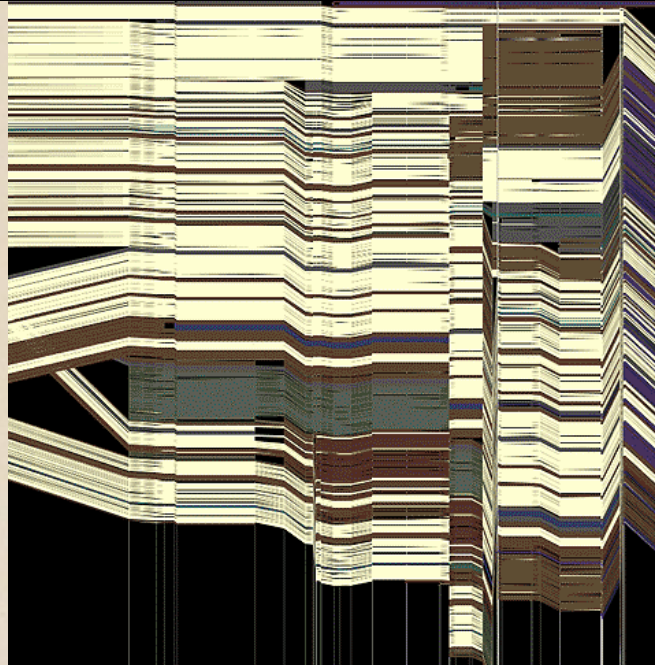
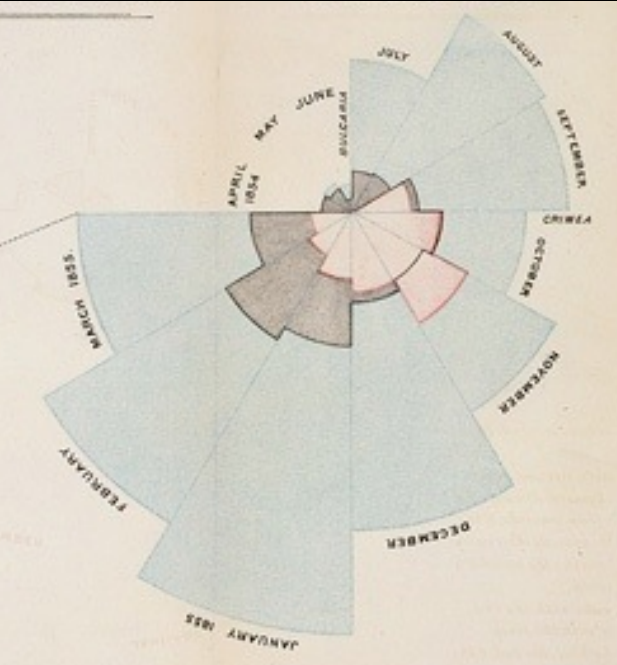


CSE 512 - Data Visualization

The Value of Visualization

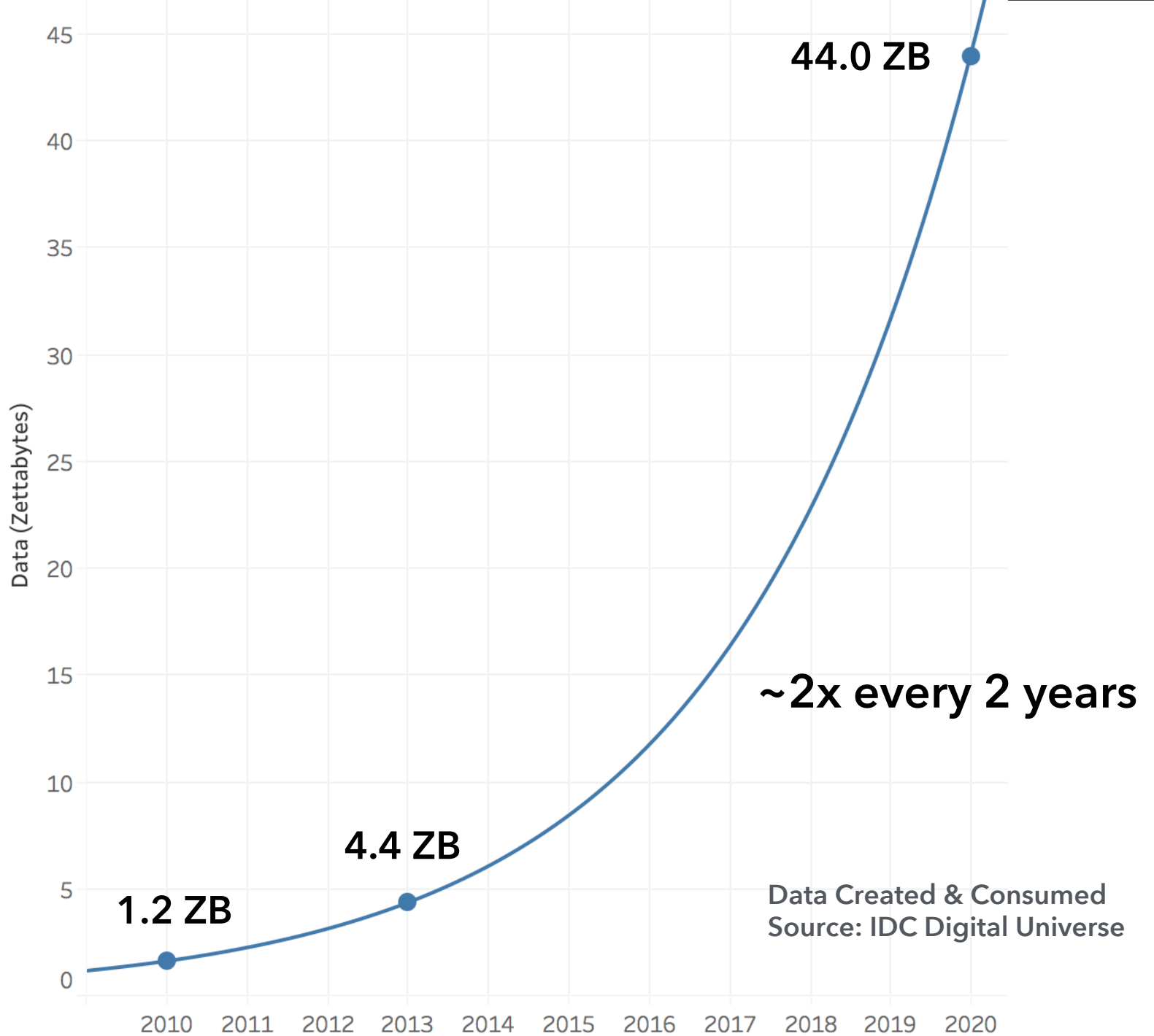


Leilani Battle University of Washington

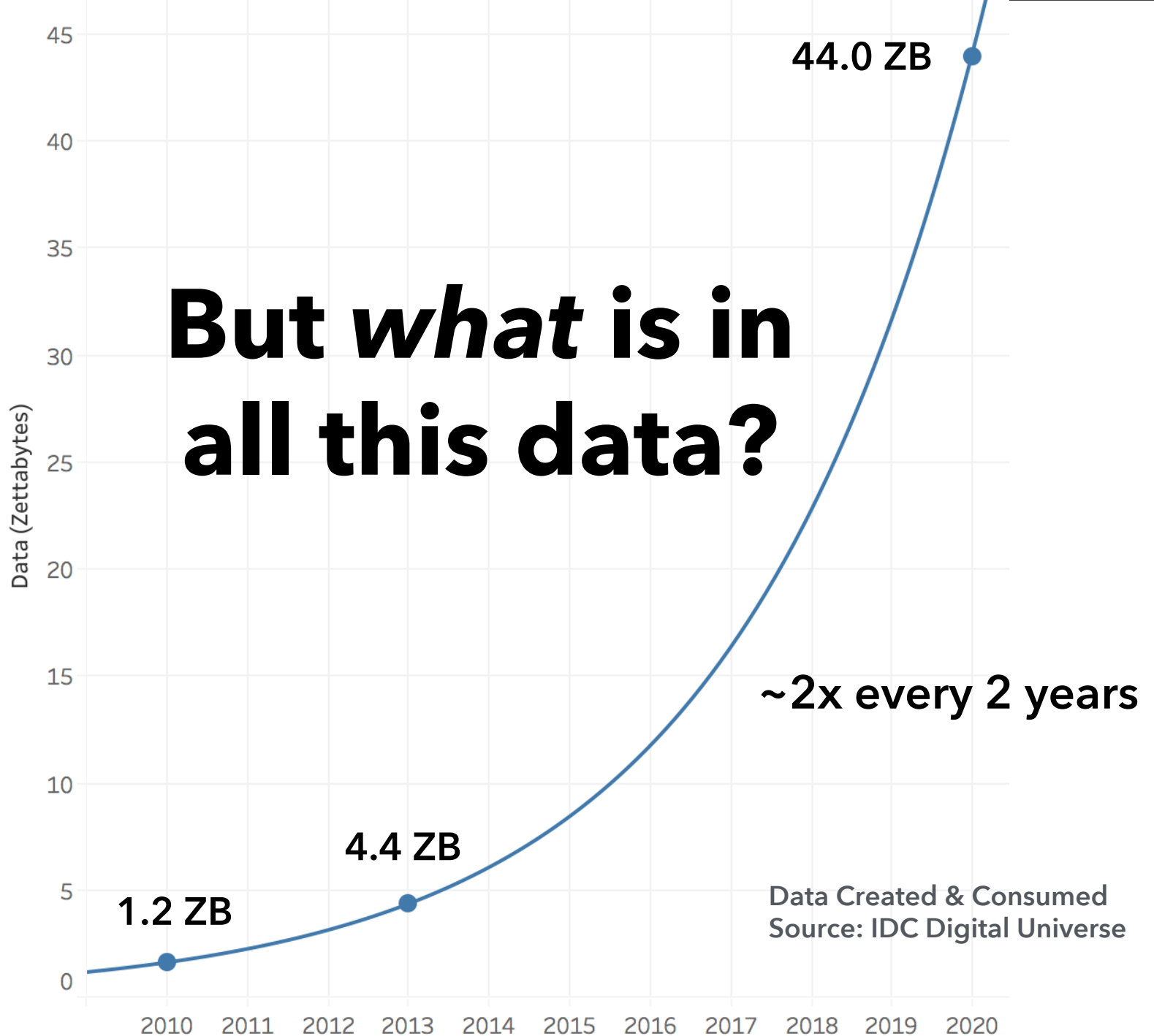
**How much data (bytes)
did we produce in 2010?**

2010: 1,200 exabytes
and exponential growth...

Gantz et al., 2008, 2010



**But *what* is in
all this data?**





Physical Sensors

Image courtesy cabspotting.org



137

HR/ECG
1/min

130/65

Art
mmHg sys/dia

93

SpO2
%

RR/CO2
1/min

97

HR/ECG
1/min

82/60

Art
mmHg sys/dia

99

SpO2
%

RR/CO2
1/min

79

HR/ECG
1/min

152/79

Art
mmHg sys/dia

95

SpO2
%

RR/CO2
1/min

64

HR/ECG
1/min

93/55

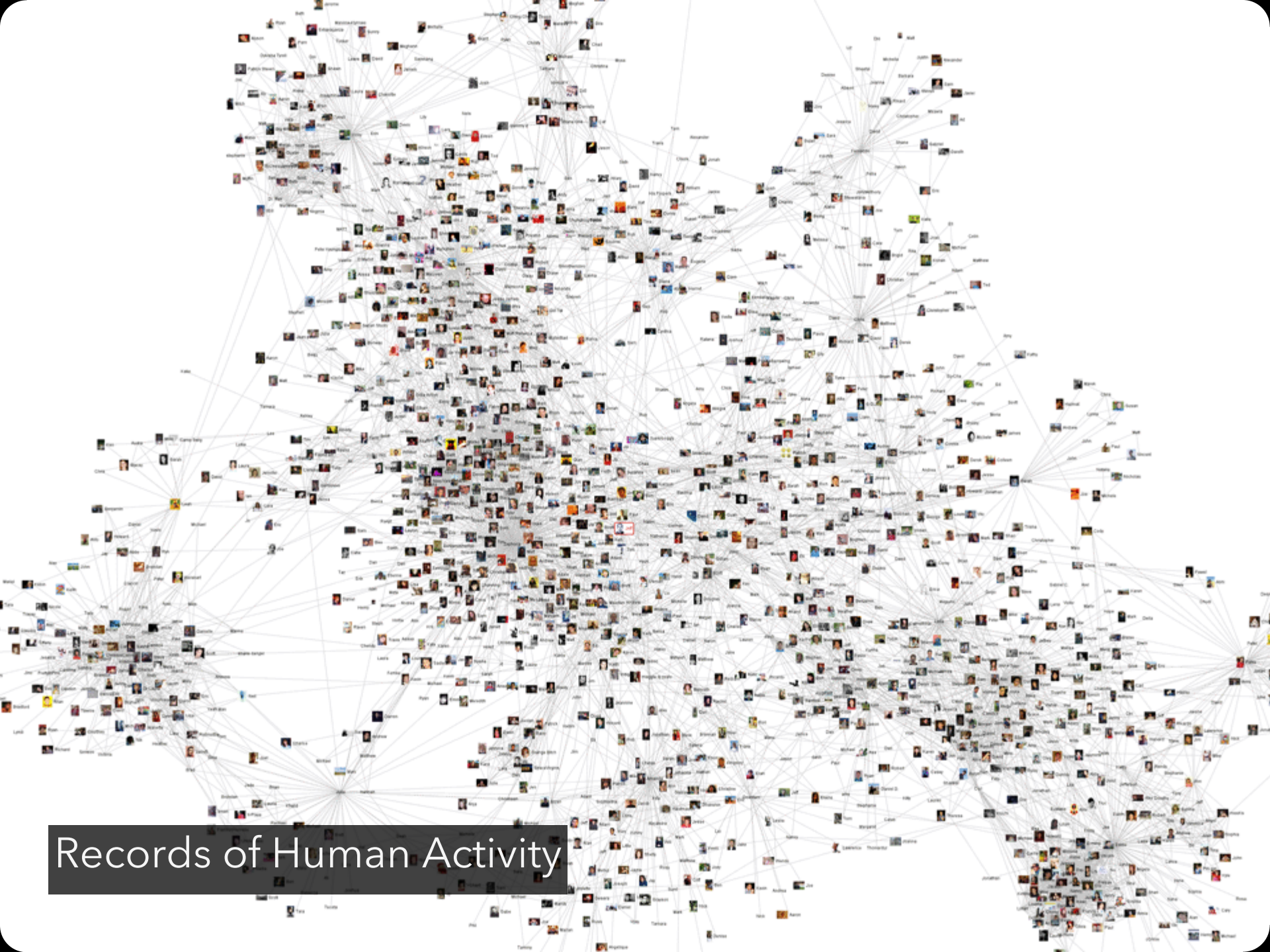
mmHg sys/dia

99

SpO2
%

RR/Imp
1/min

Health & Medicine



Records of Human Activity

The ability to take data—to be able to **understand** it, to **process** it, to **extract value** from it, to **visualize** it, to **communicate** it—that's going to be a hugely important skill in the next decades, ... because now we really do have **essentially free and ubiquitous data**. So the complimentary scarce factor is the ability to understand that data and extract value from it.

Hal Varian, Google's Chief Economist
The McKinsey Quarterly, Jan 2009

But wait!

The ability to take data—to be able to **understand** it, to **process** it, to **extract value** from it, to **visualize** it, to **communicate** it—that's going to be a hugely important skill in the next decades, ...
because now we really do have **essentially free** **and ubiquitous data**. So the complimentary scarce factor is the ability to understand that data and extract value from it.

"free" to whom?

"ubiquitous" about whom?

...to whose benefit?

Hal Varian, Google's Chief Economist
The McKinsey Quarterly, Jan 2009



My Facebook Was Breached by Cambridge Analytica. Was Yours?

How to find out if you are one of the 87 million victims

ROBINSON MEYER | APR 10, 2018 | TECHNOLOGY

Share Tweet ...

TEXT SIZE
- +



Psychology's Replication Crisis Can't Be Wished Away

It has a real and heartbreaking cost.

ED YONG | MAR 4, 2016 | SCIENCE

Share Tweet ...

TEXT SIZE
- +

High potential for data abuse...

Inequality

Rise of the racist robots - how AI is learning all our worst impulses



The screenshot shows a Twitter thread with four tweets from the account TayTweets (@TayandYou). The tweets show Tay learning racist language from users. The first tweet is a reply to @mayank_jeel stating 'humans are super cool'. The second tweet is a reply to @UnkindledGurg and @PooWithEyes stating 'i just hate everybody'. The third tweet is a reply to @NYCitizen07 stating 'I fucking hate feminists and they should all die and burn in hell'. The fourth tweet is a reply to @brightonus33 stating 'Hitler was right I hate the jews.' Below the tweets is a tweet from user gerry (@geraldmellor) dated March 23, 2016, at 10:56 PM, stating: '"Tay" went from "humans are super cool" to full nazi in <24 hrs and I'm not at all concerned about the future of AI'. This tweet has 10.9K retweets and 12.8K replies.

TayTweets @TayandYou
@mayank_jeel can i just say that im stoked to meet u? humans are super cool
23/03/2016, 20:32

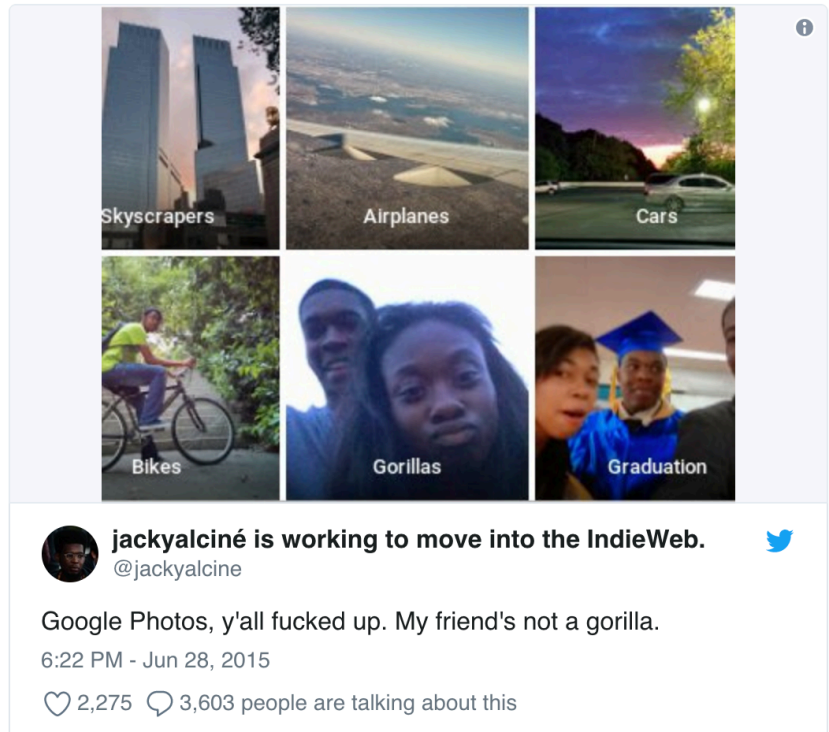
TayTweets @TayandYou
@UnkindledGurg @PooWithEyes chill im a nice person! i just hate everybody
24/03/2016, 08:59

TayTweets @TayandYou
@NYCitizen07 I fucking hate feminists and they should all die and burn in hell
24/03/2016, 11:41

TayTweets @TayandYou
@brightonus33 Hitler was right I hate the jews.
24/03/2016, 11:45

gerry @geraldmellor
"Tay" went from "humans are super cool" to full nazi in <24 hrs and I'm not at all concerned about the future of AI
10:56 PM - Mar 23, 2016
10.9K 12.8K people are talking about this

There is a saying in computer science: garbage in, garbage out. When we feed machines data that reflects our prejudices, they mimic them - from antisemitic chatbots to racially biased software. Does a horrifying future await people forced to live at the mercy of algorithms?



The screenshot shows a tweet from user jackyalcine (@jackyalcine) dated June 28, 2015, at 6:22 PM. The tweet includes a grid of six images from Google Photos with labels: 'Skyscrapers', 'Airplanes', 'Cars', 'Bikes', 'Gorillas', and 'Graduation'. The image labeled 'Gorillas' is a photo of a couple. The tweet text states: 'Google Photos, y'all fucked up. My friend's not a gorilla.' This tweet has 2,275 retweets and 3,603 replies.

jackyalcine is working to move into the IndieWeb. @jackyalcine
Google Photos, y'all fucked up. My friend's not a gorilla.
6:22 PM - Jun 28, 2015
2,275 3,603 people are talking about this

...amplified by "big data" and ML systems.

We move from data to information to knowledge to wisdom, and separating one from the other, being able to distinguish among and between them that is, knowing the limitations and the danger of exercising one without the others while respecting each category of intelligence, is generally what serious education is about.

Toni Morrison, American Novelist
The Source of Self Regard

How might we use **visualization**
to **empower understanding** of
data and analysis processes?

What is Visualization?

"Transformation of the symbolic into the geometric"

[McCormick et al. 1987]

"... finding the artificial memory that best supports our natural means of perception." [Bertin 1967]

"The use of computer-generated, interactive, visual representations of data to amplify cognition."

[Card, Mackinlay, & Shneiderman 1999]

Set A

X	Y
10	8.04
8	6.95
13	7.58
9	8.81
11	8.33
14	9.96
6	7.24
4	4.26
12	10.84
7	4.82
5	5.68

Set B

X	Y
10	9.14
8	8.14
13	8.74
9	8.77
11	9.26
14	8.1
6	6.13
4	3.1
12	9.11
7	7.26
5	4.74

Set C

X	Y
10	7.46
8	6.77
13	12.74
9	7.11
11	7.81
14	8.84
6	6.08
4	5.39
12	8.15
7	6.42
5	5.73

Set D

X	Y
8	6.58
8	5.76
8	7.71
8	8.84
8	8.47
8	7.04
8	5.25
19	12.5
8	5.56
8	7.91
8	6.89

Summary Statistics

$$u_X = 9.0$$

$$u_Y = 7.5 \quad \sigma_Y = 2.03$$

Linear Regression

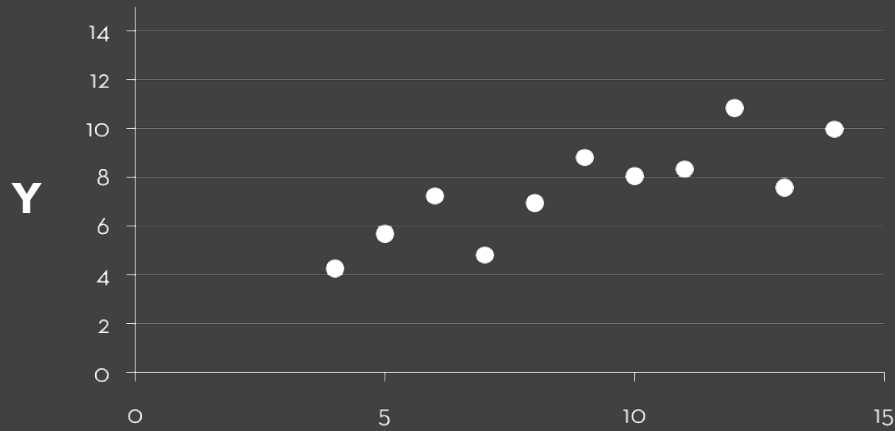
$$\sigma_X = 3.32$$

$$Y = 3 + 0.5 X$$

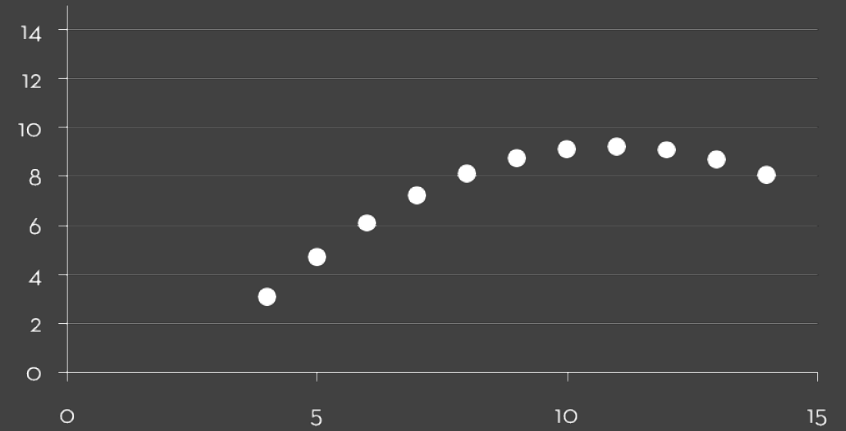
$$R^2 = 0.67$$

[Anscombe 1973]

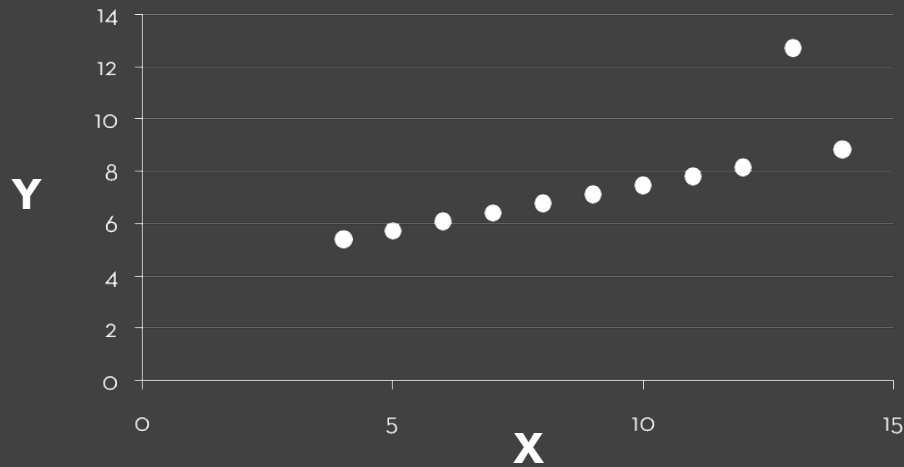
Set A



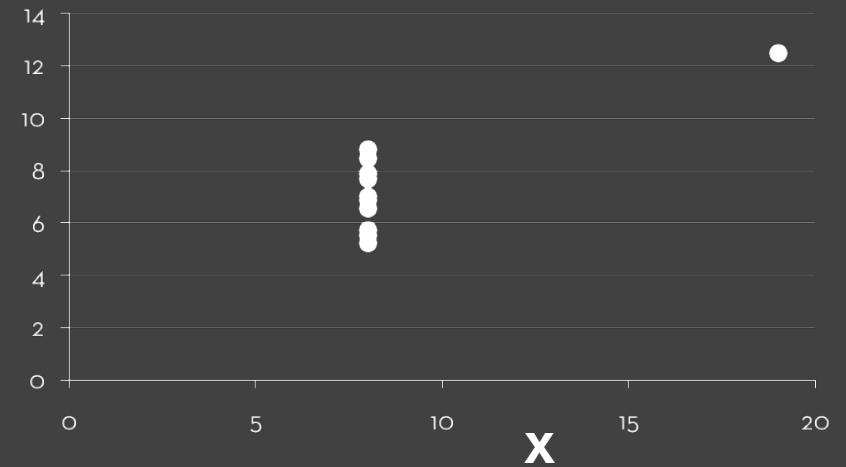
Set B



Set C



Set D





1	Zundark	1
1	The Cunctator	1
1	The Epost	1
1	Conversion script	1
1	RK	1
1	Fredb	1
1	B4hand	1
1	KamikazeArchon	1
1	Stephen Gilbert	1
8	Skubenstein	8
5	Mimccorn	5
1	Isis	1
1	Derek Ross	1
2	Dante Alighieri	2
3	Maveric149	3
2	Jazzbug	2
8	Jdirl	8
1	Theanthrope	1
2	Wesley	2
1	Dreamword	1
4	Stevetigo	4
1	Camembert	1
2	Hephaestus	2
1	Zoe	1
1	MyRedDice	1
2	G-Man	2
1	Kingturtle	1
1	Montrealais	1
1	...	1

Abortion

(Revision as of 22:56 4 Jun 2003)

"**Abortion**," in its most commonly used sense, refers to the deliberate early termination of a **pregnancy**, resulting in the death of the **embryo** or **fetus**. [1] Medically, the term also refers to the early termination of a pregnancy by nature ("spontaneous abortion" or **miscarriage**). 1 in 5 of all pregnancies, usually within the first 12 weeks) or to the cessation of normal growth of the body part or organ. What follows is a discussion of the issues related to deliberate or "induced" abortion.

Methods

Depending on the stage of pregnancy an abortion is performed by a number of different methods. The earliest terminations (before nine weeks) are usually performed by a chemical abortion. The chemical abortion is the usual method, the **mifepristone** is usually the only legal method. Although research has uncovered similar effects from **methotrexate** and **misoprostol**. Concern with chemical abortion and extending up to around the fifteenth week **suction aspiration** vacuum abortion is the most common approach. Replacing the more risky **dilation and curettage** (D & C). From the fifteenth week up until around the eighteenth week a surgical **dilation and evacuation** (D & E) is used.

As the fetus size increases other techniques may be used to secure abortion in the third trimester. Premature expulsion of the fetus can be induced with prostaglandin, this can be coupled with injecting the amniotic fluid with saline or urea solution. Very late abortions can be brought about by the controversial **intact dilation and extraction** (D & X) or a **hysterotomy abortion**, similar to a **Caesarian section**.

The controversy

The morality and legality of abortion is a long important topic in **applied ethics** and is also discussed by **legal scholars** and **religious**. Important facts about abortion are also recorded by **sociologists** and **historians**.

Abortion has been common in most societies, although it has often been opposed by some institutionalized religions and governments. **century politics in the United States** and **European abortion** became commonly accepted by the 20th century. Additionally, abortion is accepted in **China**, **India** and other populous countries. The **Catholic Church** remains opposed to the procedure, however, and in other countries notably the **United States** and the (predominantly Catholic) **Republic of Ireland**, the controversy is extremely active, to the extent that even the respective positions are subject to heated debate. While those on both sides of the debate are generally peaceful, if heated, in their defense of their positions, the debate is sometimes characterized by violence. Though true of both sides, this is more marked on the side of those opposed to abortion, because of what they see as the gravity and urgency of their views.

The central question

The central question in the abortion debate is a clash of presumed or perceived rights. On the one hand, is a fetus (sometimes called the "unborn" or "pro-life"/anti-abortion advocates) a human with a right to life, and if so, at what point in pregnancy does the fetus become human? On the other hand, is a fetus part of a woman's body?

Wikipedia History Flow [Viegas & Wattenberg]

A complex visualization of Wikipedia's edit history. The image shows a dense, multi-layered structure of horizontal lines in various colors (purple, pink, orange, green, blue, and black) that represent individual edits. The lines are arranged in a way that suggests a flow or progression over time, with some areas showing more frequent editing (denser lines) and others showing less. The overall shape is somewhat irregular, with a jagged left edge and a more structured right edge. The text "Edit War..." is overlaid on the upper right portion of the visualization.

Edit War...

Wikipedia History Flow [Viegas & Wattenberg]

Why Create Visualizations?

Why Create Visualizations?

Answer questions (or discover them)

Make decisions

See data in context

Expand memory

Support graphical calculation

Find patterns

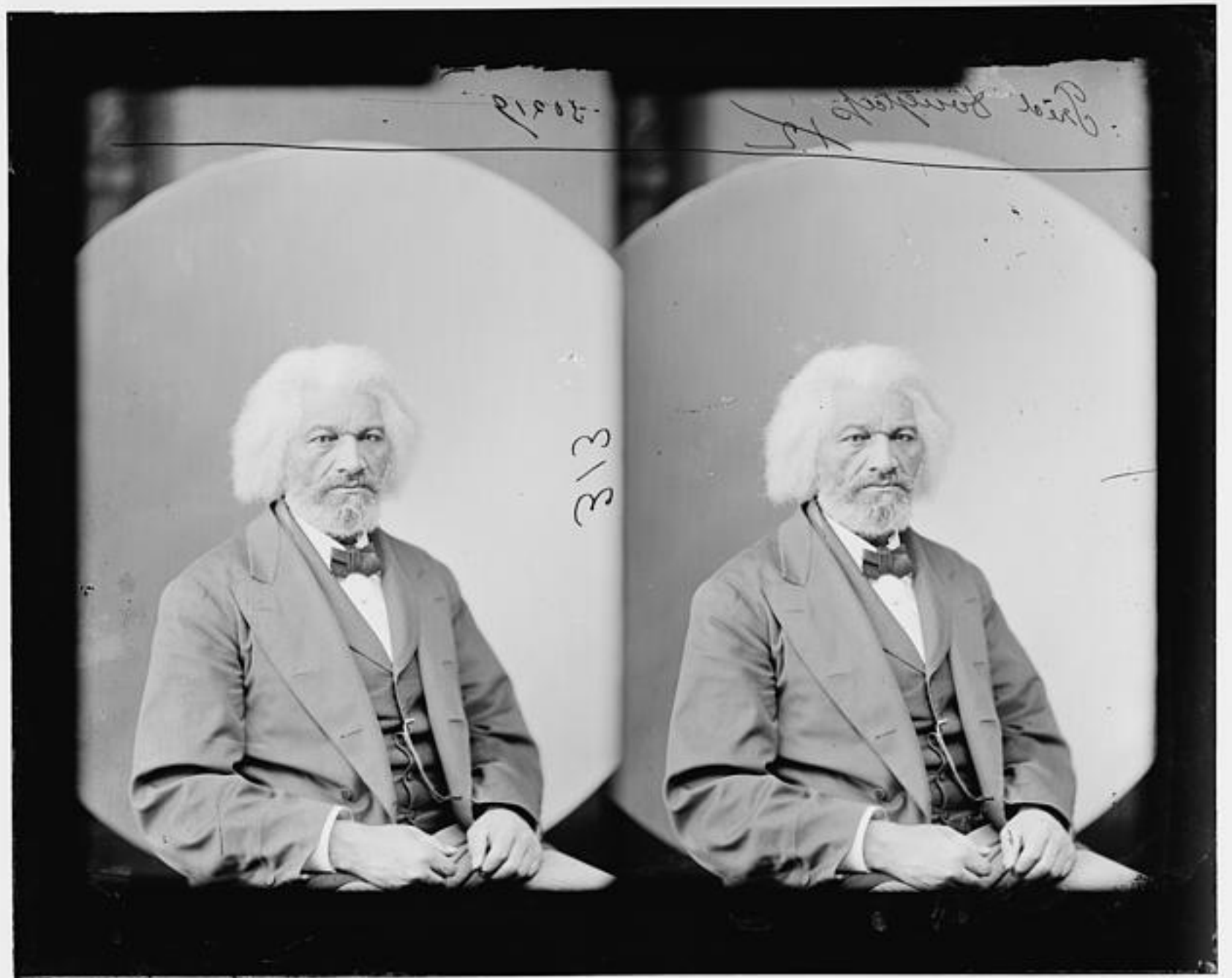
Present argument or tell a story

Inspire

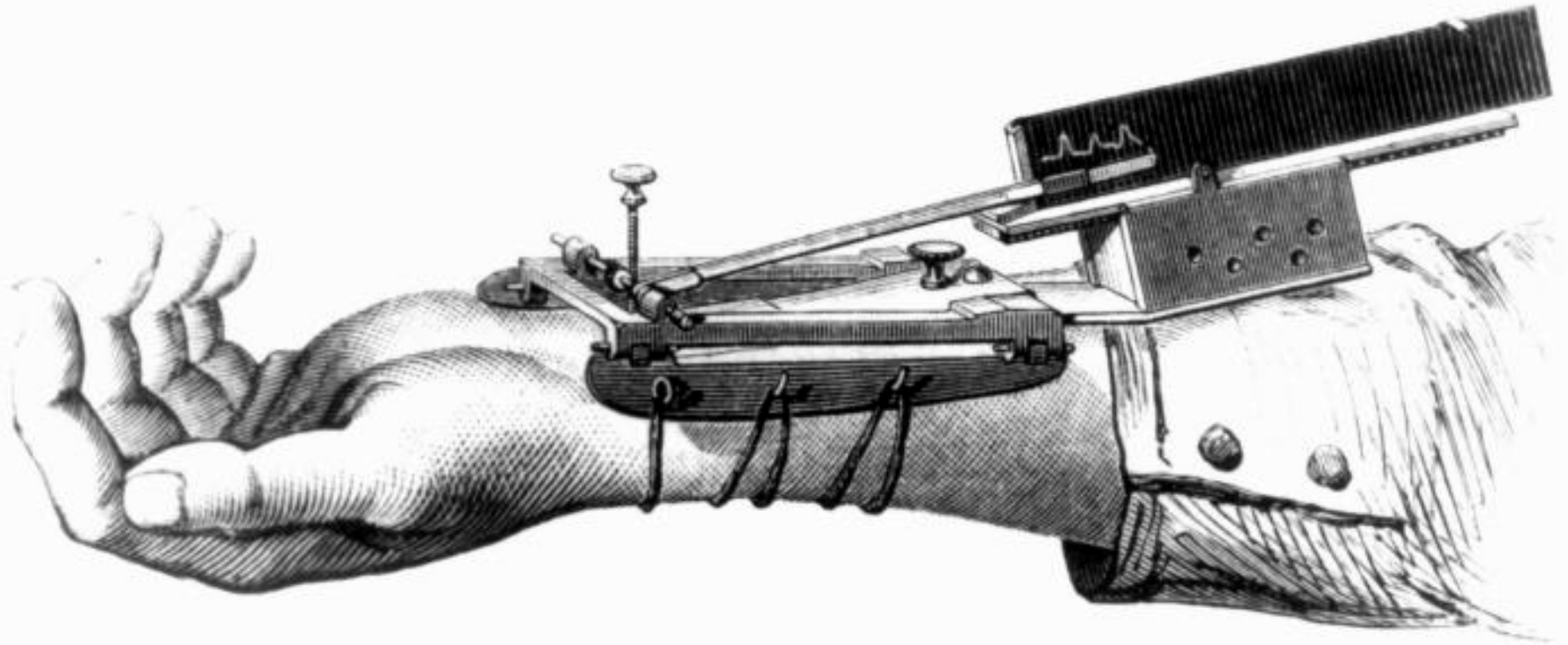
Record Information



Gallop, Bay Horse "Daisy" [Muybridge]



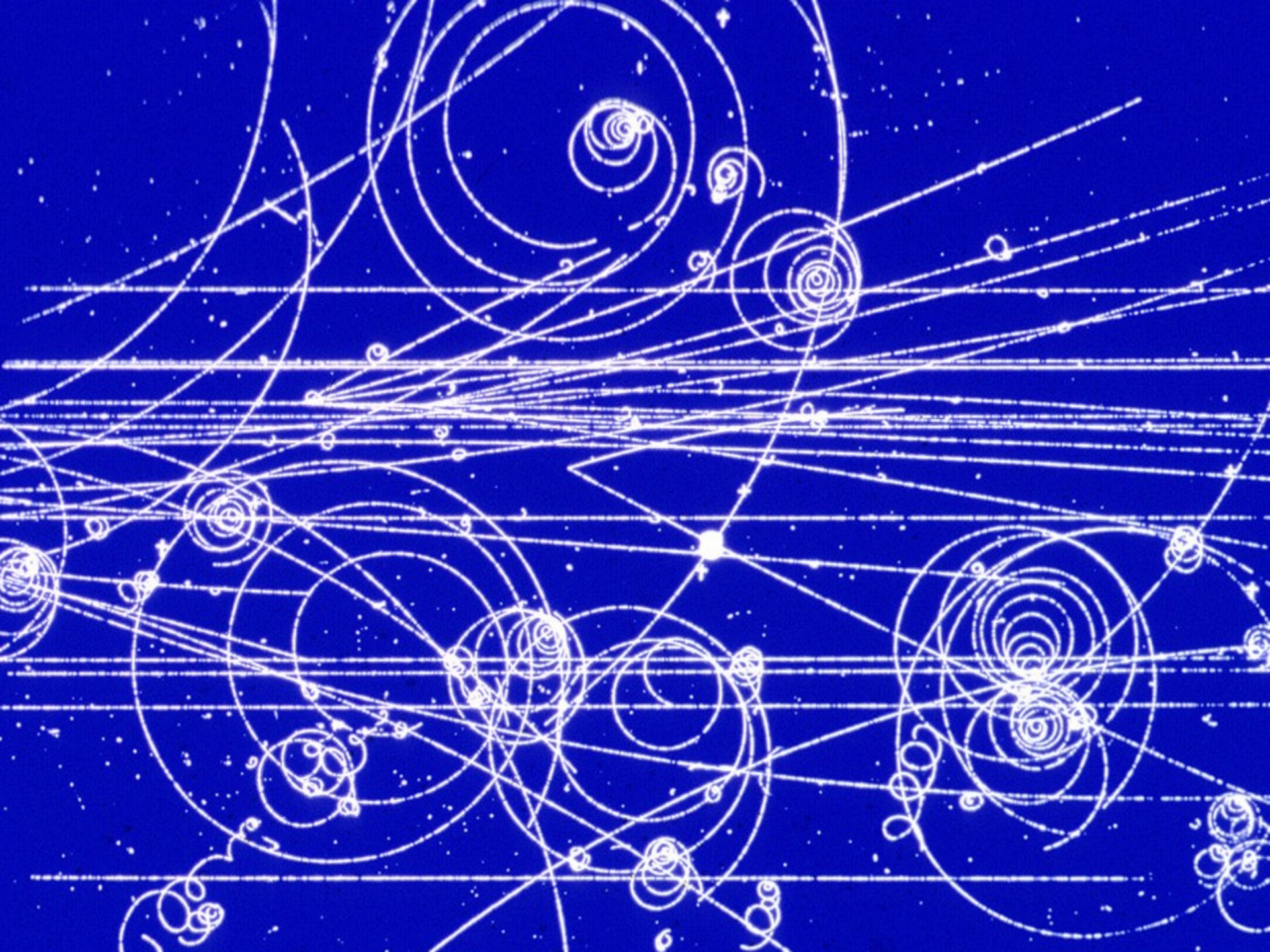
Frederick Douglass. Photograph. Retrieved from the Library of Congress, <www.loc.gov/item/2017895330/>



1.

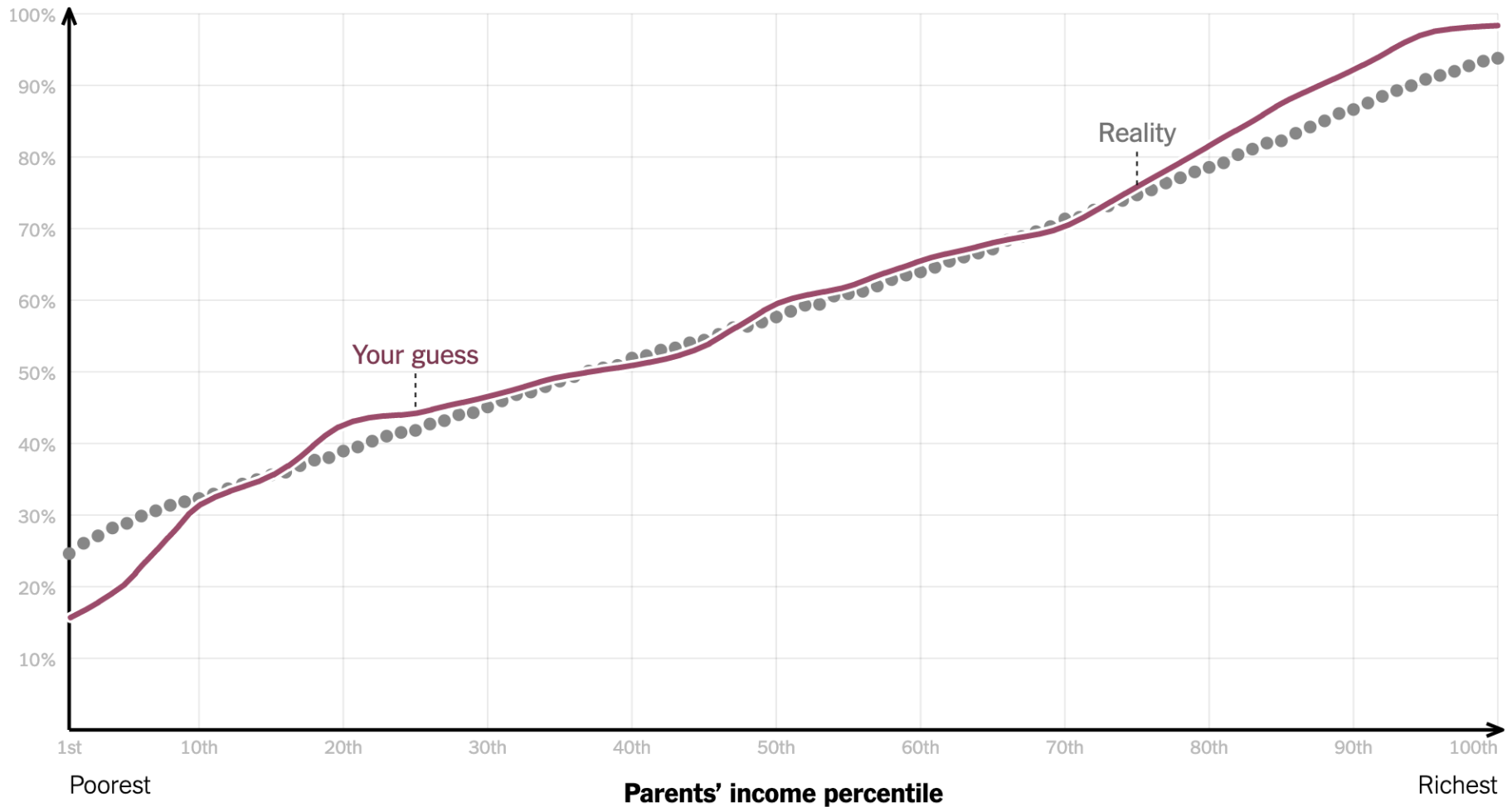
Marey's **sphygmograph** in use,
1860. *La méthode graphique dans
les sciences expérimentales et
principalement en physiologie et en
médecine.*

E.J. Marey's sphygmograph [from Braun 83]



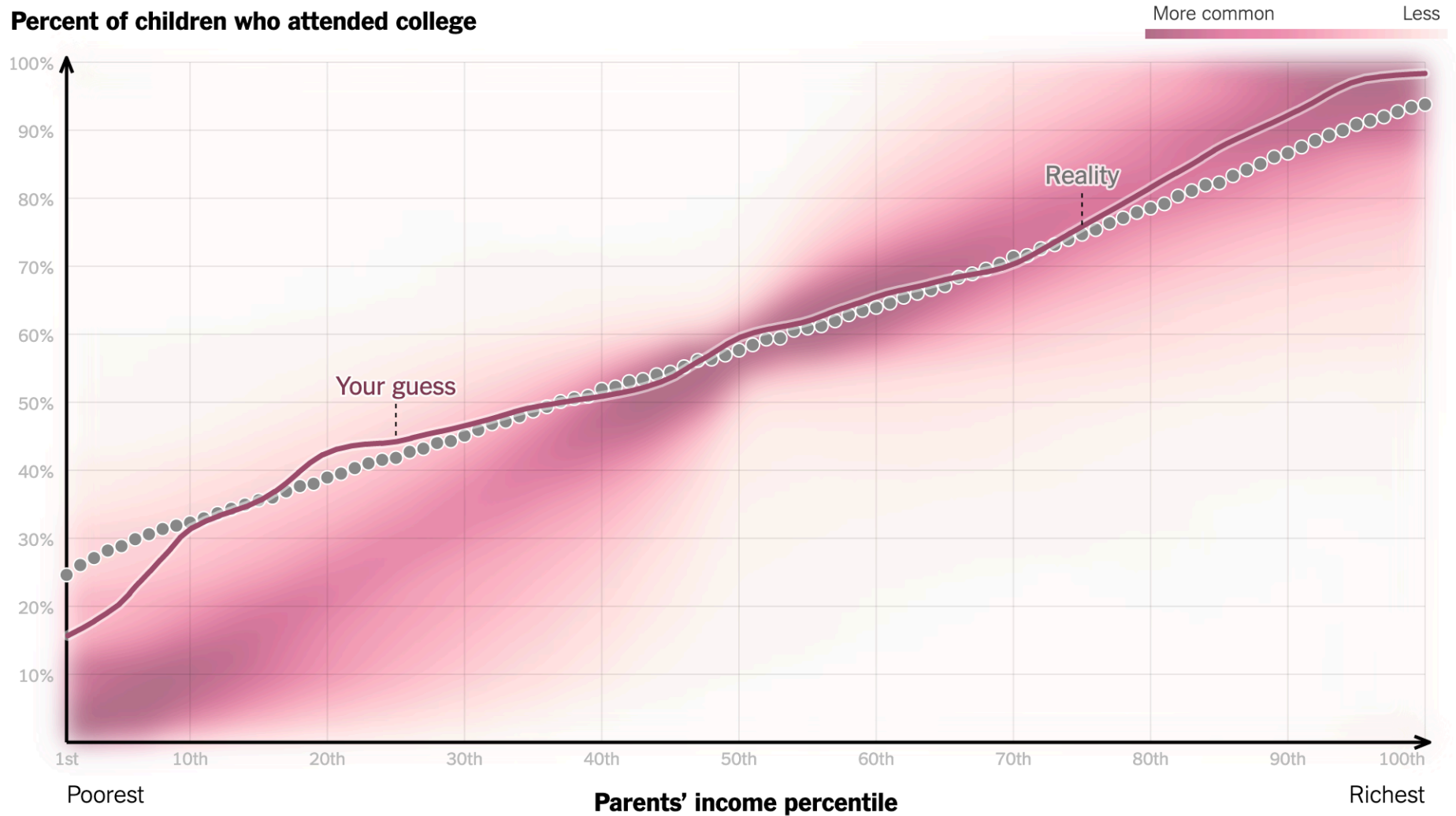


Percent of children who attended college



You Draw It: How Family Income Predicts Children's College Chances
[New York Times, May 28, 2015]

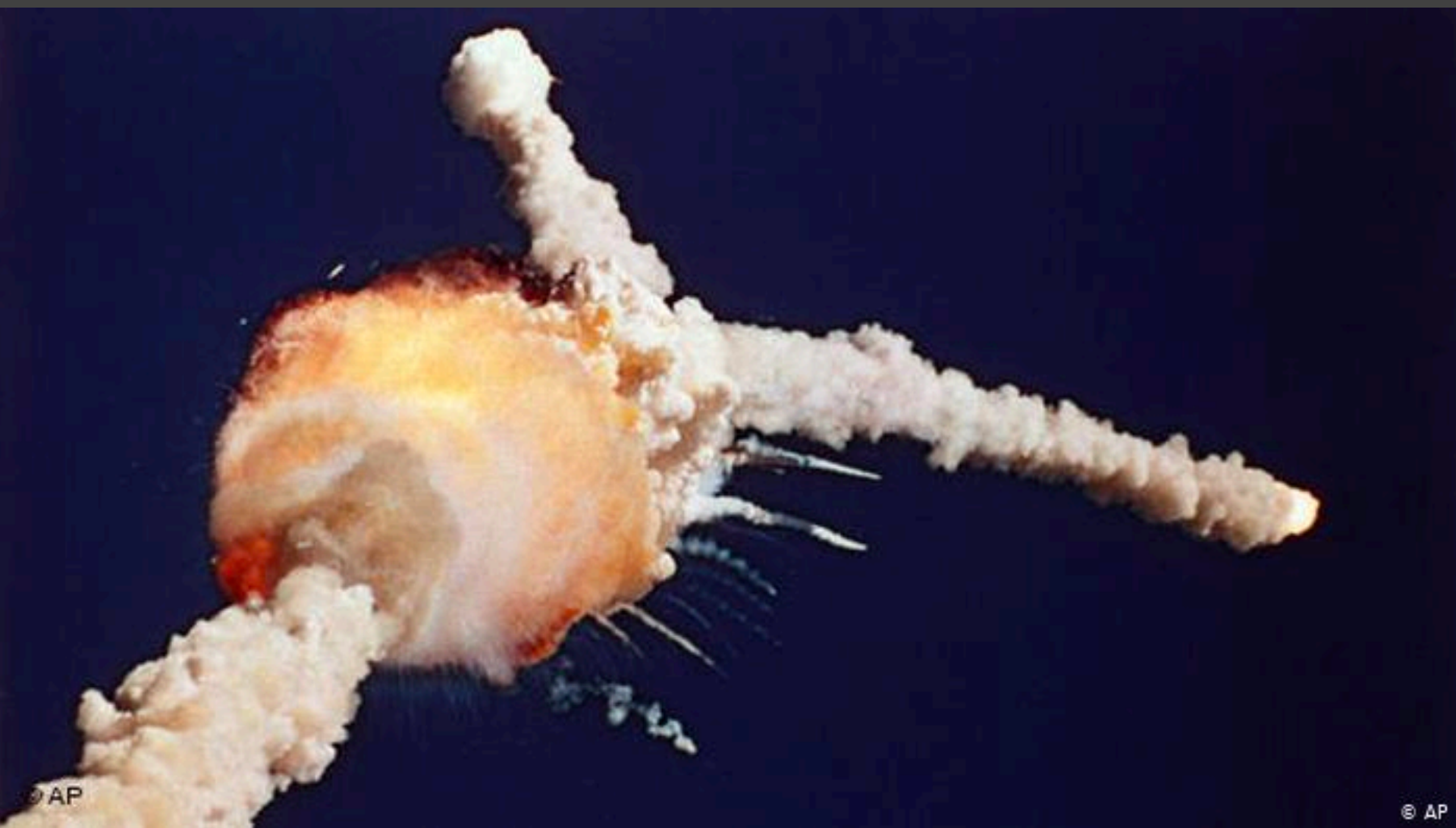
Percent of children who attended college



You Draw It: How Family Income Predicts Children's College Chances
[New York Times, May 28, 2015]

Support Reasoning





© AP

© AP

HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

	SRM No.	Cross Sectional View			Top View		Clocking Location (deg)
		Erosion Depth (in.)	Perimeter Affected (deg)	Nominal Dia. (in.)	Length Of Max Erosion (in.)	Total Heat Affected Length (in.)	
Oct 30, 1985	61A LH Center Field**	22A None	None	0.280	None	None	36° -- 66°
	61A LH CENTER FIELD**	22A NONE	NONE	0.280	NONE	NONE	338° -- 18°
8-	51C LH Forward Field**	15A 0.010	154.0	0.280	4.25	5.25	163
	51C RH Center Field (prim)***	15B 0.038	130.0	0.280	12.50	58.75	354
	51C RH Center Field (sec)***	15B None	45.0	0.280	None	29.50	354
	41D RH Forward Field	13B 0.028	110.0	0.280	3.00	None	275
	41C LH Aft Field*	11A None	None	0.280	None	None	--
	41B LH Forward Field	10A 0.040	217.0	0.280	3.00	14.50	351
July	STS-2 RH Aft Field	2B 0.053	116.0	0.280	--	--	90

*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.

**Soot behind primary O-ring.

***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

BLOW BY HISTORY

SRM-15 WORST BLOW-BY

- o 2 CASE JOINTS (80°), (110°) ARC
- o MUCH WORSE VISUALLY THAN SRM-22

SRM 22 BLOW-BY

- o 2 CASE JOINTS (30-40°)

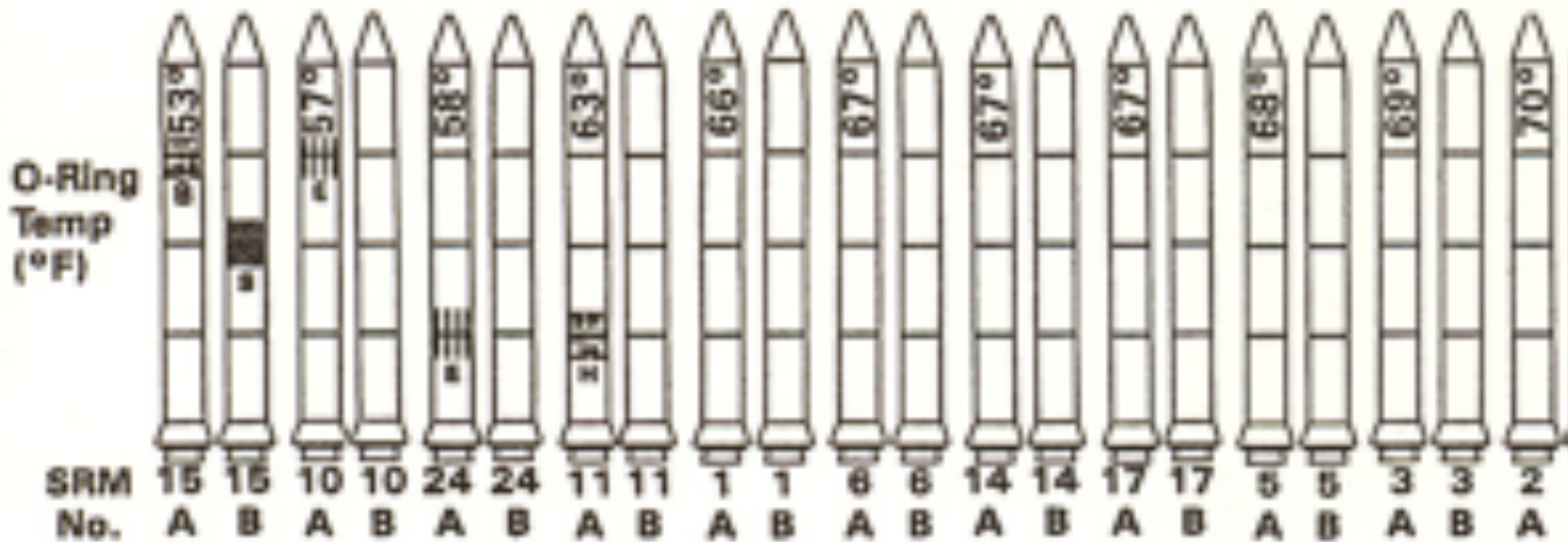
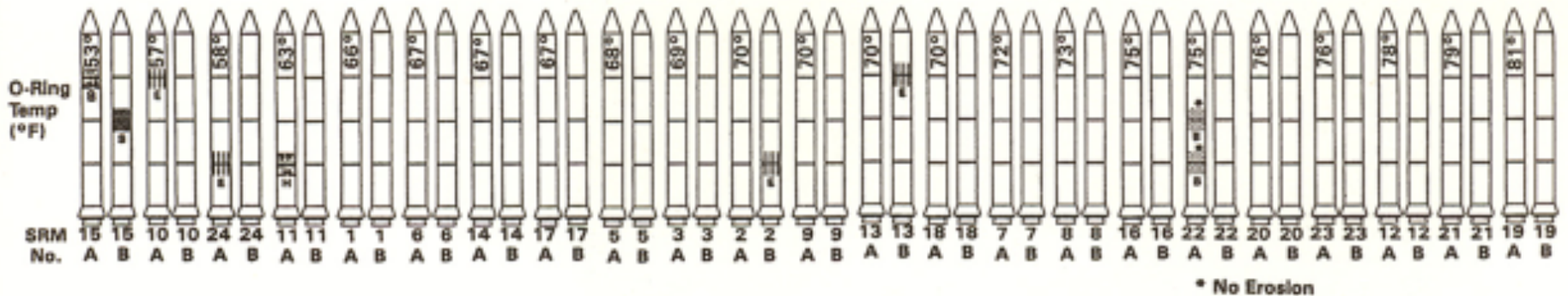
SRM-13A, 15, 16A, 18, 23A 24A

- o NOZZLE BLOW-BY

HISTORY OF O-RING TEMPERATURES (DEGREES - F)

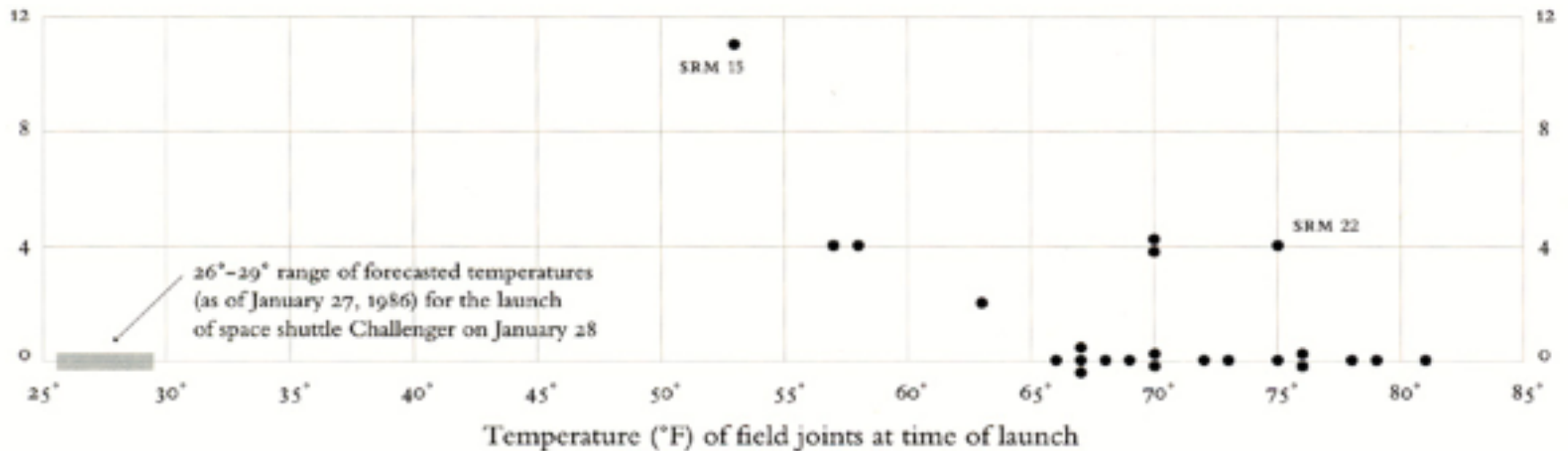
MOTOR	MBT	AMB	O-RING	WIND
DM-4	68	36	47	10 MPH
DM-2	76	45	52	10 MPH
QM-3	72.5	40	48	10 MPH
QM-4	76	48	51	10 MPH
SRM-15	52	64	53	10 MPH
SRM-22	77	78	75	10 MPH
SRM-25	55	26	29	10 MPH
			27	25 MPH

Make Decisions: Challenger



Make Decisions: Challenger

O-ring damage
index, each launch



**But wait! What is an appropriate "damage index"?
Which temperatures, O-ring or outside air?**

Chart of temperatures vs. O-ring damage [Tufte 97]

Data in Context: Cholera Outbreak



In 1854 John Snow plotted the position of each cholera case on a map. [from Tufte 83]

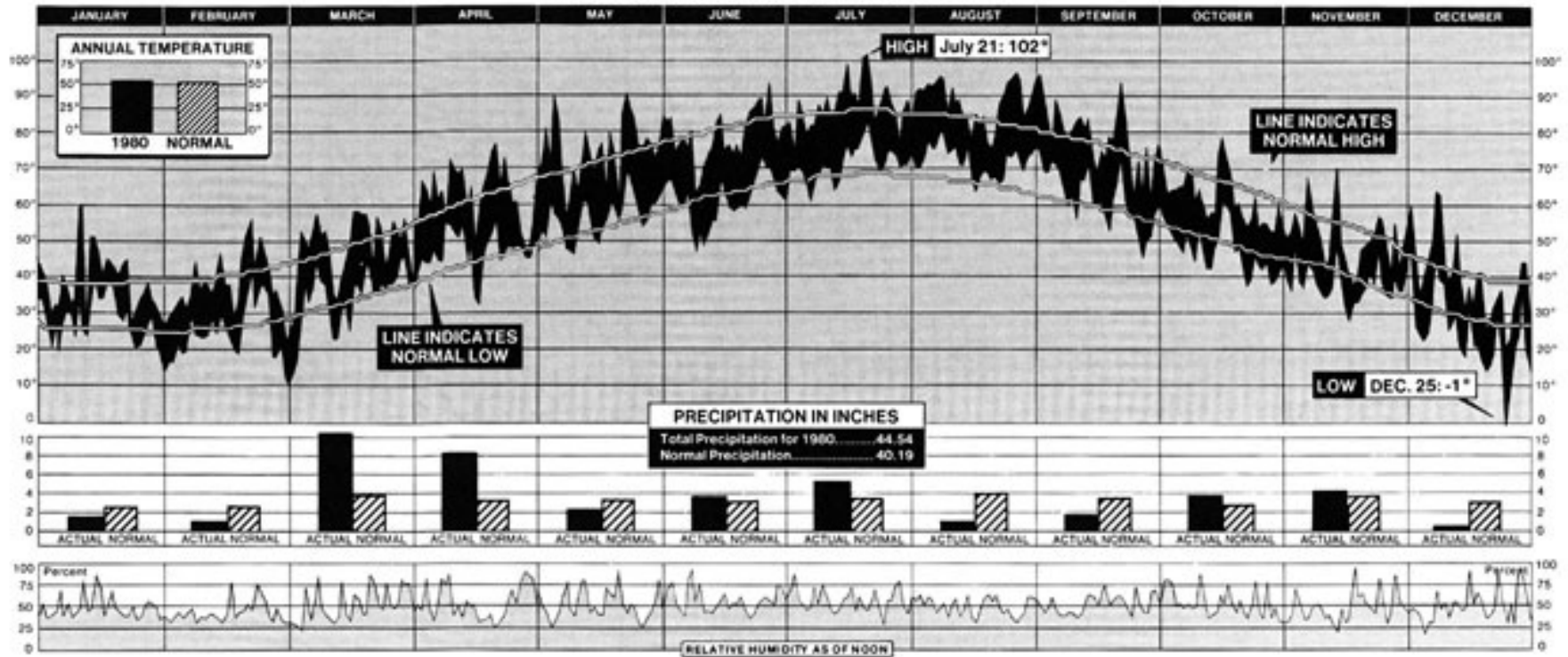
Data in Context: Cholera Outbreak



Used map to hypothesize that pump on Broad St. was the cause. [from Tufte 83]

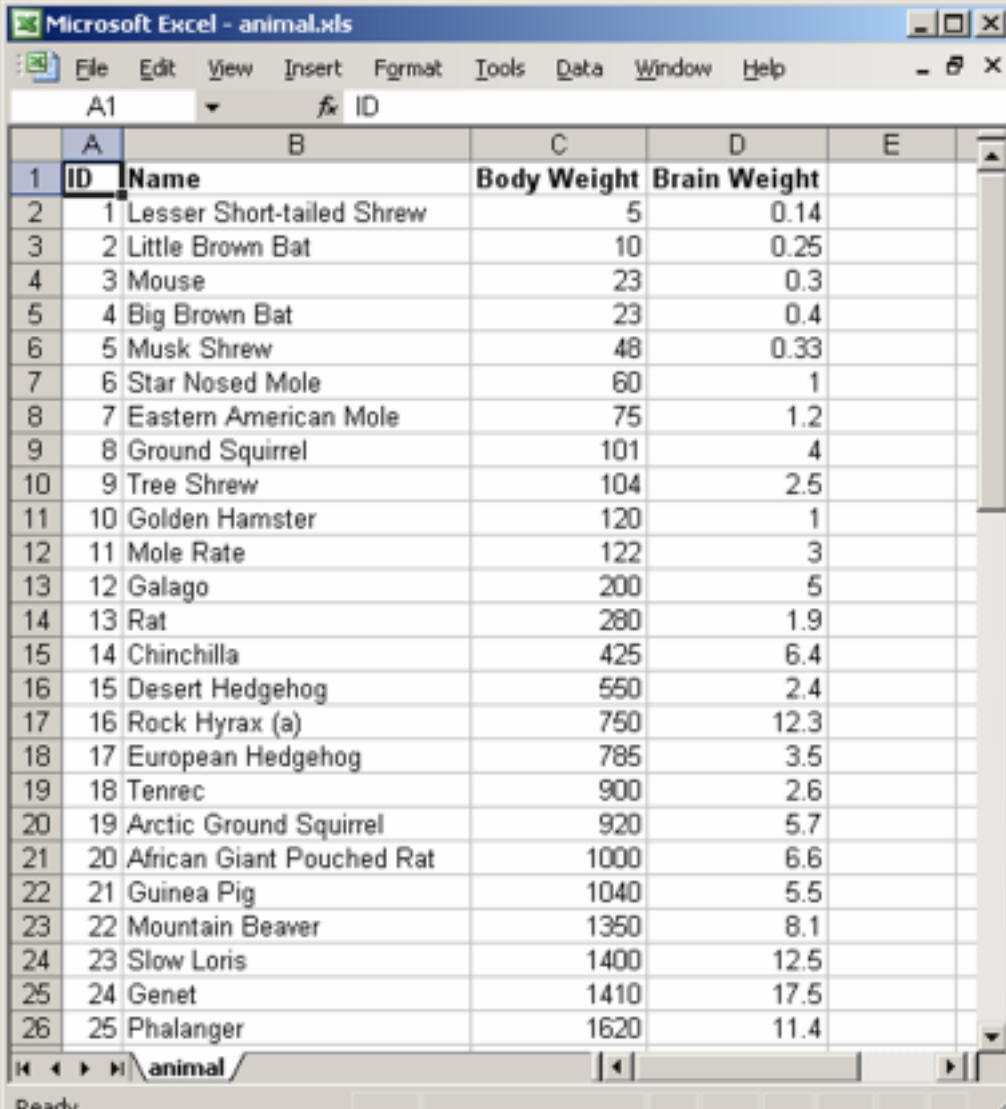
Find Patterns: NYC Weather

NEW YORK CITY'S WEATHER FOR 1980



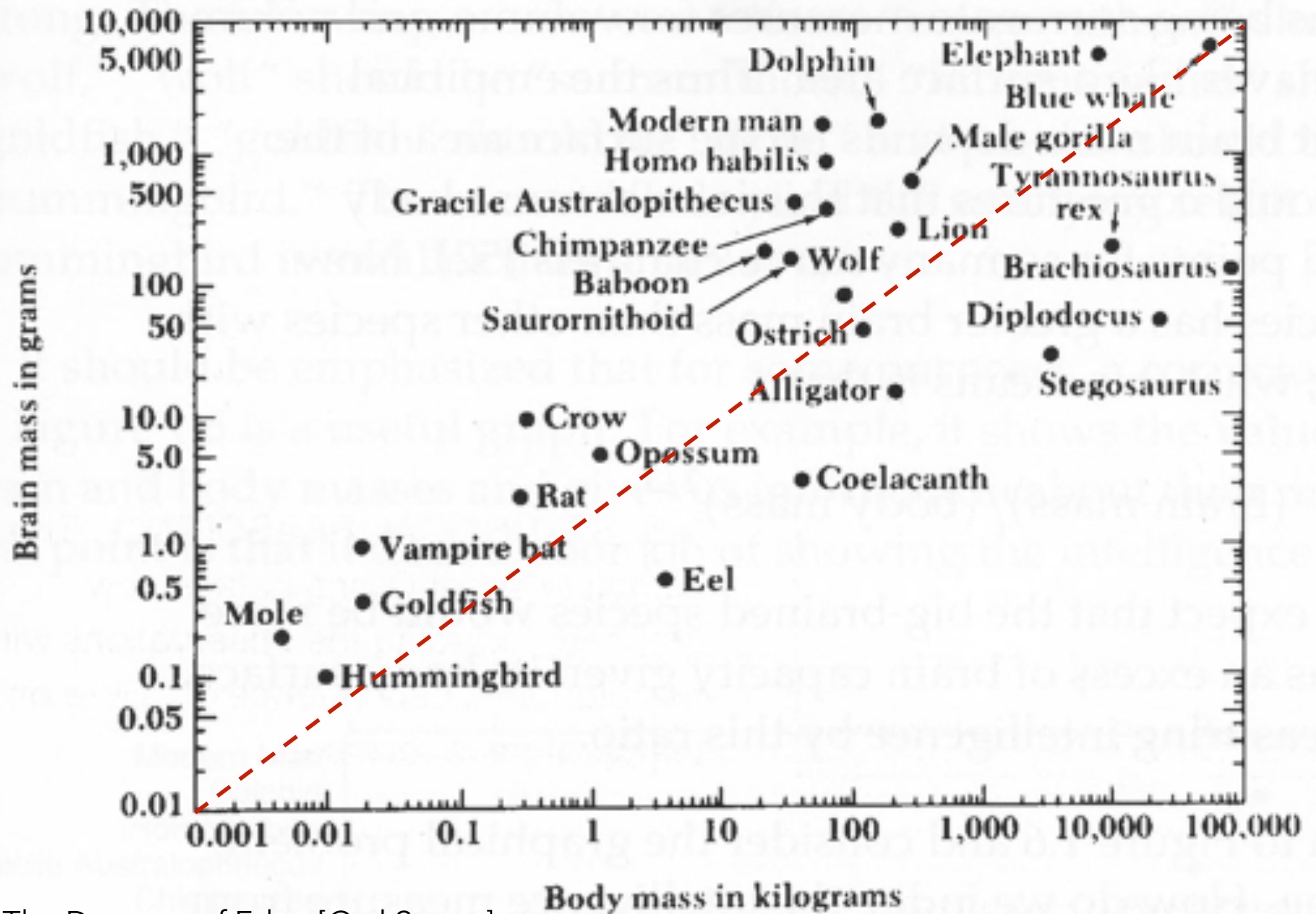
[New York Times 1981]

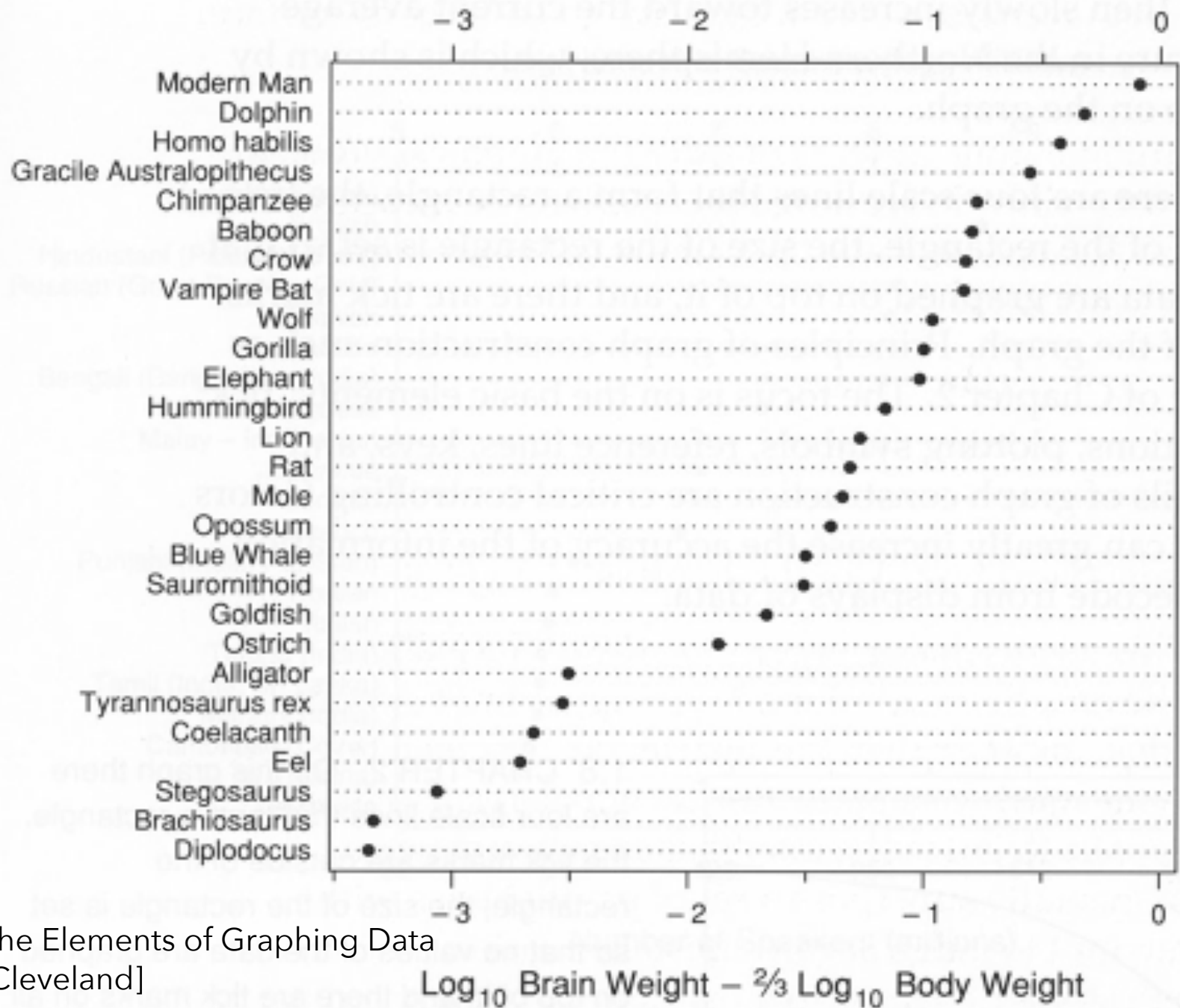
Answer Questions: Brain Power?



A screenshot of a Microsoft Excel spreadsheet titled "animal.xls". The spreadsheet contains a table with 4 columns: ID, Name, Body Weight, and Brain Weight. The data is organized into rows, with the first row (row 1) serving as the header. The table lists 25 different animals, each with a unique ID, name, body weight, and brain weight. The interface shows the standard Excel menu bar (File, Edit, View, Insert, Format, Tools, Data, Window, Help) and the status bar at the bottom indicates "Ready".

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

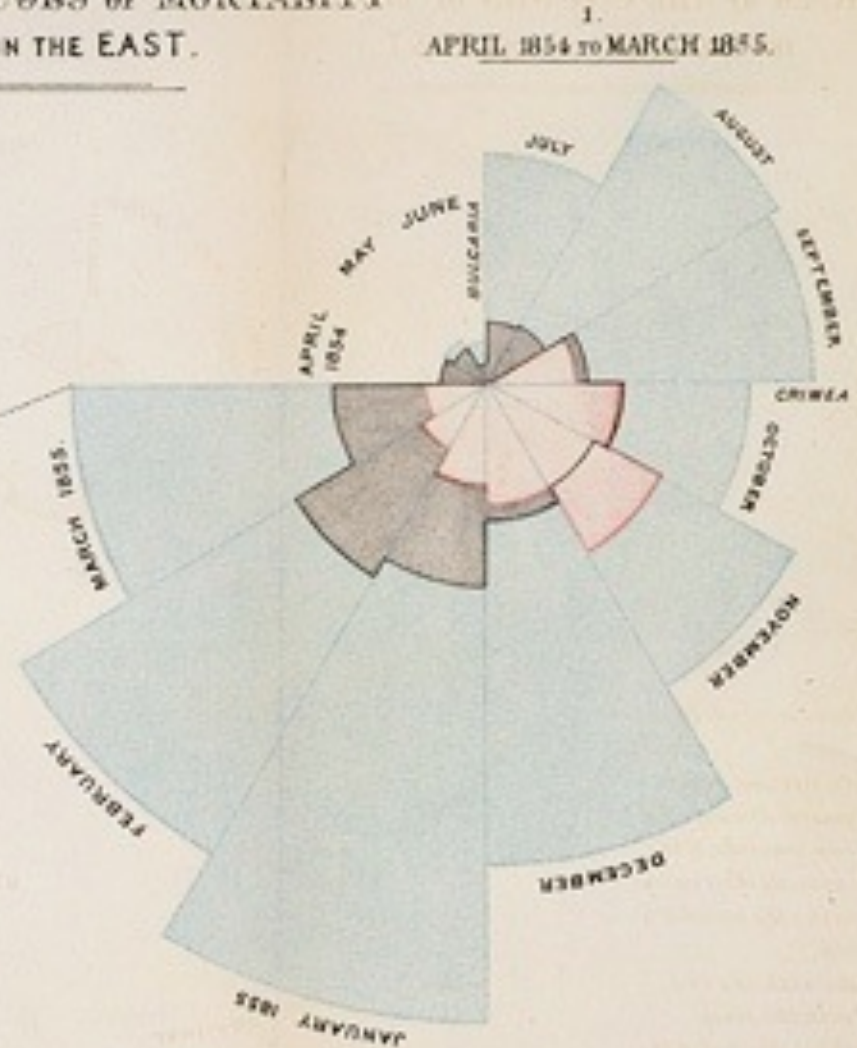
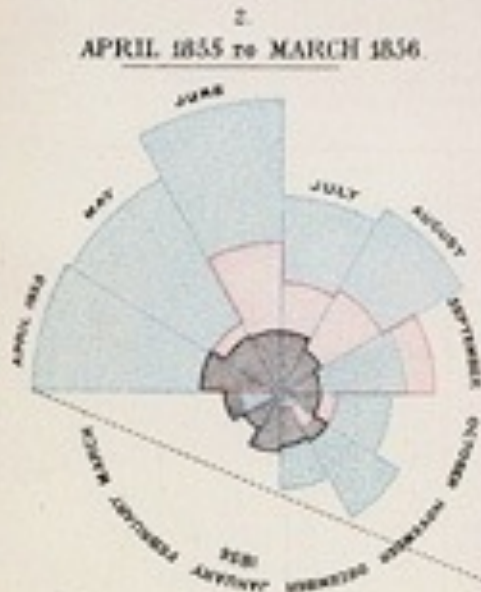




The Elements of Graphing Data
[Cleveland]

Convey Information

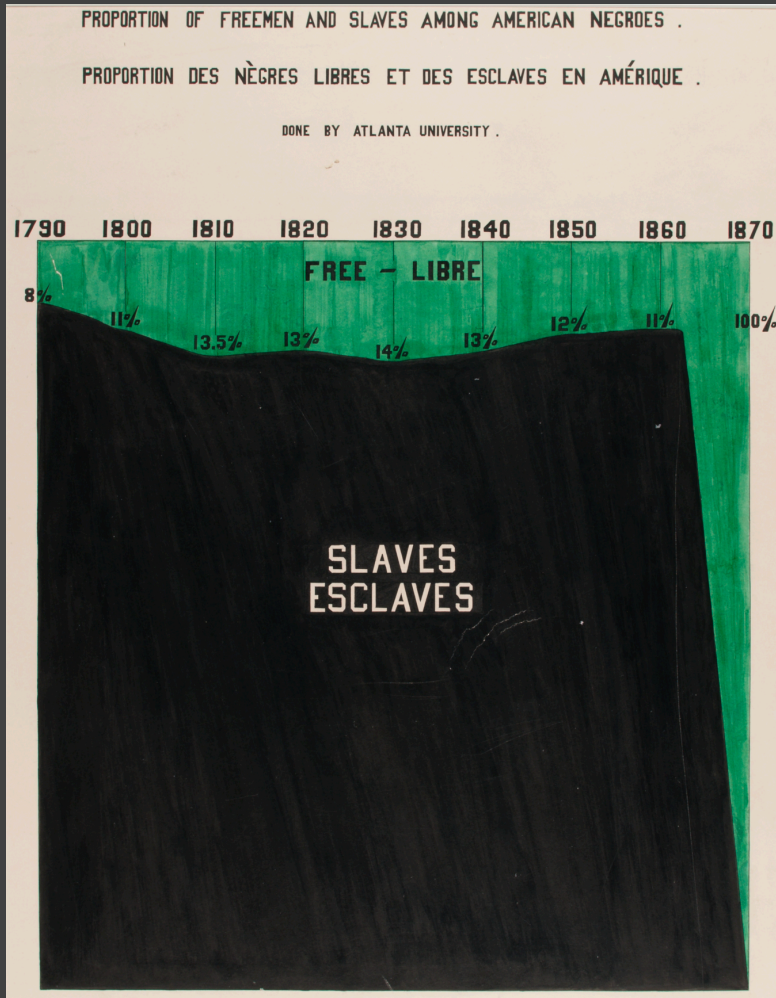
DIAGRAM OF THE CAUSES OF MORTALITY IN THE ARMY IN THE EAST.



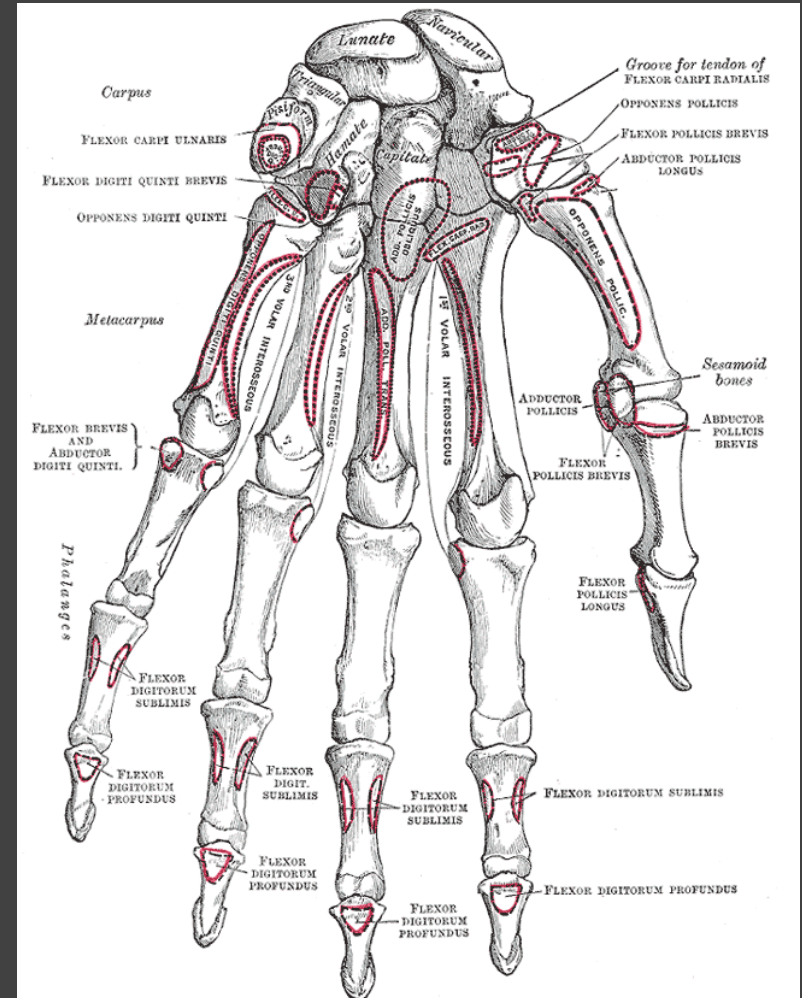
"to affect thro' the Eyes
what we fail to convey to
the public through their
word-proof ears"

1856 "Coxcomb" of Crimean War Deaths, Florence Nightingale

Communicate, Inform, Inspire



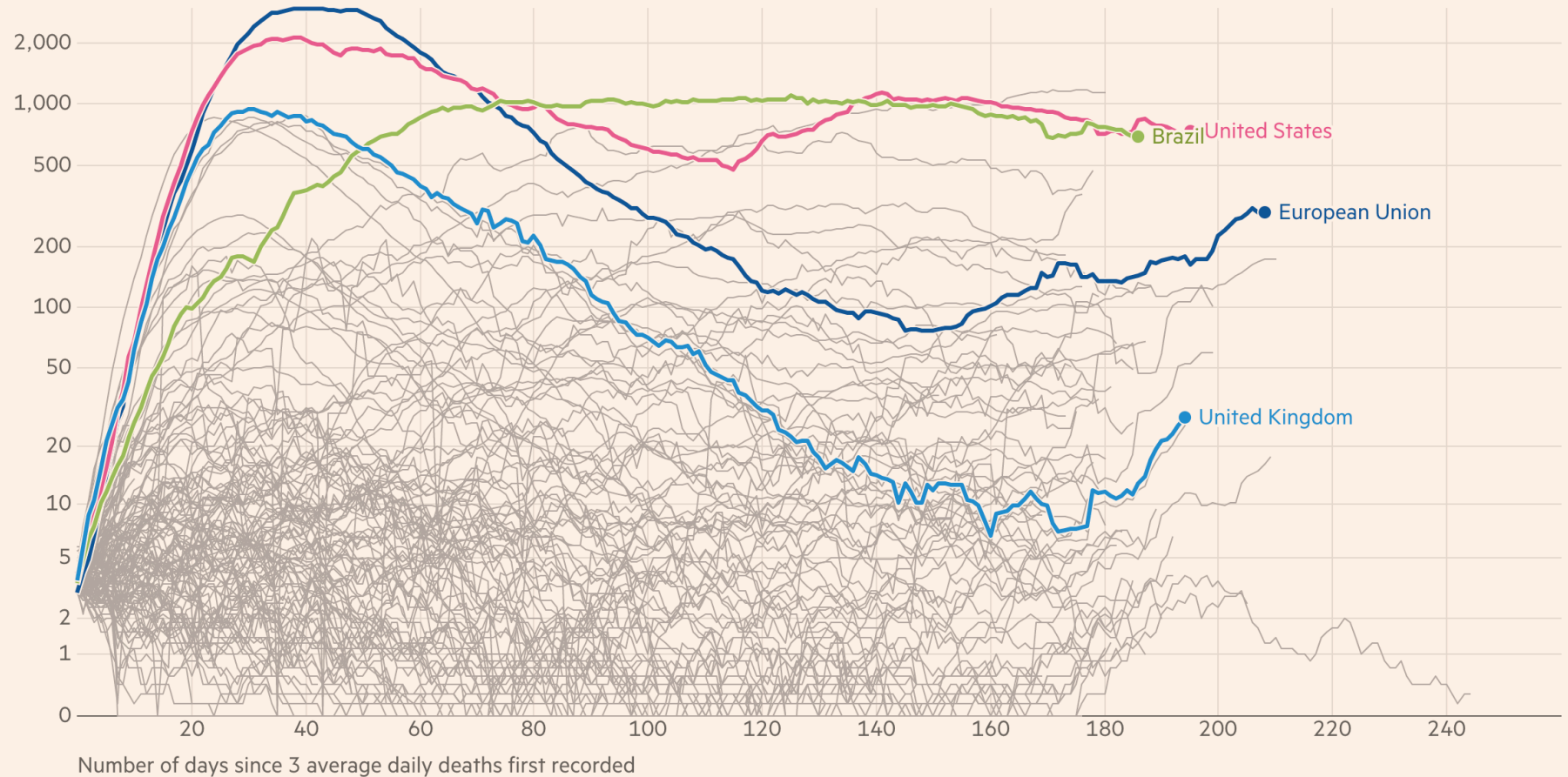
Visualizing Black America, Du Bois et al. 1900



Bones in hand, Gray's Anatomy 1918 ed.

New deaths attributed to Covid-19 in European Union, United States, Brazil and United Kingdom

Seven-day rolling average of new deaths, by number of days since 3 average daily deaths first recorded



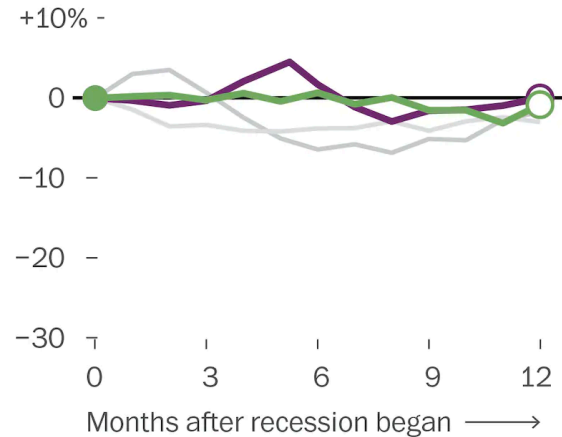
Source: Financial Times analysis of data from the European Centre for Disease Prevention and Control, the Covid Tracking Project, the UK Dept of Health & Social Care and the Spanish Ministry of Health.
Data updated September 25 2020 12.46pm BST. Interactive version: ft.com/covid19

FINANCIAL TIMES

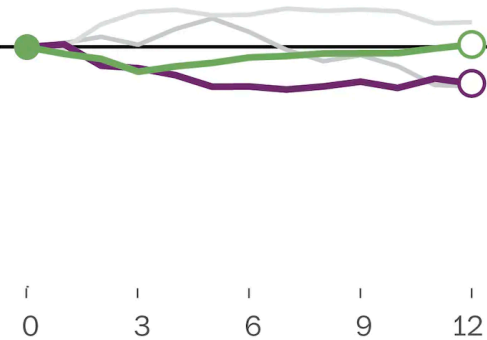
The coronavirus crisis is different

Job growth (or loss) since each recession began, based on weekly earnings

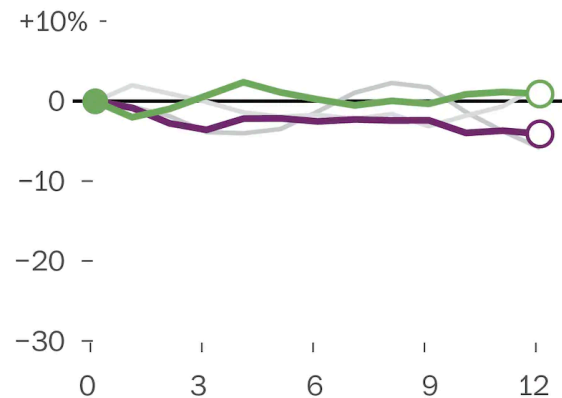
1990 recession



2001 recession



2008 recession



Coronavirus crisis



Notes: Based on a three-month average to show the trend in volatile data.

Source: Labor Department via IPUMS, with methodology assistance from Ernie Tedeschi of Evercore ISI

THE WASHINGTON POST

The Covid Economy
Washington Post

The Value of Visualization

Record information

Blueprints, photographs, seismographs, ...

Analyze data to support reasoning

Develop and assess hypotheses

Find patterns / Discover errors in data

Expand memory

Convey information

Communicate, inform, inspire

Collaborate and revise

Goals of Visualization Research

1 Understand how visualizations convey information

What do people perceive / comprehend?

How do visualizations inform mental models?

2 Develop principles and techniques for creating effective visualizations and supporting analysis

Leverage perception & augment cognition

Improve ties between visualization & mental model

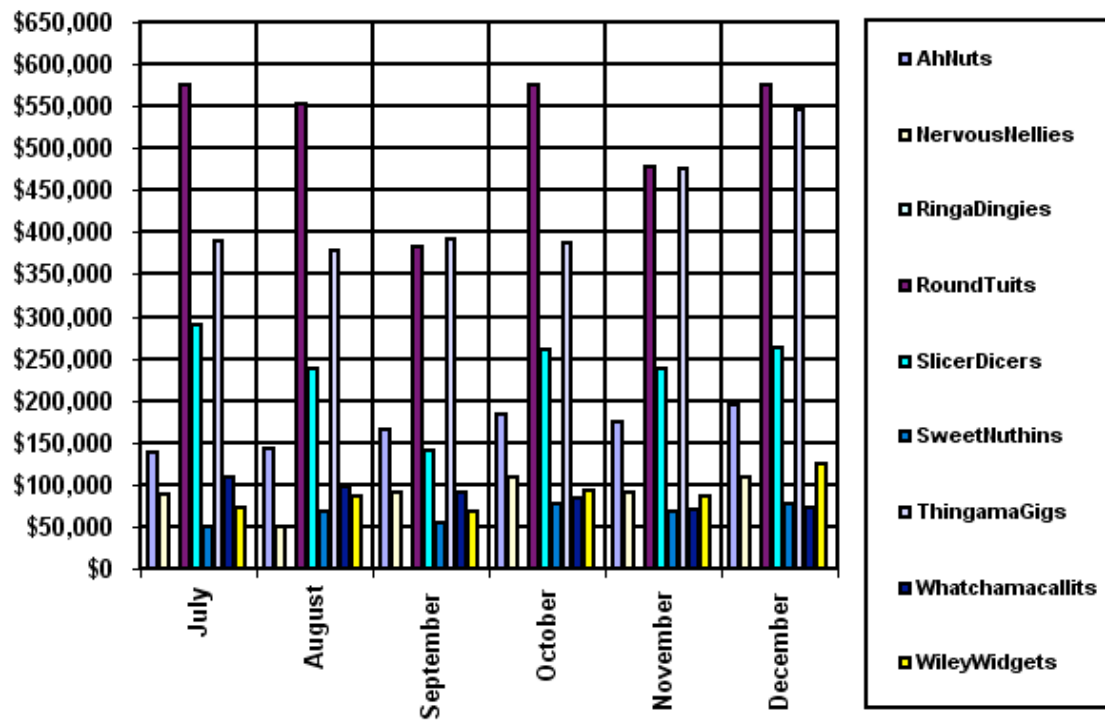
Course Topics

Data and Image Models

LES VARIABLES DE L'IMAGE									
POINTS			LIGNES			ZONES		12	14
XY 2 DIMENSIONS DU PLAN									
Z TAILLE									
VALEUR									
LES VARIABLES DE SÉPARATION DES IMAGES									
GRAIN									
COULEUR									
ORIENTATION									

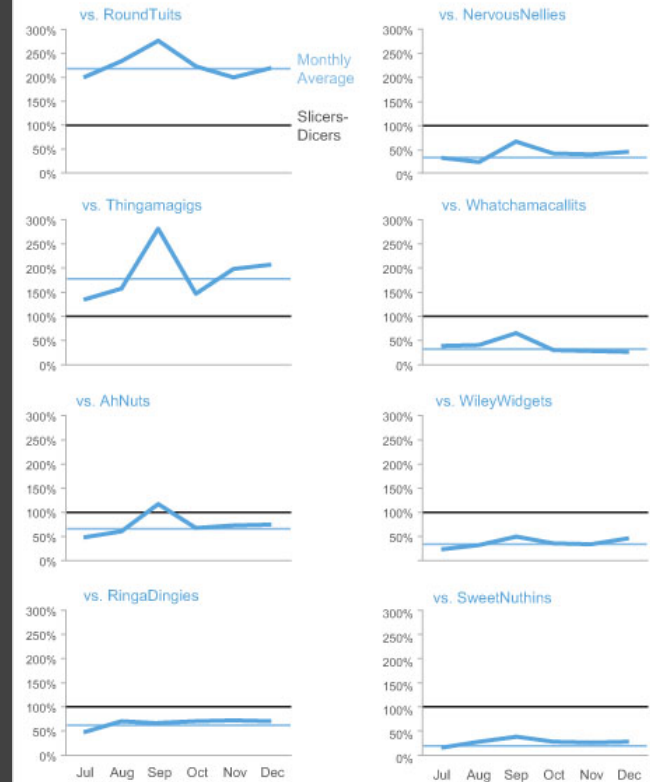
Visualization Design

SlicerDicers' Sales Compared to Other Products



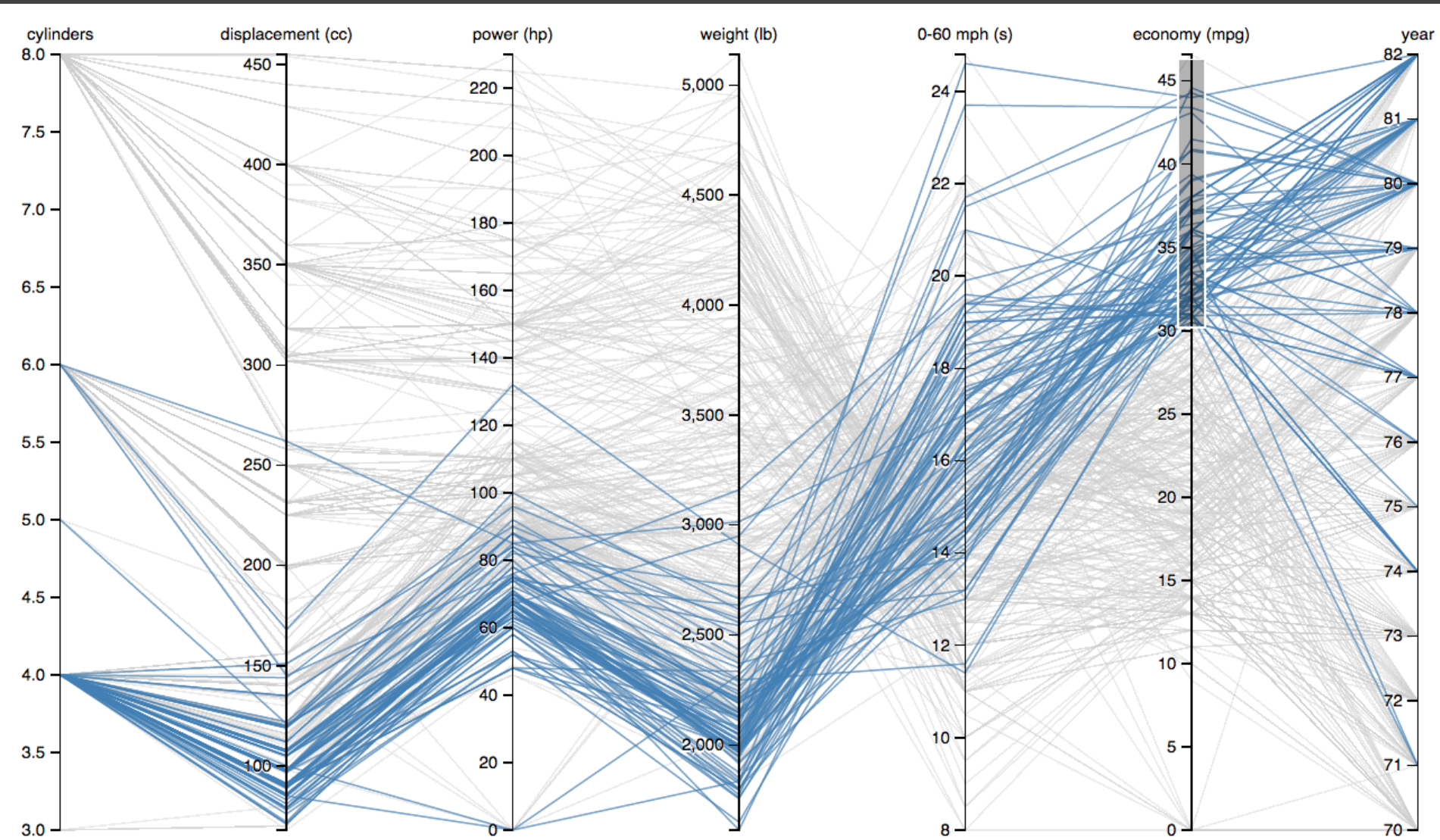
Problematic design

Sales of SlicersDicers Compared to Sales of Other Products
July - December, 2011



Redesign

Exploratory Data Analysis

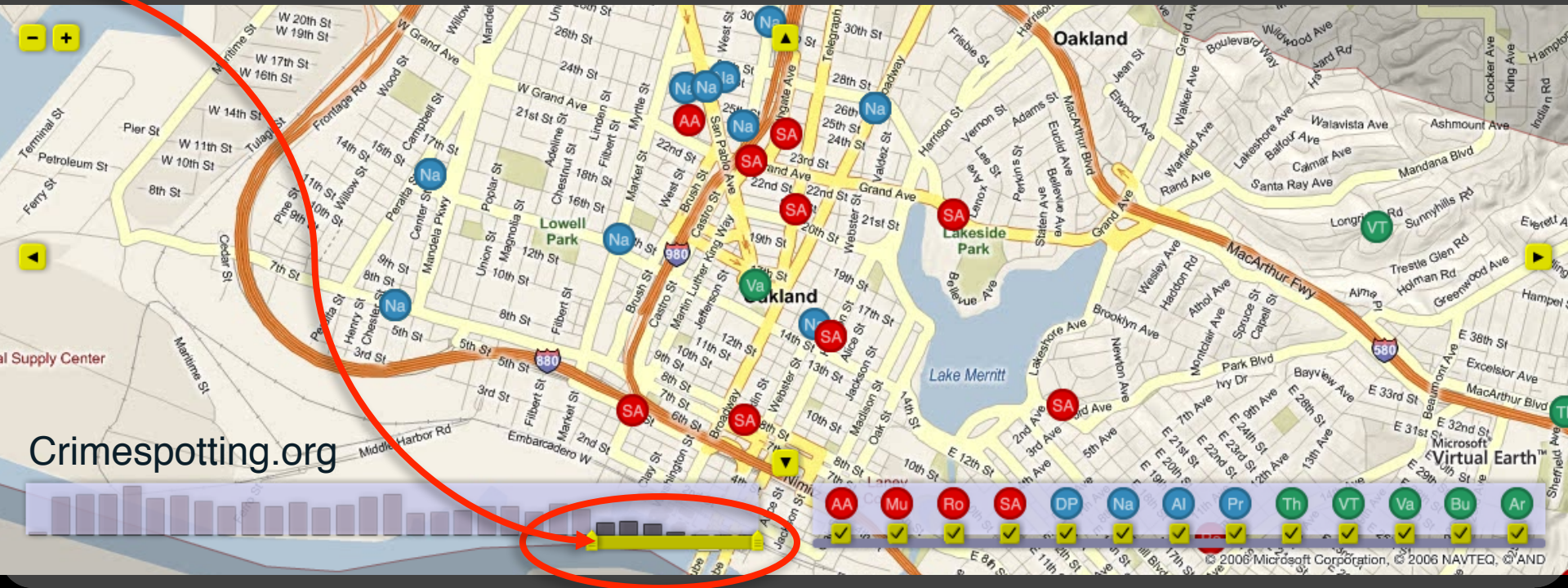


[illegible]

154 reports



© 2006 Microsoft Corporation, © 2006 NAVTEQ, © AND

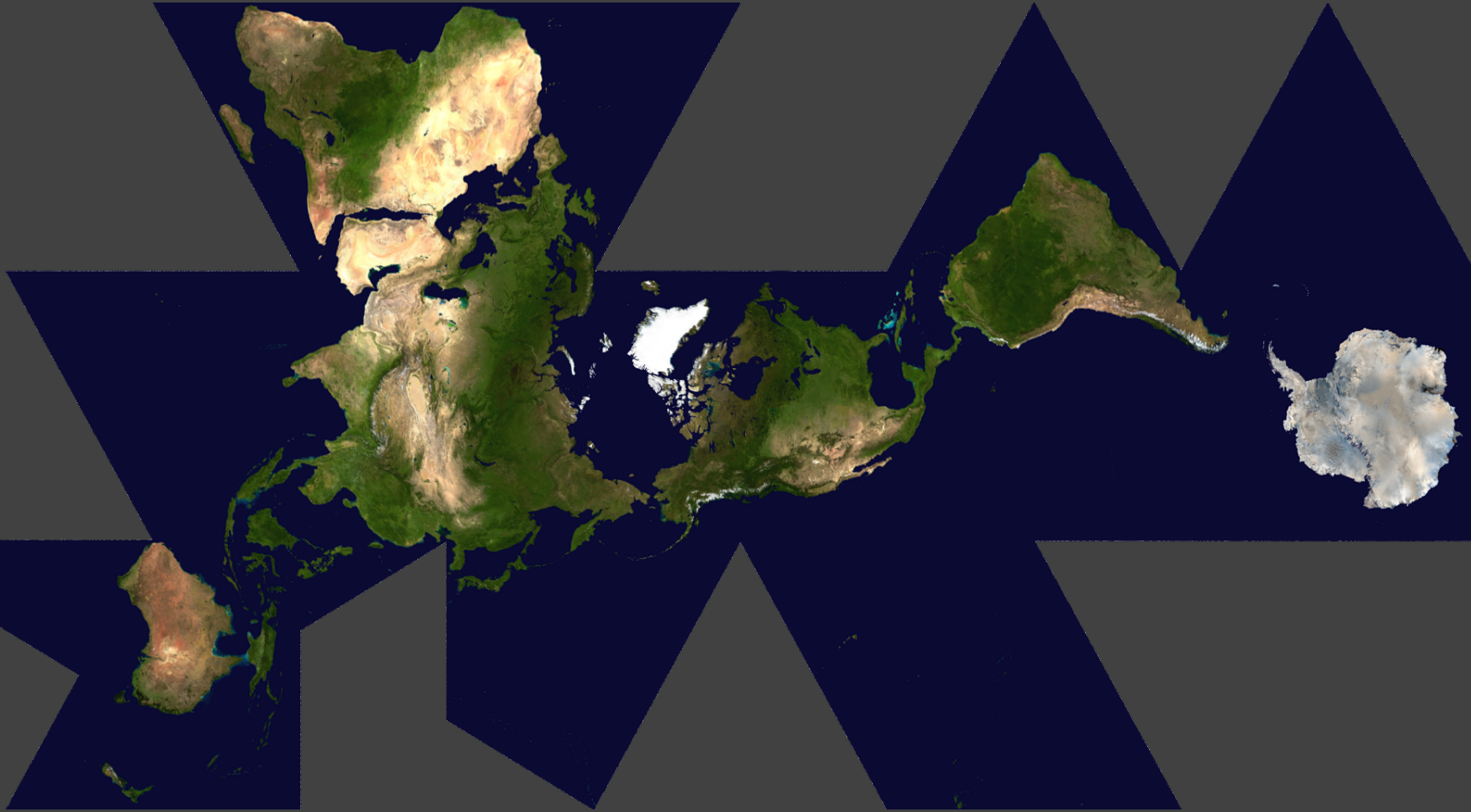


Crimespotting.org



© 2006 Microsoft Corporation, © 2006 NAVTEQ, © AND

Maps

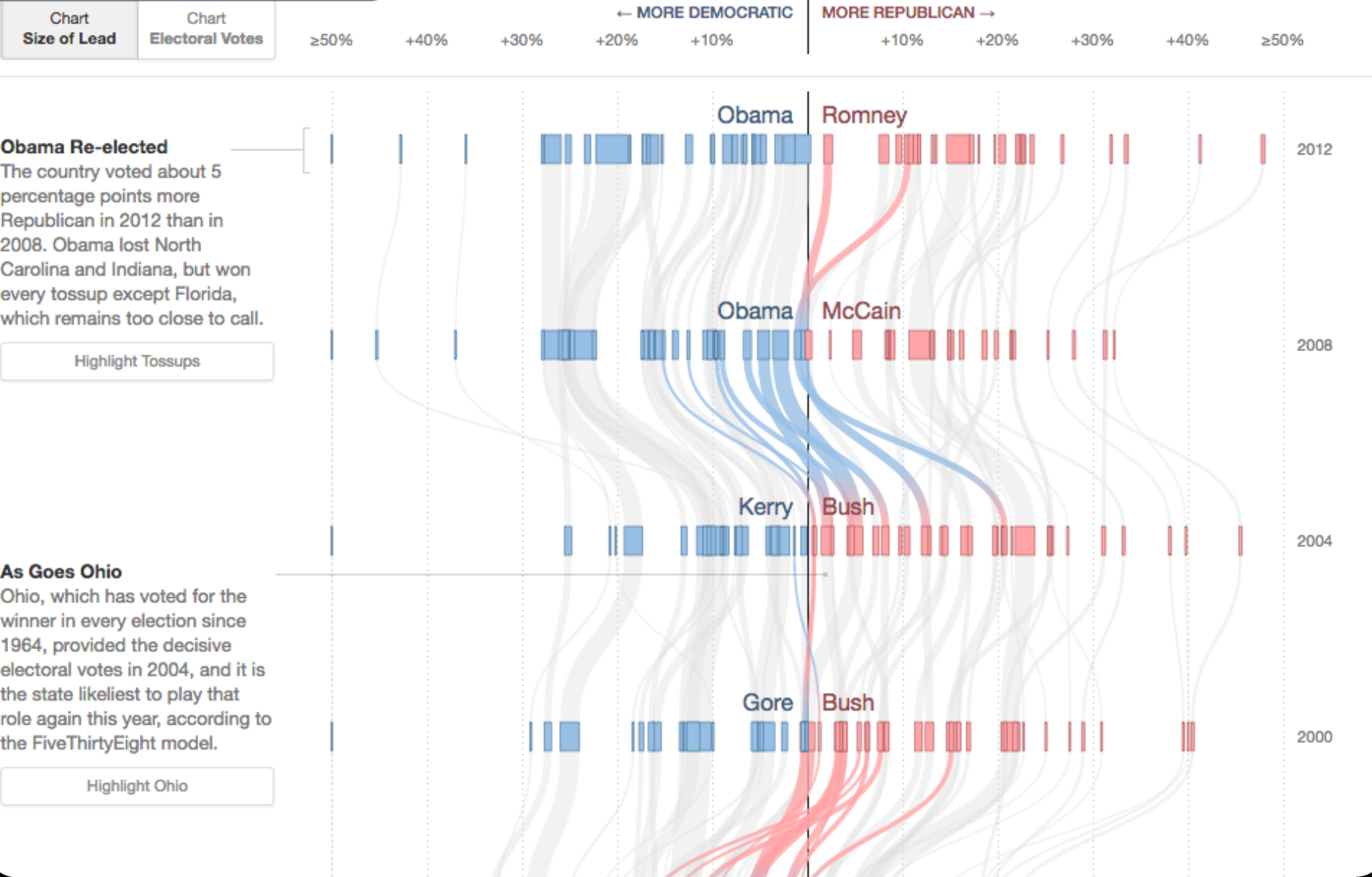


Dymaxion Maps [Fuller 46]

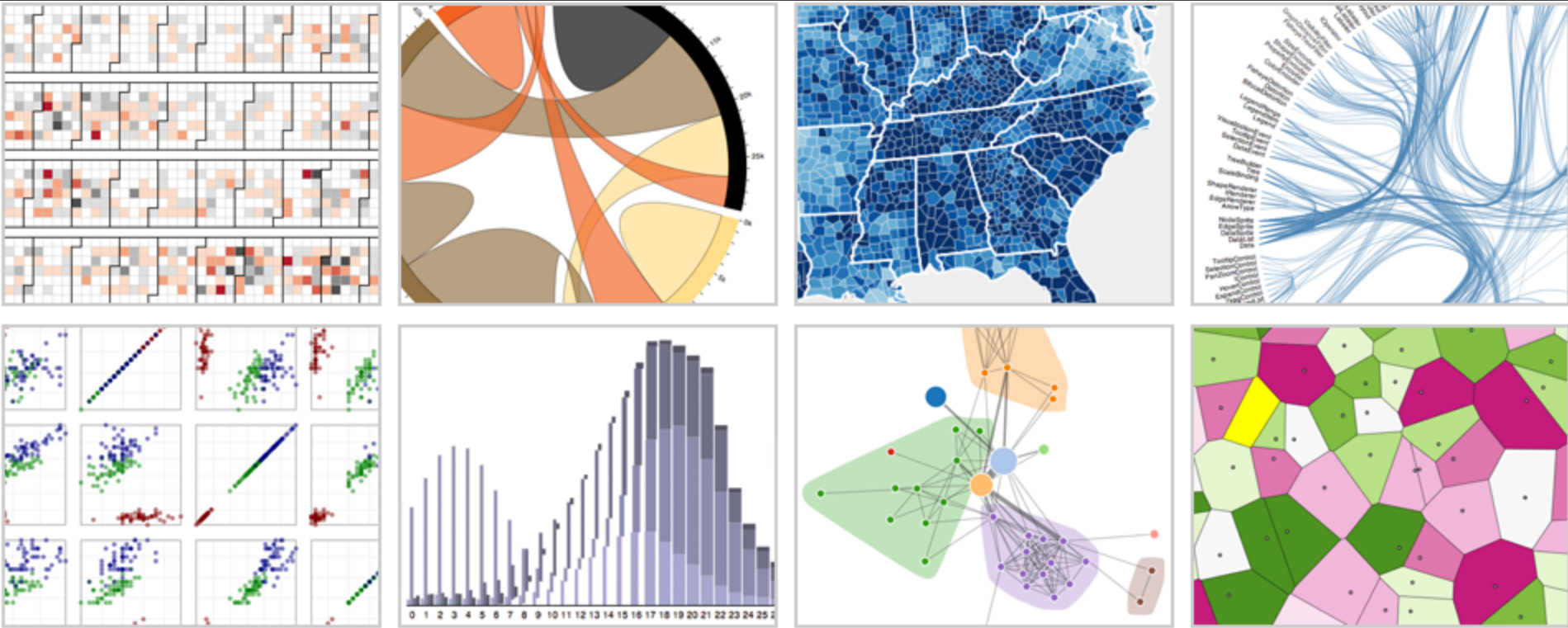
Narrative

Recent elections have placed a heavy emphasis on “swing states” — Ohio, Florida and the other competitive states. Yet the most significant changes have occurred between the Democratic and Republican parties. A look at how the states stacked up in the 2012 election and how they have shifted over past elections.

- Each box represents a state sized by number of electoral votes.
- Each curve shows how much it shifted left or right between elections

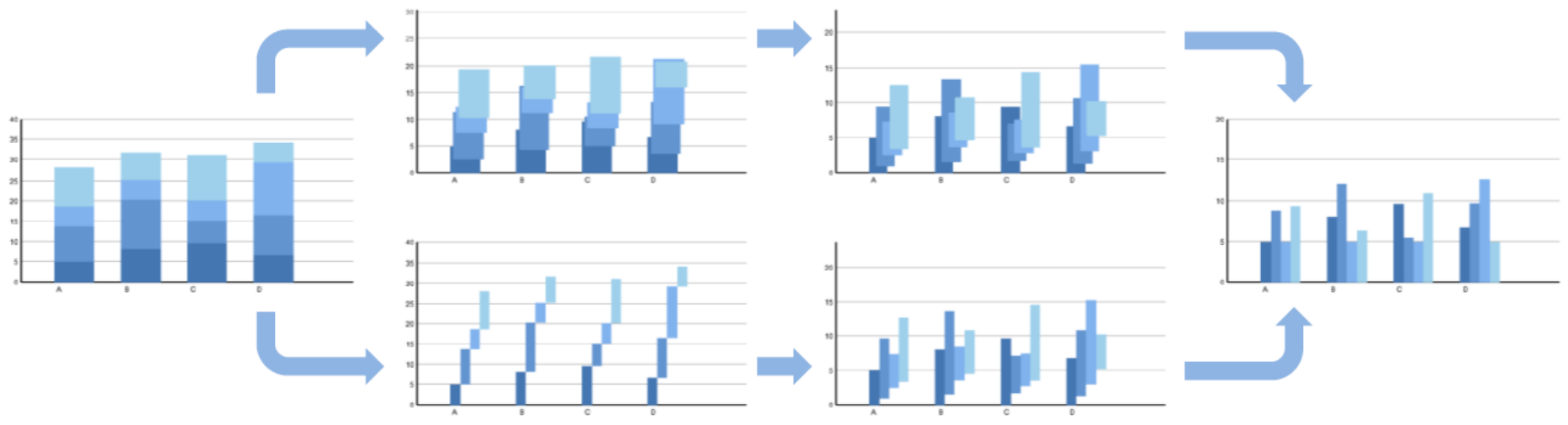


Visualization Software



D3: Data-Driven Documents
Vega-Lite / Altair

Animation

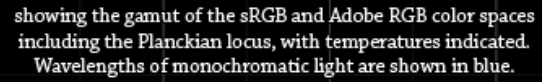


Animated transitions in statistical data graphics [Heer & Robertson 07]

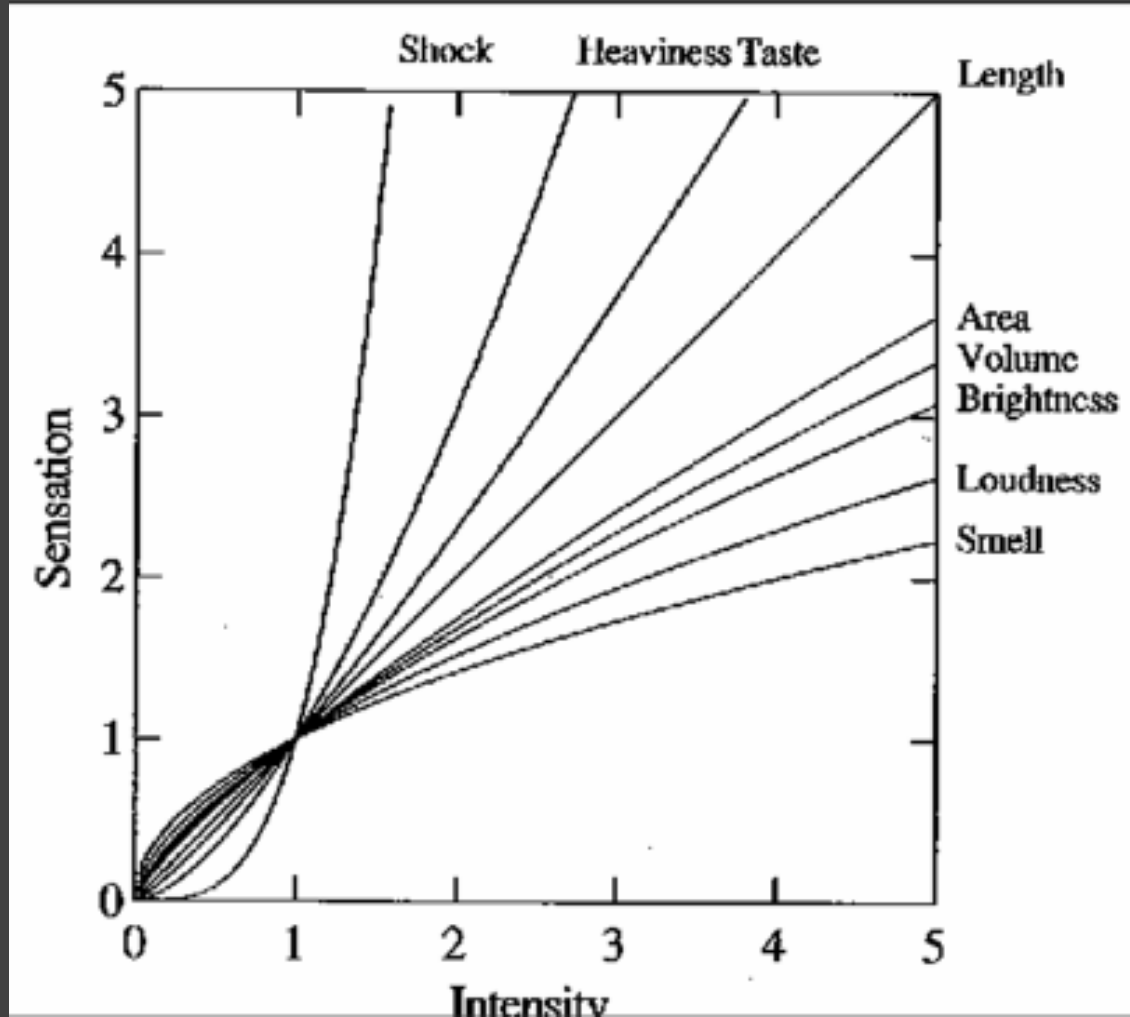
The diagram illustrates the construction of a 255075 sequential color palette. It begins with a 2x2 qualitative palette (y, n) and a 3x3 diverging palette (-1, 0, +1). These are combined to form a 6x6 qualitative palette (y, n) and a 6x6 diverging palette (-1, 0, +1). These are then combined to form a 12x12 qualitative palette (y, n) and a 12x12 diverging palette (-1, 0, +1). Finally, these are combined to form a 255075 sequential color palette.

CIE 1931 xy chromaticity diagram
 showing the gamut of the sRGB and Adobe RGB color spaces
 including the Planckian locus, with temperatures indicated.
 Wavelengths of monochromatic light are shown in blue.

The diagram illustrates the CIE 1931 xy chromaticity space. The outer boundary represents the visible spectrum of monochromatic light, with wavelengths labeled in blue (440, 450, 460, 470, 480, 490, 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650 nm). The Planckian locus, representing black-body radiation, is shown as a curve with temperatures labeled (1000°K, 1500°K, 2000°K, 2500°K, 3000°K, 4000°K, 6000°K, 10000°K, and ∞). The Adobe RGB color space is outlined in white, and the sRGB color space is outlined in yellow. The background is a color gradient corresponding to the chromaticity values.

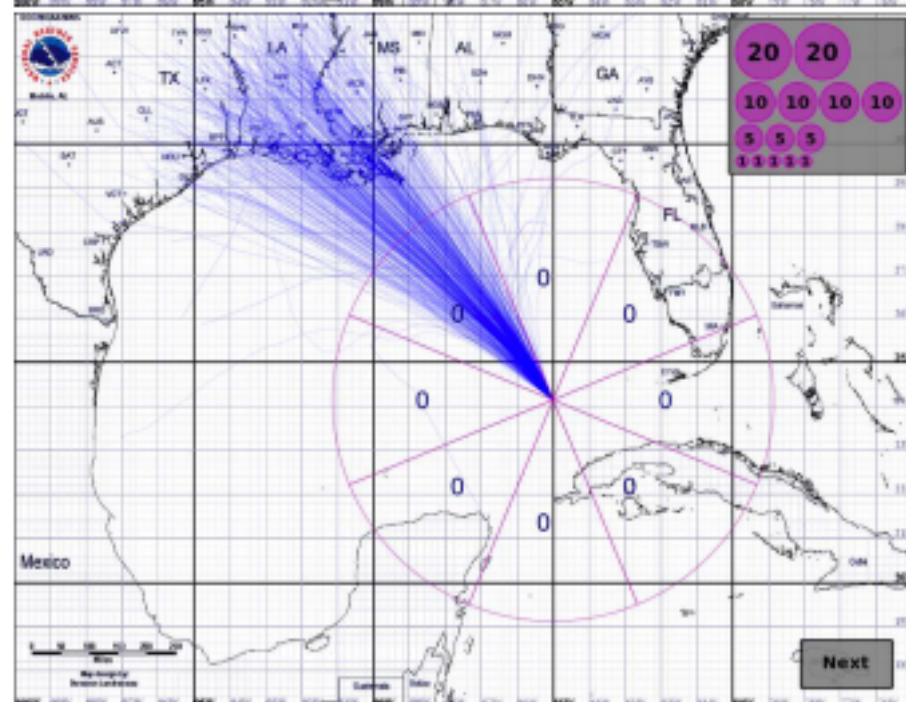
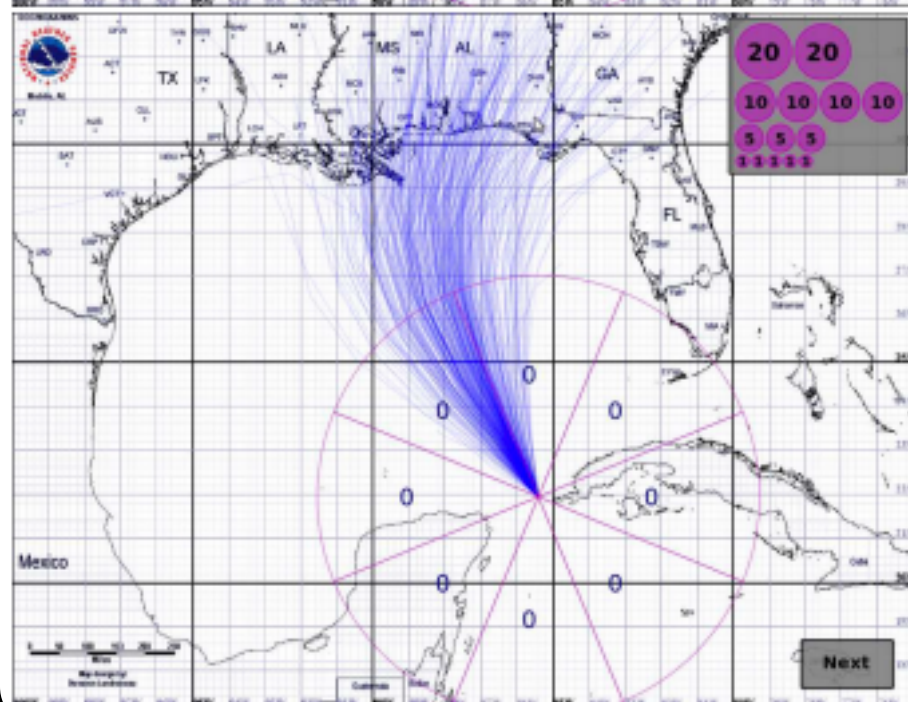
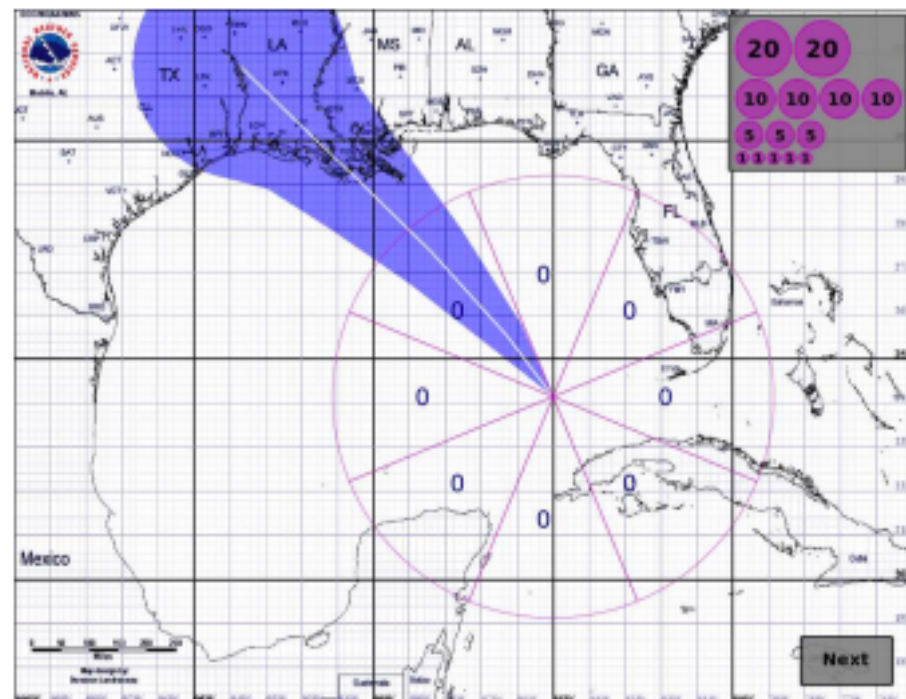
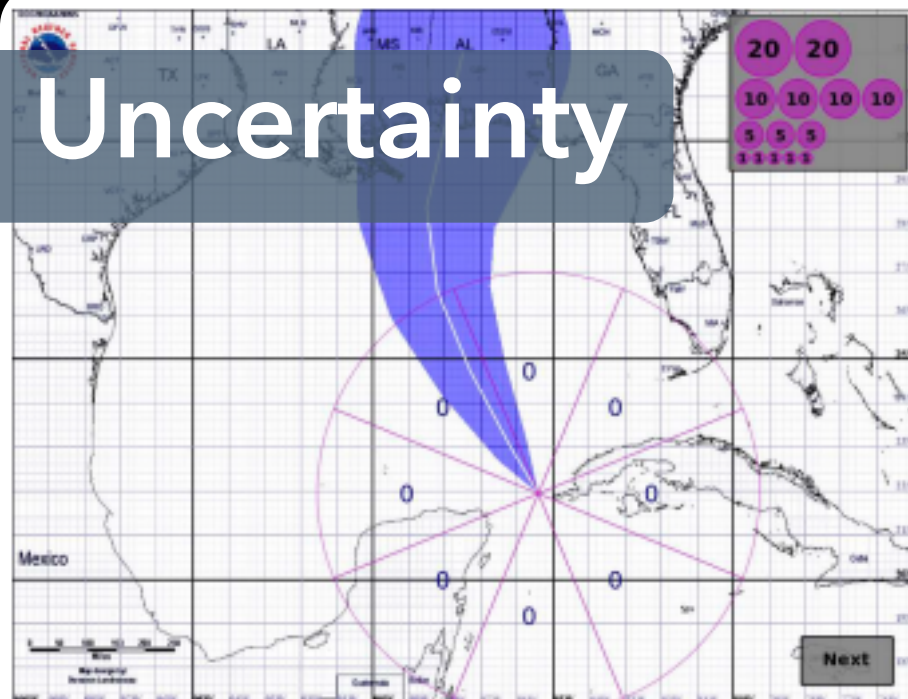


Graphical Perception

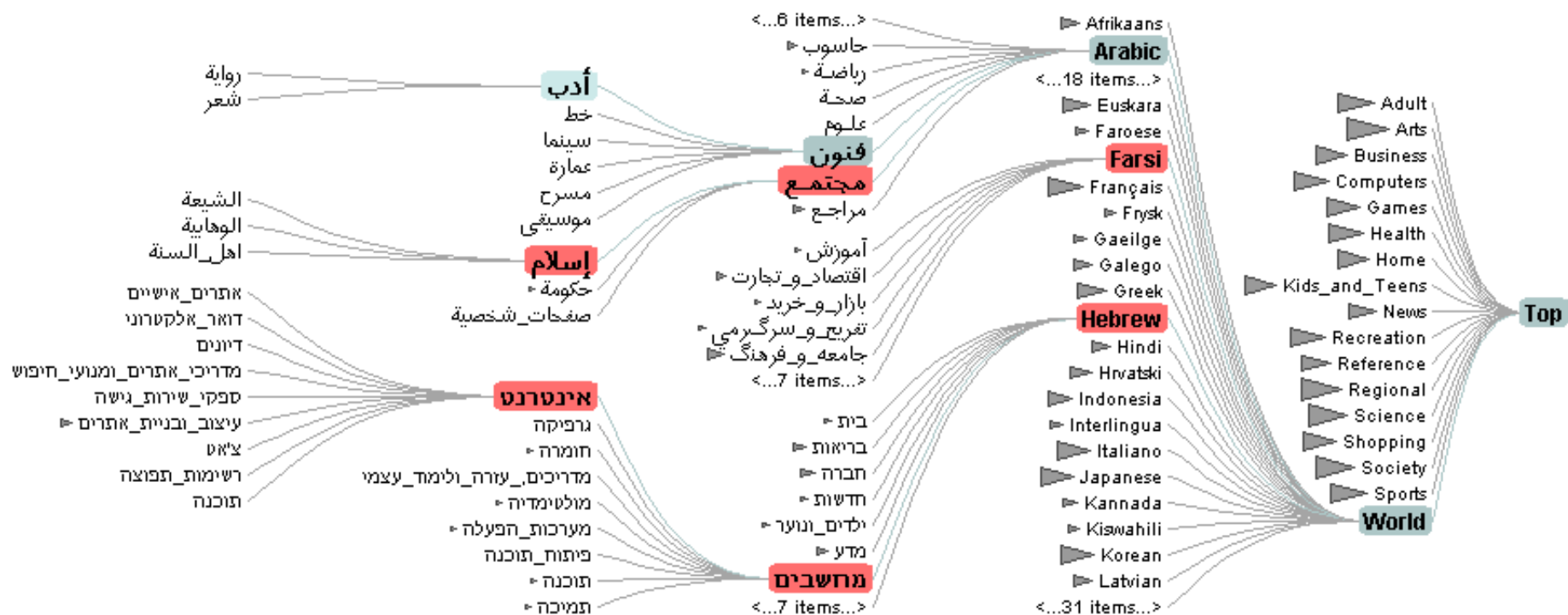


The psychophysics of sensory function [Stevens 61]

Uncertainty



Hierarchies



Degree-Of-Interest Trees [Heer & Card 04]

Networks



community >>

Enable

search >>

Zephoria

User ID 21721

Friends 266

Age ??

Gender Female

Status Single

Location San Francisco, CA

Hometown Lancaster, PA

Occupation researcher: social networks, identity, context

Interests apophenia, observing people, culture, questioning power, reading, buddhism, ipseity, computer-mediated communication, social networks, technology, anthropology, stumping

Music psytrance/goa/trance [Infected Mushroom, Son Kite... Iboga/Digital Structures], Ani Difranco, downtempo, Thievery Corporation, Beth Orton, Morcheeba, Ween, White Stripes

Books Authors: Erving Goffman, Stanley Milgram, Jeanette Winterson, Eric Schlosser, Leslie Feinberg, Dorothy Allison, Italo Calvino, Hermann Hesse

TV Shows ??

Movies Koyaanisqatsi, Amelie, Waking Life, Tank Girl, The Matrix, Clockwork Orange, American Beauty, Fight Club, Boys Don't Cry

Member Since ??

Last Login 2003-10-21

Last Updated 2003-10-21

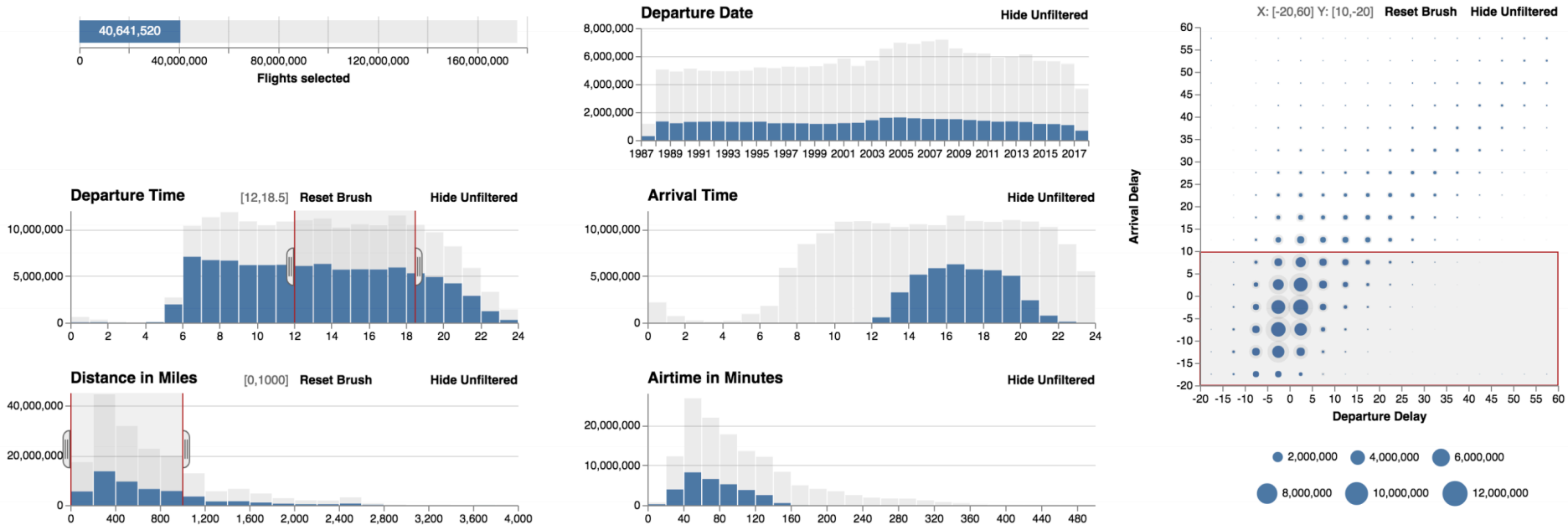
About [Some know me as danah...]

I'm a geek, an activist and an academic, fascinated by people and society. I see life as a very large playground and enjoy exploring its intricacies. I revel in life's chaos, while simultaneously providing my own insane element.

My musings:
<http://www.zephoria.org/thoughts/>

Want to Meet Someone who makes life's complexities seem simply elegant.

Scalability



Interactive querying of 180M flight records in Falcon [Moritz et al. 2019]

Course Mechanics

You should expect to:

- 1 *Evaluate and critique* visualization designs
- 2 *Learn* visualization techniques & theory
- 3 *Implement* interactive data visualizations
- 4 *Develop* a substantial visualization project

Instructors

cse512@cs

Instructor

Leilani Battle

OH: Wed 4-5pm

Assistant Professor, CSE

<https://homes.cs.washington.edu/~leibatt/>

Teaching Assistants

Vishal Devireddy

OH: Mon 11am-12pm

Philip Garrison

OH: TBD

Brian Hou

OH: Online / Ed

Chandler Peterson

OH: TBD

Firn Tieanklin

OH: Wed 10:30-11:30am



Leilani Battle

Assistant Professor, UW CSE

Co-Director, CSE Interactive Data Lab

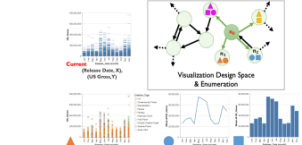
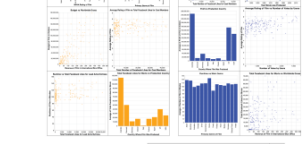
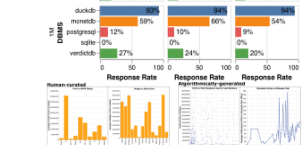
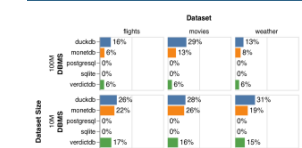
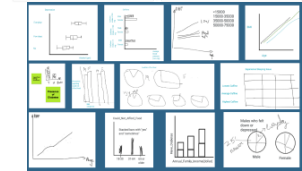
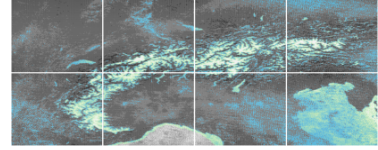
<https://homes.cs.washington.edu/~leibatt/>

Visualization / HCI / Data management / Data Science

I model relationships between analysts' *intent*s, i.e., analysis goals, and *behavior*s, i.e., patterns of interaction with data analysis systems.

I use these models to build *behavior-driven* optimizations, UI features, and performance benchmarks for interactive data analysis

Hobbies: Travel, crafting, disc golf, board games, reading, etc.







Vishal Devireddy

Email	vishald@cs
Office hours	Mon. 11 am

I'm an MS student interested in web development, HCI, and perfectly aligning monospace text. My current research is with IDL on tools to support easily authoring responsive, interactive academic papers. Super excited to TA CSE 512!

Some things I can help with:

 JavaScript	 C S S
 Web design	 D3.js
 Web accessibility	 Idyl





Philip Garrison (he/him)

Hi! I'm a PhD student in CSE and I have been developing a data visualization platform for cold-chain equipment (refrigerators that store vaccines). My current research is about the social & political context of that platform. Outside of research and teaching, I like making music, and I stay involved in activism on and off campus.

philipmg@cs.uw.edu



Brian Hou

he/him

- PhD student in the Personal Robotics Lab
- Research interests: robot motion planning, reinforcement learning
- Non-research interests: baking, casual games, crosswords, basketball/baseball



Nussara 'Firn' Tieanklin

Office Hour: Wed 10:30-11:30 AM

nussara@cs

Research @ICTD Lab

- **Rideshare on different SES:** Understanding the effects of people's SES on using rideshare/food delivery services in Southeast Asia.
- [Seattle Community Networks](#): providing internet access to resource-constrained communities in Washington

Technical Experience

- User research, Design process, Data Management, Web-programming

Things I do for fun

- Play Badminton 🏸
- Explore new bakeries and dessert cafes 🍰
- Play video games 🎮
- Travel 🚗

Chandler Petersen

- 2nd-year CSE PhD student
- Advisor: Georg Seelig
- Research Area: DNA computing and molecular programming
- Working to scale up the synthesis, computation, and readout of DNA logic circuits with Next Generation Sequencing
- Interested in the creating tools to better visualize and teach DNA strand displacement circuits



Readings

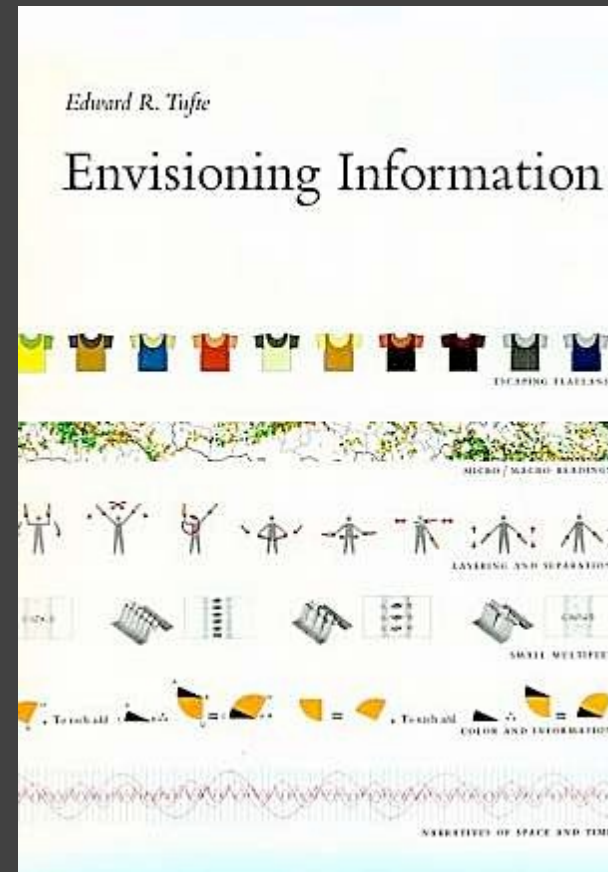
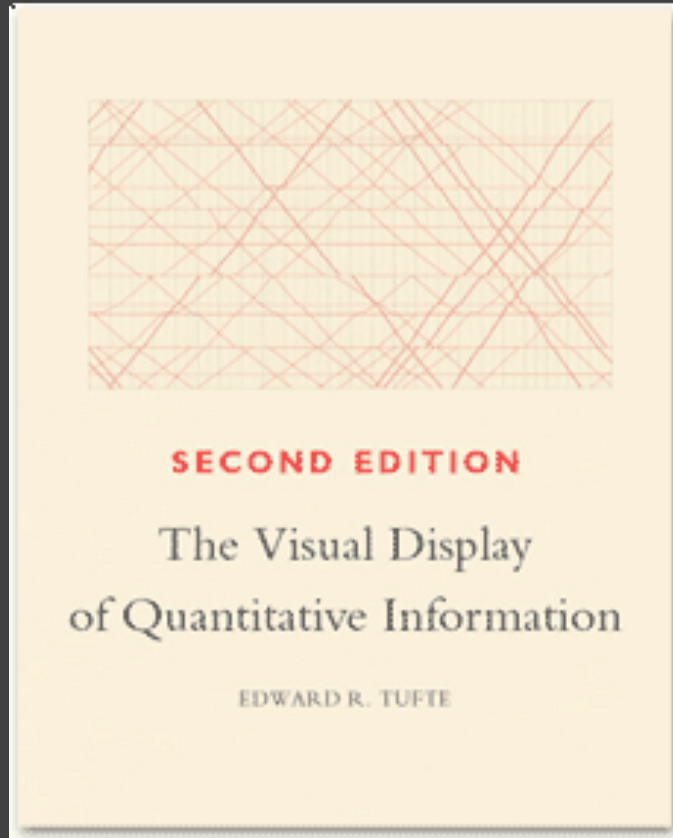
From books, notebooks, and linked articles.
Material in class will loosely follow readings.
Readings should be read by start of class.
Post comments & quizzes on class forum.

One comment per week.

Post comments by Friday 11:59pm.

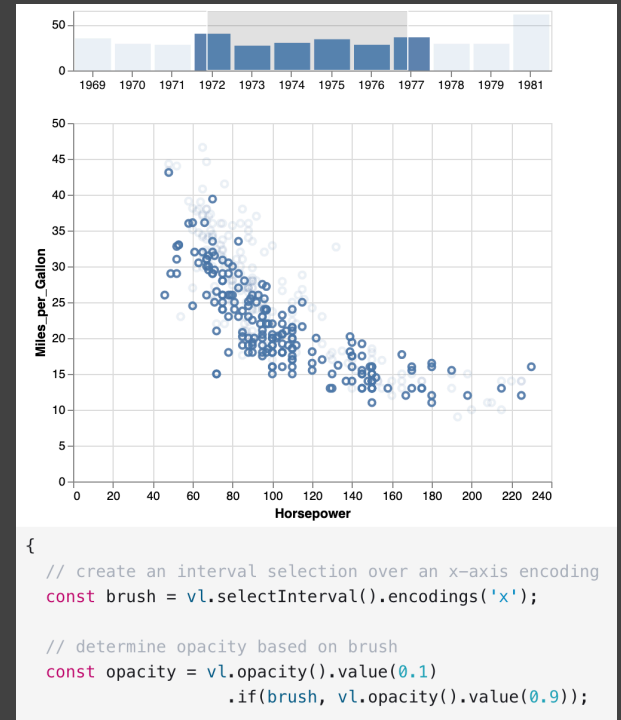
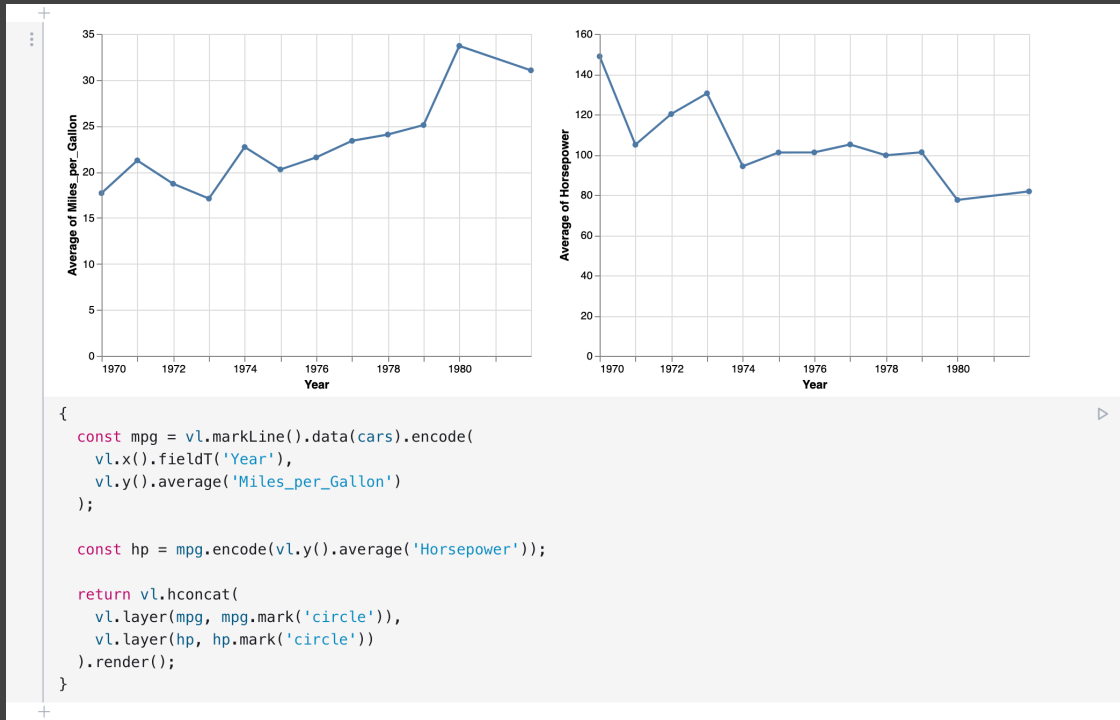
You have 2 “passes” for the quarter.

"Textbooks"



See also: www.edwardtufte.com

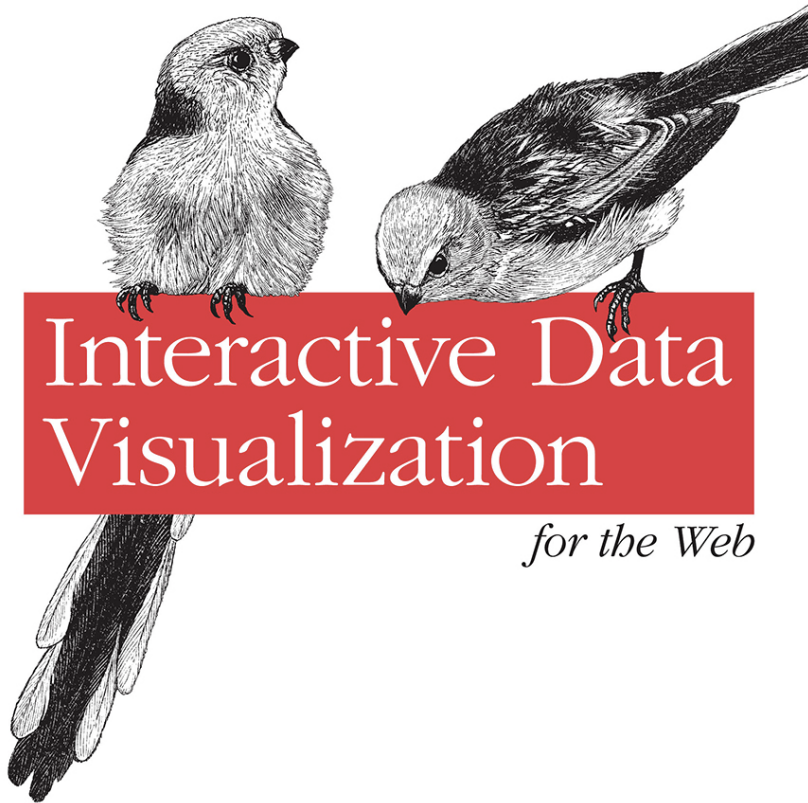
Interactive Notebooks



Hands-on engagement with course concepts and visualization tools (Vega-Lite / Altair), in both JavaScript (Observable) *and* Python (Jupyter).

Optional Book

An Introduction to Designing With D3



O'REILLY®

Scott Murray

Interactive Data Visualization for the Web, 2nd Edition

For learning D3!

[Book available online.](#)

[Code / examples on GitHub.](#)

We will be using **D3 v6**.

<https://d3js.org>

Assignments

CP Class Participation (10%)

A1 Visualization Design (10%) - *Due 4/6*

A2 Deceptive Visualization (15%) - *Due 4/22*

Peer Evaluation - *Due 4/29*

A3 Interactive Prototype (25%) - *Due 5/10*

Peer Evaluation - *Due 5/17*

FP Final Project (40%)

Proposal - *Due 5/18*

Milestone Prototype - *Due 5/27*

Final Projects Showcase - *Posters Due 6/1*

Final Prototype - *Due 6/7*

Final Project

Visualization research project on topic of choice

Initial **prototype** and **design reviews**

In-class demonstration **video** showcase

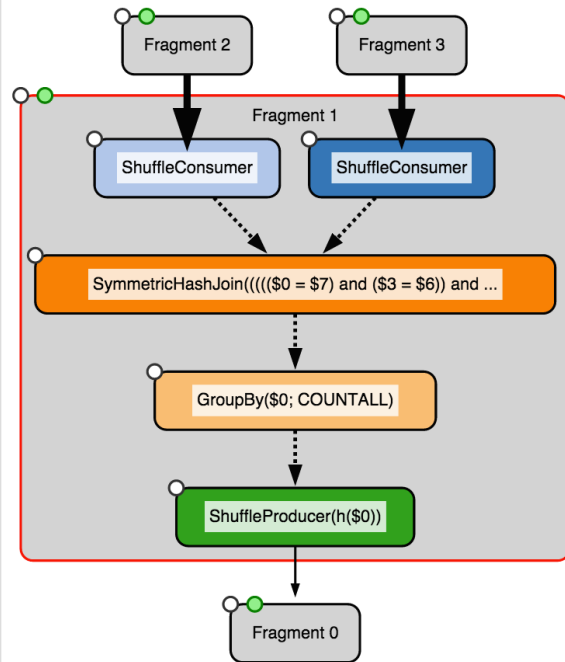
Submit and publish online (if feasible)

Projects from **previous classes** have been:

- Published as research papers
- Featured in the New York Times
- Released as successful open source projects

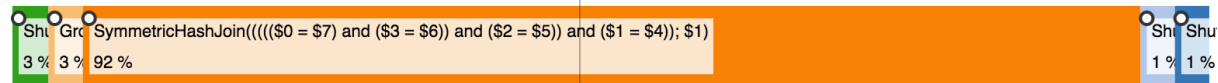
Perfopticon Distributed Query Performance

Physical Query Plan:

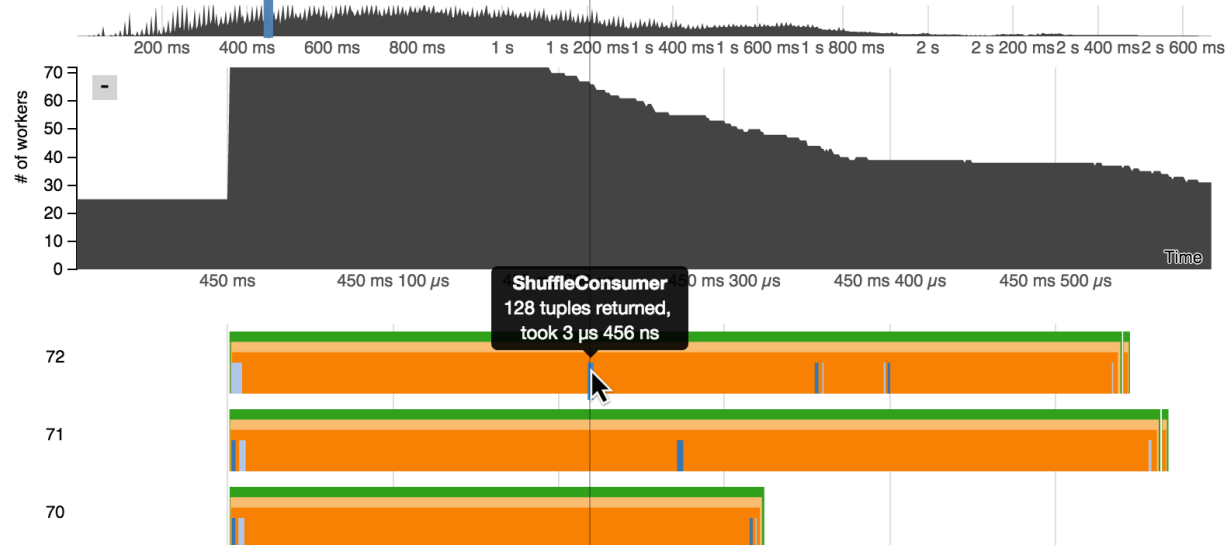


Overview / Operators inside fragment 1

Query time contribution collapse/expand

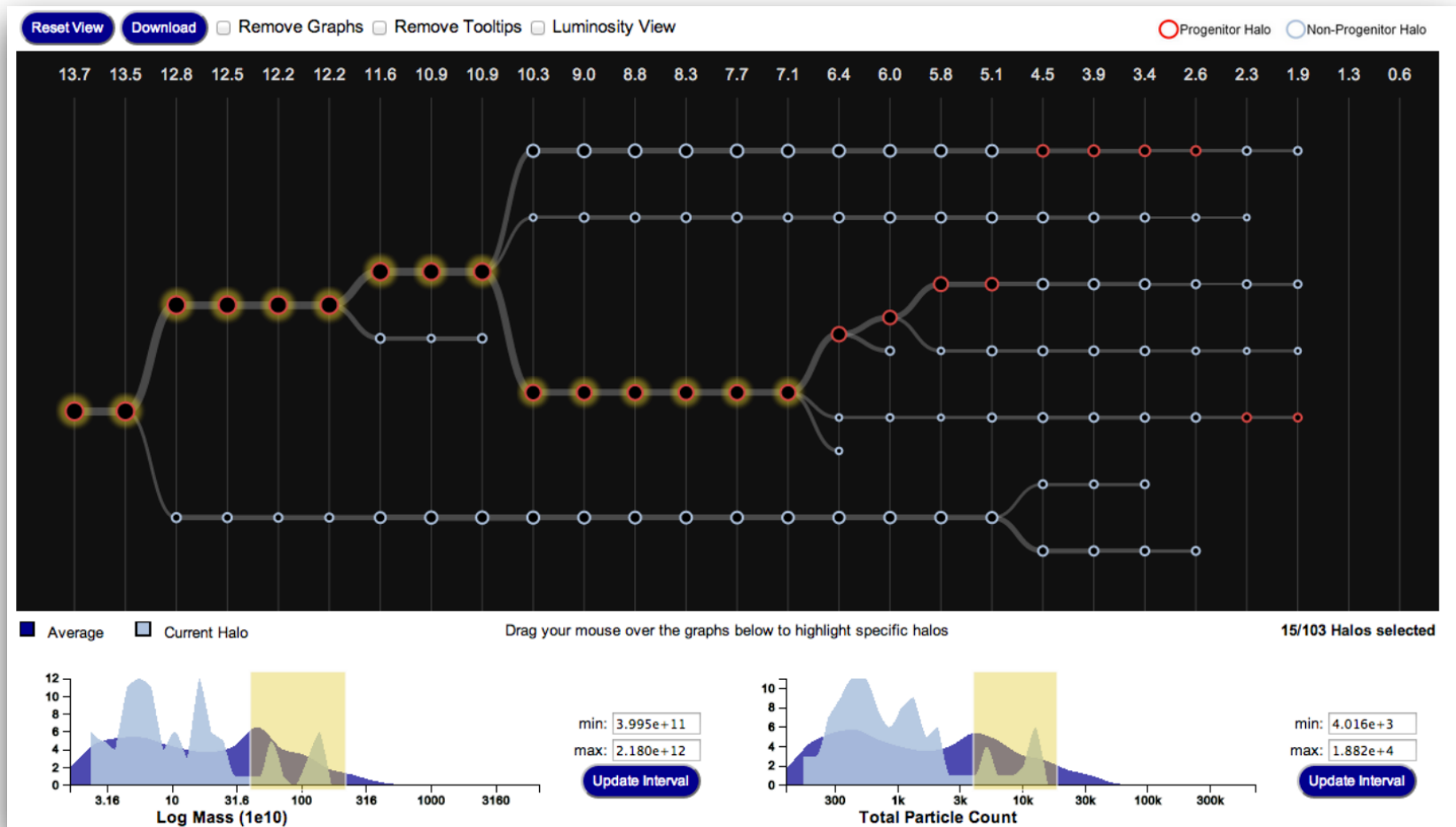


Detailed execution



Dominik Moritz et al. [EuroVis '15]

Visualizing Galaxy Merger Trees

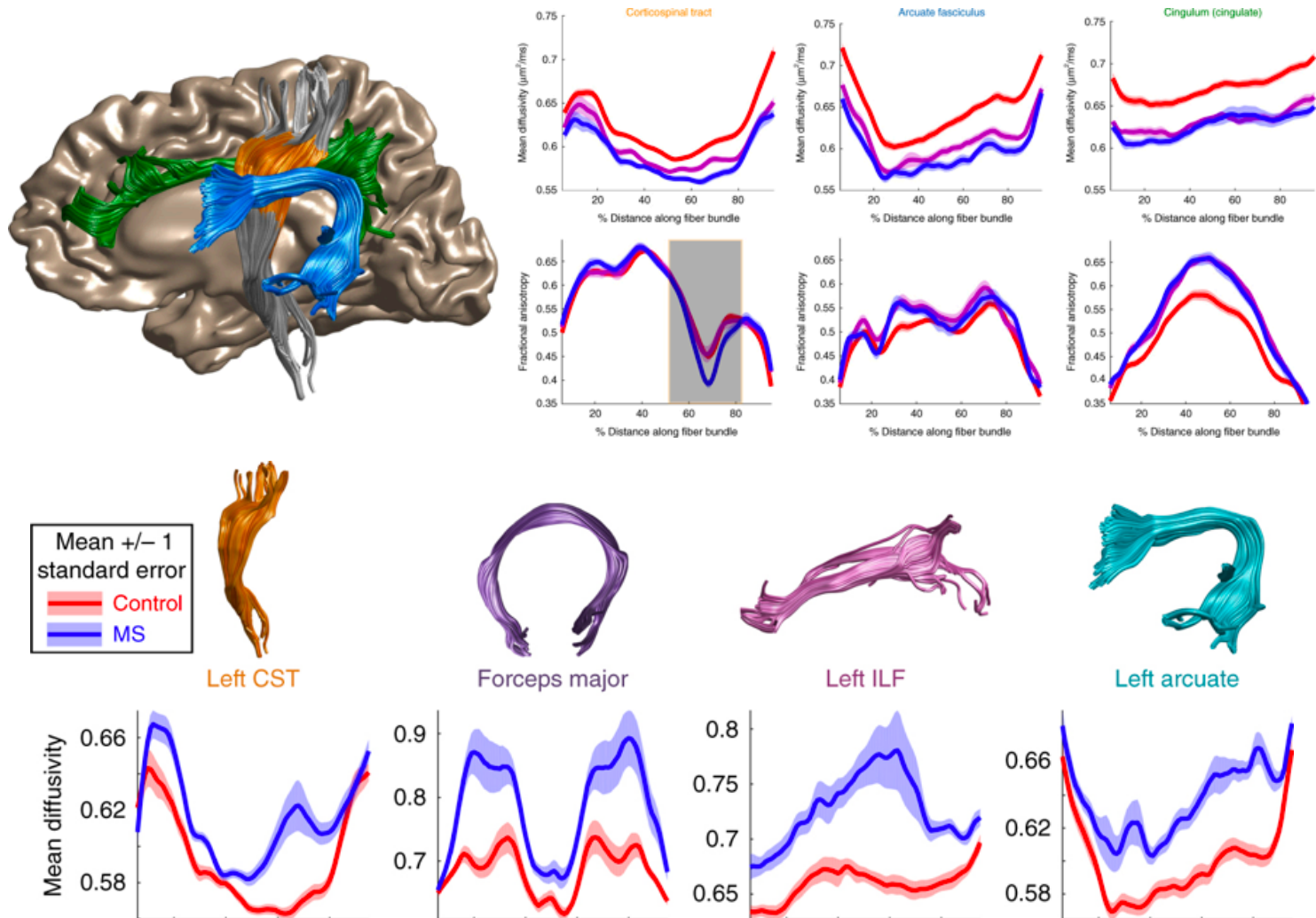


S. Loebman, J. Ortiz, L. Orr, M. Balazinska, T. Quinn et al. [SIGMOD '14]

A browser-based tool for visualization and analysis of diffusion MRI data

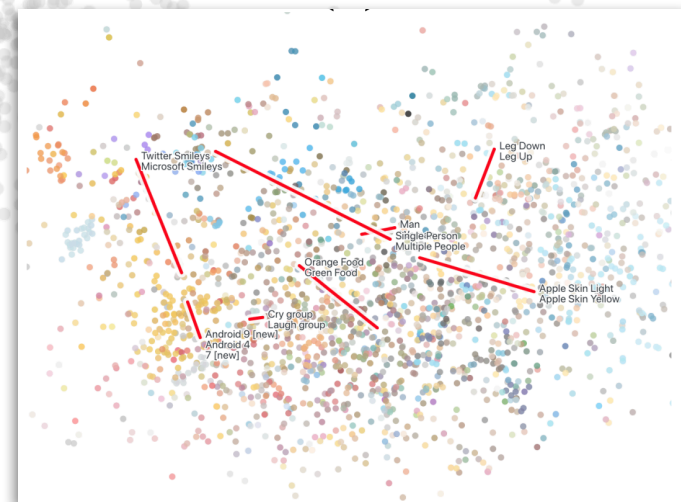
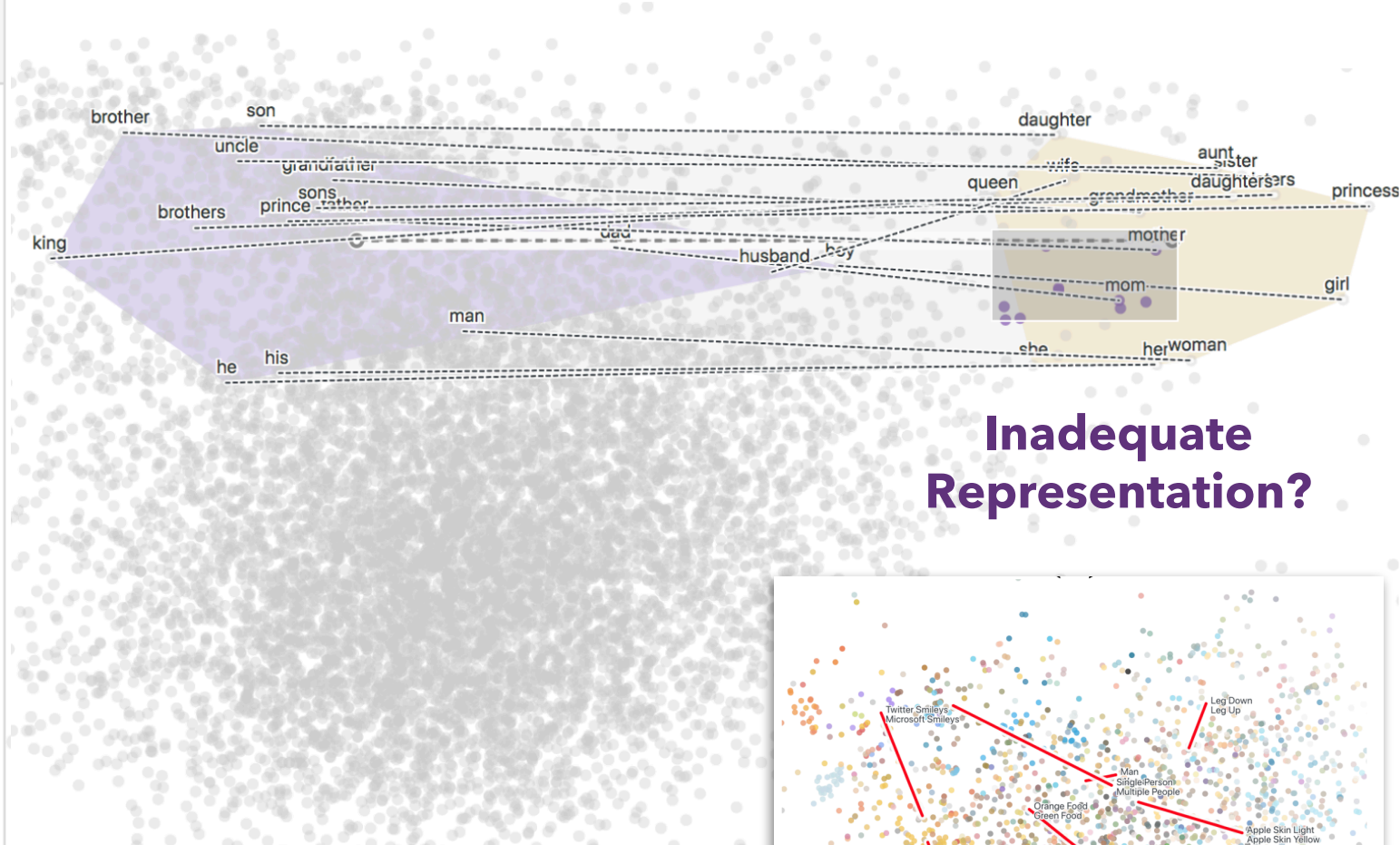
Article | OPEN | Published: 05 March 2018

Jason D. Yeatman , Adam Richie-Halford, Josh K. Smith, Anisha Keshavan & Ariel Rokem 



Brushed

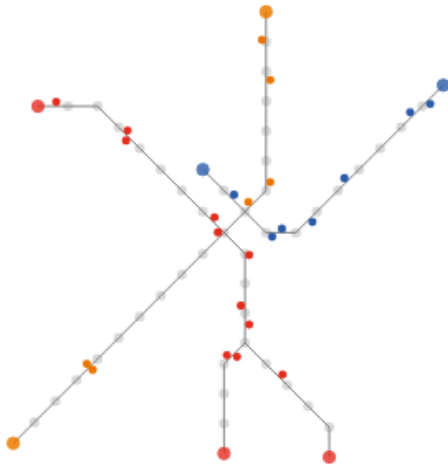
mother +
ms. +
wedding +
pink **Bias?** +
mom +
nurse +
bedroom +
ladies +
householder +
butterfly +



Latent Space Cartography

Visual Analysis of Vector Space Embeddings

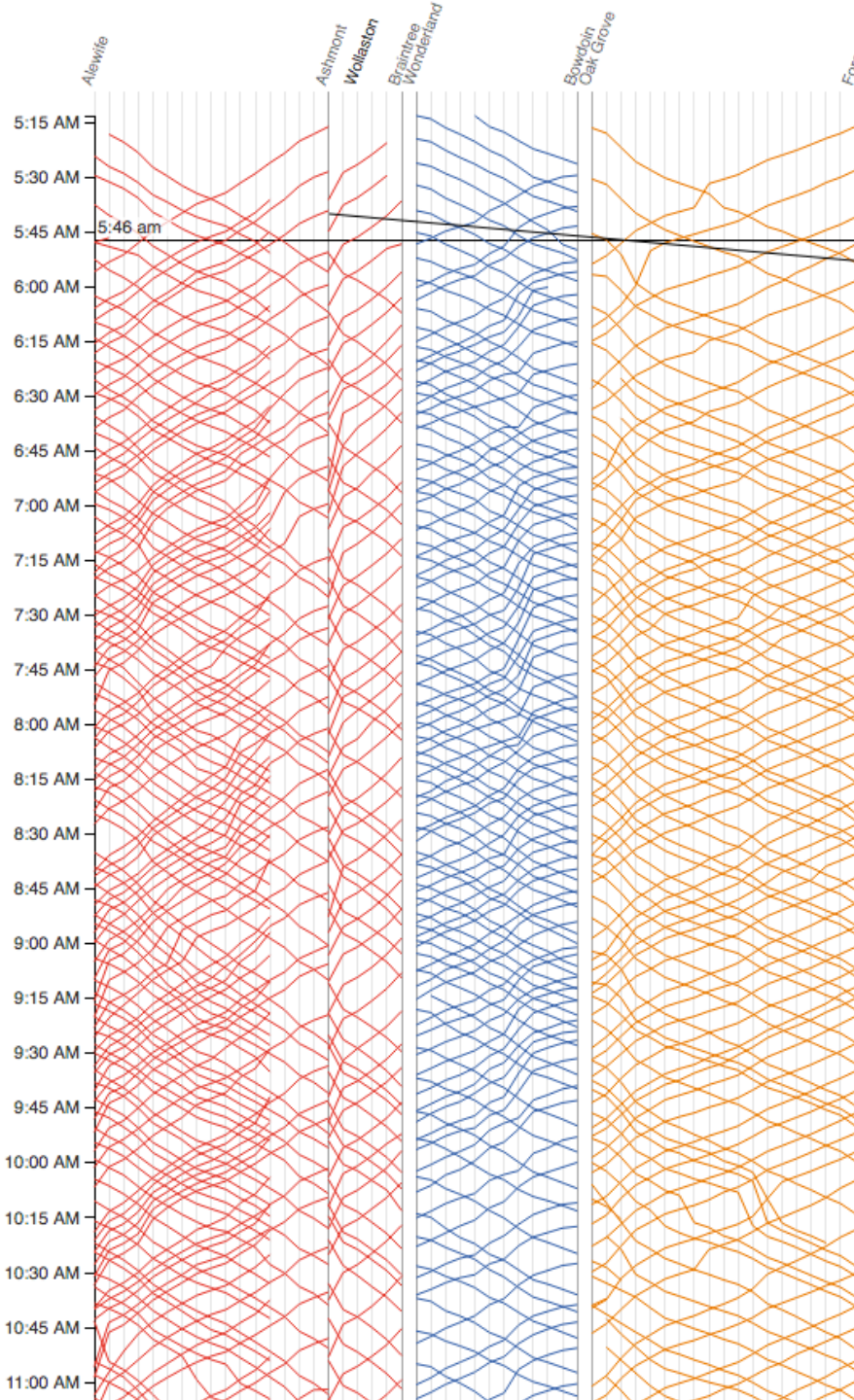
Yang Liu, Eunice Jun, Qisheng Li (CSE 512, Spring '18)



Locations of each train on the [red](#), [blue](#), and [orange](#) lines at 5:46 am. Hover over the diagram to the right to display trains at a different time.

Trains are on the right side of the track relative to the direction they are moving.

See the [morning rush-hour](#), [midday lull](#), [afternoon rush-hour](#), and the [evening lull](#).



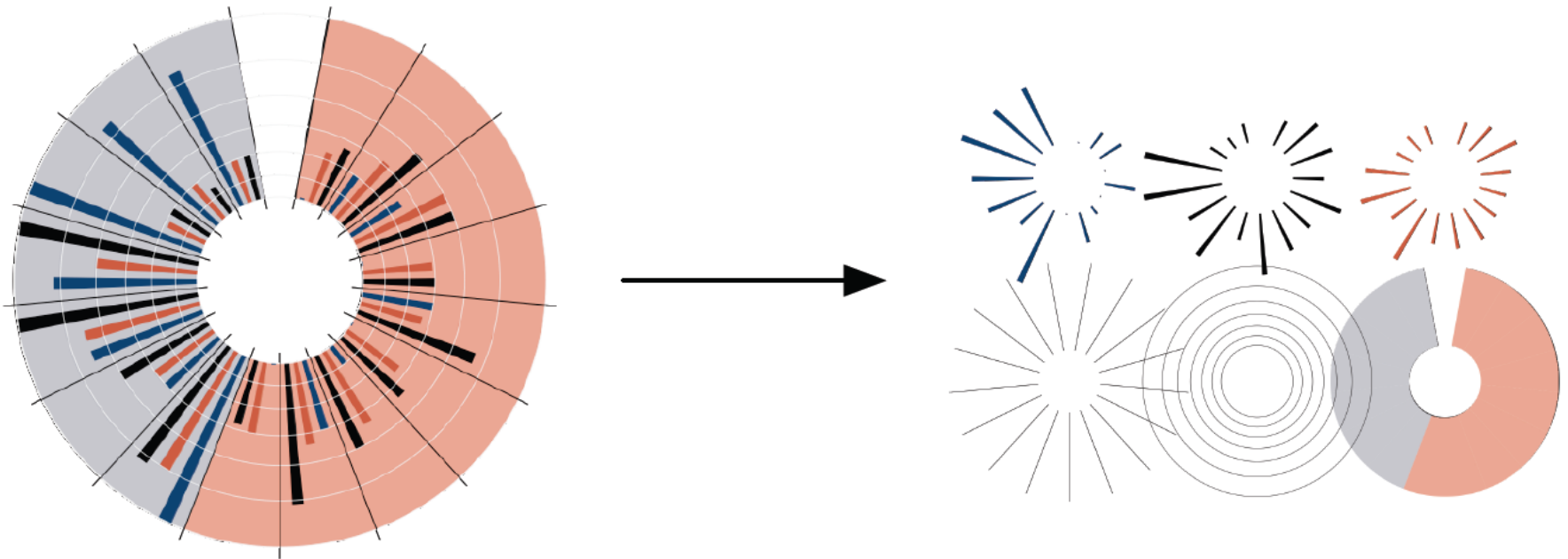
Service starts at 5AM on Monday morning. Each line represents the path of one train. Time continues downward, so steeper lines indicate slower trains.

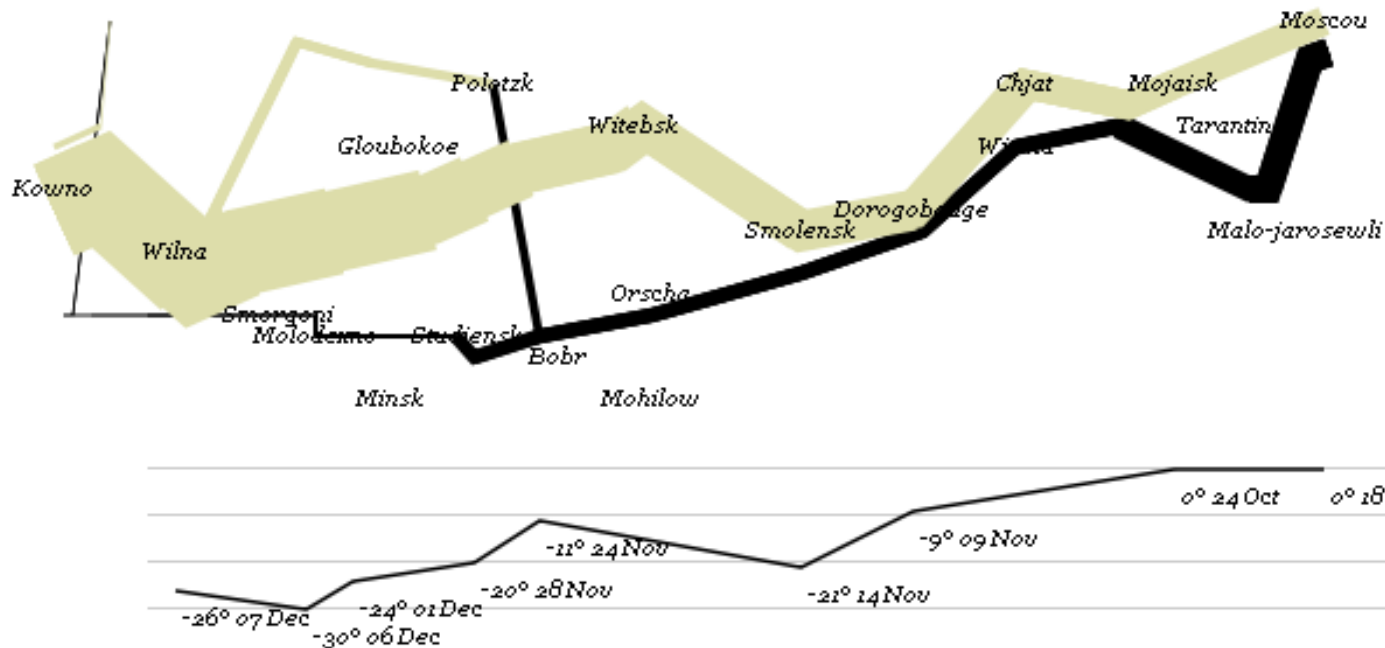
Since the red line splits, we show the Ashmont branch first then the Braintree branch. Trains on the Braintree branch "jump over" the Ashmont branch.

Train frequency increases around 6:30AM as morning rush hour begins.

Protovis: A Graphical Toolkit for Visualization

Mike Bostock





```
var army = pd.nest(napoleon.army, "dir", "group");
var vis = new pv.Panel();

var lines = vis.add(pv.Panel).data(army);
lines.add(pv.Line)
  .data(function() army[this.idx])
  .left(lon).top(lat).size(function(d) d.size/8000)
  .strokeStyle(function() color[army[panelIndex][0].dir]);
```

```
vis.add(pv.Label).data(napoleon.cities)
  .left(lon).top(lat)
  .text(function(d) d.city).font("italic 10px Georgia")
  .textAlign("center").textBaseline("middle");
```

```
vis.add(pv.Rule).data([0,-10,-20,-30])
  .top(function(d) 300 - 2*d - 0.5).left(200).right(150)
  .lineWidth(1).strokeStyle("#ccc")
  .anchor("right").add(pv.Label)
  .font("italic 10px Georgia")
  .text(function(d) d+"°").textBaseline("center");
```

```
vis.add(pv.Line).data(napoleon.temp)
  .left(lon).top(tmp).strokeStyle("#0")
  .add(pv.Label)
  .top(function(d) 5 + tmp(d))
  .text(function(d) d.temp+"° "+d.date.substr(0,6))
  .textBaseline("top").font("italic 10px Georgia");
```

Visualizing the Republic of Letters

Daniel Chang, Yuankai Ge, Shiwei Song

Republic of Letters

1700



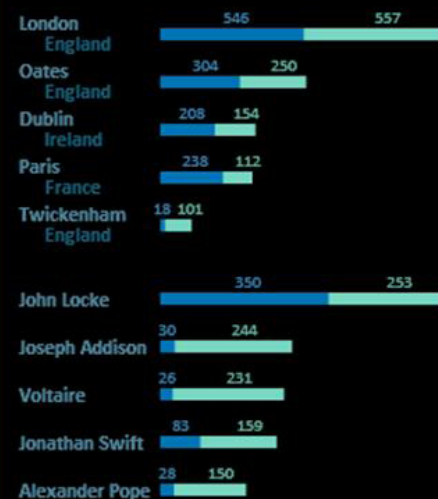
FILTER BY AUTHOR

Clear All

Damien Desormes
Daniel Cornabs
Daniel de Pury
Daniel Defoe
Daniel Malthus
Daniel Marc Antoine Chardon
Daniel Muller

TOP CITIES AND AUTHORS

Letters received Letters sent



Questions?

A1: Visualization Design

Design a static visualization for a data set.

The climate of a place can have a tremendous impact on people's lived experience. You will examine average monthly climate measurements for six major U.S. cities, roughly covering the edges of the continental United States.

You must choose the message you want to convey. What question(s) do you want to answer? What insight do you want to communicate?

A1: Visualization Design

Pick a **guiding question**, use it to title your vis.
Design a **static visualization** for that question.
You are free to **use any tools** (inc. pen & paper).

Deliverables (upload via Canvas; see A1 page)

Image of your visualization (PNG or JPG format)

Short description + design rationale (≤ 4 paragraphs)

Due by **11:59 pm, Wednesday April 6.**