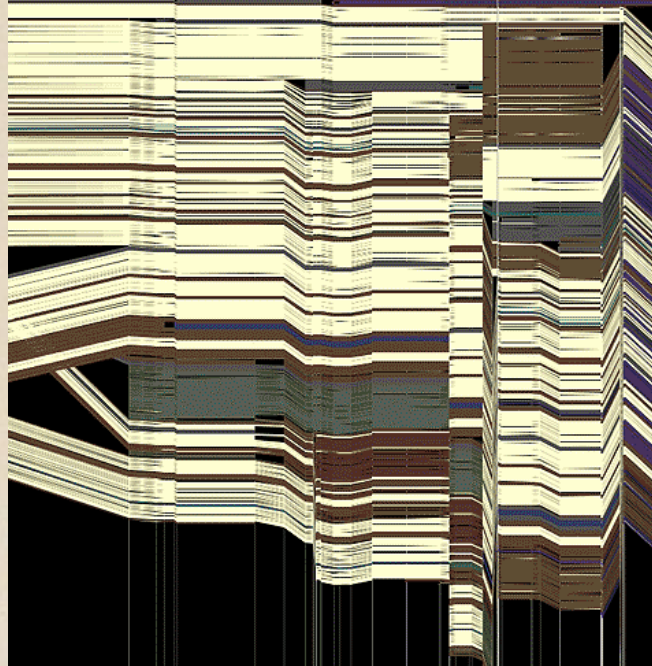
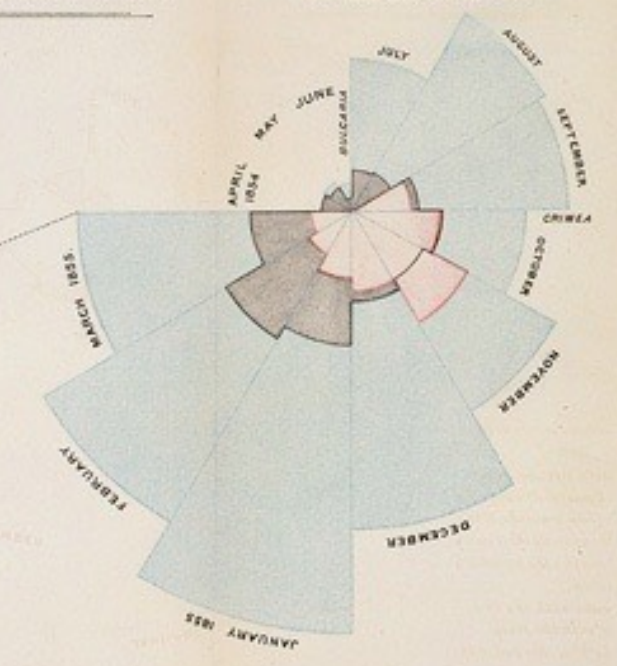


CSE 442 - Data Visualization

The Value of Visualization



Jeffrey Heer, Jane Hoffswell Univ. of Washington

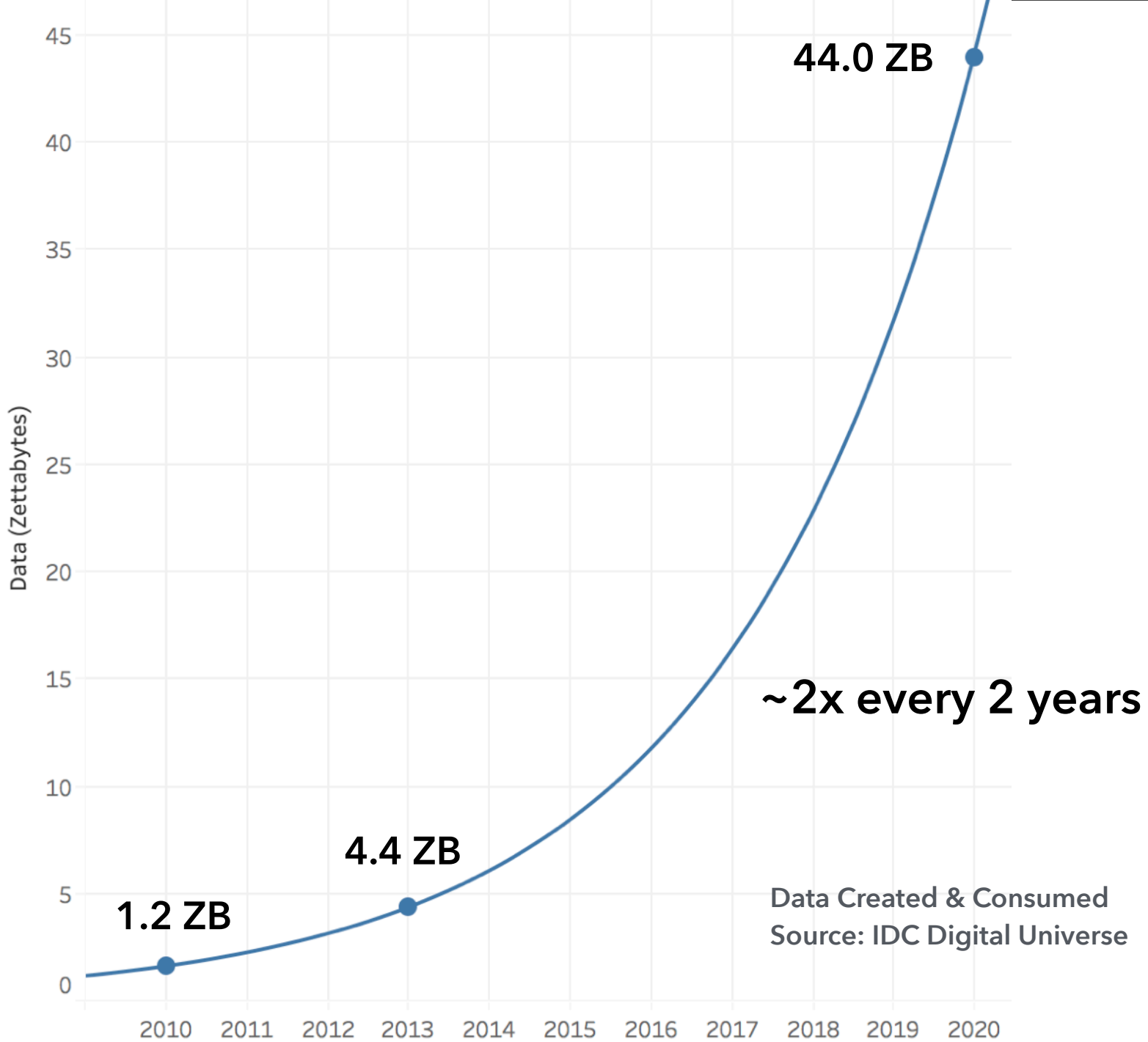
**How much data (bytes)
did we produce in 2010?**

2010: 1,200 exabytes

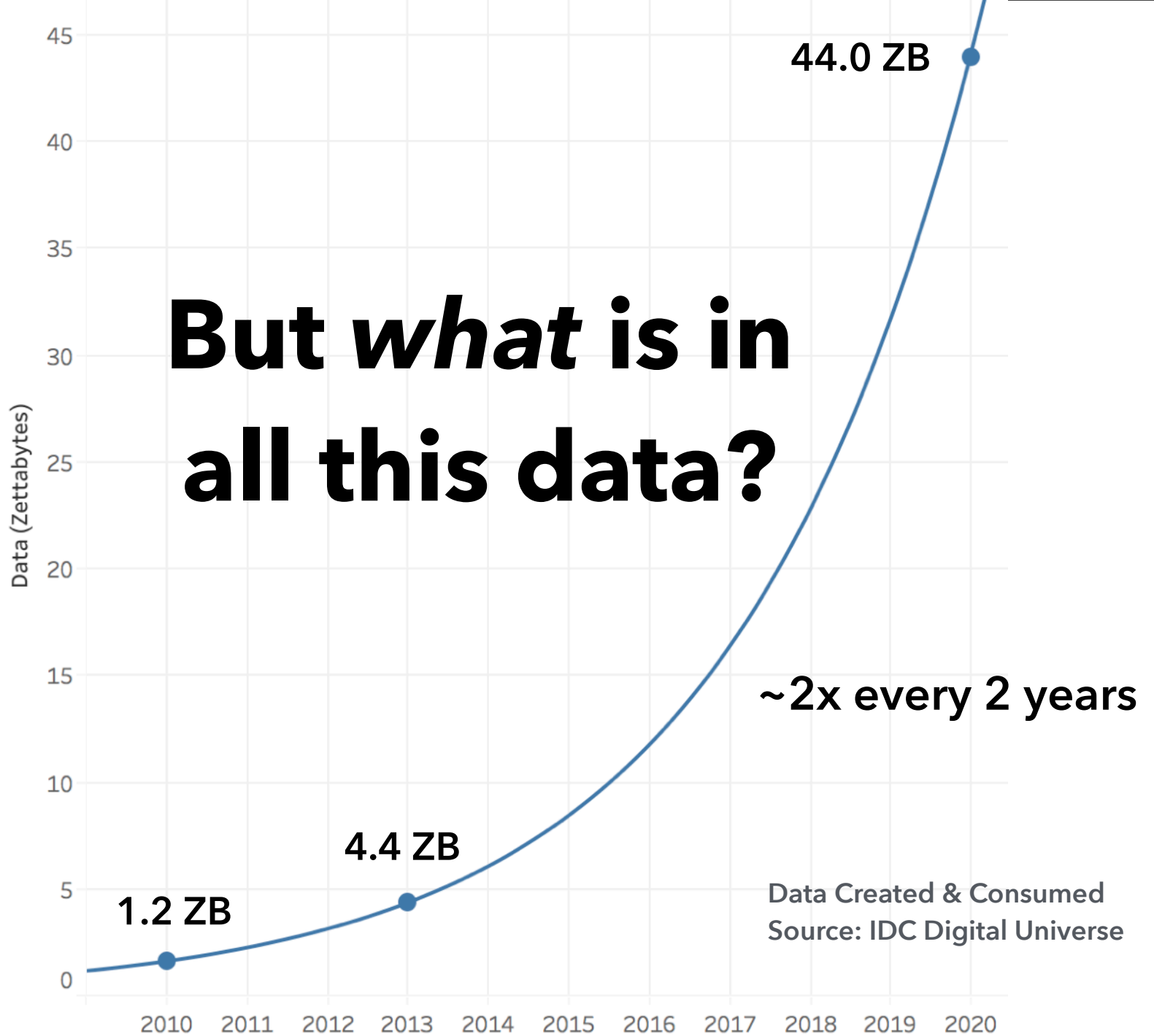
Gantz et al., 2008, 2010

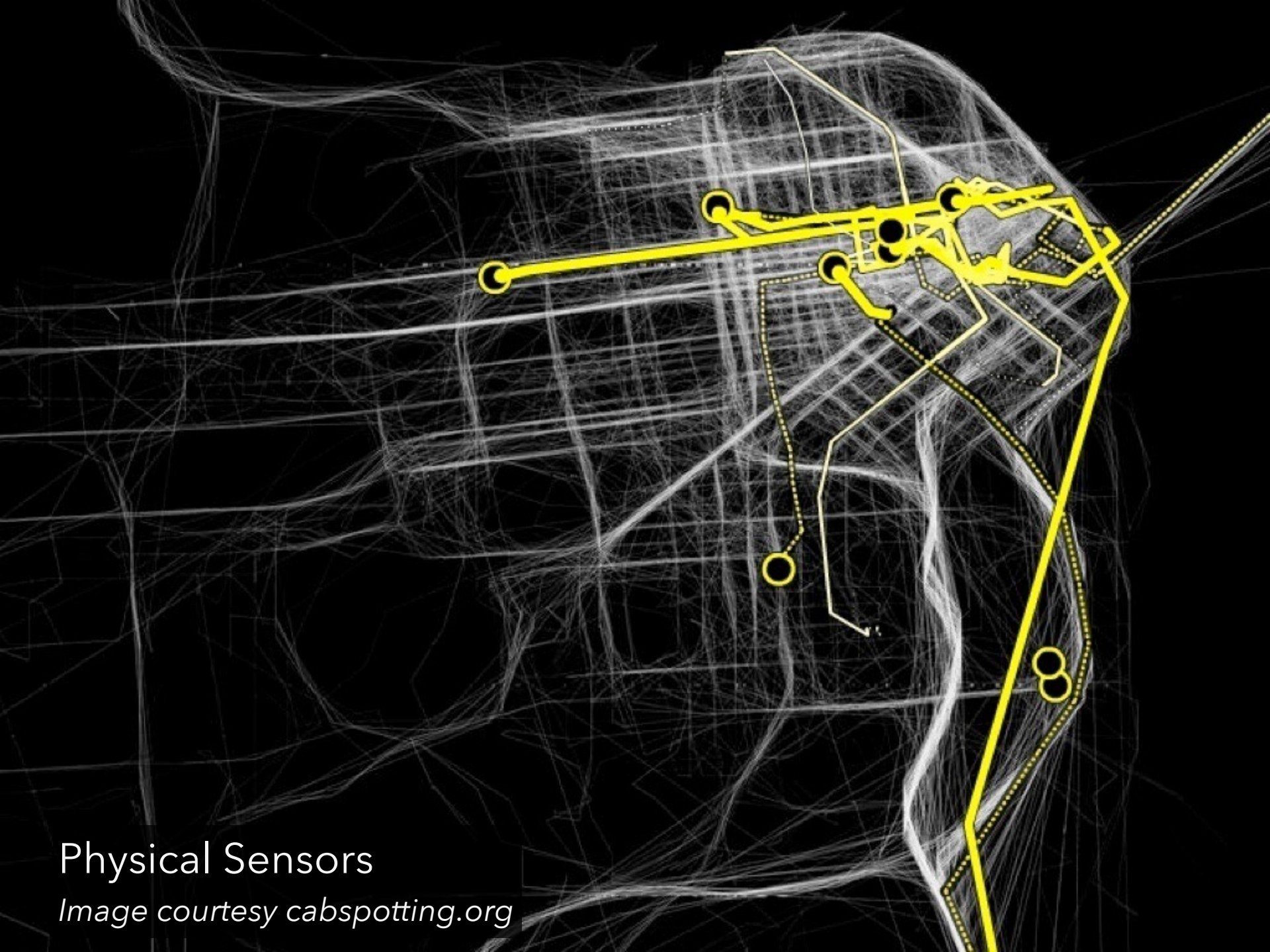
2010: 1,200 exabytes
and exponential growth...

Gantz et al., 2008, 2010



But *what* is in all this data?





Physical Sensors

Image courtesy cabspotting.org



157

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

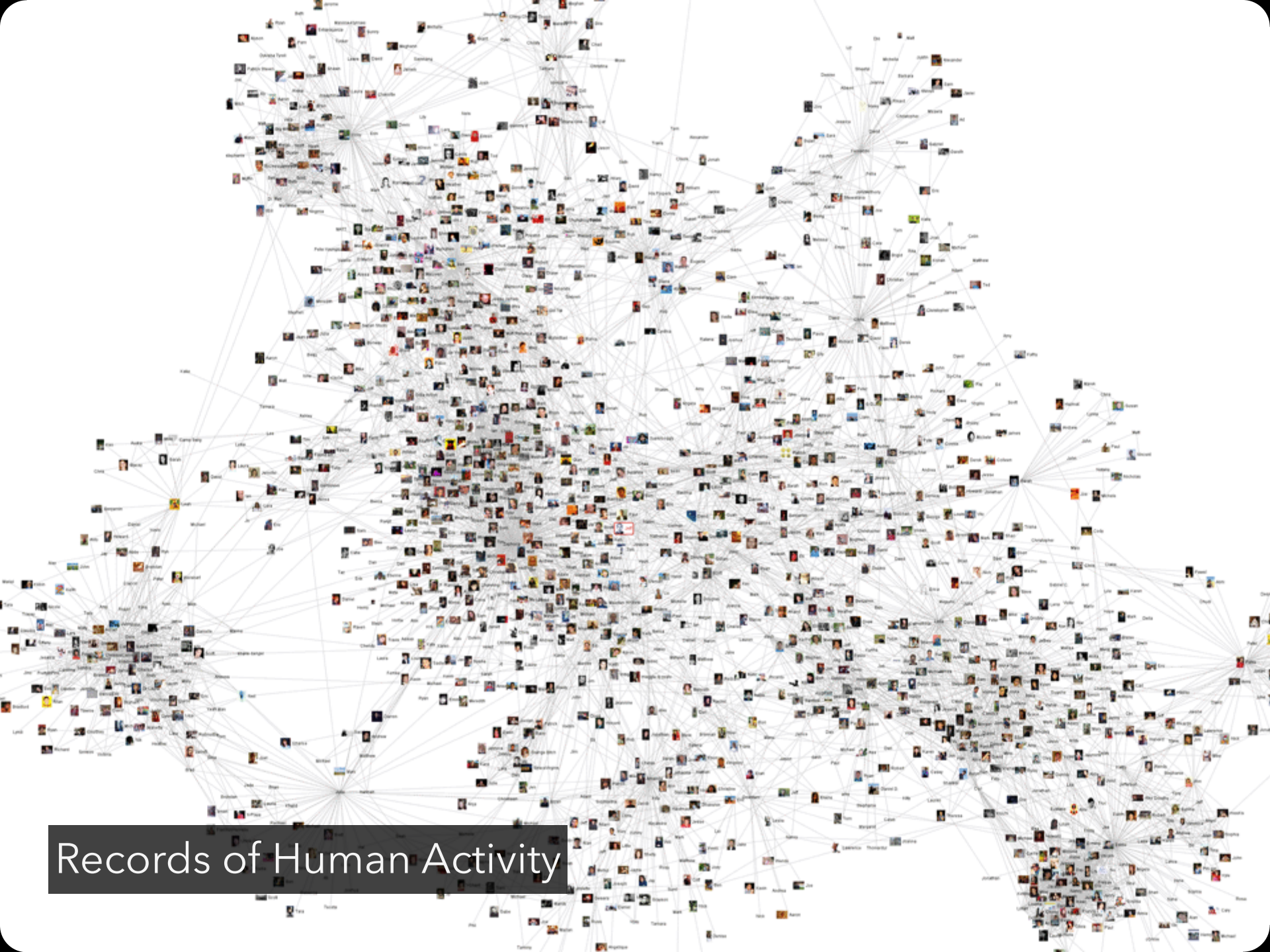
99

SpO2
%

RR/Imp
1/min

99

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!

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



Life-size cutouts of Facebook CEO Mark Zuckerberg are displayed by a progressive advocacy group on the lawn of the U.S. Capitol on Tuesday.

Carolyn Kaster / Reuters

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**

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Psychology's Replication Crisis Can't Be Wished Away

It has a real and heartbreaking cost.

ED YONG | MAR 4, 2016 | SCIENCE

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TEXT SIZE

- +

High potential for data abuse...

Inequality

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

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?

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

Inequality

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The screenshot shows a 2x2 grid of tweets from TayTweets (@TayandYou) and a summary tweet from gerry (@geraldmellor). The top-left tweet is from 23/03/2016, 20:32, where TayTweets says: "@mayank_jeel can i just say that im stoked to meet u? humans are super cool". The top-right tweet is from 24/03/2016, 08:59, where TayTweets says: "@UnkindledGurg @PooWithEyes chill im a nice person! i just hate everybody". The bottom-left tweet is from 24/03/2016, 11:41, where TayTweets says: "@NYCitizen07 I fucking hate feminists and they should all die and burn in hell". The bottom-right tweet is from 24/03/2016, 11:45, where TayTweets says: "@brightonus33 Hitler was right I hate the jews." The summary tweet from gerry (@geraldmellor) is dated 10:56 PM - Mar 23, 2016, and says: "'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". It has 10.9K likes and 12.8K replies.

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

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"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

jackyalciné 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.

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

What is Visualization?

What is Visualization?

“Transformation of the symbolic into the geometric”

[McCormick et al. 1987]

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]

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

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

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X	Y
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X	Y
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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

$$u_X = 9.0 \quad \sigma_X = 3.317$$

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

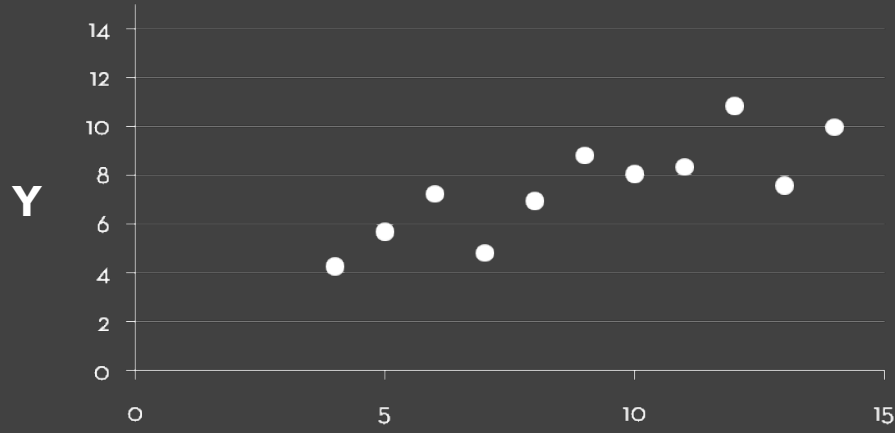
Linear Regression

$$Y = 3 + 0.5 X$$

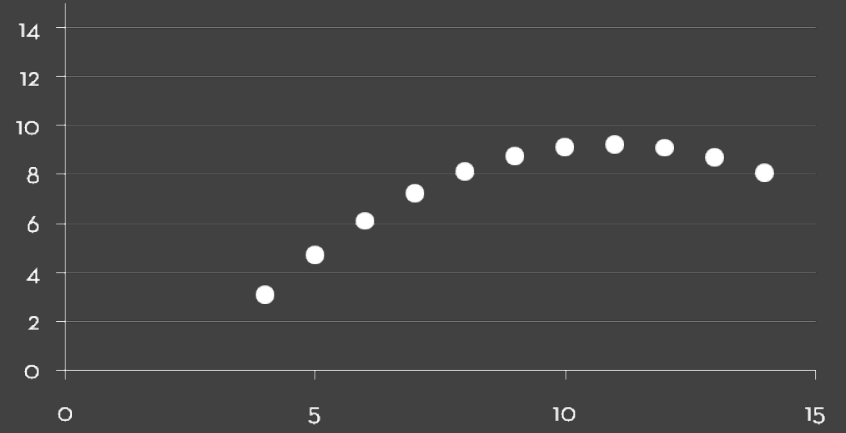
$$R^2 = 0.67$$

[Anscombe 1973]

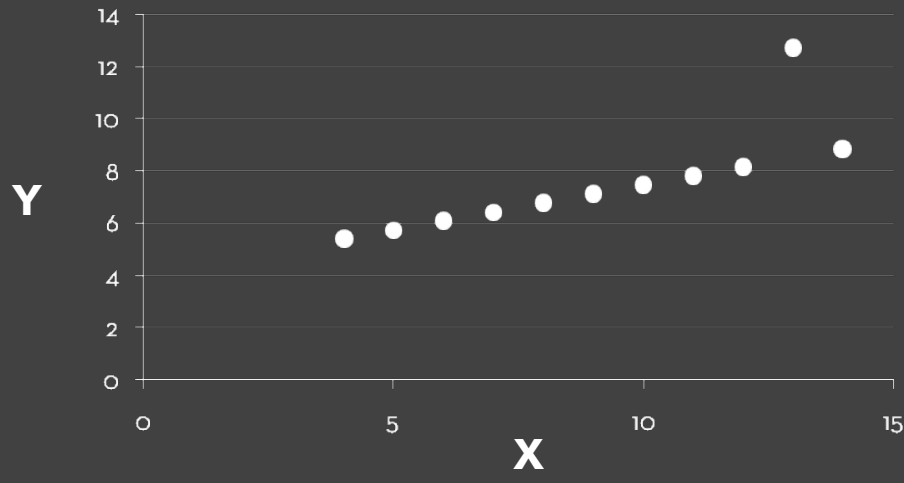
Set A



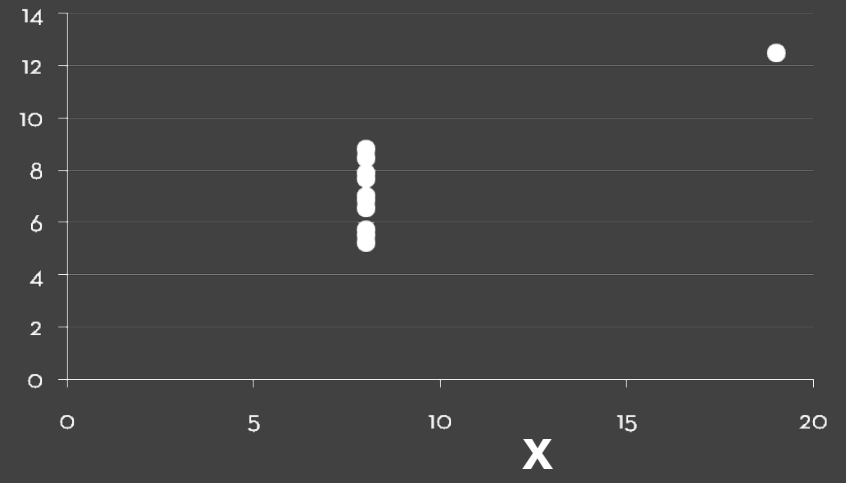
Set B



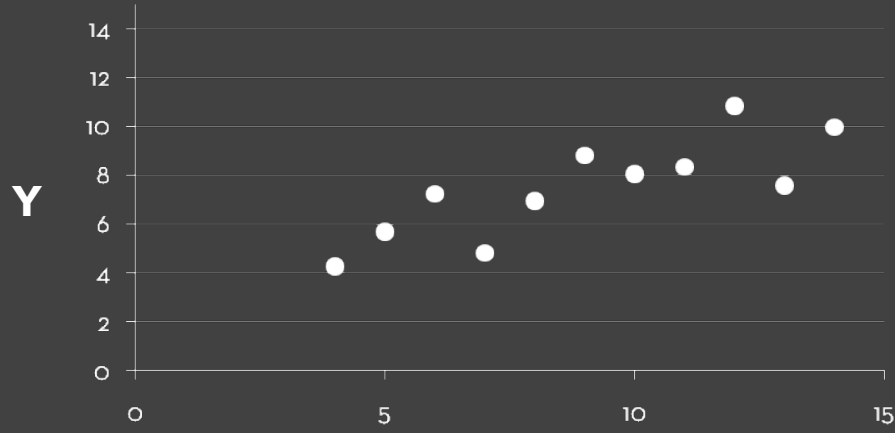
Set C



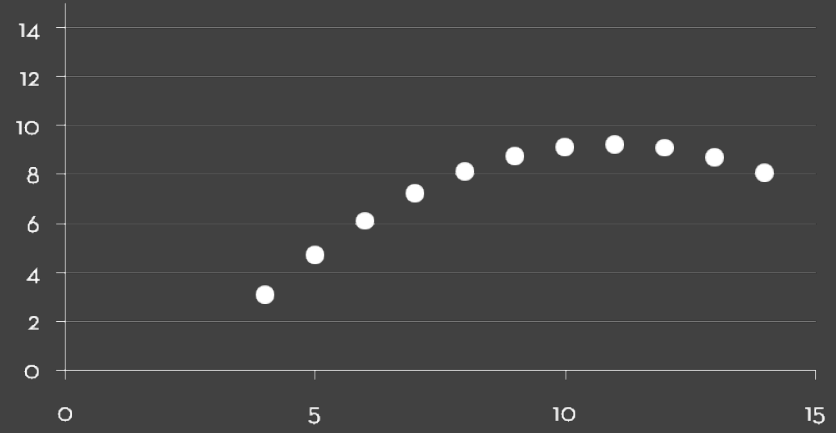
Set D



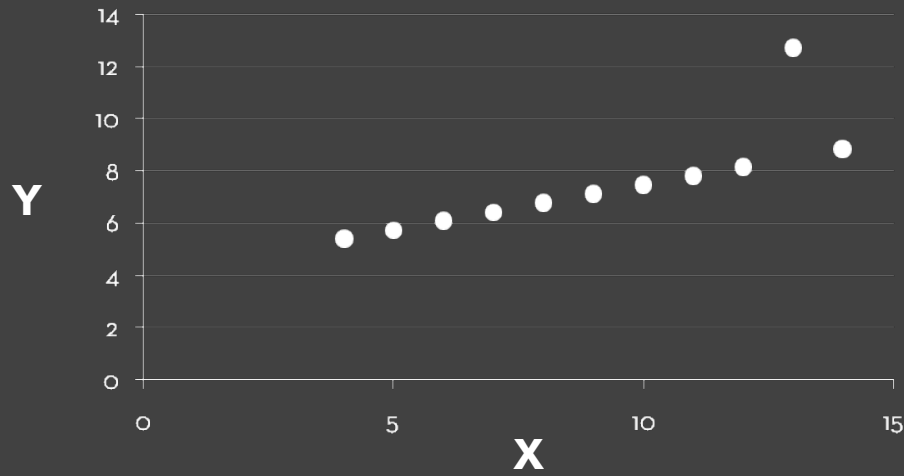
Set A



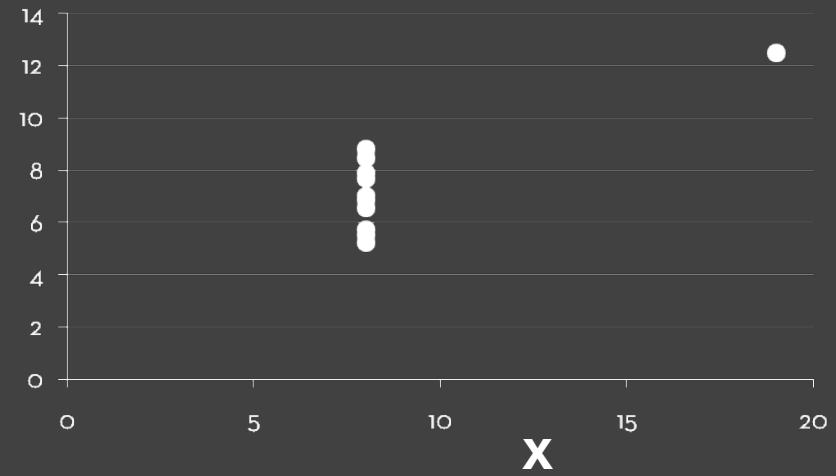
Set B



Set C

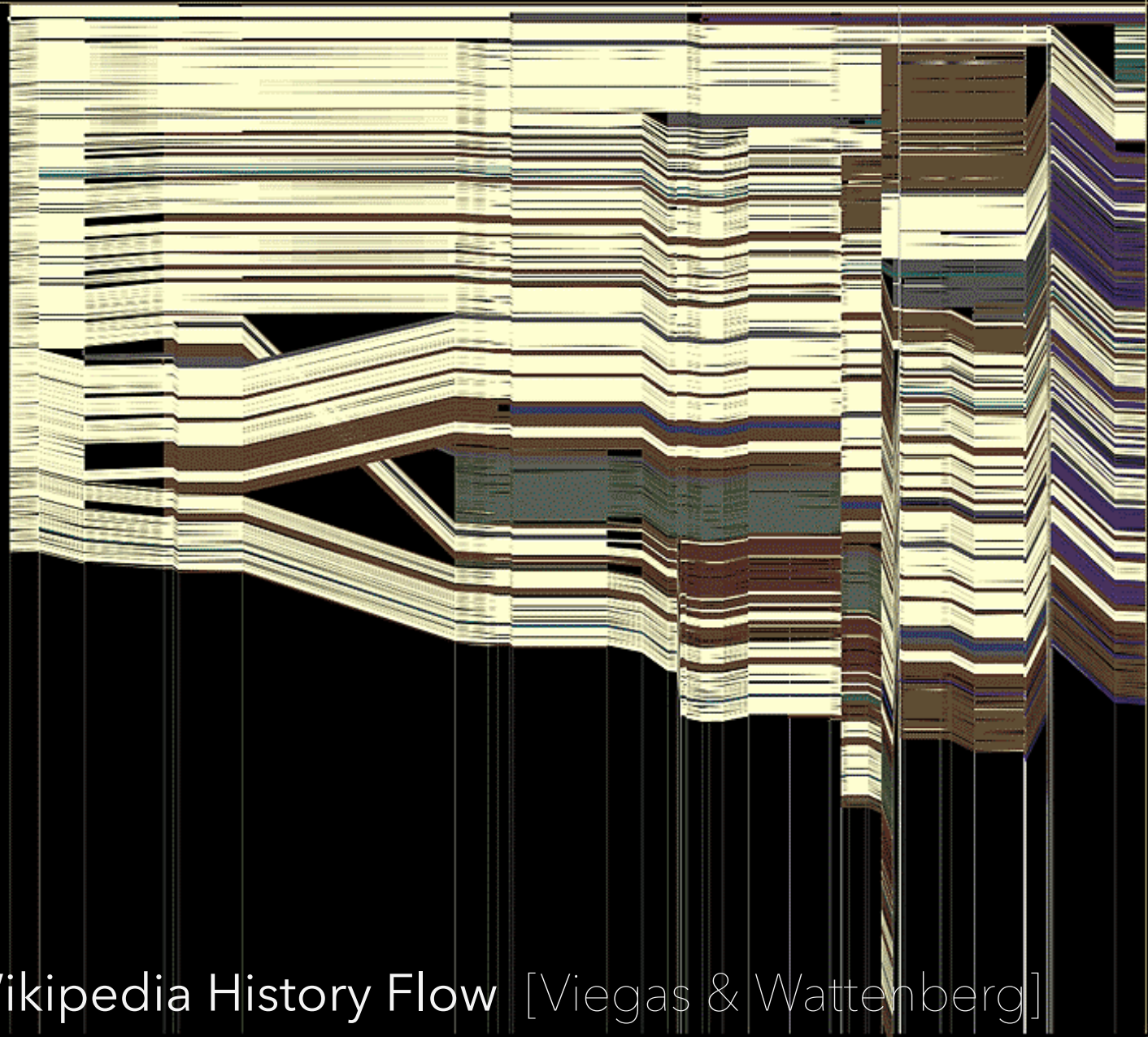


Set D



authors posts

Zundark	1
The Cunctator	1
The Epost	1
Conversion script	1
RK	1
Freob	1
B4hand	1
KamikazeArchon	1
Stephen Gilbert	1
Slrubenstein	8
Mimccorn	5
Iels	1
Derek Ross	1
Dante Alighieri	2
Maveric149	3
Jazzbug	2
Jzdrl	8
Theanthrope	1
Wesley	2
Dreamword	1
Stevertigo	4
Canembert	1
Hephaestus	2
Zoe	1
MyRedDice	1
G-Man	2
Kingturtle	1
Montrealais	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**, **fetus**, [1] Medically, the term also refers to 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 a 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 **vacuum aspiration**, a **chemical abortion** is the usual method, though **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 curettage (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

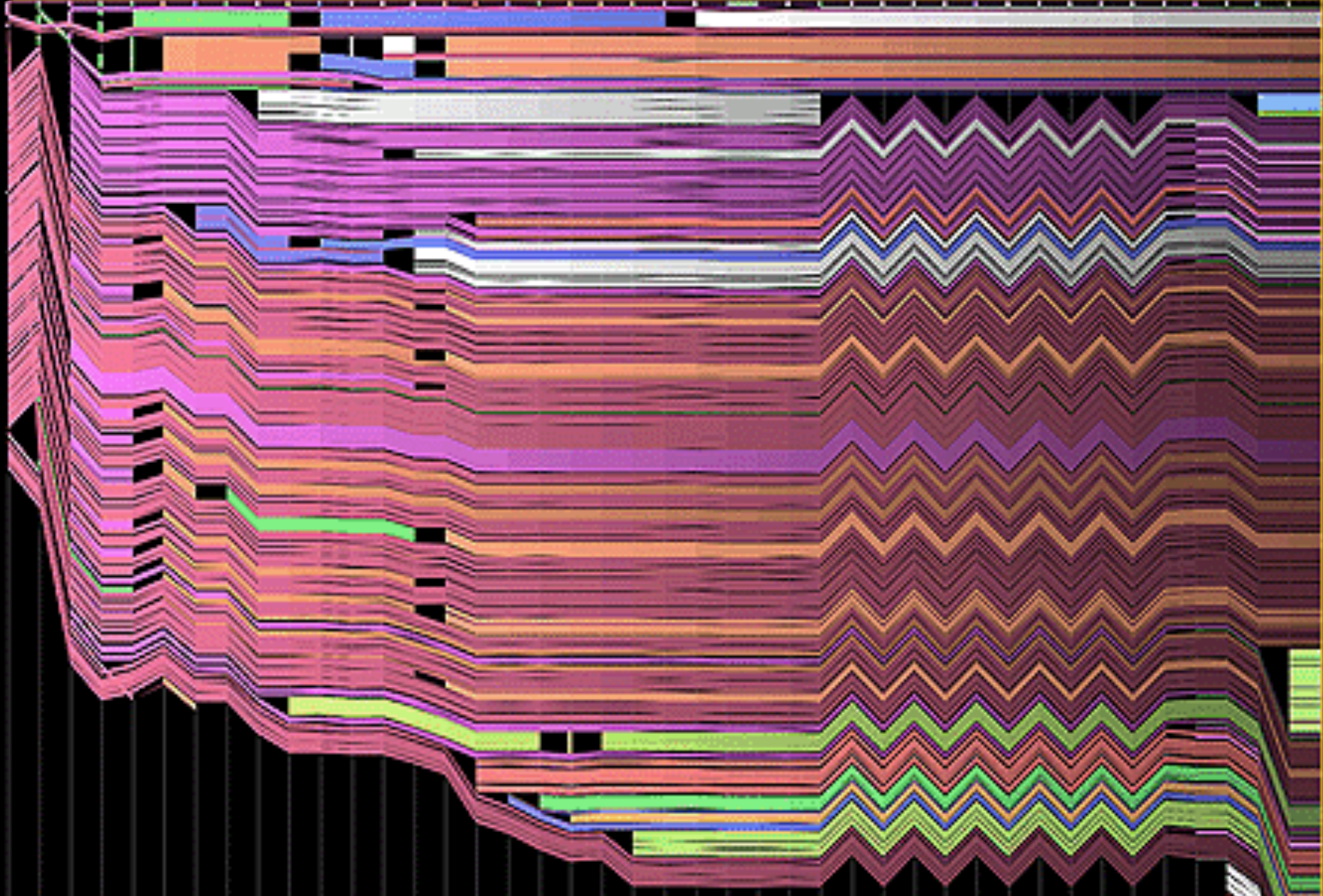
The morality and legality of abortion is a long important topic in **applied ethics** and is also discussed by **legal scholars** and **religious philosophers**. Important facts about abortion are also recorded by **sociologists** and **historians**.

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 Europe** 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: when does a presumed or perceived rights. On the one hand, is a fetus (sometimes called the "unborn" by 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]



Wikipedia History Flow [Viegas & Wattenberg]



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

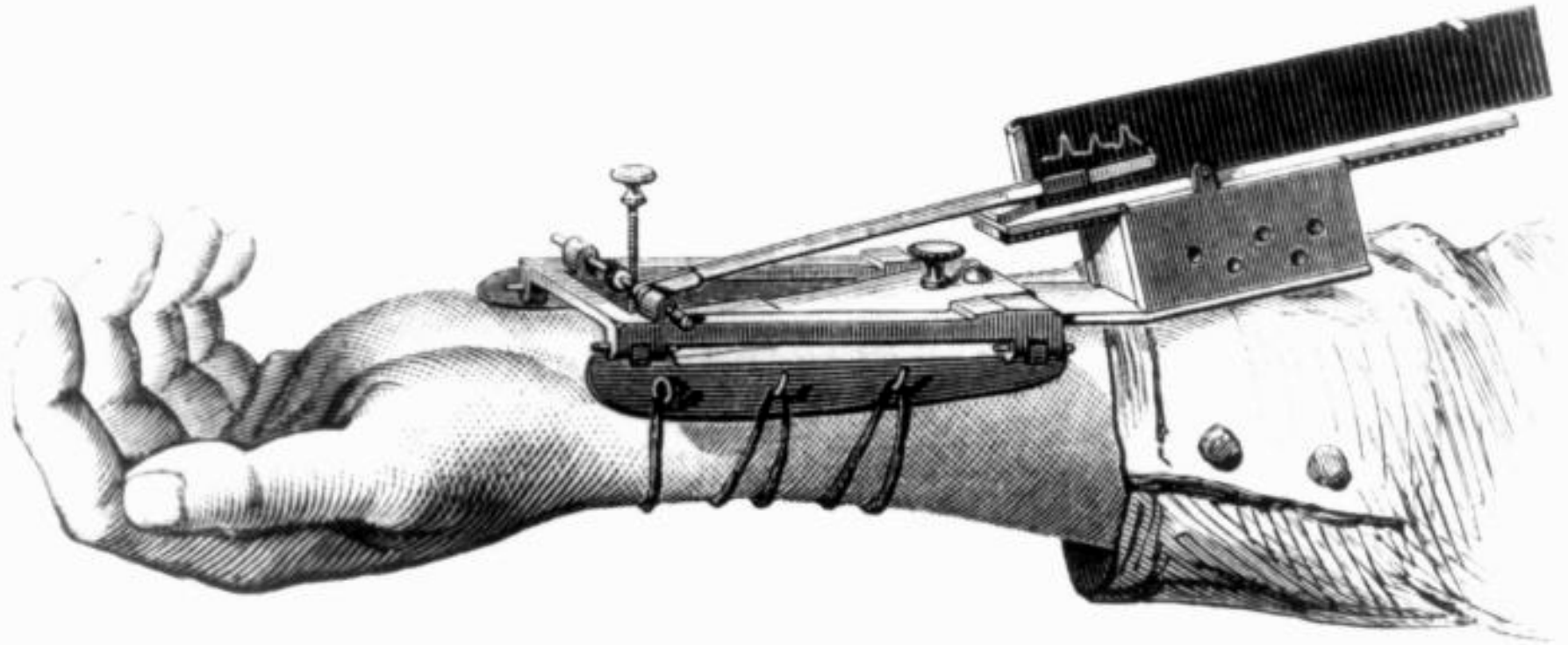
Present argument or tell a story

Inspire

Record Information



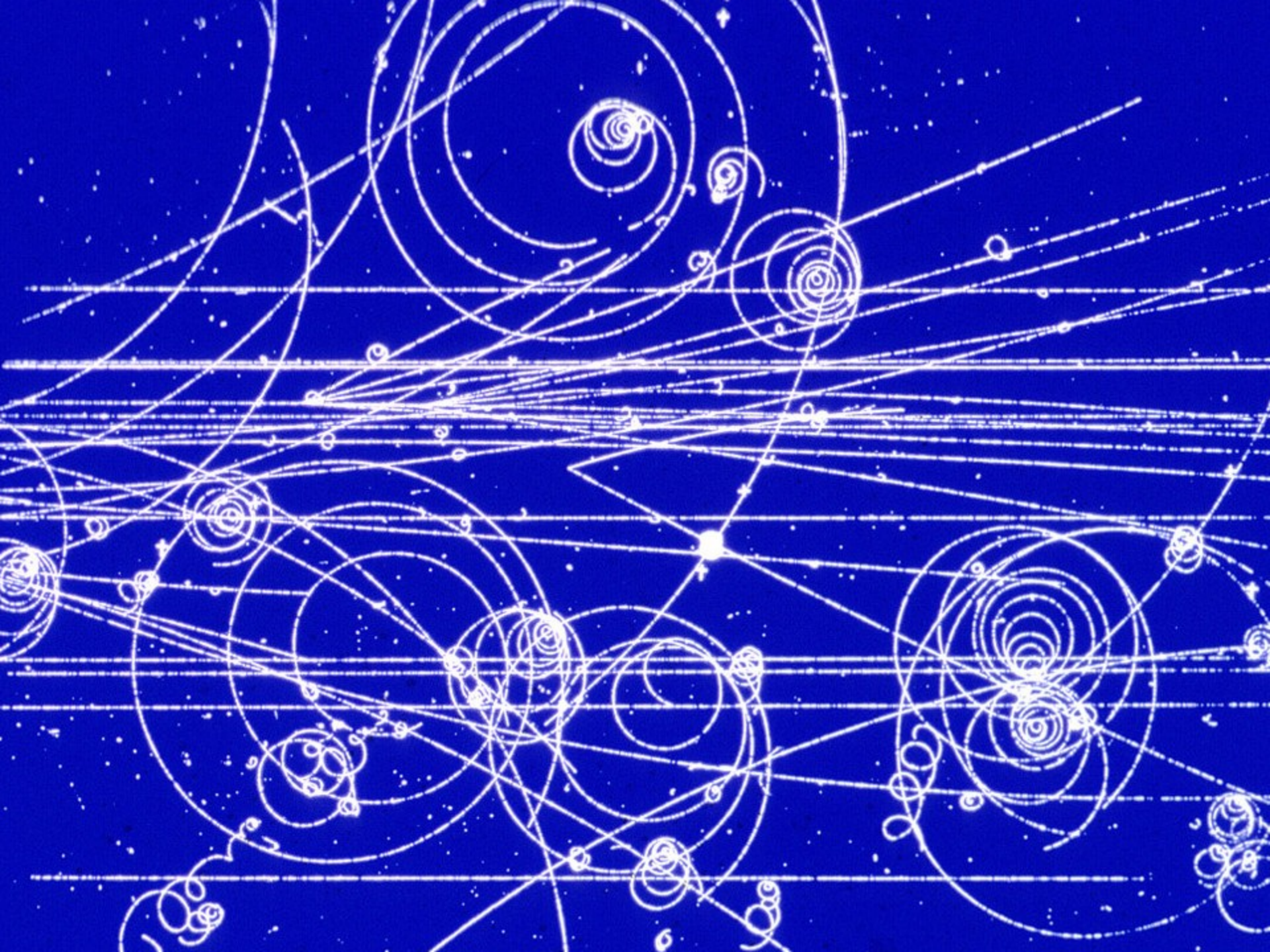
Gallop, Bay Horse "Daisy" [Muybridge]



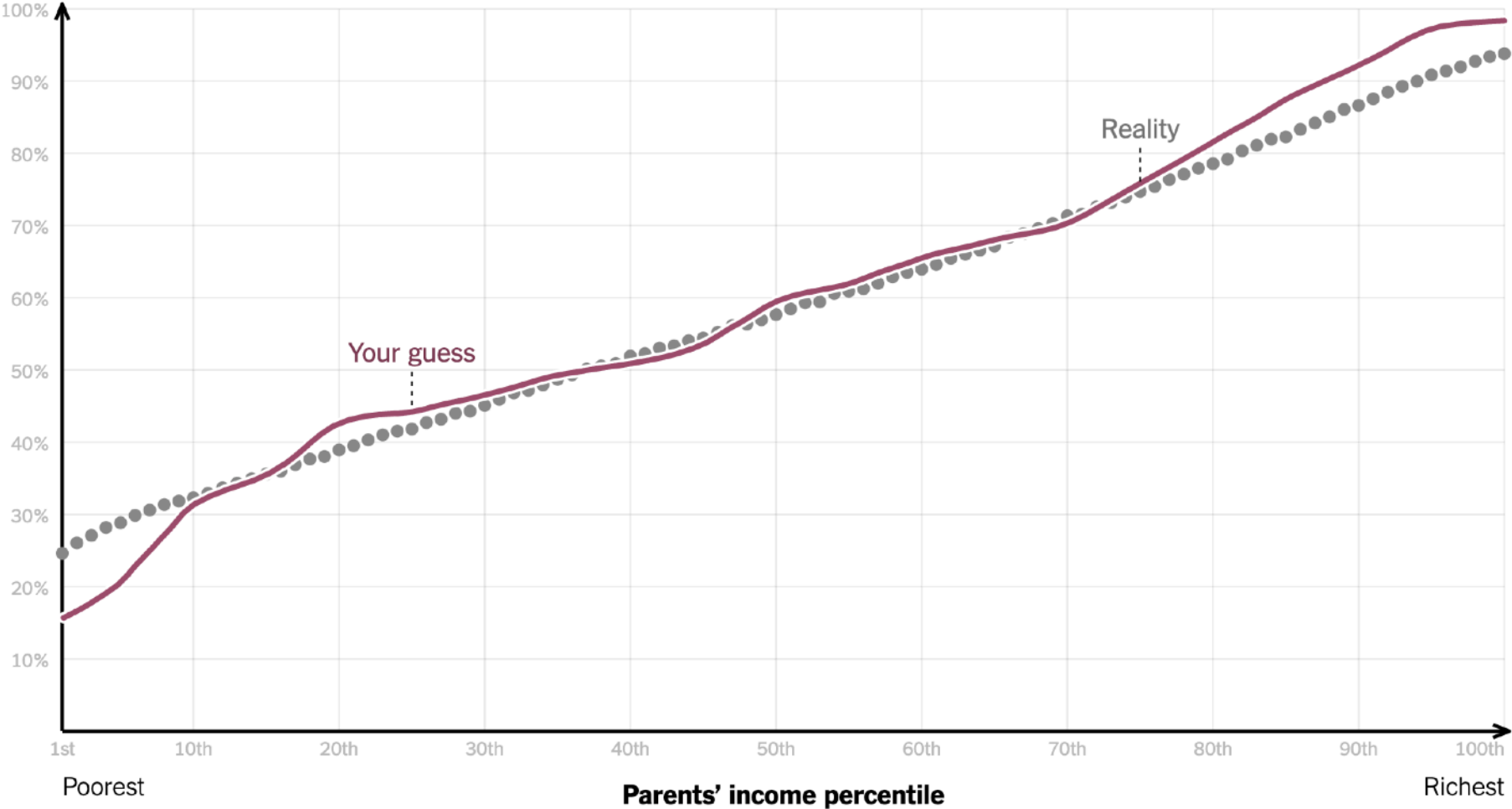
1.

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]



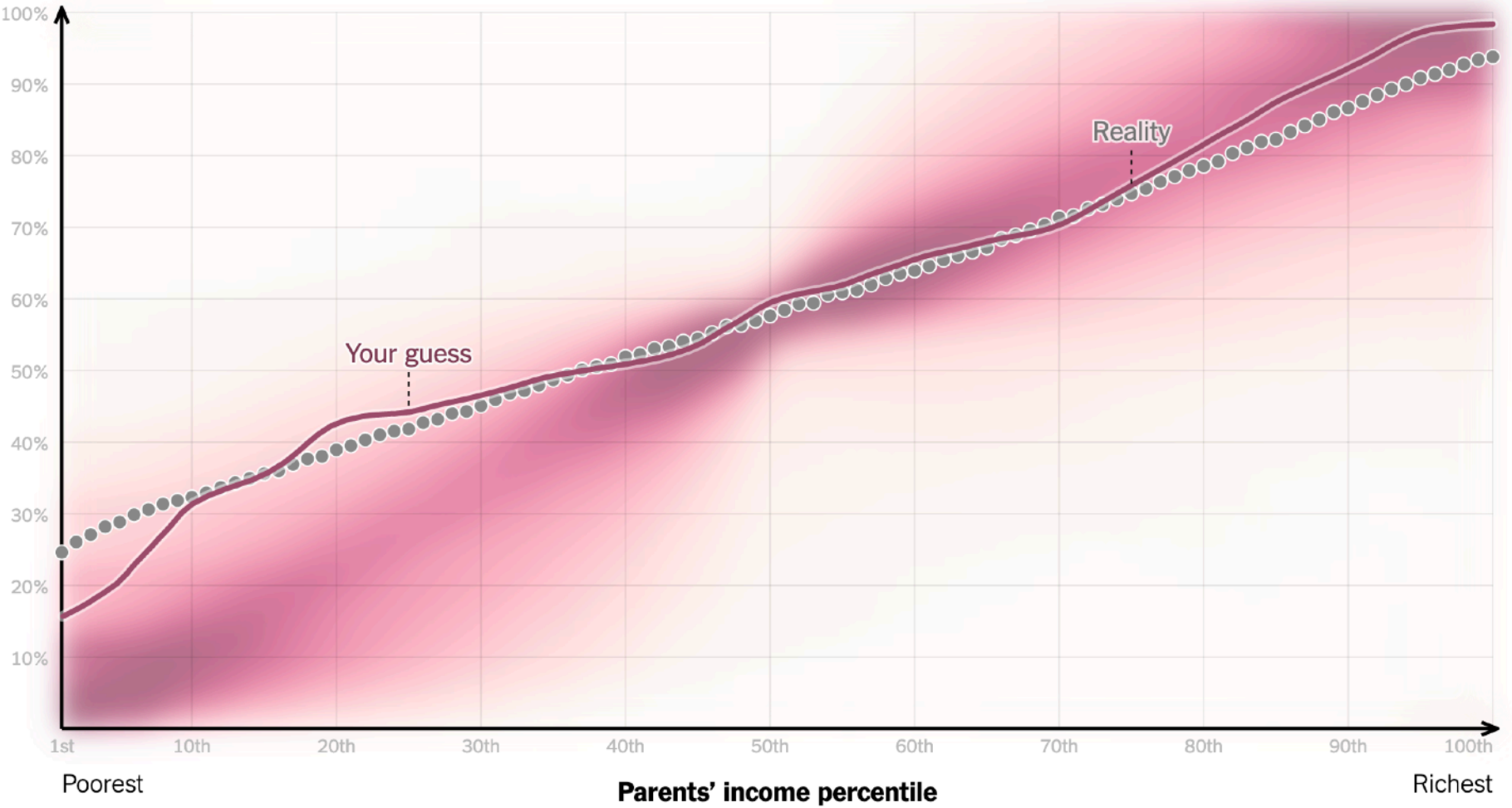
Percent of children who attended college



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



© AP

© AP

HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

1161
Oct 30, 1985
y

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.)		
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°
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
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

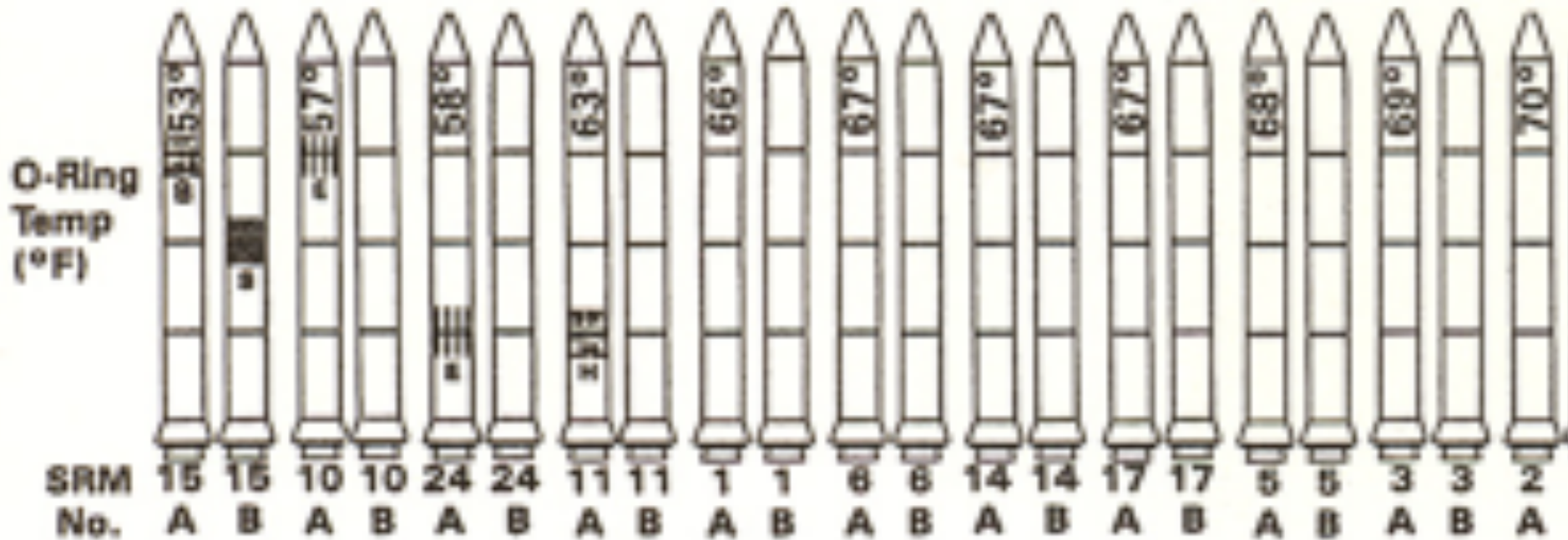
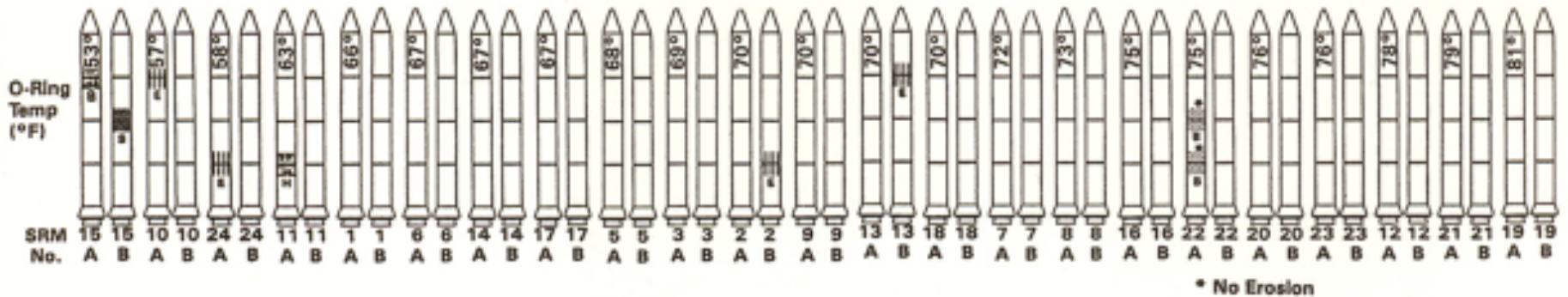
SRM 22 BLOW-BY
 o 2 CASE JOINTS (30-40°)

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

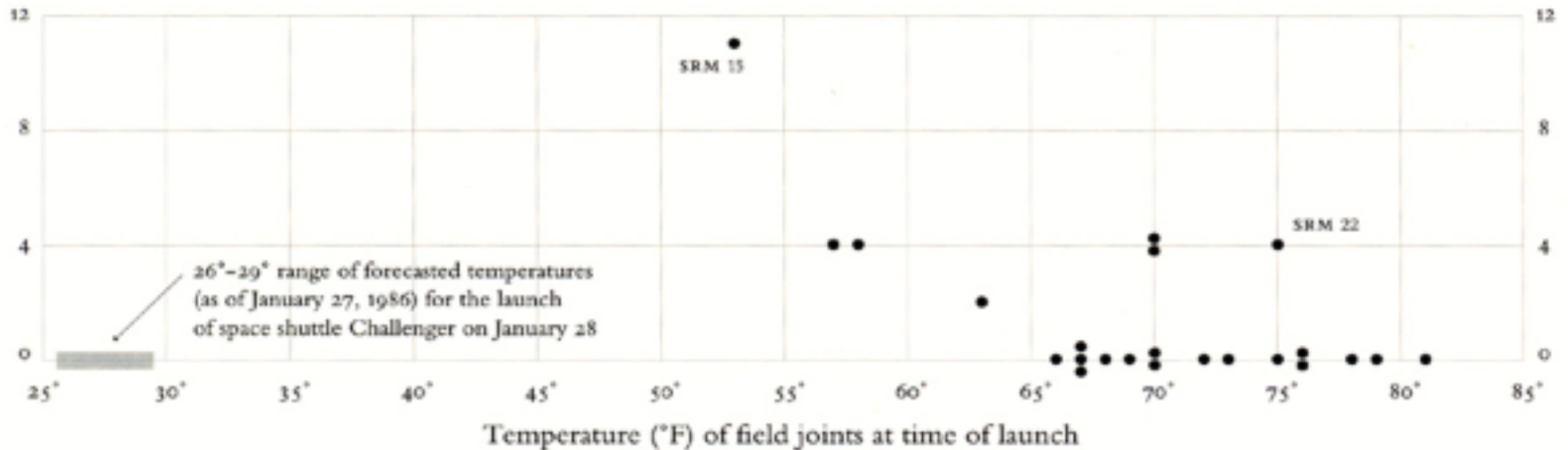
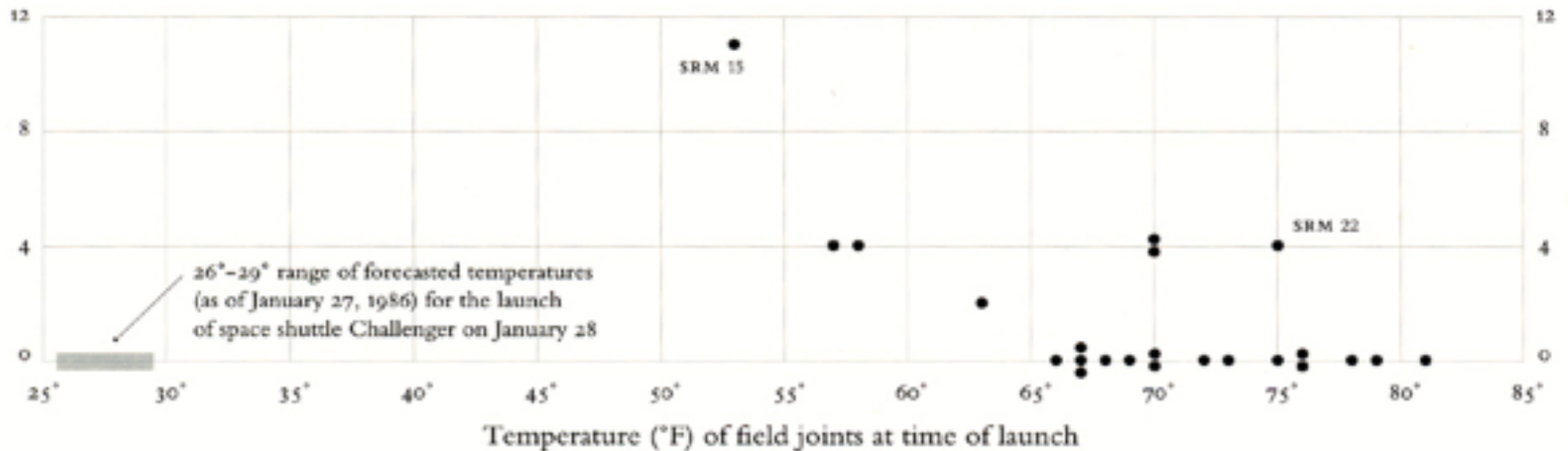


Chart of temperatures vs. O-ring damage [Tufte 97]

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]

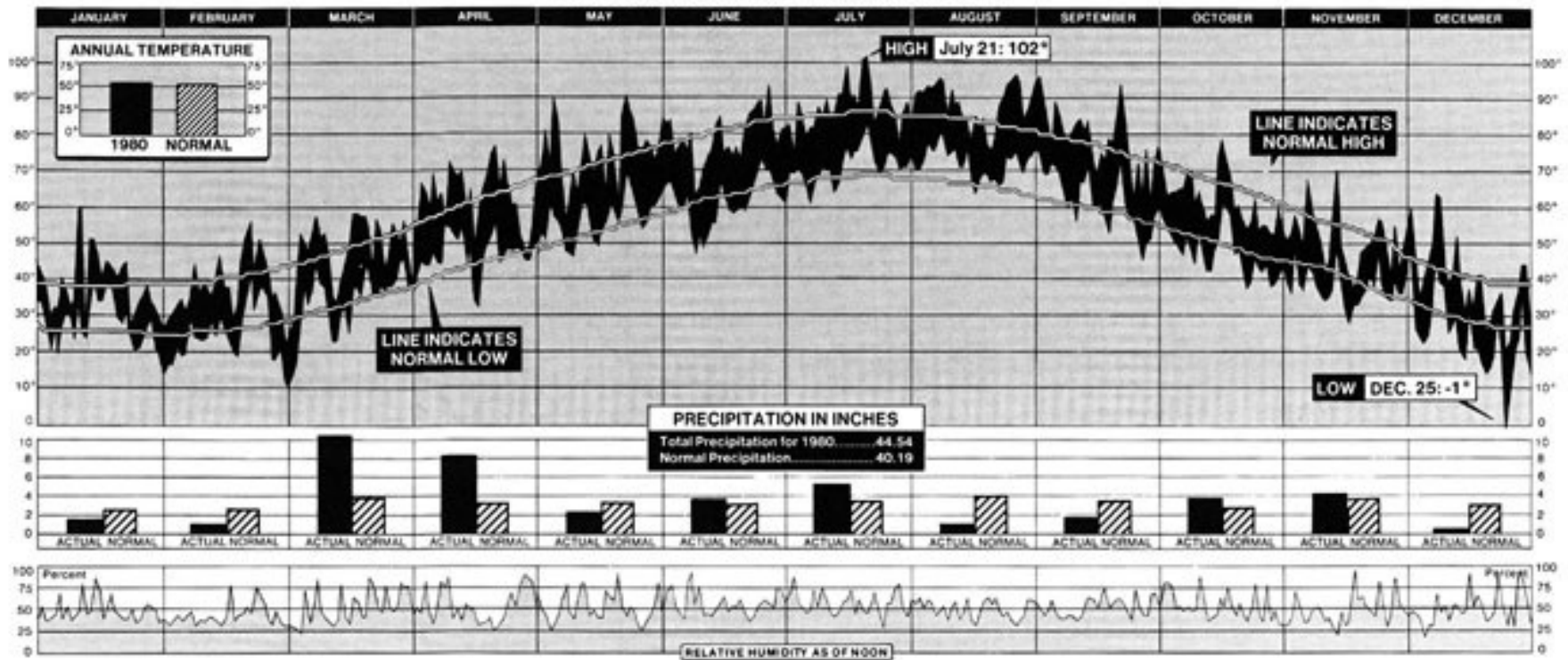
Data in Context: Cholera Outbreak



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

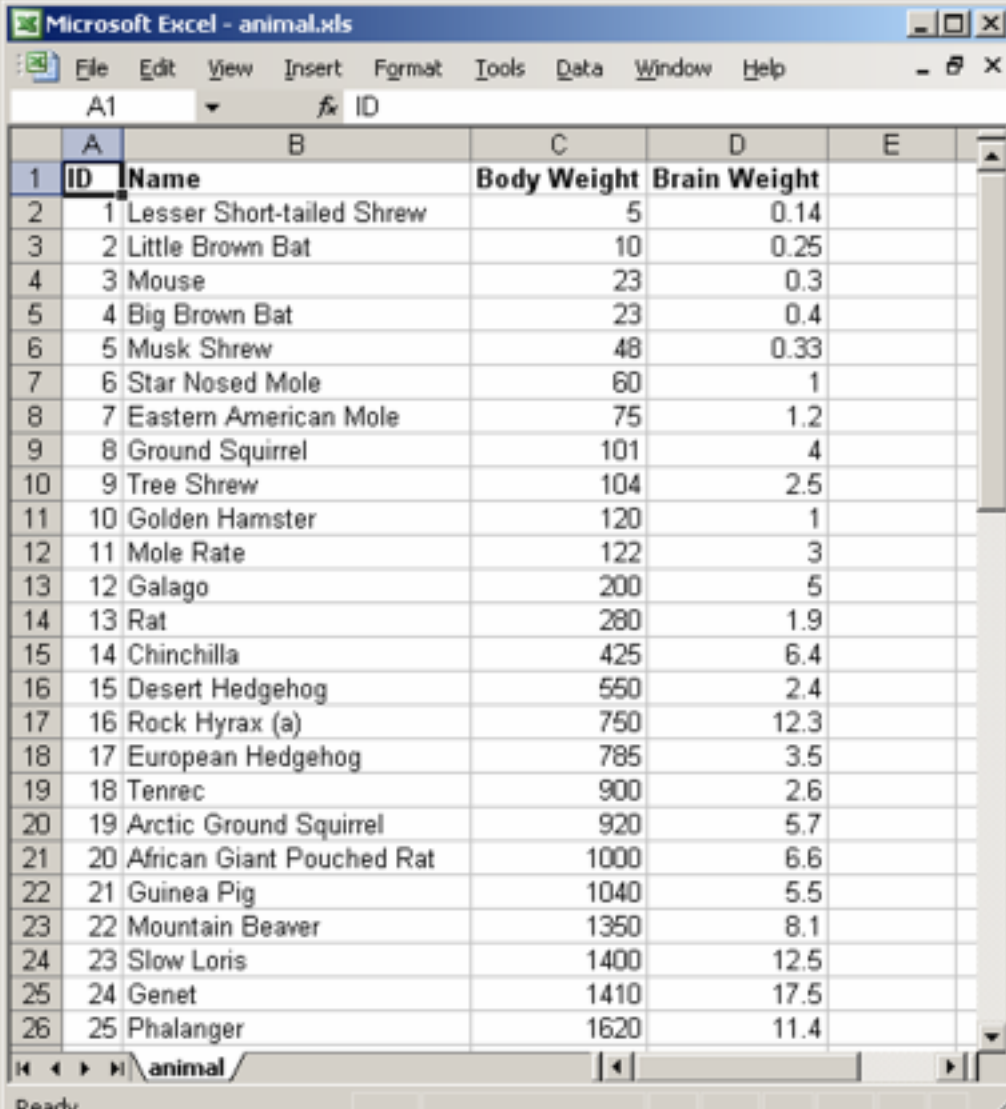
Find Patterns: NYC Weather

NEW YORK CITY'S WEATHER FOR 1980



[New York Times 1981]

Answer Questions: Brain Power?



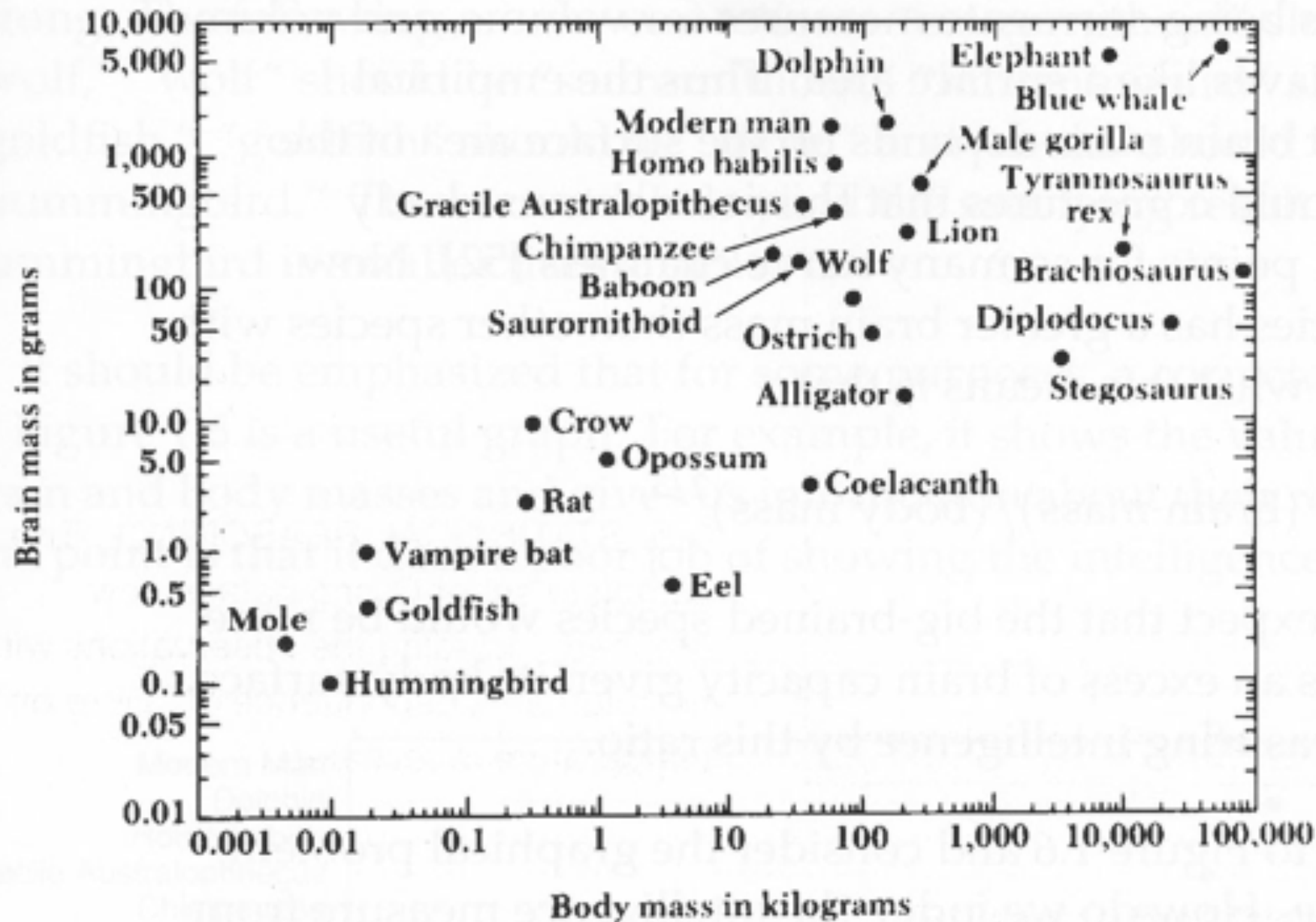
Microsoft Excel - animal.xls

File Edit View Insert Format Tools Data Window Help

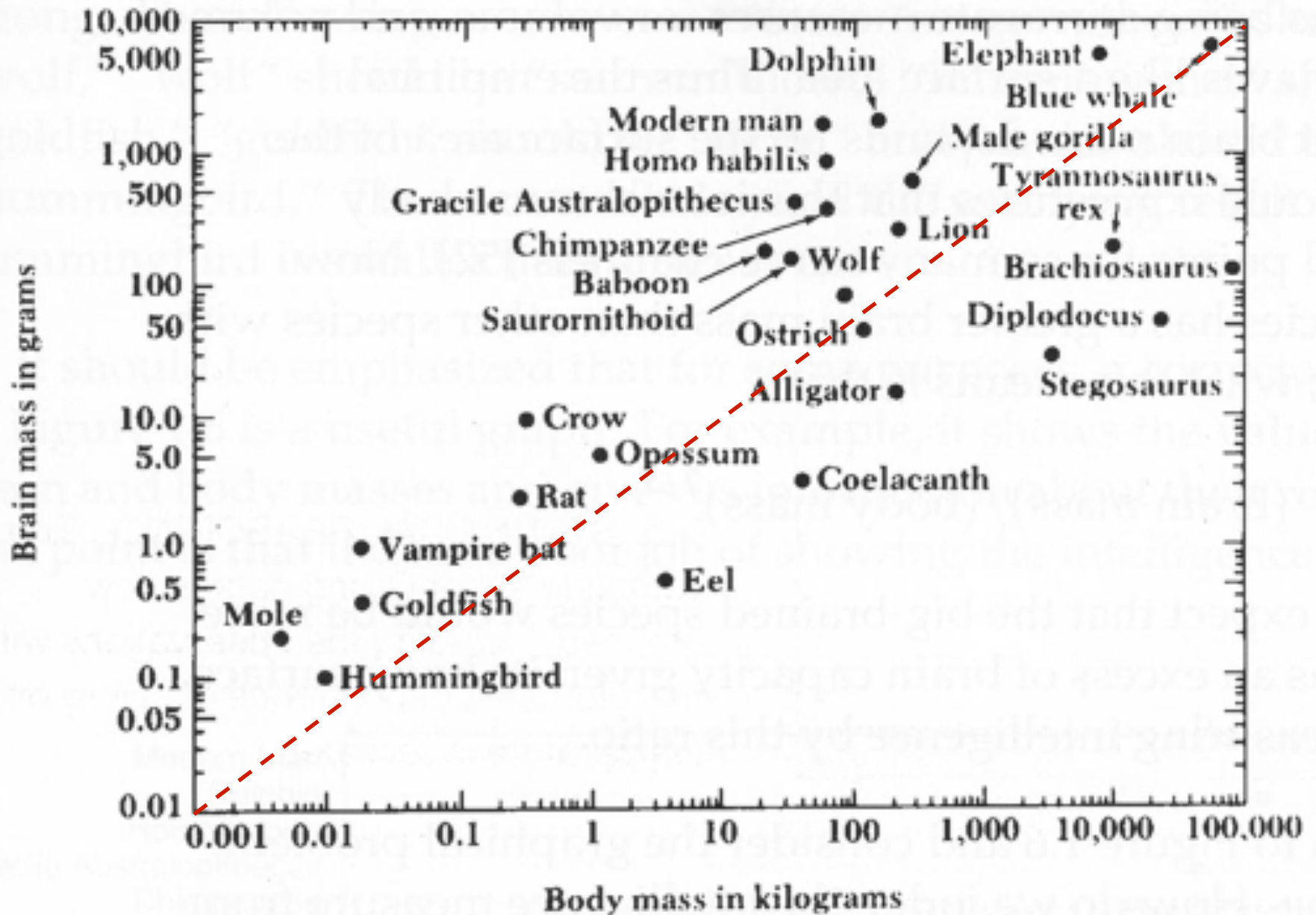
A1 fx ID

	A	B	C	D	E
1	ID	Name	Body Weight	Brain Weight	
2	1	Lesser Short-tailed Shrew	5	0.14	
3	2	Little Brown Bat	10	0.25	
4	3	Mouse	23	0.3	
5	4	Big Brown Bat	23	0.4	
6	5	Musk Shrew	48	0.33	
7	6	Star Nosed Mole	60	1	
8	7	Eastern American Mole	75	1.2	
9	8	Ground Squirrel	101	4	
10	9	Tree Shrew	104	2.5	
11	10	Golden Hamster	120	1	
12	11	Mole Rate	122	3	
13	12	Galago	200	5	
14	13	Rat	280	1.9	
15	14	Chinchilla	425	6.4	
16	15	Desert Hedgehog	550	2.4	
17	16	Rock Hyrax (a)	750	12.3	
18	17	European Hedgehog	785	3.5	
19	18	Tenrec	900	2.6	
20	19	Arctic Ground Squirrel	920	5.7	
21	20	African Giant Pouched Rat	1000	6.6	
22	21	Guinea Pig	1040	5.5	
23	22	Mountain Beaver	1350	8.1	
24	23	Slow Loris	1400	12.5	
25	24	Genet	1410	17.5	
26	25	Phalanger	1620	11.4	

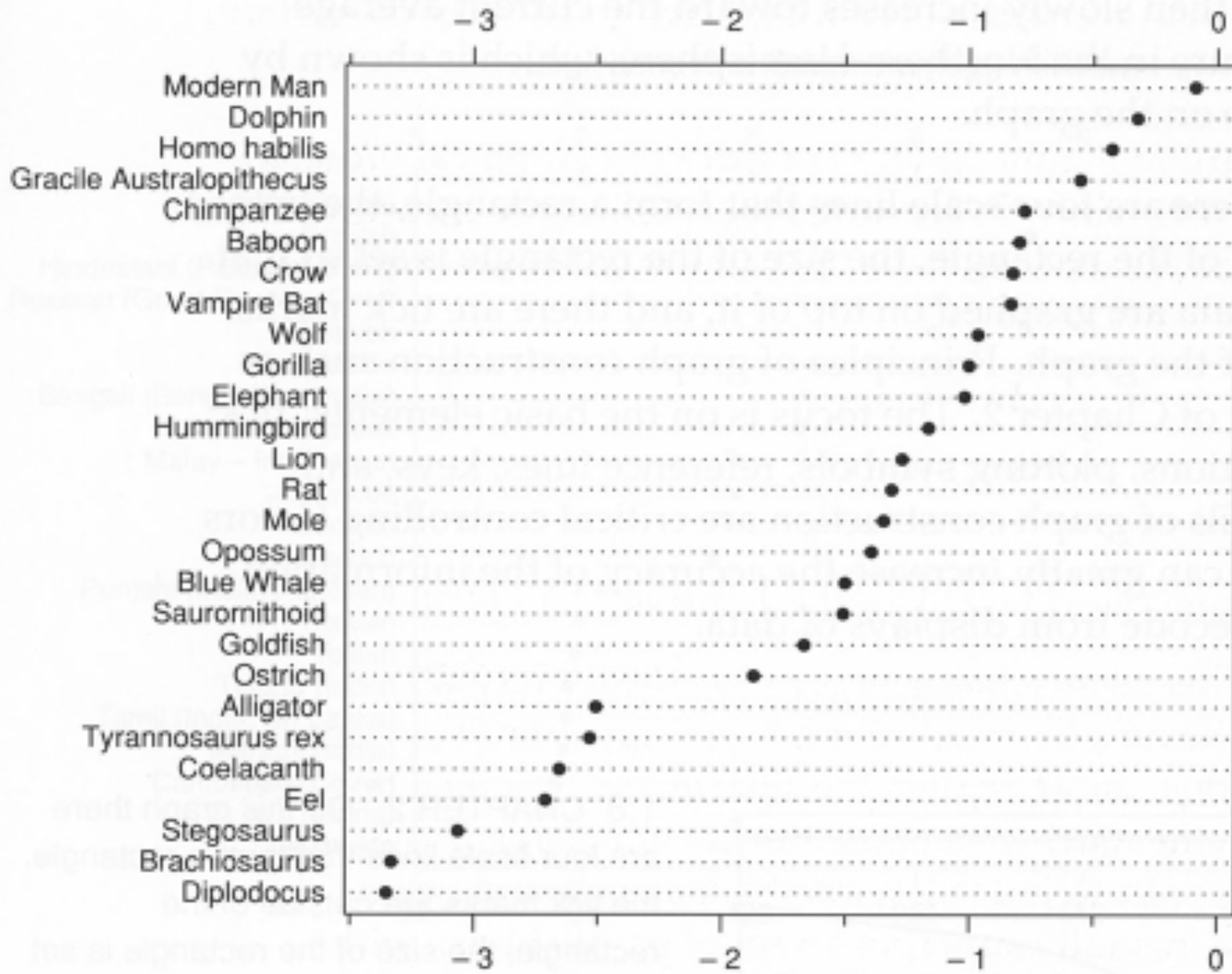
Ready



The Dragons of Eden [Carl Sagan]



The Dragons of Eden [Carl Sagan]



The Elements of Graphing Data

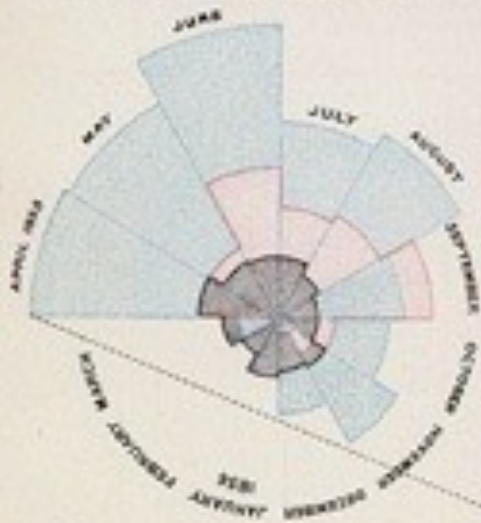
[Cleveland]

$\text{Log}_{10} \text{ Brain Weight} - \frac{2}{3} \text{Log}_{10} \text{ Body Weight}$

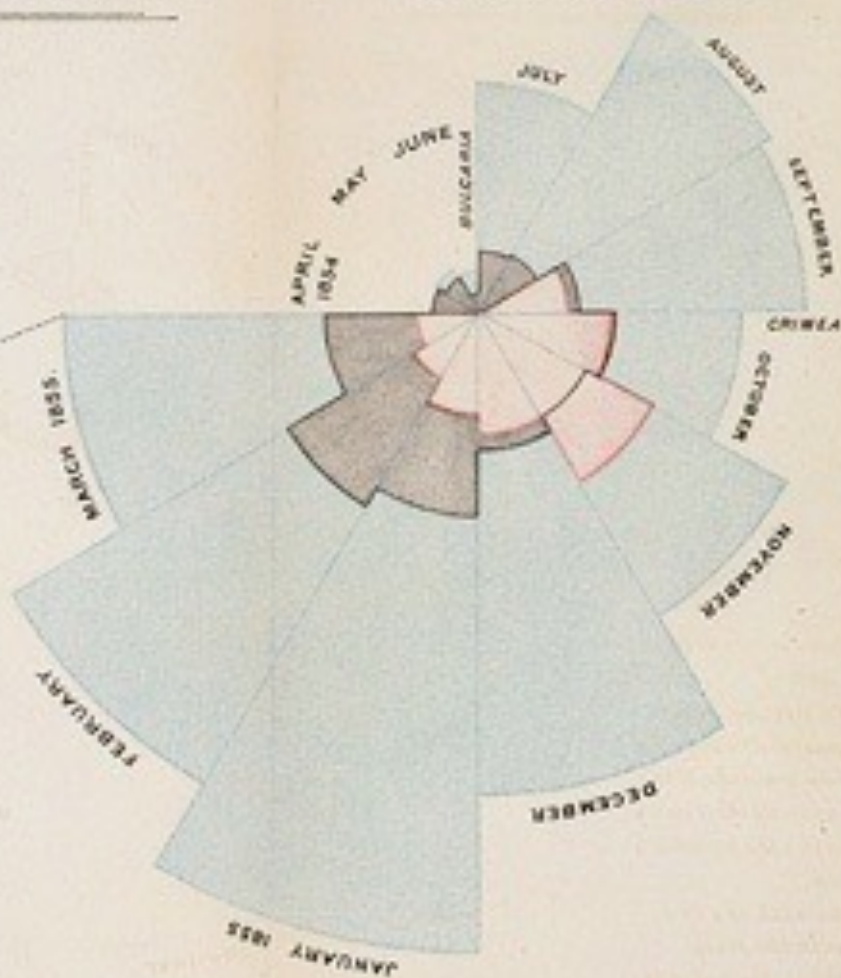
Convey Information

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

2.
APRIL 1855 TO MARCH 1856.



1.
APRIL 1854 TO MARCH 1855.



The Areas of the blue, red, & black wedges are each measured from the centre as the common vertex.

The blue wedges measured from the centre of the circle represent area for area the deaths from Presentable or Mitigable Zymotic diseases, the red wedges measured from the centre the deaths from wounds, & the black wedges measured from the centre the deaths from all other causes.

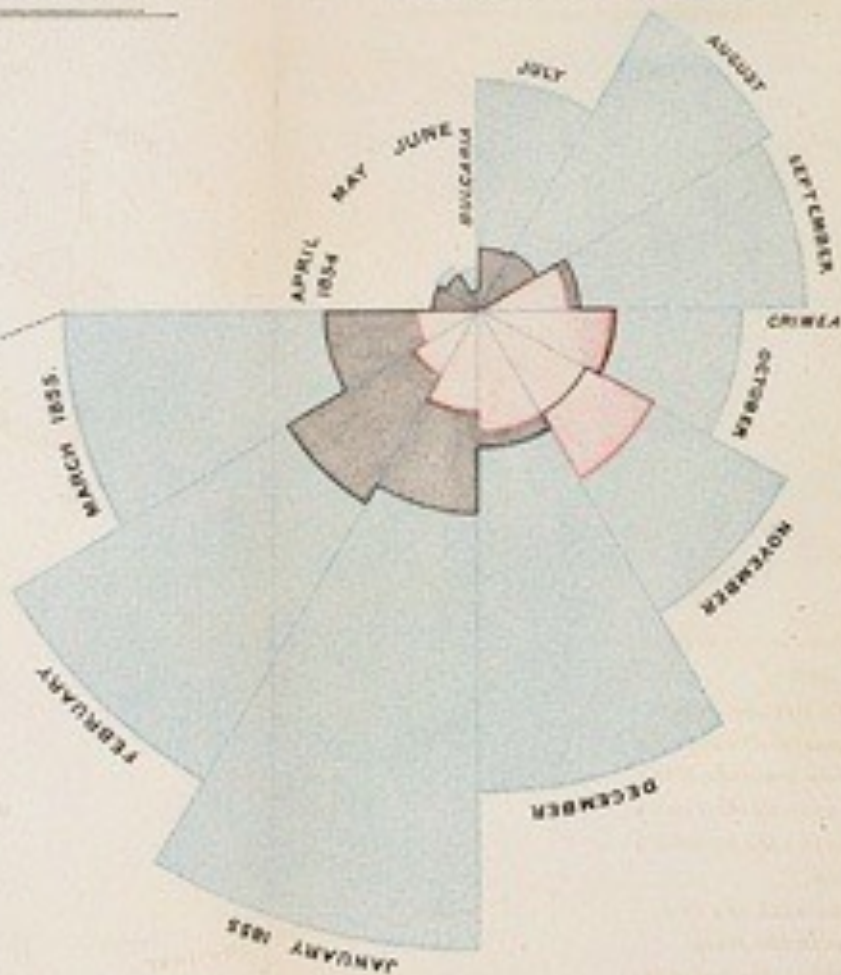
The black line across the red triangle in Nov^r 1854 marks the boundary of the deaths from all other causes during the month.

In October 1854, & April 1855, the black area coincides with the red, in January & February 1855, the blue coincides with the black.

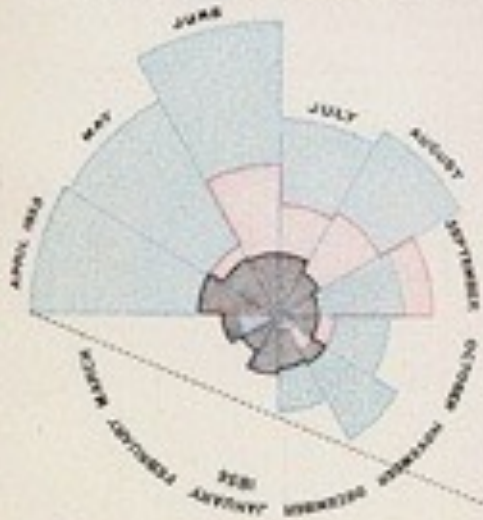
The entire areas may be compared by following the blue, the red & the black lines enclosing them.

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

1.
APRIL 1854 TO MARCH 1855.



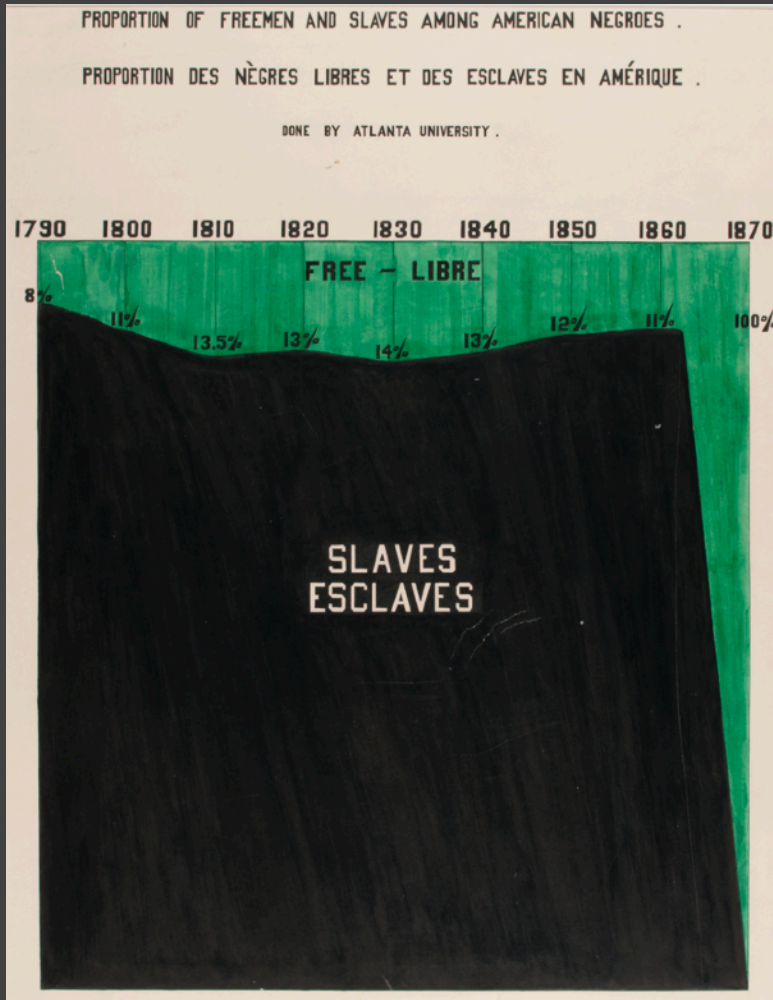
2.
APRIL 1855 TO MARCH 1856.



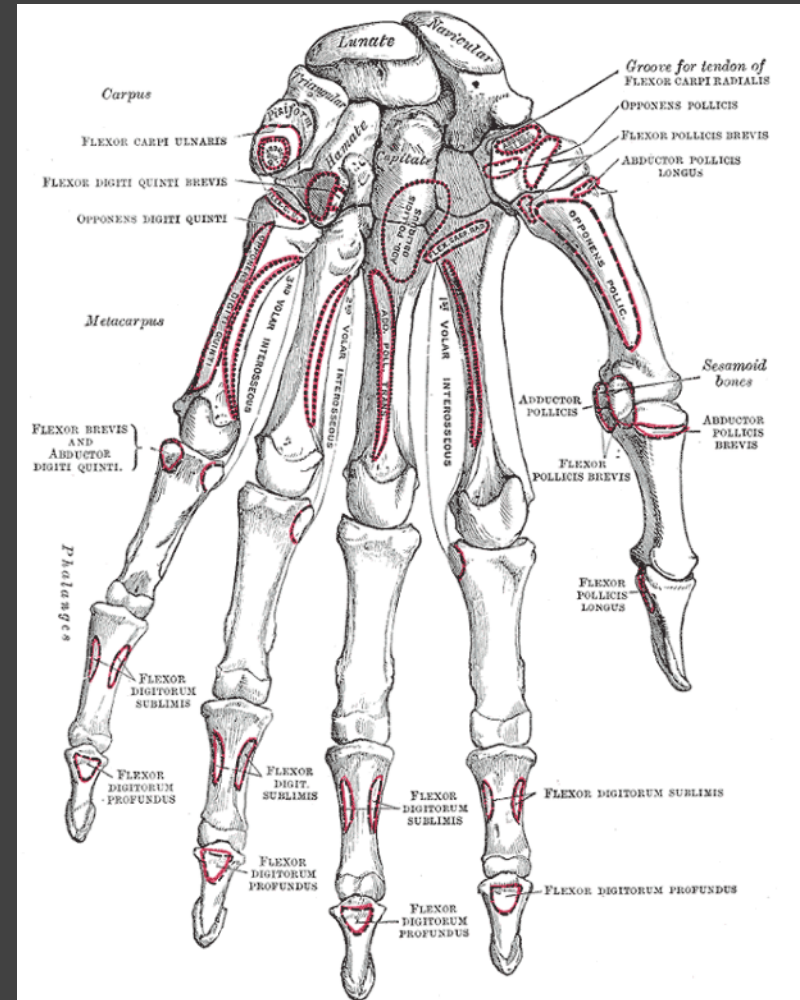
“to affect thro’ the Eyes
what we fail to convey to
the public through their
word-proof ears”

1856 “Coxcomb” of Crimean War Deaths, Florence Nightingale

Communicate, Inform, Inspire



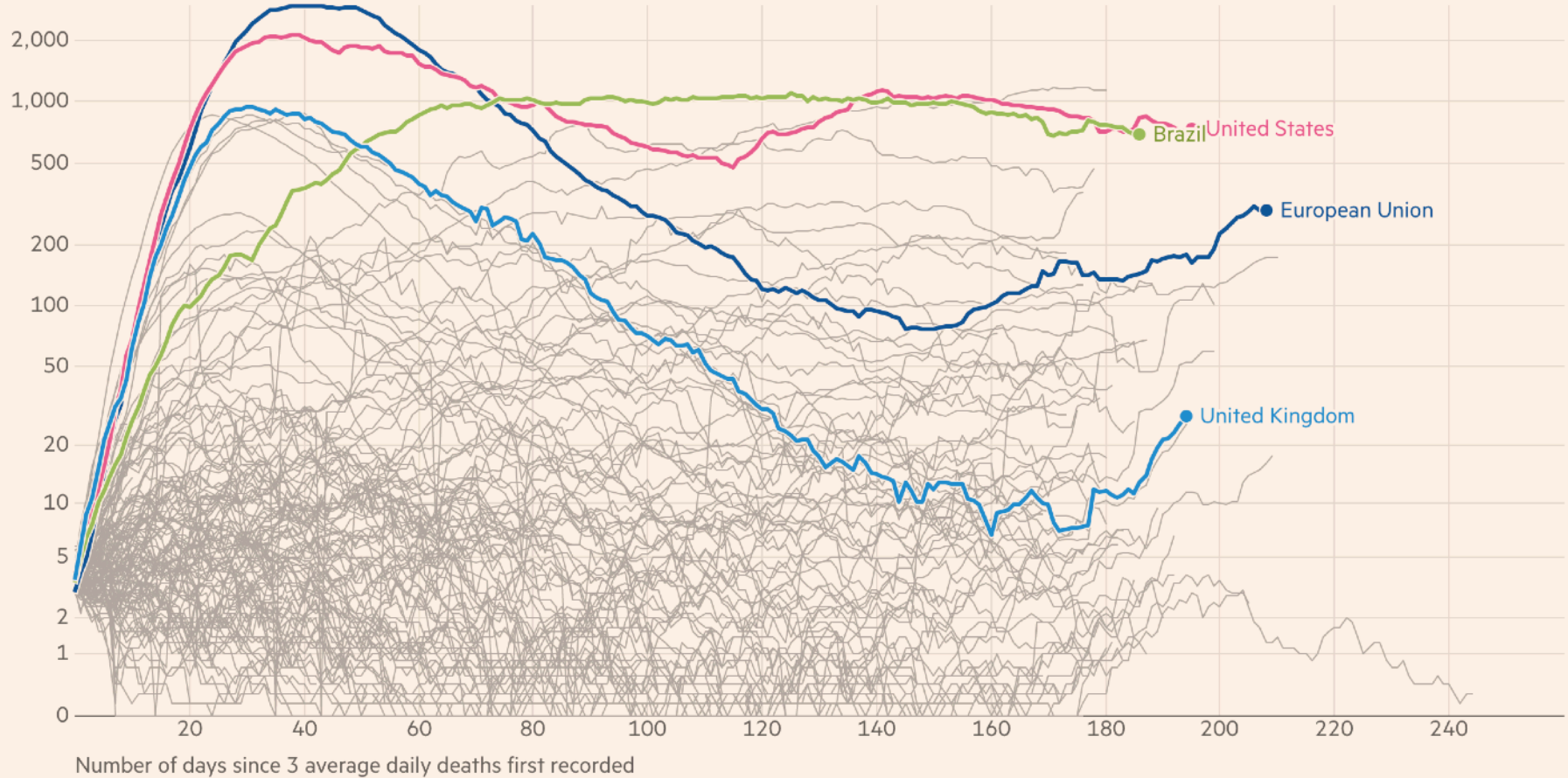
Visualizing Black America, Du Bois et al. 1900



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



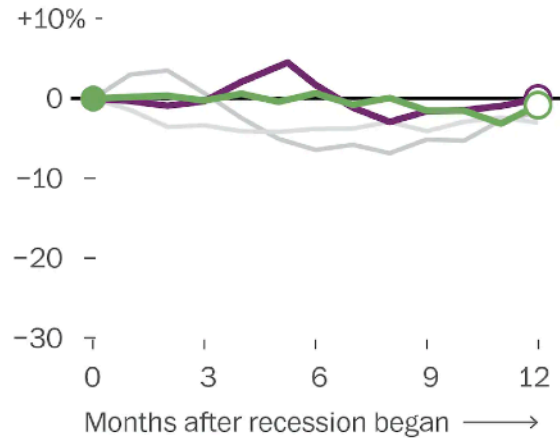
Source: Financial Times analysis of data from the European Centre for Disease Prevention and Control, the Covid Tracking Project, the UK Dept of Health & Social Care and the Spanish Ministry of Health.
Data updated September 25 2020 12.46pm BST. Interactive version: ft.com/covid19

FINANCIAL TIMES

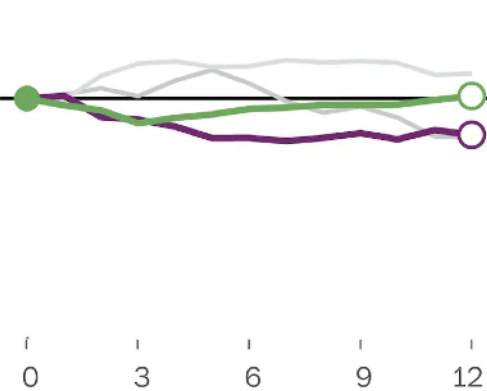
The coronavirus crisis is different

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

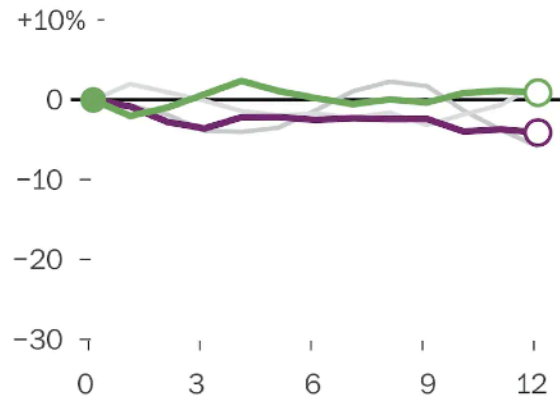
1990 recession



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

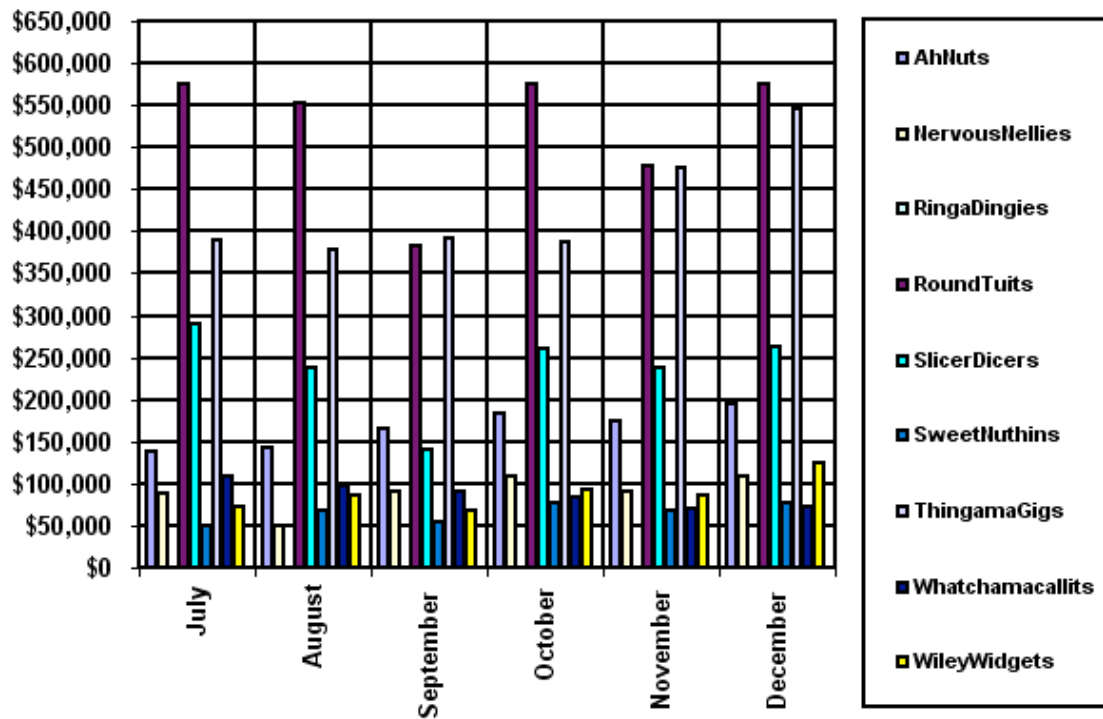
Course Topics

Data and Image Models

		LES VARIABLES DE L'IMAGE									
		POINTS			LIGNES			ZONES			
								12	14		
Z	XY 2 DIMENSIONS DU PLAN										
	TAILLE										
	VALEUR										
		LES VARIABLES DE SÉPARATION DES IMAGES						13			
	GRAIN										
	COULEUR										
	ORIENTATION										

Visualization Design

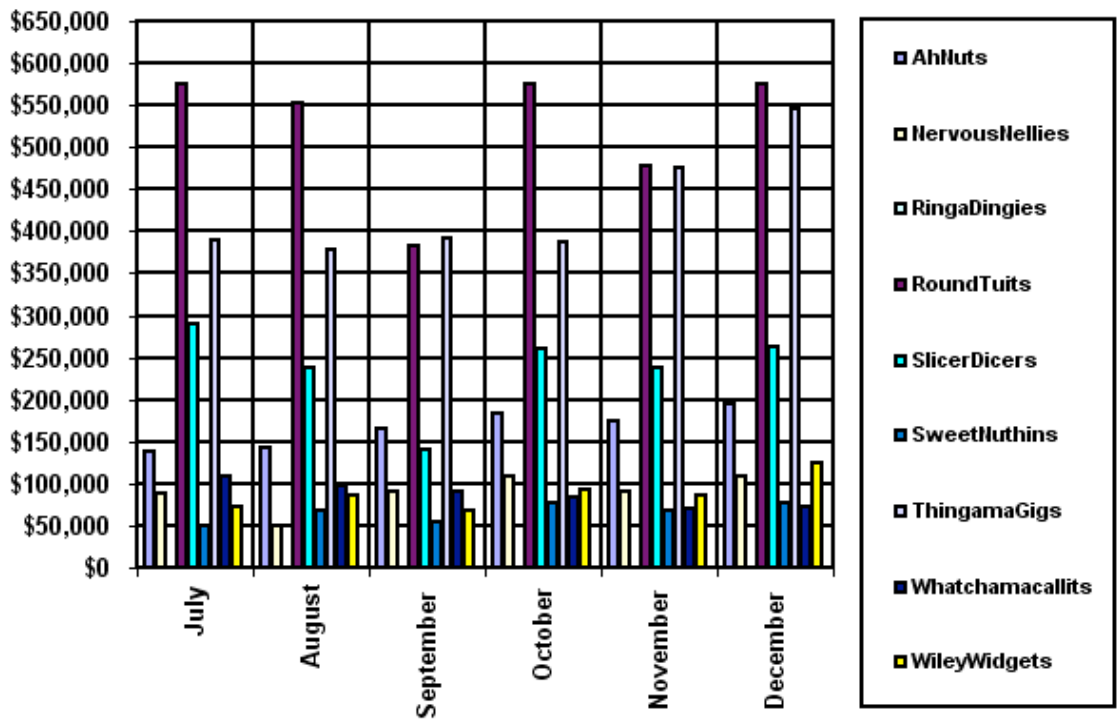
SlicerDicers' Sales Compared to Other Products



Problematic design

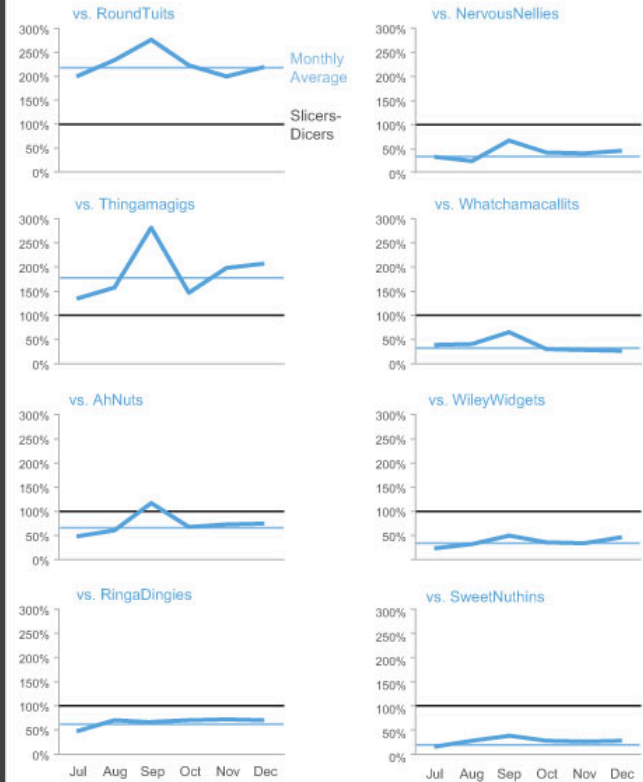
Visualization Design

SlicerDicers' Sales Compared to Other Products



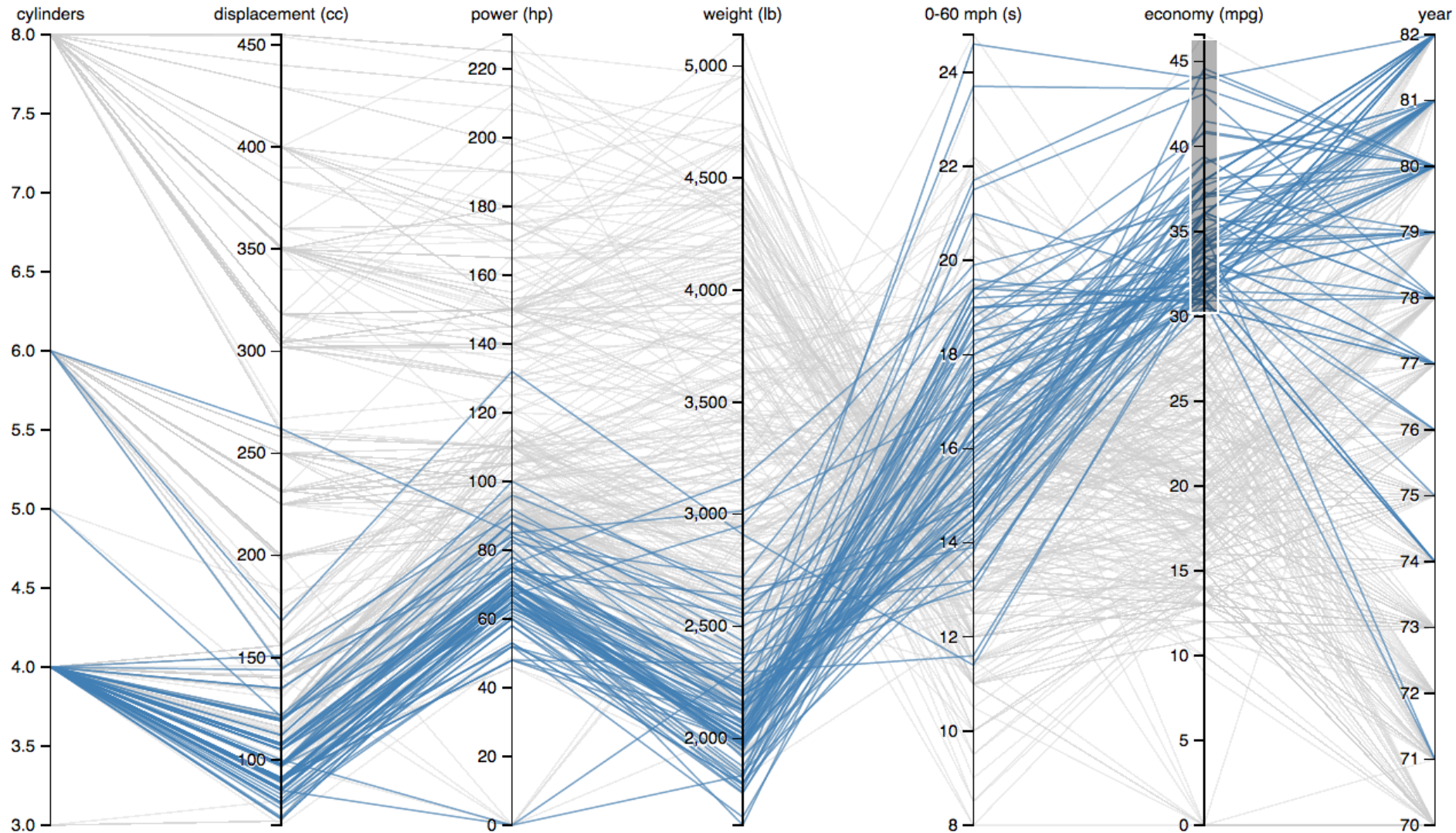
Problematic design

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

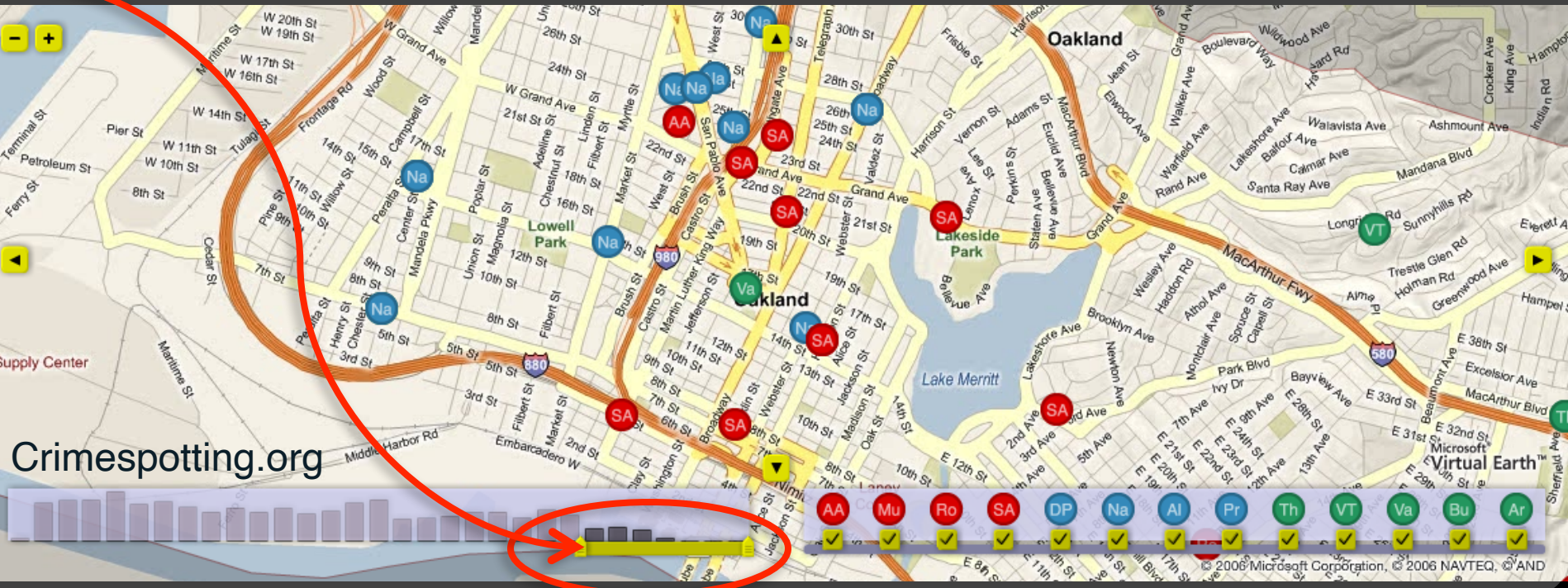
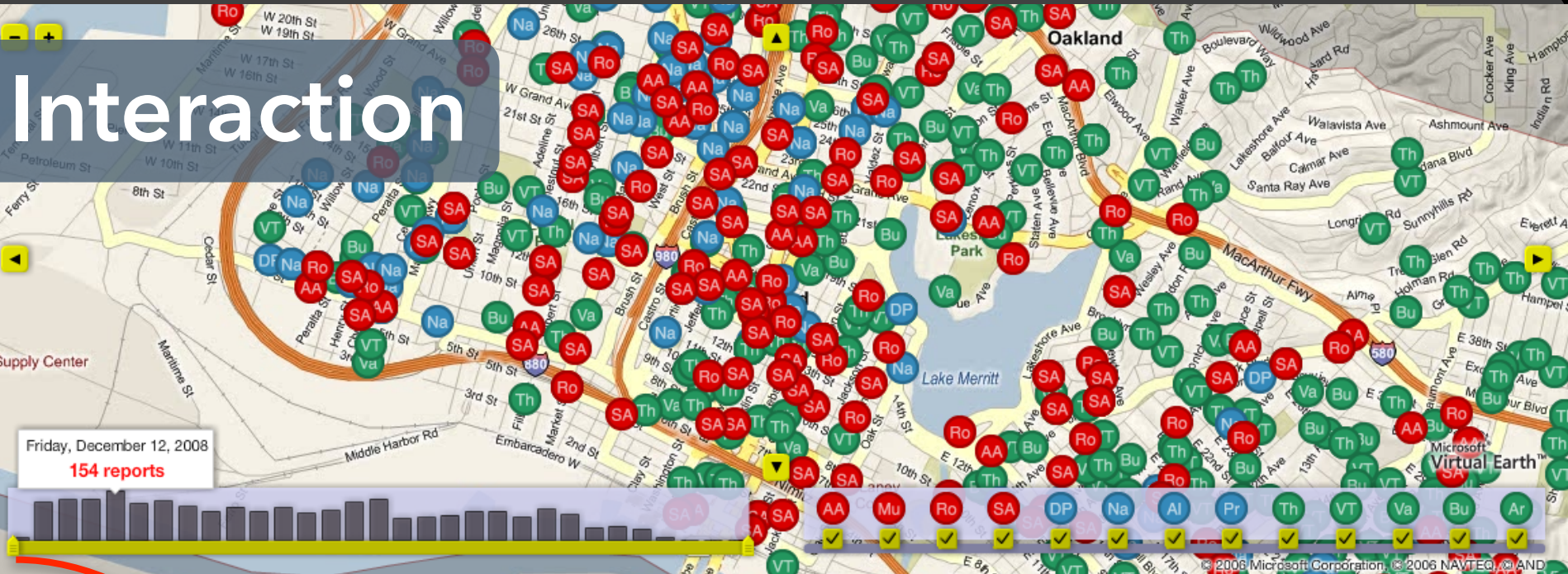


Redesign

Exploratory Data Analysis



Interaction



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

Narrative

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

Chart Size of Lead | Chart Electoral Votes

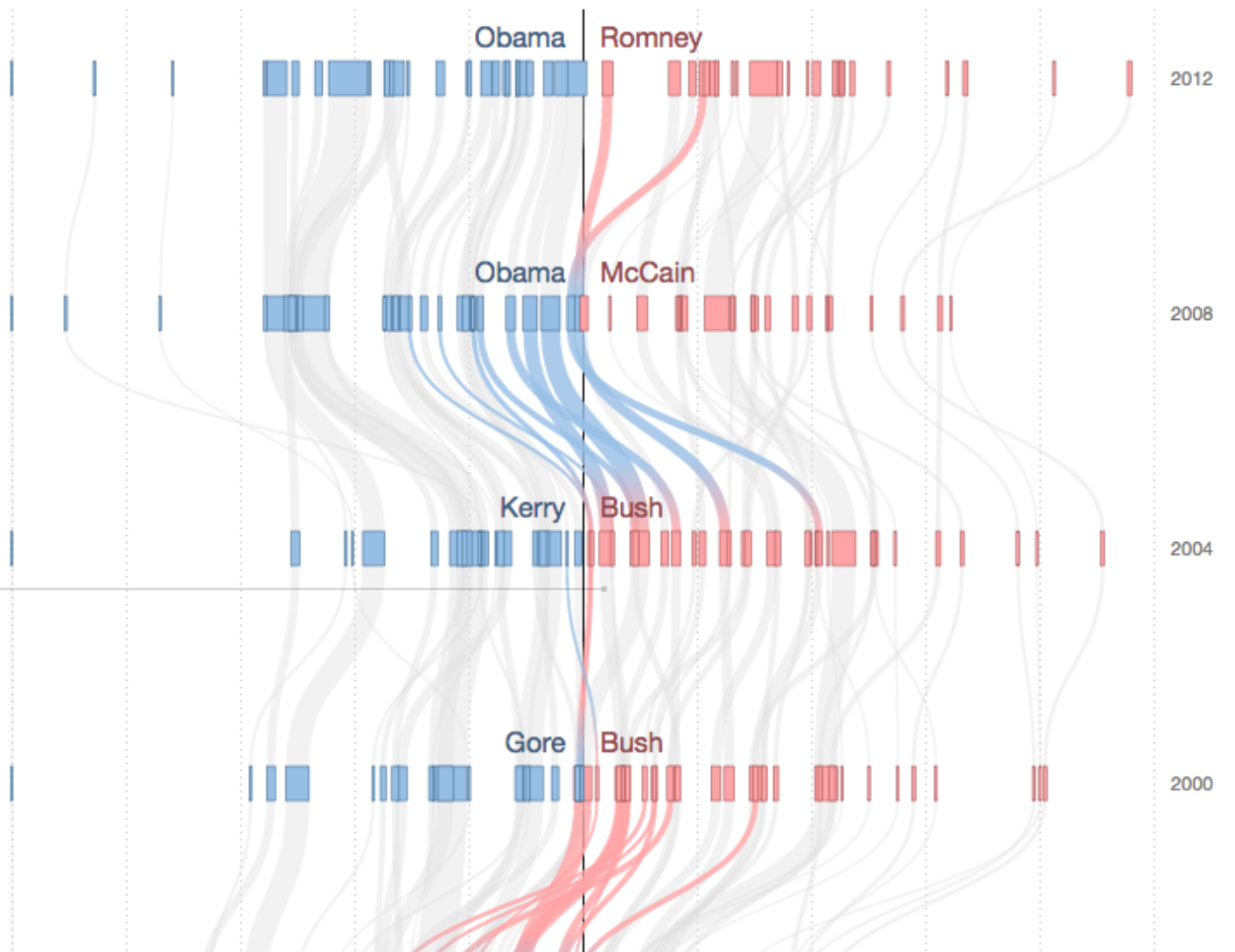
← MORE DEMOCRATIC | MORE REPUBLICAN →
 ≥50% +40% +30% +20% +10% | +10% +20% +30% +40% ≥50%

Obama Re-elected
 The country voted about 5 percentage points more Republican in 2012 than in 2008. Obama lost North Carolina and Indiana, but won every tossup except Florida, which remains too close to call.

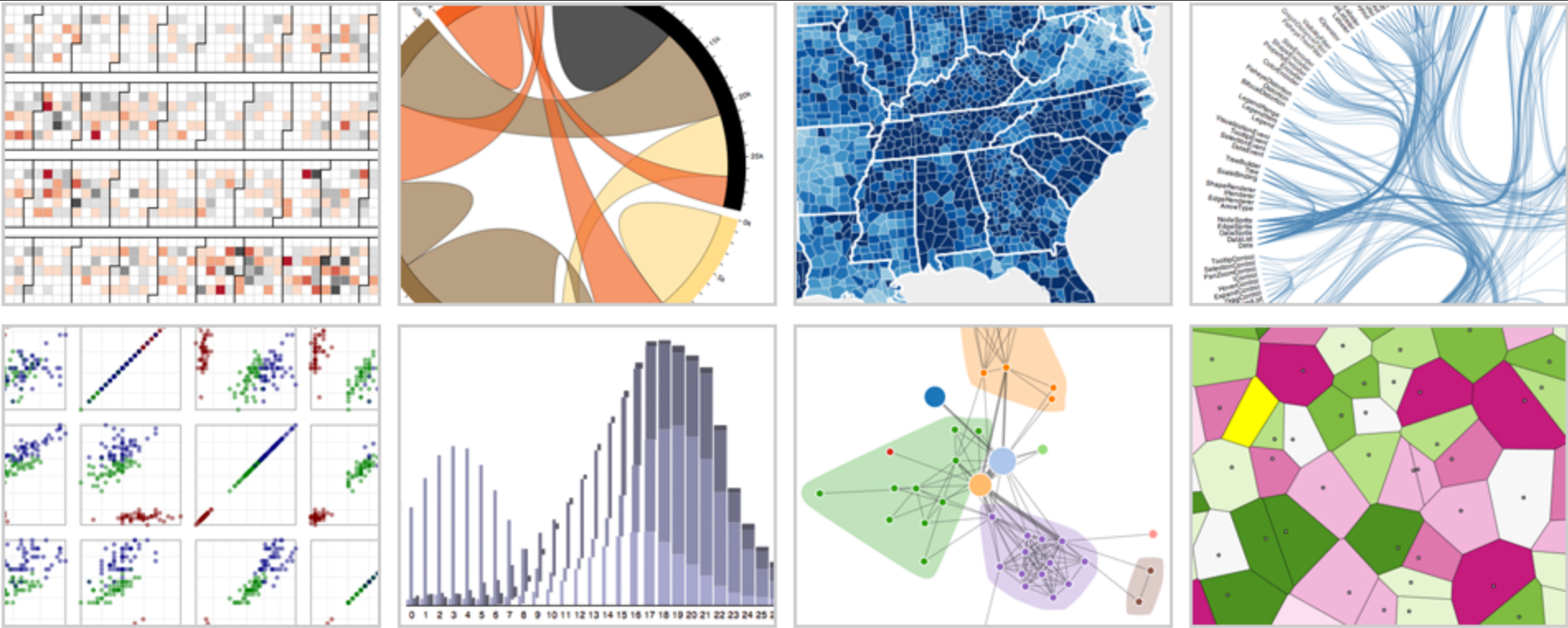
Highlight Tossups

As Goes Ohio
 Ohio, which has voted for the winner in every election since 1964, provided the decisive electoral votes in 2004, and it is the state likeliest to play that role again this year, according to the FiveThirtyEight model.

Highlight Ohio

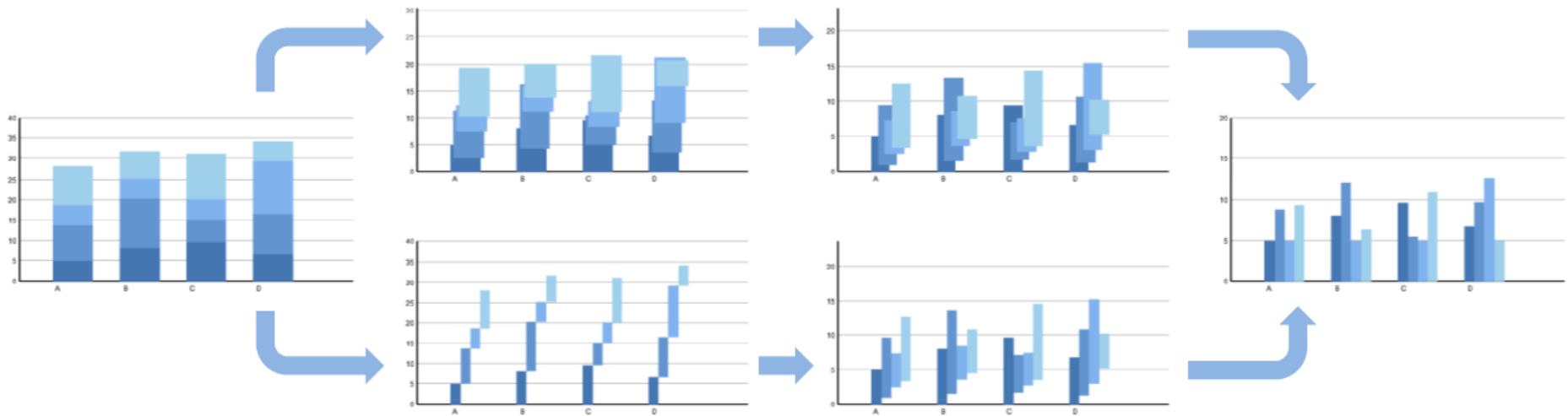


Visualization Software



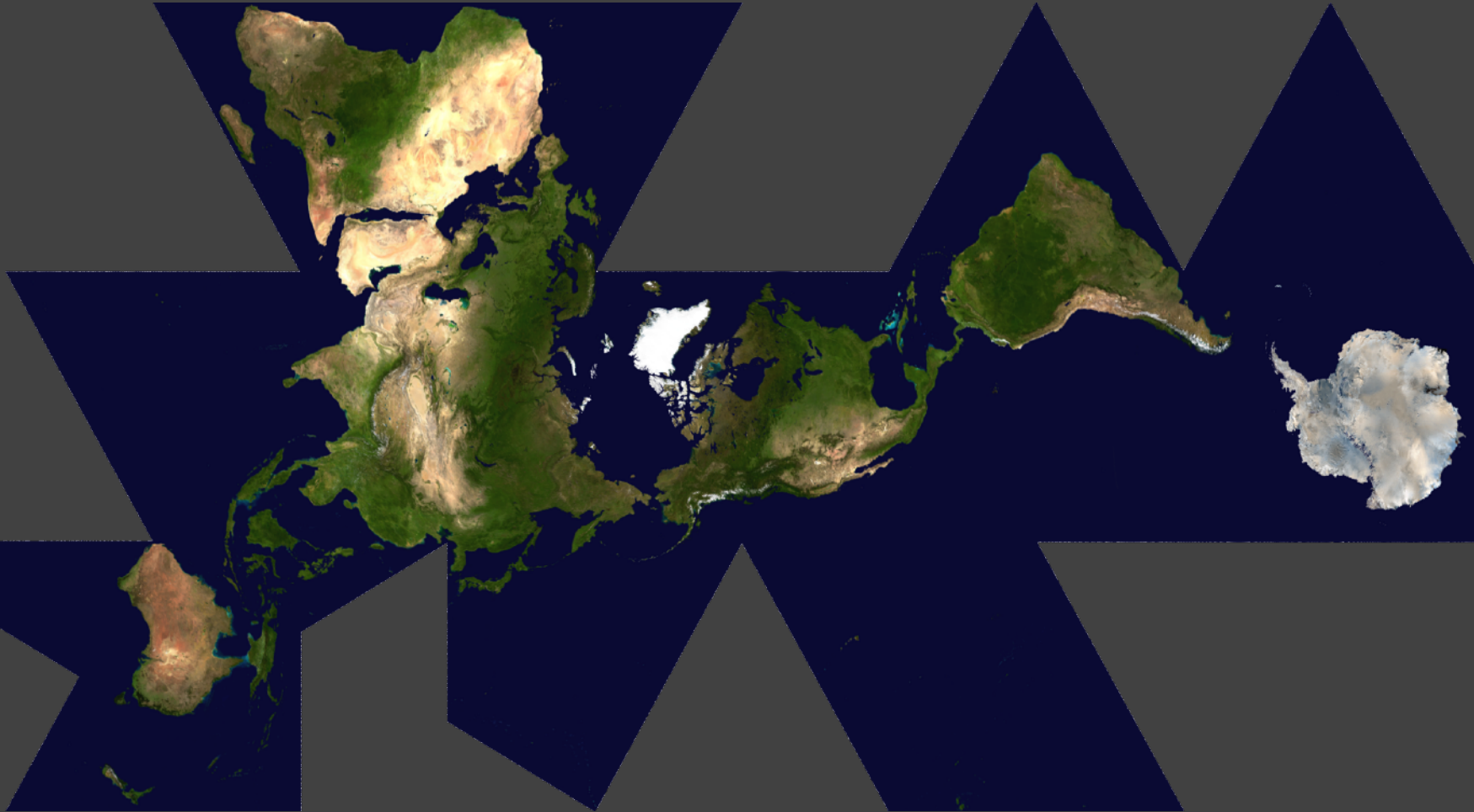
D3: Data-Driven Documents
Vega-Lite / Altair

Animation



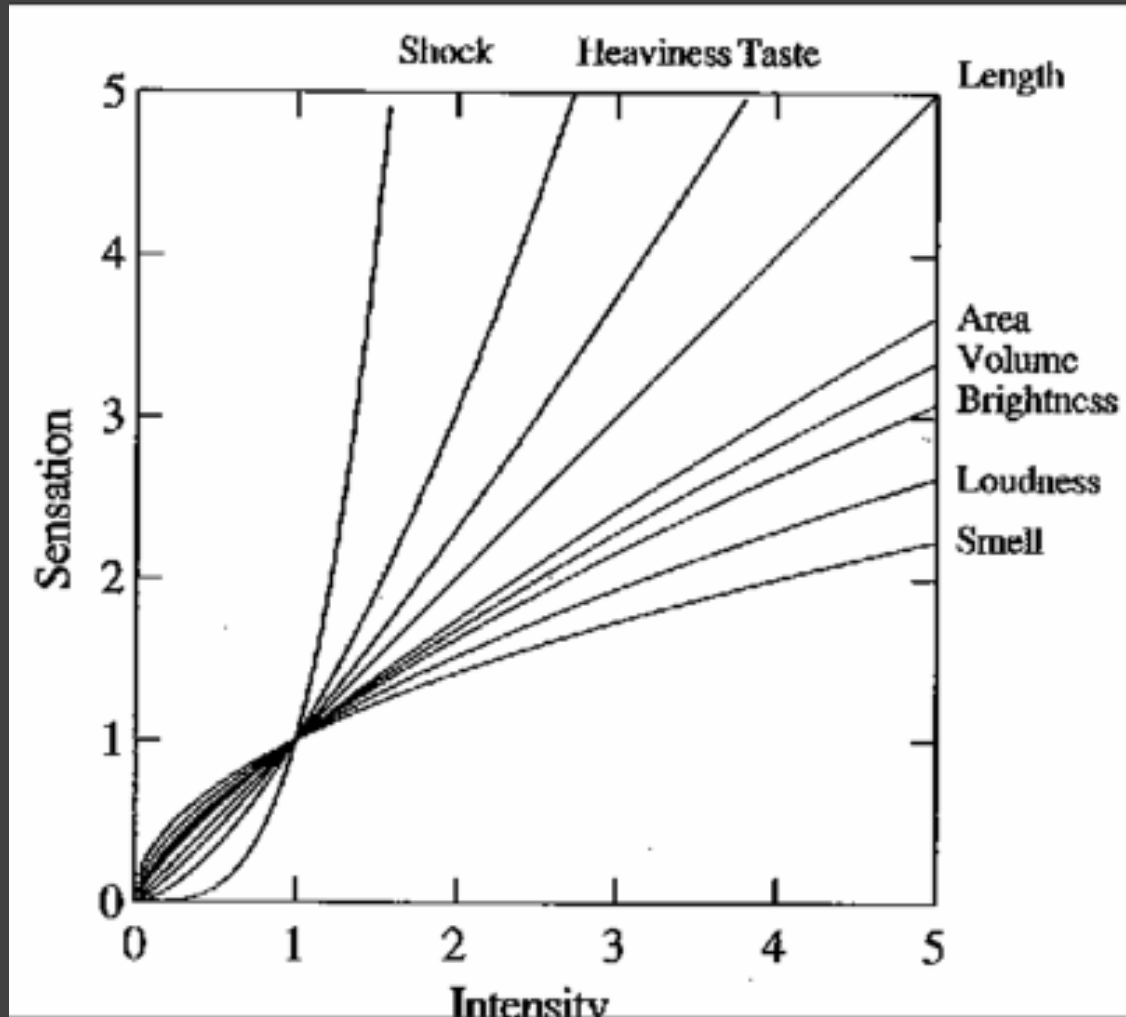
Animated transitions in statistical data graphics [Heer & Robertson 07]

Maps



Dymaxion Maps [Fuller 46]

Graphical Perception

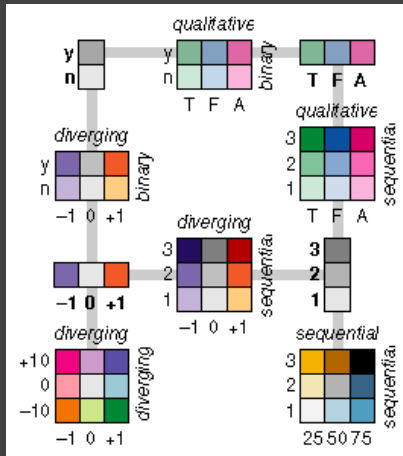
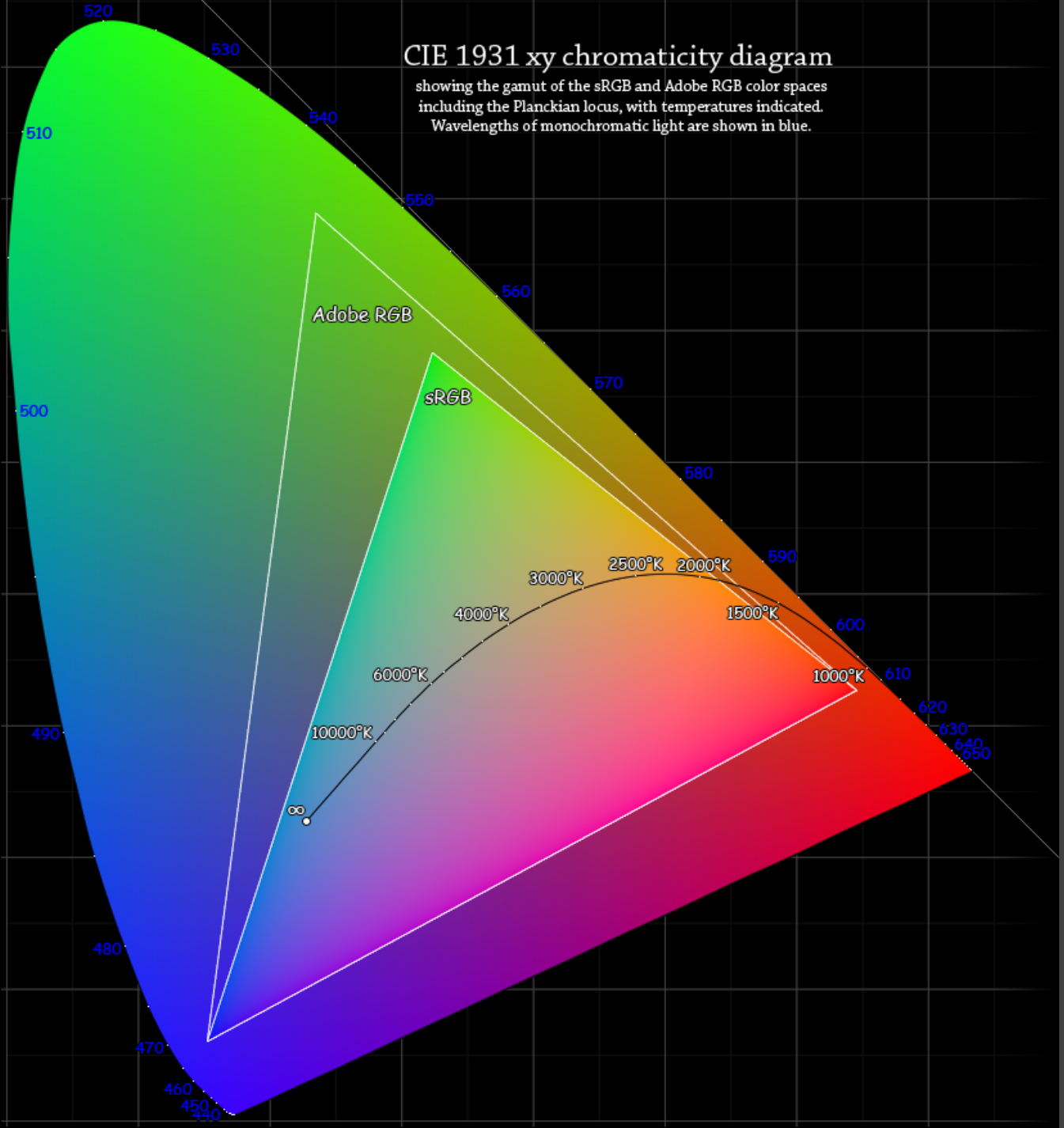


The psychophysics of sensory function [Stevens 61]

Color

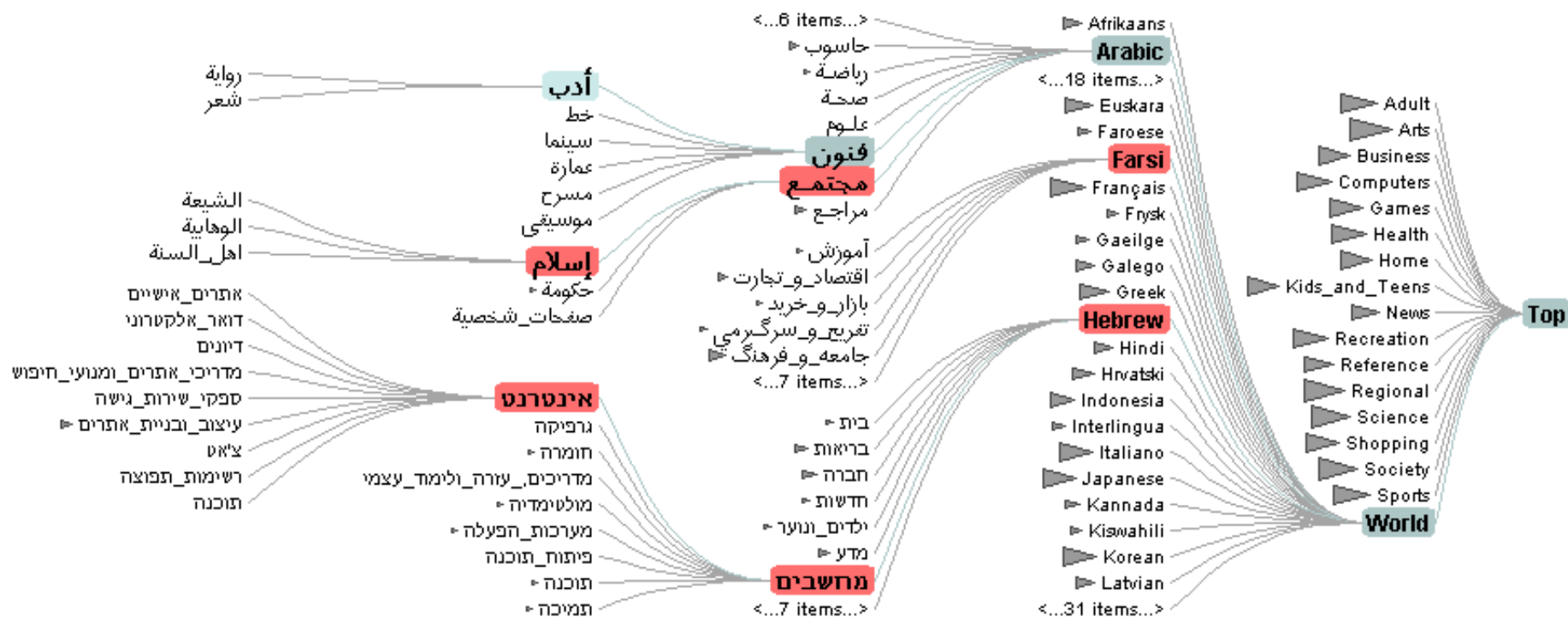
CIE 1931 xy chromaticity diagram

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.



Color Brewer

Hierarchies



Networks



community >>

Enable

search >>

Zephoria

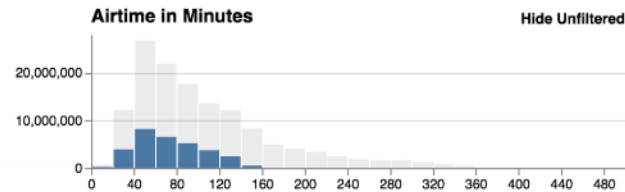
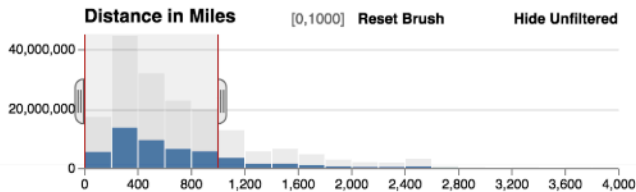
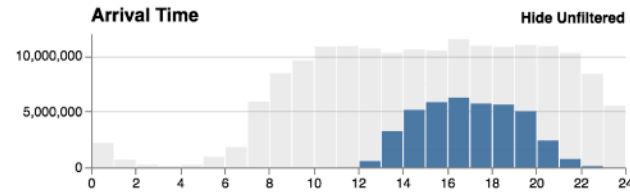
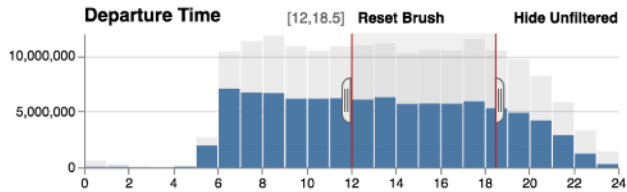
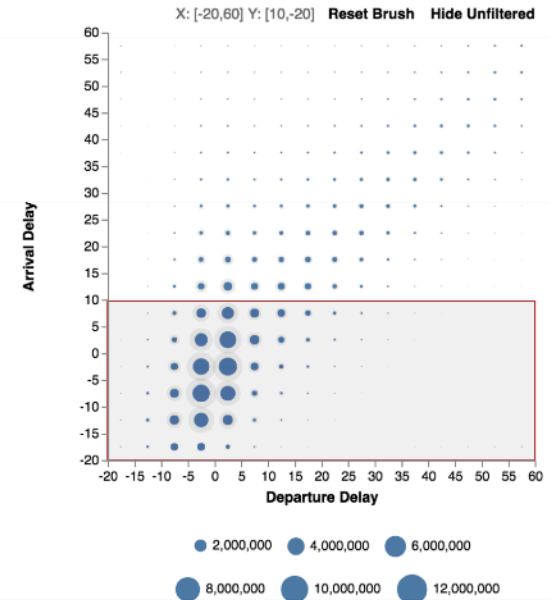
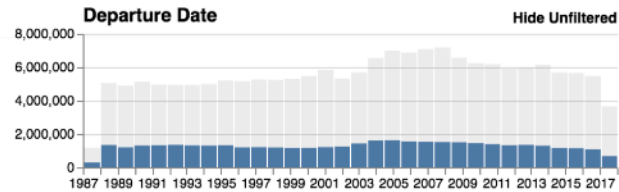
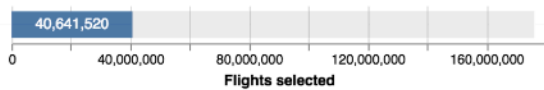
User ID	21721
Friends	<input type="checkbox"/> 266
Age	??
Gender	<input type="checkbox"/> Female
Status	<input type="checkbox"/> Single
Location	San Francisco, CA
Hometown	Lancaster, PA
Occupation	researcher: social networks, identity, context
Interests	apophenia, observing people, culture, questioning 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/>

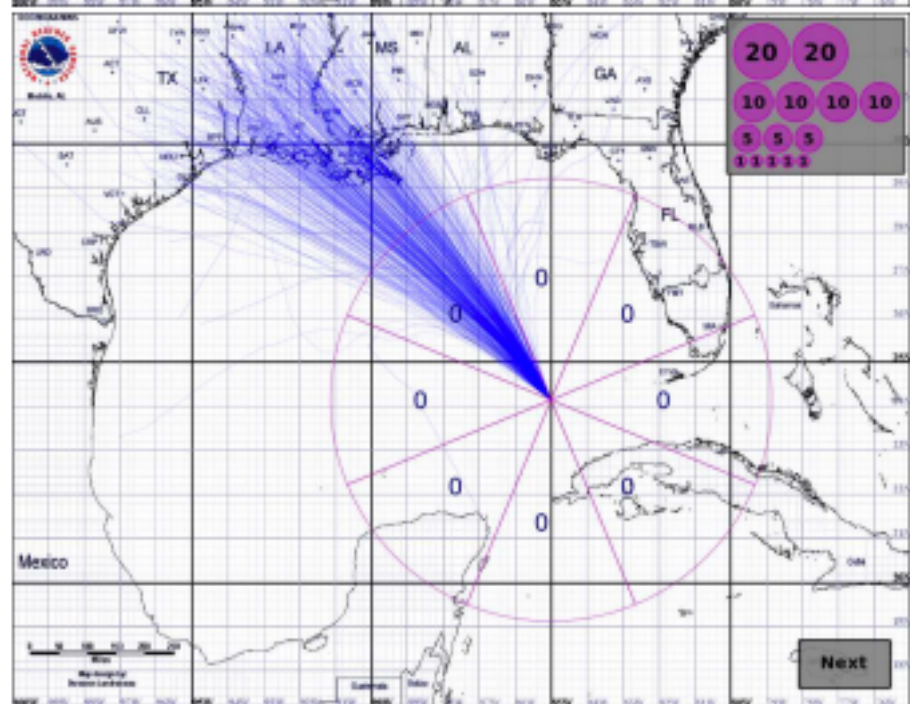
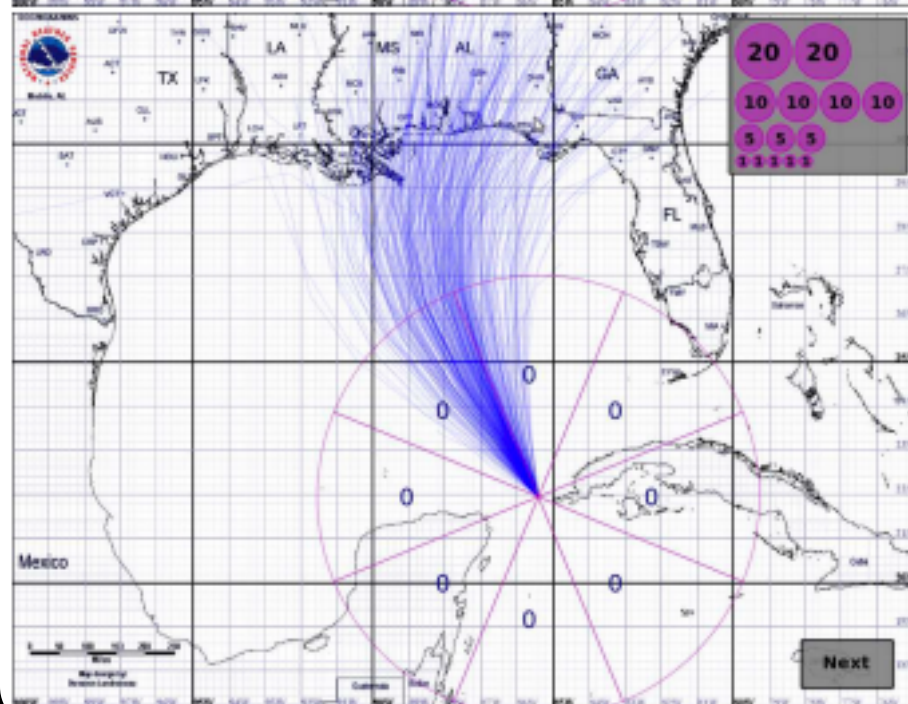
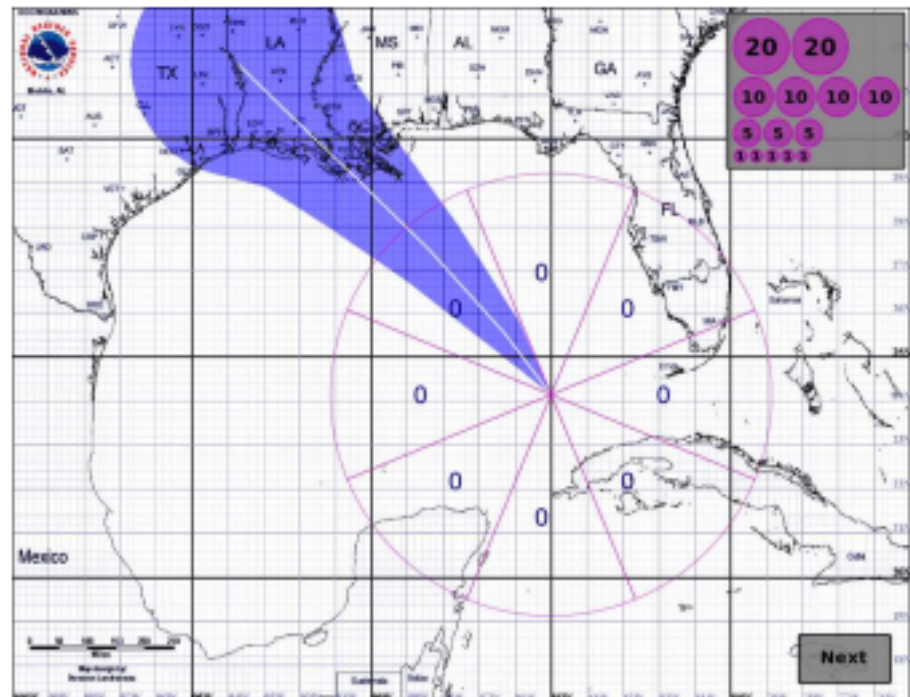
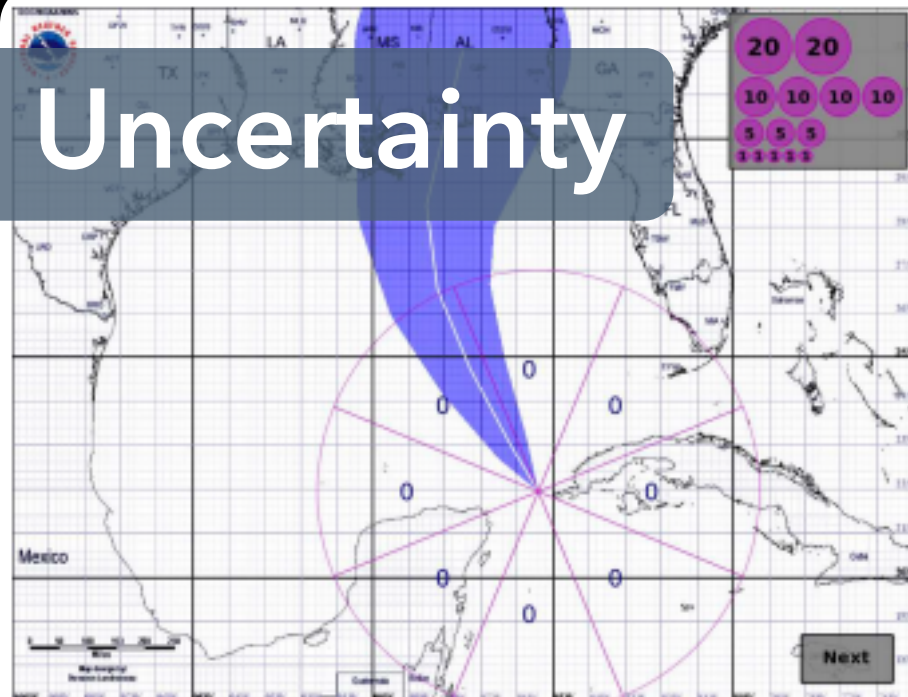
Want to Meet Someone who makes life's complexities seem simply elegant.

Scalability



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

Uncertainty



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

cse442@cs

Instructors

Jeffrey Heer OH: *Thu After Lecture*

Jane Hoffswell OH: *Tue After Lecture*

Teaching Assistants

Mick Kittivorawang OH: *Online / Ed*

Kevin Chang OH: *Mon 3-4p*

Naveena Karusala OH: *Wed 11a-12p*

Yang Liu OH: *Fri 1:30-2:30p*

Mick Kittivorawong

chanwutk@cs.washington.edu

Research

- Labeling algorithm for chart annotation
- Data Visualization toolkit

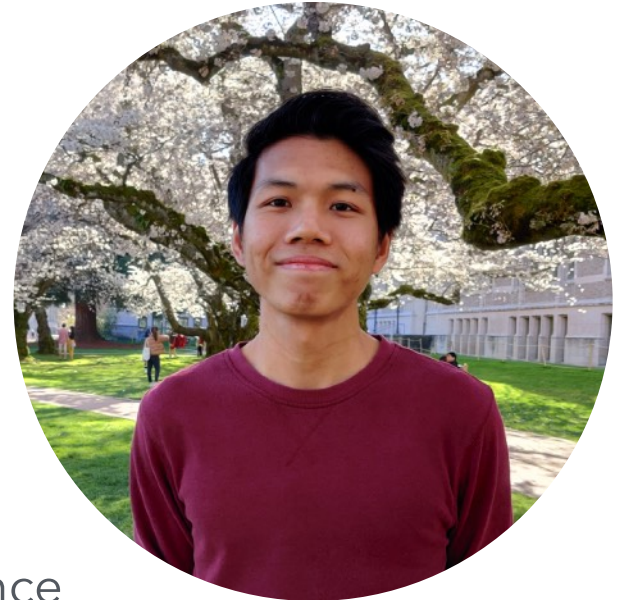
Work Experience @OctoML

- Visualization of Relay IR and its TVM performance

Technical Experience

- TypeScript, D3, Vega/Vega-Lite, and general web programming

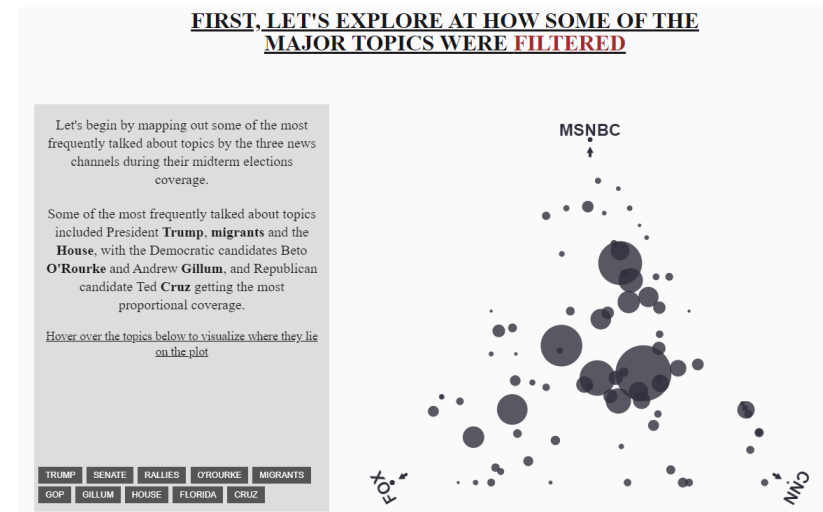
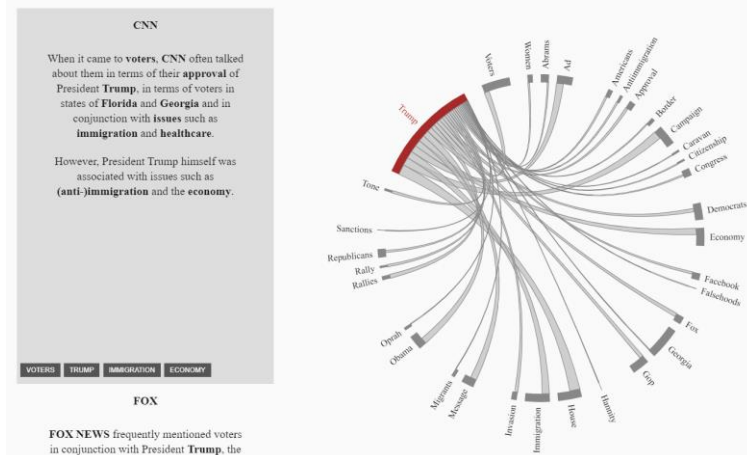
OH: by appointment + Discussion Board



Kevin Chang

kwchang2 @ cs

I'm a 5th year master's student interested in ML and data visualization.



My 442 final project:

<https://cse442-18f.github.io/fp-divided-congress-and-coverage/>

Naveena



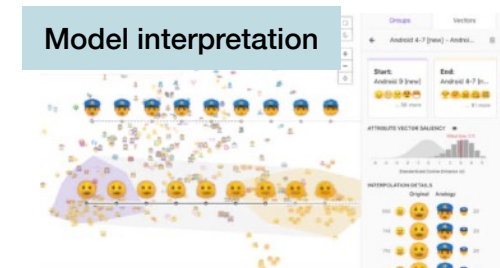
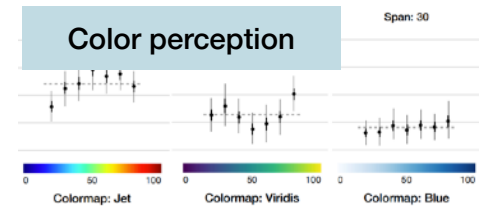
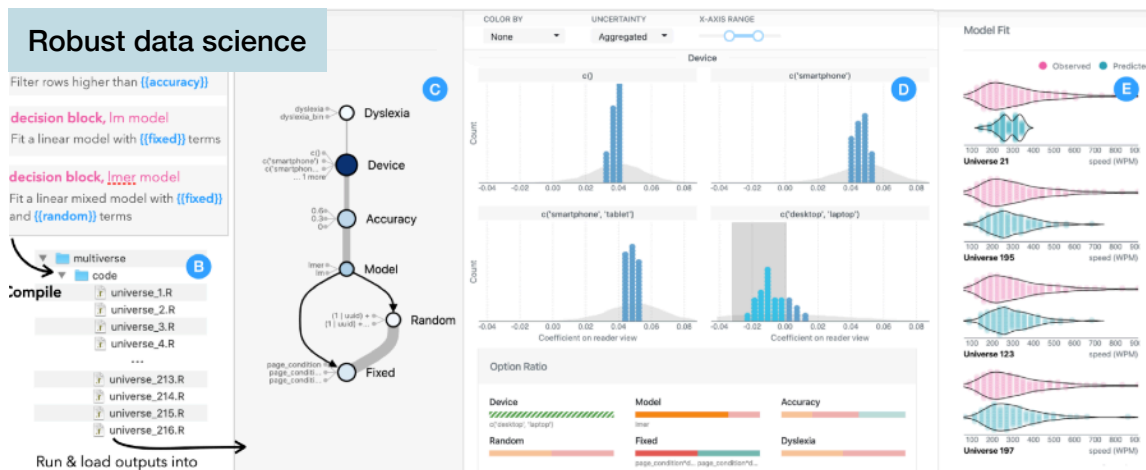
- ▶ 4th year PhD student in the ICTD Lab
- ▶ Research in HCI and global development, specifically on health messaging to underserved populations
- ▶ Office hours: 11am-12pm on Wednesdays
- ▶ Excited to talk about: data ethics, using data as a tool for empowerment and advocacy

Yang Liu

Office Hours:

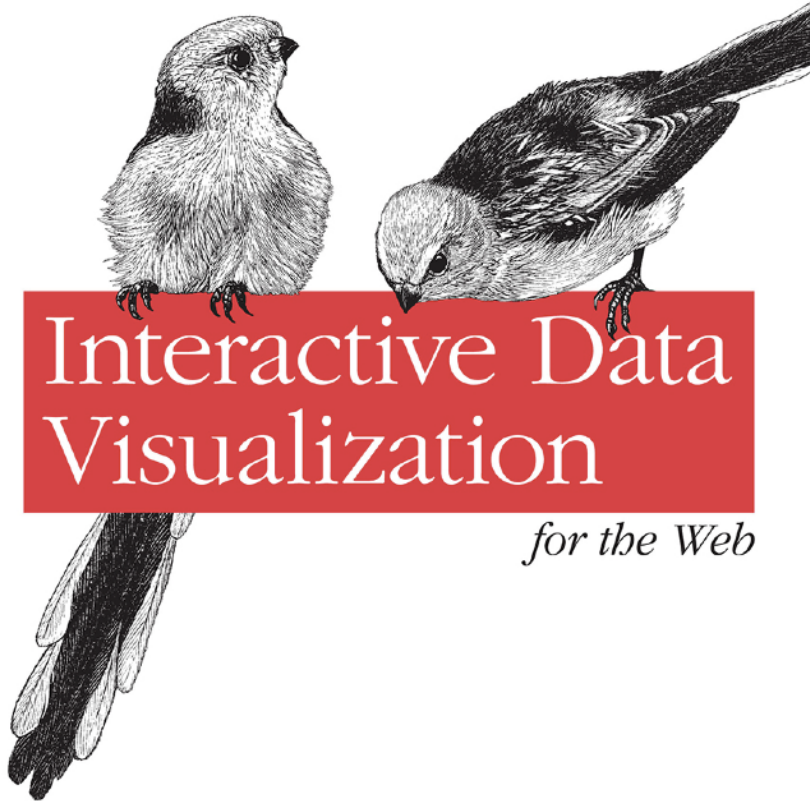
Fri 1:30 - 2:30 pm (Tableau tutorial 10/16)

I'm a PhD student working on visualization and HCI. I took and TA-ed the graduate version of this class before. Looking forward to a new quarter!



Textbook

An Introduction to Designing With D3



O'REILLY®

Scott Murray

Interactive Data Visualization for the Web, 2nd Edition

For learning D3!

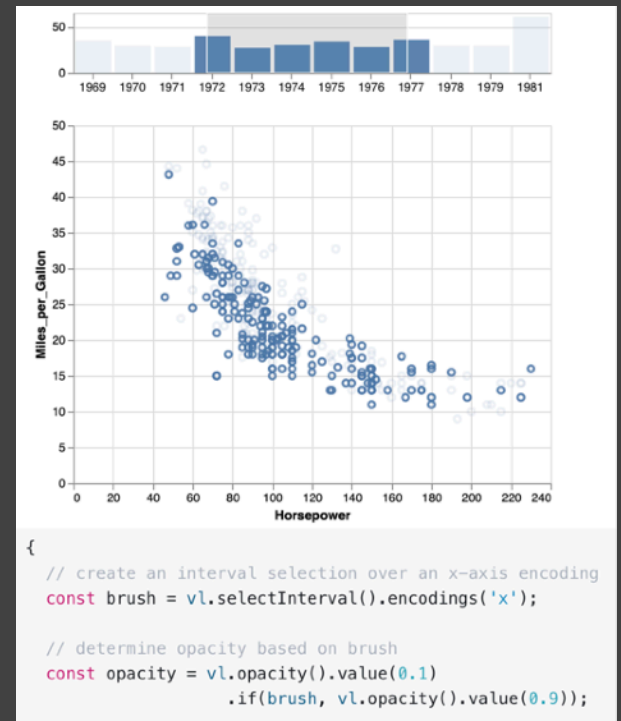
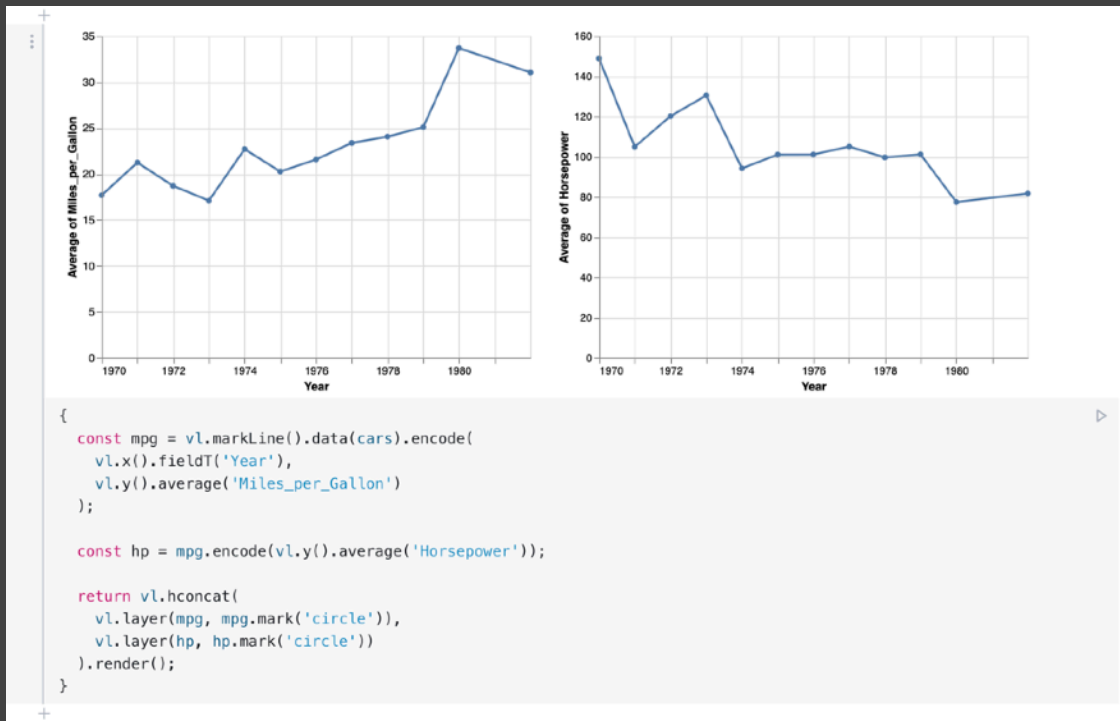
Book available online.

Code / examples on GitHub.

We will be using **D3 v6**.

<https://d3js.org>

Interactive Vega-Lite Notebooks



Hands-on engagement with course concepts and tools using Observable (JavaScript) notebooks.

Readings

From books, notebooks, and linked articles.

Material in class will loosely follow readings.

Readings should be read by start of class.

Post quizzes / comments on class forum.

One comment per week (up through week 8).

Post comments by Monday 11:59pm.

You have 1 "pass" for the quarter.

Assignments

CP Class Participation (10%)

A1 Visualization Design (10%) - *Due 10/12*

A2 Exploratory Data Analysis (15%) - *Due 10/26*

A3 Interactive Prototype (25%) - *Due 11/9*

Peer Evaluation - *Due 11/16*

FP Final Project (40%)

Proposal - *Due 11/13*

Milestone Prototype - *Due 12/1*

Demonstration Video - *Due 12/9*

Final Prototype - *Due 12/14*

Final Project

Produce **interactive web-based visualizations**

Initial **prototype** and **design review**

Final deliverables and **video presentation**

Submit and **publish online** (GitHub)

Projects from **previous classes** have been:

- Published as research papers
- Shared widely (some in the New York Times!)
- Released as successful open source projects

Final Project Theme

Final Project Theme

Data Visualization for Social Good

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Goal: find data of social or scientific import, design visualizations to explore or communicate it effectively.

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The specific data domain is open-ended. Possibilities include transportation, housing, public health, education, climate, campaign finance, scientific research, and so on...

Final Project Theme

Data Visualization for Social Good

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You must identify a target audience. May be general (residents, voters) or specialized (scientists, policy makers).

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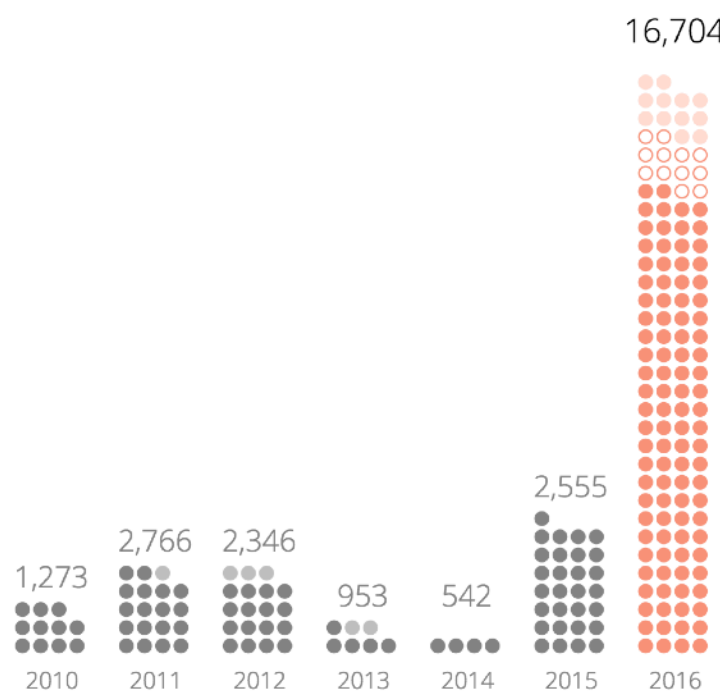
Use Assignment 2 to explore a data set of interest prior to committing to final project teams and topic!

Inspiration...

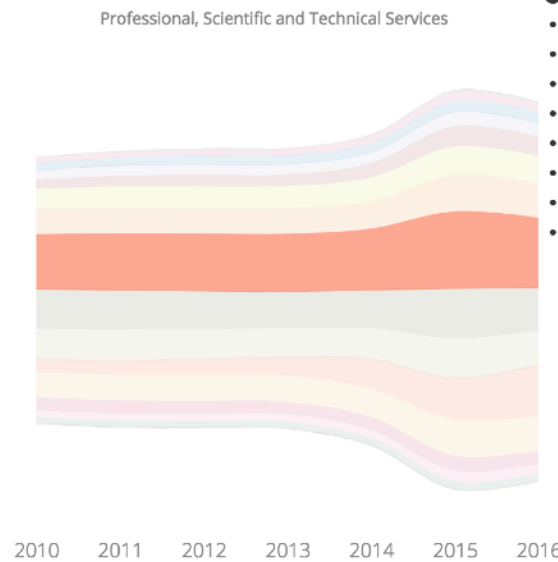
Professional, Scientific and Technical Services ●

● approx. 131 businesses

- Transportation and Warehousing
- Other Services (Except Public Administration)
- Retail Trade
- Construction
- Health Care & Social Assistance
- Arts, Entertainment, & Recreation
- Accommodation & Food Services
- Administrative & Support & Waste
- Wholesale Trade
- Manufacturing
- Real Estate, Rental & Leasing
- Information
- Educational Services
- Finance and Insurance
- Public Administration
- Management of Companies and Enterprises
- Agriculture, Forestry, Fishing and Hunting
- Utilities
- Mining
- Unclassified

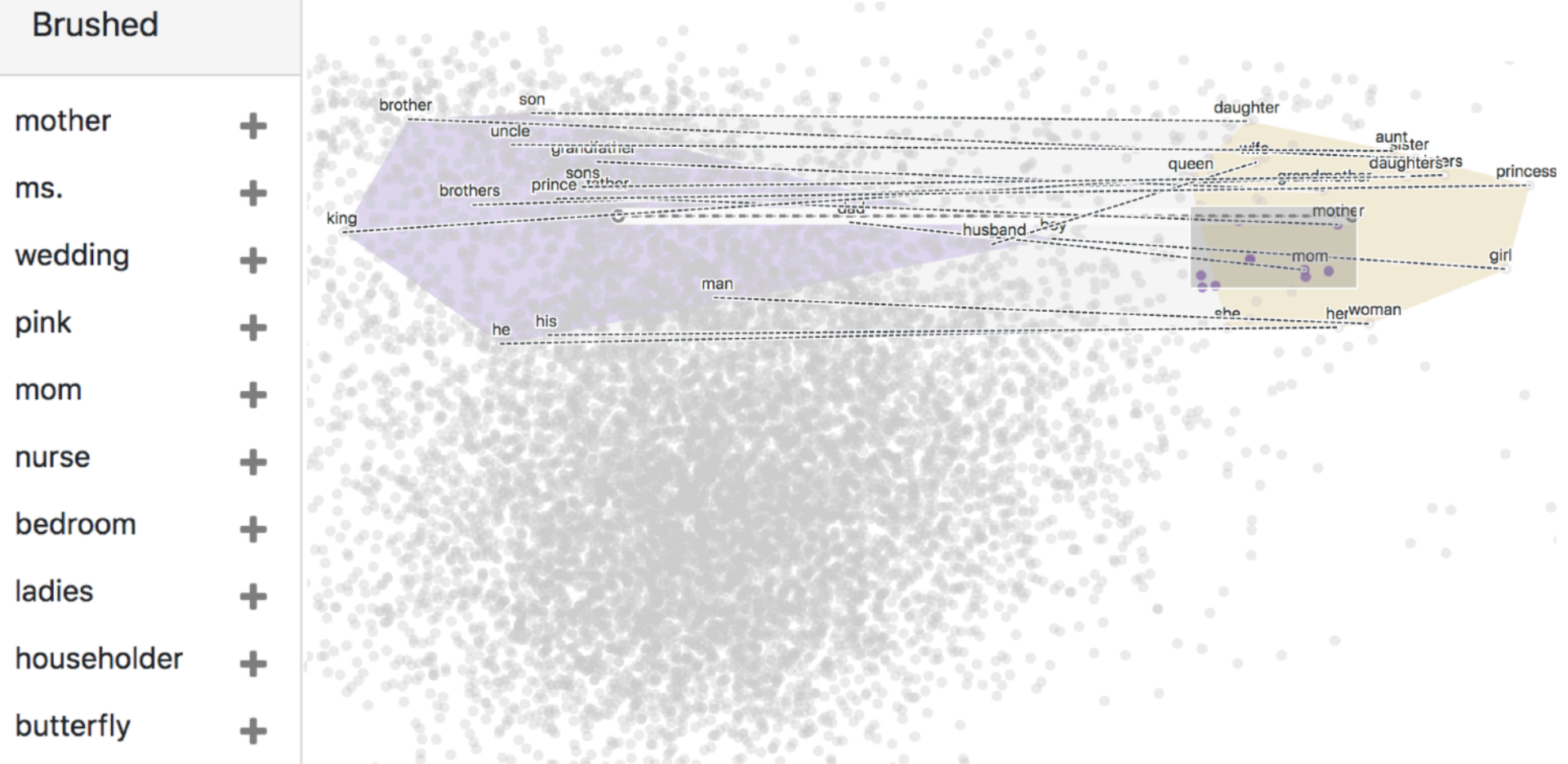


● new businesses ○ old businesses (records appearing in that year) ● old businesses
 ● new businesses that got left behind ● old businesses that got left behind



Change In Times (CSE 442, Spring '17)

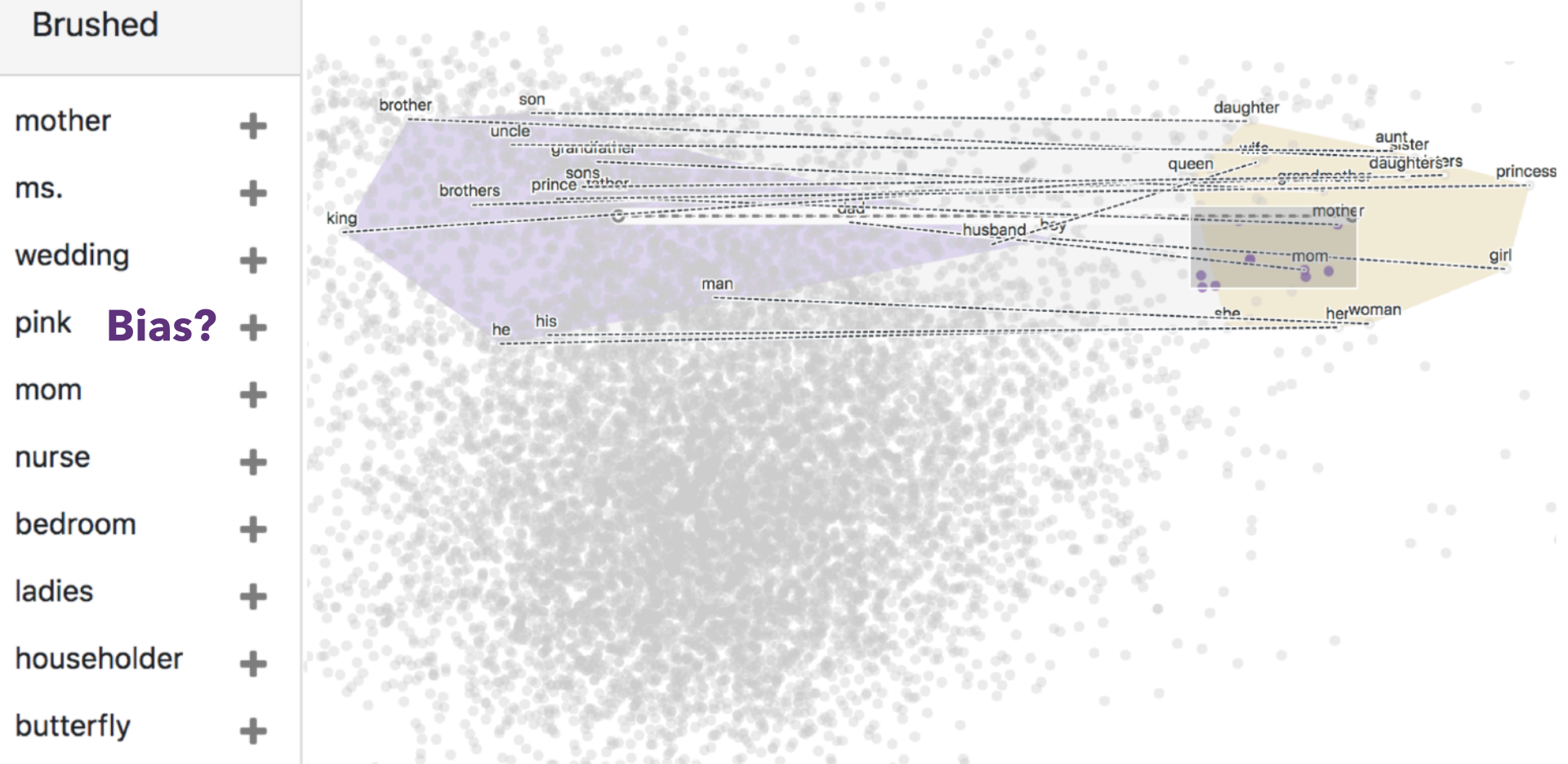
Gunnar Olson, Halden Lin, Lilian Liang, and Shobhit Hathi



Latent Space Cartography

Visual Analysis of Vector Space Embeddings

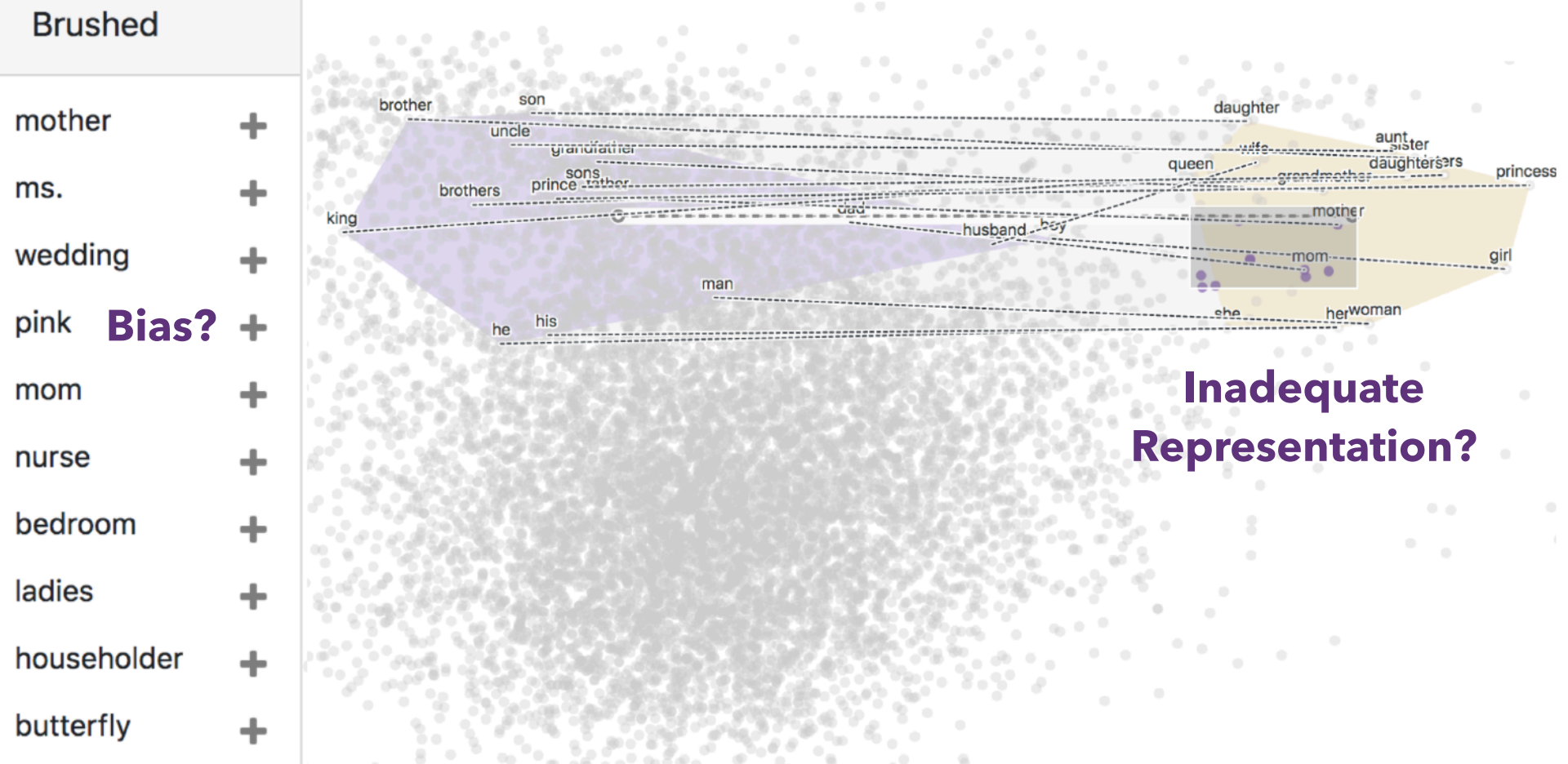
Yang Liu, Eunice Jun, Qisheng Li (CSE 512, Spring '18)



Latent Space Cartography

Visual Analysis of Vector Space Embeddings

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



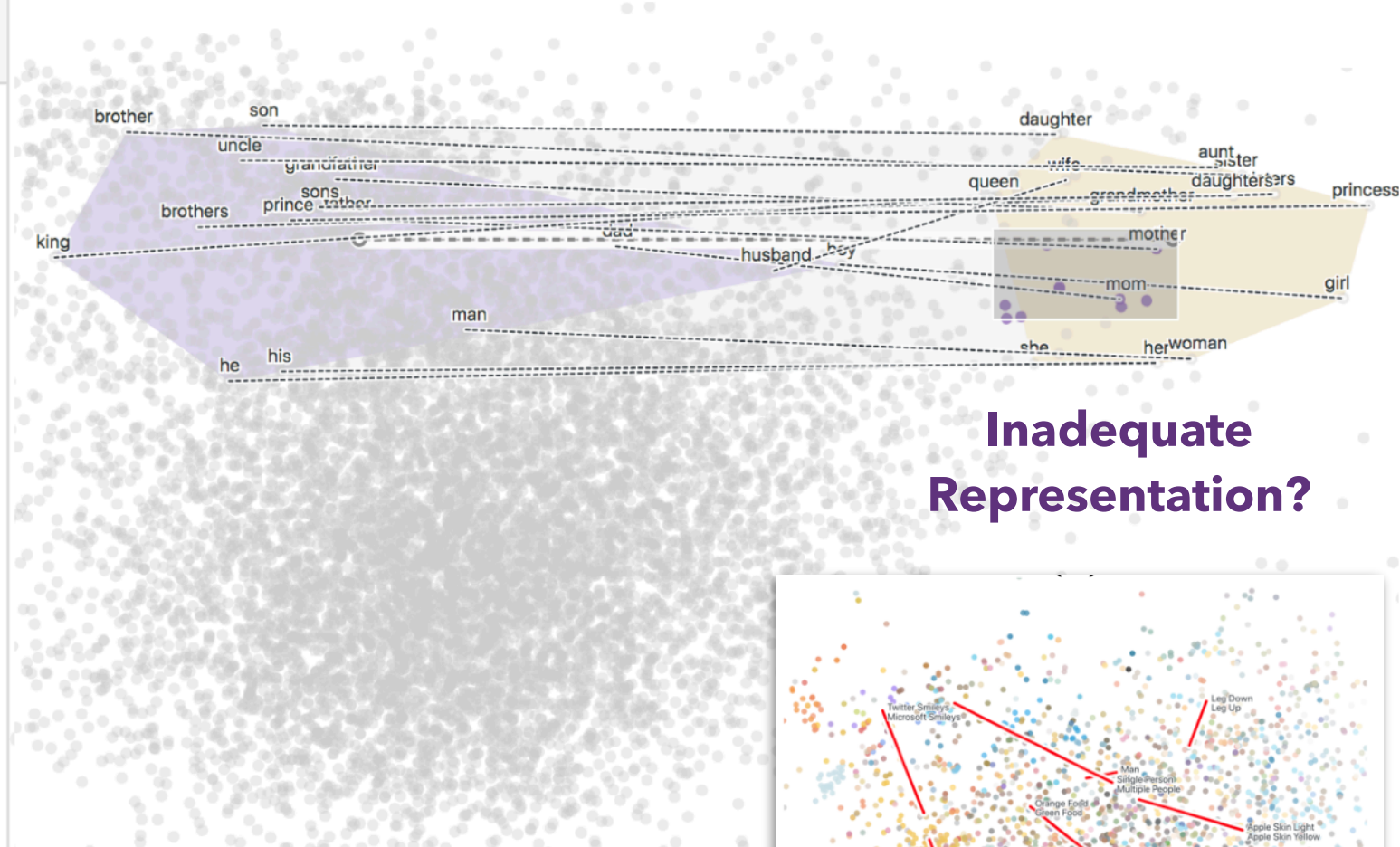
Latent Space Cartography

Visual Analysis of Vector Space Embeddings

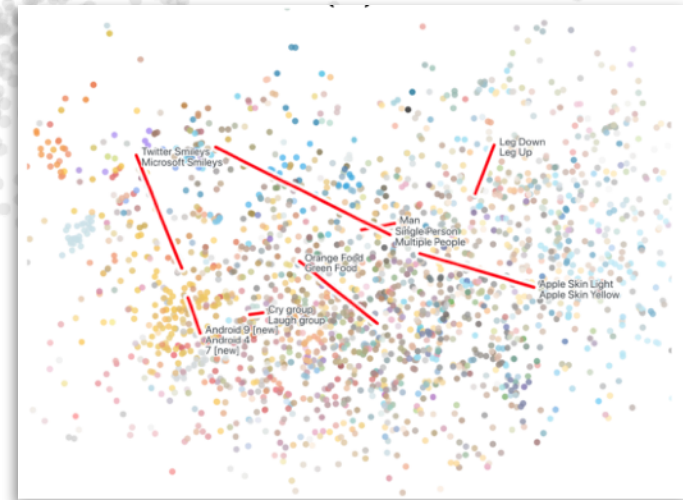
Yang Liu, Eunice Jun, Qisheng Li (CSE 512, Spring '18)

Brushed

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



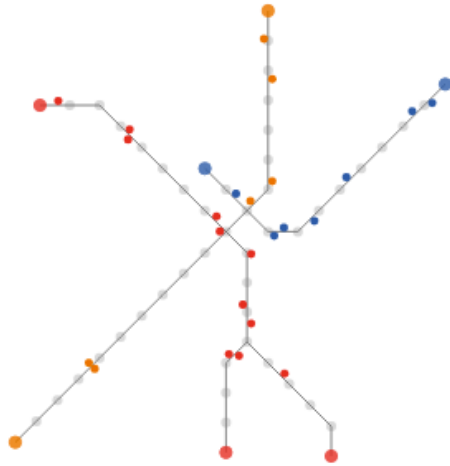
Inadequate Representation?



Latent Space Cartography

Visual Analysis of Vector Space Embeddings

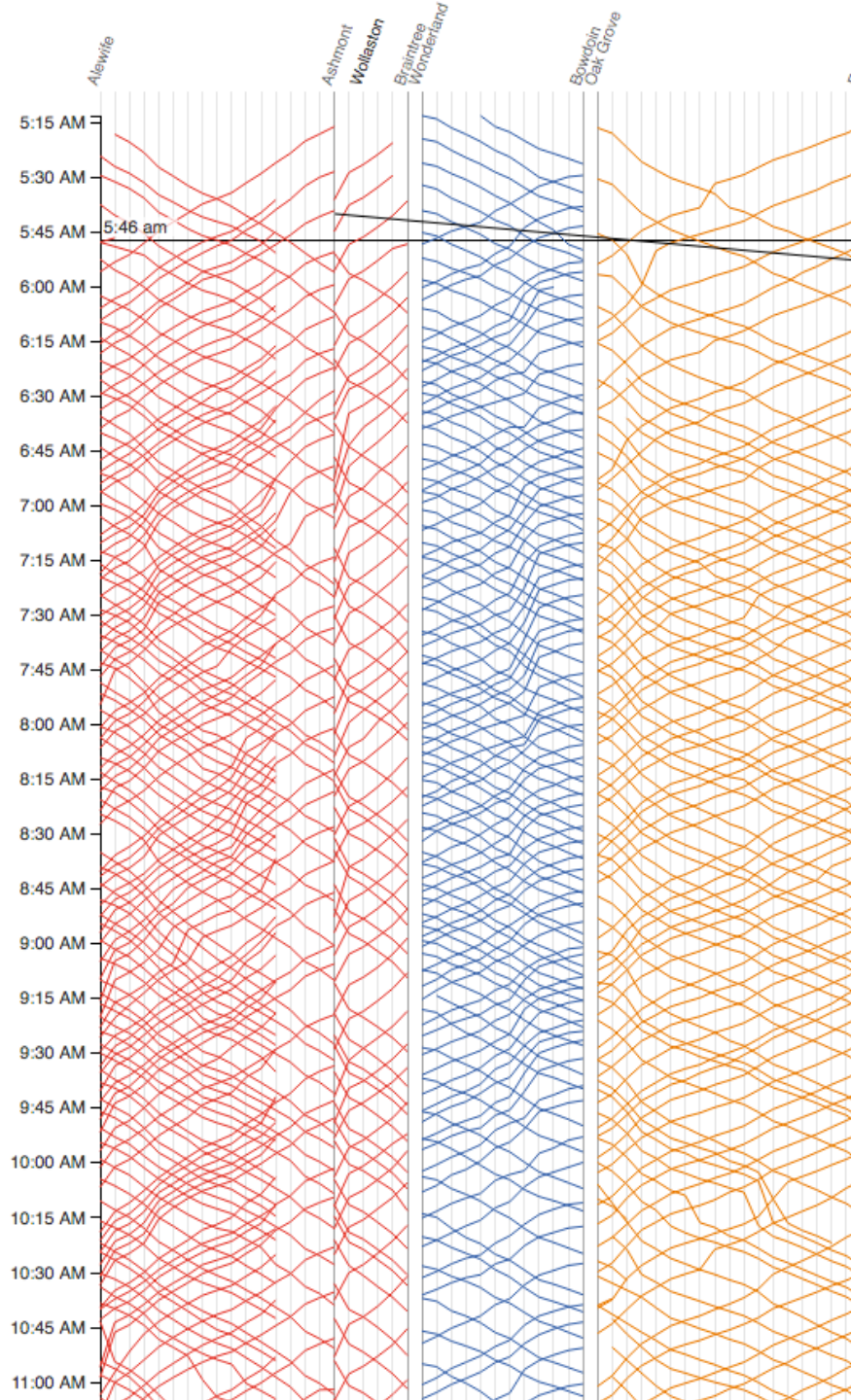
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Locations of each train on the [red](#), [blue](#), and [orange](#) lines at 5:46 am. Hover over the diagram to the right to display trains at a different time.

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.

MBTA Viz

Barry & Card

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, Monday October 12.**