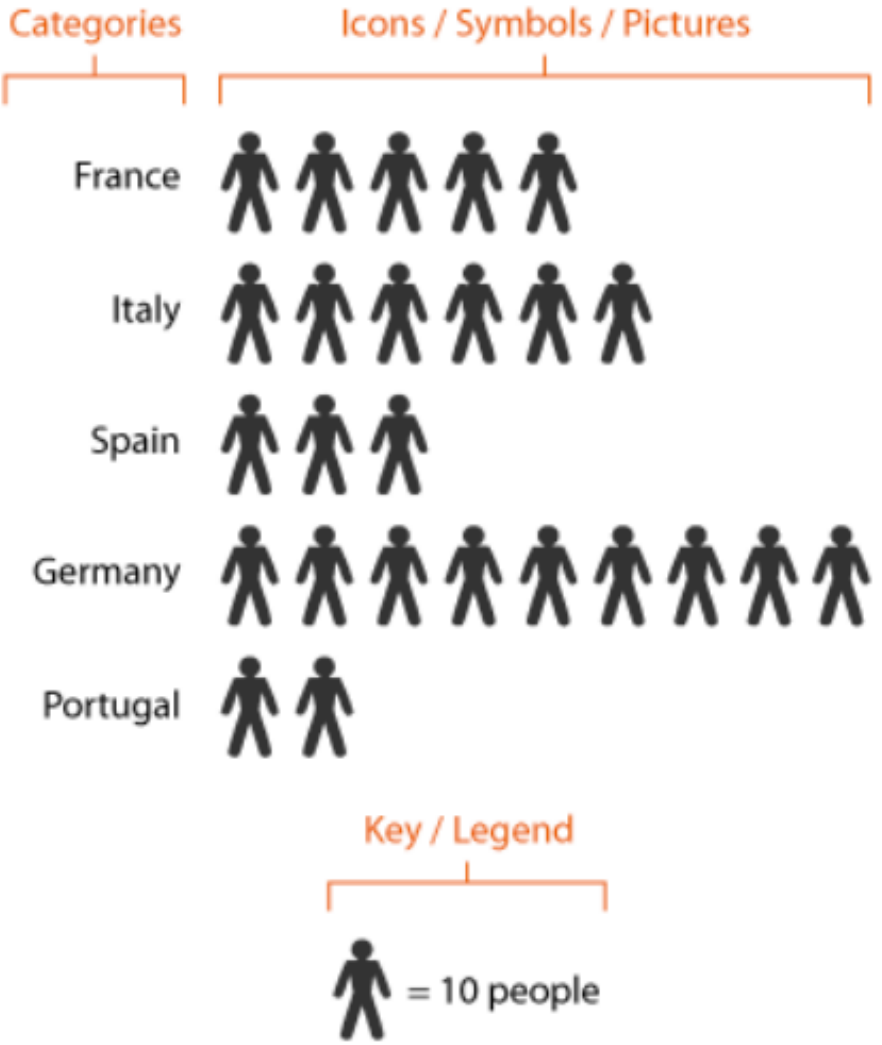
Quantitative Comparison

- Bubble Charts

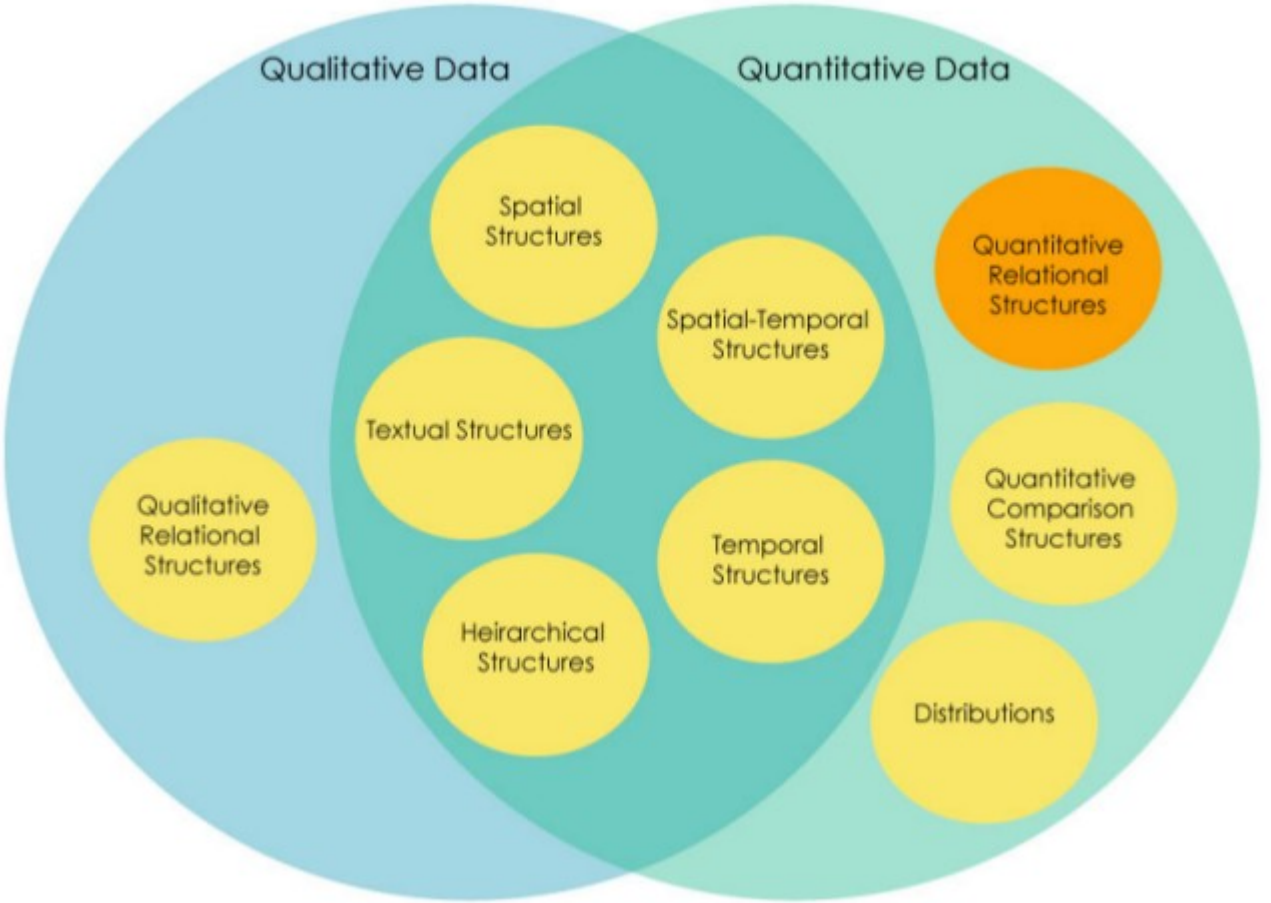


Quantitative Comparison

- Pictogram Chart
  - For discrete data

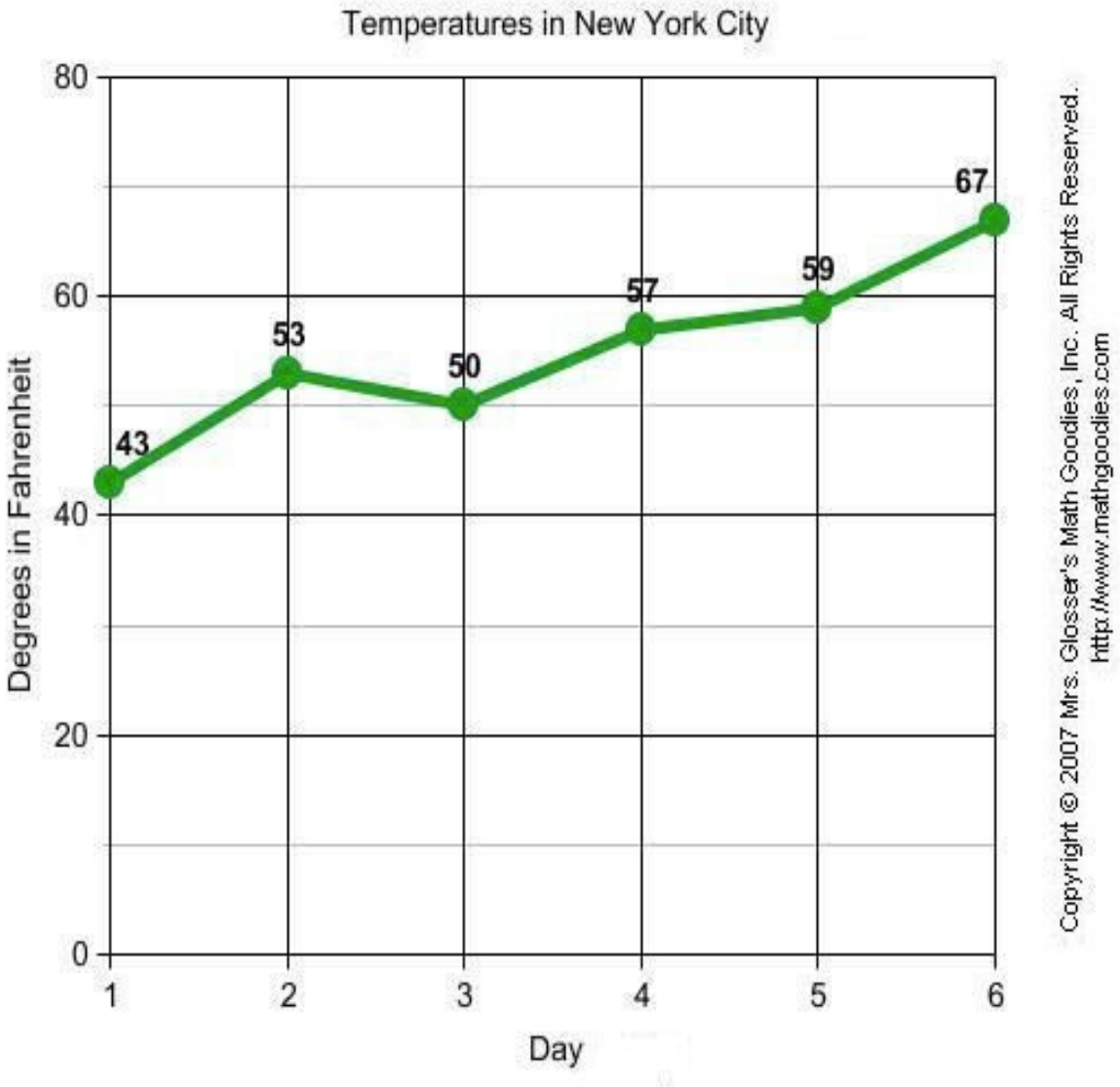


Different Types of Data



Quantitative Relational

- Line Charts
  - For identifying trends.



Quantitative Relational

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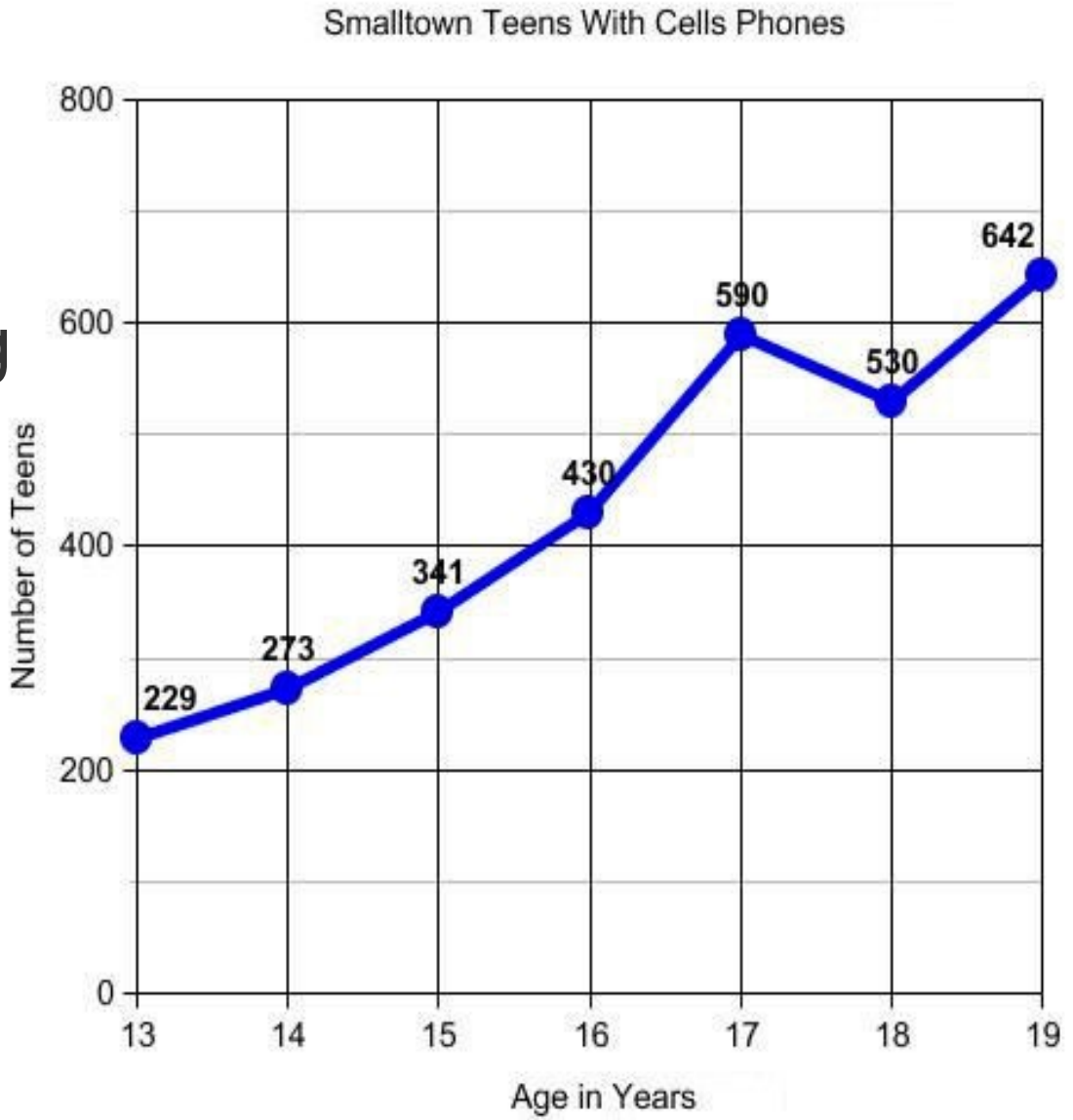
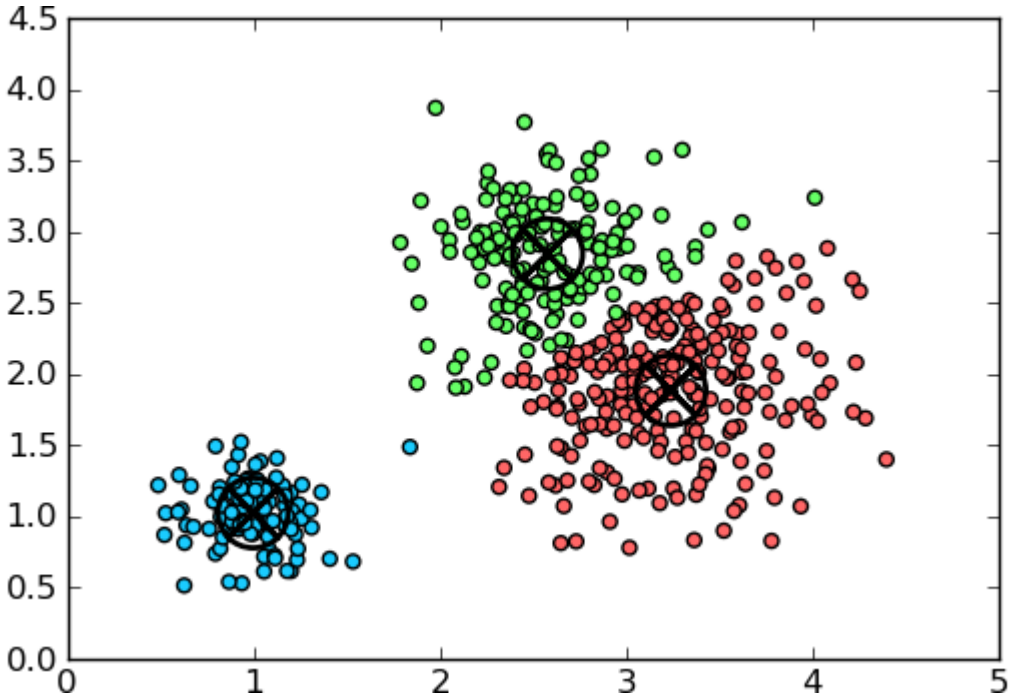


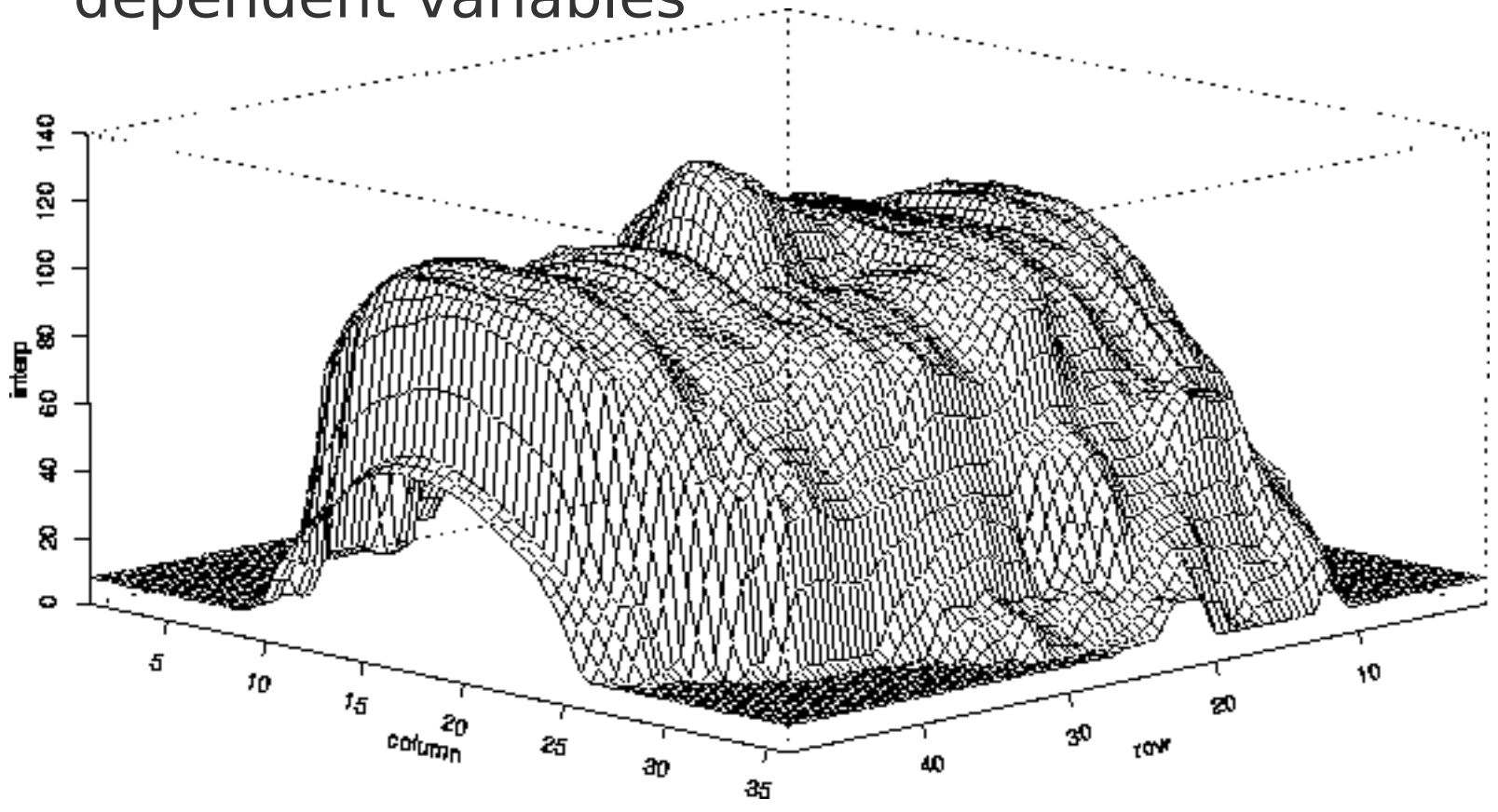
Quantitative Relational

Scatter Plots- For testing and identifying relationships, and statistical correlations



Quantitative Relational

- Surface plots
  - Topography, Density Functions that have two dependent variables



Quantitative Relational

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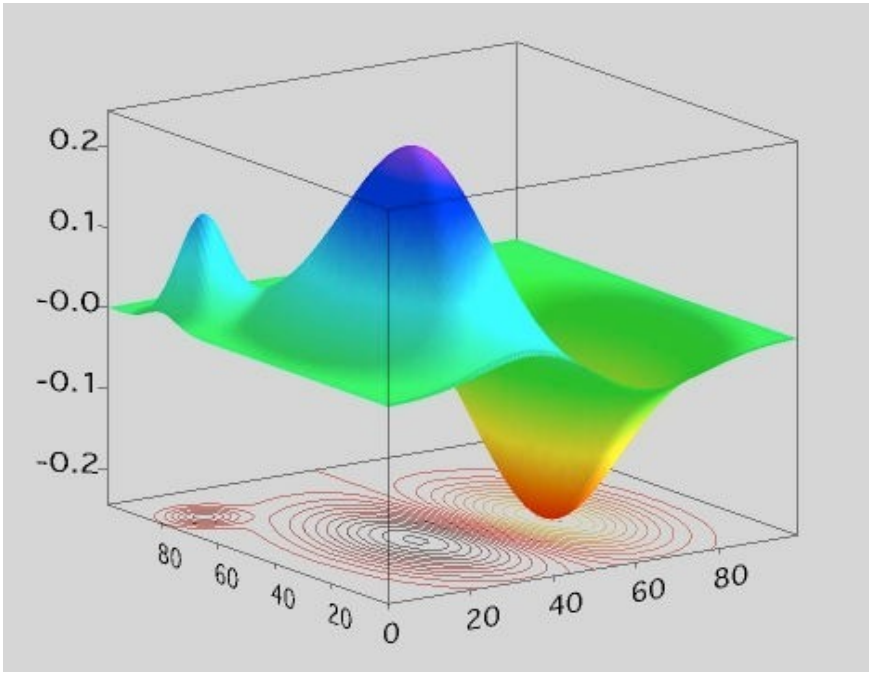
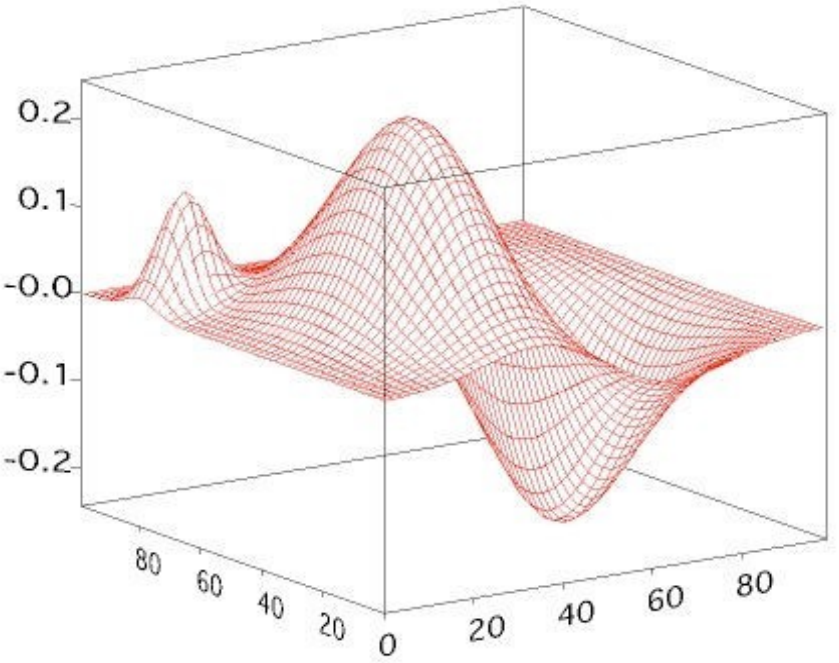




Quantitative Relational

- **Heat Map**

Quantitative Relational

- Co-occurrence matrix / Heat map

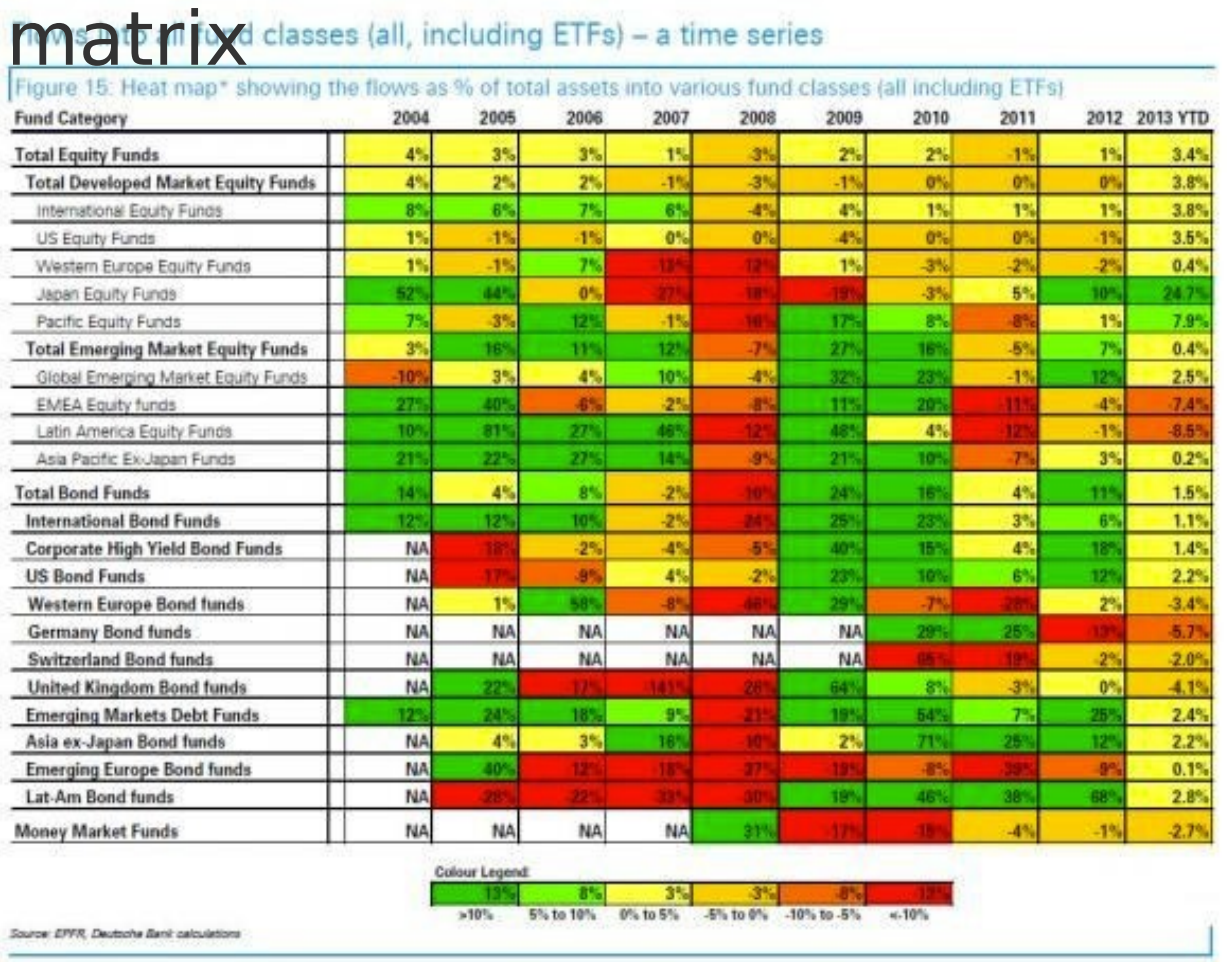


Figure 15: Heat map* showing the flows as % of total assets into various fund classes (all including ETFs)

Fund Category	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013 YTD
Total Equity Funds	4%	3%	3%	1%	-3%	2%	2%	-1%	1%	3.4%
Total Developed Market Equity Funds	4%	2%	2%	-1%	-3%	-1%	0%	0%	0%	3.8%
International Equity Funds	8%	6%	7%	6%	-4%	4%	1%	1%	1%	3.8%
US Equity Funds	1%	-1%	-1%	0%	0%	-4%	0%	0%	-1%	3.5%
Western Europe Equity Funds	1%	-1%	7%	13%	12%	1%	-3%	-2%	-2%	0.4%
Japan Equity Funds	52%	44%	0%	-27%	18%	19%	-3%	5%	10%	24.7%
Pacific Equity Funds	7%	-3%	12%	-1%	16%	17%	8%	-8%	1%	7.9%
Total Emerging Market Equity Funds	3%	16%	11%	12%	-7%	27%	16%	-5%	7%	0.4%
Global Emerging Market Equity Funds	-10%	3%	4%	10%	-4%	32%	23%	-1%	12%	2.5%
EMEA Equity funds	27%	40%	-6%	-2%	-8%	11%	20%	-11%	-4%	-7.4%
Latin America Equity Funds	10%	81%	27%	48%	12%	48%	4%	-12%	-1%	-8.5%
Asia Pacific Ex-Japan Funds	21%	22%	27%	14%	-9%	21%	10%	-7%	3%	0.2%
Total Bond Funds	14%	4%	8%	-2%	-10%	24%	16%	4%	11%	1.5%
International Bond Funds	12%	12%	10%	-2%	-24%	25%	23%	3%	6%	1.1%
Corporate High Yield Bond Funds	NA	18%	-2%	-4%	-5%	40%	15%	4%	18%	1.4%
US Bond Funds	NA	17%	-9%	4%	-2%	23%	10%	6%	12%	2.2%
Western Europe Bond funds	NA	1%	58%	-8%	-46%	29%	-7%	-28%	2%	-3.4%
Germany Bond funds	NA	NA	NA	NA	NA	NA	29%	25%	-13%	-5.7%
Switzerland Bond funds	NA	NA	NA	NA	NA	NA	65%	19%	-2%	-2.0%
United Kingdom Bond funds	NA	22%	-17%	-141%	-26%	64%	8%	-3%	0%	-4.1%
Emerging Markets Debt Funds	12%	24%	18%	9%	21%	19%	54%	7%	25%	2.4%
Asia ex-Japan Bond funds	NA	4%	3%	16%	-10%	2%	71%	25%	12%	2.2%
Emerging Europe Bond funds	NA	40%	-12%	-18%	-27%	19%	-8%	-38%	-8%	0.1%
Lat-Am Bond funds	NA	-28%	-22%	-33%	-30%	19%	46%	38%	68%	2.8%
Money Market Funds	NA	NA	NA	NA	31%	-17%	-18%	-4%	-1%	-2.7%

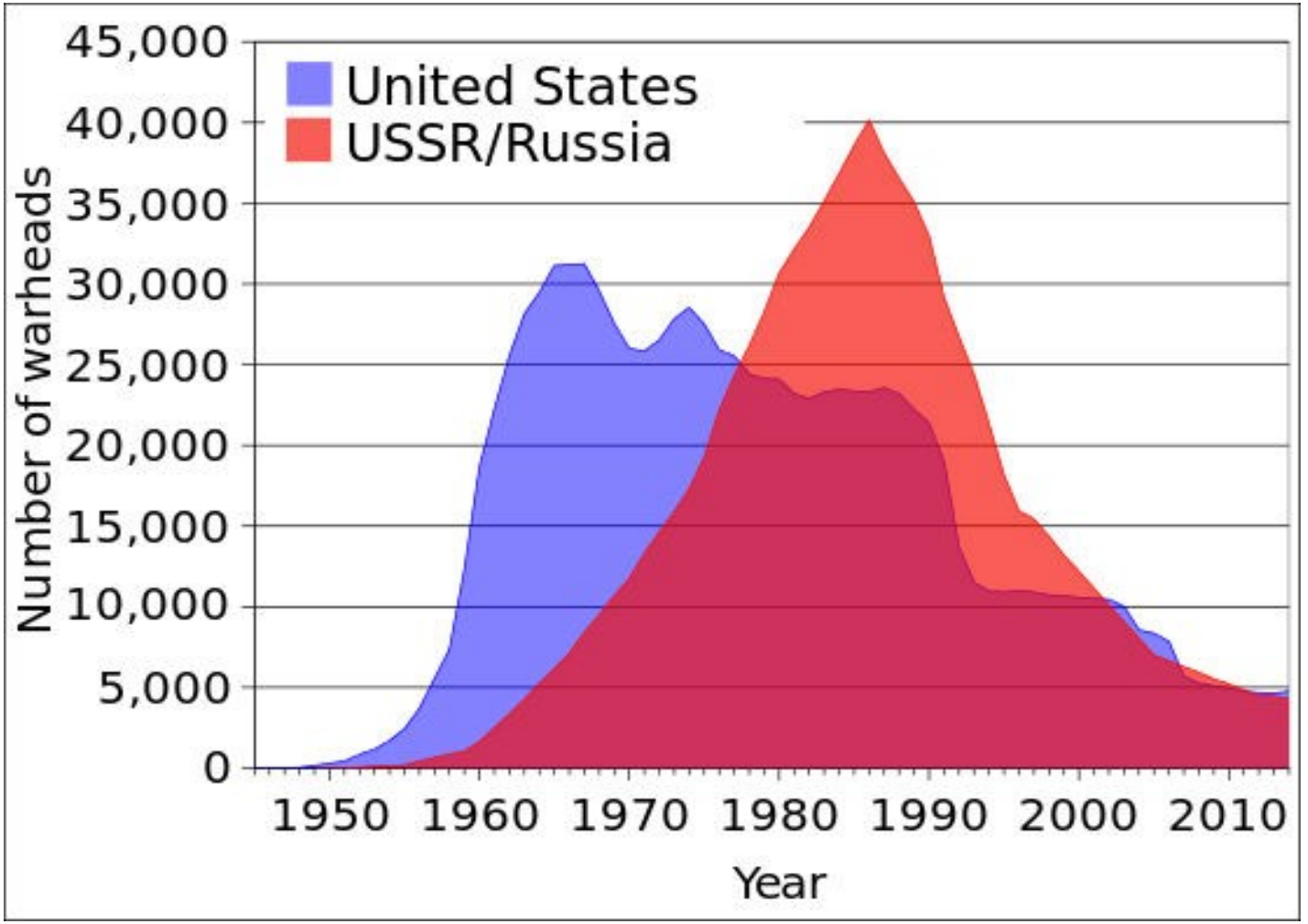
Colour Legend:

>10%	5% to 10%	0% to 5%	-5% to 0%	-10% to -5%	<-10%

Source: EPFR, Deutsche Bank calculations

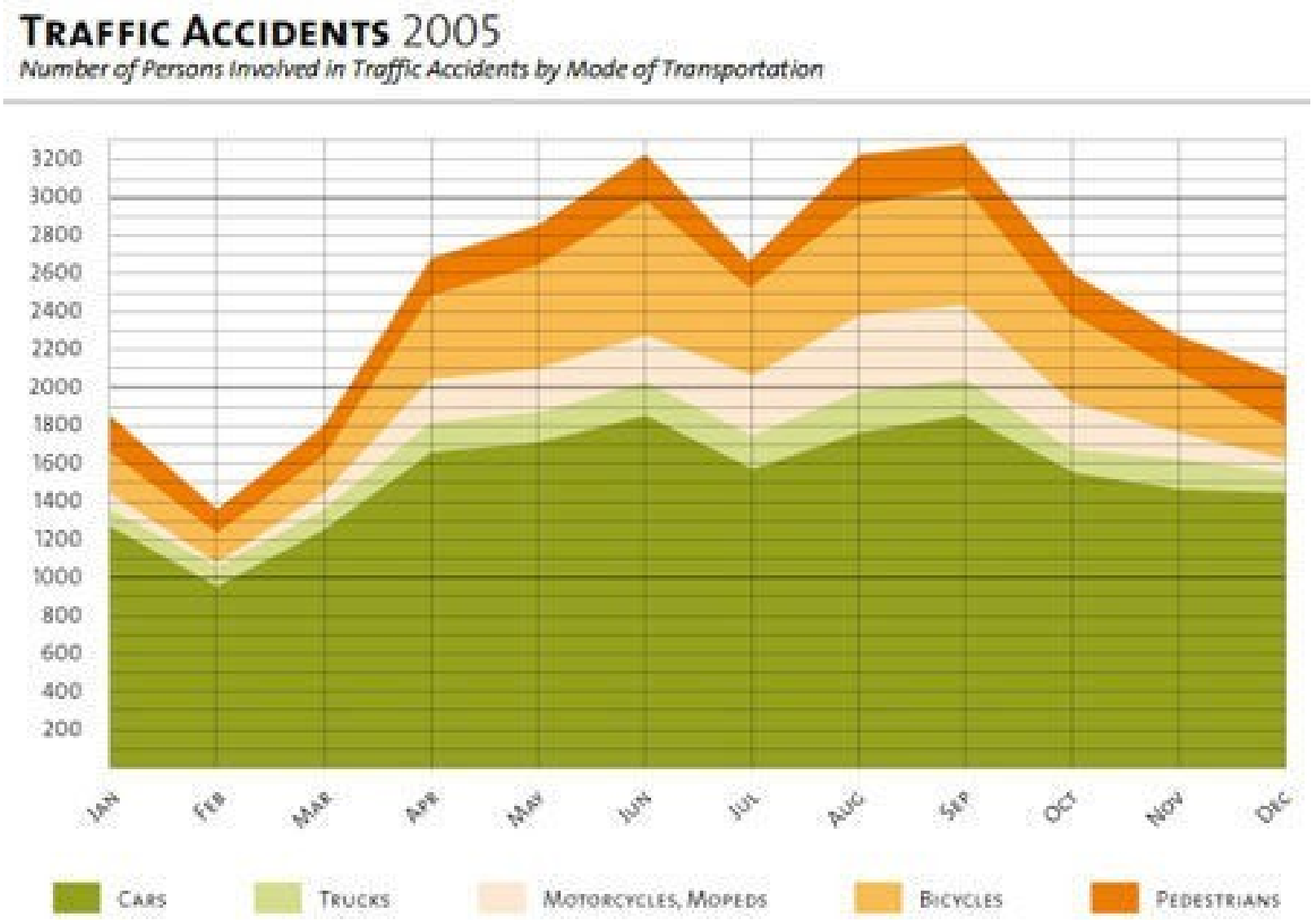
Quantitative Relational and Comparison

- Area Graph

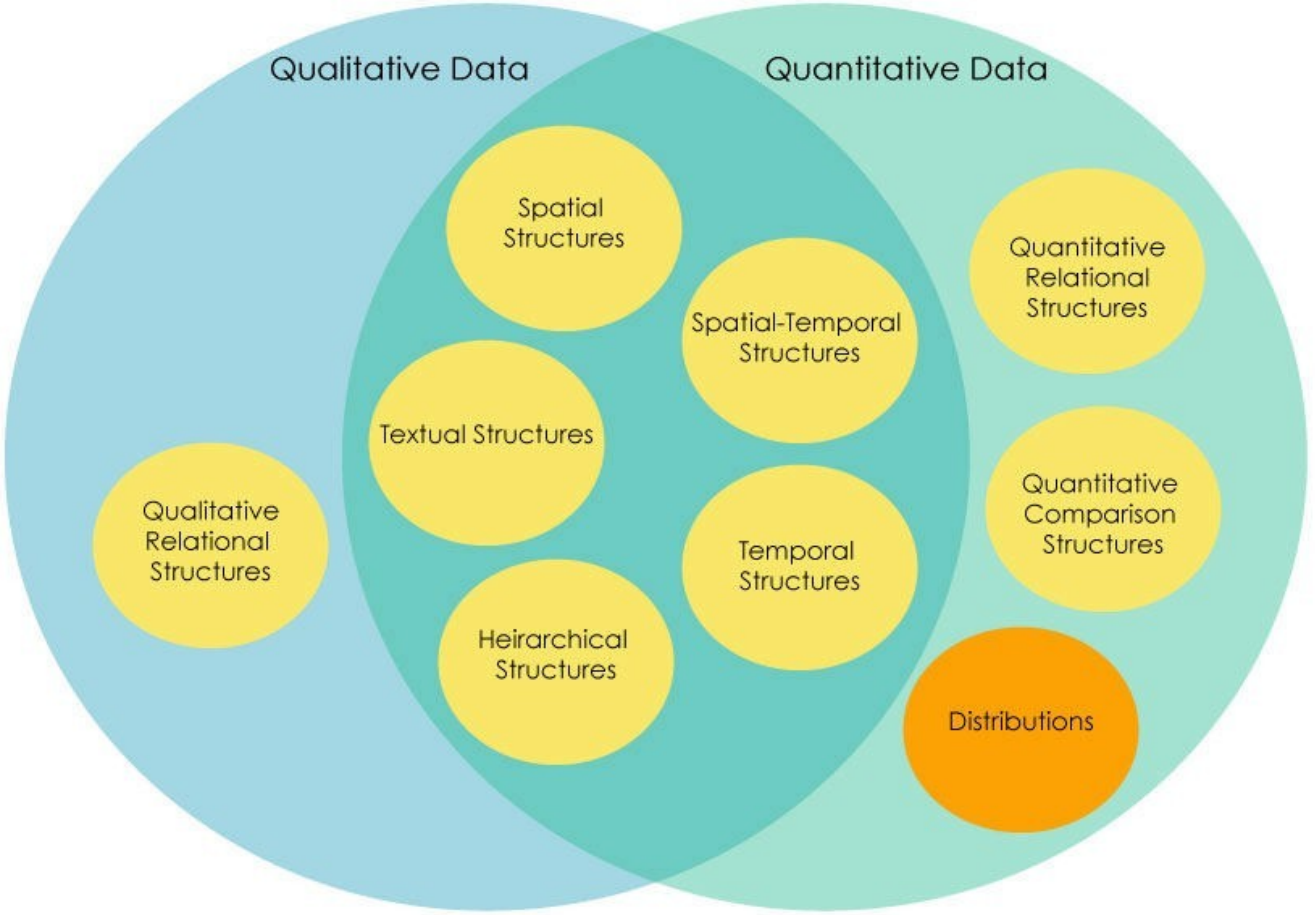


Quantitative Relational and Comparison

Stacked Area Graph

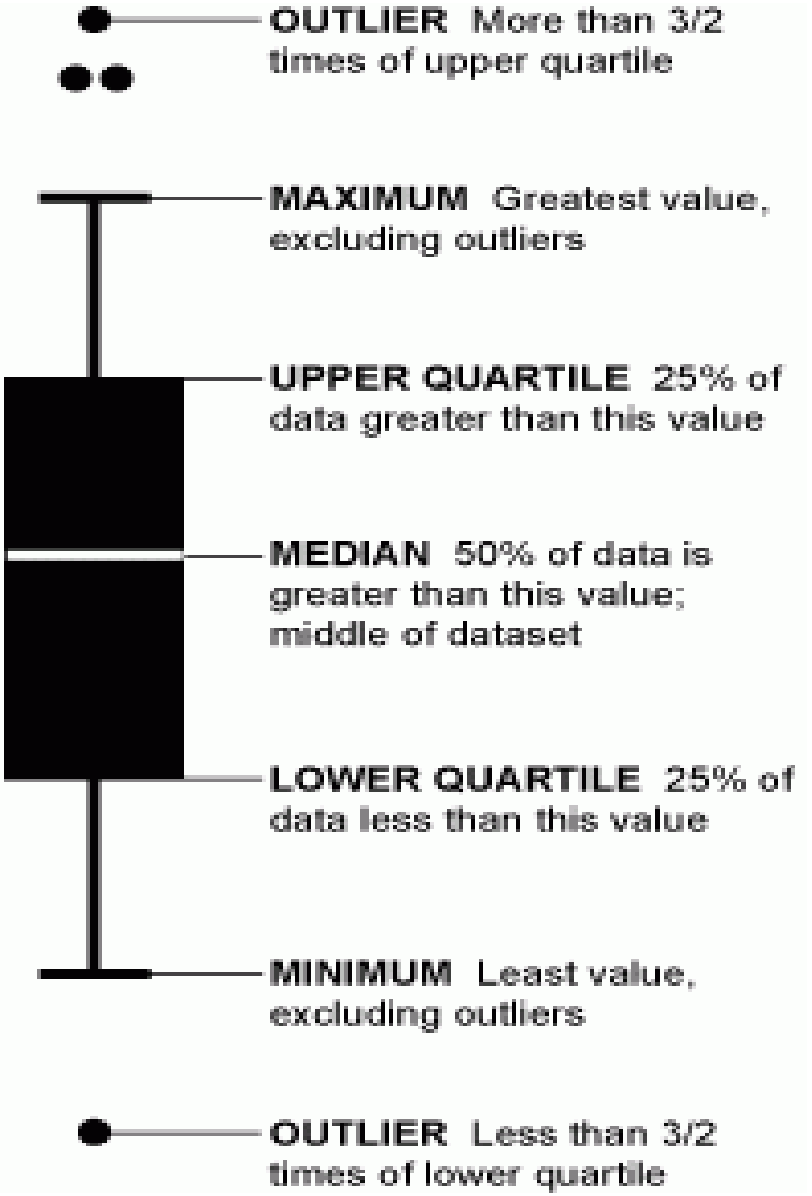


Different Types of Data

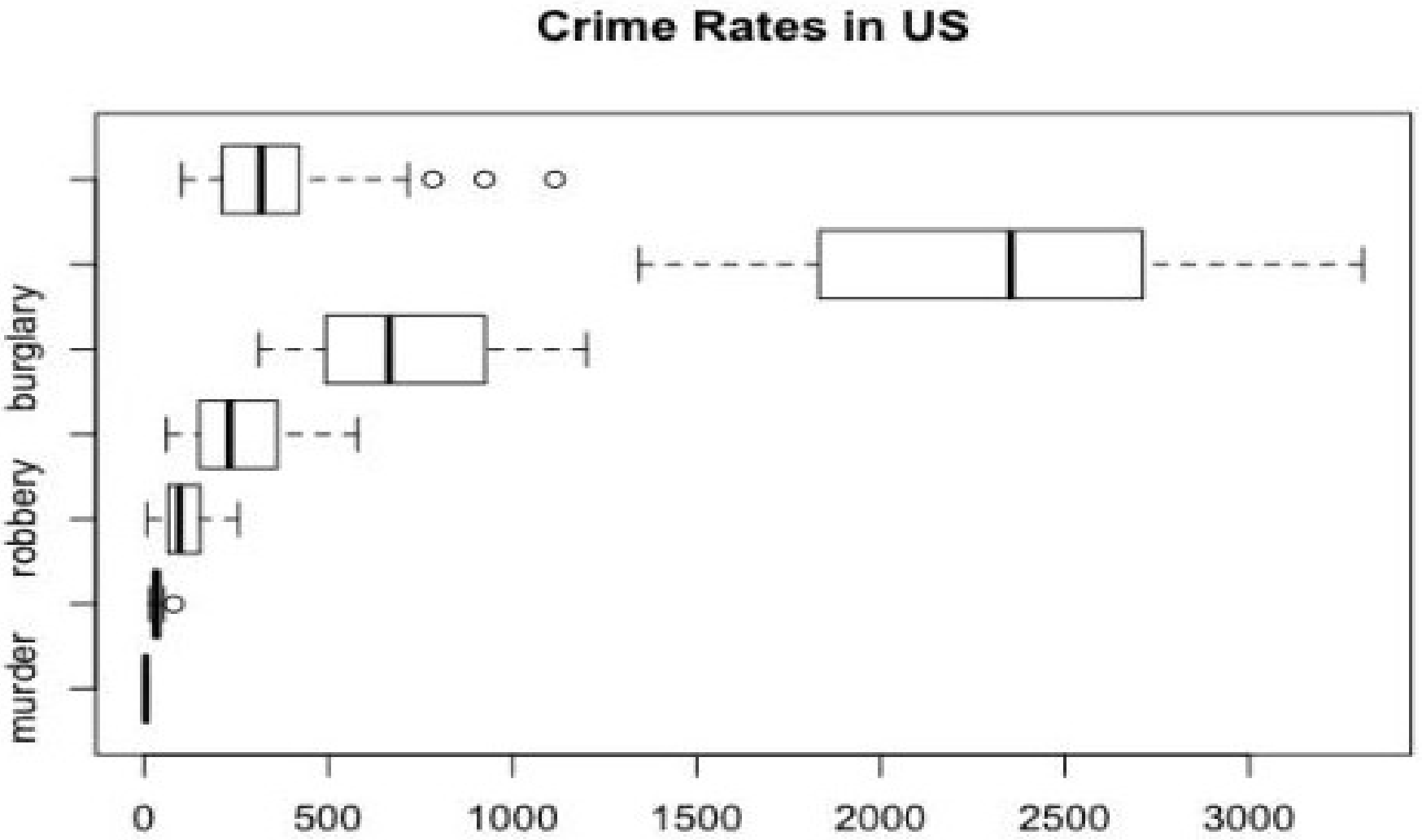


Distributions

Box and Whisker Plot

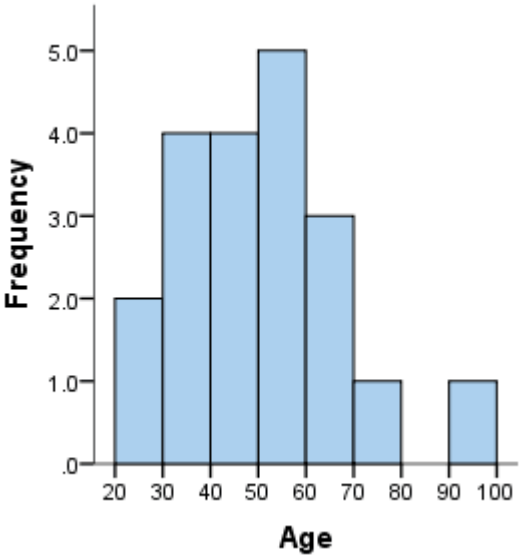


Distributions

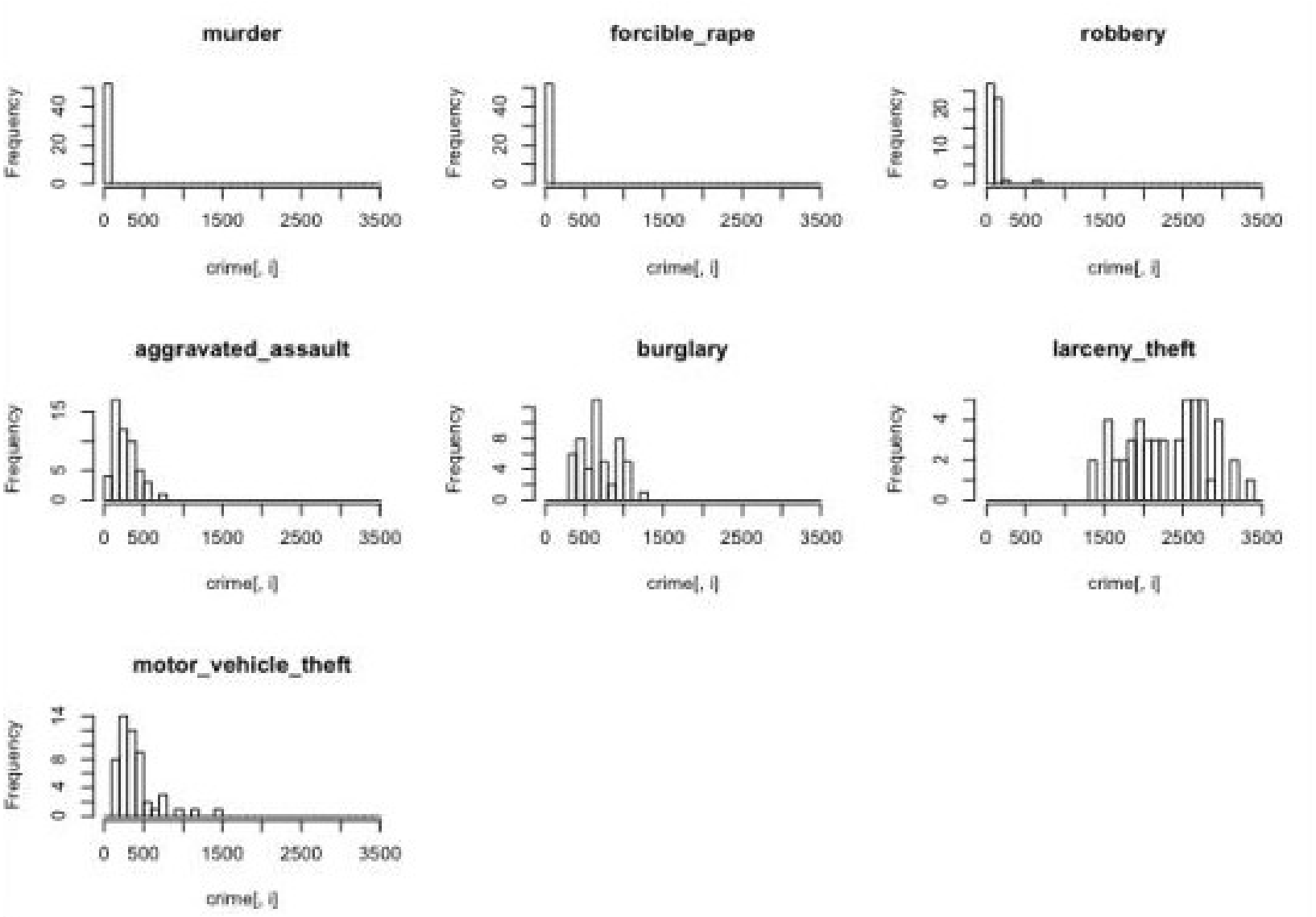


Distributions

- Histograms
  - A histogram is a plot that lets you discover, and show, the underlying frequency distribution (shape) of a set of continuous data.



Distributions



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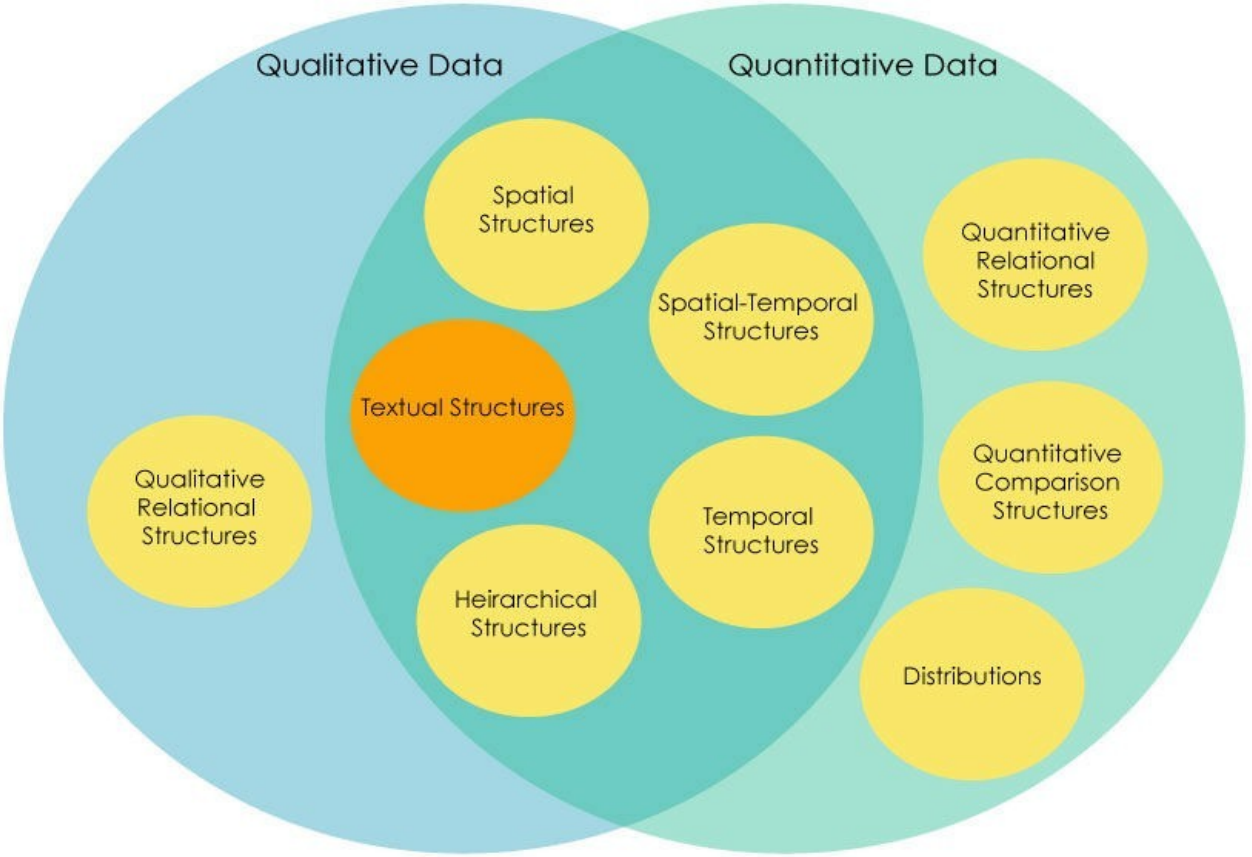
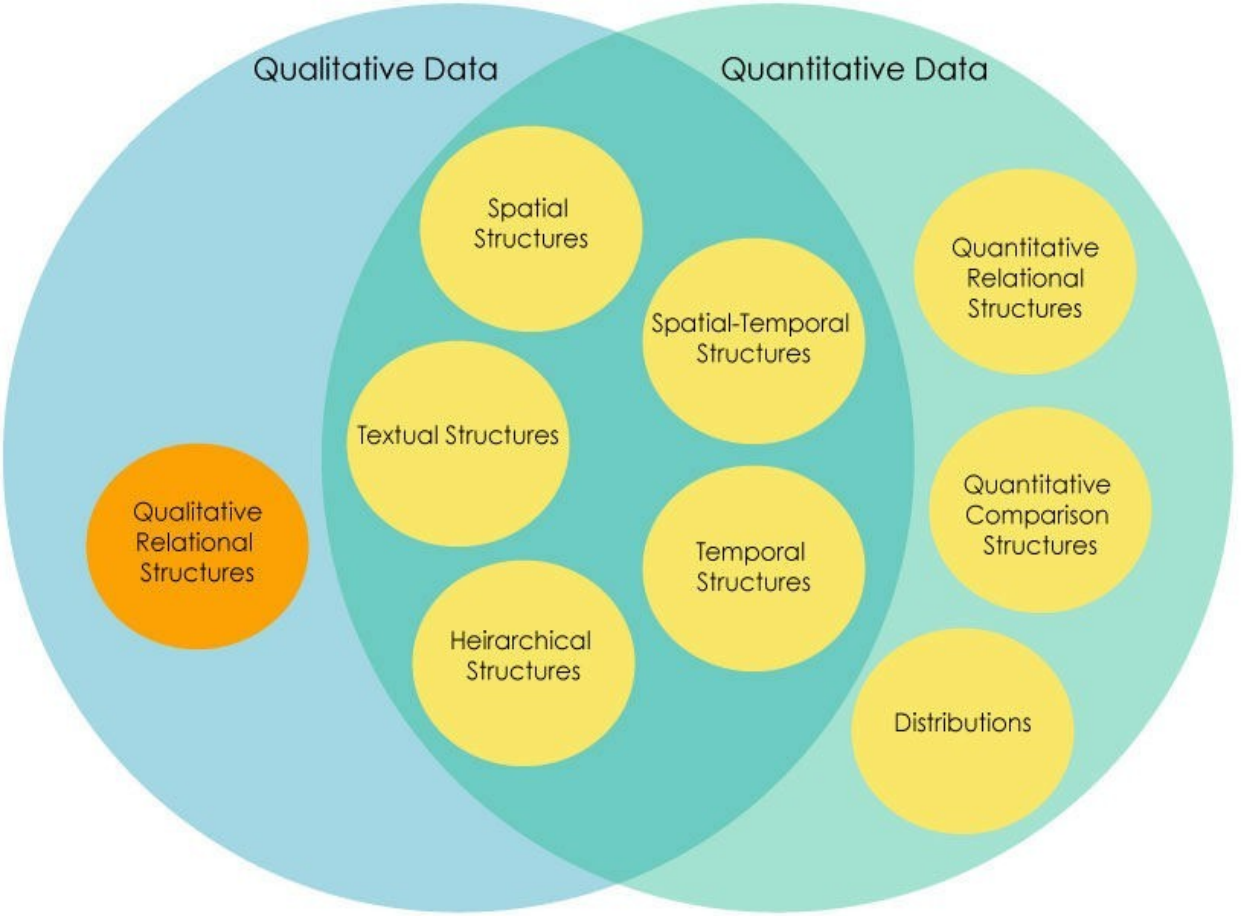


Qualitative Data: Textual Structures

Qualitative Data: Textual Structures

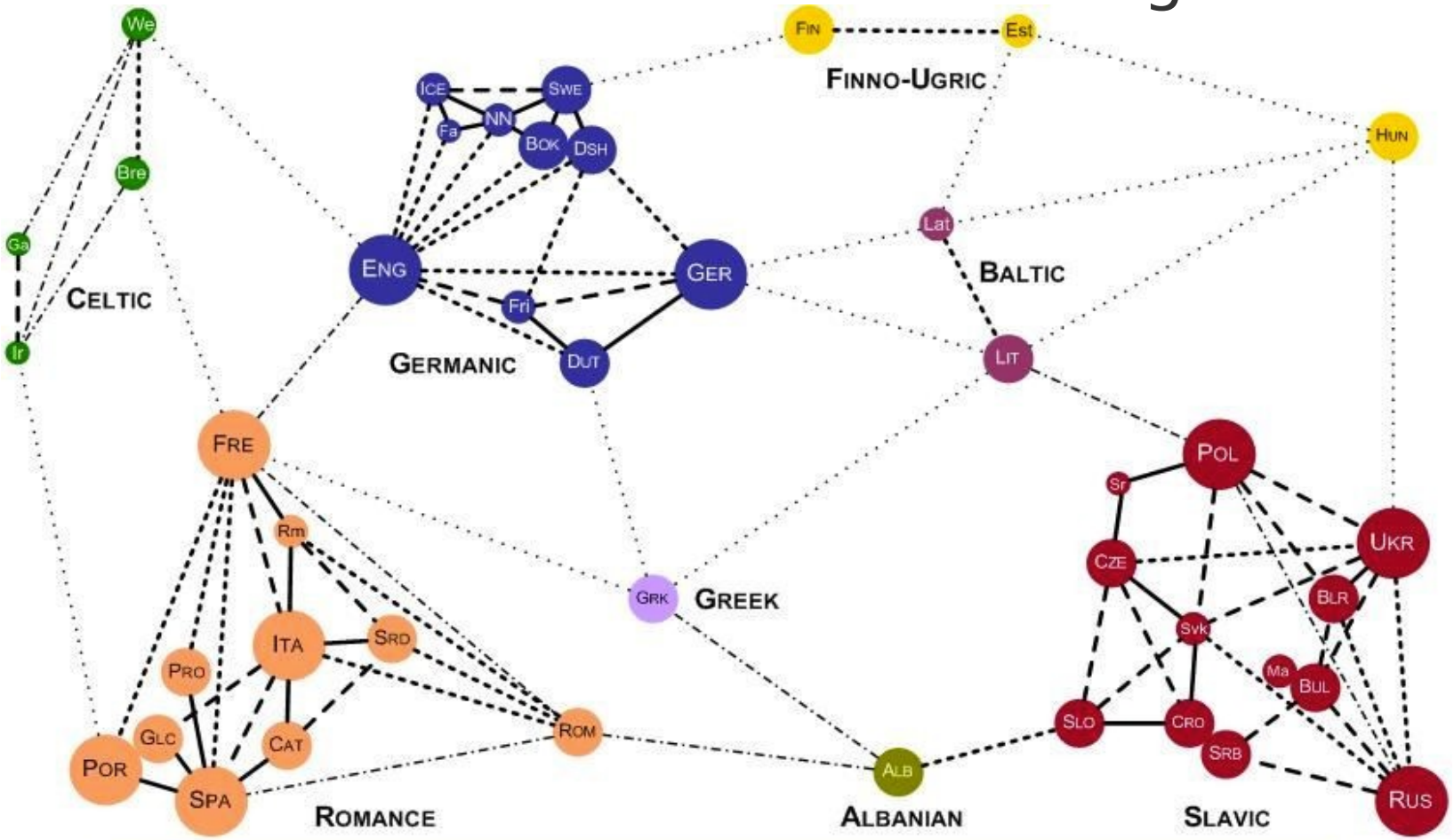
- Word Tree

Different Types of Data



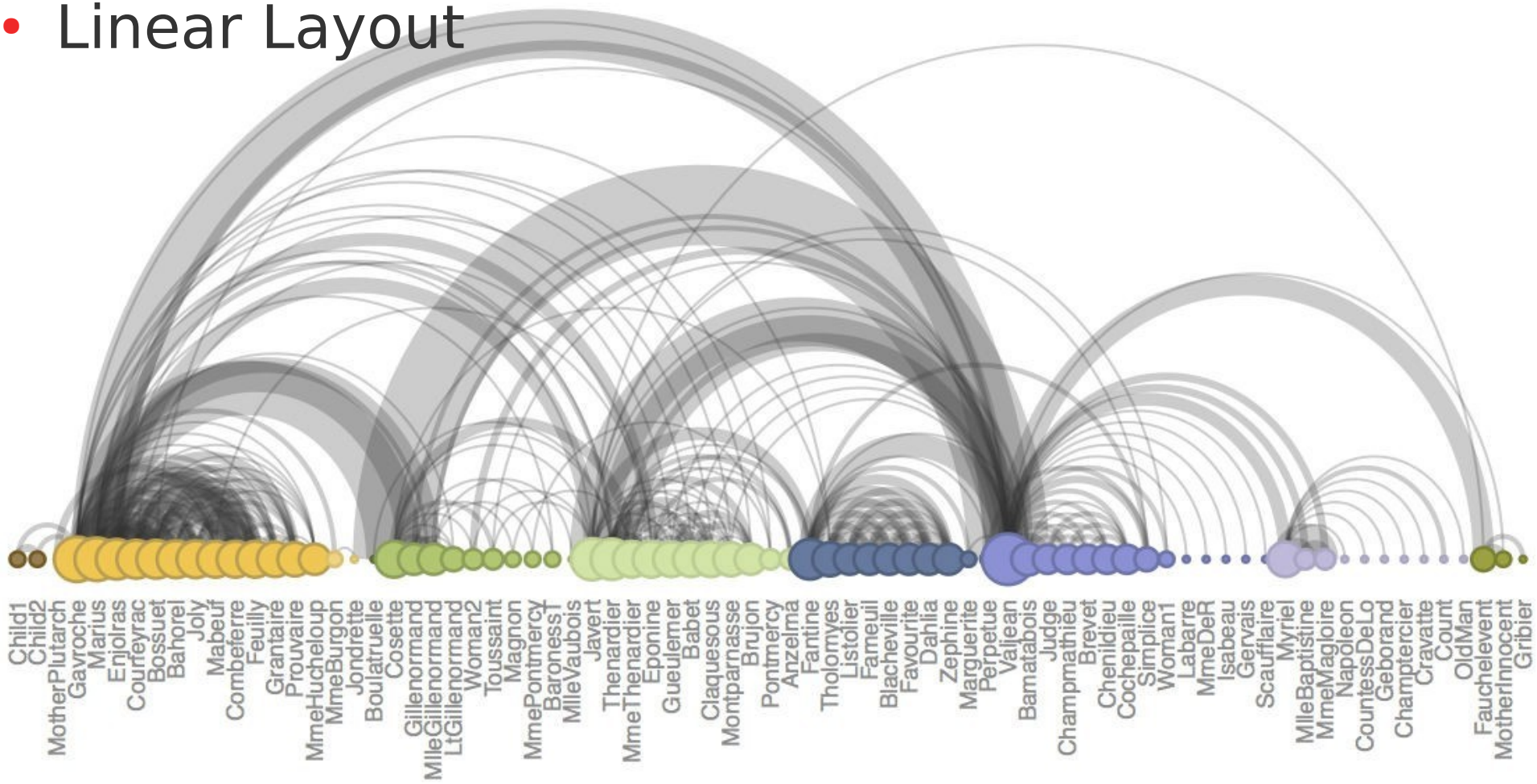
Qualitative Relational Structures

- Source Directed Node Link Diagram

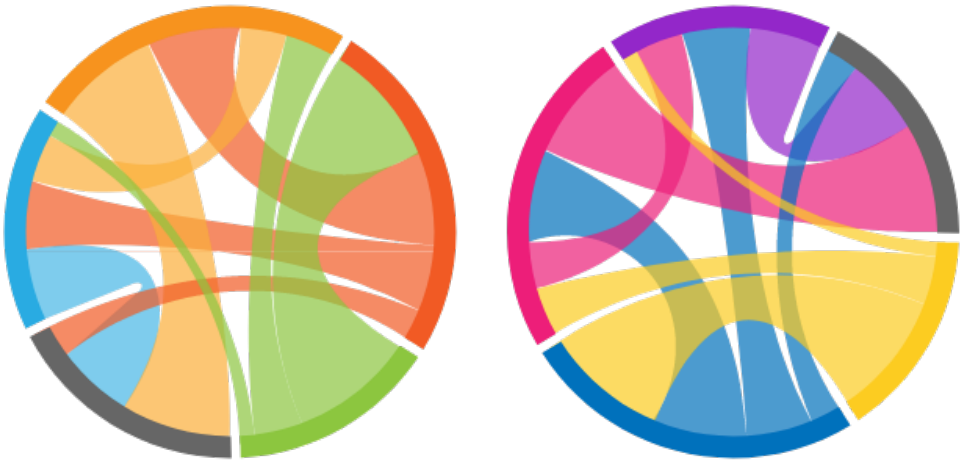


Qualitative Relational Structures

- Linear Layout

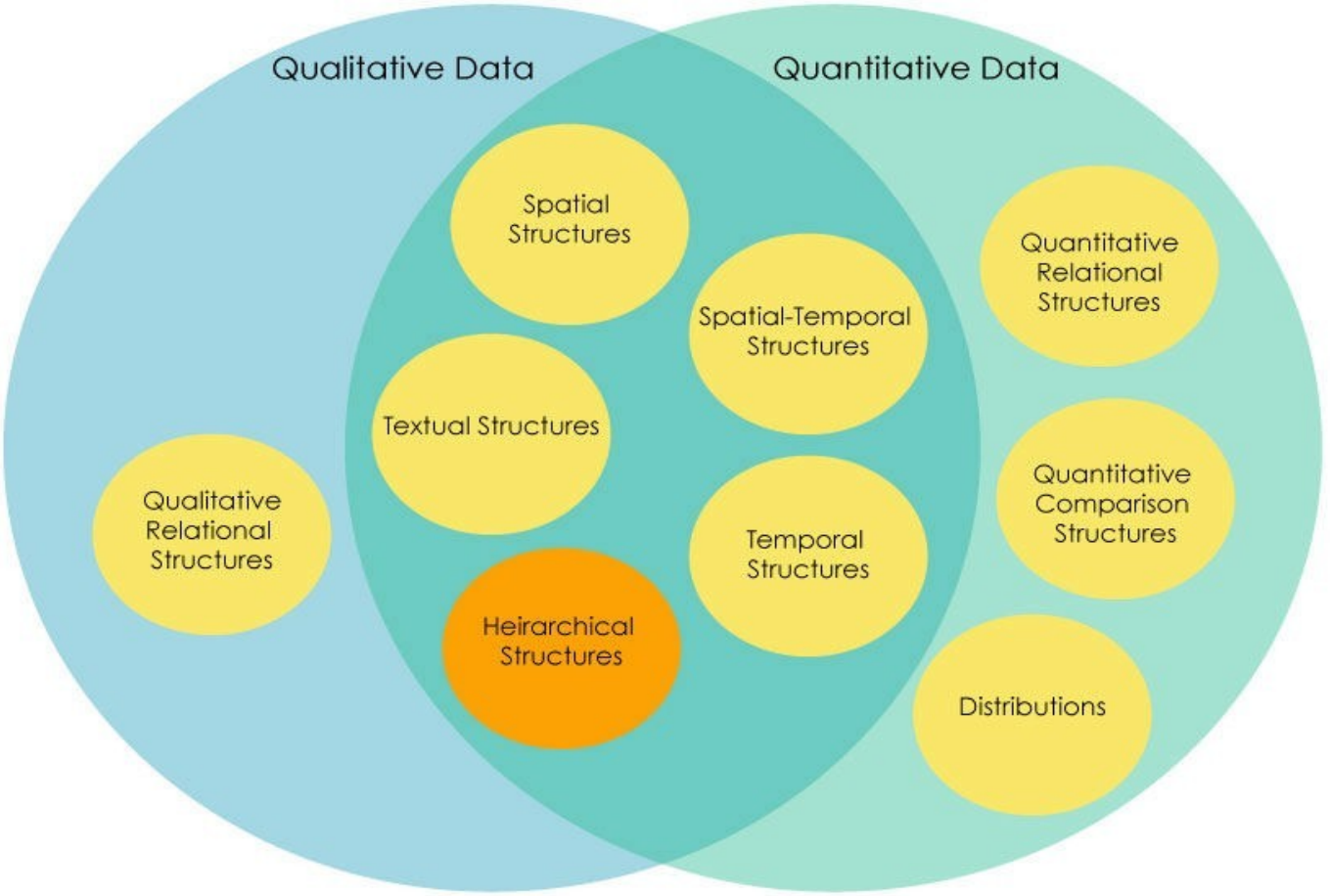


Qualitative Relational Structures



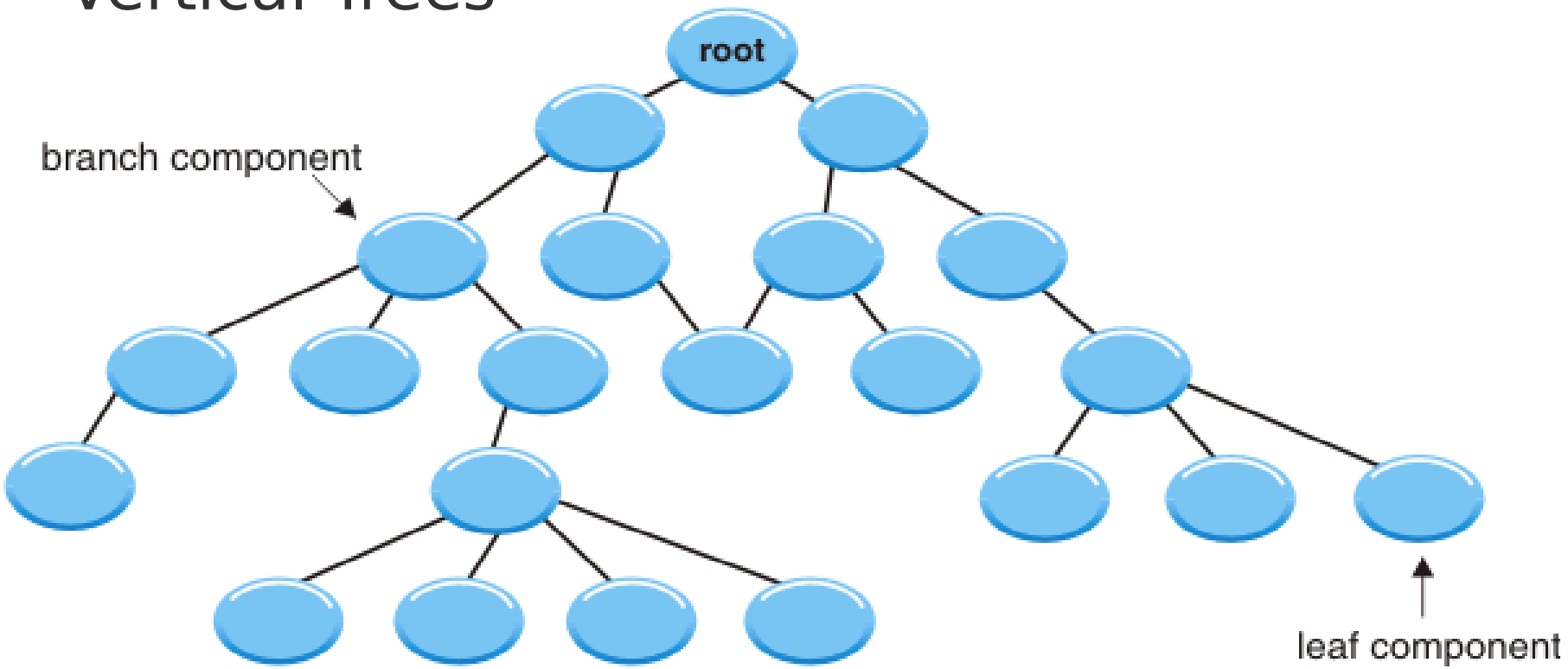
- Chord Diagram
  - visualises the inter-relationships between entities. The connections between entities are used to display that they share something in common.
  - The size of the arc is proportional to the importance of the flow.

Different Types of Data



Hierarchical Structures

- Vertical Trees

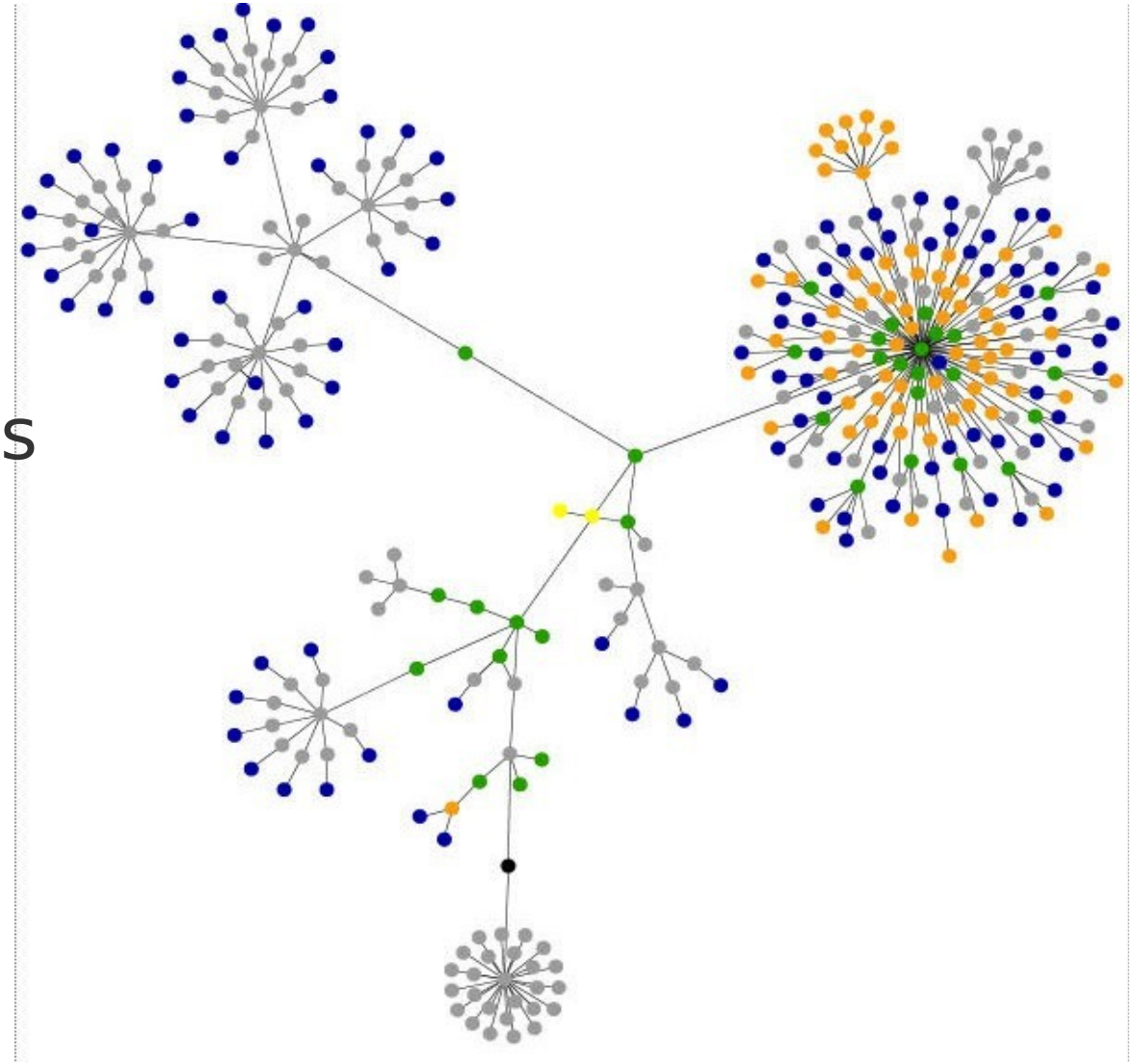


Hierarchical Structures

- Horizontal Trees

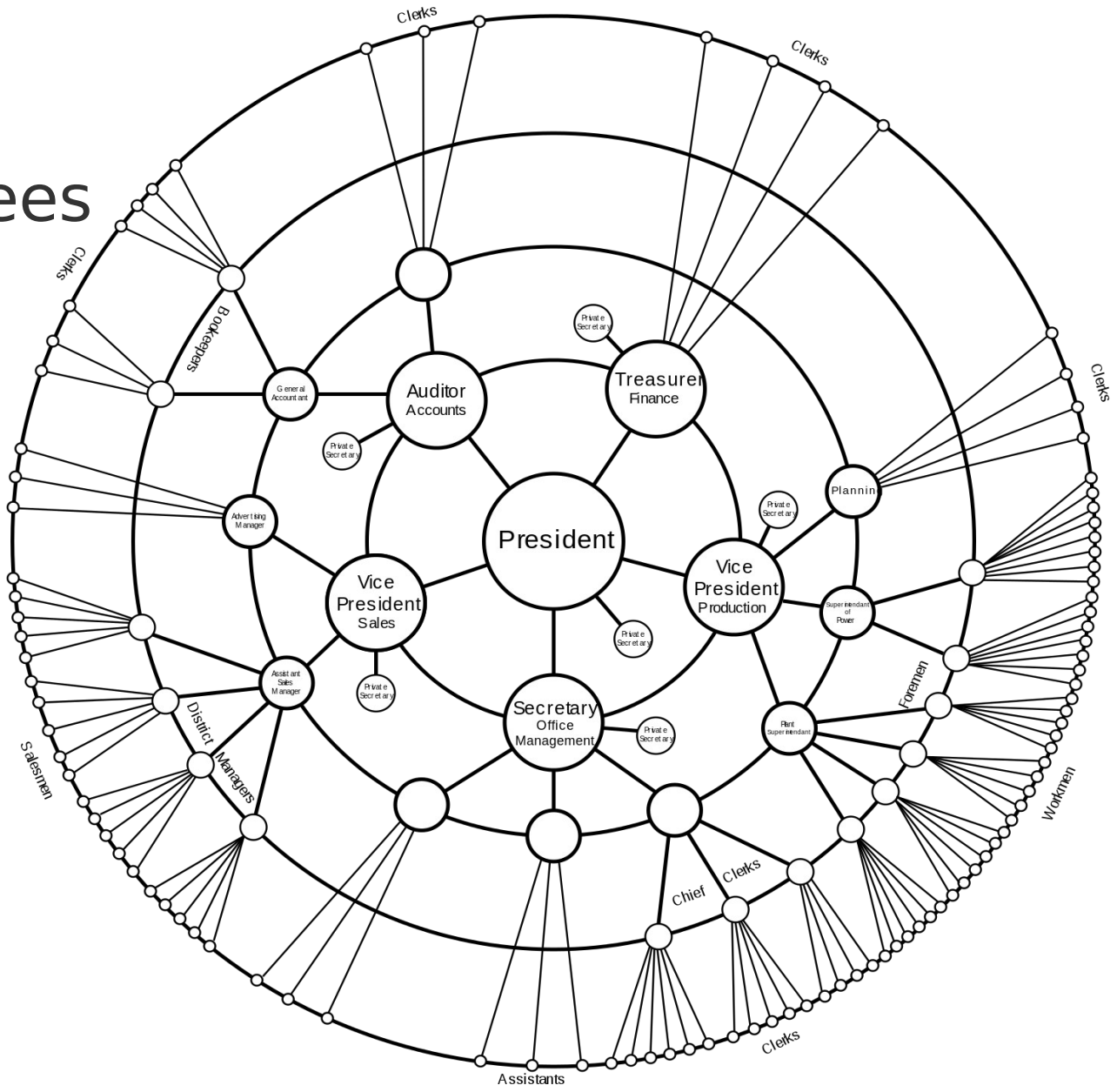
Hierarchical Structures

- Multi-Directional Trees
- Websites as Graphs



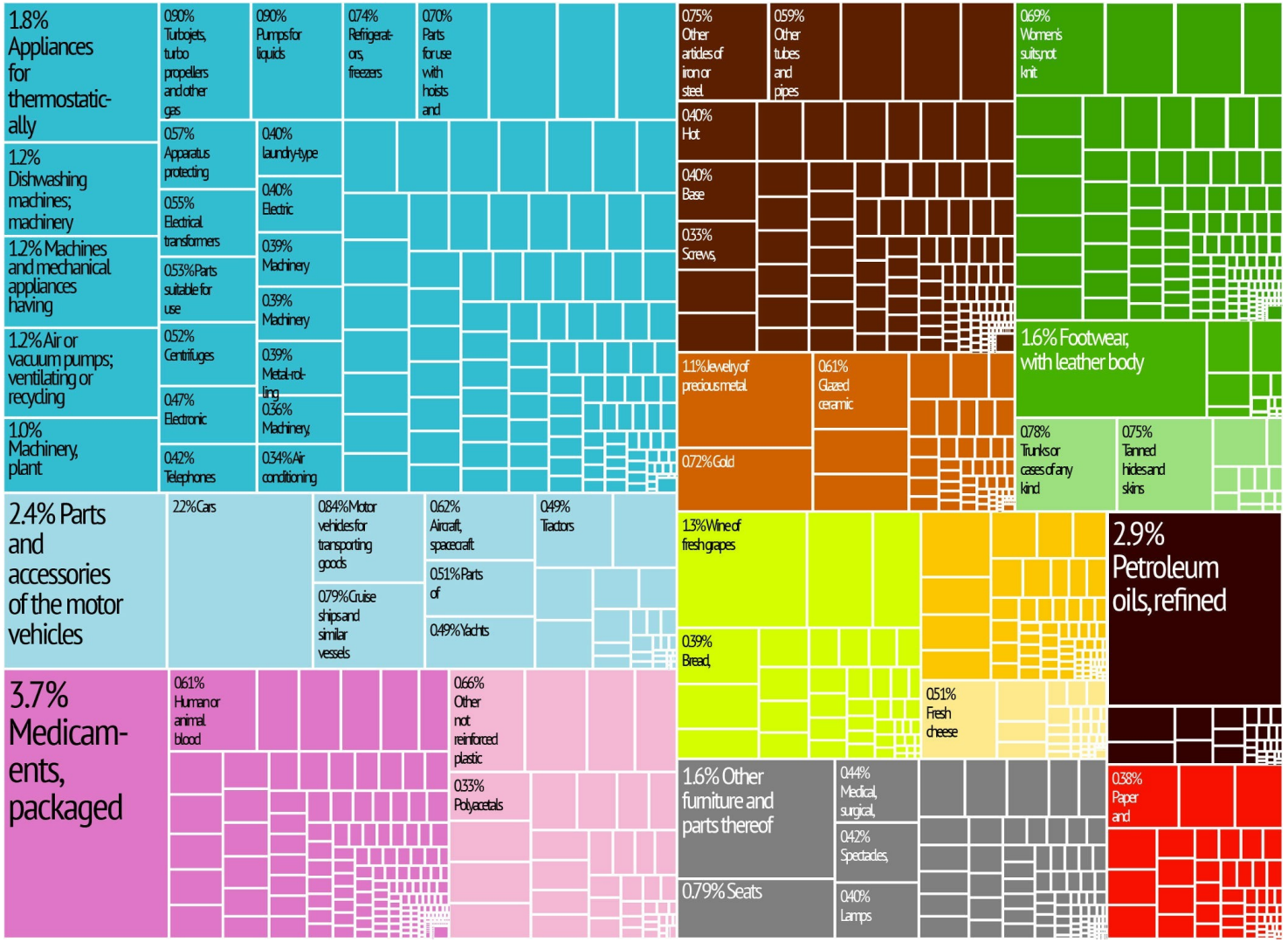
Hierarchical Structures

- Radial Trees



Hierarchical Structures

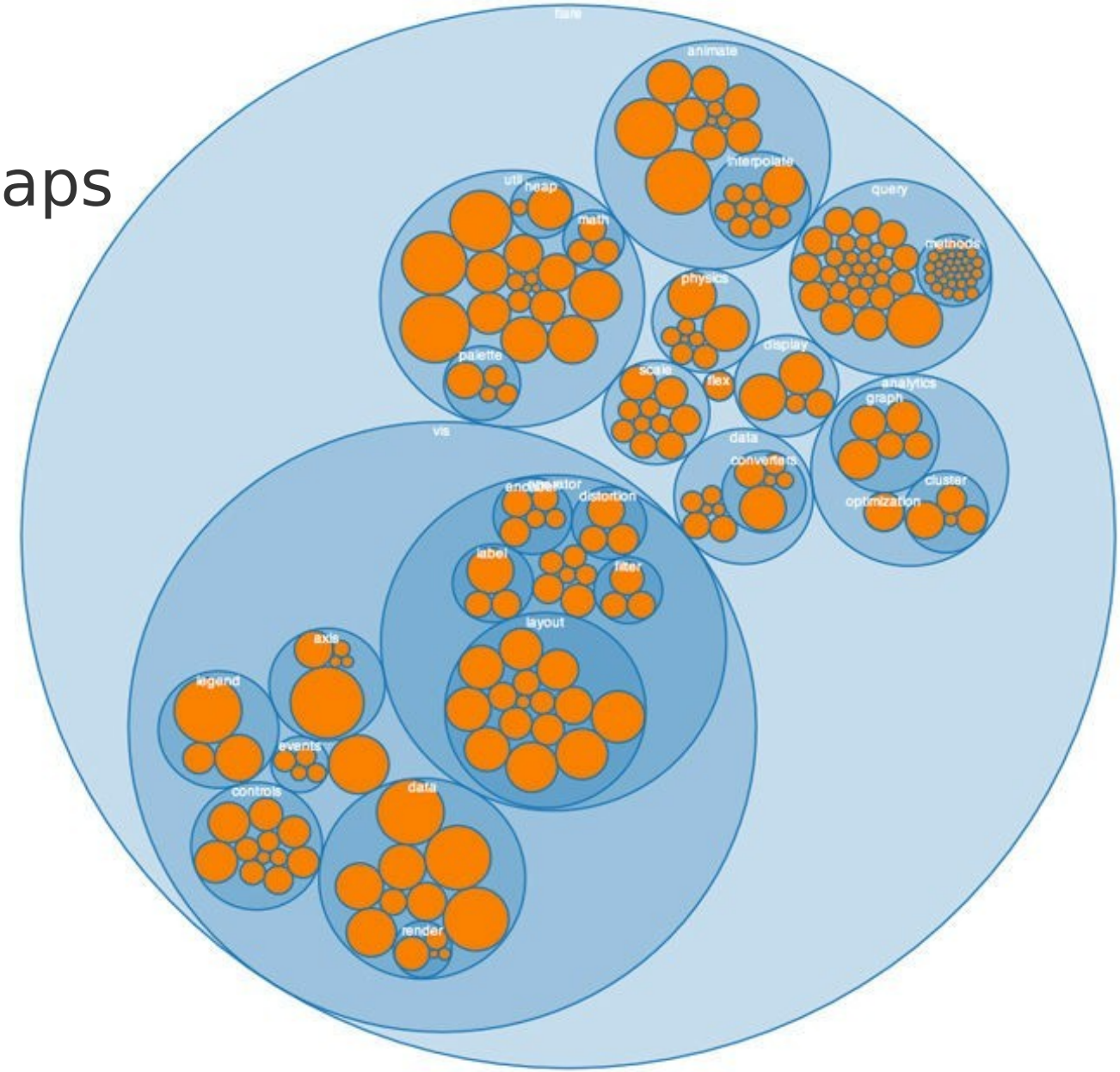
- Rectangular Tree Maps



Hierarchical Structures

Hierarchical Structures

- Circular Tree Maps



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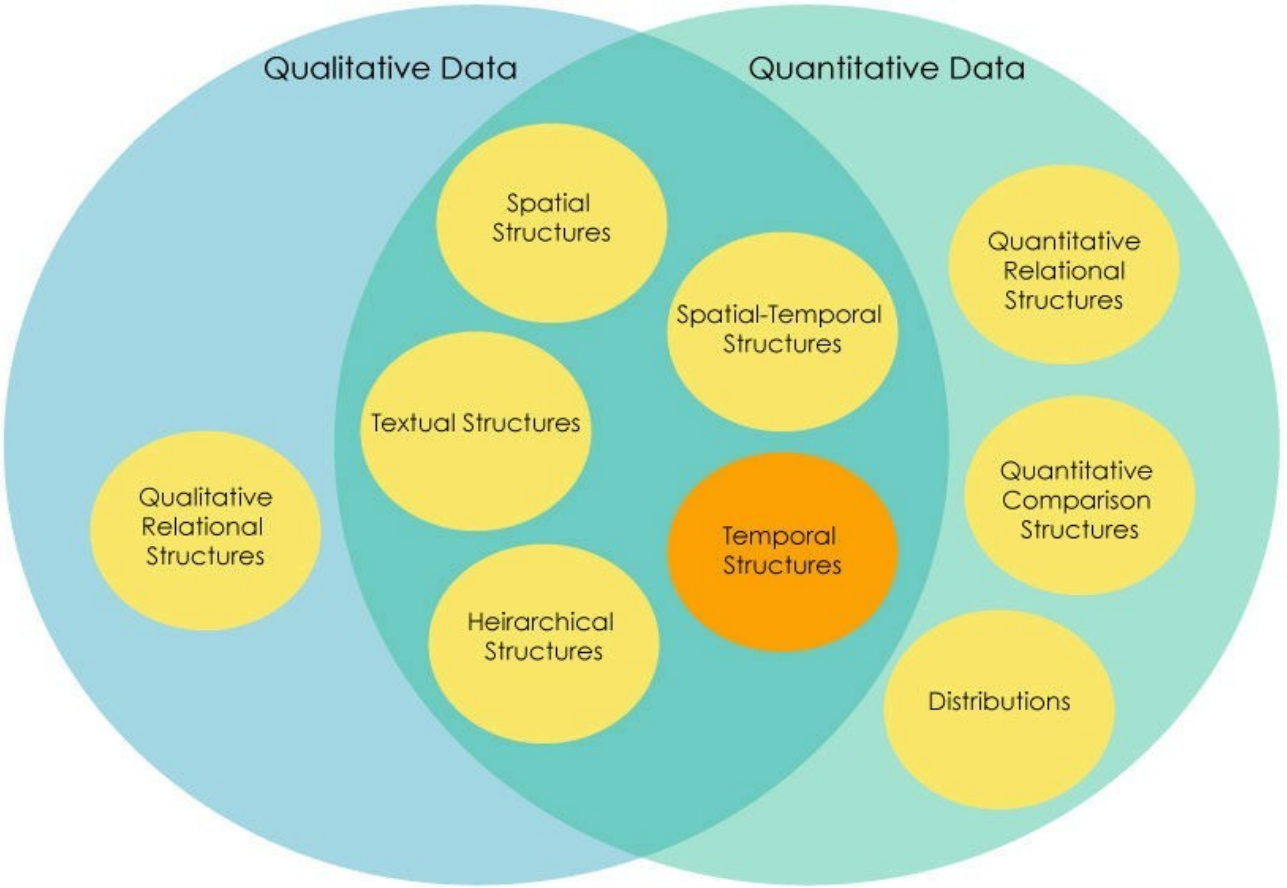
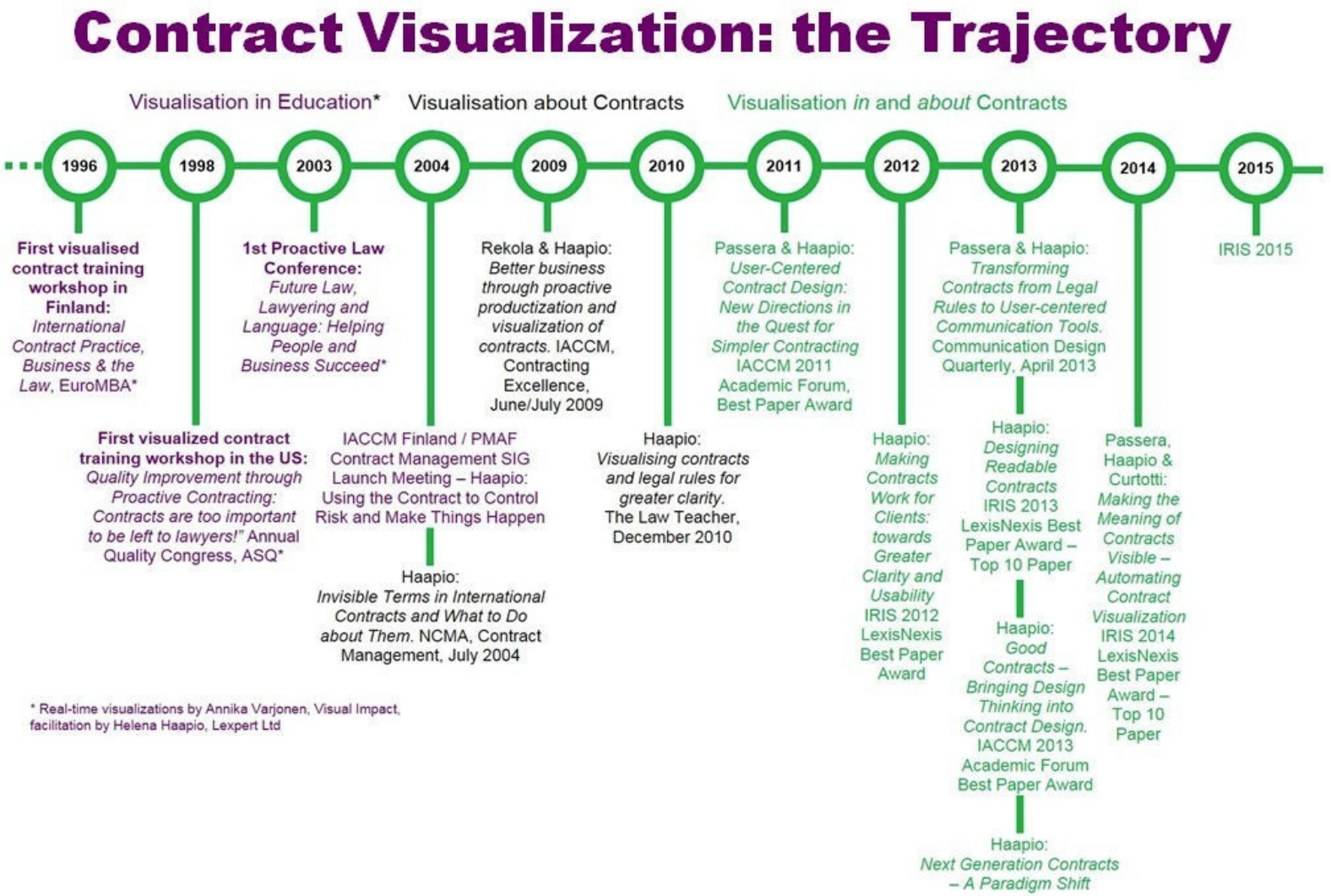


Temporal Structures

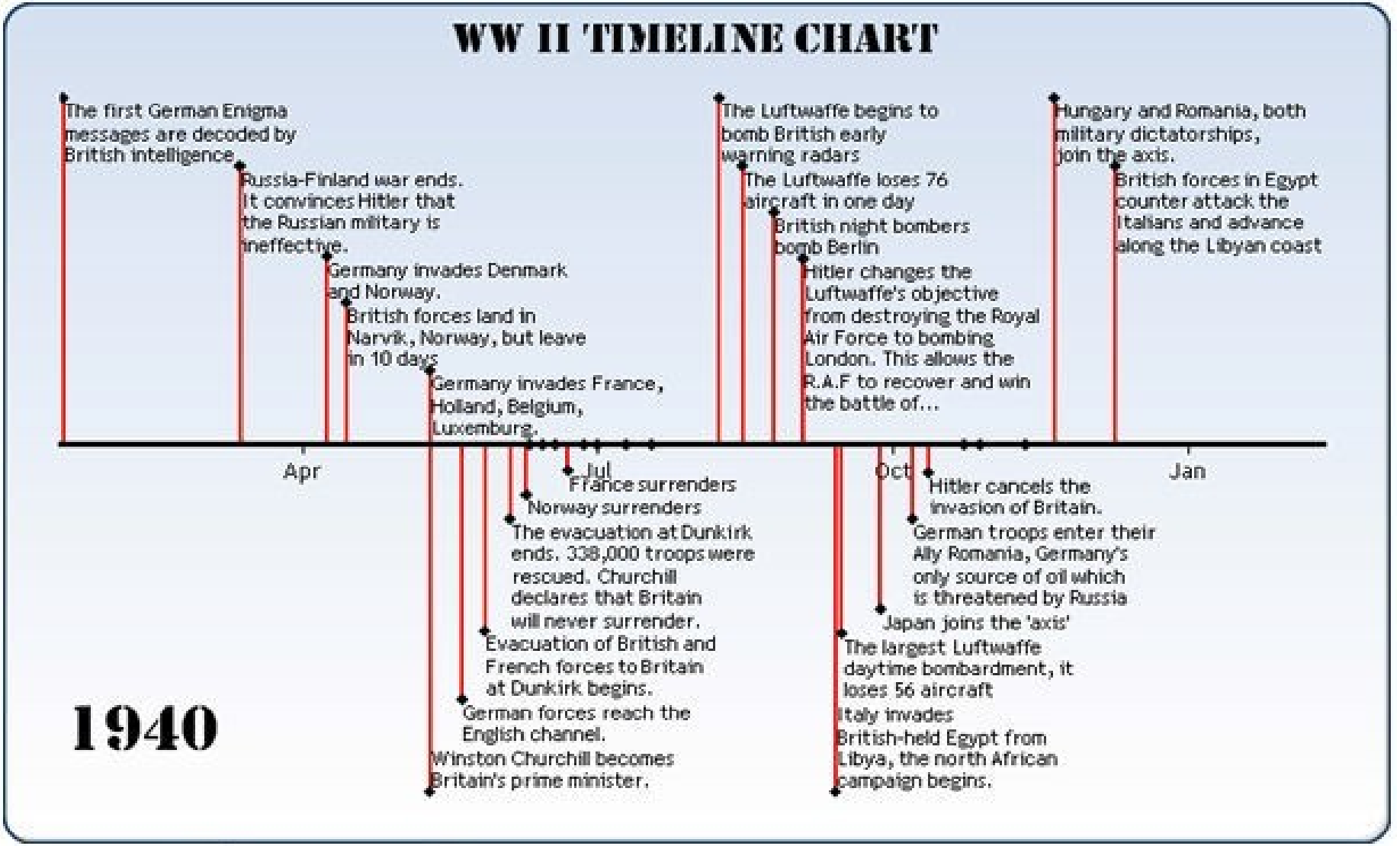
- Time Lines



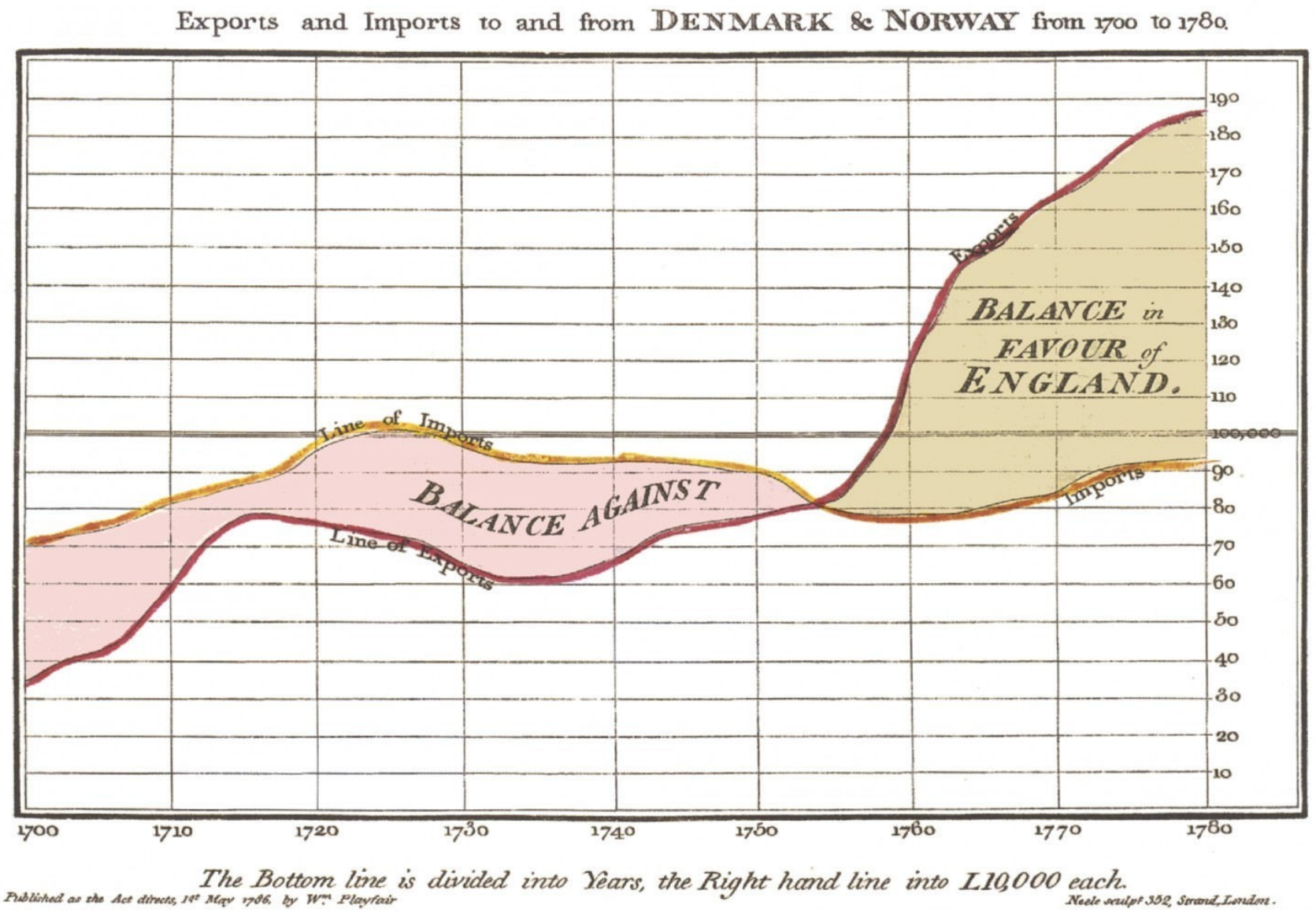
Temporal Structures

Timeline Chart

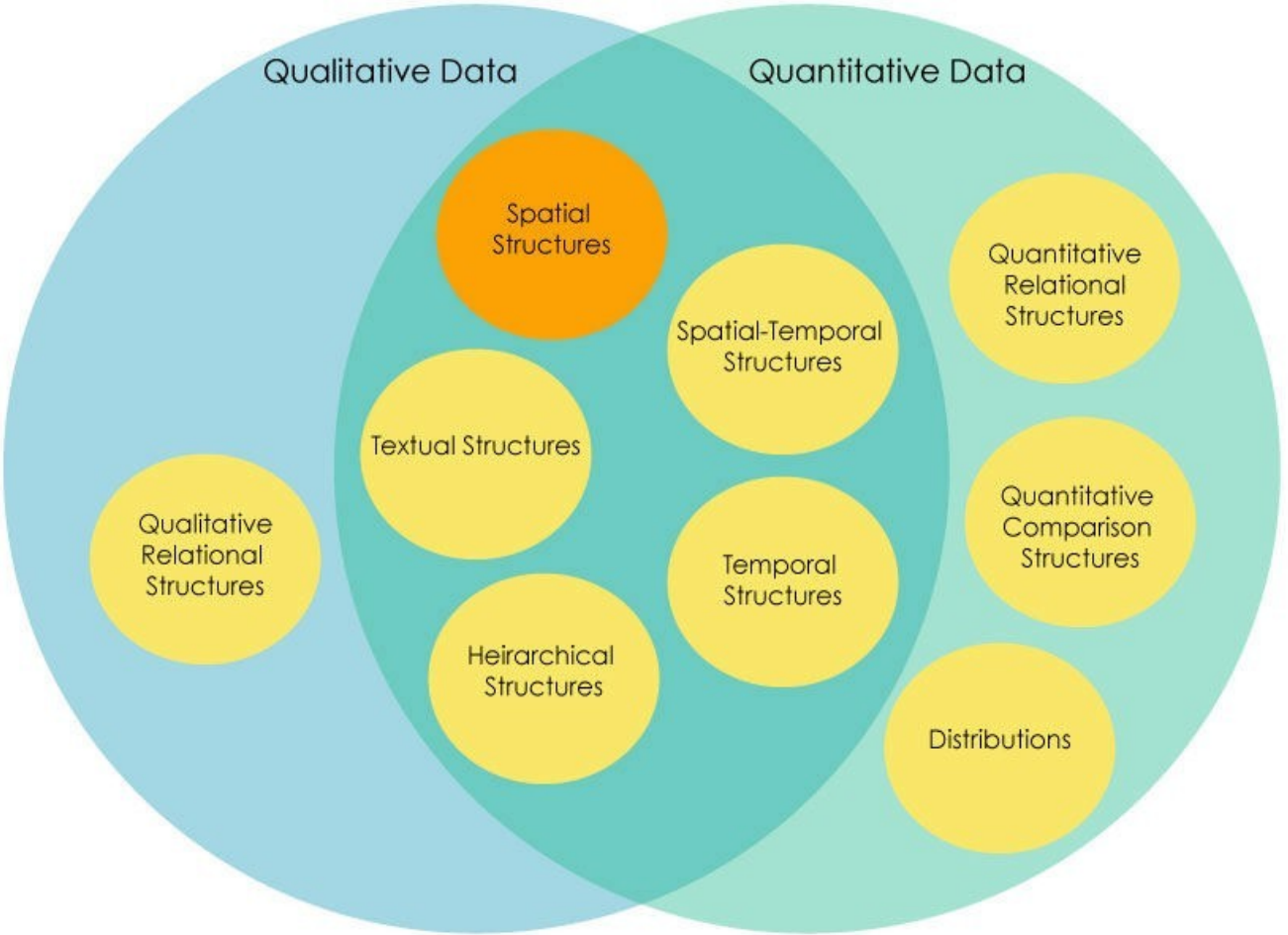
WW II Timeline Chart



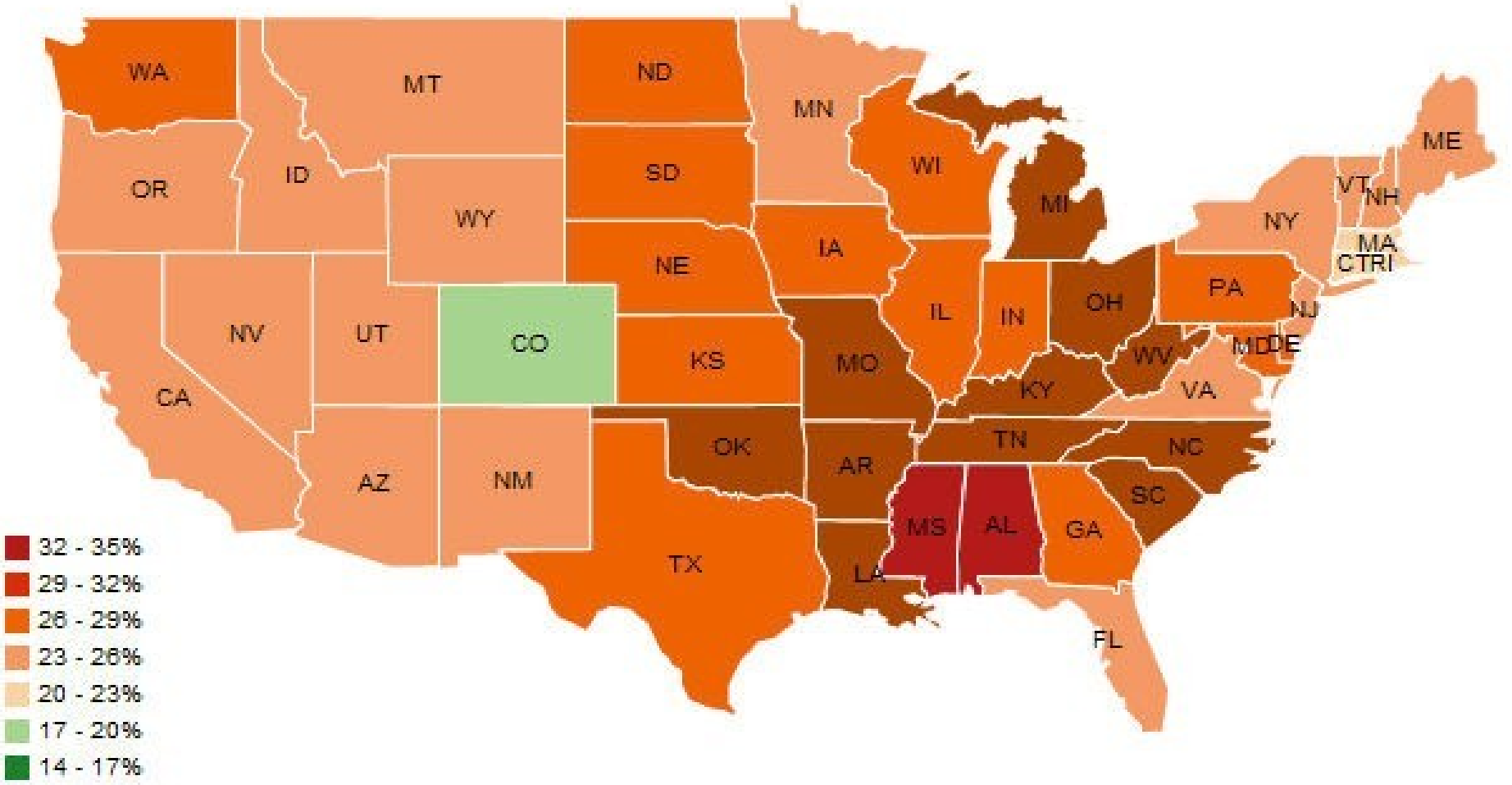
Temporal Structures



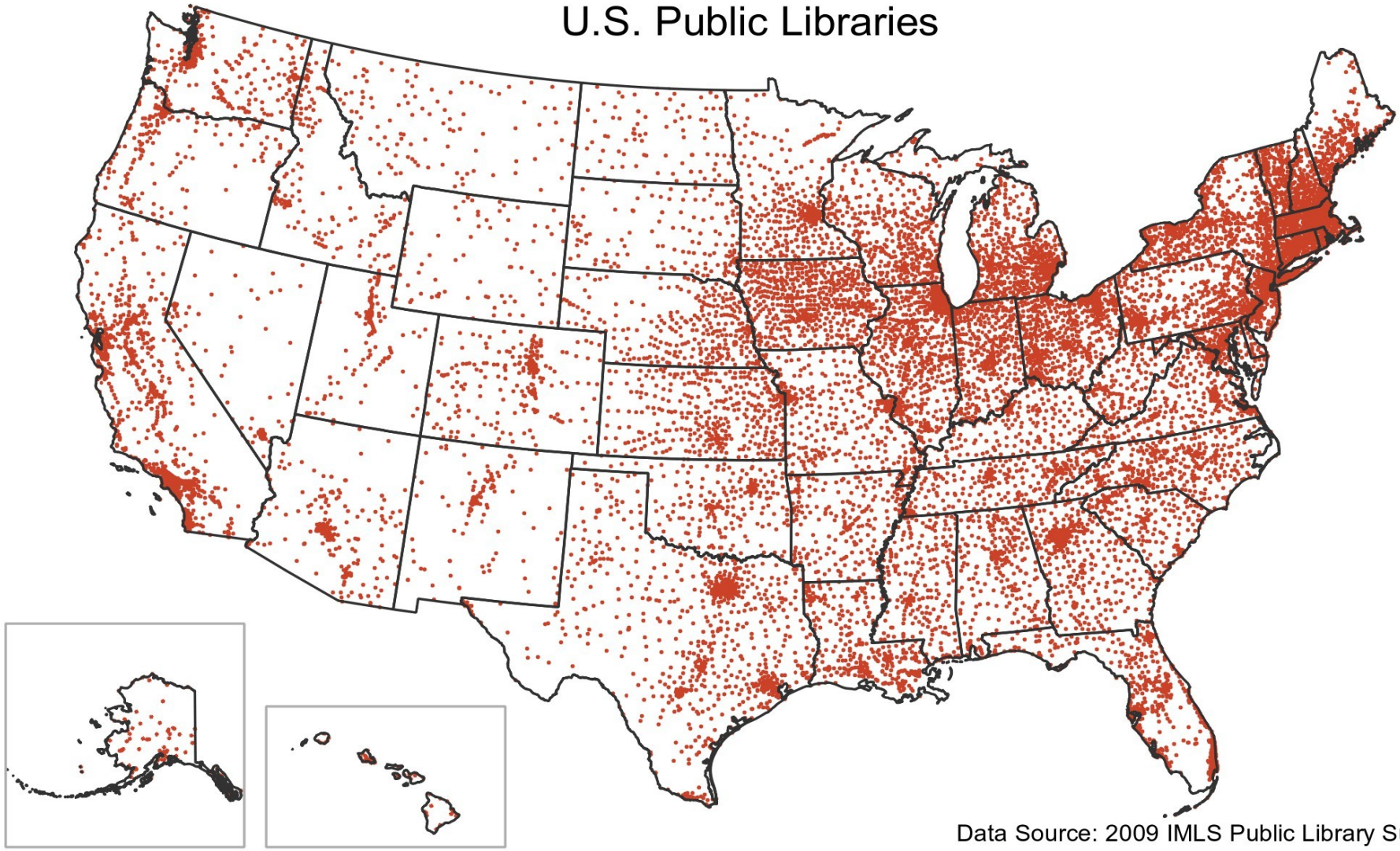
Different Types of Datas



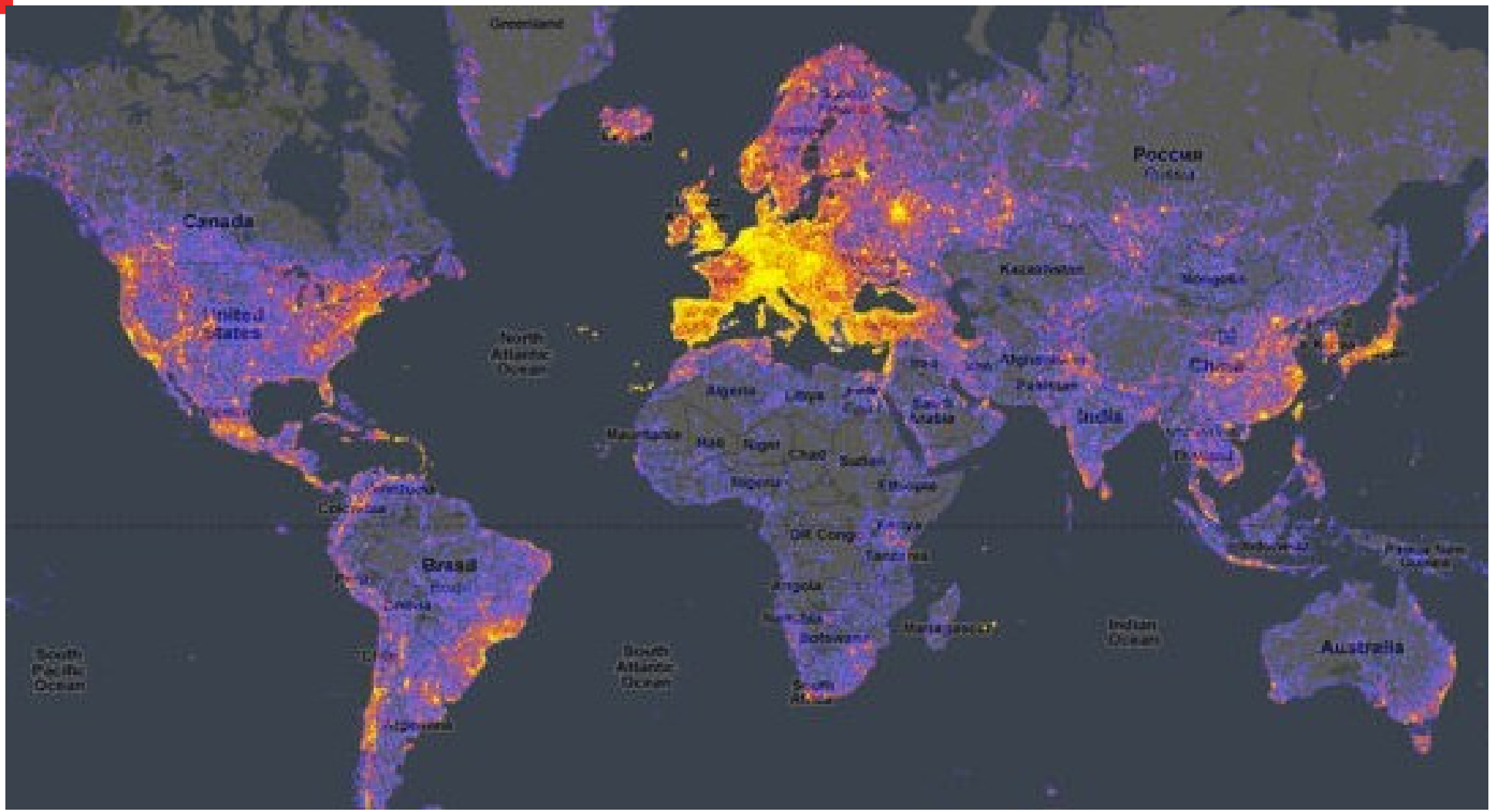
Spatial Structures: Maps



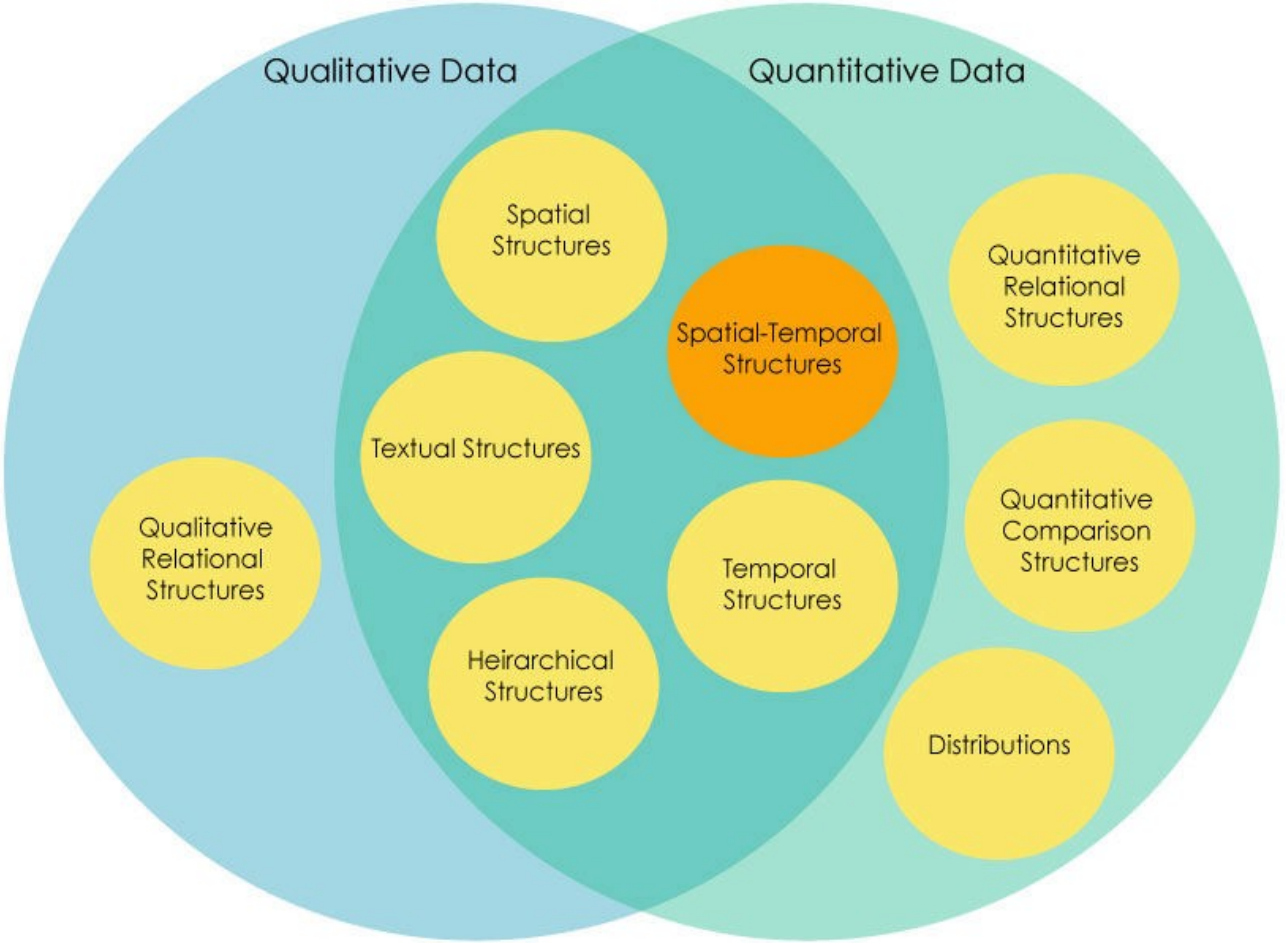
Spatial Structures: Maps



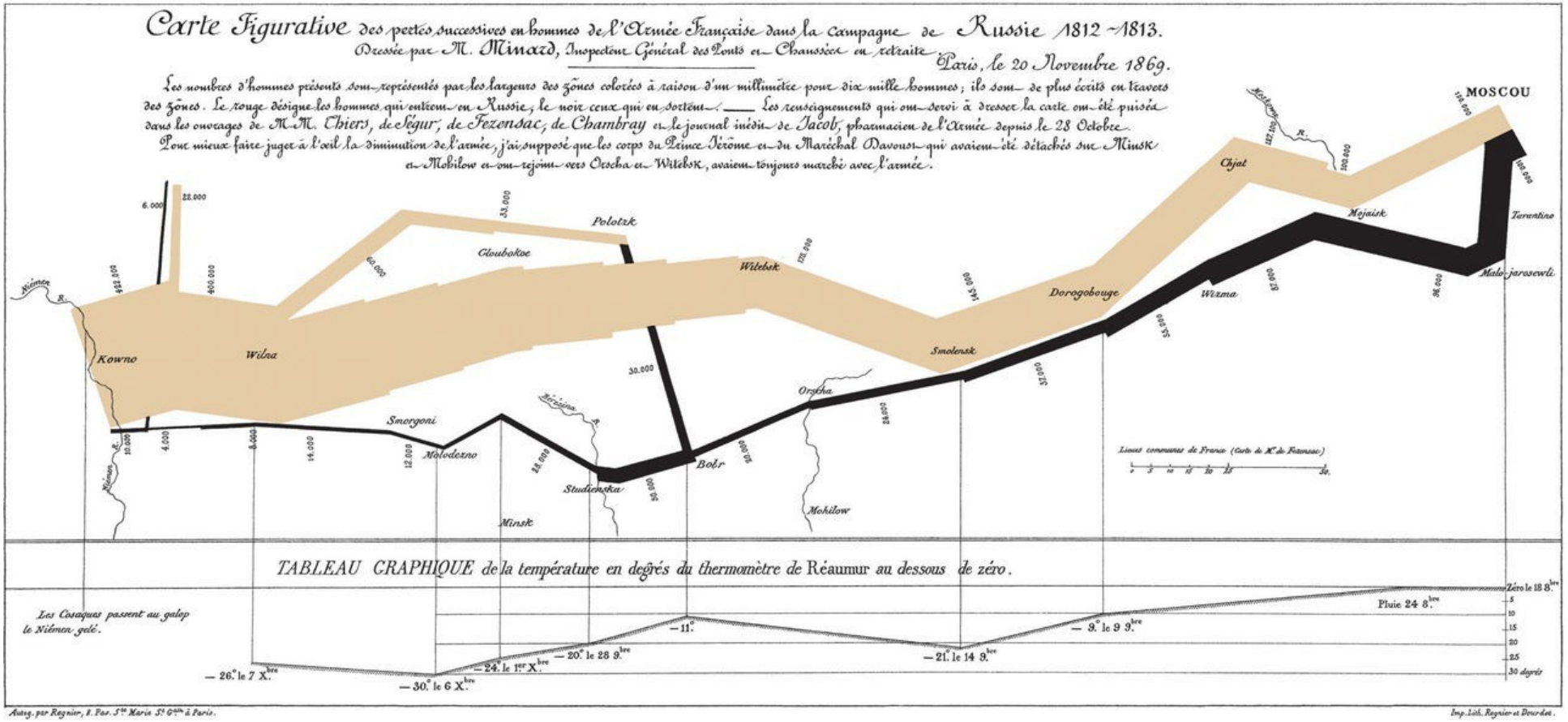
Spatial Structures: HeatMap



Different Types of Data

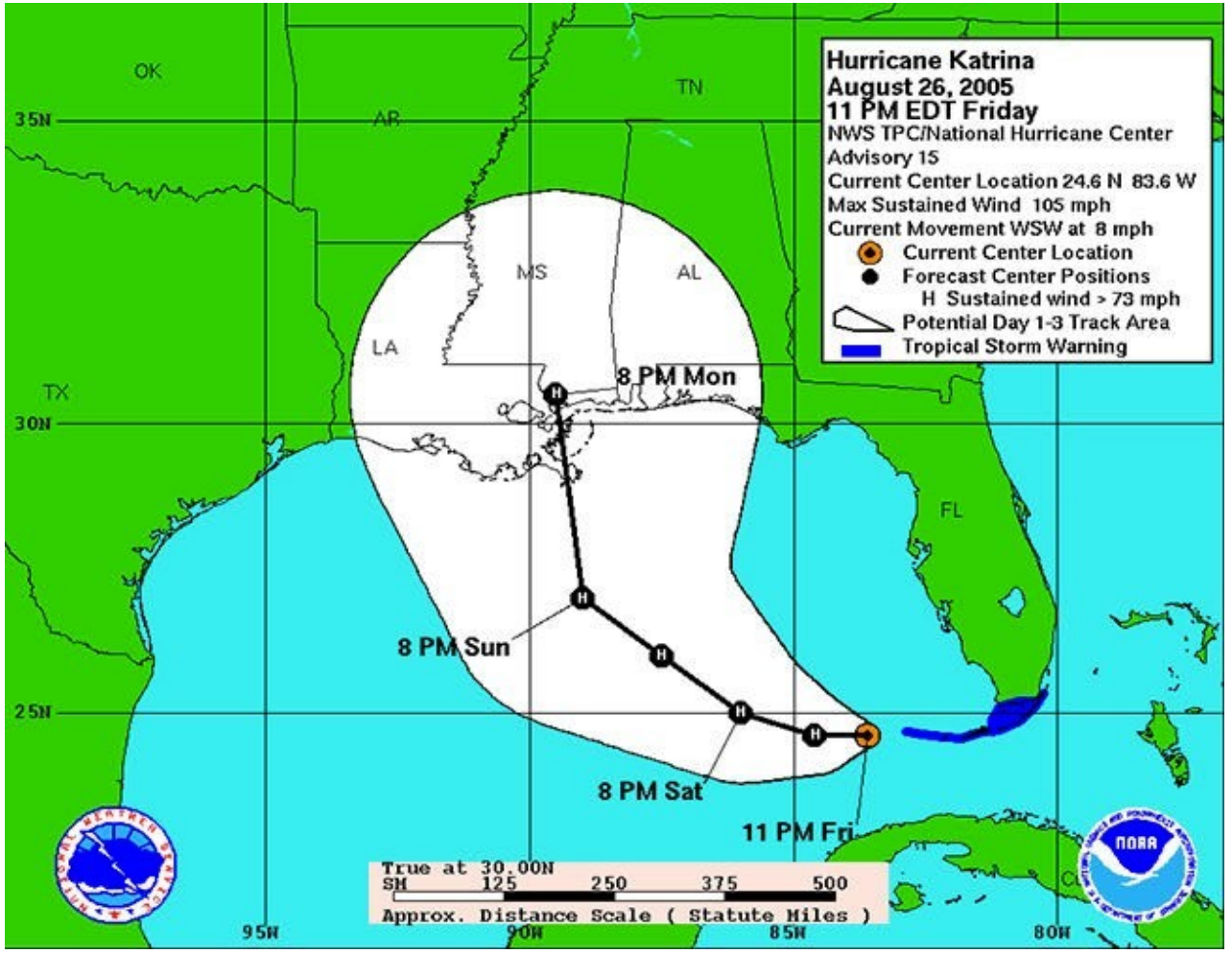


Spatial-Temporal Structures



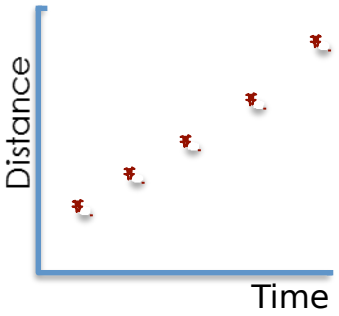
Charles Minard's map of Napoleon's disastrous Russian campaign of 1812. The graphic is notable for its representation in two dimensions of six types of data: the number of Napoleon's troops; distance; temperature; the latitude and longitude; direction of travel; and location relative to specific dates

Spatial-Temporal Structures

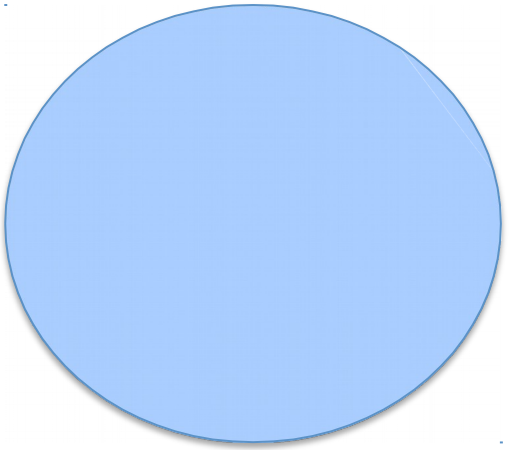


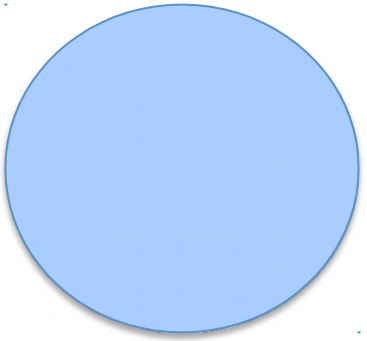
Visual Variables

- Visual variables for quantitative data (quantities)

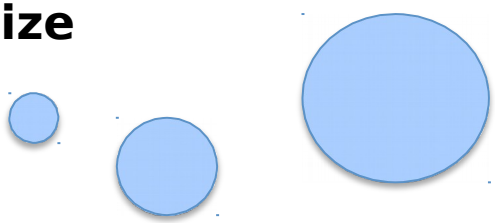


Position

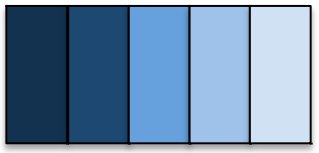


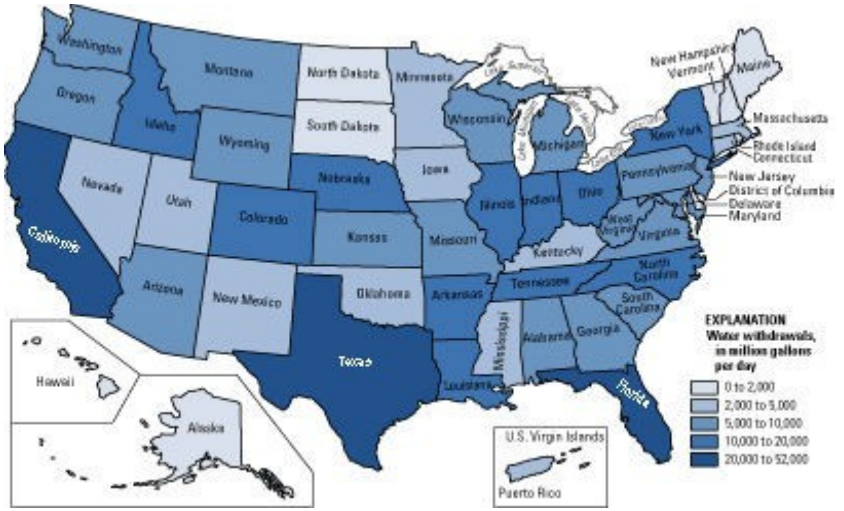


Size



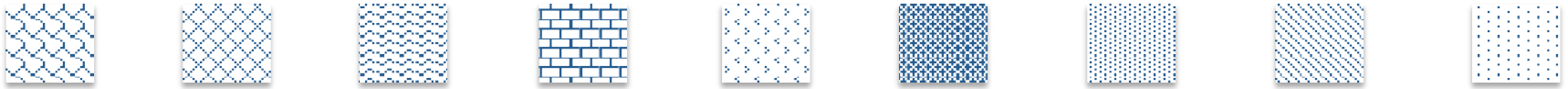
Value





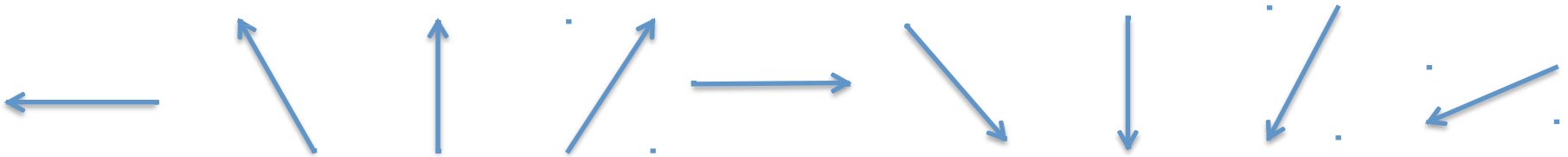
Visual variables for qualitative data (category)

Texture

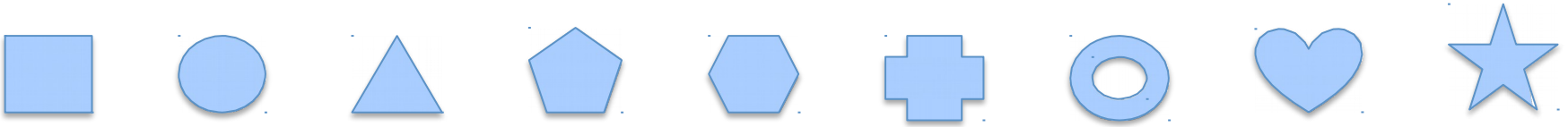


Colour

Orientation



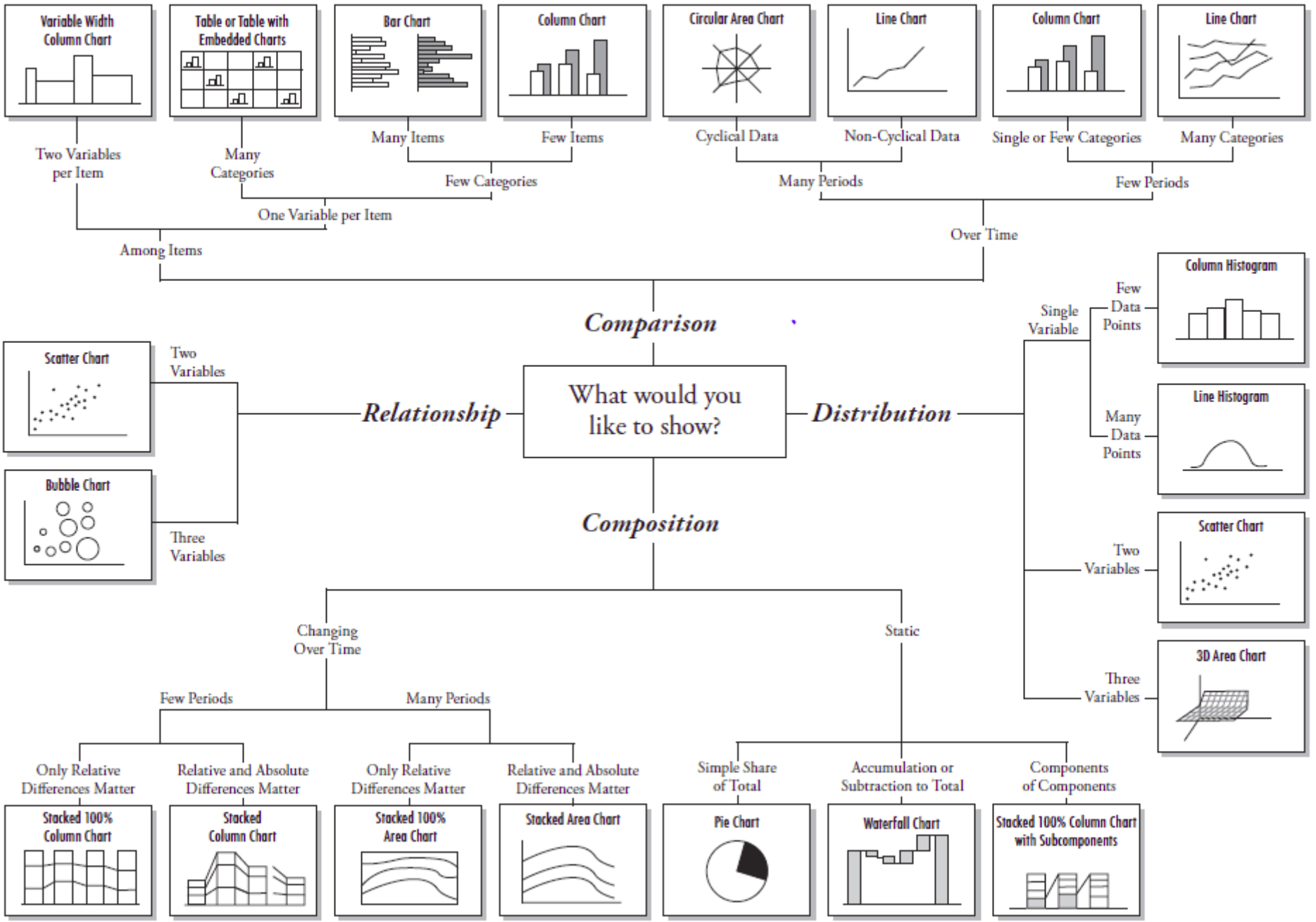
Shape



Class Activity

- Find a visualization online.
- Answer the following questions:
  - In one or two sentences, what story does it tell? Identify the data.
  - What type of data is it?
  - How many dimensions are being visually mapped? Identify the visual variables used.
  - Identify the type of visualization, or methods used.
  - If it is interactive, describe the interaction, and the data revealed.

Chart Suggestions—A Thought-Starter



Thank You