1 VISUAL ANALYTICS INTRO

S. Rinzivillo – rinzivillo@isti.cnr.it

WHO I AM?

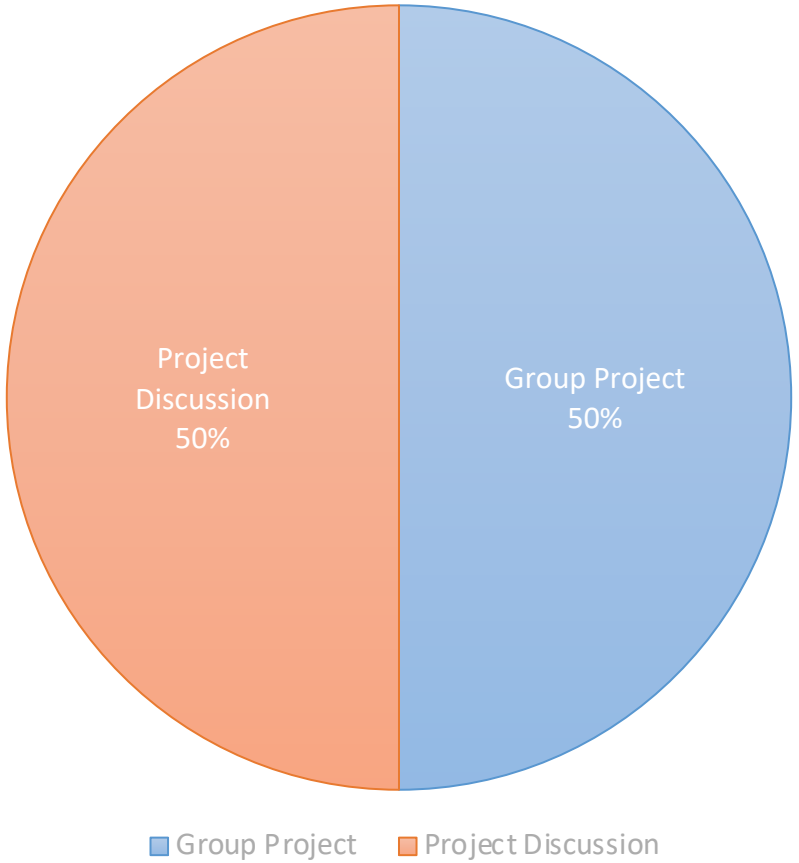
- Salvatore Rinzivillo
  - rinzivillo@isti.cnr.it
- Page course: http://didawiki.cli.di.unipi.it/
  - Visual Analytics
- Github page:
  - https://github.com/va602aa-master
- Telegram channel:
  - https://t.me/va602aa

SCHEDULE

- On Monday
  - 16:15 to 18:00
- On Wednesday
  - 16:15 to 18:00

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

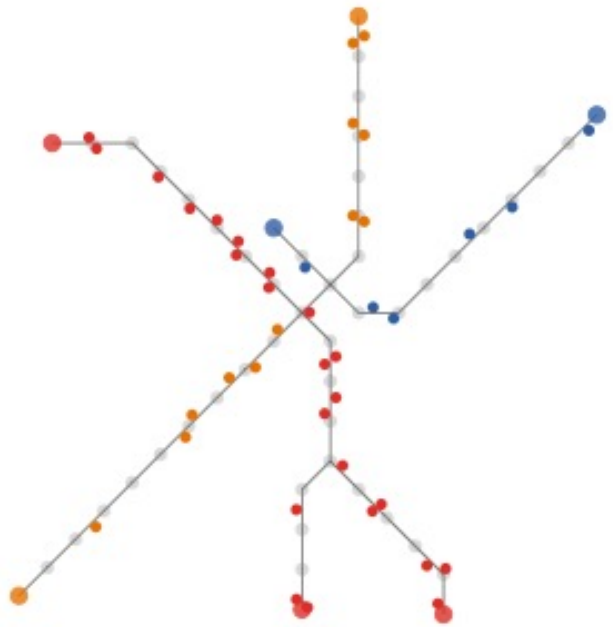


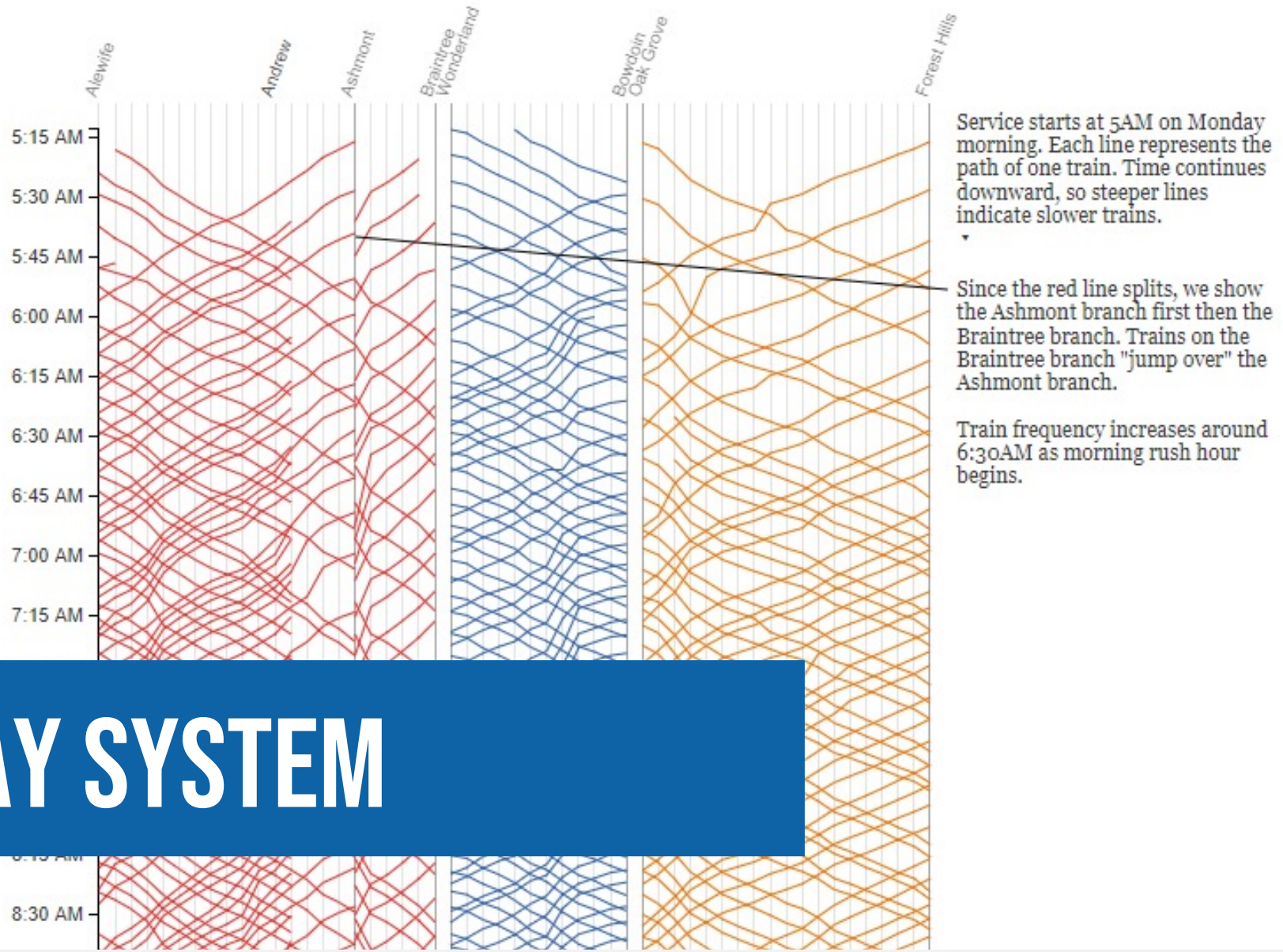
PROJECT FEATURES

- A project should have the following requirements:
  - The application should contain **multiple 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, vega, 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

EXAMPLE: SCHOOL DISTRICTS

Where is the best place to send your child to school in New York City?



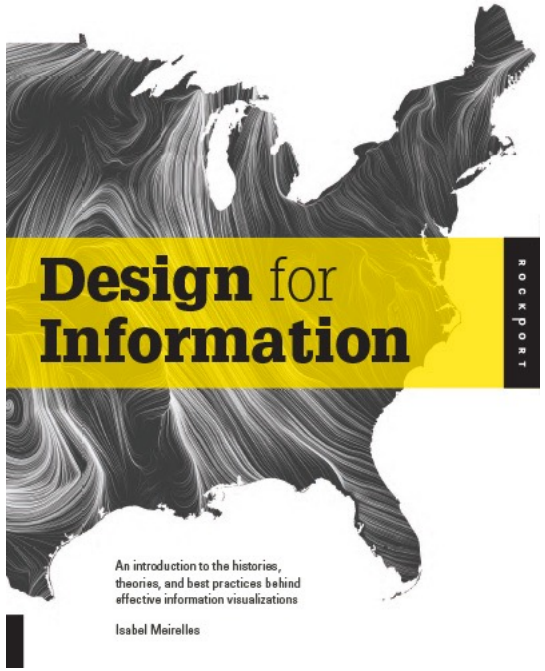


BOSTON SUBWAY SYSTEM

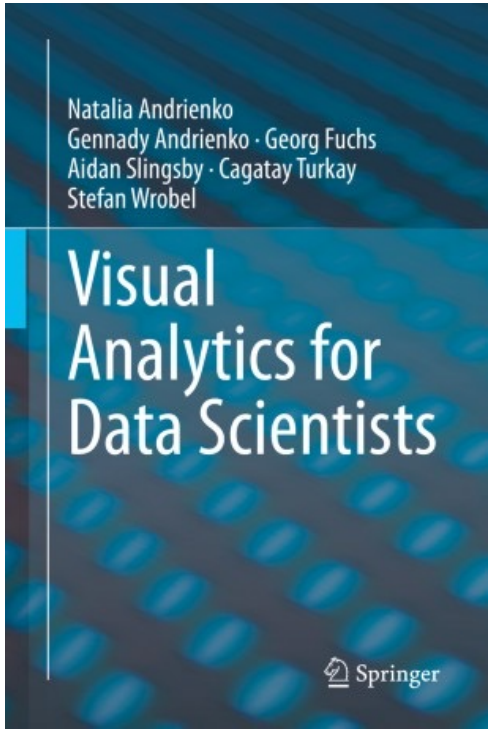
http://mbtaviz.github.io/

TEXTBOOKS

Design for Information
Isabel Meirelles



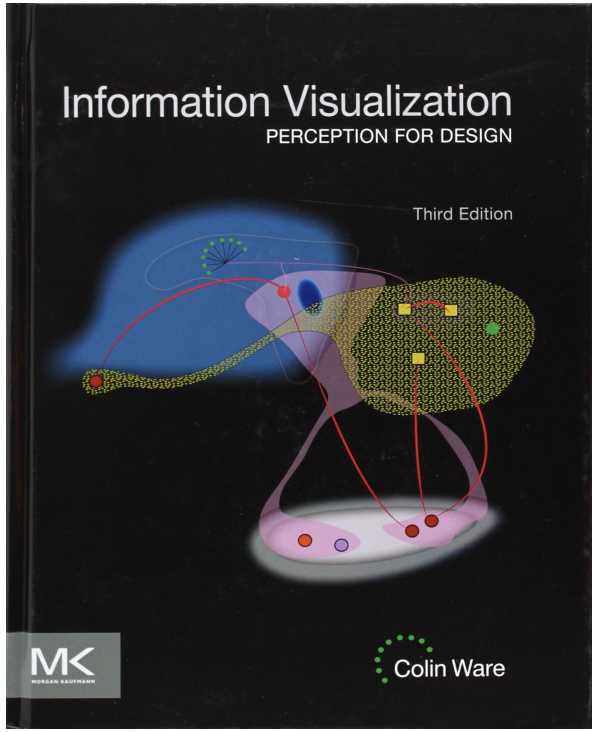
Visual Analytics for Data Scientists
Andrienko et al.



INTERESTING READINGS

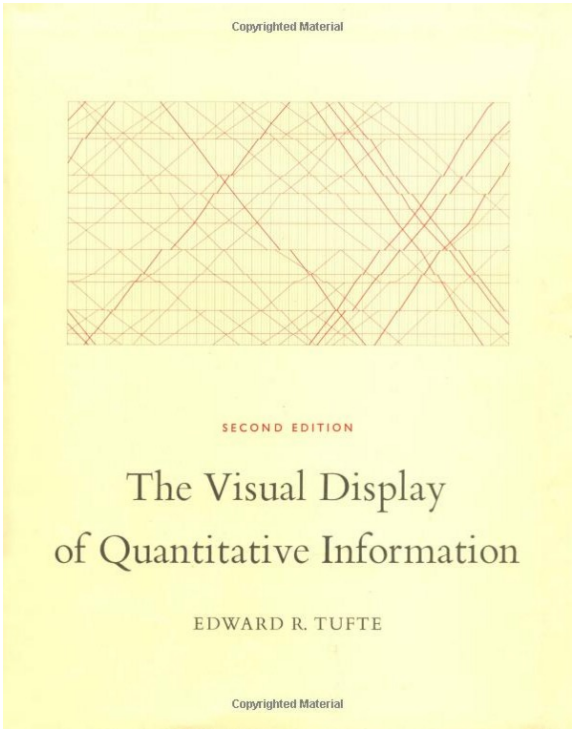
Information Visualization

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, Vega, 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

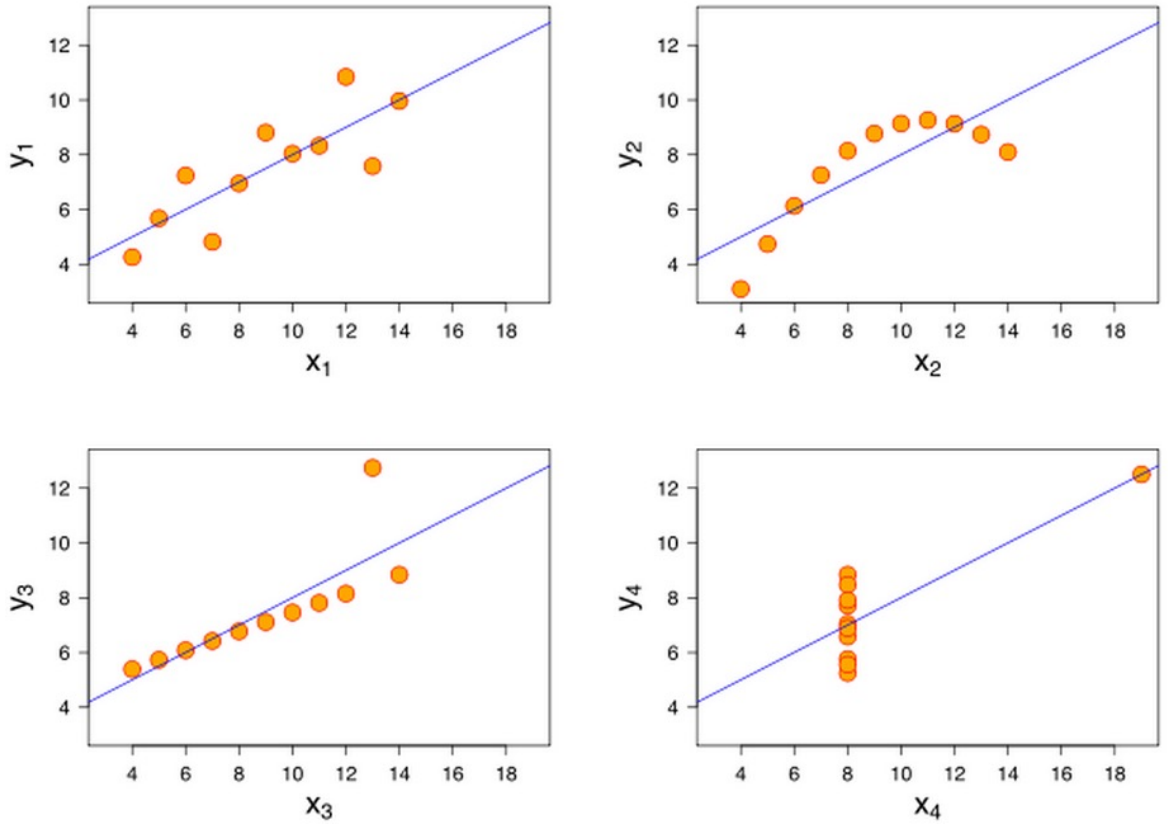
ANALYZE: ANSCOMBE'S QUARTET - DATASETS

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

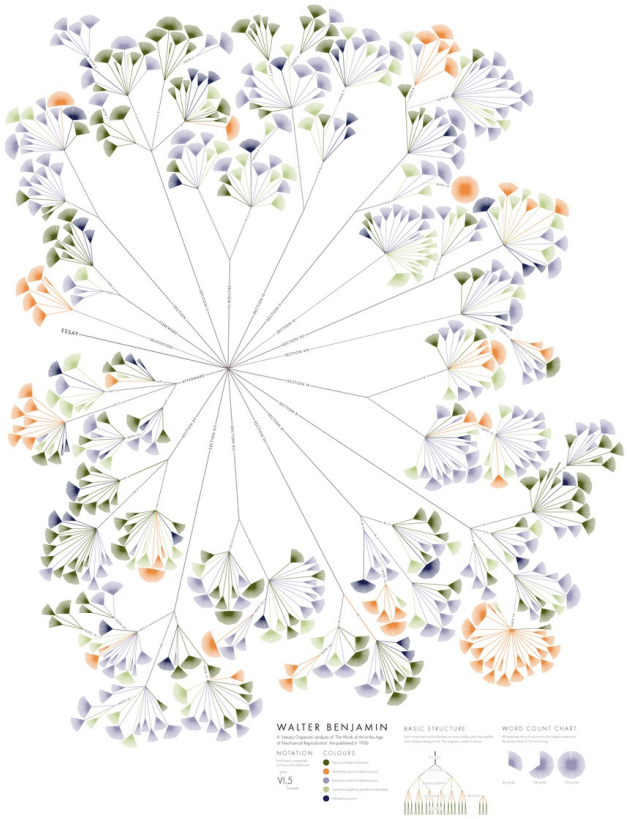
ANALYZE: ANSCOMBE'S QUARTET - PROPERTIES

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)

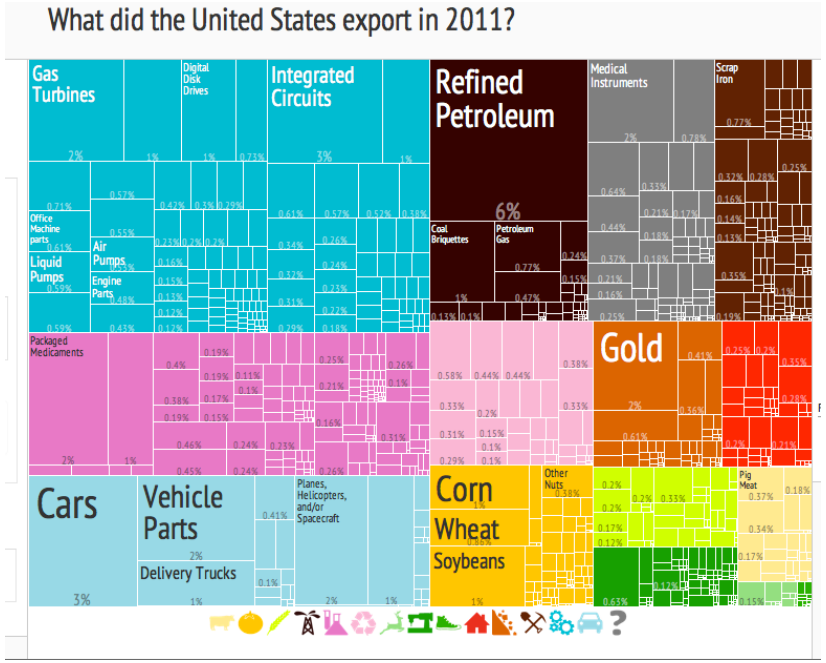
ANALYZE: ANSCOMBE'S QUARTET – GRAPHICS



COMMUNICATE: HIERACHICAL STRUCTURES

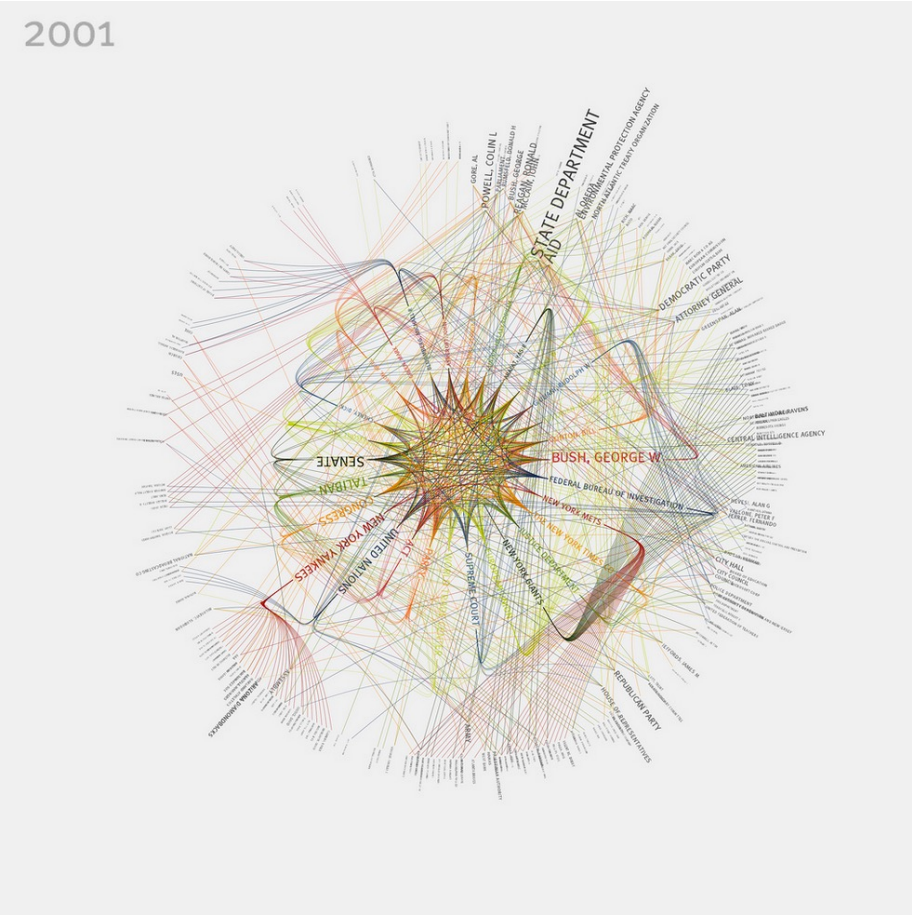


http://www.stefanieposavec.co.uk/entangled-word-bank/

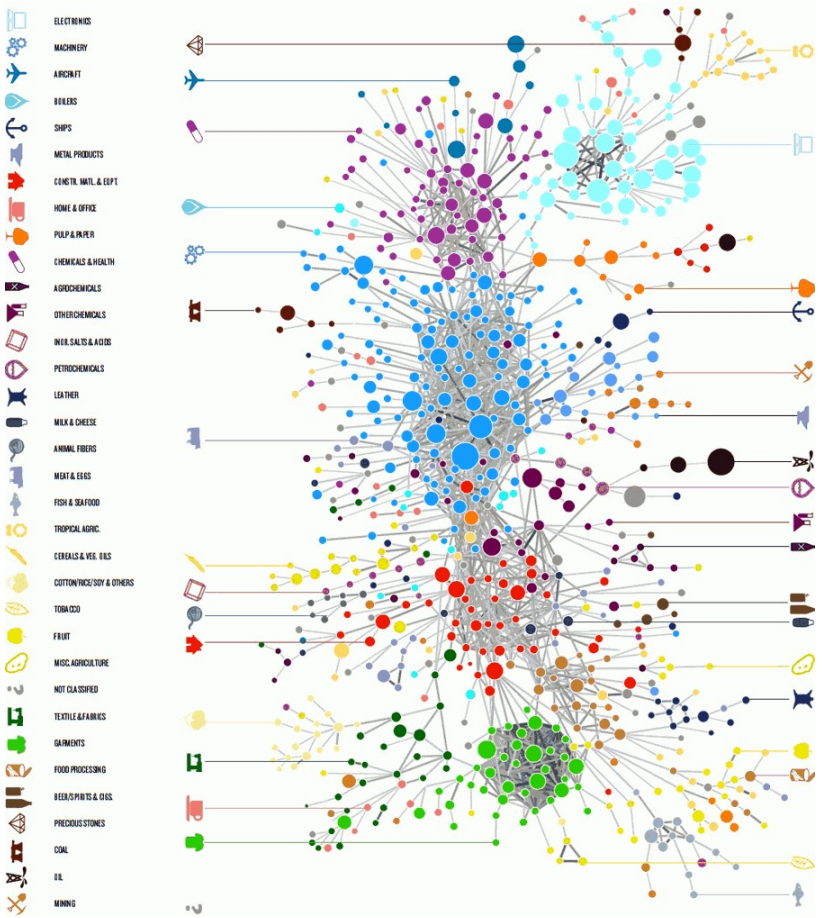


https://atlas.cid.harvard.edu/

COMMUNICATE: NETWORKS

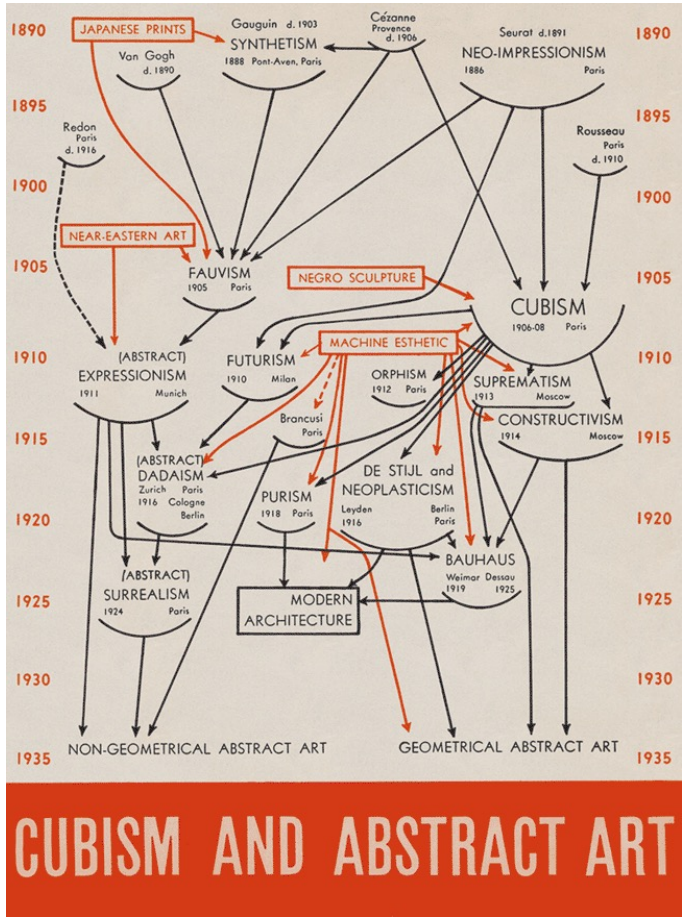


https://www.flickr.com/photos/blprnt/sets/72157614008027965/

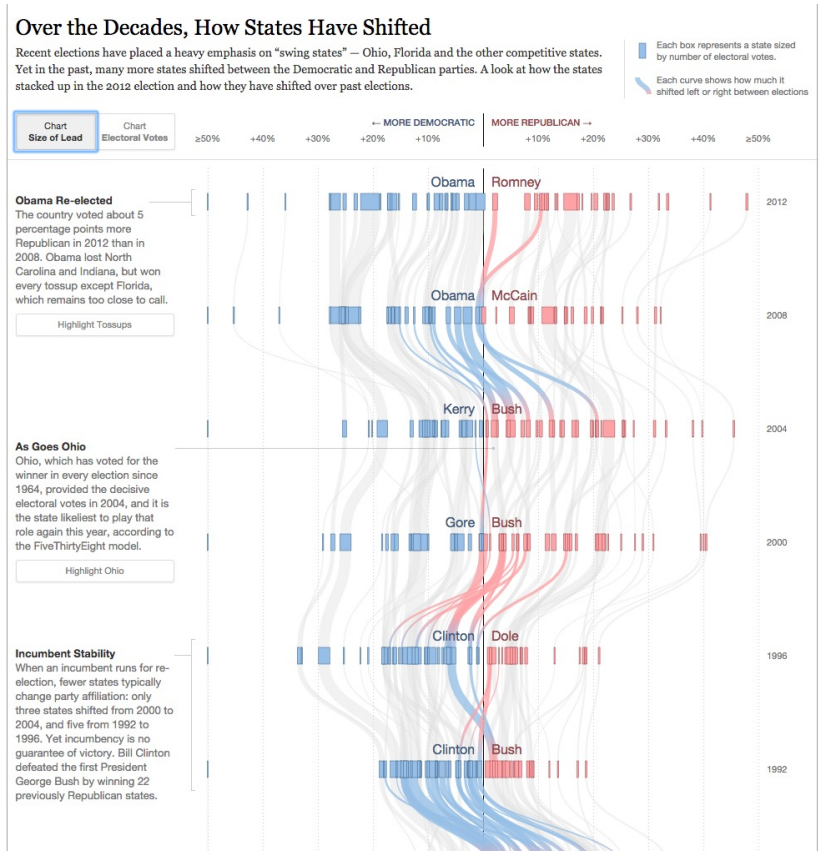


https://atlas.cid.harvard.edu/

COMMUNICATE: TEMPORAL STRUCTURES

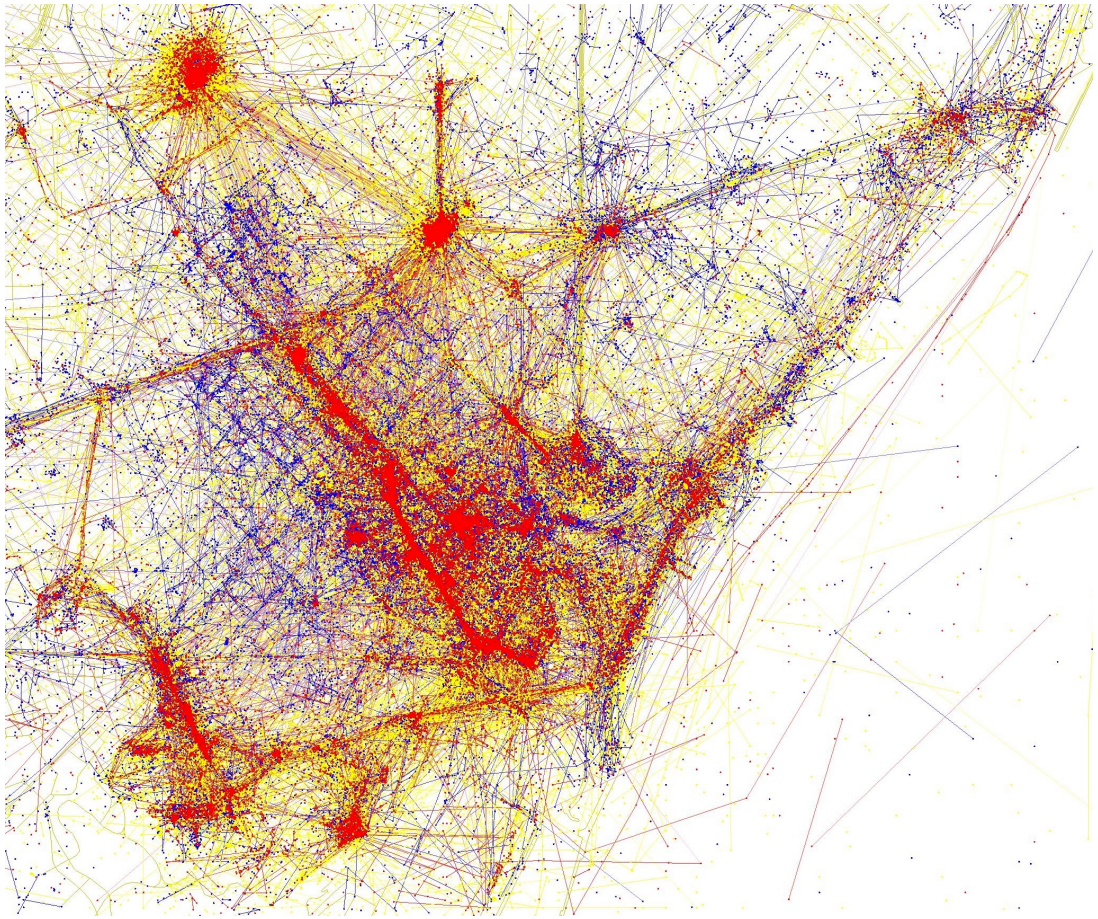


Cubism And Abstract Art (Alfred H. Barr 1936)

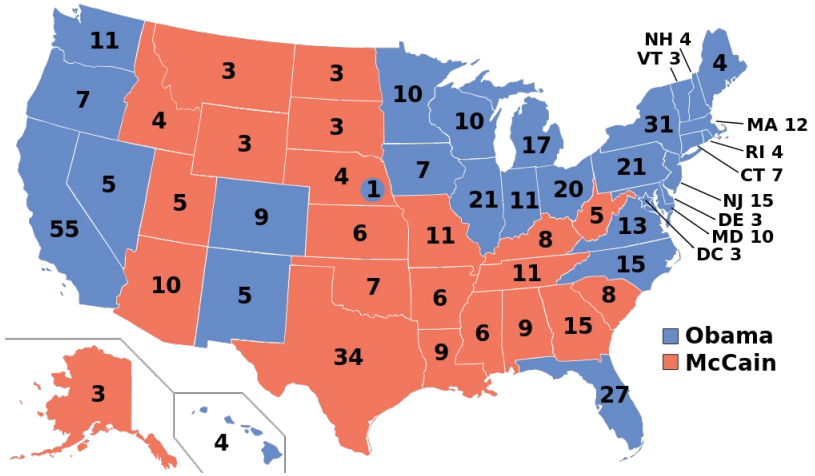


http://www.nytimes.com/interactive/2012/10/15/us/politics/swing-history.html

COMMUNICATE: MAPS

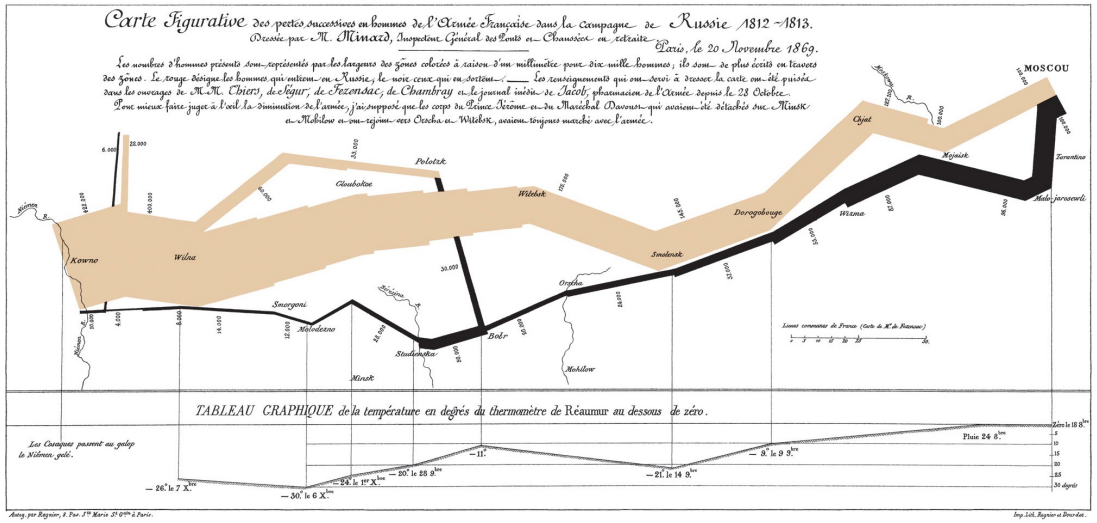


https://www.flickr.com/photos/walkingsf/sets/72157624209158632/

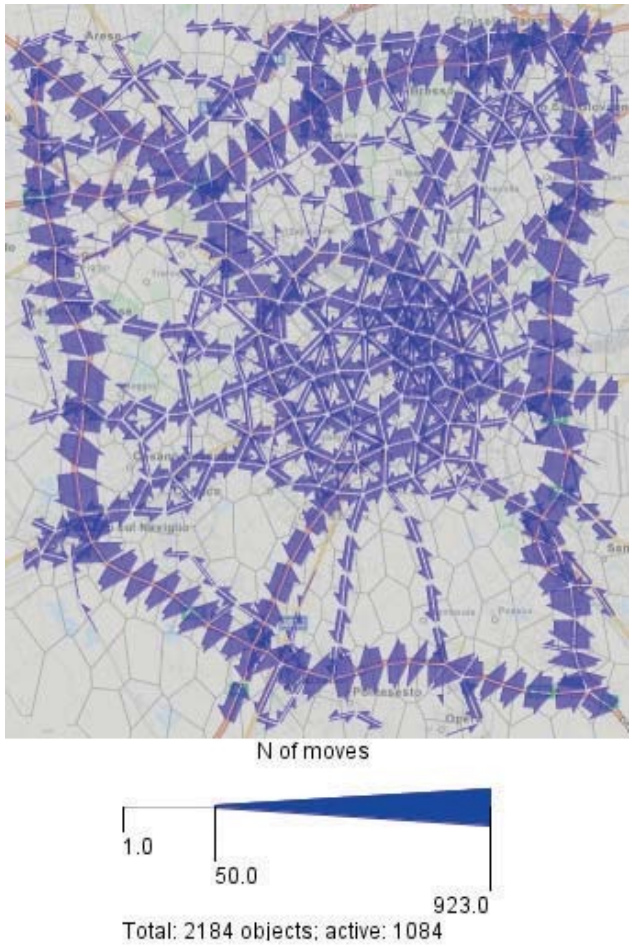


"ElectoralCollege2008" by Gage - Own work. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:ElectoralCollege2008.svg#mediaviewer/File:ElectoralCollege2008.svg

COMMUNICATE: SPATIO-TEMPORAL DATA

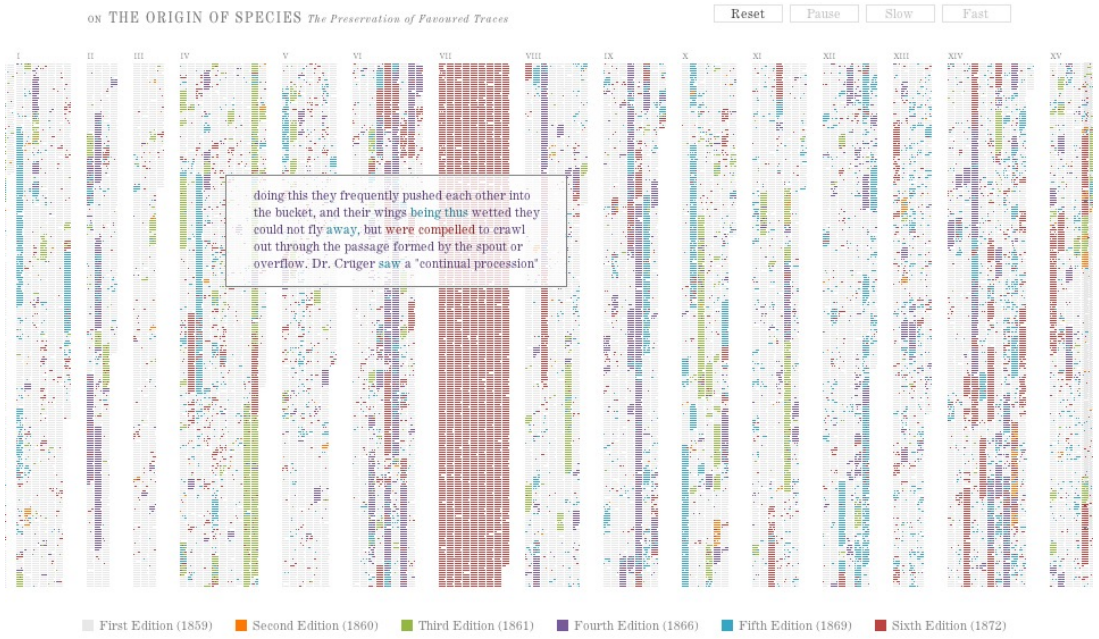


"Minard" by Charles Minard (1781-1870) - see upload log. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Minard.png#mediaviewer/File:Minard.png



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

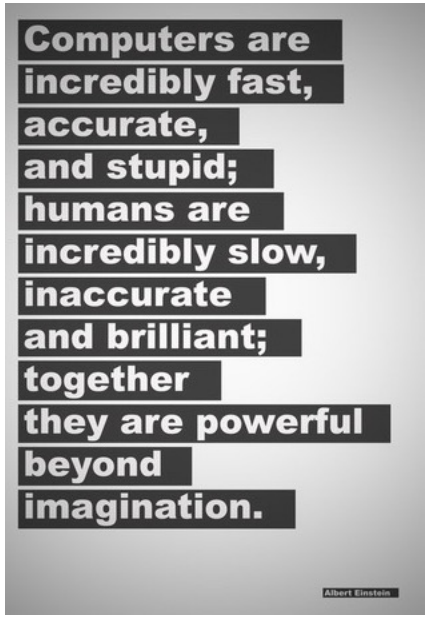
COMMUNICATE: TEXT



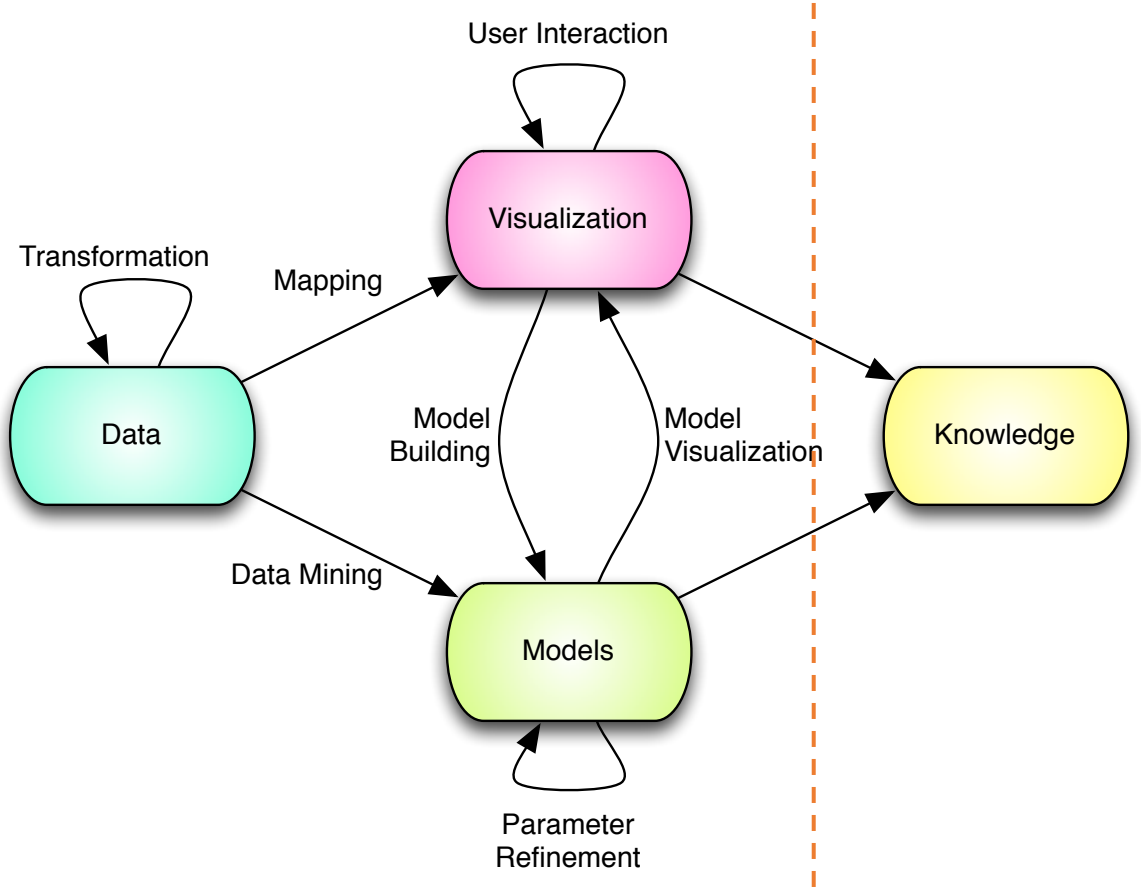
http://benfry.com/writing/archives/529

VISUALIZATION AND VISUAL ANALYTICS

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



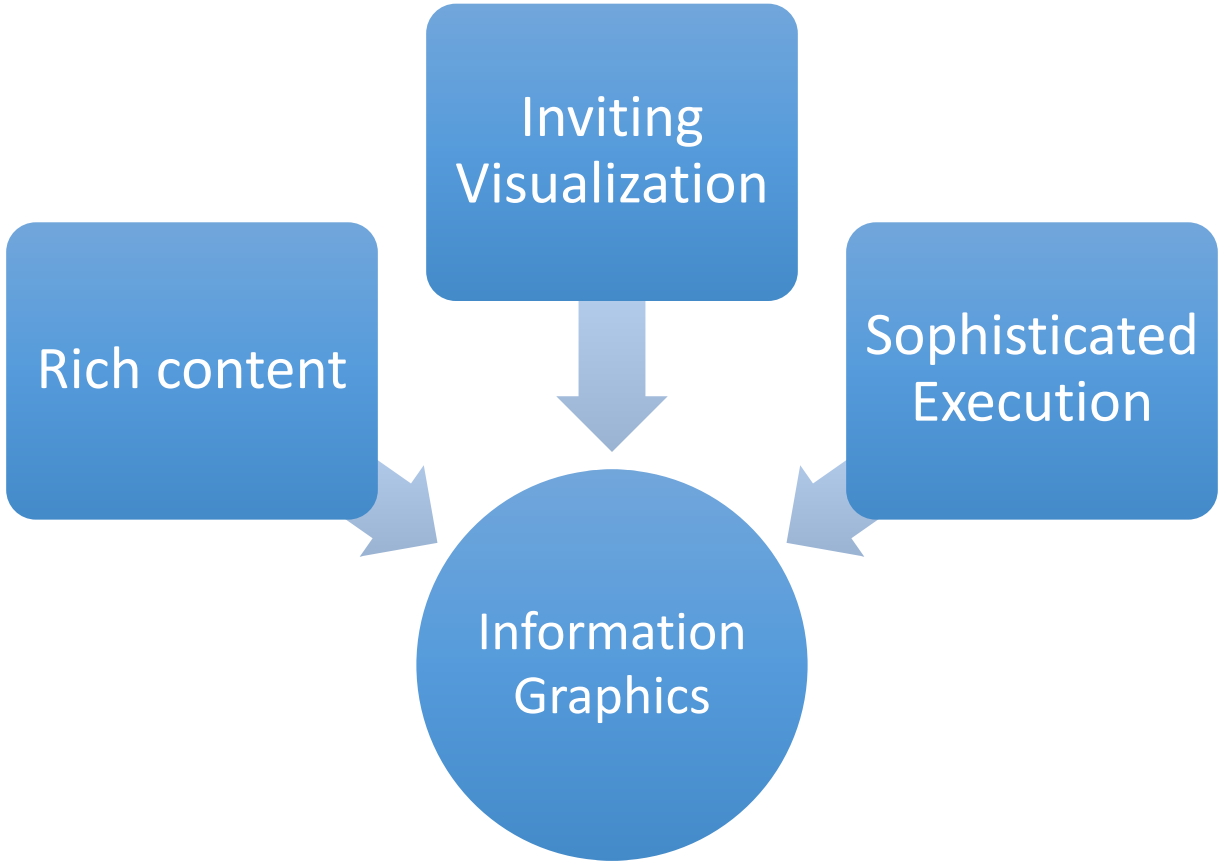
VISUAL ANALYTICAL PROCESS



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

Exploration **Explanation**

ELEMENTS OF GOOD VISUALIZATION

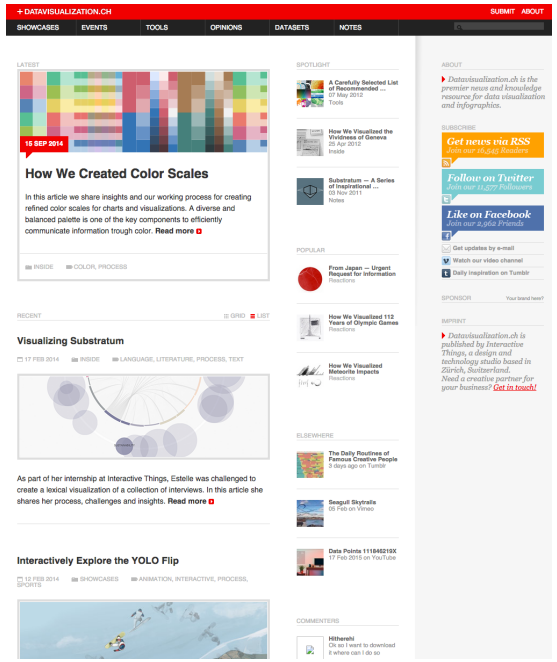


IMPORTANCE OF VALID DATA

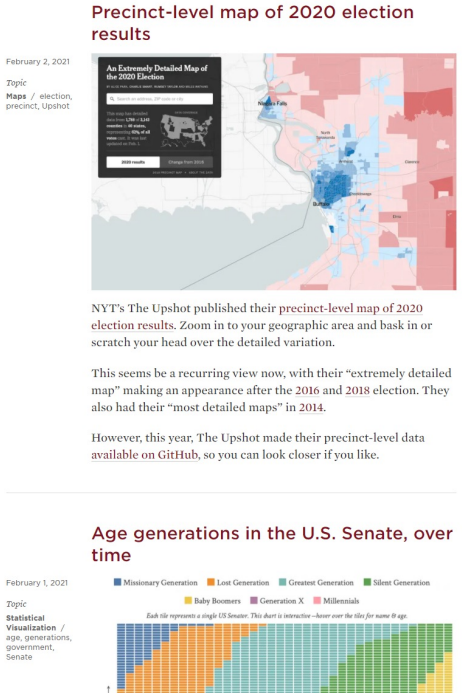
OTHER RESOURCES

Observe how others resolved design problems

datavisualization.ch



https://flowingdata.com/



infosthetics.com