S. Rinzivillo – rinzivillo@isti.cnr.it

DATA VISUALIZATION AND VISUAL ANALYTICS

Who I Am?

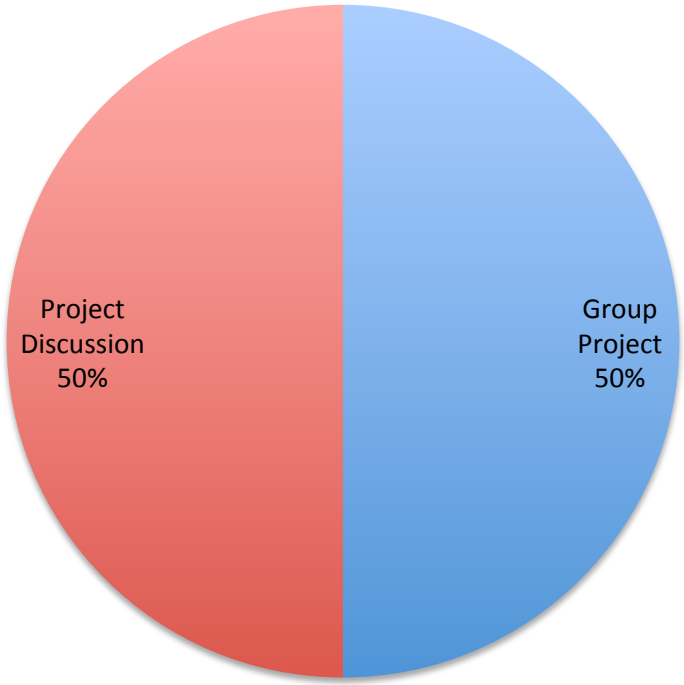
- Salvatore Rinzivillo
  - rinzivillo@isti.cnr.it
- Page course: http://didawiki.cli.di.unipi.it/
  - Visual Analytics
- Github page:
  - https://github.com/va602aa-2020
- Telegram channel:
  - https://t.me/va602aa

Schedule

- On Monday
  - 16:00 to 18:00
  - Room: L1
- On Friday
  - 16:00 to 18:00
  - Room: C1

Grading

- Project (50%)
  - Up to 2 persons per group (!)
- Project discussion (50%)
- Project topic
  - Multidimensional exploration of a dataset
  - One (or two) dataset(s) assigned for all
  - Specific proposal may be discussed



Project features

- A project should have the following requirements:
  - The application should contain **several visual widgets**, each providing insights on a selection of dimensions of the original data
  - It is possible to use state-of-the-art charts (bar charts, line charts, etc.) and libraries (plotly, nvd3, etc). It is should implement a **novel, original visualization** to present the data in a creative, non-trivial way. (see examples on Vast Challenge 2008 developed in class)
  - **Interactivity** should be implemented, providing toolbars, selections and filters for the data.
  - The visual widget should interact among them, realising a set of **linked display** to browse the data across multiple dimensions

http://itisaasta.com/nycs/

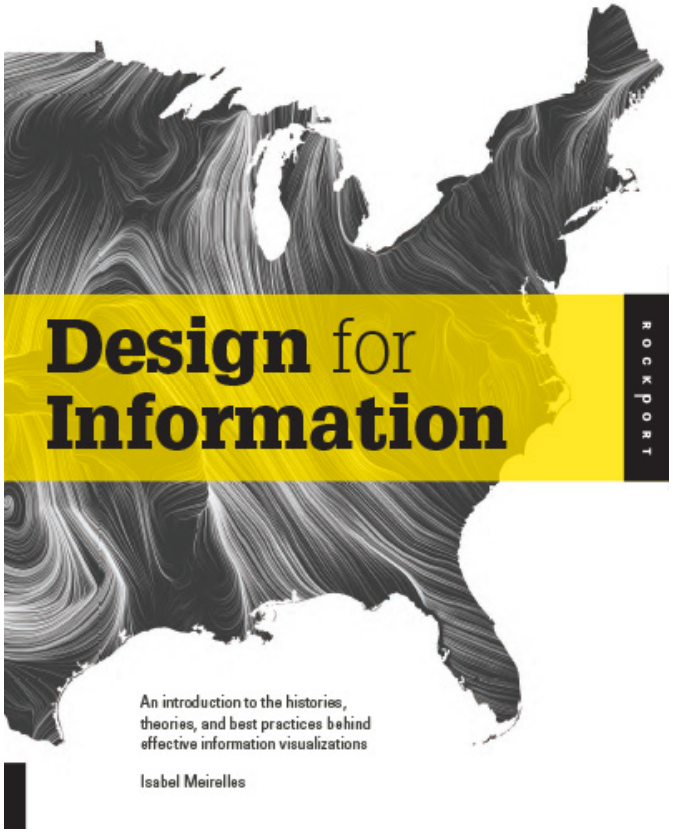
EXAMPLE SCHOOL DISTRICTS

http://mbtaviz.github.io/

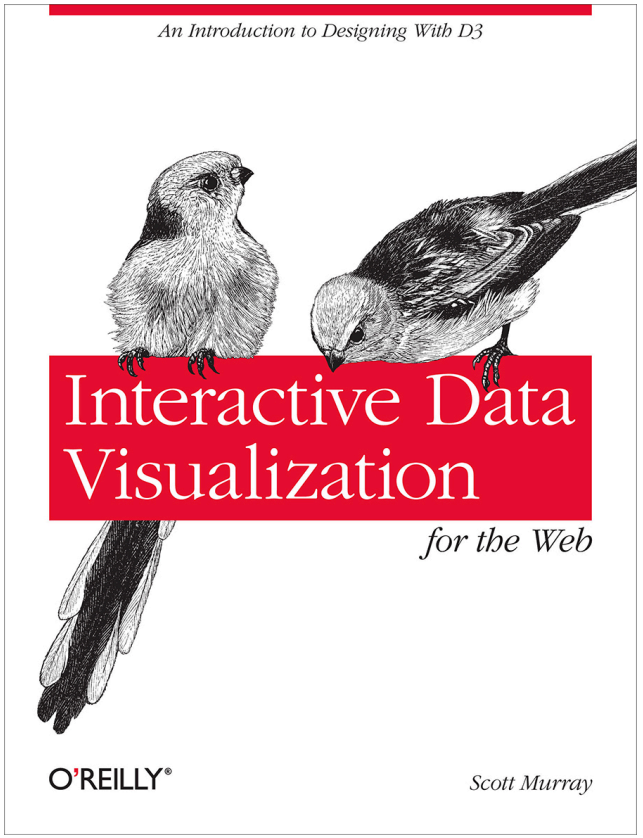
BOSTON SUBWAY SYSTEM

Textbooks

Design for Information
Isabel Meirelles



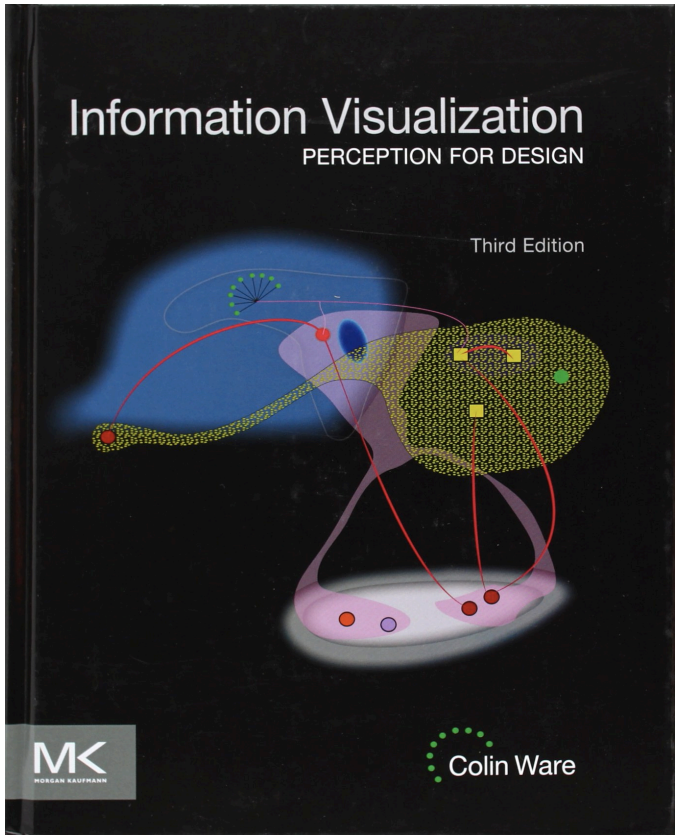
Interactive Data Visualization
Scott Murray



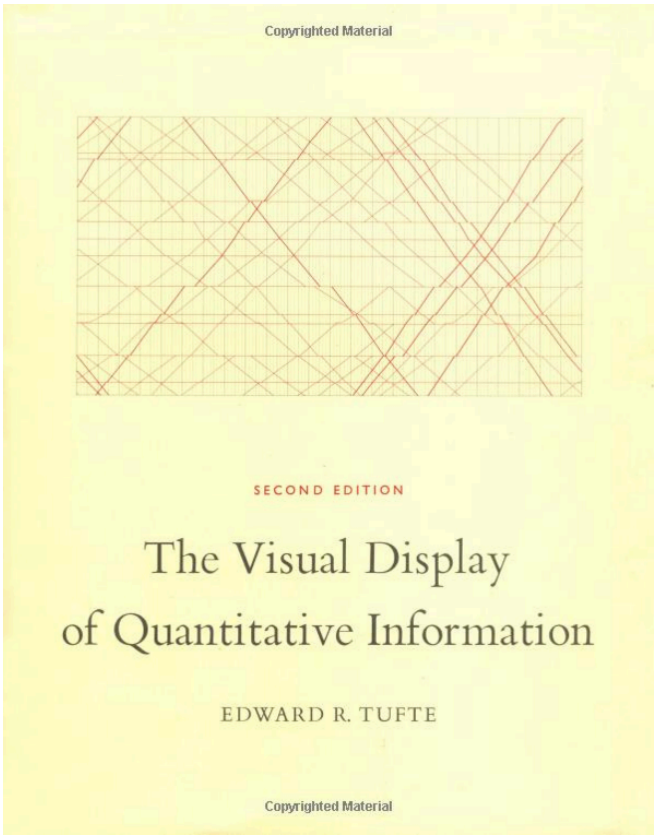
http://alignedleft.com/tutorials

Interesting Readings

Information Visualization
Colin Ware



The Visual Display of Visual Information
Edward R. Tufte

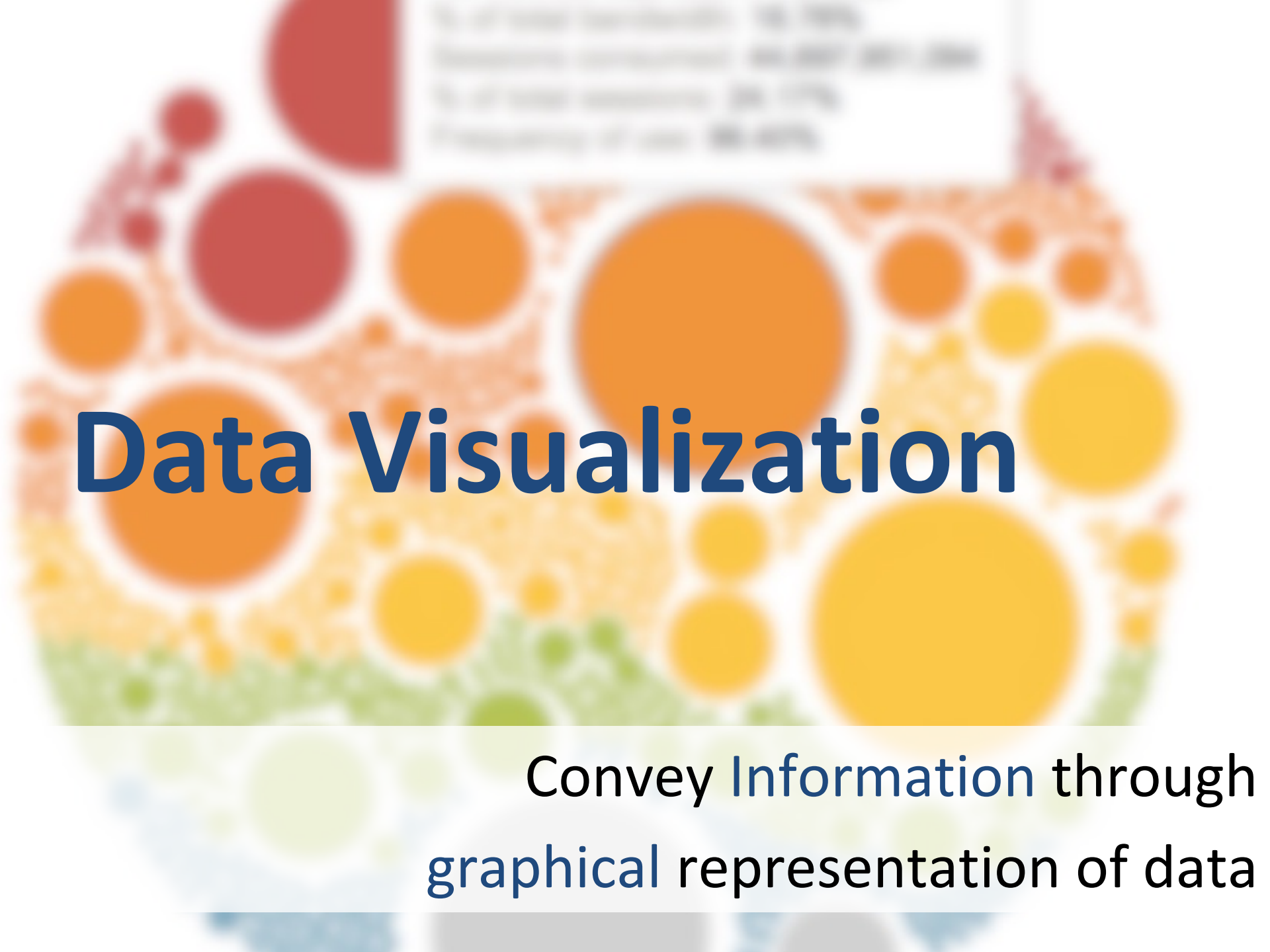


DATA VISUALIZATION AND VISUAL ANALYTICS

INTRODUCTION

VA - Crash course

- Effective Visual Representation
  - Vision System
  - Visual Variables
- Toolbox – Bootstrap, Node.js, Vue.js, crossfilter.js
- Toolbox – Base visualizations (Plotly.js, DC.js)
- Toolbox – D3.js
  - Basics
  - Charts
  - Advanced Visualization
- Scientific Visualization
  - Plotting
  - Geography
- Storytelling



Data Visualization

Convey Information through graphical representation of data

Motivations

- Data everywhere
- No value for raw data
  - Need to extract valuable information
- Information overload:
  - Irrelevant for current task
  - Processed in an inappropriate way
  - Presented in an inappropriate way

Visualization Goal

- Record Information
  - Sketches, photographs, ECG,…
- Analyze data to support decisions (exploration)
  - Create and verify hypotheses
  - Identify Patterns
  - Identify Outliers
- Communicate (explanation)
  - Share or highlight insights on data
  - Persuade

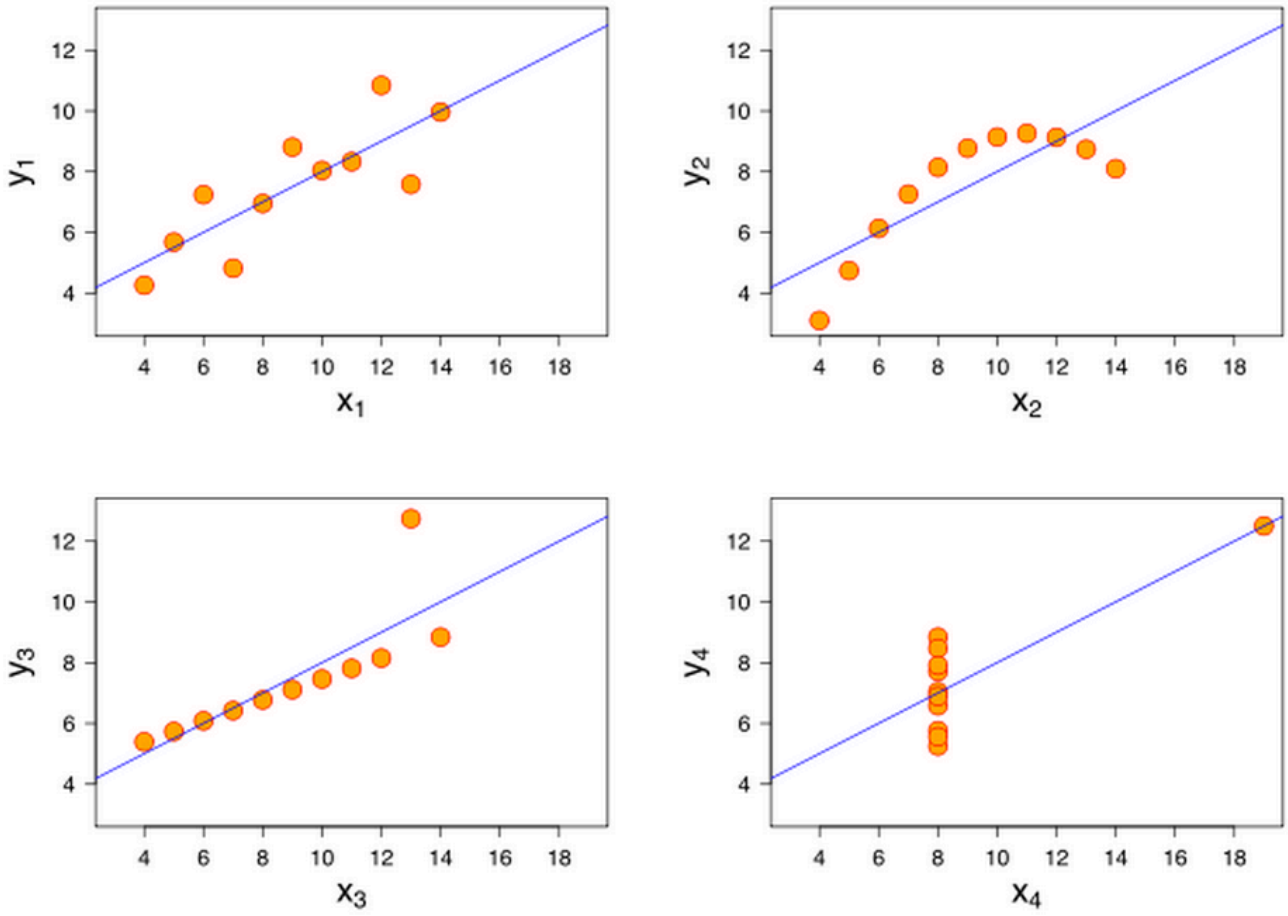
Analyze: Anscombe's quartet - datasets

Data Set A		*Data Set B*		*Data Set C*		*Data Set D*	
X	**Y**	**X**	**Y**	**X**	**Y**	**X**	**Y**
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

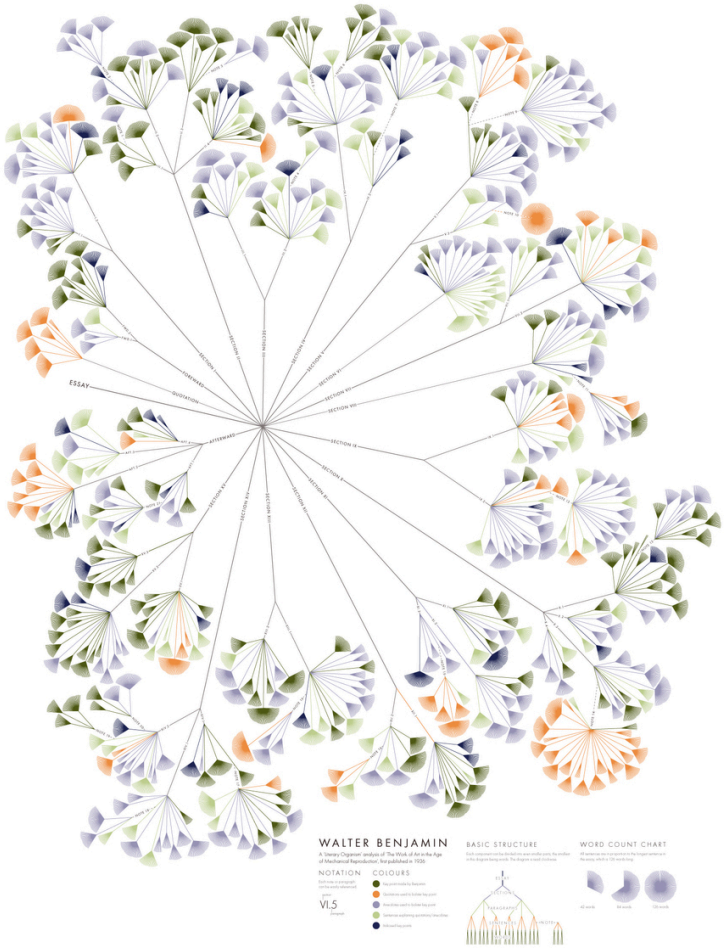
Analyze: Anscombe's quartet - properties

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

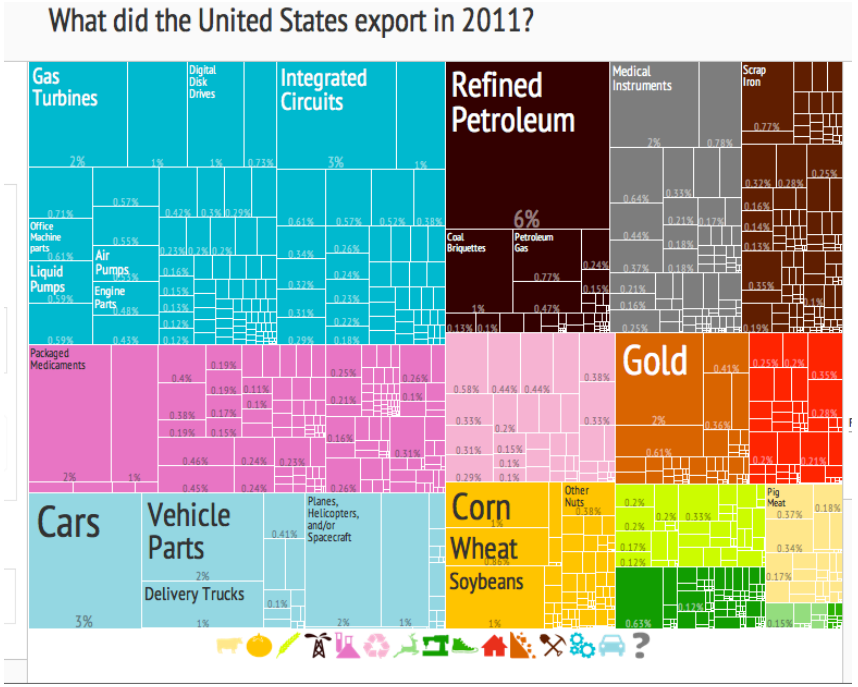
Analyze: Anscombe's quartet – graphics



Communicate: Hierachical Structures

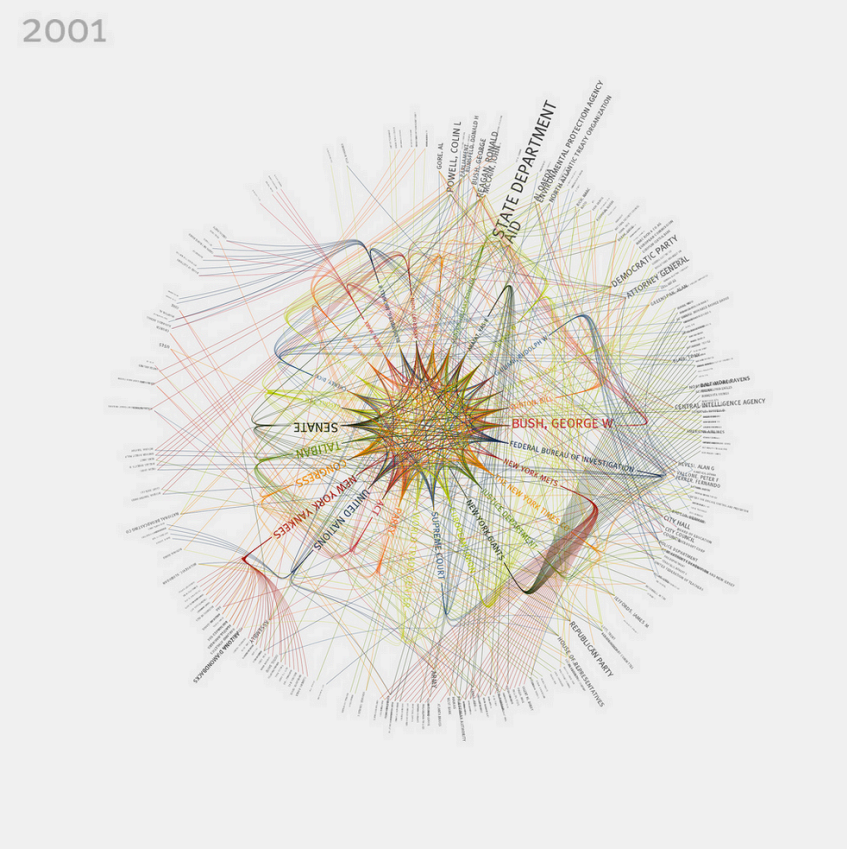


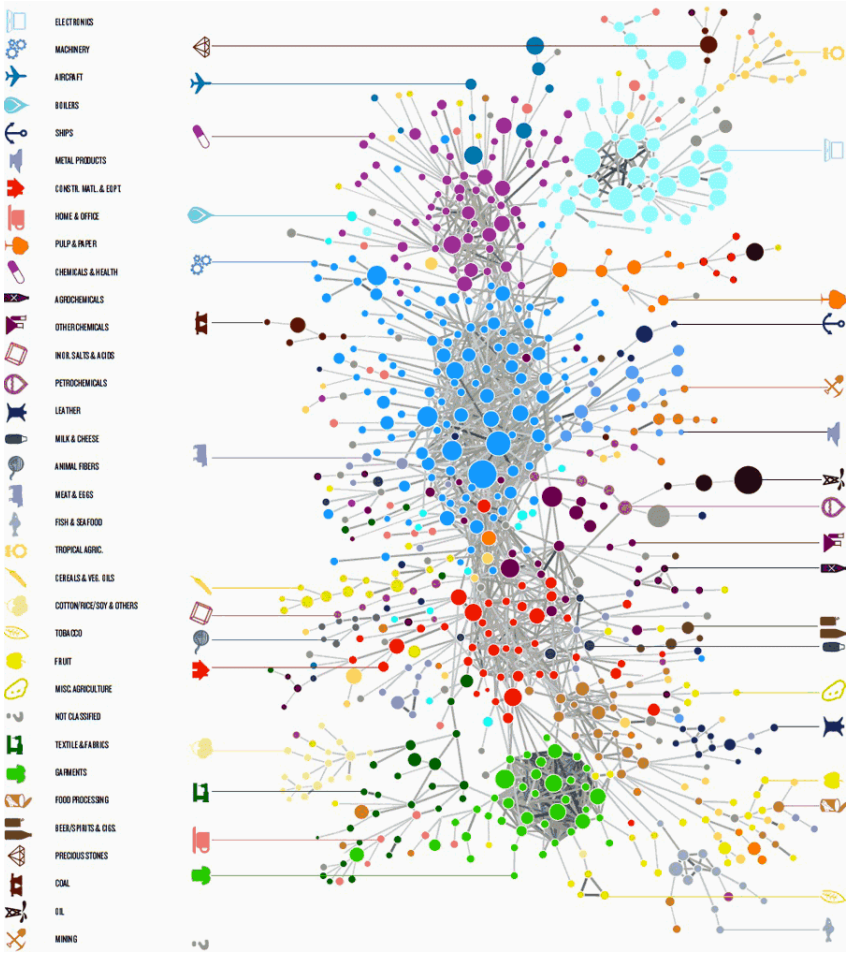
http://www.stefanieposavec.co.uk/entangled-word-bank/



http://atlas.media.mit.edu/

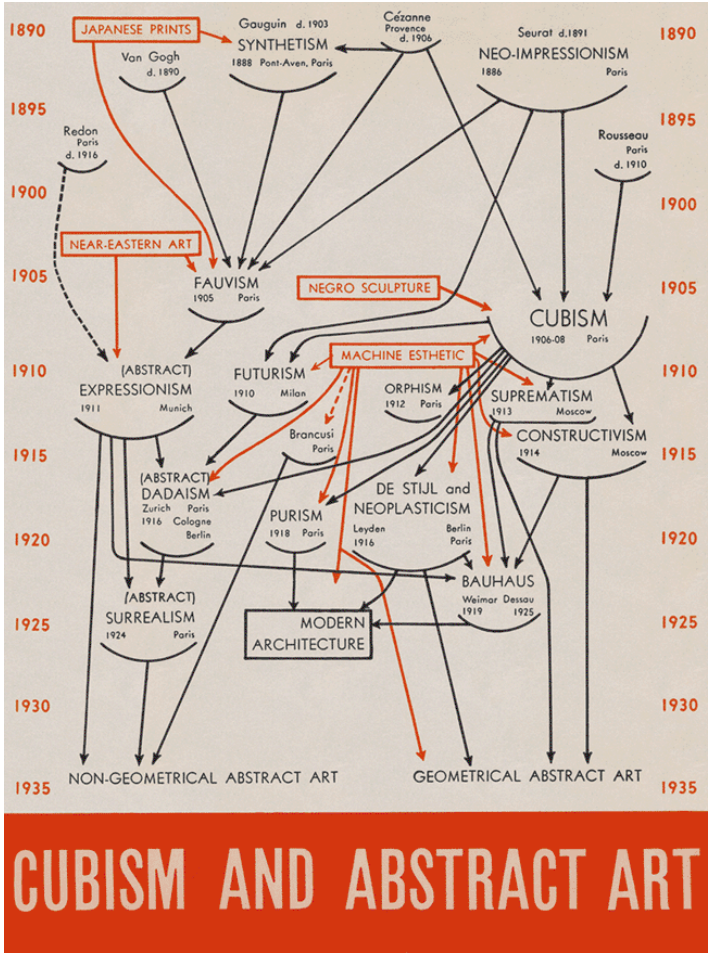
Communicate: Networks



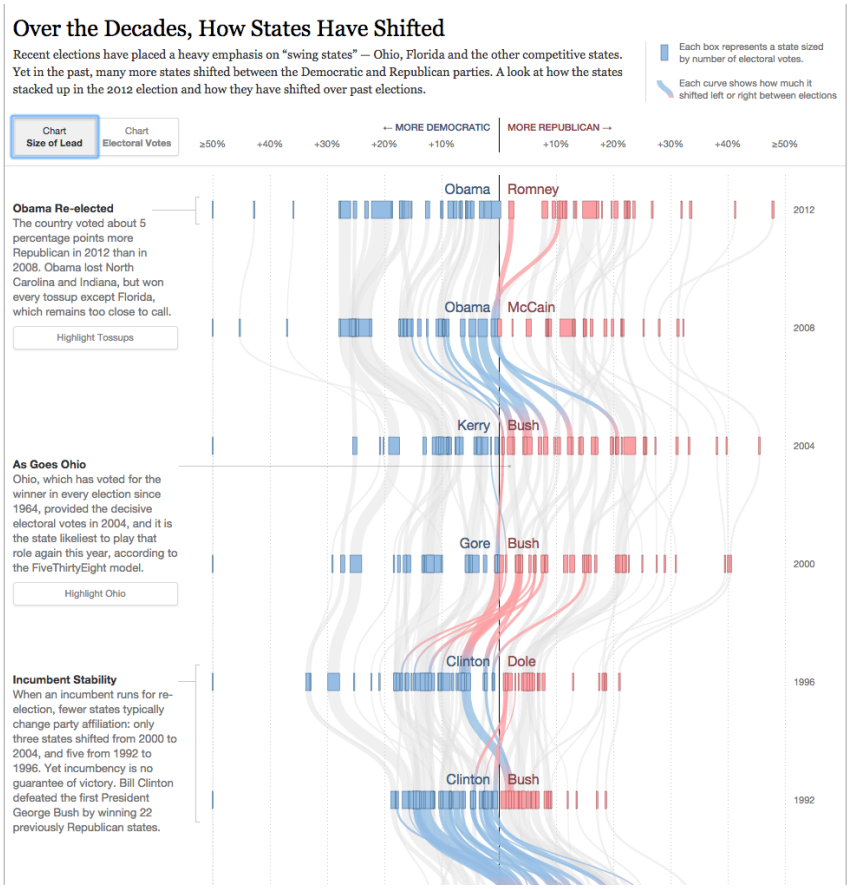


https://www.flickr.com/photos/blprnt/sets/72157614008027965/ http://atlas.media.mit.edu/

Communicate: Temporal Structures

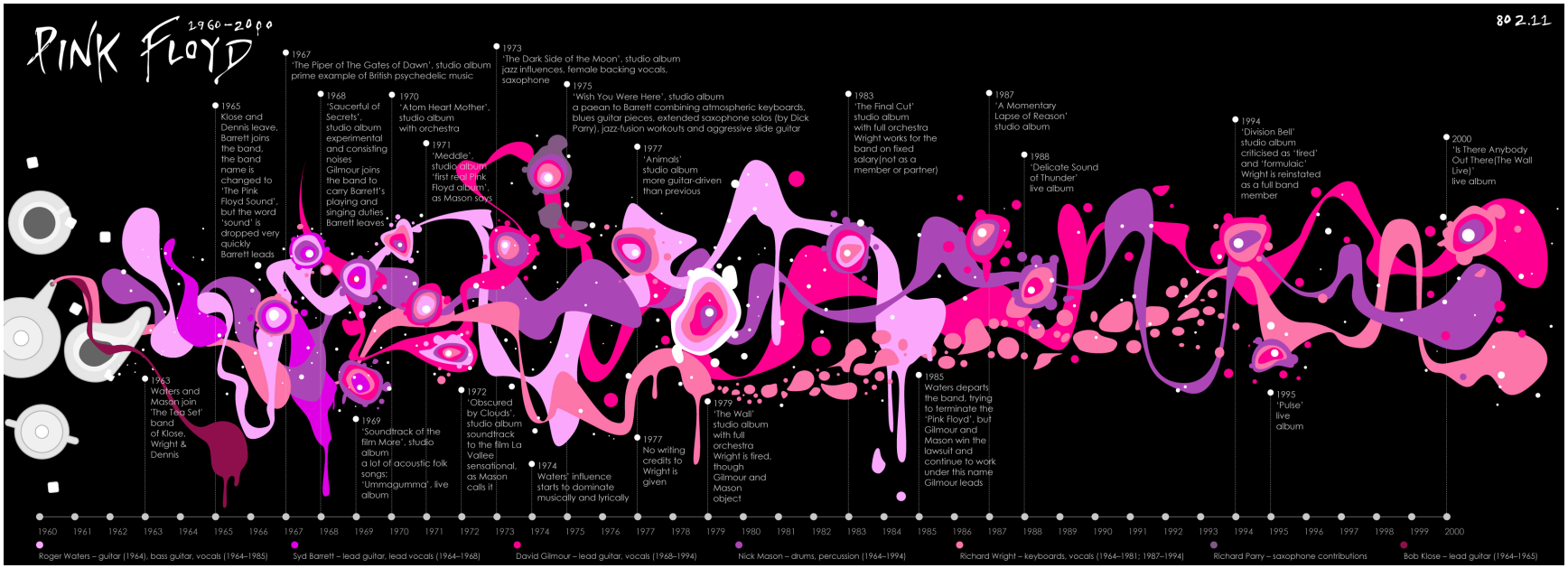


Cubism And Abstract Art (Alfred H. Barr 1936)



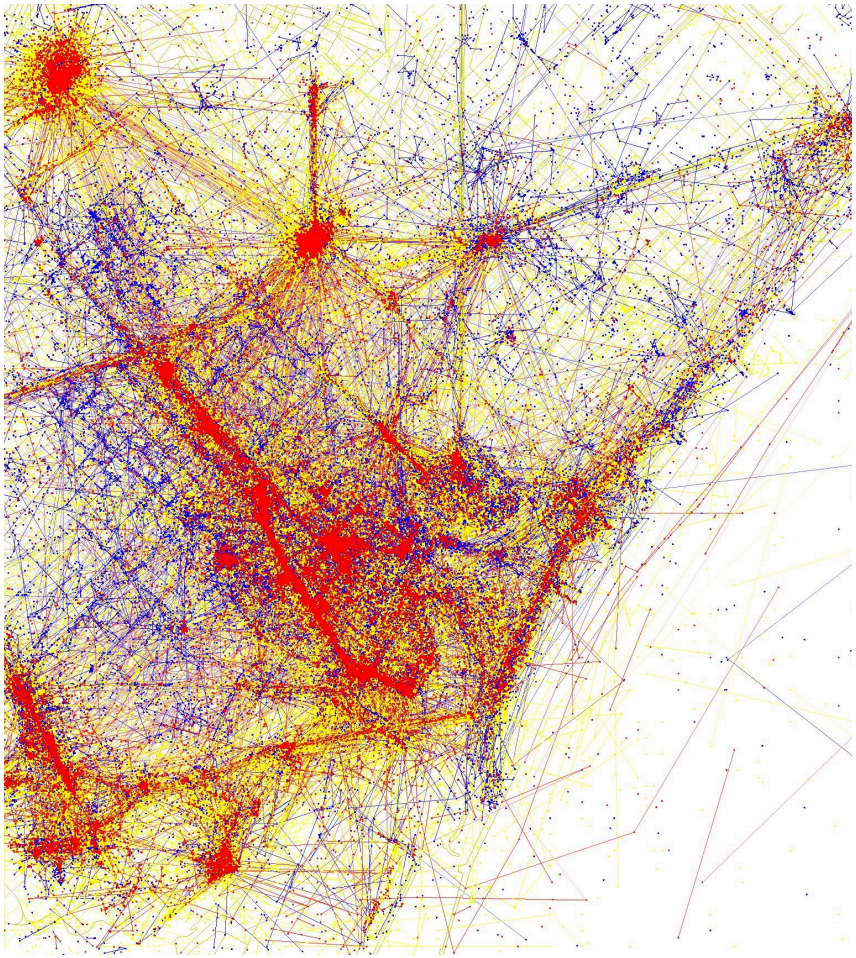
http://www.nytimes.com/interactive/2012/10/15/us/politics/swing-history.html

Communicate: Temporal Structures

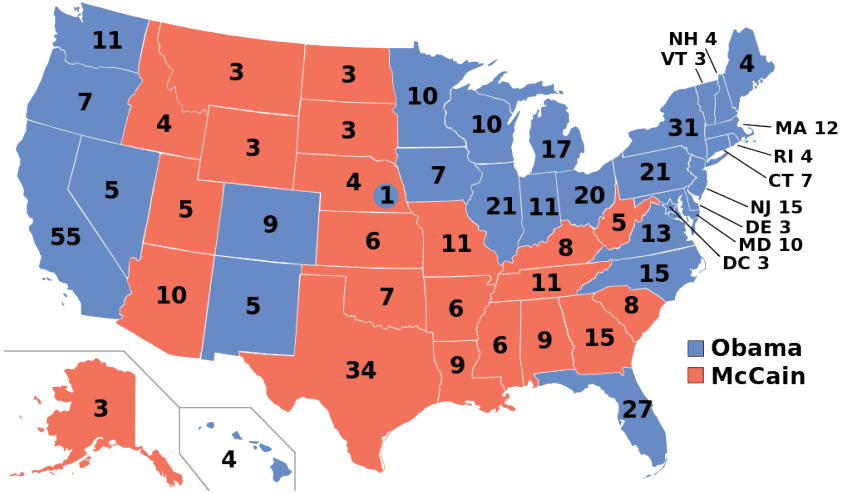


http://www.80211.cc/

Communicate: Maps

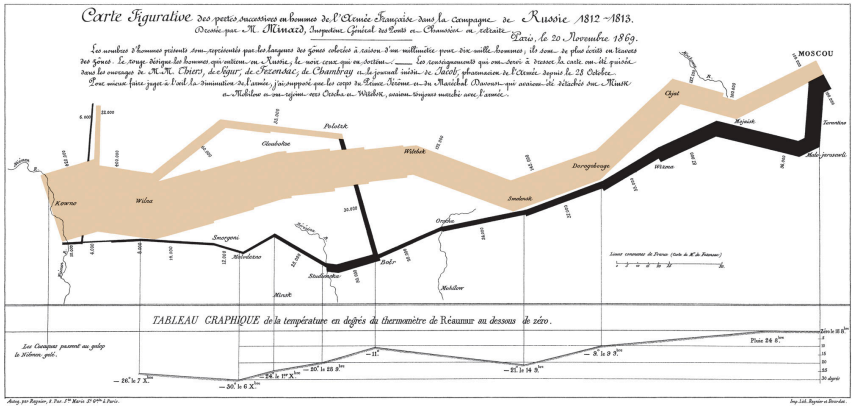


https://www.flickr.com/photos/walkingsf/sets/72157624209158632/

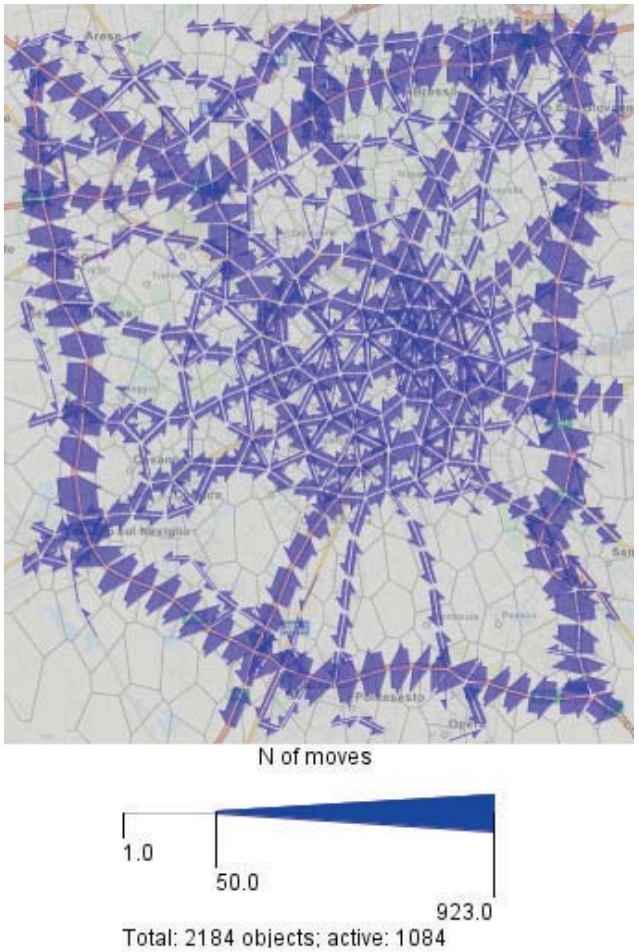


"ElectoralCollege2008" by Gage - Own work. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:ElectoralCollege2008.svg#mediaviewer/File:ElectoralCollege2008.svg

Communicate: Spatio-Temporal data

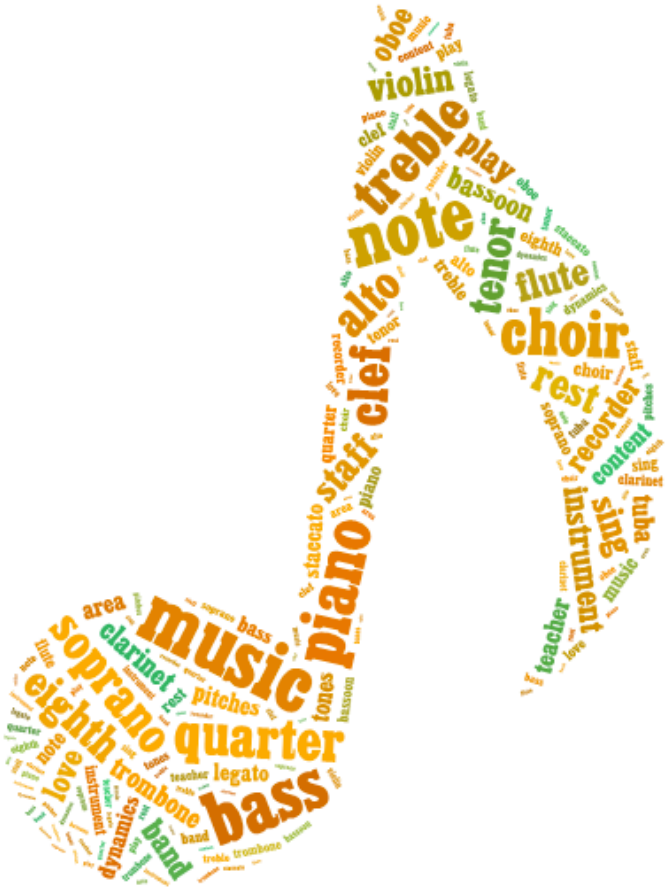


"Minard" by Charles Minard (1781-1870) - see upload log. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Minard.png#mediaviewer/File:Minard.png



Visual Analytics of Movement.
G. Andrienko, N. Andrienko, P. Bak, D. Keim, S. Wrobel
Springer, 2013

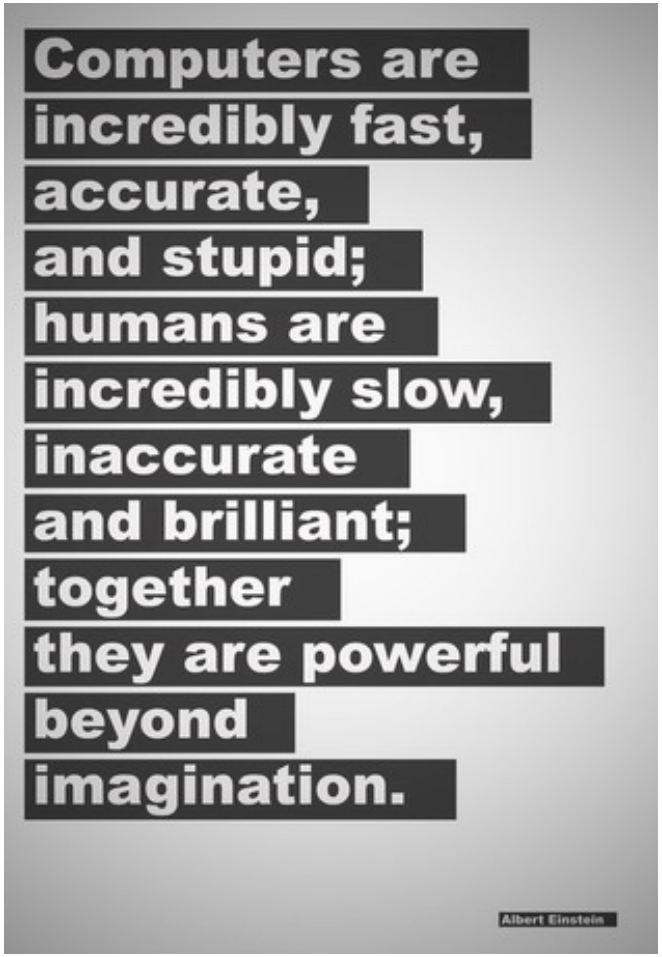
Communicate: Text



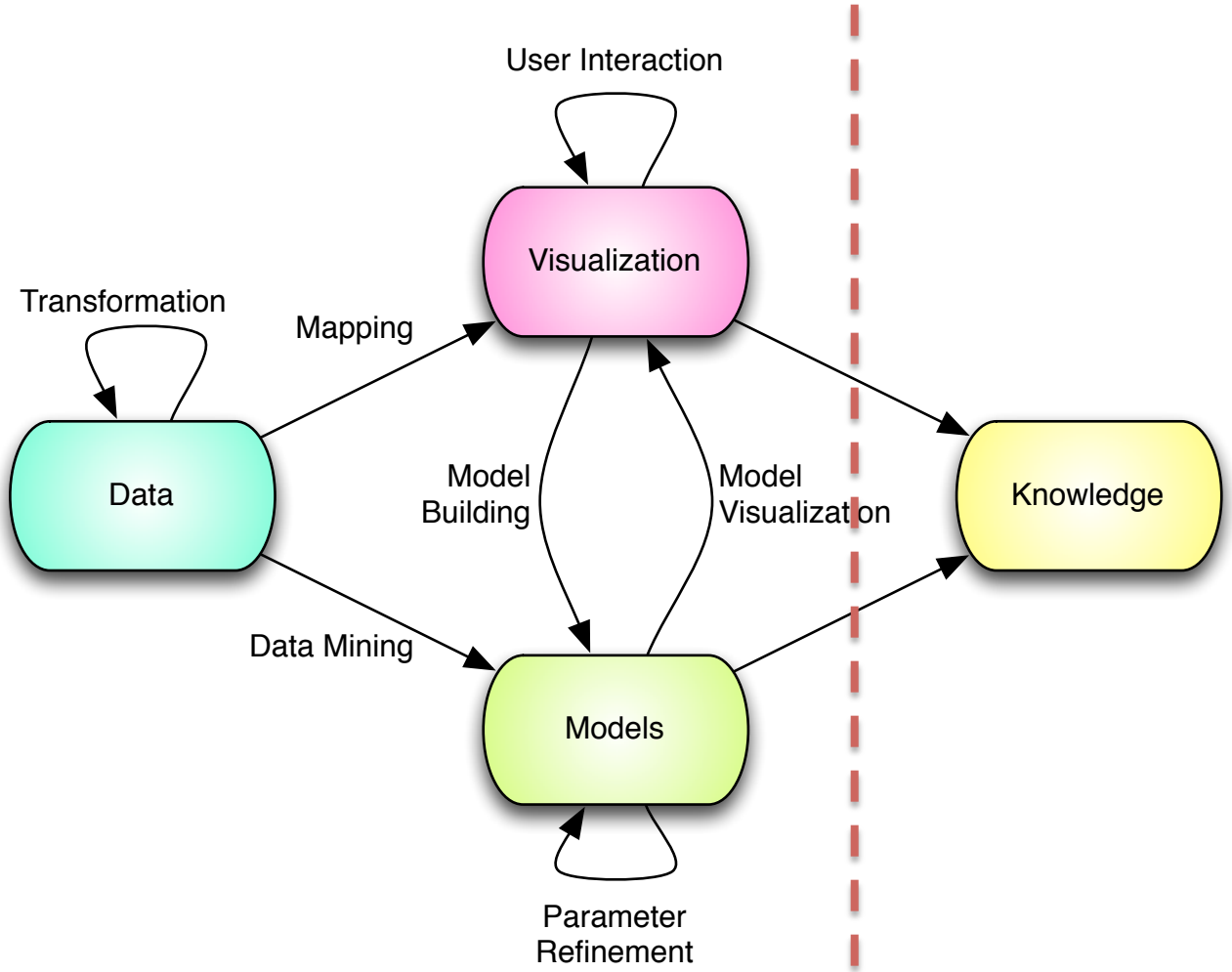
http://benfry.com/writing/archives/529

Visualization and Visual Analytics

- Make data and information processing transparent
- Combine strengths of humans and computers



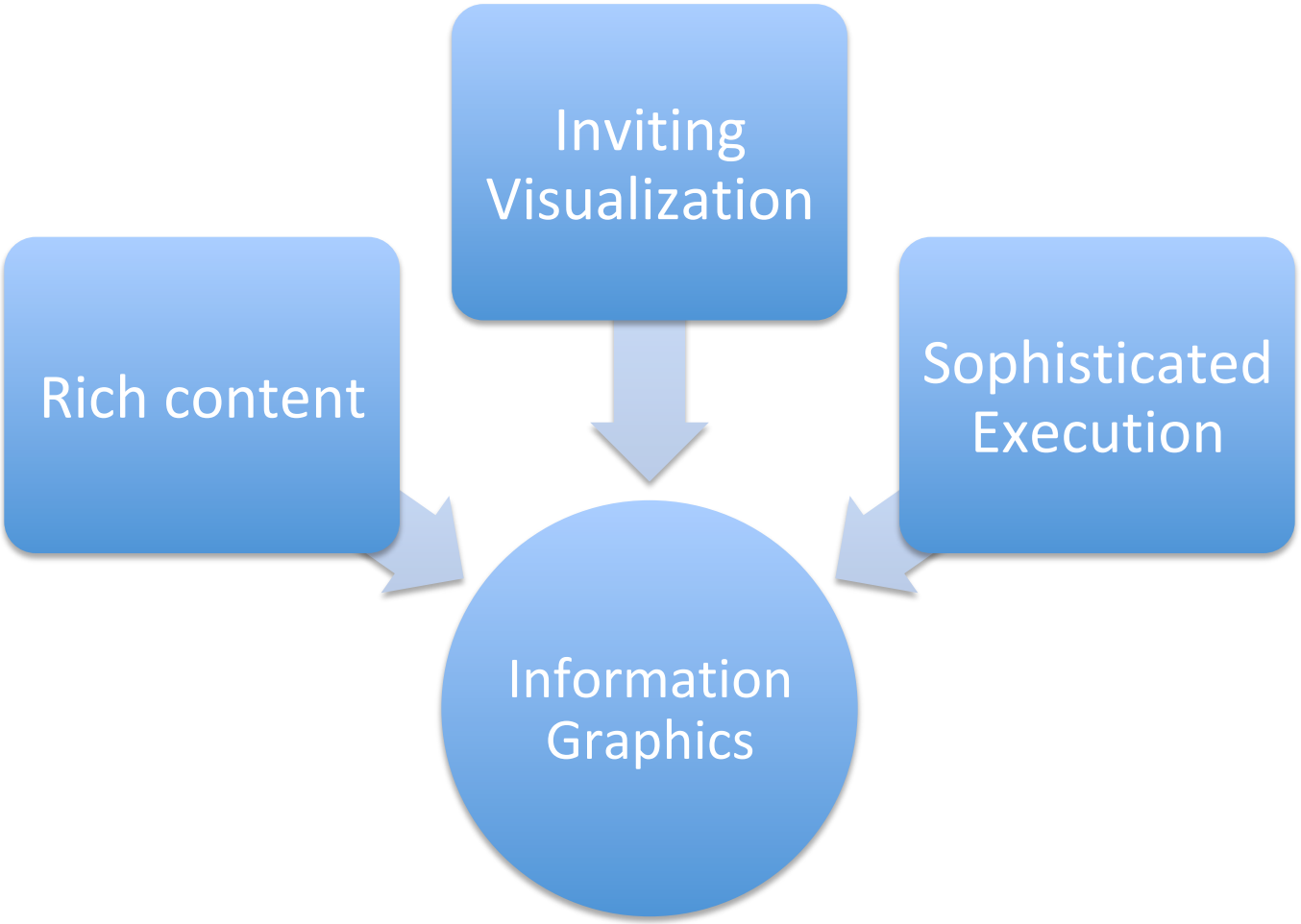
Visual Analytical Process



Exploration | Explanation

Adapted from:
Mastering the Information Age
Keim, Kohlhammer, Ellis, Mansmann

Elements of Good Visualization

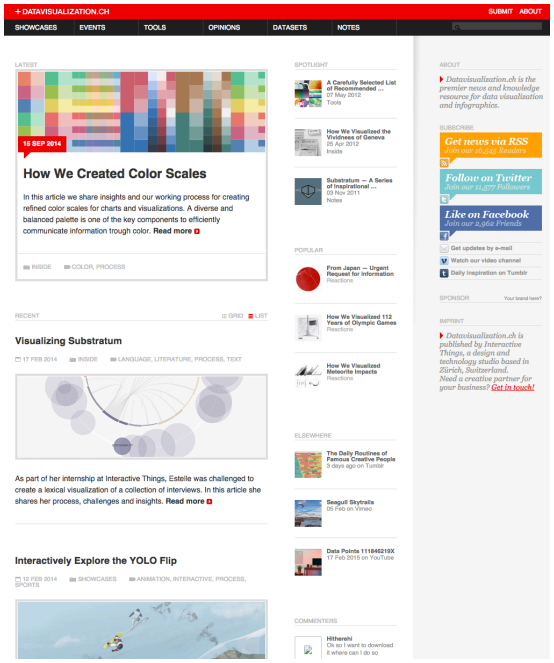


Importance of valid data

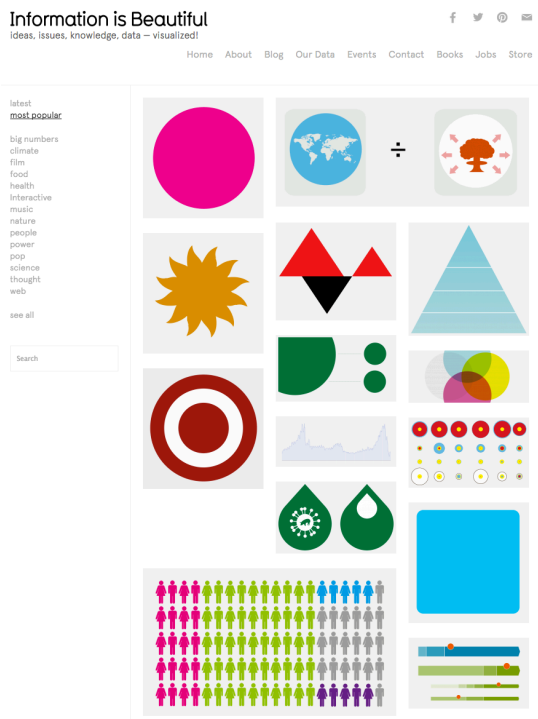
Other Resources

Observe how others resolved design problems

datavisualization.ch



informationisbeautiful.net



infosthetics.com