Seneca | SDDS

Business Analytics

Introduction to Data Visualization

BAN140 - Section NBB /NCC

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Week 1

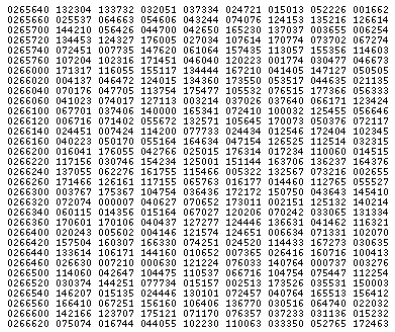
Week Topics

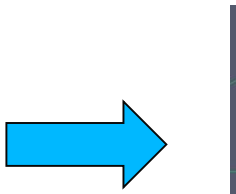
Current Week

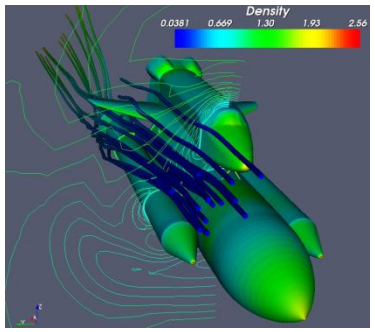
- Introduction
- Communicating Visually

What is data visualization?

- **Data visualization** is the ***process*** of acquiring, interpreting and comparing data in order to clearly **communicate** complex ideas, thereby facilitating the identification and analysis of meaningful **patterns**.
  - Computer-based visualization systems provide visual representations of datasets designed to help ***people carry out tasks more effectively***







More about What is data visualization?

- **Data visualization** is a *graphic representation that expresses the significance of data*. It reveals **insights** and **patterns** that are **not immediately visible** in the raw data. **It is an art** through which information, numbers, and measurements can be made more understandable. According to (Friedman 2008):

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http://www.bu.edu/students/life/
http://www.bu.edu/students/life/housing/
http://www.bu.edu/students/life/dining-vending/
http://www.bu.edu/students/life/phone/
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http://www.bu.edu/students/academics/registration/
http://www.bu.edu/students/academics/advising/
http://www.bu.edu/students/academics/grades/
http://www.bu.edu/students/academics/services/
http://www.bu.edu/students/academics/support/
http://www.bu.edu/students/health/
http://www.bu.edu/students/health/services/
http://www.bu.edu/students/health/counseling/
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http://www.bu.edu/students/health/varsitysports/
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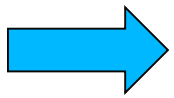
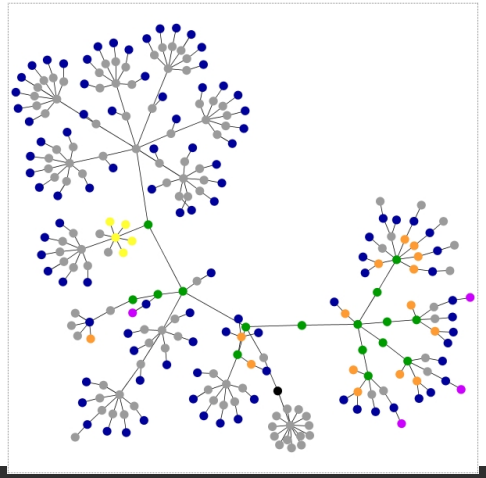




Visualization offers a method for seeing the unseen.

Dictionary Definition

- Definition (www.oed.com)
- The **action** or **fact** of visualizing; the power or process of forming a mental picture or vision of something not actually present to the sight; a picture thus formed.

Check these data sets

Set A		Set B		Set C		Set D	
X	Y	X	Y	X	Y	X	Y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	19	12.5
12	10.84	12	9.11	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89

Summary Statistics

$u_X = 9.0$ $\sigma_X = 3.317$

$u_Y = 7.5$ $\sigma_Y = 2.03$

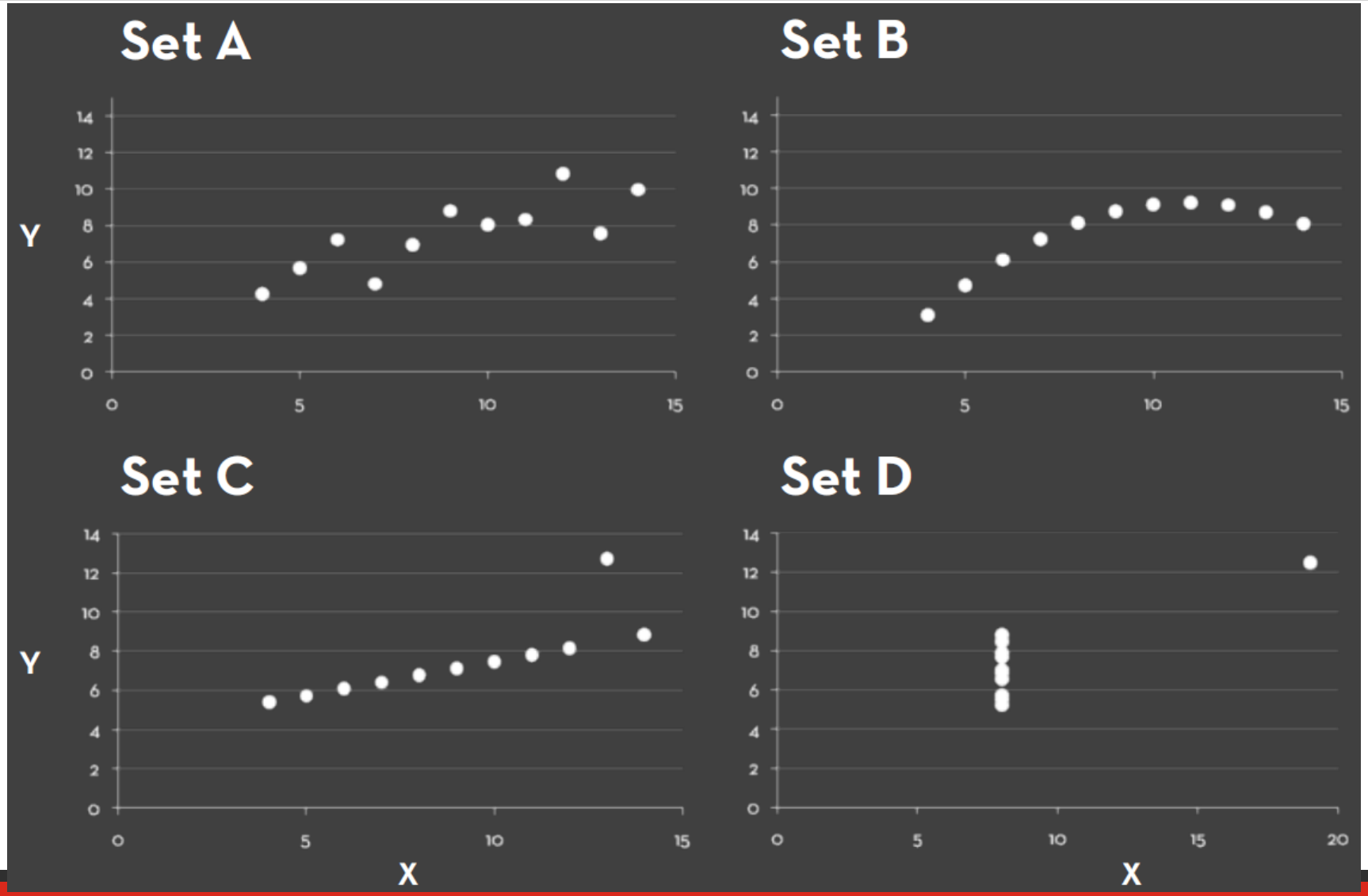
Linear Regression

$Y = 3 + 0.5\ X$

$R^2 = 0.67$

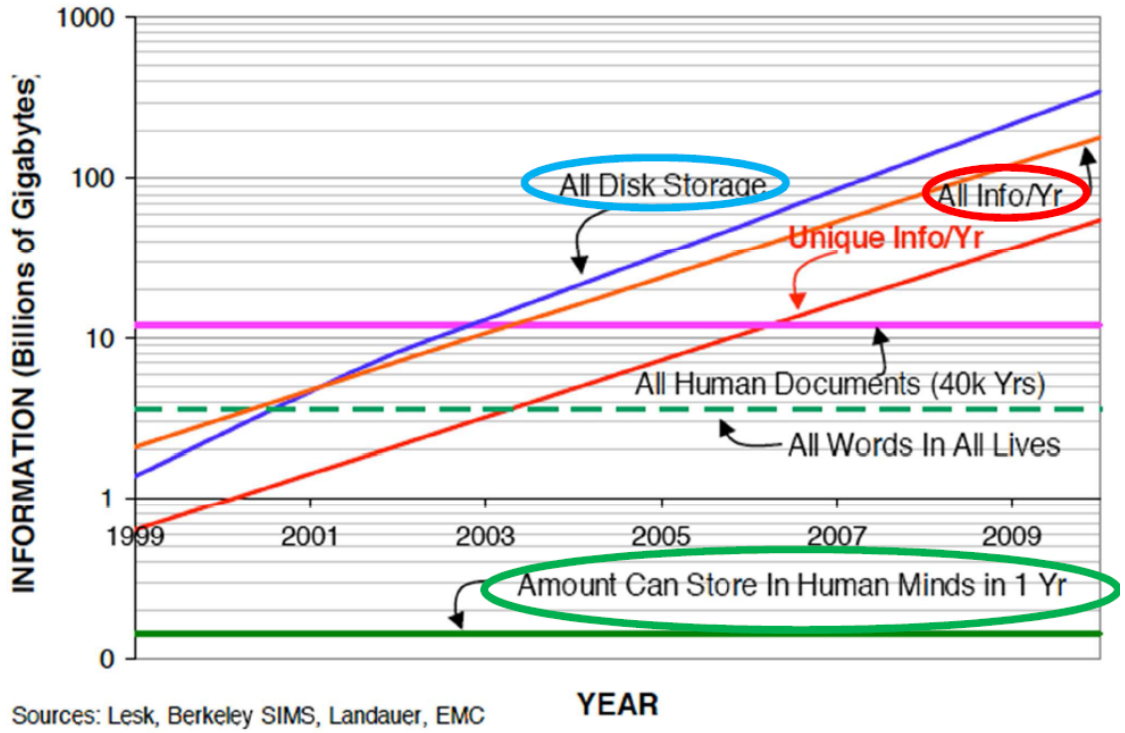
[Anscombe 73]

What Now?



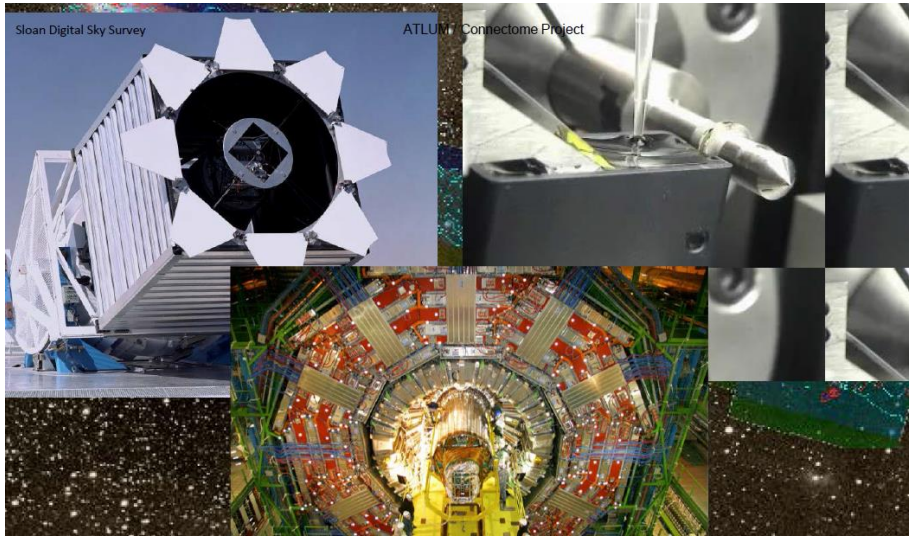
Why Data Visualization is important?

- Thanks to the rise of **social media**, the **popularity** of mobile devices, and service digitalization, data is available on any human activity that utilizes technology.
  - The world produces **2.5 quintillion** bytes of data every day, and 90% of all data has been created in the last two years.



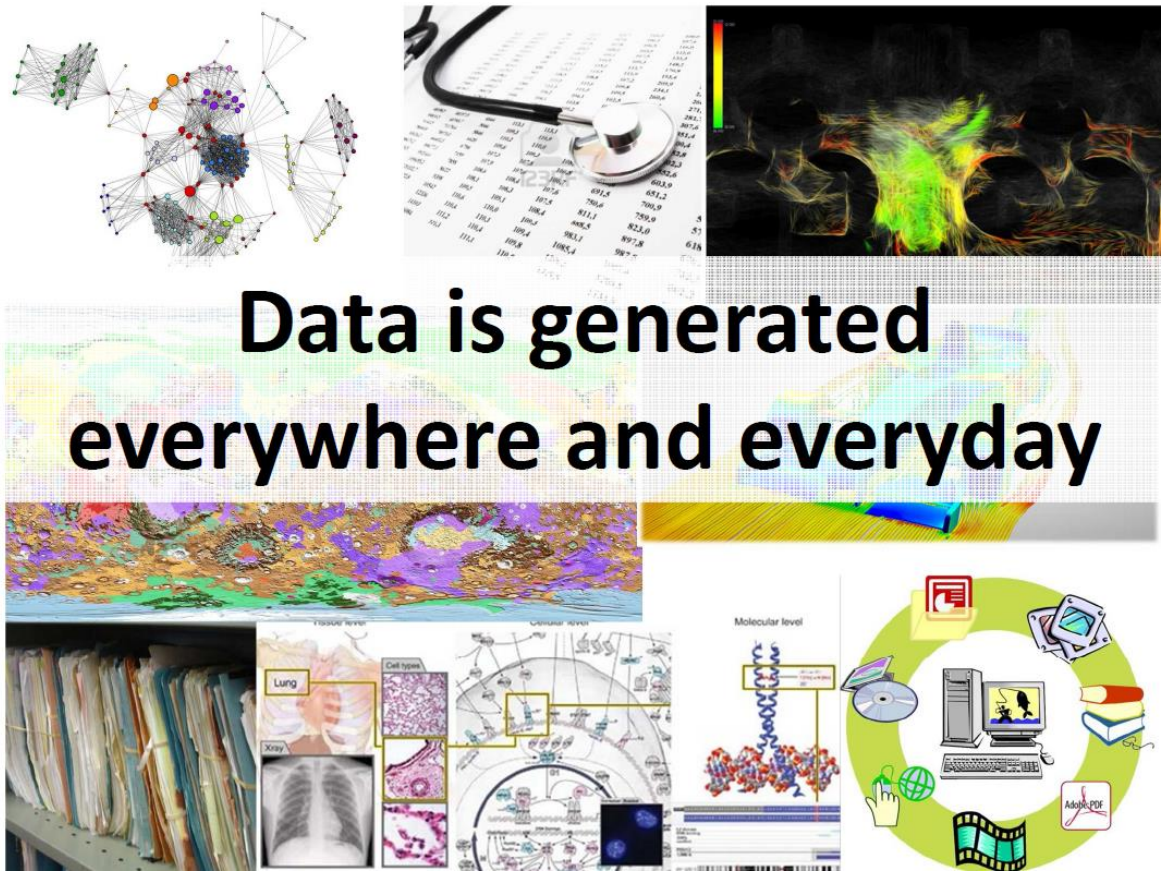
Why Data Visualization is important?

- Information Explosion
- Instrument Data Explosion
  - "The Industrial Revolution of Data"



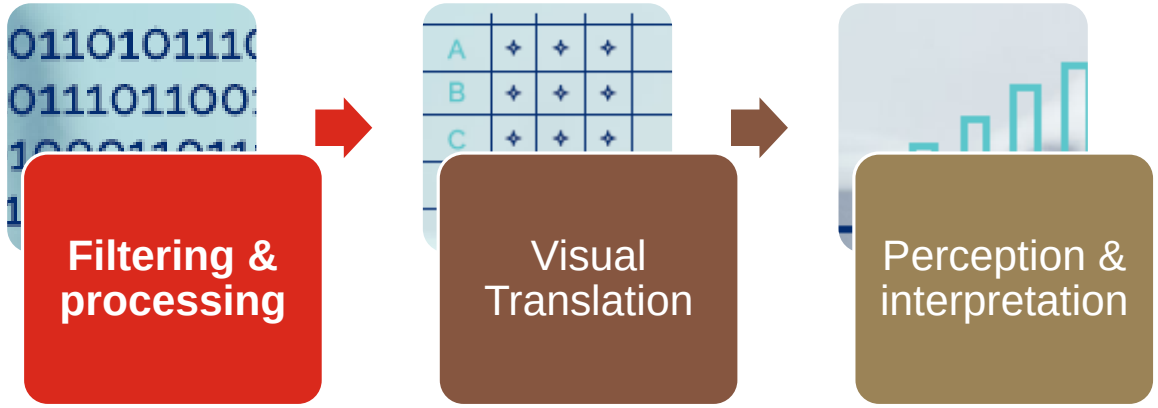
Why Data Visualization is important?

- The generated information is hugely valuable and makes it possible to analyze trends and patterns, and to use big data to **draw connections between events**. Thus, **data visualization** *can be an effective mechanism for presenting the end user with understandable information in real time*.

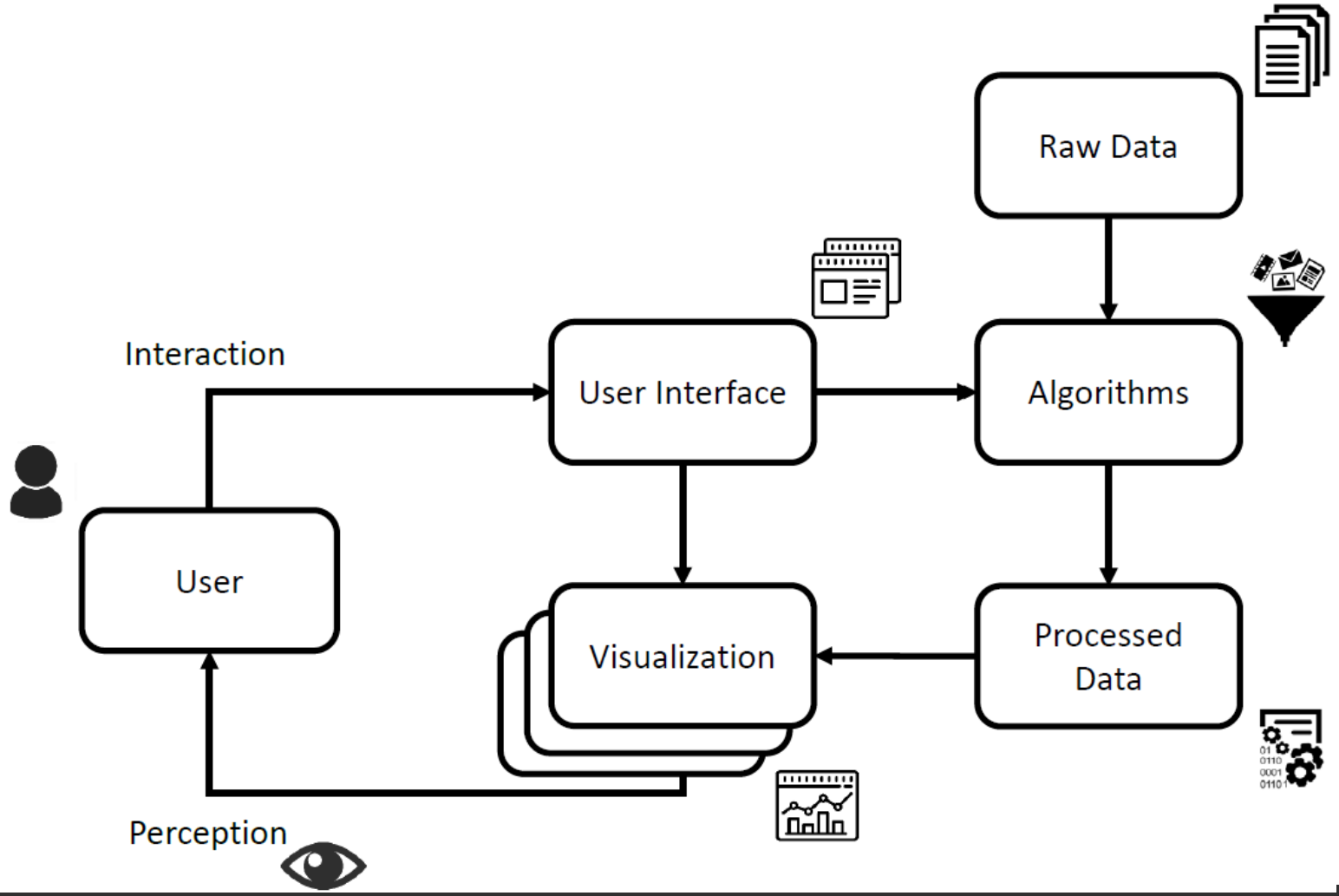


Top level: the Data Visualization Process

- **Filtering & processing:** Refining and cleaning data to convert it into information through analysis, interpretation, contextualization, comparison, and research.
- **Translation & visual representation:** Shaping the visual representation by defining graphic resources, language, context, and the tone of the representation, all of which are adapted for the recipient.
- **Perception & interpretation:** Finally, the visualization becomes effective when it has a perceptive impact on the construction of knowledge.



System Overview

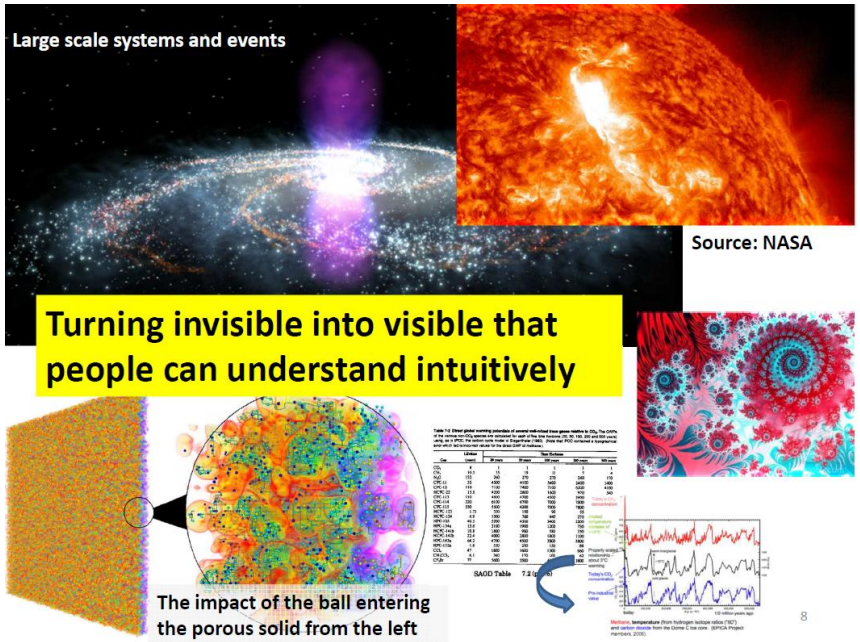


Why Data Visualization is needed?

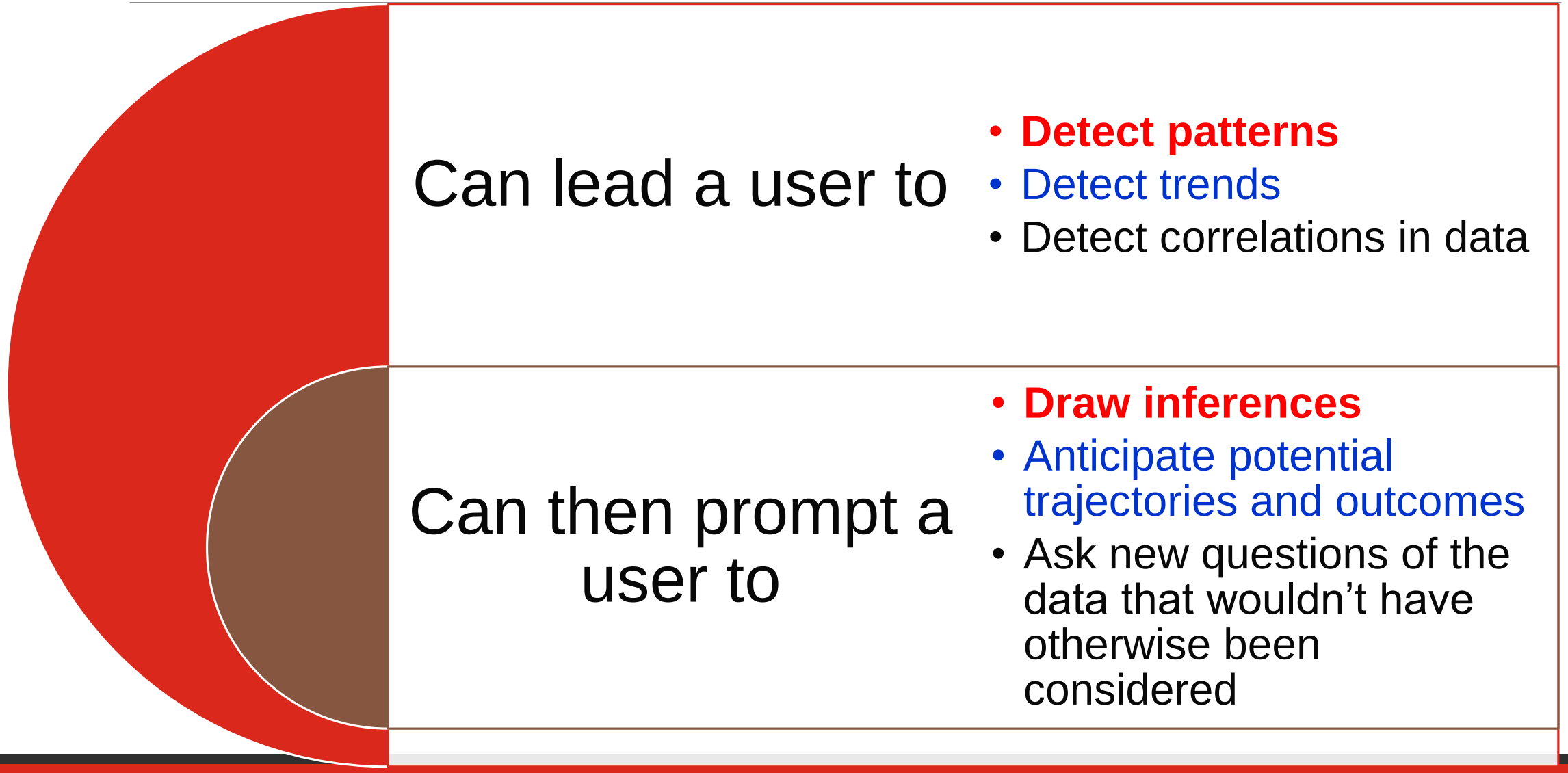
- **Intuitive**: People can easily understand graphs
- **Fast**: Our brains are great at identifying patterns, spotting trends and outliers in a tangible data visualization graph.
- **Flexible**: Allow users to represent different relationship in any given data.
- **Insightful**: Allows users to gain more **in-depth knowledge.**

Data Visualization used for

- **Support reasoning about information (analysis)**
  - Finding relationships
  - Discover structure
  - Quantifying values and influences
- **Inform and influence others (communication)**
  - Capture attention, engage
  - Tell a story visually
  - Focus on certain aspects, and omit others



More about Data Visualization usage



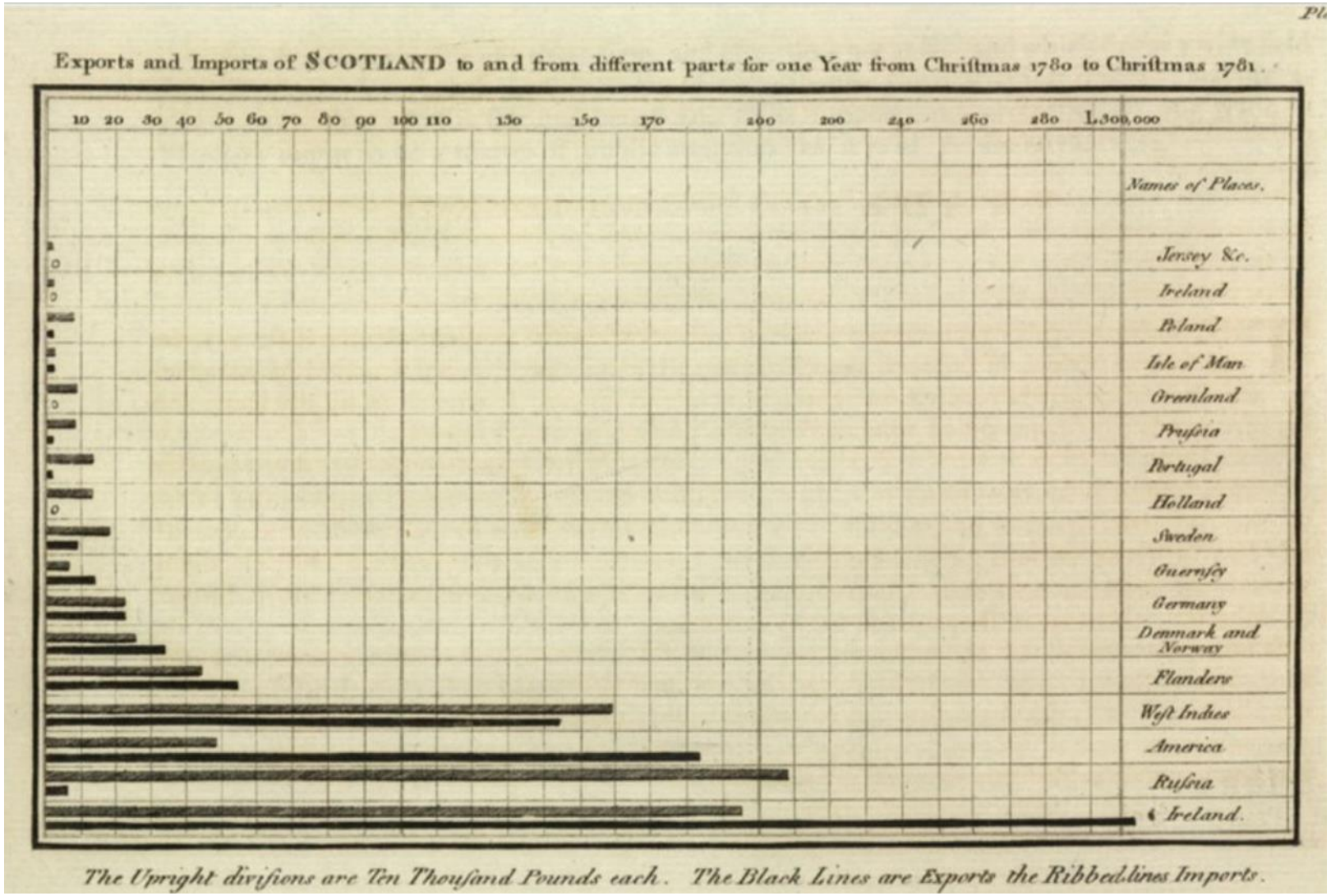
In class Discussion

- Some visualizations allow the user to filter out undesirable properties in the dataset. This produces a refined list of results to better help with decision making or understanding (think facets on a database).
- So let's apply these ideas to an example:
- https://informationisbeautiful.net/visualizations/worlds-biggest-data-breaches-hacks/
- https://informationisbeautiful.net/visualizations/diversity-in-tech/
- https://informationisbeautiful.net/visualizations/top-500-passwords-visualized/

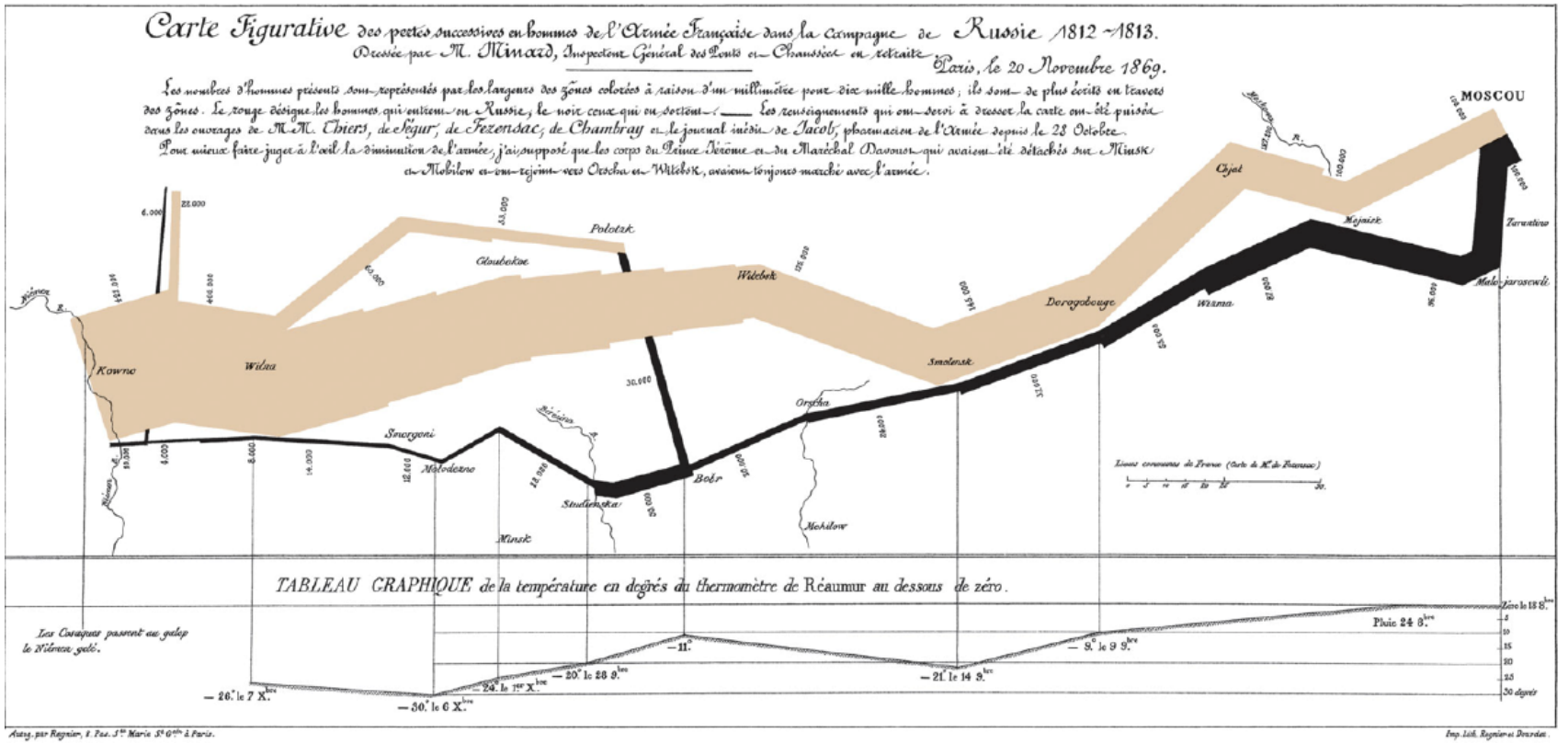
History of Data Visualization

William Playfair (1821) – line, bar charts, etc.

Chart of the Exports and Imports of Scotland to and from different parts for one year from Christmas 1780 to Christmas 1781.



Charles Joseph Minard1869: Napoleon's March



According to Tufte: "It may well be the best statistical graphic ever drawn."
5 variables: **Army Size**, **location, dates**, **direction**, **temperature**

Edward R. Tufte, The Visual Display of Quantitative Information (1983)

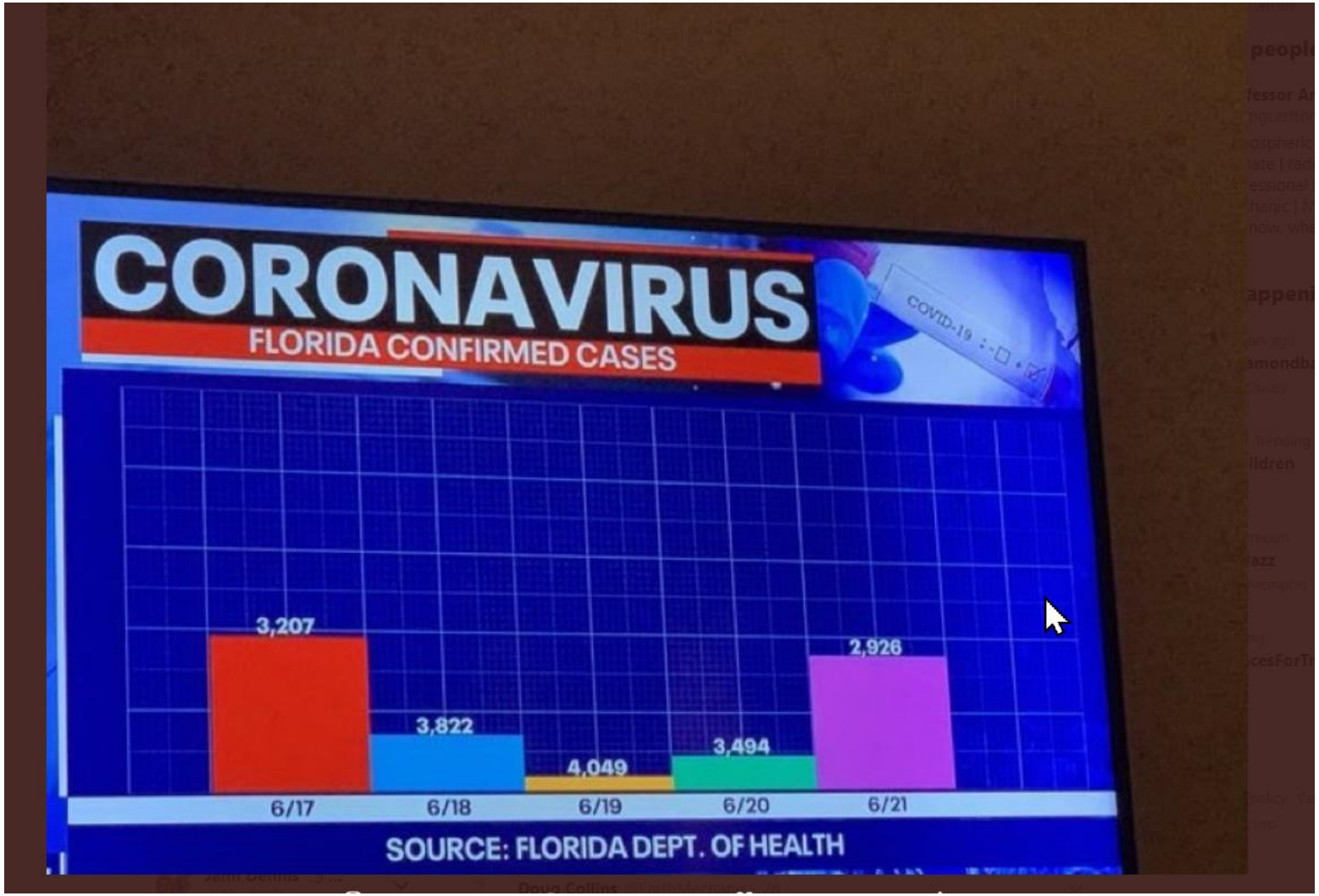
In Class Examples - Modern

- The famous Gapminder Video, Hans Rosling: 200 Countries, 200 Years, 4 Minutes
  - https://youtu.be/jbkSRLYSojo
- NY Times words, words, numbers
- 50 examples (from June 2009, somewhat dated)
- D3 Gallery
- Netflix Queues
- Unemployment Visualization

Cases for Bad or Ugly visualizations

Courtesy of WTFViz.net

Example 1

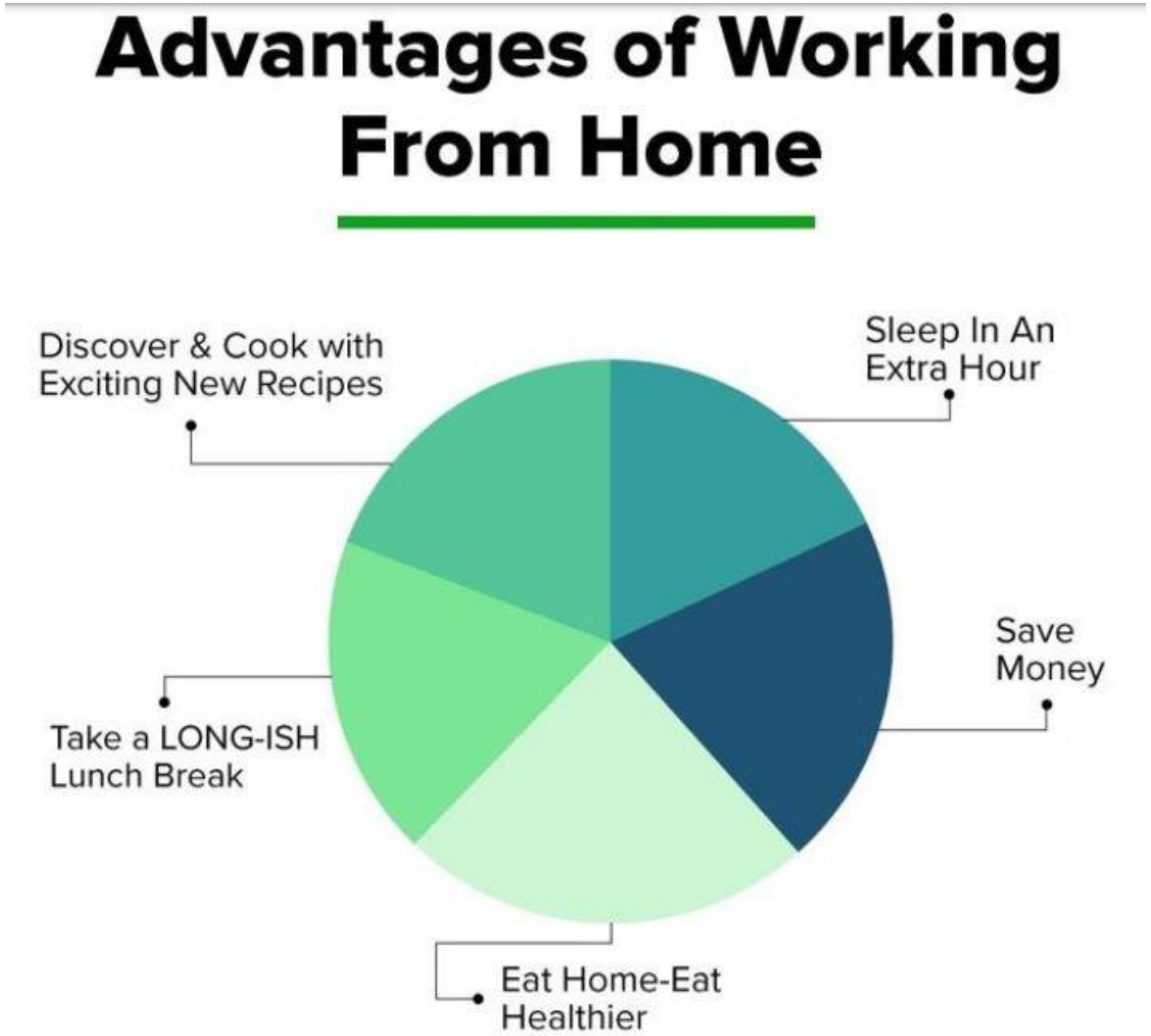


https://viz.wtf/

Example 2

https://viz.wtf/

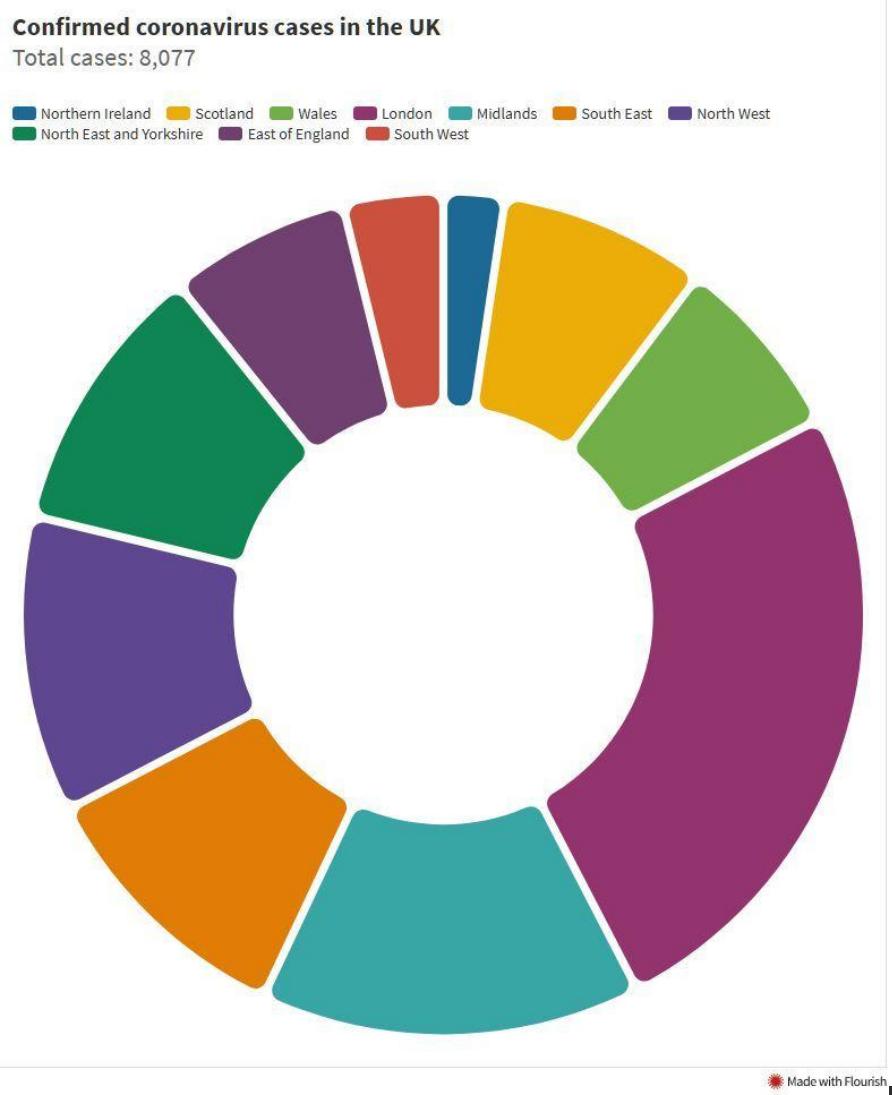
Example 3



https://viz.wtf/

Example 4

Select an appropriate view for your data



https://viz.wtf/

Thinking about Creating a Data Visualization

- Determine what you are **ultimately trying to communicate**
- Determine which visualization best **achieves** your aim in the **clearest manner possible**
- Check
  - The Data Visualization Catalogue

Further Considerations

- What data (or subset of data) is **relevant**for your aim?
- Who is your **audience**?
- How will you **encode** your data?
- How will you **structure** the visualization?
- How will you demonstrate the **relationship** between data?
- Determine the **scale** of your visualization.
- Which elements will the user **interact** with?
- Will a user **intuitively understand** how the visualization works and what it represents?

Data visualization Vs data narrative

Data Narrative

The data narrative include:

- Context
- Clarity
- Emotional connection
- Engagement

Storytelling with data

"I think people have begun to forget how powerful human stories are, exchanging their sense of empathy for a fetishistic fascination with data, networks, patterns, and total information … Really, the data is just part of the story. The human stuff is the main stuff, and the data should enrich it."

Jonathan Harris, Creator We Feel Fine
http://number27.org/wefeelfine

Examples

ProPublica

Workers Comp Benefits: How Much is a Limb Worth?

https://projects.propublica.org/graphics/workers-compensation-benefits-by-limb#

Faces of Fracking

California's Getting Fracked

http://www.facesoffracking.org/data-visualization/

Visualization software

Software Tools for analyzing and data visualization

- Tableau,
- Microsoft Excel
- Google charts
- **Many Eyes: IBM's Free Online Data Visualization Tool**
- **R Language (Data Visualization with R)**
- Statistical Analysis System **SAS**
- Statistical Package for the Social Sciences **SPSS**
- ....

References and Resources

- [Knaflic] Cole Nussbaumer Knaflic, **Storytelling with Data: A Data Visualization Guide for Business Professionals**, Wiley, 2017
  - Available online through Seneca Libraries: https://senecacollege-primo.hosted.exlibrisgroup.com/permalink/f/t3376v/01SENC_ALMA5146374280003226
- [Ryan] Lindy Ryan, **Visual Data Storytelling with Tableau**, Pearson Addison-Wesley, 2018
  - Available online through Seneca Libraries: https://senecacollege-primo.hosted.exlibrisgroup.com/permalink/f/t3376v/01SENC_ALMA5167006190003226
- [Healy] Kieran Healy, **Data Visualization: A Practical Introduction**, Princeton University Press, 2018.
  - Available (hardcopy) at Seneca Libraries: https://senecacollege-primo.hosted.exlibrisgroup.com/permalink/f/t3376v/01SENC_ALMA2172469250003226
- **A Reader on Data Visualization:** https://mschermann.github.io/data_viz_reader/
- **Data visualization:** https://en.wikipedia.org/wiki/Data_visualization