

# The Purpose of Visualization

*Maneesh Agrawala*

**CS 448B: Visualization  
Fall 2020**

1

**How much data (bytes)  
did we produce in 2016?**

2

**2016: 16.1 zetabytes**

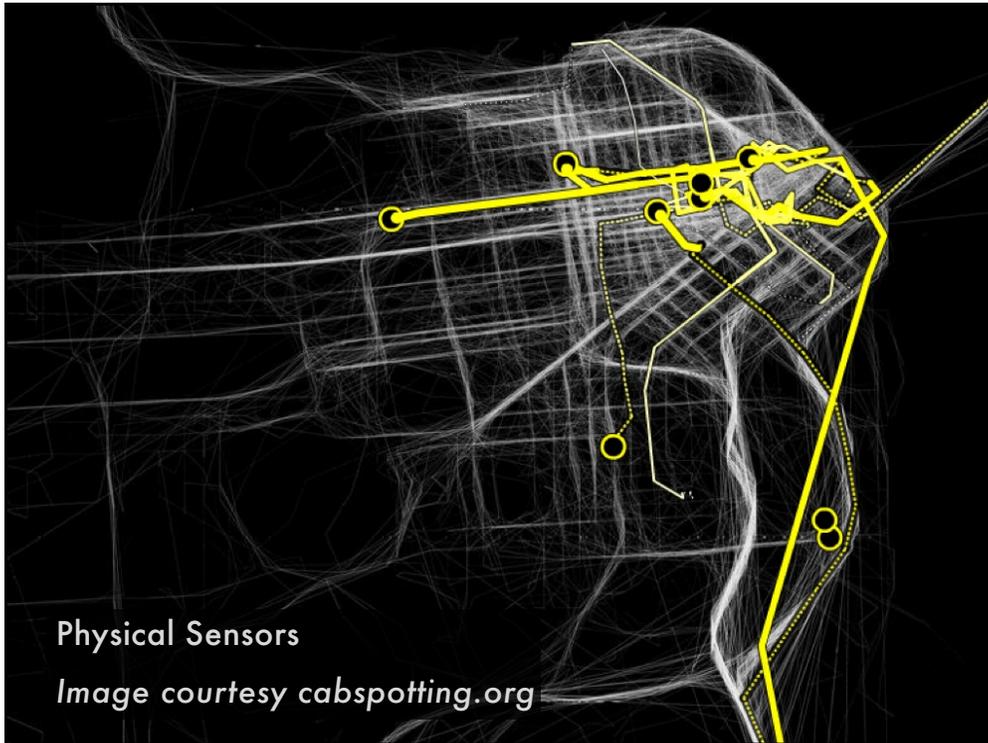
[Gantz 2017]

3

**2016: 16.1 zetabytes**  
**10x increase over 5 years**

[Gantz 2017]

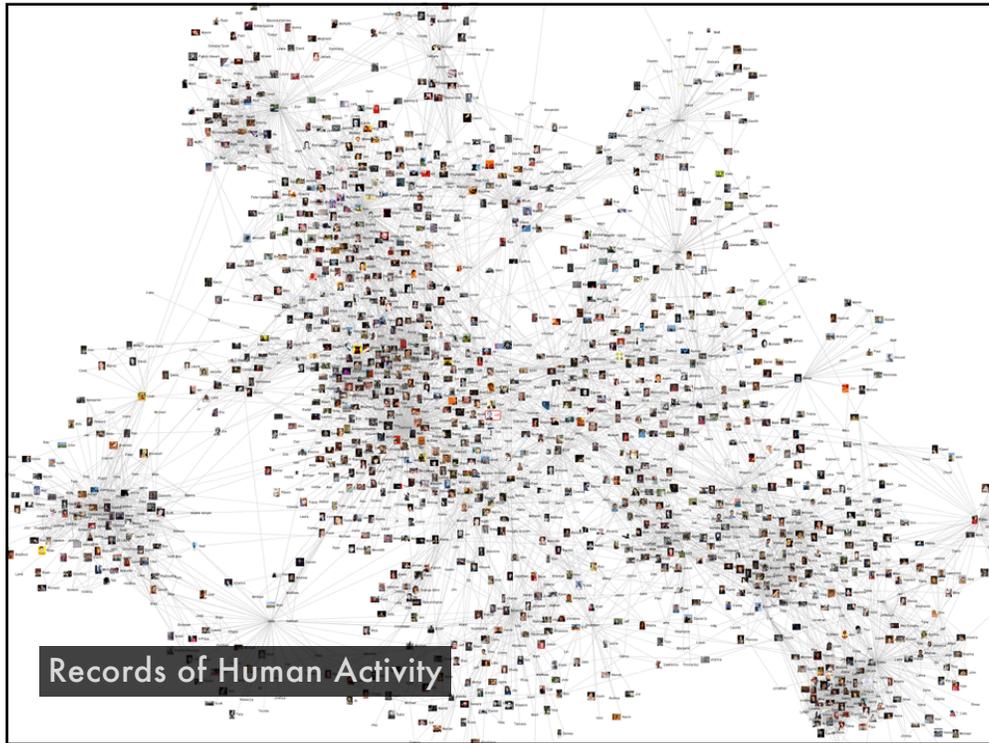
4



5



6



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## Abortion

From Wikipedia, the free encyclopedia

*For other uses, see [Abortion \(disambiguation\)](#).*

**Abortion** is the ending of a pregnancy by removal or expulsion of an embryo or fetus before it can survive outside the uterus.<sup>[note 1]</sup> An abortion that occurs without intervention is known as a miscarriage or spontaneous abortion. When deliberate steps are taken to end a pregnancy, it is called an induced abortion, or less frequently "induced miscarriage". The unmodified word *abortion* generally refers to an induced abortion.<sup>[1][2]</sup> A similar procedure after the fetus has potential to survive outside the womb is known as a "late termination of pregnancy" or less accurately as a "late term abortion".<sup>[3]</sup>

When properly done, abortion is one of the safest procedures in medicine,<sup>[4][5]</sup> but unsafe abortion is a major cause of maternal death, especially in the developing world.<sup>[6]</sup> Making safe abortion legal and accessible reduces maternal deaths.<sup>[7][8]</sup> It is safer than childbirth, which has a 14 times higher risk of death in the United States.<sup>[9]</sup> Modern methods use medication or surgery for abortions.<sup>[10]</sup> The drug mifepristone in combination with prostaglandin appears to be as safe and effective as surgery during the first and second trimester of pregnancy.<sup>[10][11]</sup> The most common surgical technique involves dilating the cervix and using a suction device.<sup>[12]</sup> Birth control, such as the pill or intrauterine devices, can be used immediately following abortion.<sup>[11]</sup> When performed legally and safely on a woman who desires it, induced abortions do not increase the risk of long-term mental or physical problems.<sup>[13]</sup> In contrast, unsafe abortions (those performed by unskilled individuals, with hazardous equipment, or in unsanitary facilities) cause 47,000 deaths and 5 million hospital admissions each year.<sup>[13][14]</sup> The World Health Organization recommends safe and legal abortions be available to all women.<sup>[15]</sup>

Around 56 million abortions are performed each year in the world,<sup>[16]</sup> with about 45% done unsafely.<sup>[17]</sup> Abortion rates changed little between 2003 and 2008,<sup>[18]</sup> before which they decreased for at least two decades as access to family planning and birth control increased.<sup>[19]</sup> As of 2008, 40% of the world's women had access to legal abortions without limits as to reason.<sup>[20]</sup> Countries that permit abortions have different limits on how late in pregnancy abortion is allowed.<sup>[20]</sup>

Historically, abortions have been attempted using herbal medicines, sharp tools, forceful massage, or through other traditional methods.<sup>[21]</sup> Abortion laws and cultural or religious views of abortions are different around the world. In some areas abortion is legal only in specific cases such as rape, problems with the fetus, poverty, risk to a woman's health, or incest.<sup>[22]</sup> There is debate over the moral, ethical, and legal issues of abortion.<sup>[23][24]</sup> Those who oppose abortion often argue that an embryo or fetus is a human with a right to life, and they may compare abortion to murder.<sup>[25][26]</sup> Those who support the legality of abortion often hold that it is part of a woman's right to make decisions about her own body.<sup>[27]</sup> Others favor legal and accessible abortion as a public health measure.<sup>[28]</sup>

Abortion	
<b>Other names</b>	Induced miscarriage, termination of pregnancy
<b>Specialty</b>	Obstetrics and gynecology
<b>ICD-10-PCS</b>	O04
<b>ICD-9-CM</b>	779.6
<b>MeSH</b>	D000028
<b>MedlinePlus</b>	007382
<a href="#">[edit on Wikidata]</a>	

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Languages

1 type(s)

1.1	Induced
1.2	Spontaneous

Wikipedia: Collaborative Creation

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Article **Abortion: Revision history**

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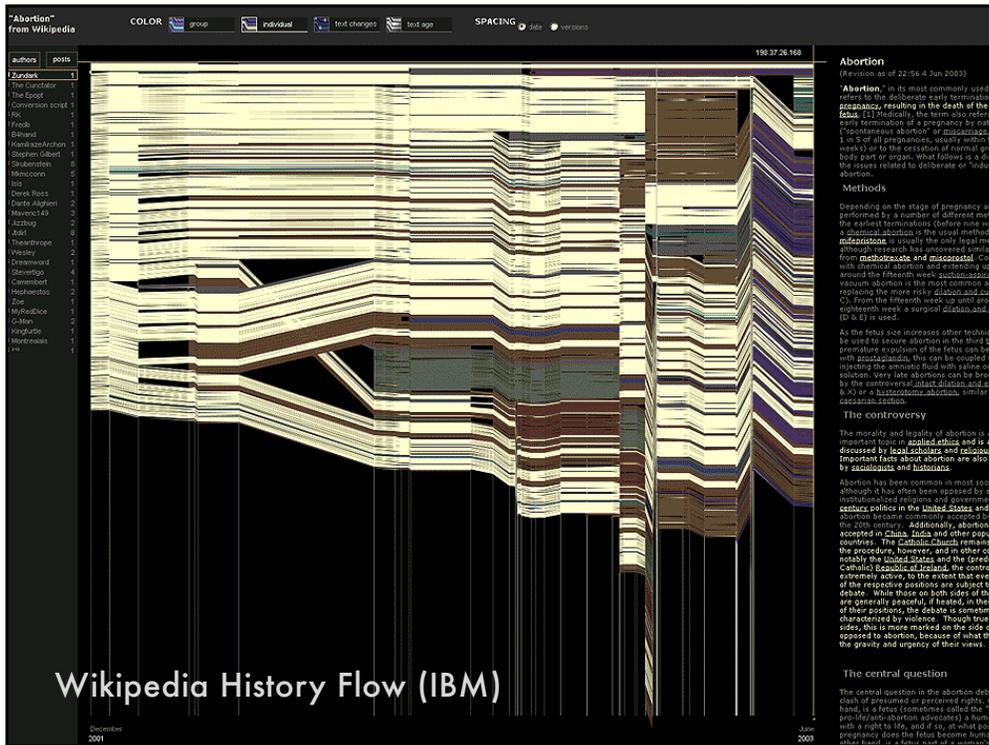
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For any version listed below, click on its date to view it. For more help, see [Help:Page history](#) and [Help:Edit summary](#). (cur) = difference from current version, (prev) = difference from preceding version, m = minor edit, → = section edit, ← = automatic edit summary (newest | oldest) View (newer 50 | older 50) (20 | 50 | 100 | 250 | 500)

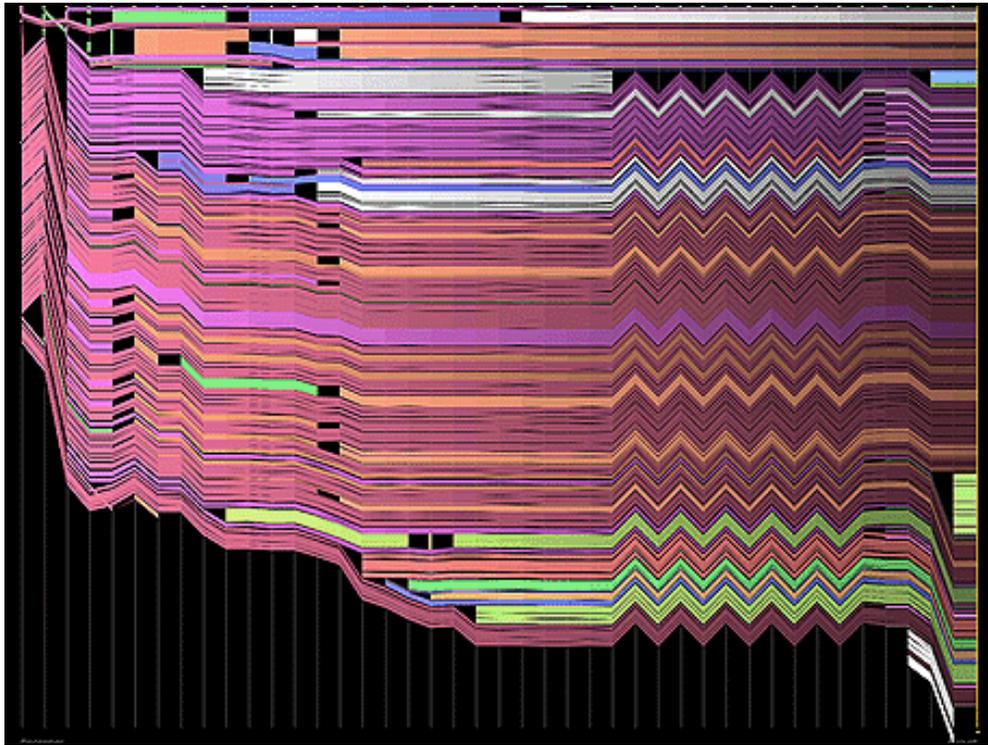
Compare selected revisions

- (cur | prev) 15:50, 17 December 2019 InternetArchiveBot (talk | contribs) . . (175,162 bytes) (+406) . . (*Blueinking 4 books for verifiability.*) #IABot (v2.1alpha3)
- (cur | prev) 11:54, 16 December 2019 NightHeron (talk | contribs) . . (174,756 bytes) (+5) . . (*→Anti-abortion violence: "pro-life" changed to "anti-abortion" in wikivoice*)
- (cur | prev) 04:42, 15 December 2019 Doc James (talk | contribs) . . (174,751 bytes) (+113) . . (*adjusted*)
- (cur | prev) 04:40, 15 December 2019 Doc James (talk | contribs) . . (174,638 bytes) (-27) . . (*→History and religion: condense*)
- (cur | prev) 04:07, 15 December 2019 Edit5001 (talk | contribs) . . (174,665 bytes) (+211) . . (*Better quoted from source, more details*)
- (cur | prev) 07:54, 13 December 2019 FakeRealAlbert (talk | contribs) m . . (174,454 bytes) (-207) . . (*→History and religion: Removed repetition*) (Tag: Visual edit)
- (cur | prev) 03:32, 12 December 2019 Rhododendrites (talk | contribs) . . (174,661 bytes) (-368) . . (*Reverted 1 edit by Edit5001 (talk): WP:EDITORIALIZING (TW)*) (Tag: Undo)
- (cur | prev) 01:41, 12 December 2019 Edit5001 (talk | contribs) . . (175,029 bytes) (+368) . . (*Direct quote from a reliable (https://en.wikipedia.org/wiki/Wikipedia:Reliable\_sources) and independent (https://en.wikipedia.org/wiki/Wikipedia:Independent\_sources) source.*) (Tag: Visual edit)
- (cur | prev) 15:21, 11 December 2019 Triacylglyceride (talk | contribs) . . (174,661 bytes) (-31) . . (*Undid revision 930253916 by Edit5001 (talk) two people disagreeing with you and you agreeing with yourself isn't a consensus.*) (Tag: Undo)
- (cur | prev) 06:59, 11 December 2019 Edit5001 (talk | contribs) . . (174,692 bytes) (+31) . . (Tag: Visual edit)
- (cur | prev) 21:02, 4 December 2019 Doc James (talk | contribs) . . (174,661 bytes) (+88) . . (*→Safety: added quote*)
- (cur | prev) 20:13, 4 December 2019 Doc James (talk | contribs) . . (174,573 bytes) (+202) . . (*The quote is literally right there.*) (Tag: Undo)
- (cur | prev) 20:07, 4 December 2019 Doc James (talk | contribs) . . (174,274 bytes) (-426) . . (*trimmed not great source*)

9



10



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“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  
January 2009

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“What information consumes is rather obvious:  
**it consumes the attention of its recipients.**  
Hence a wealth of information creates a poverty  
of attention, and a need to allocate that  
attention efficiently among the overabundance of  
information sources that might consume it.”



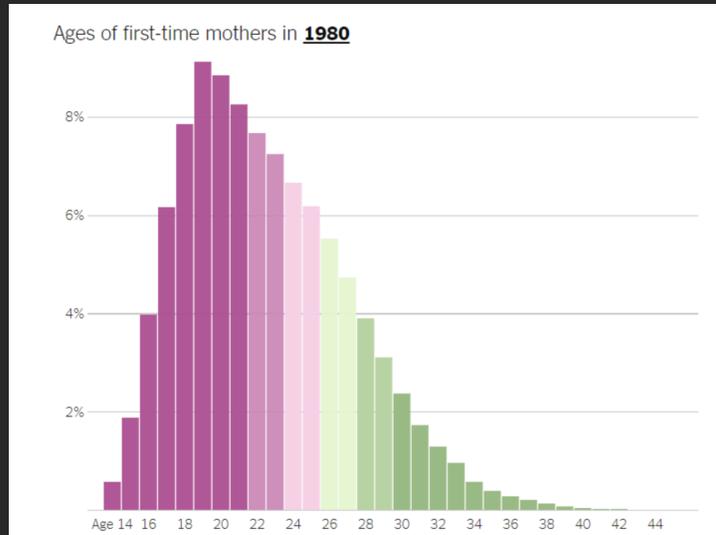
*Herb Simon*  
as quoted by Hal Varian  
Scientific American  
September 1995

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**What is visualization?**

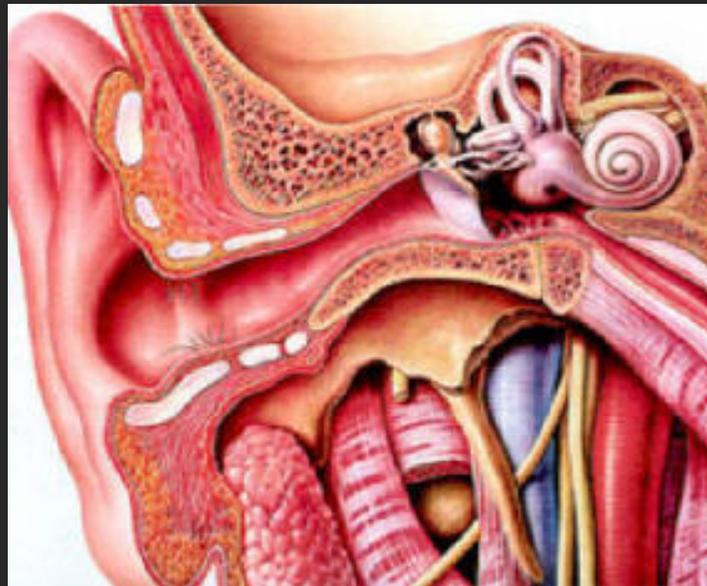
14

# Examples



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# Examples



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## Examples

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## What is visualization?

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**“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]

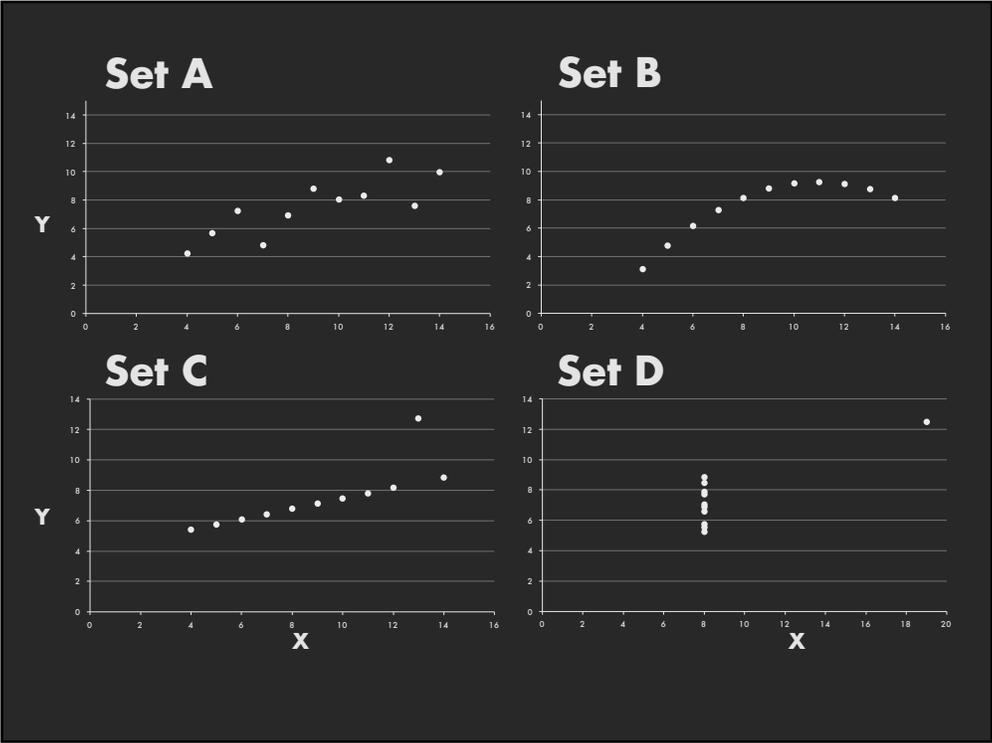
19

Set A		Set B		Set C		Set D	
X	Y	X	Y	X	Y	X	Y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	19	12.5
12	10.84	12	9.11	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89

<b>Summary Statistics</b>	<b>Linear Regression</b>	
$\mu_X = 9.0$ $\sigma_X = 3.317$	$Y = 3 + 0.5 X$	<b>[Anscombe 73]</b>
$\mu_Y = 7.5$ $\sigma_Y = 2.03$	$R^2 = 0.67$	

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## Why do we create visualizations?

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## Why do we create visualizations?

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

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# The Purpose of Visualization

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## Record information

- Photographs, blueprints, ...

## Support reasoning about information (analyze)

- Process and calculate
- Reason about data
- Expand memory

## Convey information to others (present)

- Share and persuade
- Emphasize important aspects of data

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# Record Information

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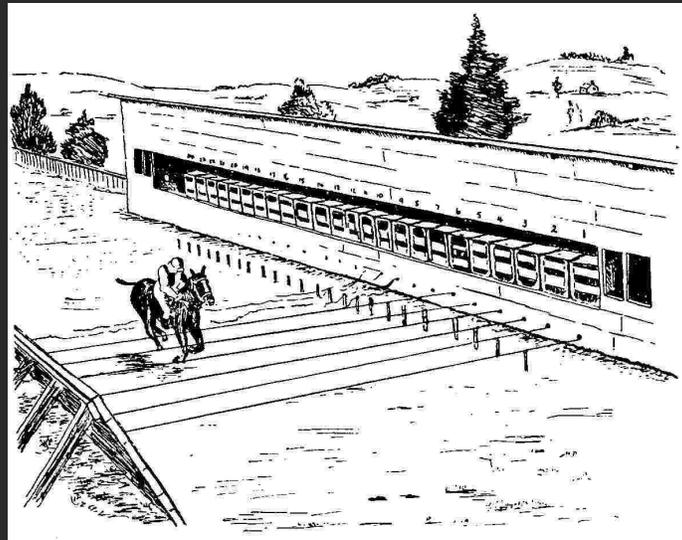
## Answer question



Gallop, Bay Horse "Daisy" [Muybridge 1884-86]

30

## Answer question



Gallop, Bay Horse "Daisy" [Muybridge 1884-86]

31

## Photographs: Phases of the moon

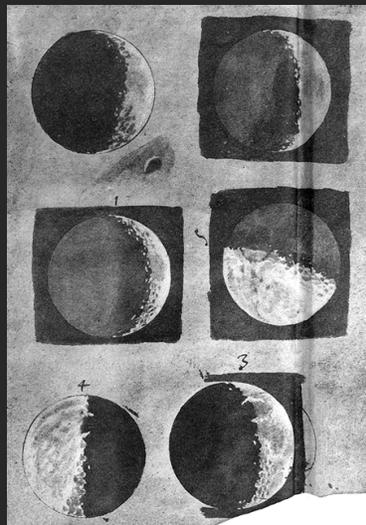
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## Drawing: Phases of the moon

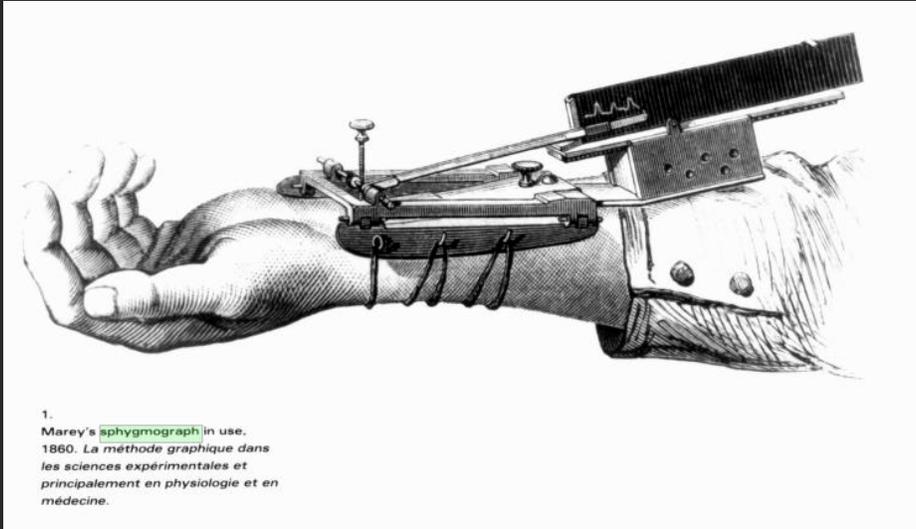
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Galileo's drawings of the phases of the moon from 1616  
<http://galileo.rice.edu/sci/observations/moon.html>

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## Other recording instruments



Marey's sphygmograph [from Braun 83]

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## Support Reasoning

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# Make a decision: Challenger

HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

SRM No.	Erosion Depth (in.)	Cross Sectional View		Top View		Clocking Location (deg)
		Perimeter Affected (deg)	Nominal Dia. (in.)	Length of Max Erosion (in.)	Total Heat Affected Length (in.)	
61A LH Center Field**	None	None	0.280	None	None	36°-55°
62A LH Outer Field**	None	None	0.280	None	None	33°-11°
61C LH Forward Field**	0.010	154.0	0.280	4.25	5.25	163
61C RH Center Field (prtg)***	0.038	130.0	0.280	12.50	56.75	354
61C RH Center Field (sec)***	None	45.0	0.280	None	23.50	354
410 RH Forward Field	0.028	110.0	0.280	3.00	None	275
41C LH Aft Field*	None	None	0.280	None	None	--
41B LH Forward Field	0.040	217.0	0.280	3.00	14.50	381
575-2 RH Aft Field	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

- 2 CASE JOINTS (90°) (110°) AEC
- MUCH WORSE VIBRALLY THAN SRM-22

SRM-22 BLOW-BY

- 2 CASE JOINTS (30-40°)

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

- NOZZLE BLOW-BY

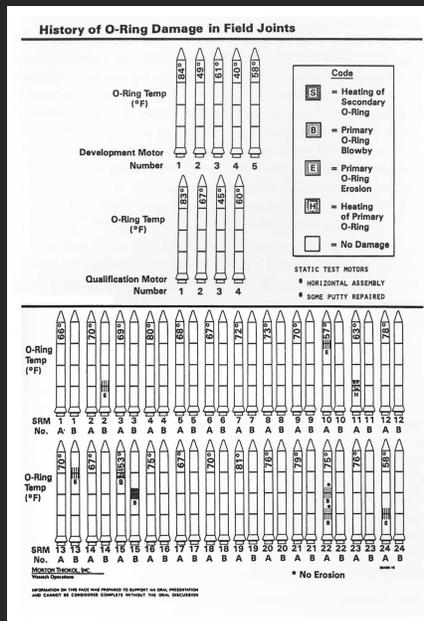
HISTORY OF O-RING TEMPERATURES (DEGREES-F)

MOTOR	MBT	AMB	O-RING	WIND
DM-1	68	36	47	10 MPH
DM-2	76	45	52	10 MPH
DM-3	72.5	40	48	10 MPH
DM-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

2 of 13 pages of material faxed to NASA by Morton Thiokol [from Tufte 1997]

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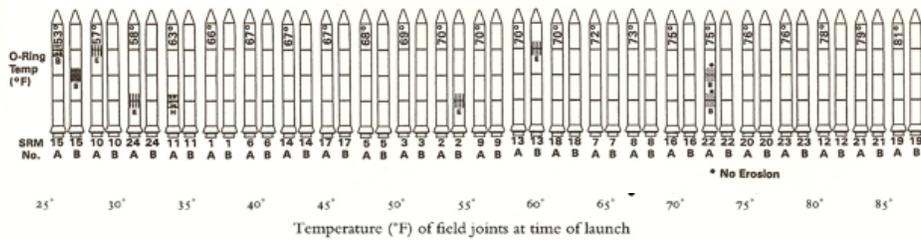
# Make a decision: Challenger



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# Make a decision: Challenger

O-ring damage index, each launch

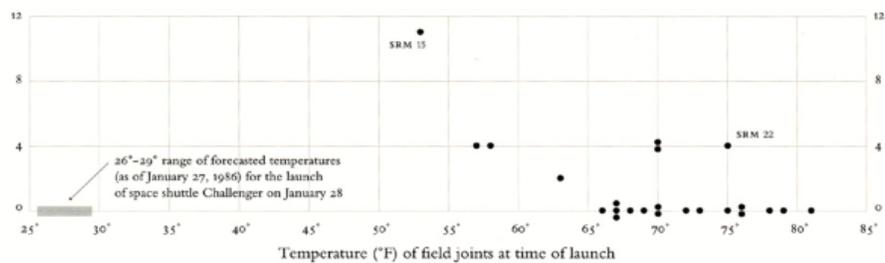


Visualizations drawn by Tufte show how low temperatures damage O-rings [Tufte 97]

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# Make a decision: Challenger

O-ring damage index, each launch



Visualizations drawn by Tufte show how low temperatures damage O-rings [Tufte 97]

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## Expand memory: Multiplication

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Class Exercise

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## Expand memory: Multiplication

---

$$\begin{array}{r} 34 \\ \times 87 \\ \hline \end{array}$$

44

## Expand memory: Multiplication

---

$$\begin{array}{r} 34 \\ \times 87 \\ \hline 238 \\ 2720 \\ \hline 2958 \end{array}$$

45

## Expand memory: Multiplication

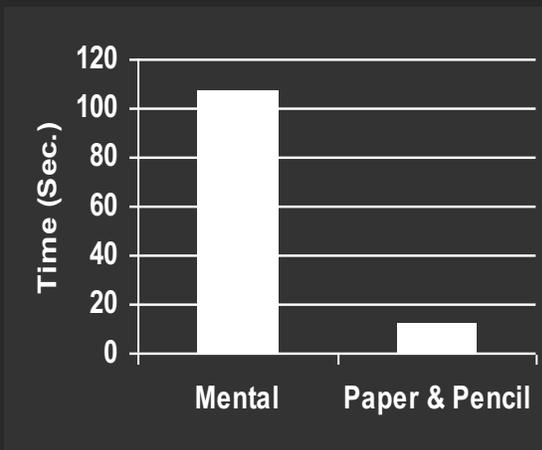
---

$$\begin{array}{r} 74 \\ \times 48 \\ \hline \end{array}$$

46

# Expand memory: Multiplication

$$\begin{array}{r} 74 \\ \times 48 \\ \hline 592 \\ 2960 \\ \hline 3552 \end{array}$$



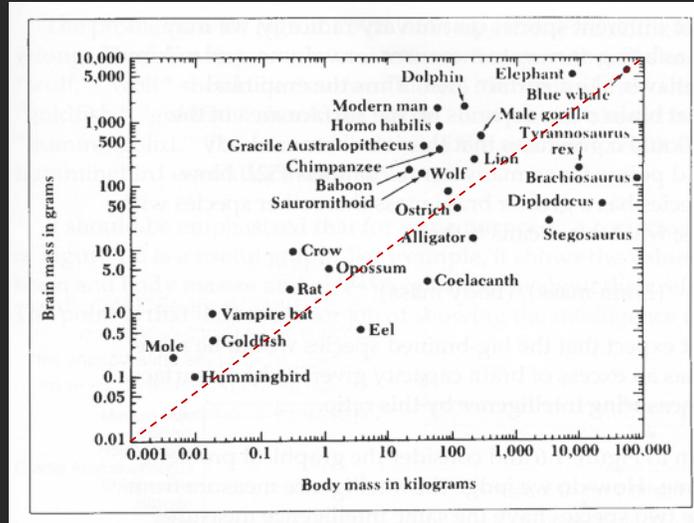
47

# 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

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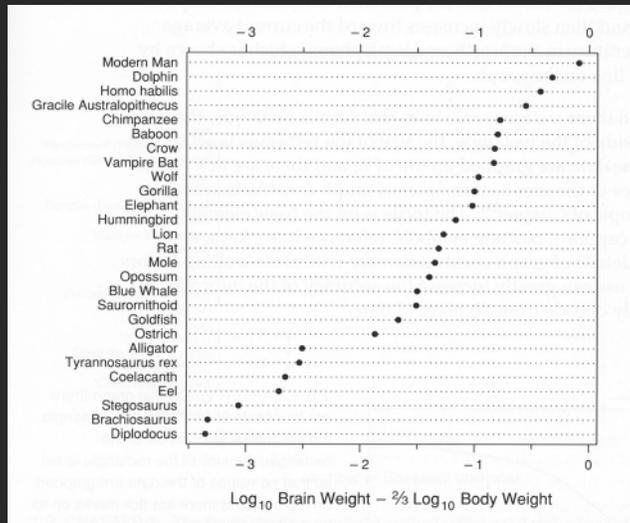
# Most powerful brain?



The Dragons of Eden [Carl Sagan]

53

# Tell a story: Most powerful brain?



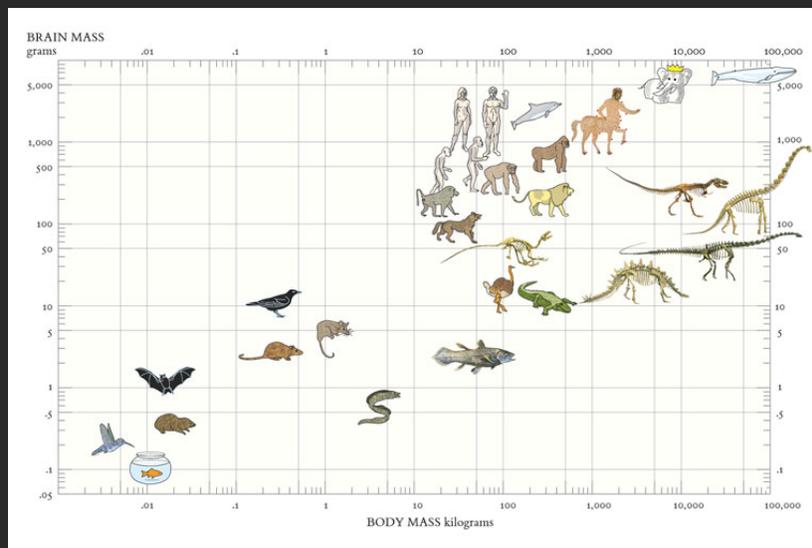
The Elements of Graping Data [Cleveland]

54

# Convey Information to Others

55

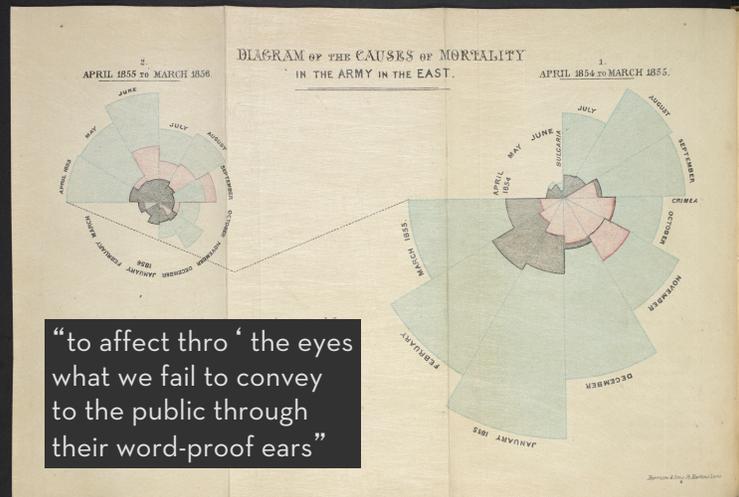
## Most powerful brain?



Beautiful Evidence [Tufte]

56

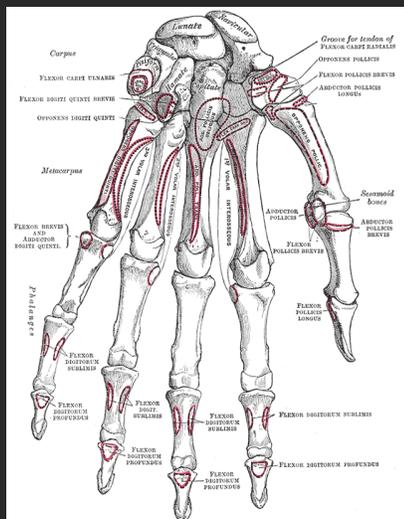
# Present argument



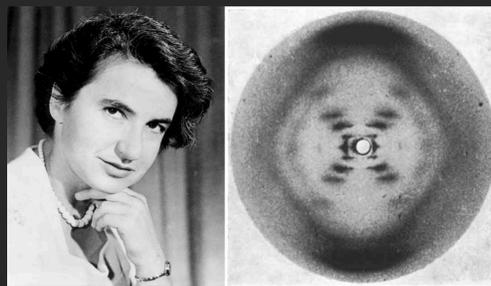
Crimean War Deaths [Nightingale 1858]

57

# Inspire



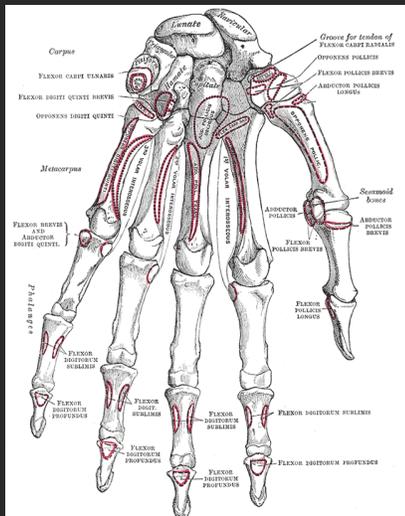
Bones in hand [from 1918 edition]



X-ray crystallography of DNA [Franklin 52]

58

# Inspire



Bones in hand [from 1918 edition]



Double helix model [Watson and Crick 53]

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## The Purpose of Visualization

### Record information

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### Support reasoning about information (analyze)

- Process and calculate
- Reason about data
- Expand memory

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# Goals of visualization research

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## 1. Understand how visualizations convey information

- What do people perceive/comprehend ?
- How do visualizations correspond with mental models of data?

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

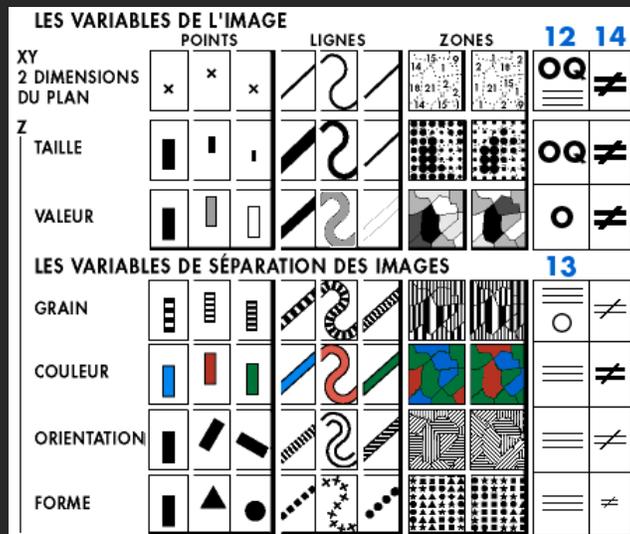
- Leverage perception and cognition
- Strengthen connection between visualization and mental models

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# Course Topics

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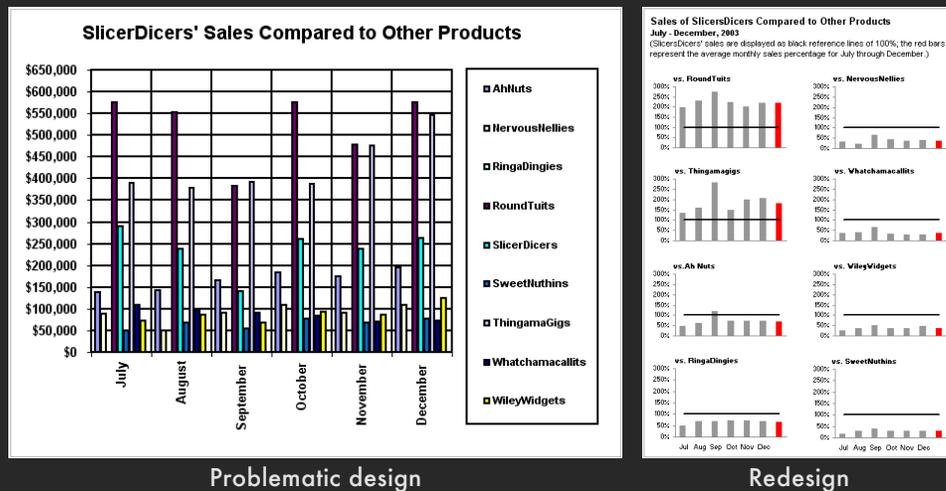
# Data and image models



[Bertin, Graphics and Graphic Information Processing 1981]

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# Visualization Design & ReDesign



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# Exploratory Data Analysis

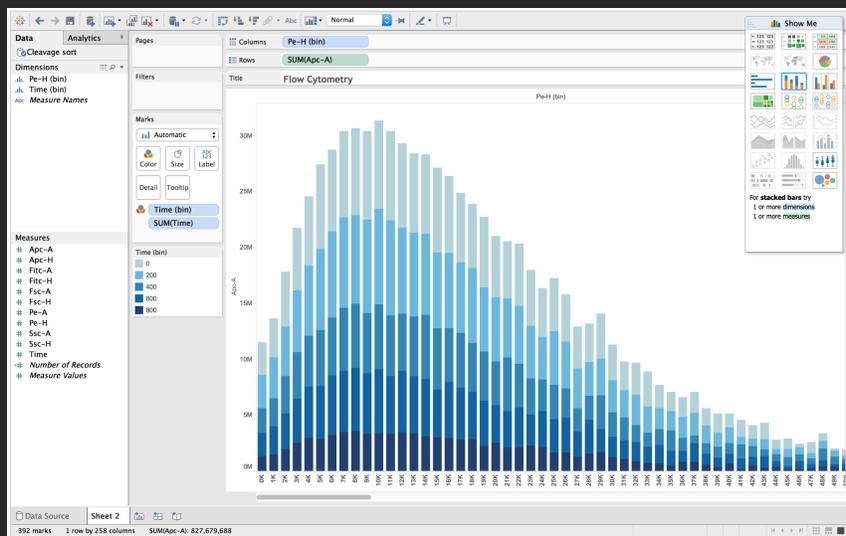
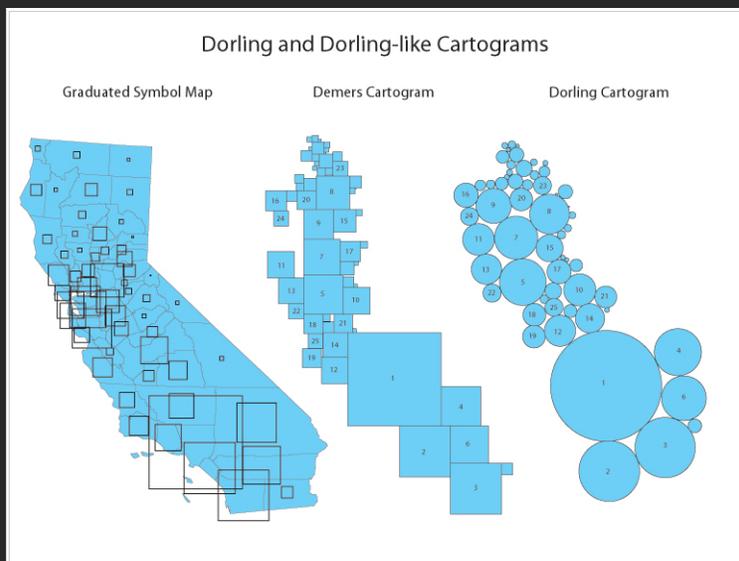


Tableau – based on Polaris [Stolte, Tang, Hanrahan]

72

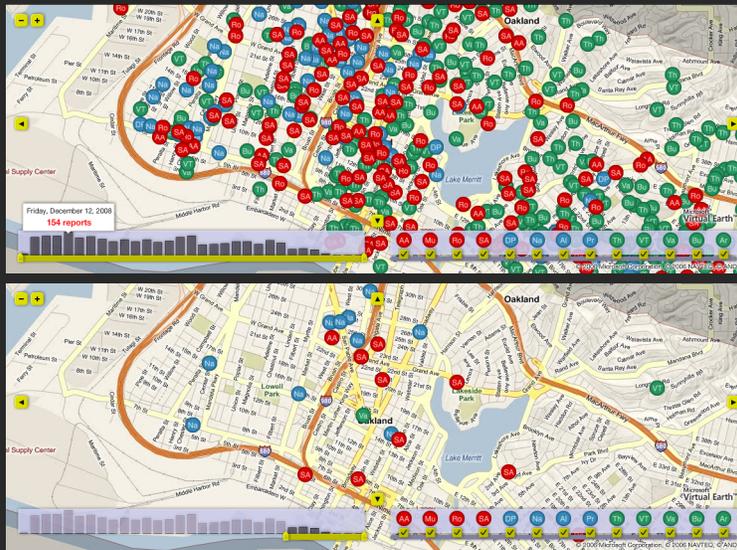
# Using Space Effectively



[http://www.ncgia.ucsb.edu/projects/Cartogram\\_Central/types.html](http://www.ncgia.ucsb.edu/projects/Cartogram_Central/types.html)

73

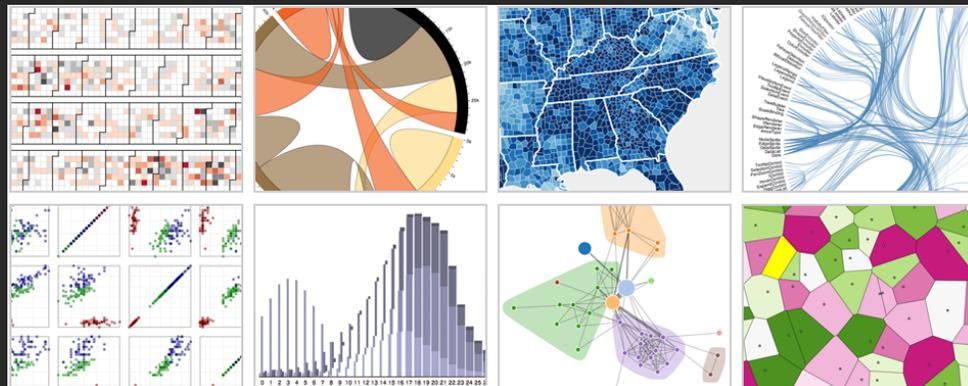
# Interaction



Oakland Crimespotting (crimespotting.org) [Stamen]

74

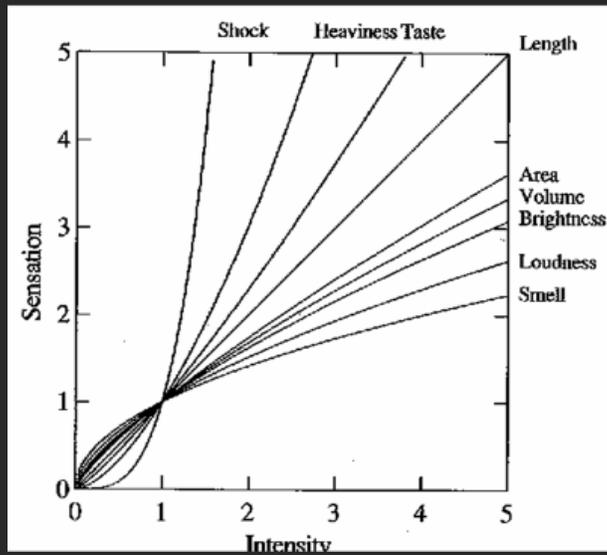
# Introduction to D3



D3: Data Driven Documents [Bostock 2011]

75

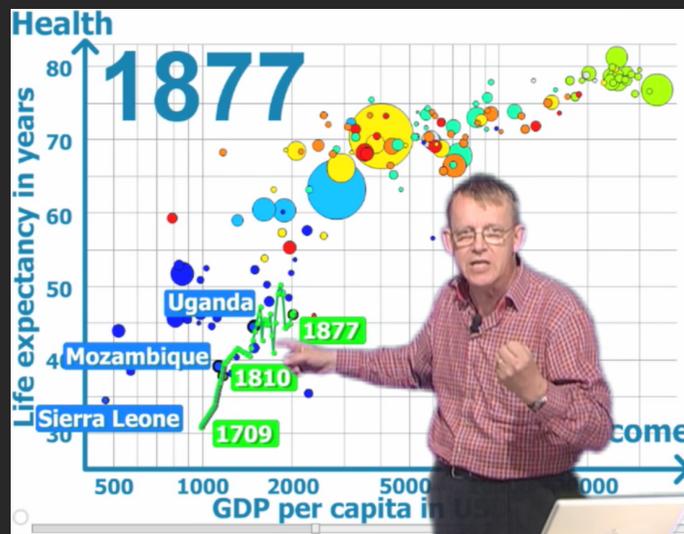
# Perception



The psychophysics of sensory function [Stevens 61]

76

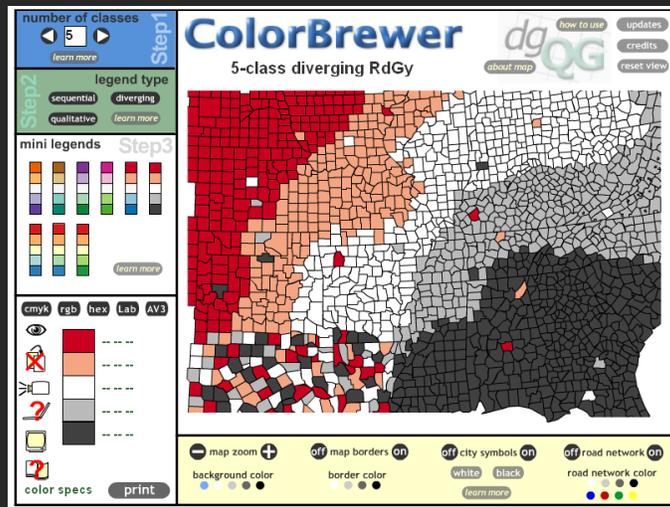
# Visual Explainers



Gapminder [Rosling]

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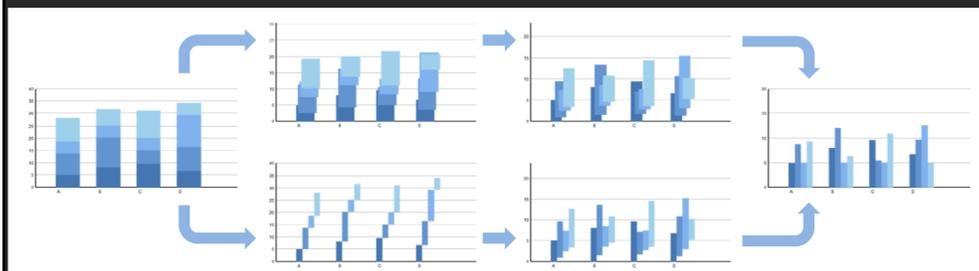
# Color



[from Cynthia Brewer <http://www.personal.psu.edu/faculty/c/a/cab38/>]

78

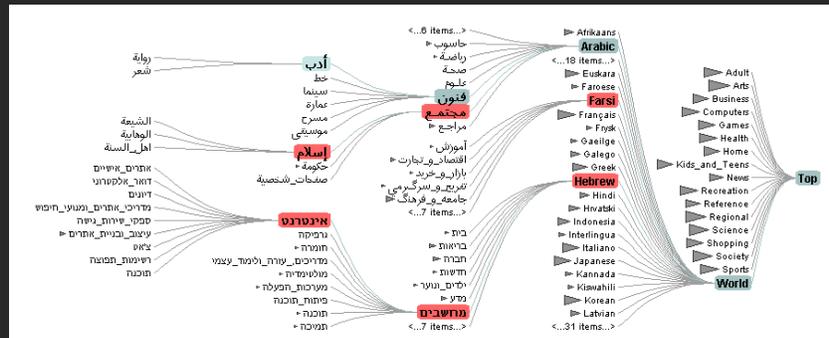
# Animation



Animated Transitions [Heer 07]

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# Networks



Degree-of-Interest Trees [Heer 2004]

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## You should expect to

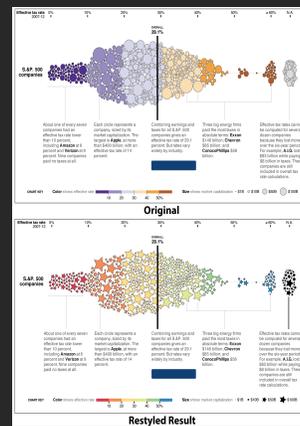
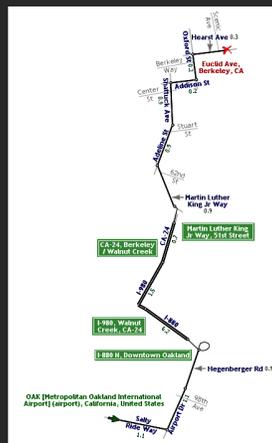
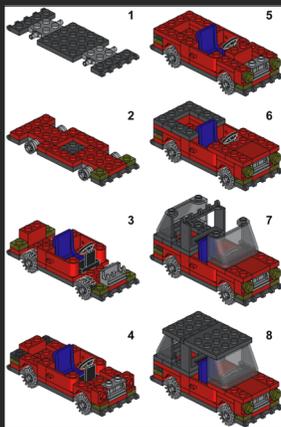
1. Design, evaluate and critique visualizations
2. Explore data using existing visualization tools
3. Implement interactive data visualizations
4. Develop a substantial visualization project

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# Course Mechanics

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## Instructor: Maneesh Agrawala



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# Course Assistant: Dae Hyun Kim

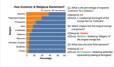


## Dae Hyun Kim



I am a Computer Science PhD student at Stanford, working with Prof. Maneesh Agrawala. My research focuses on building natural language interfaces for data visualizations. I did my undergrad in Computer Science at California Institute of Technology.

### My Works



#### Answering Questions about Charts and Generating Visual Explanations

Dae Hyun Kim, Enamul Hoque and Maneesh Agrawala  
ACM Human Factors in Computing Systems (CHI), Apr 2020 (to appear)  
PDF | Supplemental PDF | Code & Data



#### Facilitating Document Reading by Linking Text and Tables

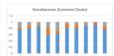
Dae Hyun Kim, Enamul Hoque, Juho Kim and Maneesh Agrawala  
The 31st Annual ACM Symposium on User Interface Software and Technology (UIST), Oct 2018, pp. 423-434.  
PDF | MP4 | Data

$$\text{Minimize } \sum_{i=1}^n (X_i A_i^T) (X_i A_i^T)^T$$

subject to  $\|X - X A_i^T\|_{F,2} \leq D$   
Minimize  $\|y - X_{i=1}^n X_i A_i^T\|_2$   
subject to  $\|X_{i=1}^n X_i\|_2 \leq D$

#### Finding Solutions to Generative Adversarial Privacy

Dae Hyun Kim, Taeyoung Kong and Seungbin Jeong  
arXiv preprint arXiv:1810.02069, Oct 2018  
PDF



#### Multiple Item, Ascending Price Auctions: An Experimental Examination of Alternative Auction Sequences

Dae Hyun Kim, Hsing Yang Lee, Travis Maron, Charles R. Plott and Ruijie D. Teo  
SSRN, Apr. 2015.  
PDF



#### Chromatic Bounds on Orbital Chromatic Roots

Dae Hyun Kim, Alexander H. Mun and Mohamed Omar  
The Electronic Journal of Combinatorics, 21(4), Oct 2014, pp. 4-17.  
Presented at 2014 Joint Mathematics Meetings (JMM)  
(American Mathematical Society + Mathematical Association of America)  
PDF



#### Schedule-Dependent Synergistic Effect of Rituximab on Methotrexate Chemotherapy against Lymphoma of the Central Nervous System

Juyoun Jin, Kyeong Min Joo, Younhee Nam, Dae Hyun Kim, Se Joong Lee, Mi-Hyoung Jo, Youngsoon Jin, Hyeon-Seok Kim, Seo Won Seo, Seok Jin Kim, Do-Hyun Nam and Won-Seog Kim  
Experimental and Therapeutic Medicine, 1(6), Nov 2010, pp. 943-946.

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## Office Hours

**Maneesh:** 1:30-3pm Wed, Canvas/Zoom & by appt.

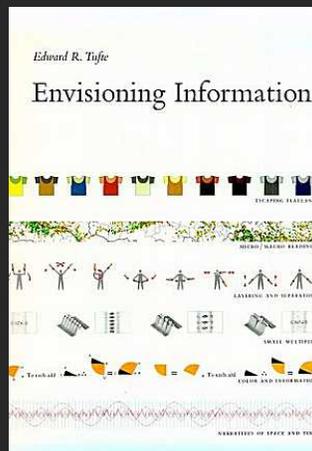
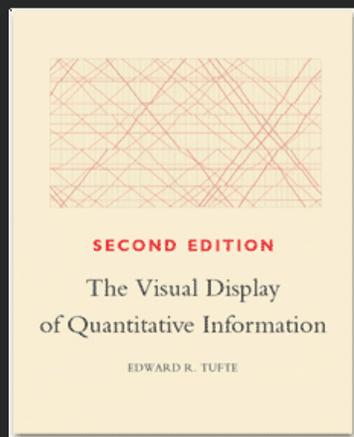
**Dae Hyun:** 7-8:00pm Tue, Canvas/Zoom & by appt.

**Outside of OH use Piazza to connect with us**

<https://piazza.com/stanford/fall2020/cs448b/>

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# Textbooks



See also: [www.edwardtufte.com](http://www.edwardtufte.com)

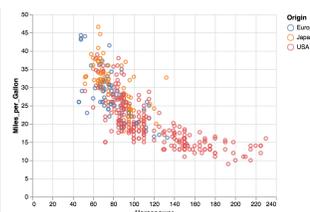
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# Interactive Notebooks

## Interactivity

In addition to basic plotting and view composition, one of Vega-Lite's more exciting features is its support for interaction.

Starting with a scatter plot, we can add a basic (yet valuable) form of interactivity - tooltips upon mouse hover - by including a tooltip encoding channel:

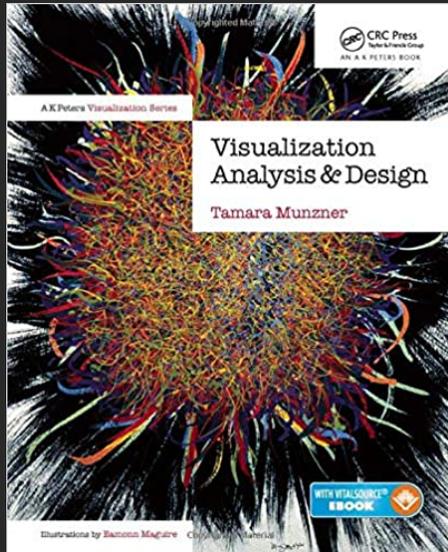


```
vl.markPoint().data(cars).encode({
  vl.x().fieldQ('Horsepower'),
  vl.y().fieldQ('Miles_per_Gallon'),
  vl.color().fieldQ('Origin'),
  vl.tooltip(['Name', 'Origin']) // show the Name and Origin fields in a tooltip
}).render()
```

Hands-on engagement with course concepts and modern visualization tools (Vega-Lite / D3), in JavaScript (Observable)

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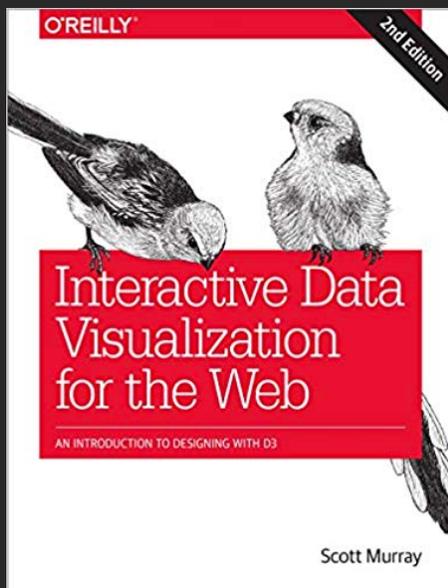
## Optional Textbook



For additional theory  
and depth

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## Optional Book



For learning D3!

Book available online  
Code/examples on GitHub

We will be using D3 v6  
<https://d3js.org>

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## Readings

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- **From books, notebooks and linked articles**  
Many open to public, some may require SUNetID/Password
- **Material in class will be loosely based on readings**
- **Readings should be read by start of class**
  
- **Post comments (about reading, notebooks or lecture) using link on class webpage**
  - **One** comment per week through week 9
  - Must post by **end of the week**
  - You have 1 **pass** for the quarter

### Class home page

<https://magrawala.github.io/cs448b-wi20/>

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## Reading/Notebook/Lecture Responses

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### Good responses typically exhibit one or more

- Critiques of arguments made in the papers/lectures
- Analysis of implications or future directions for ideas in readings/lectures
- Insightful questions about the readings/lectures

### Responses should not be summaries

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## Discussion

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**Discussion is essential** for effective design, evaluation and critique of visualizations

- Attendance for is very highly recommended
- Video – please leave on if you are comfortable doing so

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## Assignments

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**Class participation (10%)**

**Assignment 1: Visualization Design (10%) due 9/22**

**Assignment 2: Exploratory Data Analysis (15%) due 10/6**

Learn to use Tableau

**Assignment 3: Interactive Prototype (25%) due 10/20**

Should be familiar with Javascript (**start now if you are not**)

Will cover basics of D3 in class

**Final Project (40%) proposal due 10/27, presentation 11/10**

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# Final project

Either

- Create an extended visual explainer
- Small visualization research project

Projects from previous classes have been:

- Gone viral on blogs
- Published as research papers
- Released as open source projects

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# Structure of Musicals

## LYRICAL THEMES IN HAMILTON

### THEMES:

How Does	Alexander Hamilton	Aaron Burr, Sr	Talk Less, Smile More	Stand For Nothing	My Shot	King's College
Imagine Death	Story of Tonight	The Schuyler Sisters	Look Around	King George	Right Hand Man	Helpless
Satisfied	Wait For It	Stay Alive	Un...Deu...	Duel Commandments	That Would Be Enough	The Narrative
Who Lives, Who Dies	History Has Its Eyes On You	Yorktown	Blow Us All Away	Running Out Of Time	Coming/Goin' Home	The Room Where It Happens
On Your Side	One Last Time	Quiet Uptown				

Act 1



Act 2



THESIS: Helpless | Song: "Helpless"

LYRICS:  
And long as I'm alive, Eliza, swear to God  
You'll never feel so...

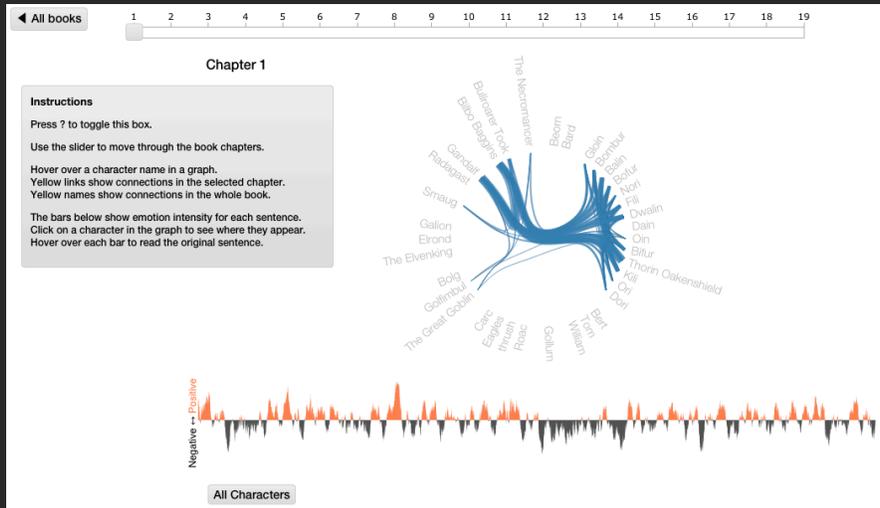
### SONGS:



Lyrical themes in Hamilton [Townley-Smith, Sterman, Cook 2016]

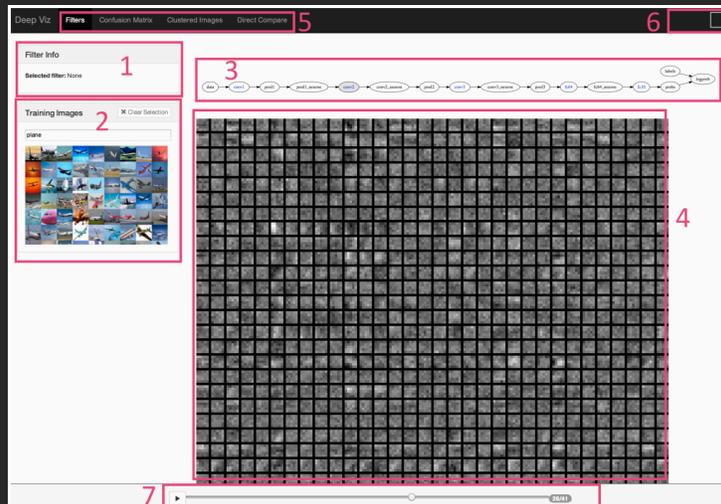
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# Visualization of Narrative Structure



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# deepviz: Visualizing Convolutional NNs



[Bruckner, Rosen, Sparks 2013]

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## Assignment 1: Visualization Design

Design a static visualization for a data set.

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

### Data: Stanford Olympic Medals

The [Stanford Daily](#) publishes a variety of datasets through the [Stanford Open Data Portal](#). We have extracted and wrangled a small data table containing information about the Stanford students that have won medals at the summer Olympics since 1912. Our data contains the following information:

Number of records: 270

#### Variable Names:

**Athlete Name:** Name of athlete.

**Host City:** Name of city that hosted the Olympics.

**Host Country:** Name of country that hosted the Olympics.

**Year:** Year the summer Olympics took place.

**Athlete Team Country:** Country whose team the athlete represented.

**Sport:** Name of sport athlete competed in.

**Event:** Name of event athlete competed in ("-" indicates event name is same as name of sport).

**Medal:** Type of medal won (ties are indicated in parentheses).

The extracted dataset is available in csv format: [olympic\\_athletes-wrangled.csv](#)

**Due by 7am on Tue Sep 22**

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## Assignment 1: Visualization Design

Pick a guiding question, use it to title your visualization

Design a static visualization for that question

You are free to use any tools (including pen & paper)

Deliverables (upload via Canvas; see A1 page)

PDF of your visualization with a short description including design rationale ( $\leq 4$  paragraphs)

**Due by 7am on Tue Sep 22**

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