The University of Nottingham
UNITED KINGDOM • CHINA • MALAYSIA

G53FIV: Fundamentals of Information Visualization

Lecture 2: The Value of Visualization

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https://moodle.nottingham.ac.uk/course/view.php?id=68644

Overview

- What are the Key Values of IV?
  - Record
  - Communicate
  - Reason
- What is the Process of IV?

What are the Key Values of IV?

Why Create Visualization?

Why Create Visualization?

- Answer questions (or discover them)
- Make decisions
- See data in context
- Expand memory
- Support graphical calculation
- Find patterns
- Present argument or tell a story
- Inspire

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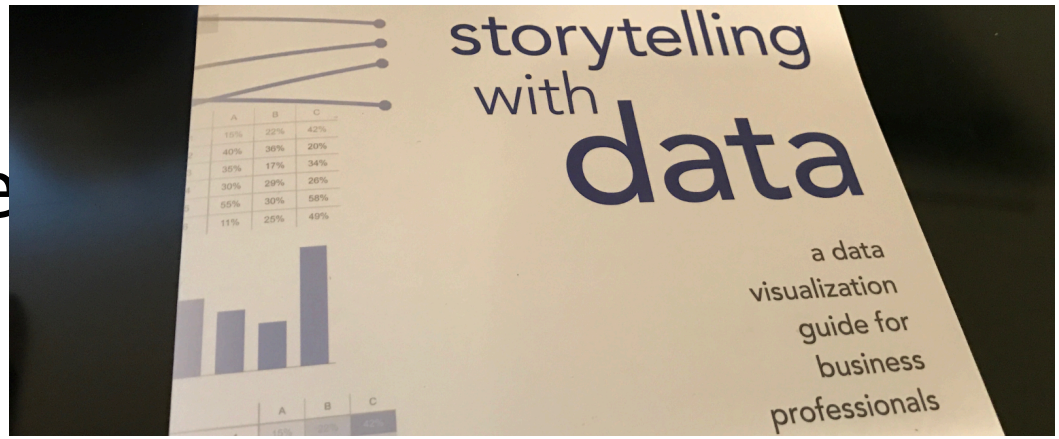
"A picture is worth a thousand words"



Summary of Reasons

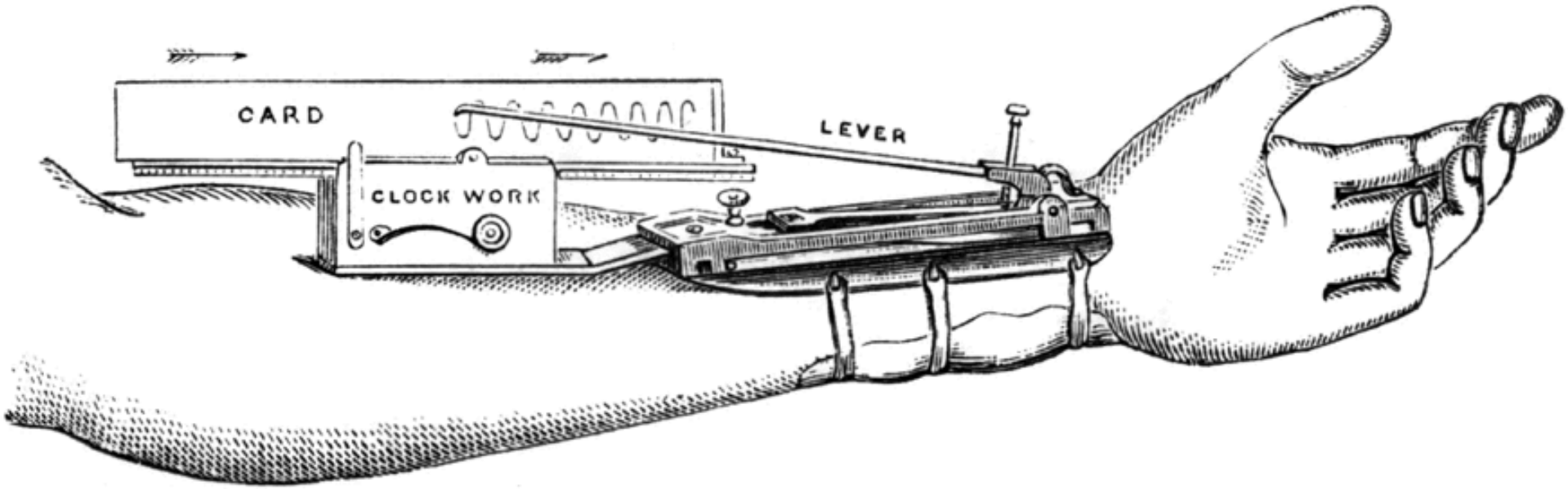
- **Record** information
  - Blueprints, photographs, seismographs, ...
- **Communicate** information to others
  - Share and persuade
  - Collaborate and revise
- Analyze data to **support reasoning**
  - Find patterns / Discover errors in data
  - Expand memory
  - Develop and assess hypotheses

Record Information

- Egyptian hieroglyphs

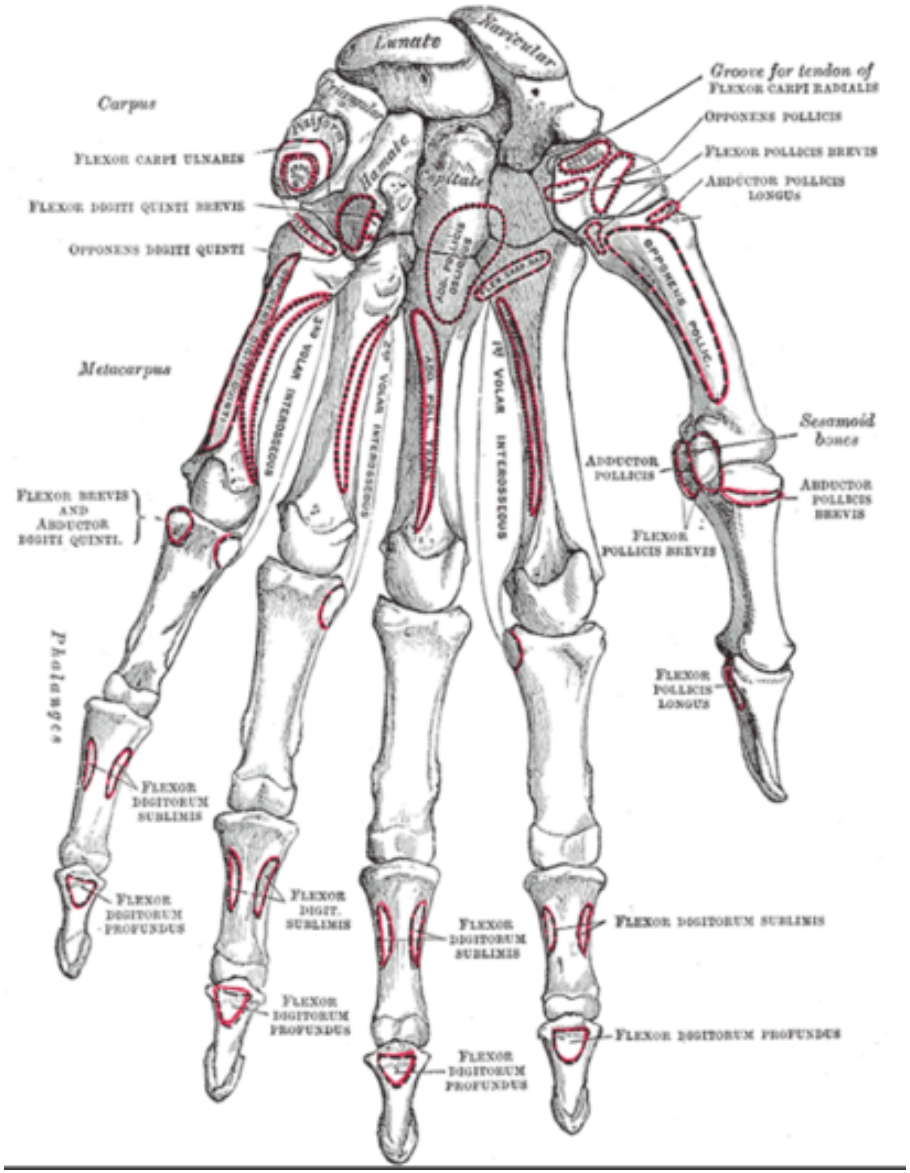
Record Information

- E.J. Marey's sphygmograph (1854)
  - an instrument which produces a line recording the strength and rate of a person's pulse.



Communicate:
convey information to others

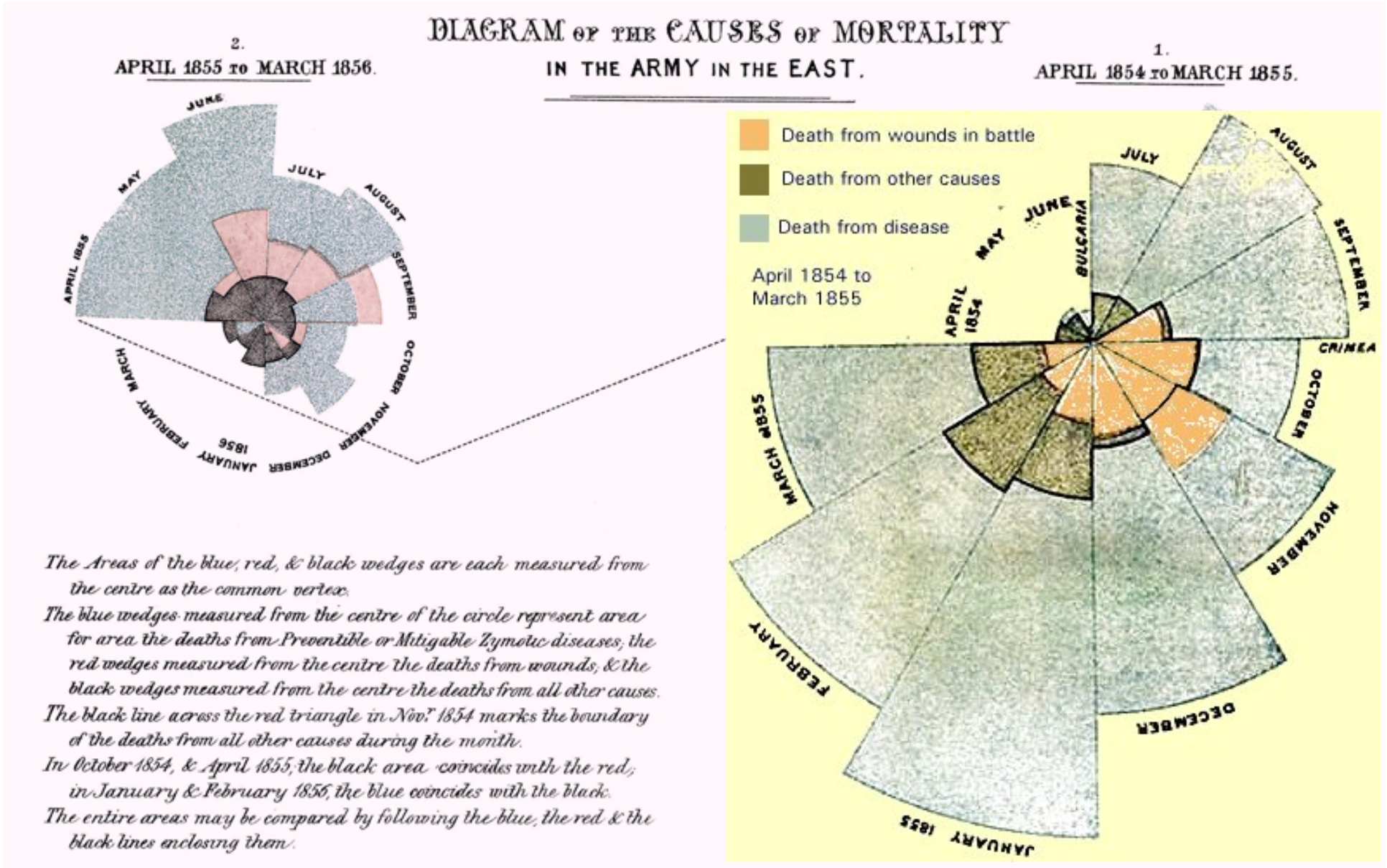
Share and collaborate



Bones in hand (drawn in 1918)

DNA Helix

Persuade: Nightingale's Graph



Clarify/Revise:
London's underground map

1926

Clarify/Revise: London's underground map

- Horizontal, vertical and 45° segments
- Key insight: topology and relative location of stations

1926 vs. 1987

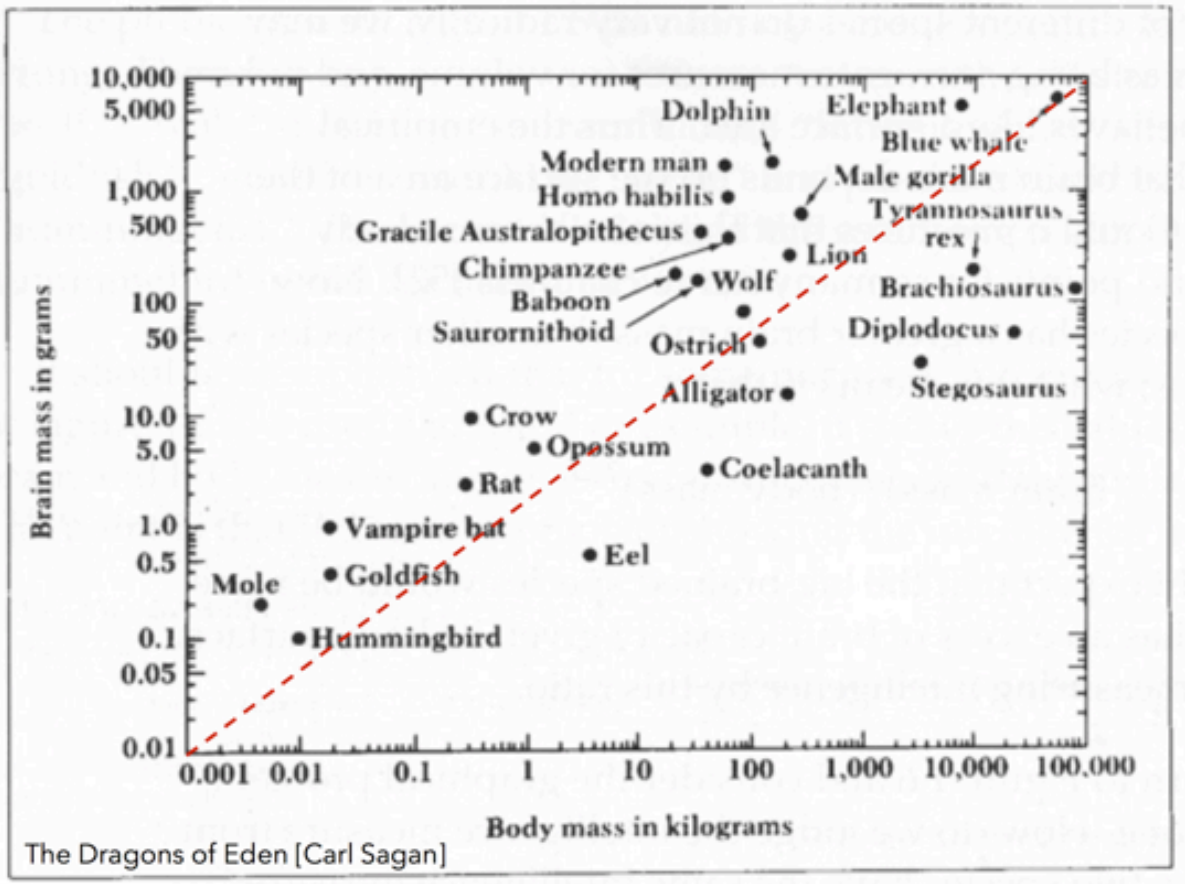
Beer Infographics

Support reasoning

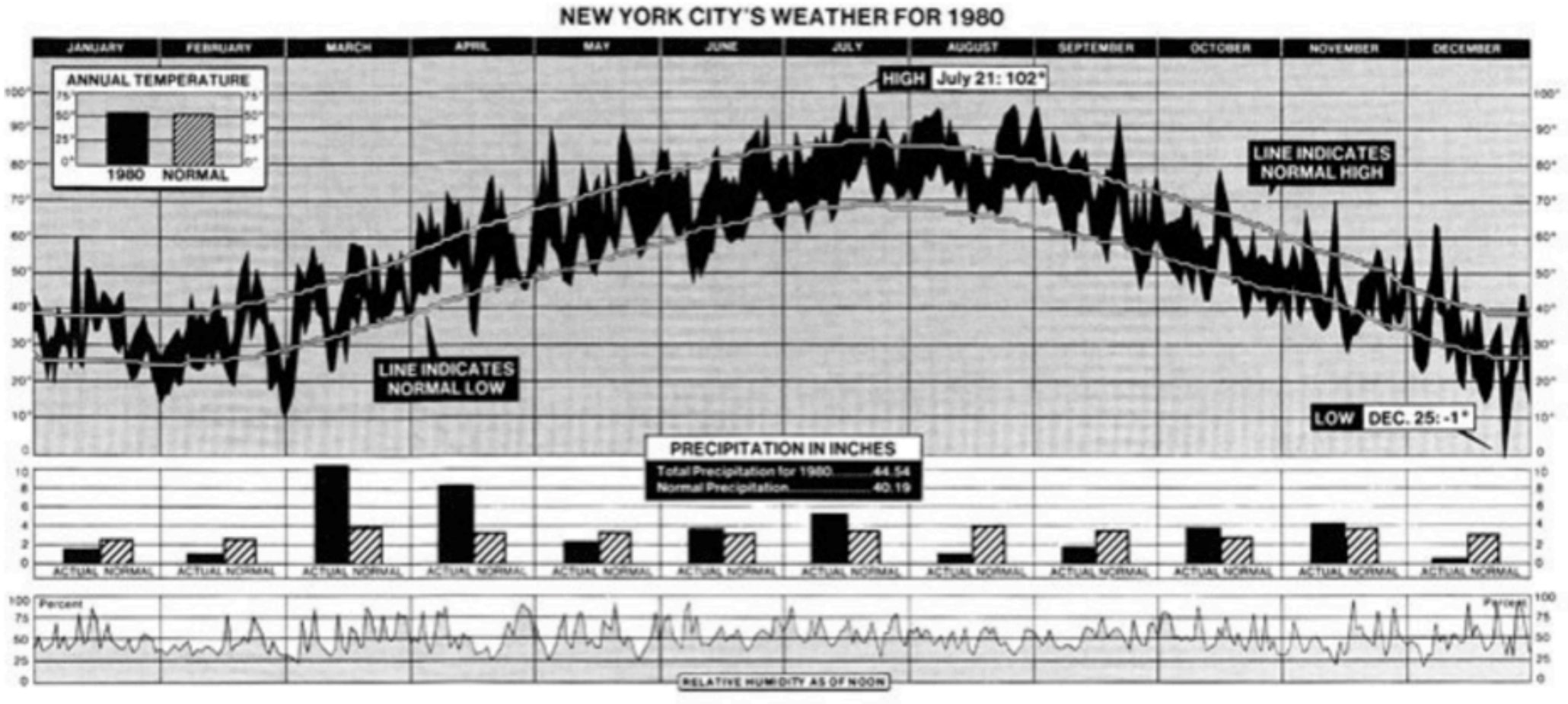
Dr. Ke Zhou (http://www.cs.nott.ac.uk/~pszkz/)

Find Patterns: the most powerful brain

ID	Name	Body Weight	Brain Weight
1	Lesser Short-tailed Shrew	5	0.14
2	Little Brown Bat	10	0.25
3	Mouse	23	0.3
4	Big Brown Bat	23	0.4
5	Musk Shrew	48	0.33
6	Star Nosed Mole	60	1
7	Eastern American Mole	75	1.2
8	Ground Squirrel	101	4
9	Tree Shrew	104	2.5
10	Golden Hamster	120	1
11	Mole Rate	122	3
12	Galago	200	5
13	Rat	280	1.9
14	Chinchilla	425	6.4
15	Desert Hedgehog	550	2.4
16	Rock Hyrax (a)	750	12.3
17	European Hedgehog	785	3.5
18	Tenrec	900	2.6
19	Arctic Ground Squirrel	920	5.7
20	African Giant Pouched Rat	1000	6.6
21	Guinea Pig	1040	5.5
22	Mountain Beaver	1350	8.1
23	Slow Loris	1400	12.5
24	Genet	1410	17.5
25	Phalanger	1620	11.4



Find Patterns: NYC weather



2200 data points

Dr. Ke Zhou (http://www.cs.nott.ac.uk/~pszkz/)

Expand Memory

- Class Exercise

```
   34
 x 72
--------
```

Expand Memory

- Class Exercise

```
   34
x 72
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```
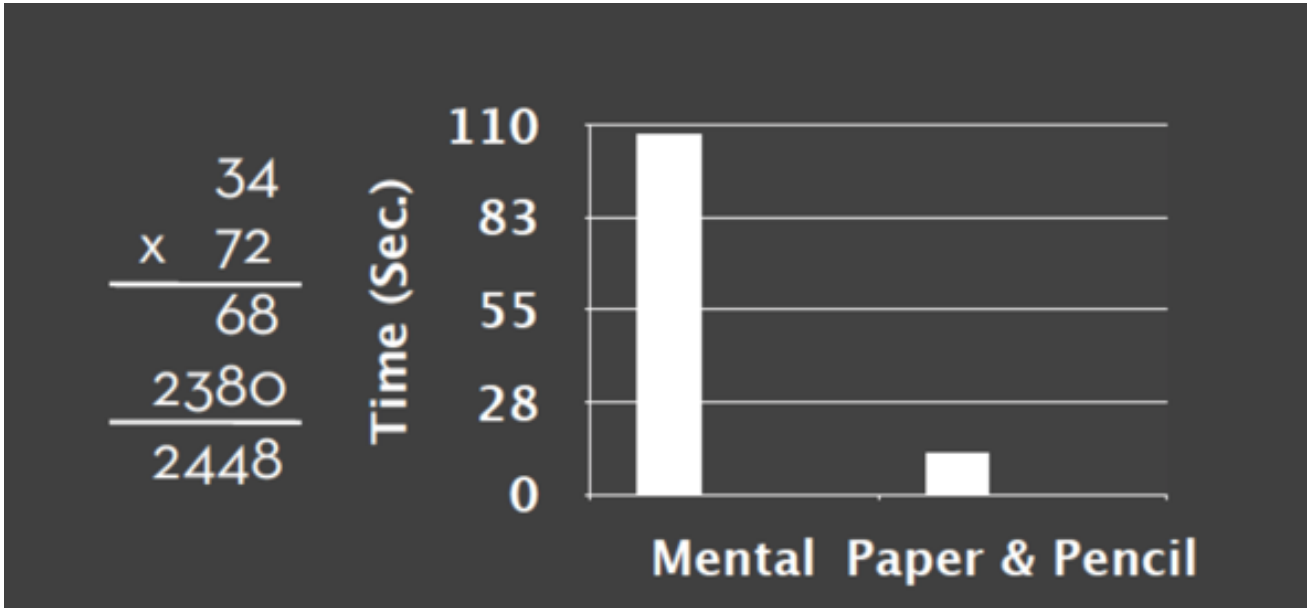
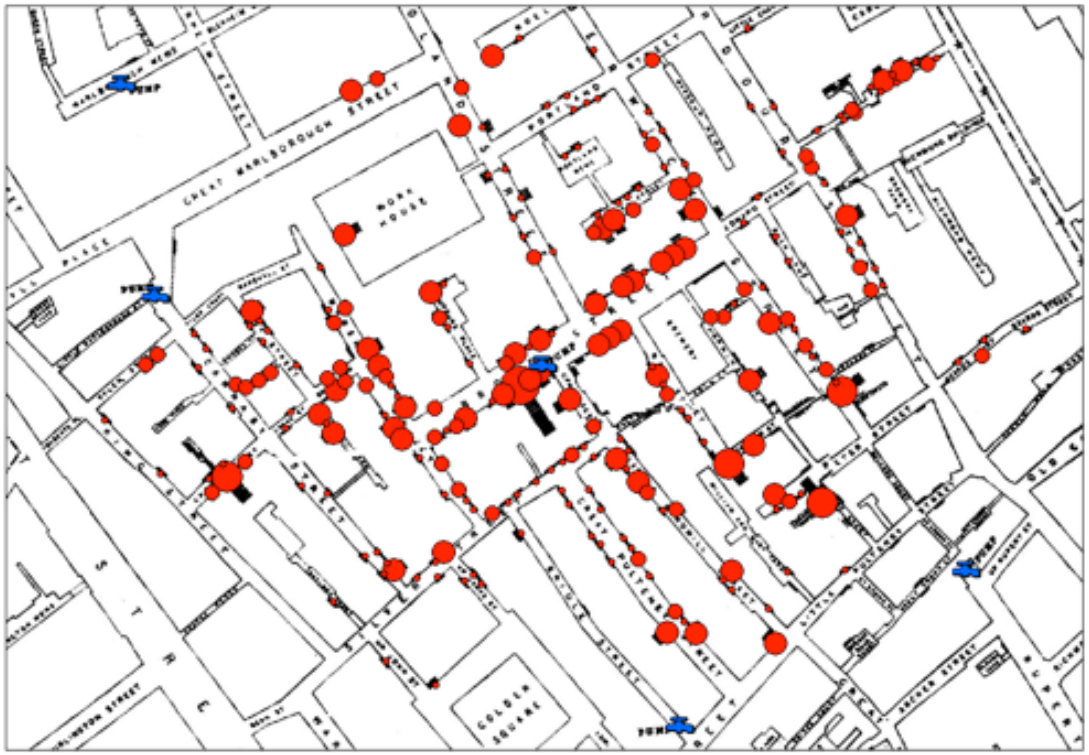



Develop and Assess Hypothesis
London Cholera Map



London Cholera Map
Visualization by John Snow, 1854.

- The closer to the Broad Street water pump, the greater the number of deaths.
- The information helped convince the public a true sewage system was needed.

Surprises in Data

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

John Tukey, 1977

"Contained within the data of any investigation is information that can yield conclusions to questions not even originally asked. That is, there can be surprises in the data..."

W. Cleveland

The Elements of Graphing Data

Reasoning / Exploration

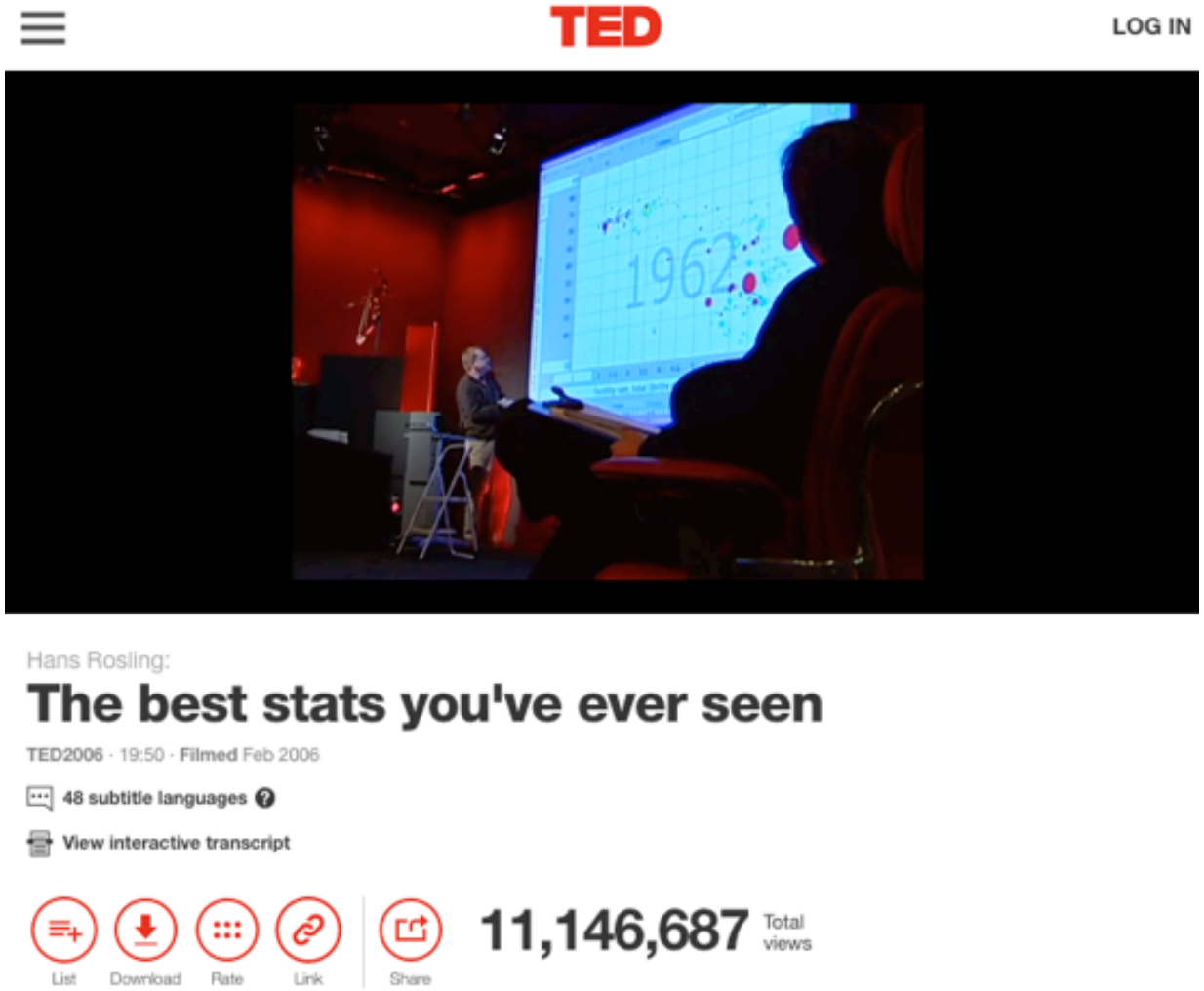
"If you can articulate very precisely what you're seeking, visualization likely isn't your best approach"

J. Stasko, EuroVis'14

Exploration

- Don't know what you're looking for
- Don't have a priori questions
- Want to know what questions to ask

Hans Rosling's TED talk



http://www.ted.com/talks/hans_rosling_shows_the_best_stats_you_ve_ever_seen

Key Applications of IV

- I. **Record Information**

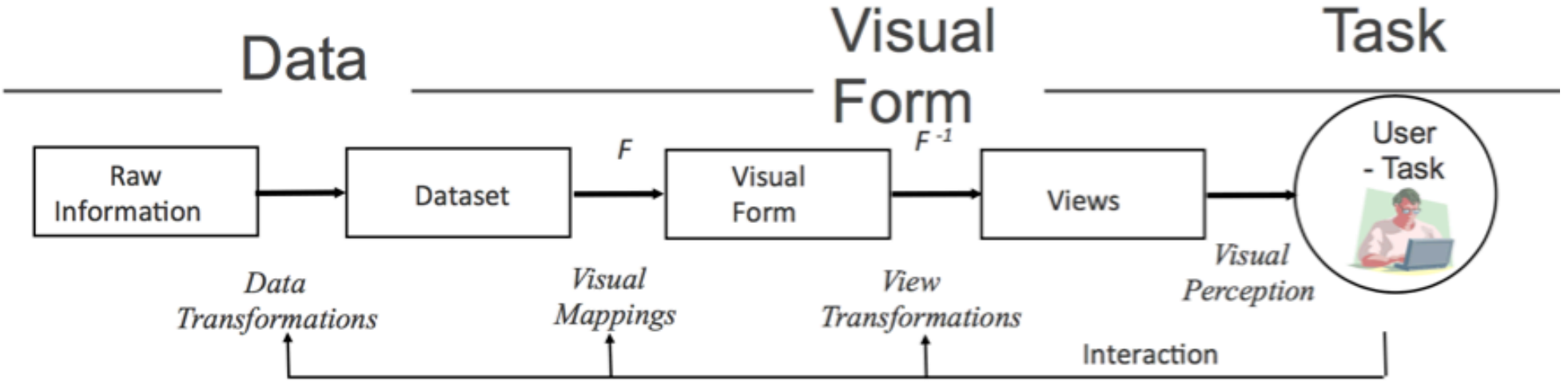
- II. **Communications (Presentation)**
  - Communicate data and ideas
  - Explain and inform
  - Provide evidence and support
  - Influence and persuade

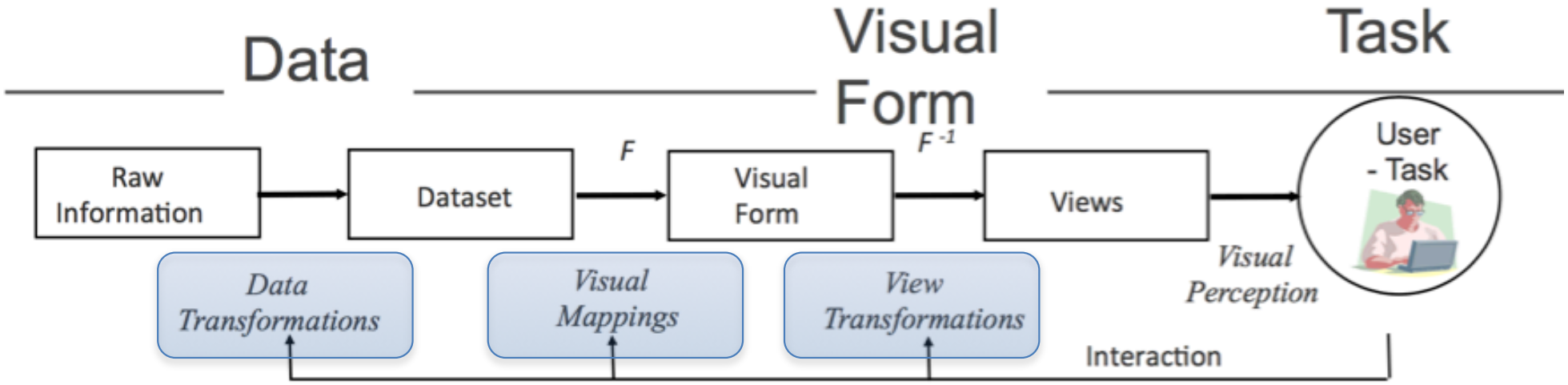
- III. **Reasoning (Analysis)**
  - Explore the data
  - Assess a situation
  - Determine how to proceed
  - Decide what to do

The Visualization Process

Dr. Ke Zhou (http://www.cs.nott.ac.uk/~pszkz/)

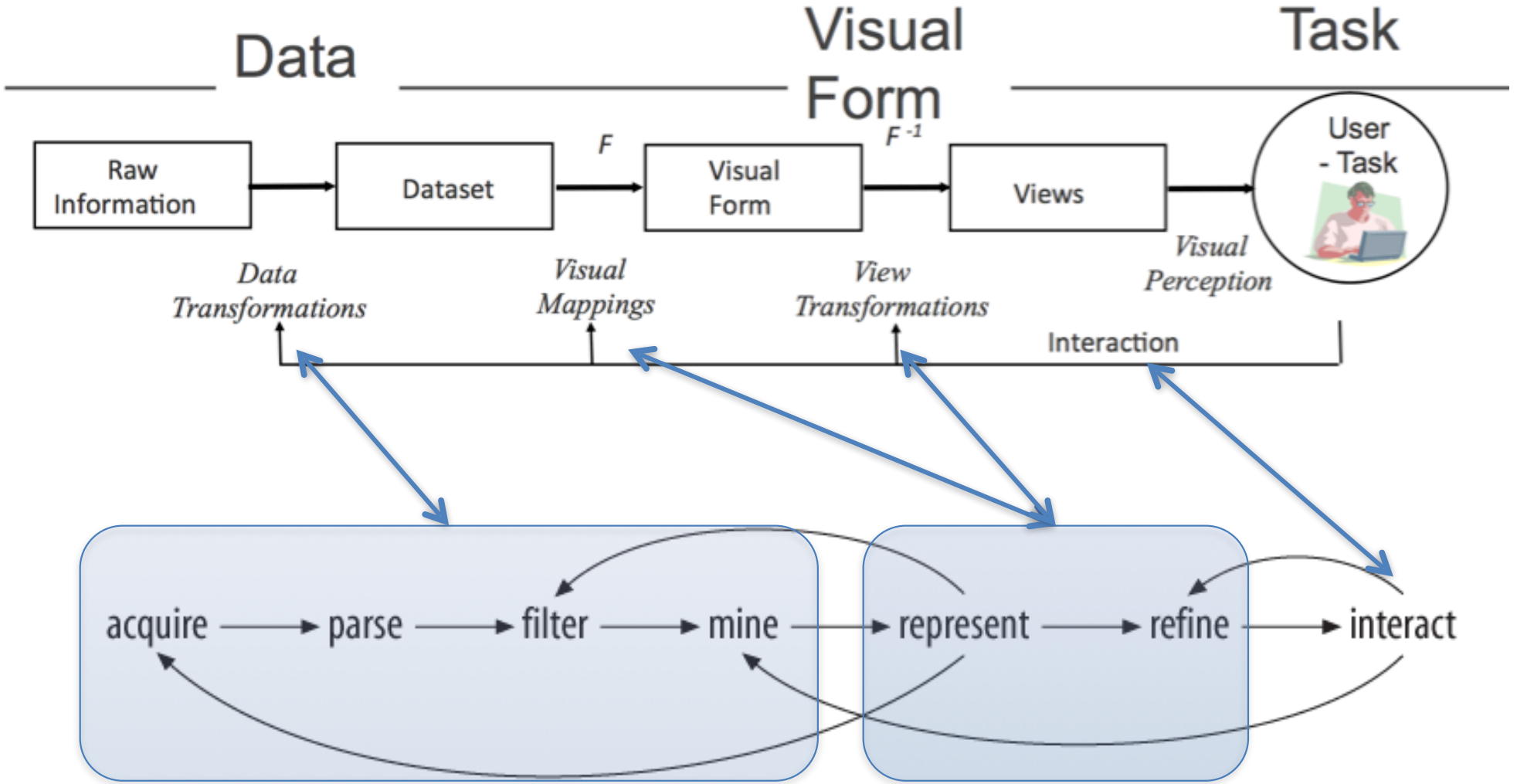
Different Stages of Visualization





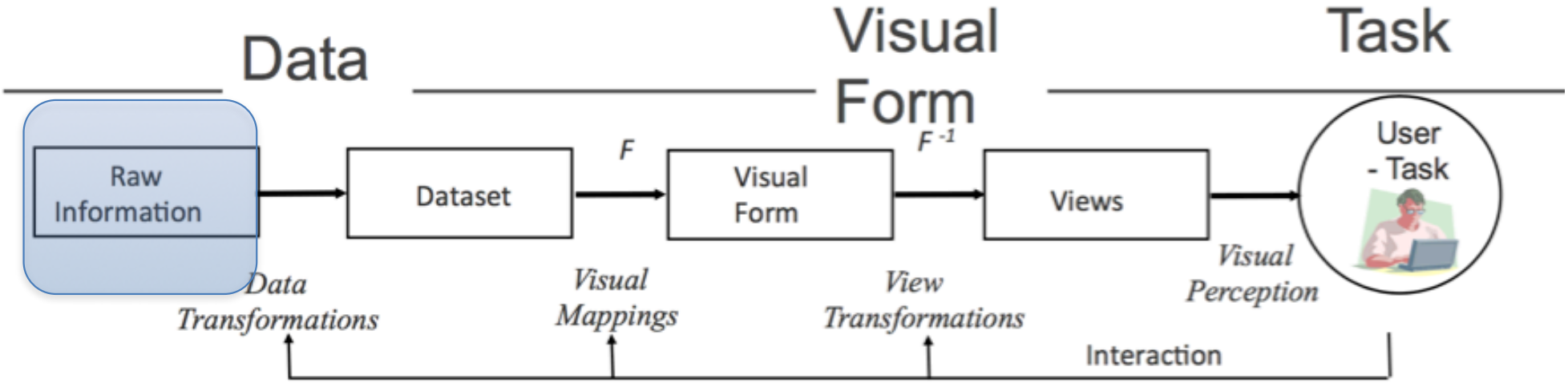
- Data transformation
  - create a structural model (schema), mapping raw data into data tables
- Visual mapping
  - create a visual spatial model, transforming data tables into visual structures
- View Transformations
  - Create views of the Visual Structures by specifying graphical parameters such as position, scaling, and clipping

Different Stages of Visualization



Visualizing Data by Ben Fry

Seven Stages: Acquire

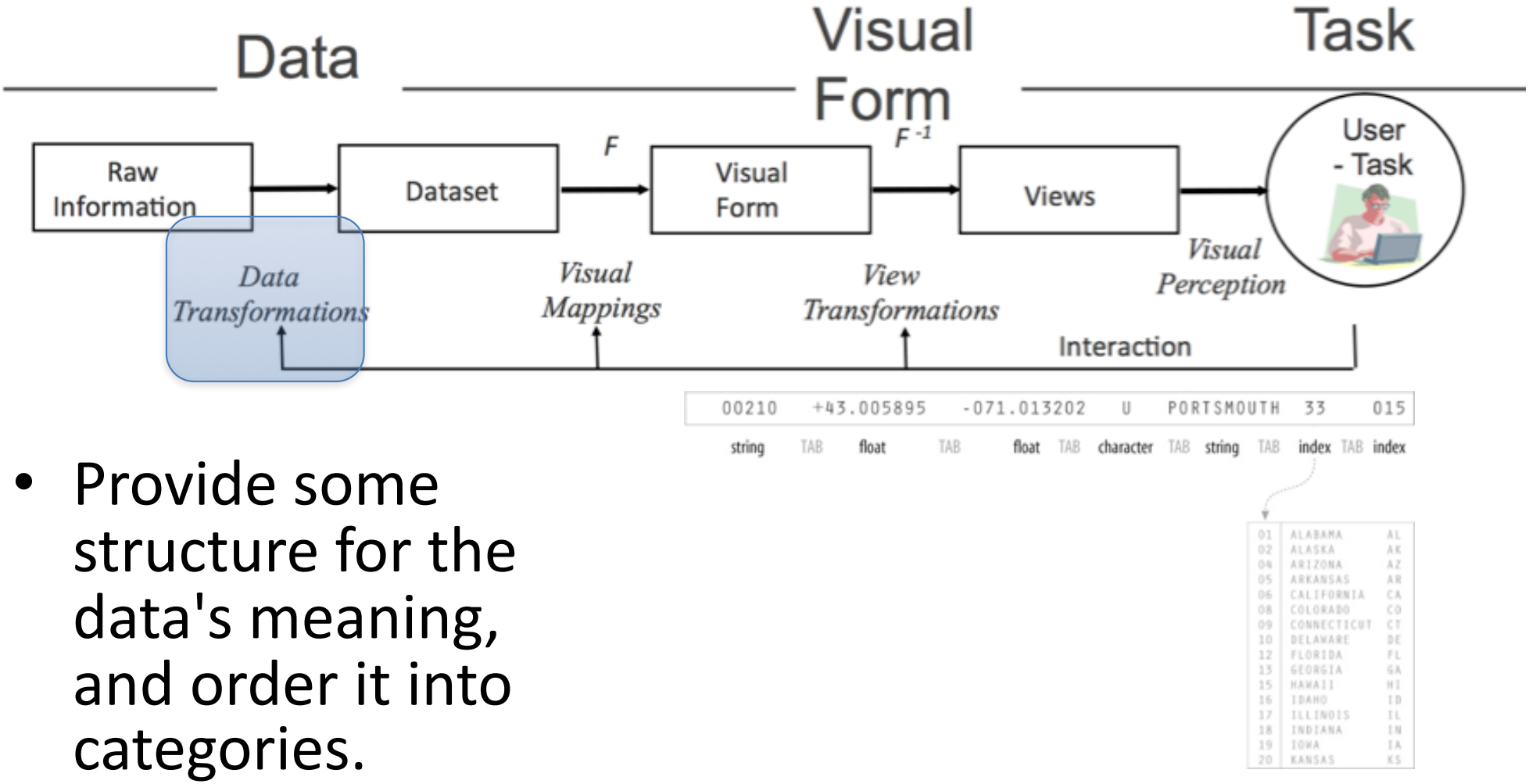


- Obtain the data, whether from a file on a disk or a source over a network

00210	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00211	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00212	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00213	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00214	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00215	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00501	+40.922326	-072.637078	U	HOLTSVILLE	36	103
00544	+40.922326	-072.637078	U	HOLTSVILLE	36	103
00601	+18.165273	-066.722583		ADJUNTAS	72	001
00602	+18.393103	-067.180953		AGUADA	72	003
00603	+18.455913	-067.145780		AGUADILLA	72	005
00604	+18.493520	-067.135883		AGUADILLA	72	005
00605	+18.465162	-067.141486	P	AGUADILLA	72	005
00606	+18.172947	-066.944111		MARICAO	72	093
00610	+18.288685	-067.139696		ANASCO	72	011

Zip codes in the format provided by the U.S. Census Bureau

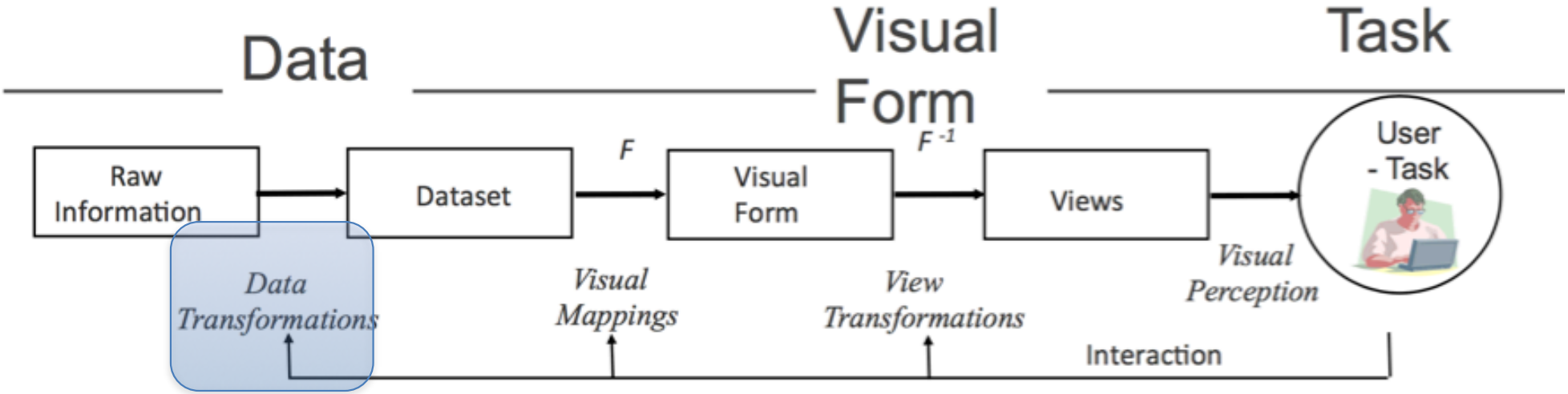
Seven Stages: Parse



- Provide some structure for the data's meaning, and order it into categories.

Structure of acquired data, formatted as a data type that we'll handle in a conversion program

Seven Stages: Filter

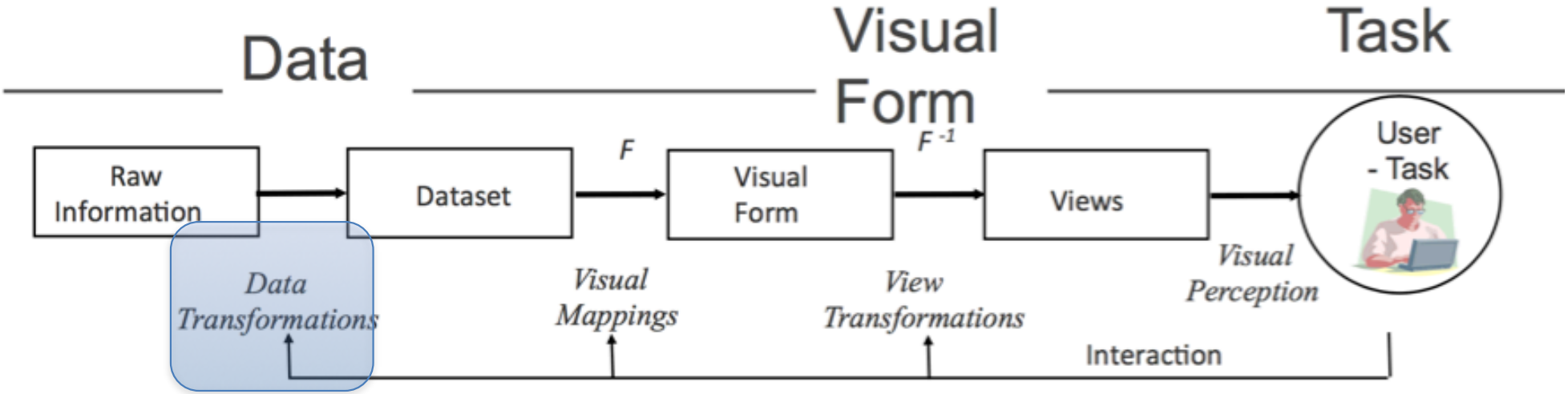


- Remove all but the data of interest.

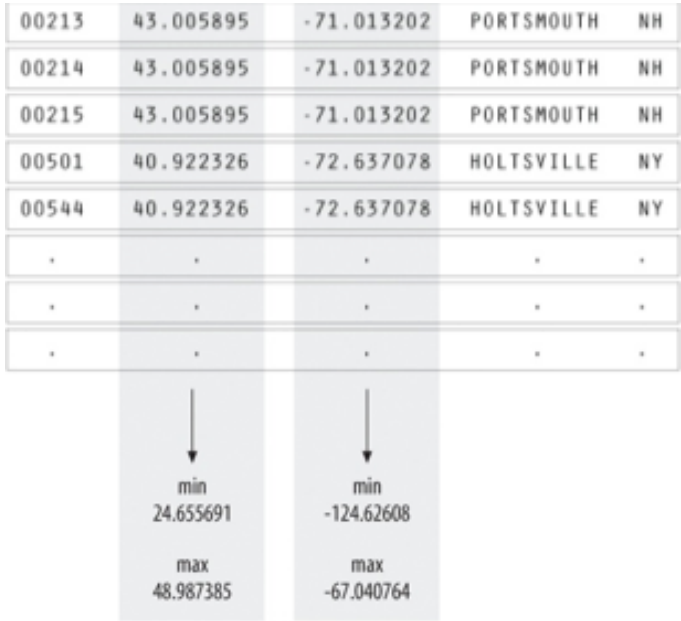
00210	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00211	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00212	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00213	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00214	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00215	+43.005895	-071.013202	U	PORTSMOUTH	33	015
00501	+40.922326	-072.637078	U	HOLTSVILLE	36	103
00544	+40.922326	-072.637078	U	HOLTSVILLE	36	103
00601	+18.165273	-066.722583		ADJUNTAS	72	001
00602	+18.393103	-067.180953		AGUADA	72	003
00603	+18.455913	-067.145780		AGUADILLA	72	005
00604	+18.493520	-067.135883		AGUADILLA	72	005
00605	+18.465162	-067.141486	P	AGUADILLA	72	005
00606	+18.172947	-066.944111		MARICAO	72	093
00610	+18.288685	-067.139696		ANASCO	72	011

Filter out some data points
remain only some data fields

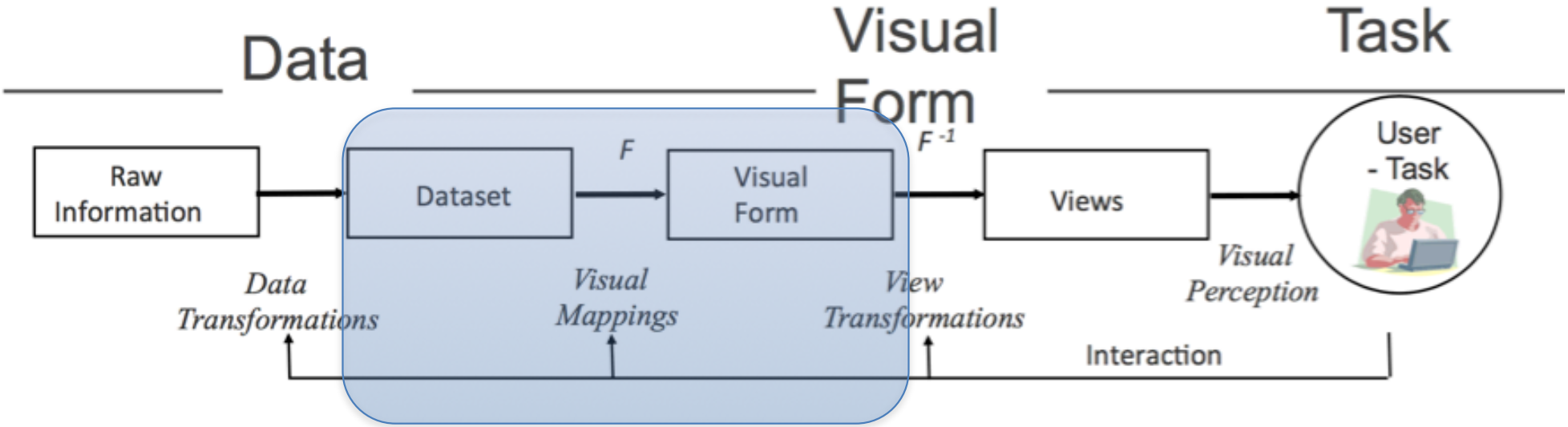
Seven Stages: Mine



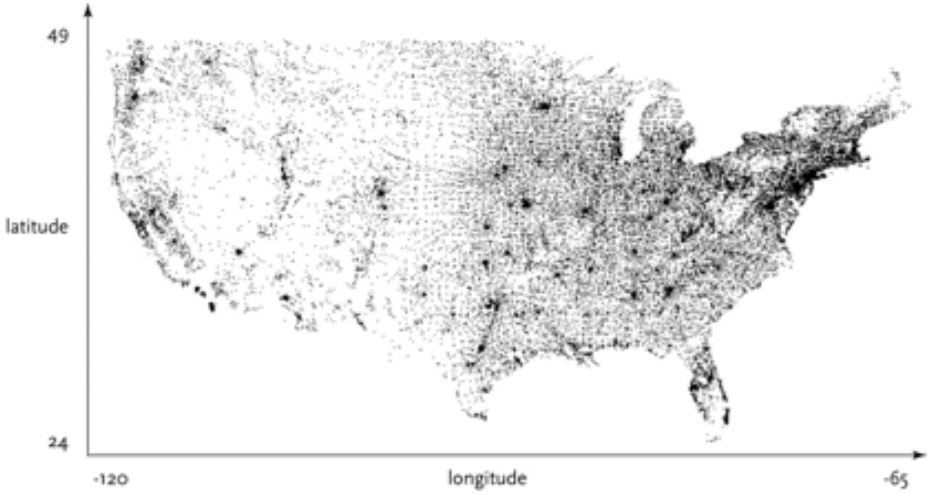
- Apply methods from statistics or data mining as a way to discern patterns or place the data in mathematical context.



Seven Stages: Represent

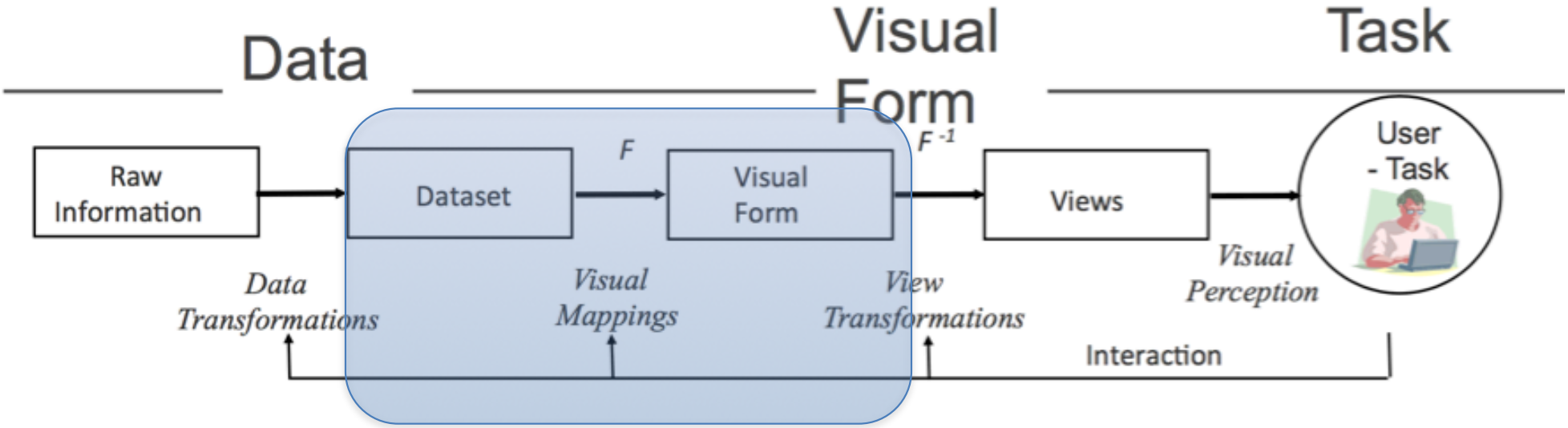


- Choose a visual model, such as a bar graph, list, or tree.

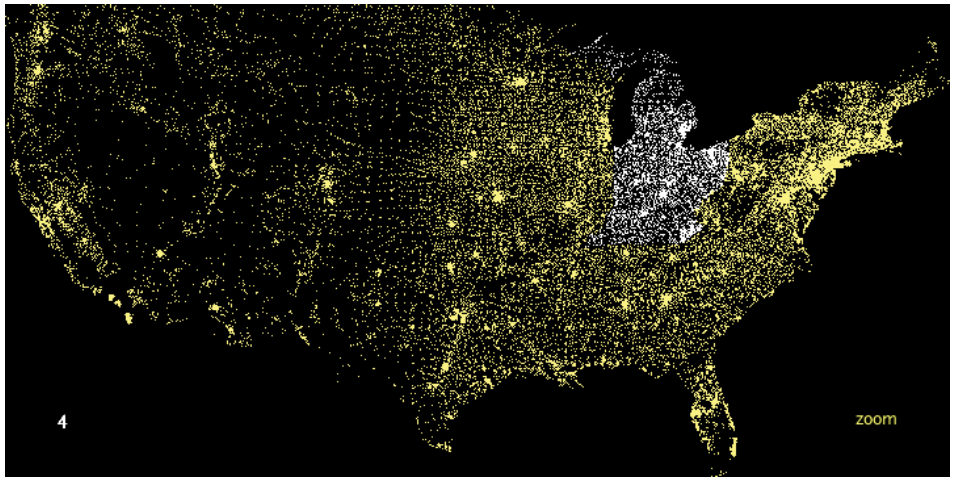


Basic visual representation of zip code data

Seven Stages: Refine



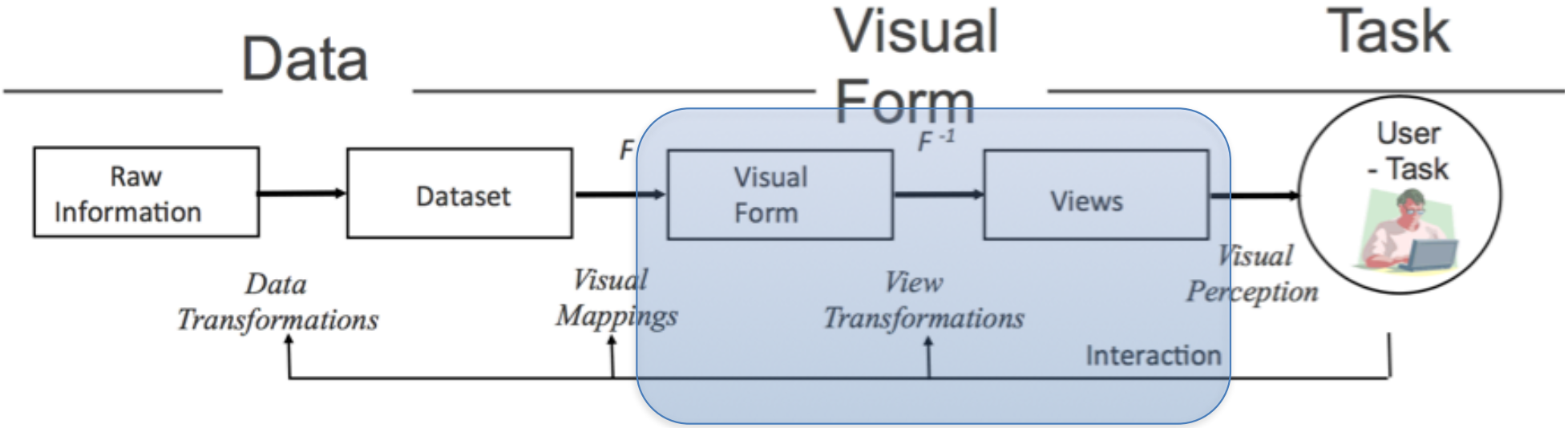
- Improve the basic representation to make it clearer and more visually engaging.



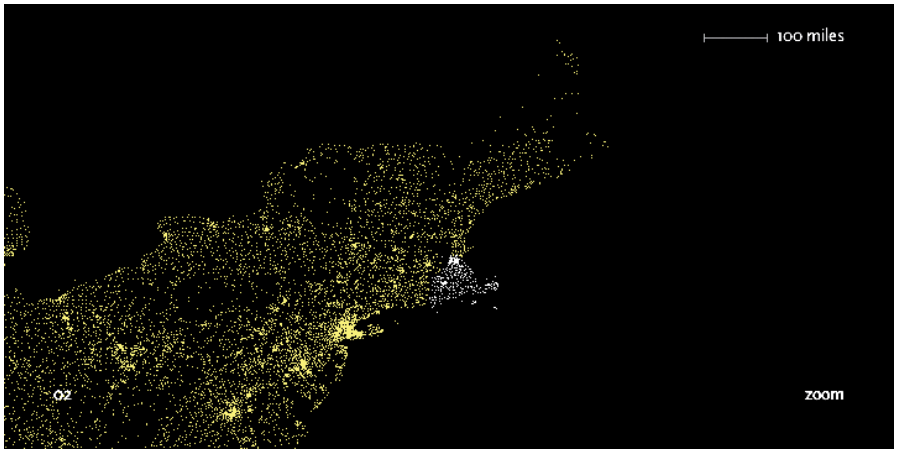
Using color to refine the representation

Dr. Ke Zhou (http://www.cs.nott.ac.uk/~pszkz/)

Seven Stages: Interact



- Add methods for manipulating the data or controlling what features are visible.



Zooming in with two digits of the post code (02)

Dr. Ke Zhou (http://www.cs.nott.ac.uk/~pszkz/)

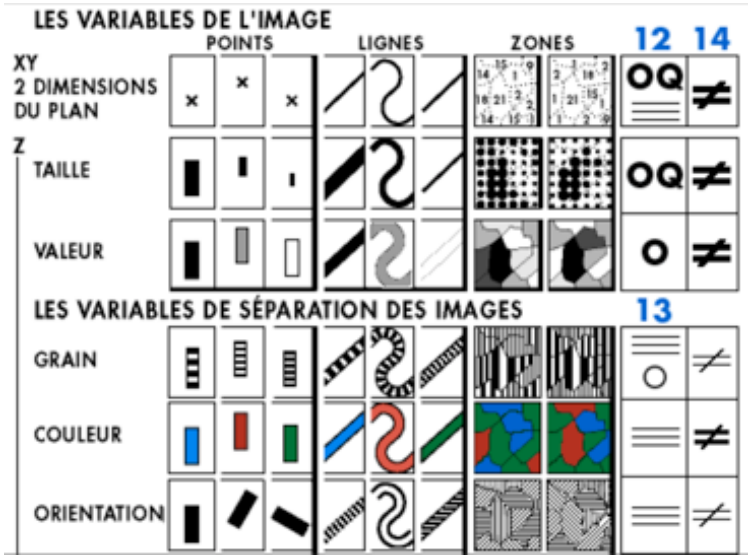
Interaction is Vital for Exploration

- Engage in a dialog with your data
- Employ interaction in a more fundamental manner to strengthen the power of visualization
- Possible Actions
  - Select
  - Explore
  - Reconfigure
  - Encode
  - Abstract/Elaborate
  - Filter
  - Connect

Yi, et al. "Toward a deeper understanding of the role of interaction in information visualization." 2007.

Next Lecture

- Topic: Data and Image Models
  - Process data
  - Encode information



- Next Monday (4 Feb)
  - 12:00 – 14:00
  - A25, Business South, Jubilee Campus