Data Visualization

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Introduction

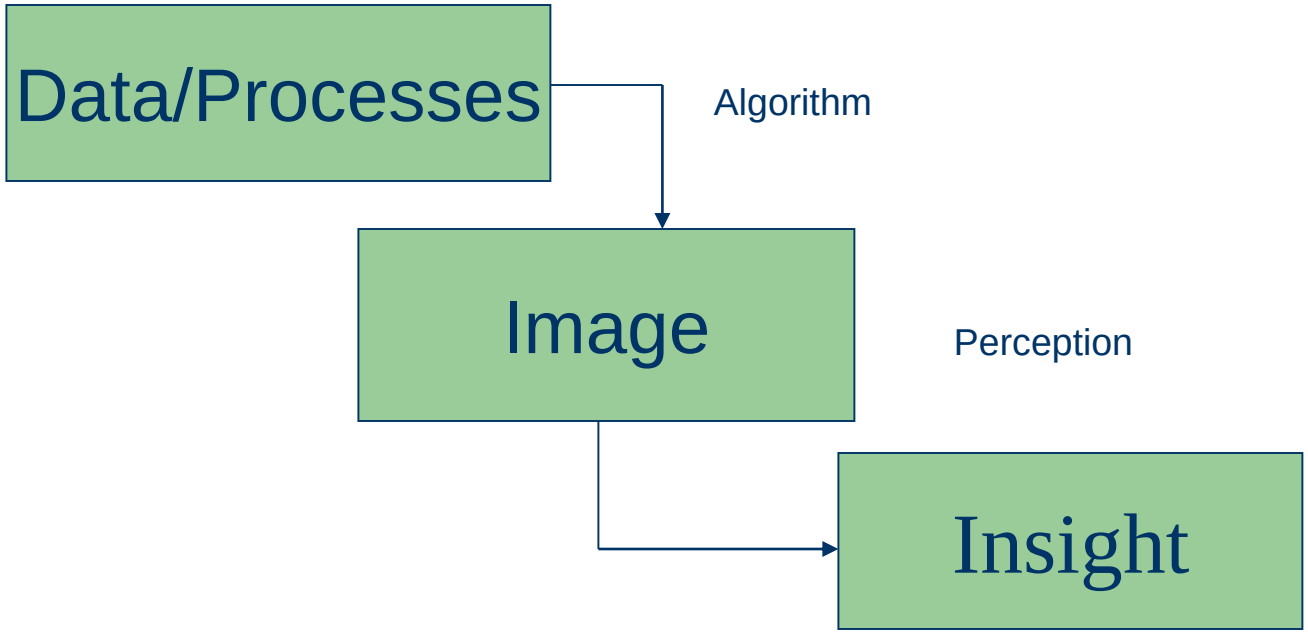
- What is Data Visualization?
- How does Data Visualization Work?
- What are the benefits of Data Visualization?
- Examples of Data Visualization
- Types of Visualization
- Types of Data
- Conclusion

What is Data Visualization

- Data visualization is the process of converting raw data into easily understood pictures of information that enable fast and effective decisions.
- Early in the 20th-century, gestalt psychologists observed that when elements were gathered into a figure, the figure took on a perceptual salience that exceeded the sum of its parts;

Data -> Easily Understood Pictures

- “transformation from numbers to insight requires two stages.”



Visual Variables

- Seven Visual Variables
  - position
  - form
  - orientation
  - color
  - texture
  - value
  - size
- Combined with a visual semantics for linking data attributes to visual elements

Image Theory

- Visual Processing occurs in 3 steps.
  - 1) formation of the retinal image,
  - 2) decomposition of the retinal image information into an array of specialized representations and
  - 3) reassembly of the information into object perception.

Uses Today

- Data-driven actions are increasingly made without access to information provided by traditional information presentation
- Information visualization is emerging as an important fusion of graphics, scientific visualization, database, and human-computer interaction.
  - In Military, Commercial Industries use Data Visualization to convey complex results as understandable images.

What is Data Visualization

- Data visualization is used in software applications to provide an intuitive graphical interface.
- It is applied to many areas to enable users to glean useful information from their data for faster, more informed decision making.
- These areas include: Military, private business sectors and scientific research.

What are the benefits of Data Visualization?

- Data visualization allows users see several different perspectives of the data.
- Data visualization makes it possible to interpret vast amounts of data
- Data visualization offers the ability to note exceptions in the data.
- Data visualization allows the user to analyze visual patterns in the data.
- Exploring trends within a database through visualization by letting analysts navigate through data and visually orient themselves to the patterns in the data.

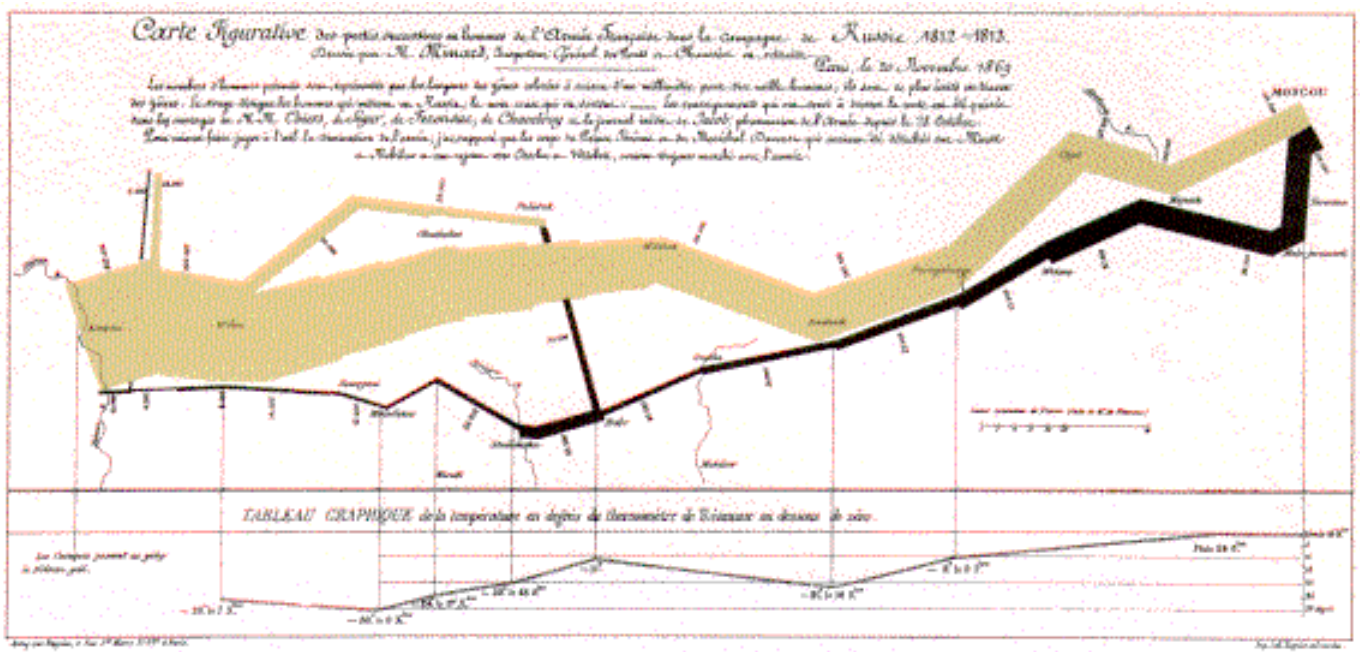
Benefits

- Data visualization can help translate data patterns into insights, making it a highly effective decision-making tool.
- Data visualization equips users with the ability to see influences that would otherwise be difficult to find.
- With all the data available, it is difficult to find the nuances that can make a difference.
- By simplifying the presentation, Data Visualization can reduce the time and difficulty it takes to move from data to decision making.

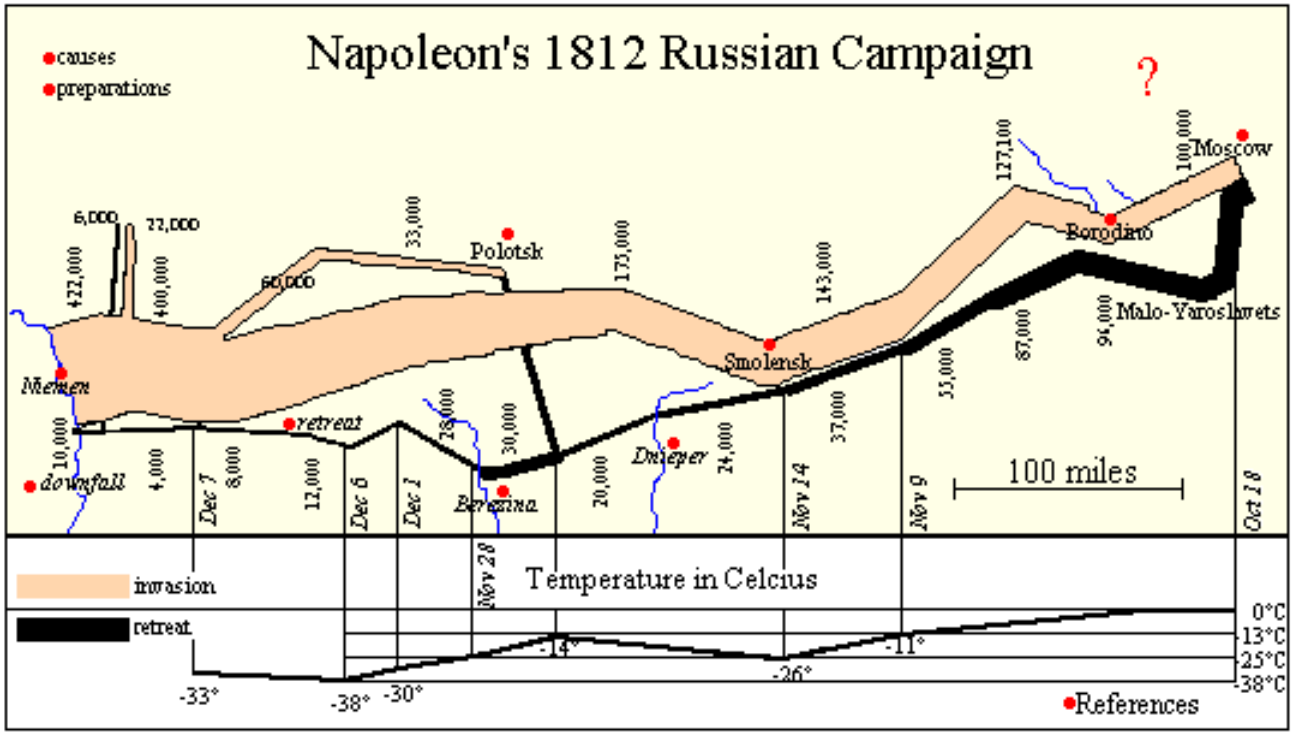
Data Visualization Examples

- The French engineer, Charles Minard (1781-1870), illustrated the disastrous result of Napoleon's failed Russian campaign of 1812. The graph shows the size of the army by the width of the band across the map of the campaign on its outward and return legs, with temperature on the retreat shown on the line graph at the bottom.

  Many consider Minard's original the best statistical graphic ever drawn.



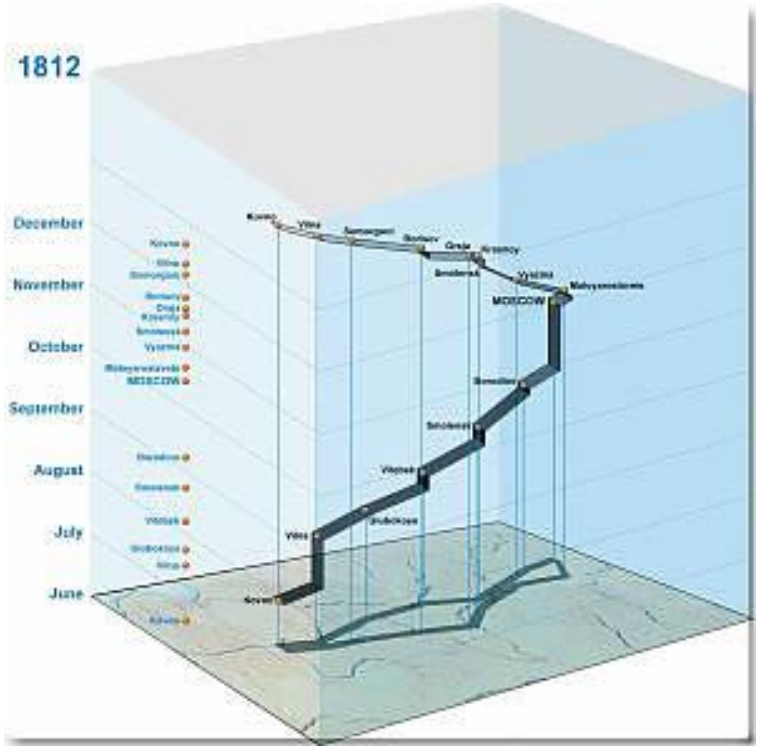
Charles Minard



http://www.math.yorku.ca/SCS/Gallery/minard/march-animated.gif

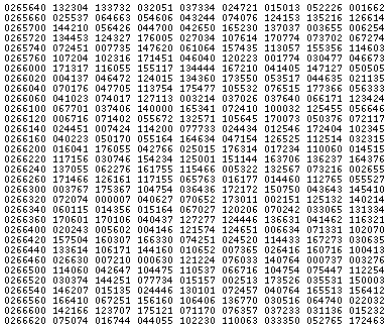
Charles Minard

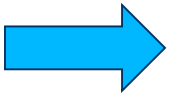
- This one unravels time into the 3rd dimension, superposed above the base map.

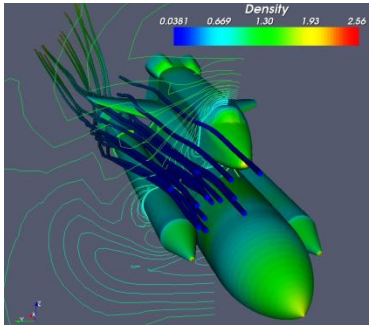


Sci. vis. Via Info. Vis.

- Scientific visualization: specifically concerned with data that has a well-defined representation in 2D or 3D space (e.g., from simulation mesh or scanner).







- Information visualization: concerned with data that does not have a well-defined representation in 2D or 3D space (i.e., “abstract data”).

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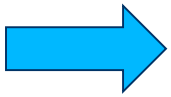
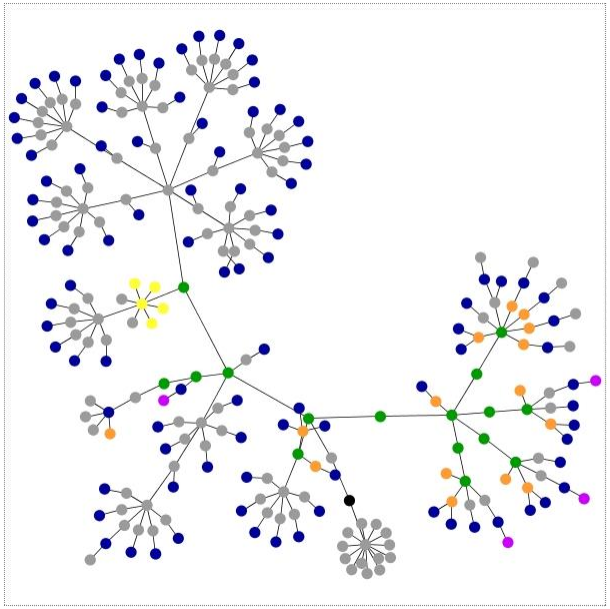
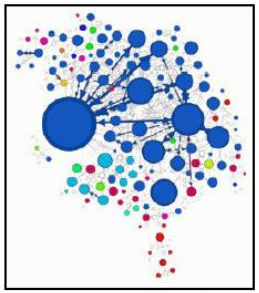
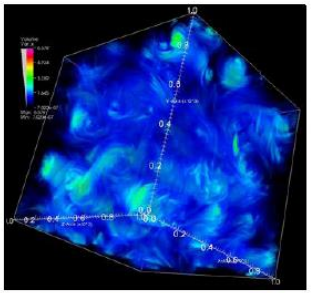
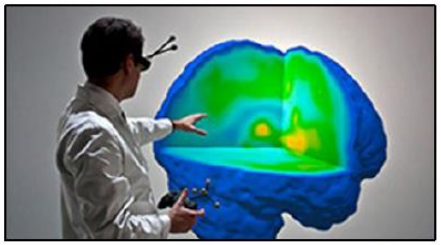


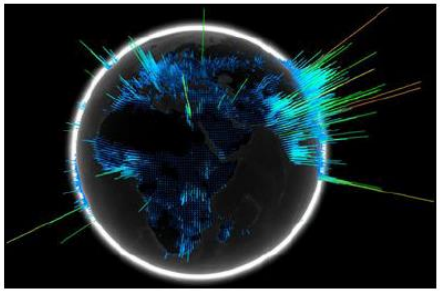


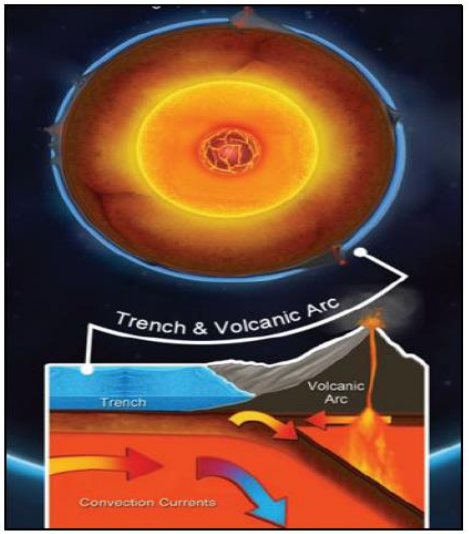
Types of visualization

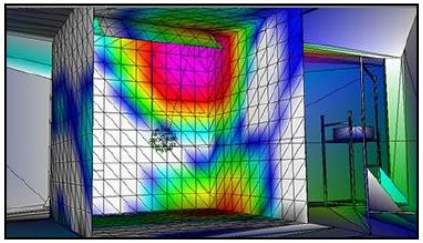


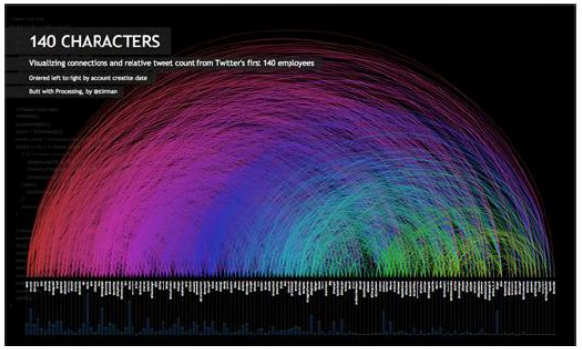


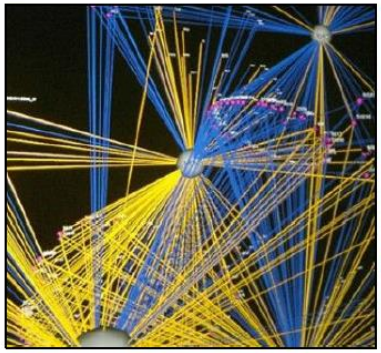


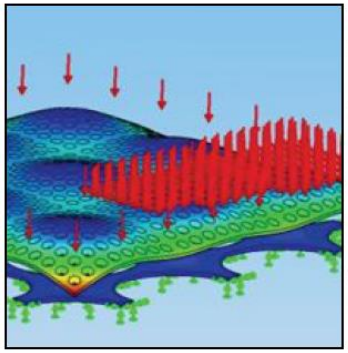


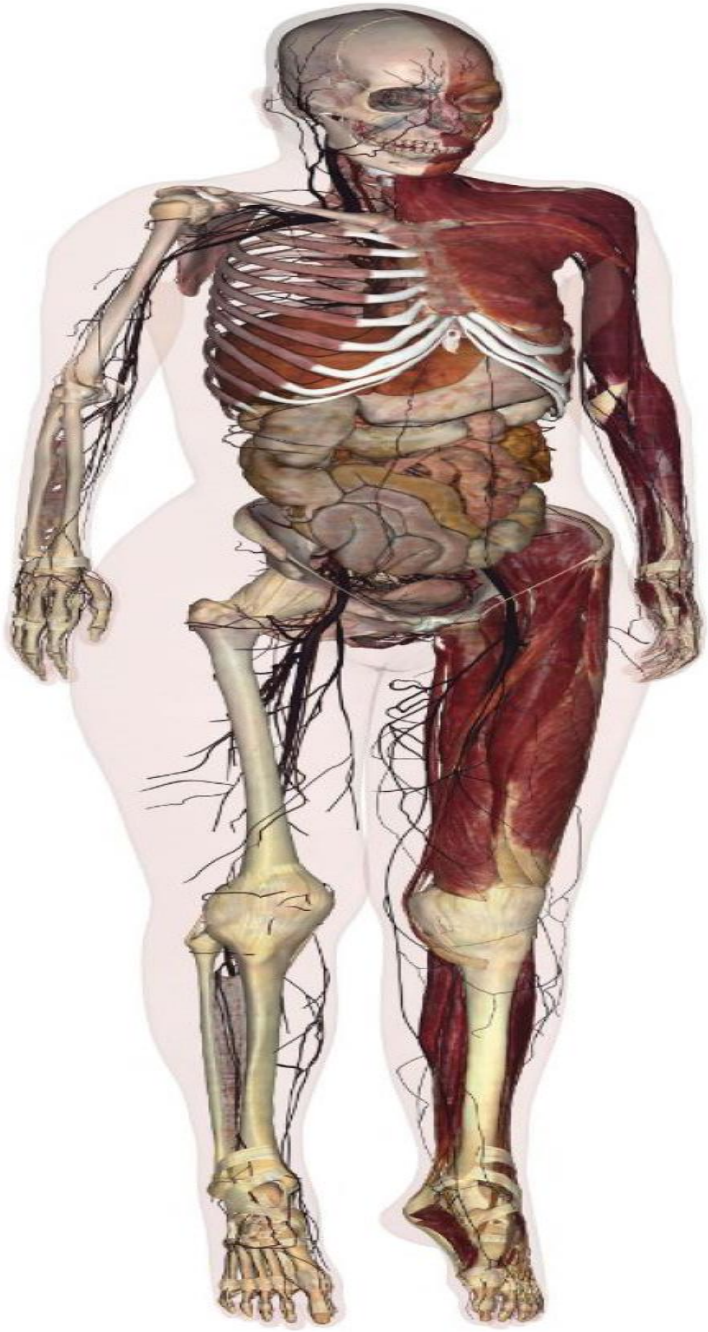




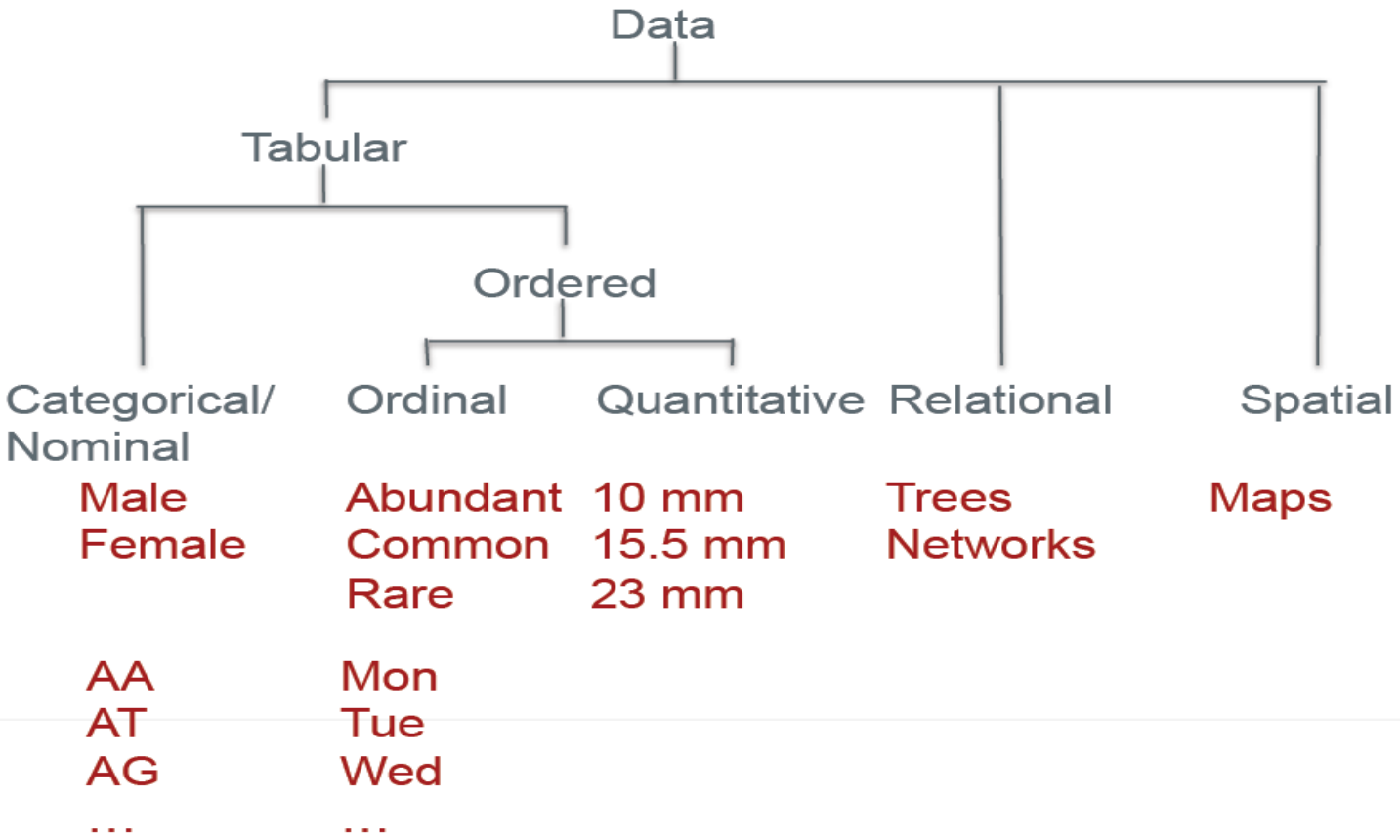








Types of Data



Conclusions

Graphical displays should:

- 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 have to say
- present many numbers in a small space
- 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