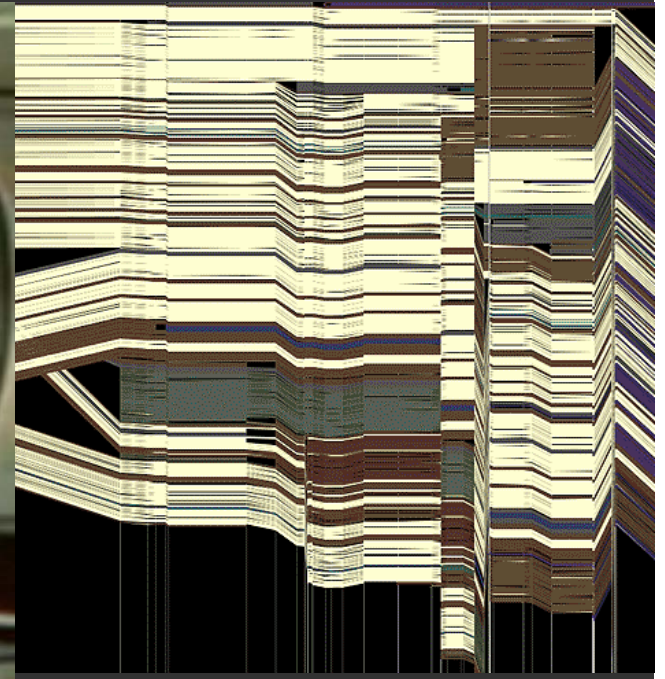
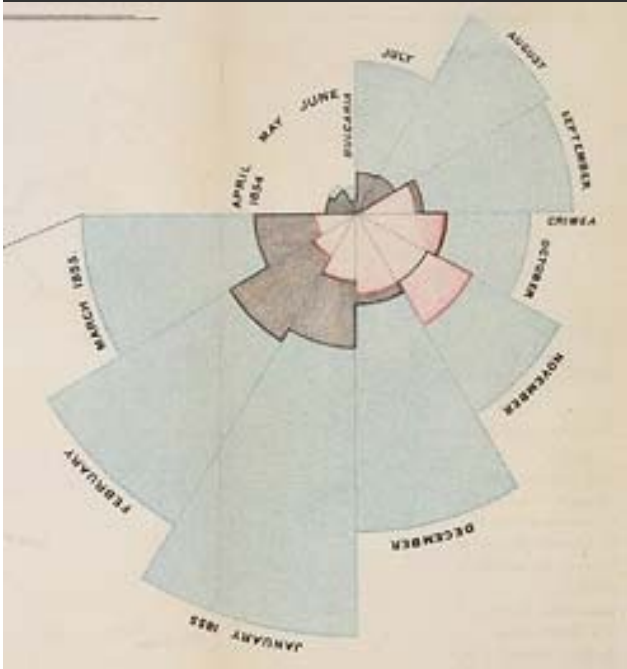


a brief introduction to

Data Visualization



Jeffrey Heer Stanford University

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

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

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

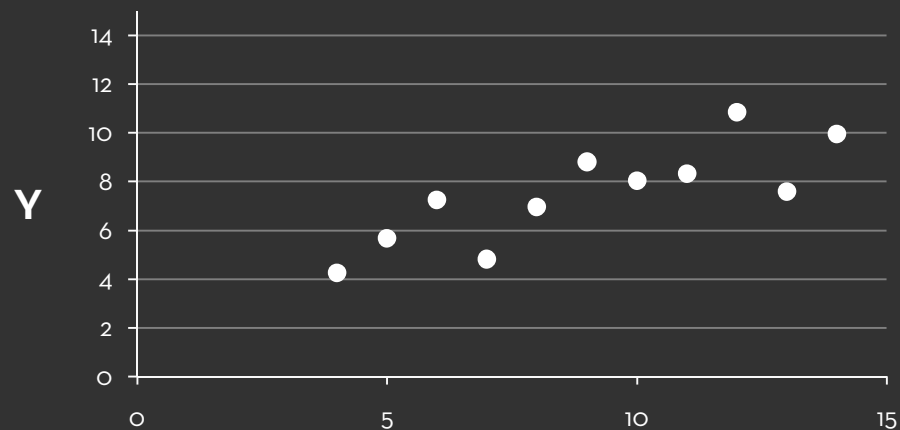
Linear Regression

$$Y = 3 + 0.5 X$$

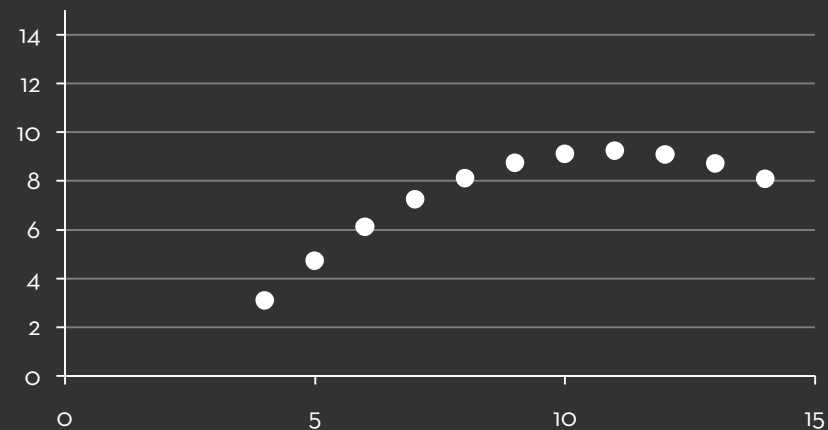
$$R^2 = 0.67$$

[Anscombe 73]

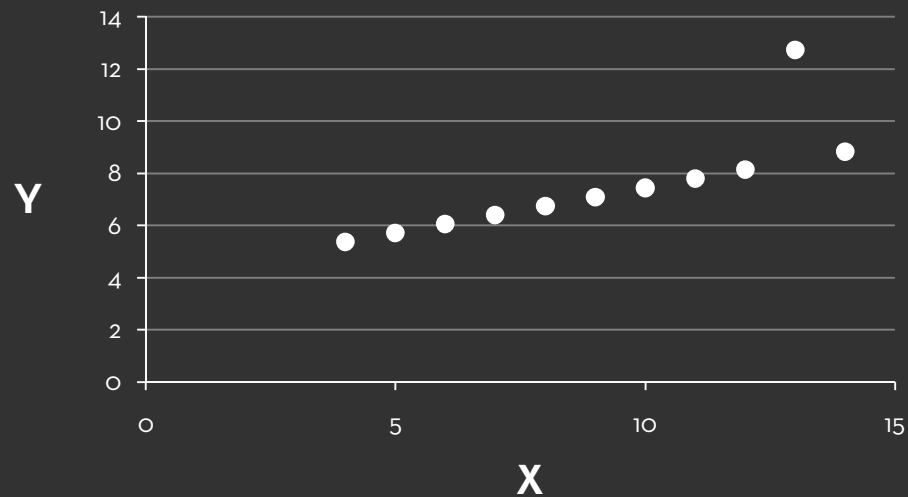
Set A



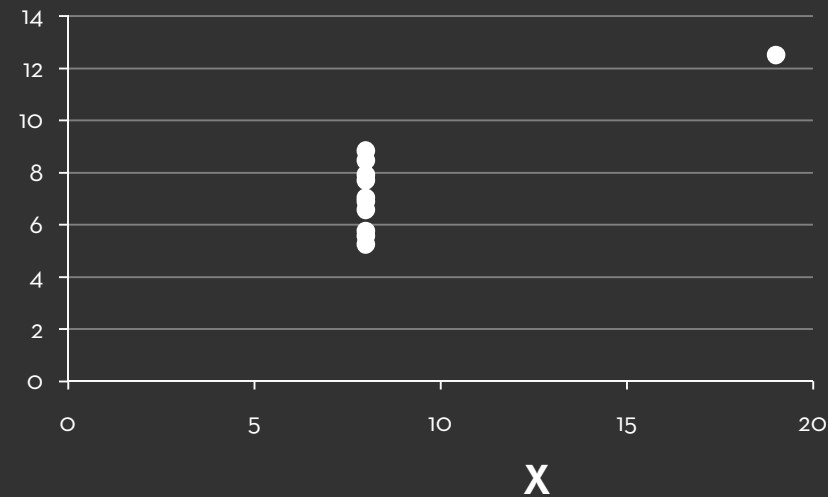
Set B

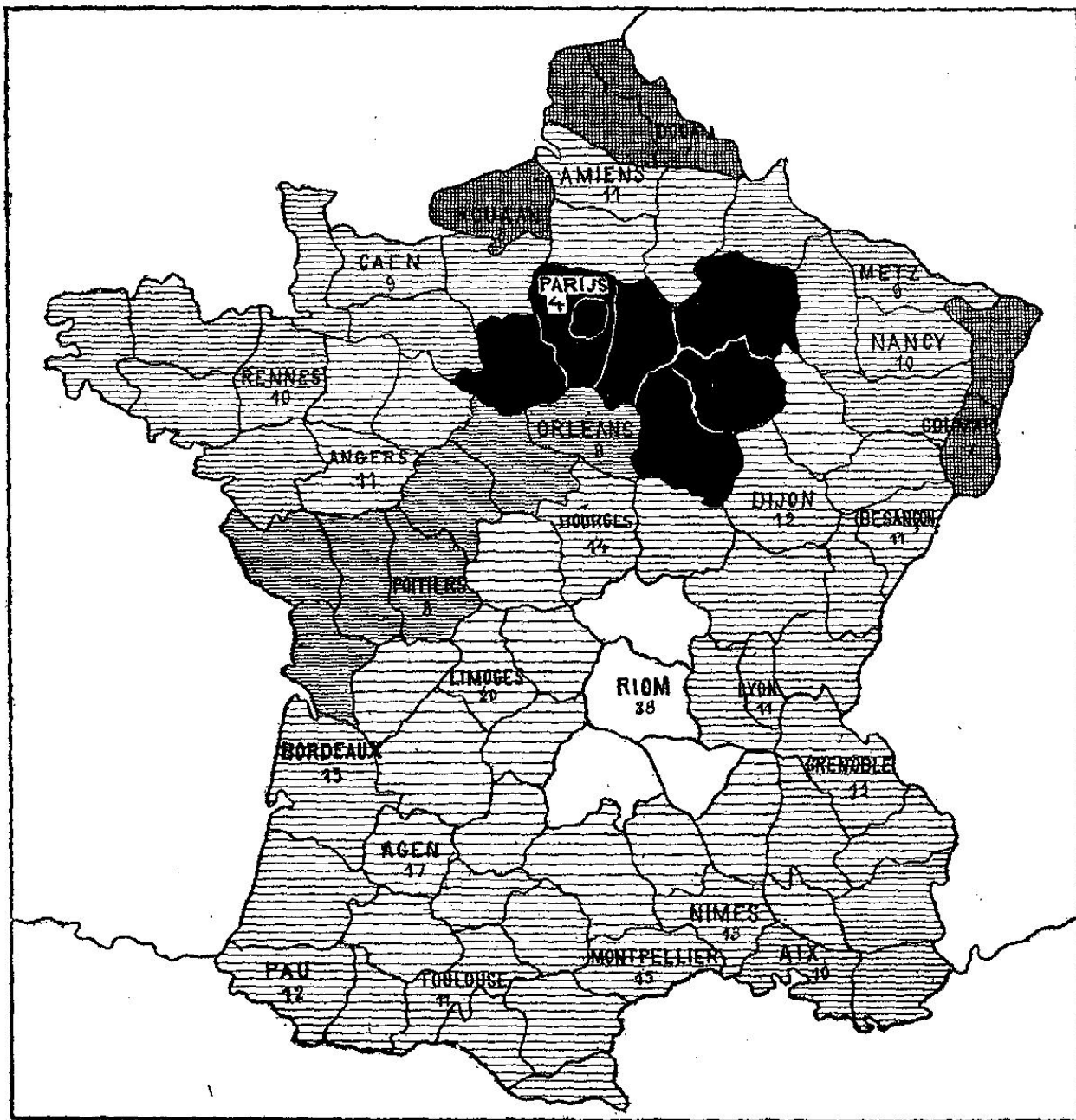


Set C



Set D





1826(?) Illiteracy in France, Pierre Charles Dupin



cabspotting.org

"Abortion" from Wikipedia

COLOR

group

individual

text changes

text age

SPACING

date

versions

authors

posts

Zundark	1
The Conductor	1
The Epost	1
Conversion script	1
RK	1
Fredb	1
B4hand	1
KamikazeArchon	1
Stephen Gilbert	1
Slurbenstein	8
Mimicconn	5
Isle	1
Derek Ross	2
Dante Alighieri	2
Maveric149	3
Jazzbug	2
Jdirl	8
Theanthrope	1
Wesley	2
Dreamword	1
Steventigo	4
Camembert	1
Hephaestus	2
Zoe	1
MyRedDice	1
G-Man	2
Kingturtle	1
Montrealais	1
...	1

198 37 26 168

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 early termination of a pregnancy by nature ("spontaneous abortion" or **miscarriage**, which occurs in 1 in 5 of all pregnancies, usually within the first trimester) or to the cessation of normal growth of the embryo or fetus. 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 most common method is **mifepristone**, which 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. From the fifteenth week up until around the eighteenth week a surgical dilation and curettage (D & C) is used.

As the fetus size increases other techniques can be used to secure abortion in the third trimester. Premature expulsion of the fetus can be achieved with prostaglandin, this can be coupled with injecting the amniotic fluid with saline or a 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 highly important topic in applied ethics and is also discussed by legal scholars and religious groups. Important facts about abortion are also reviewed by sociologists and historians.

Abortion has been common in most societies, although it has often been opposed by some institutionalized religions, and governments. In the 20th century, politics in the United States and Europe became commonly accepted by the 1960s. 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 respective 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 perceive as the gravity and urgency of their views.

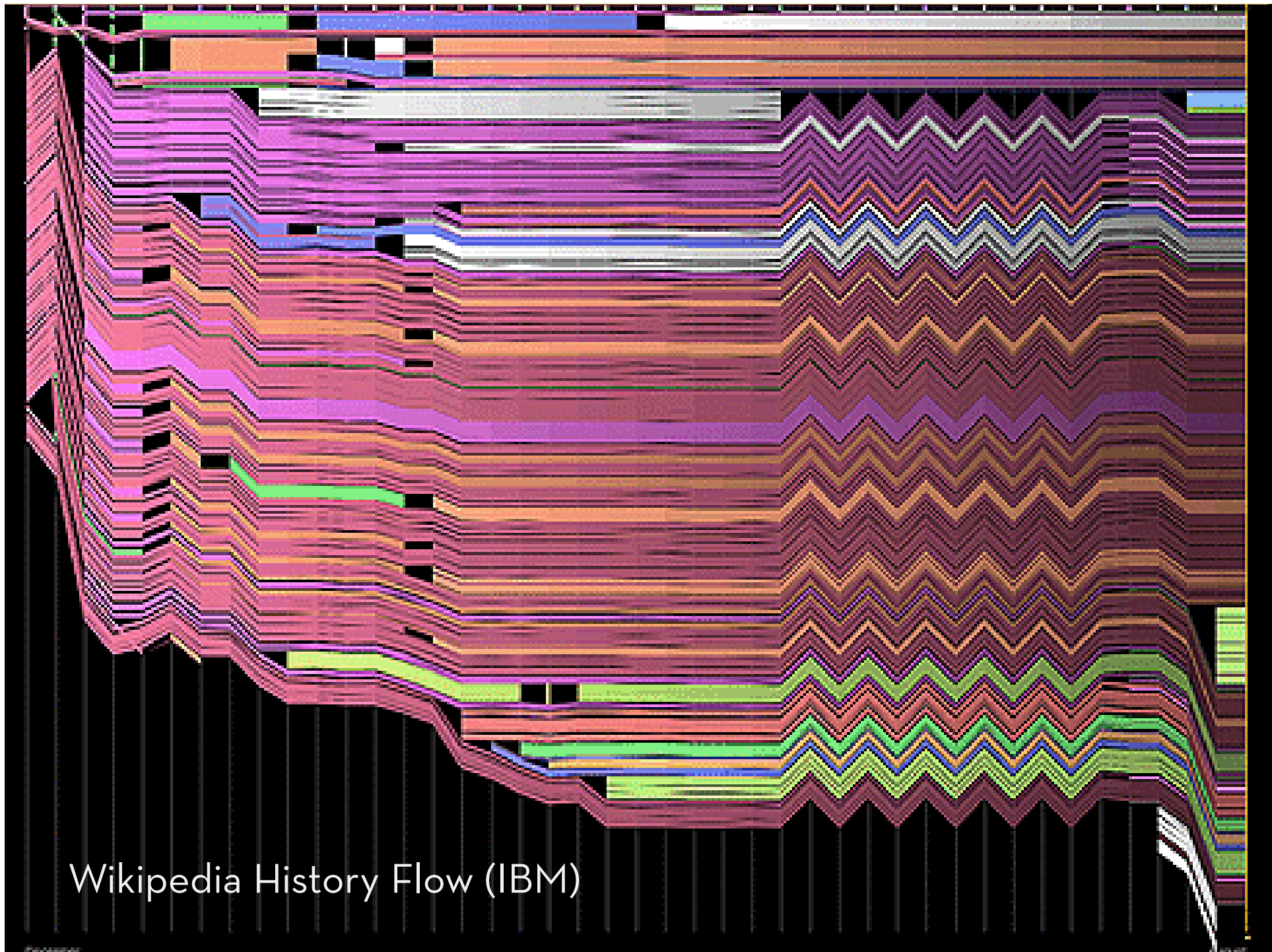
The central question

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 child" 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 (IBM)

December
2001

June
2003

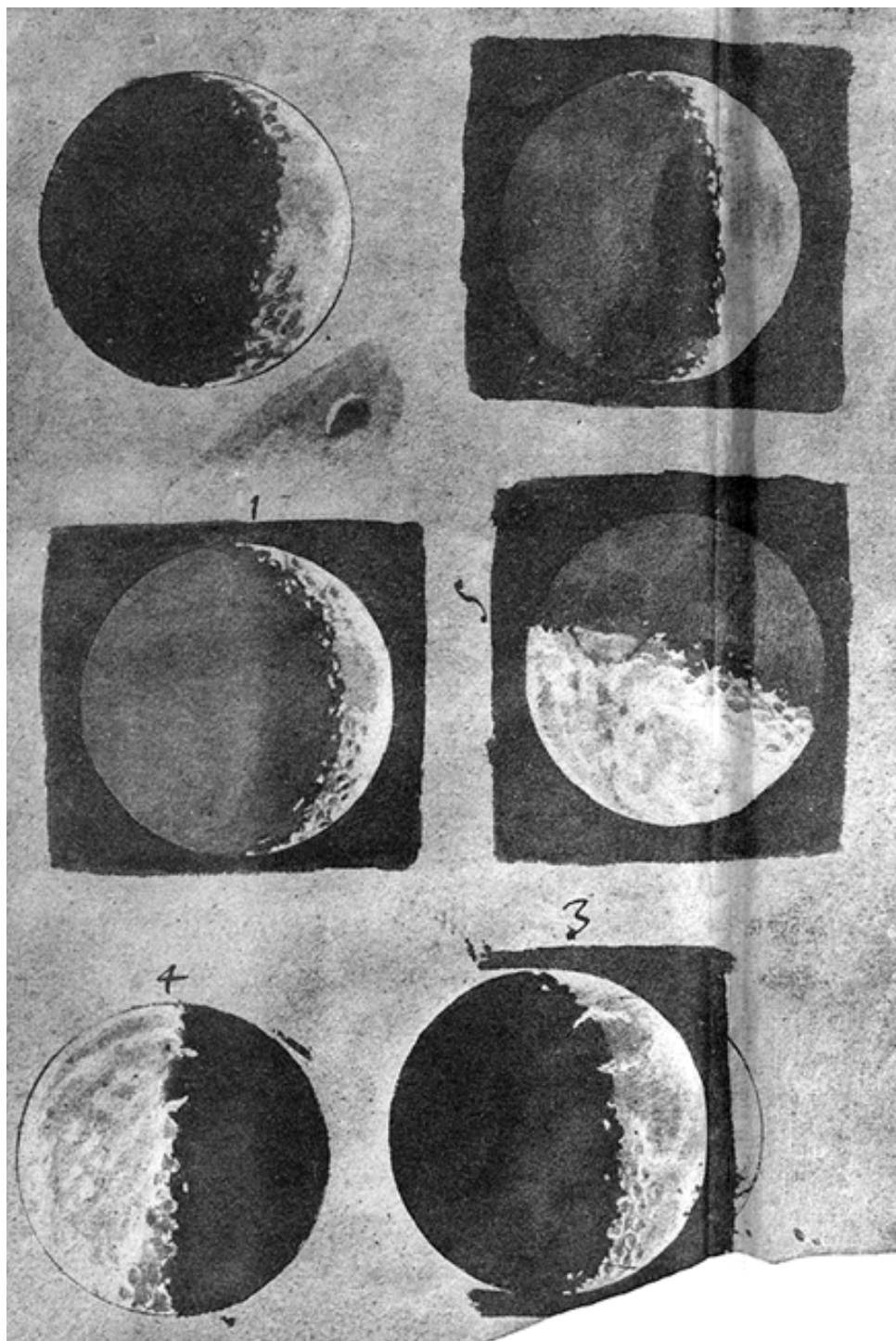


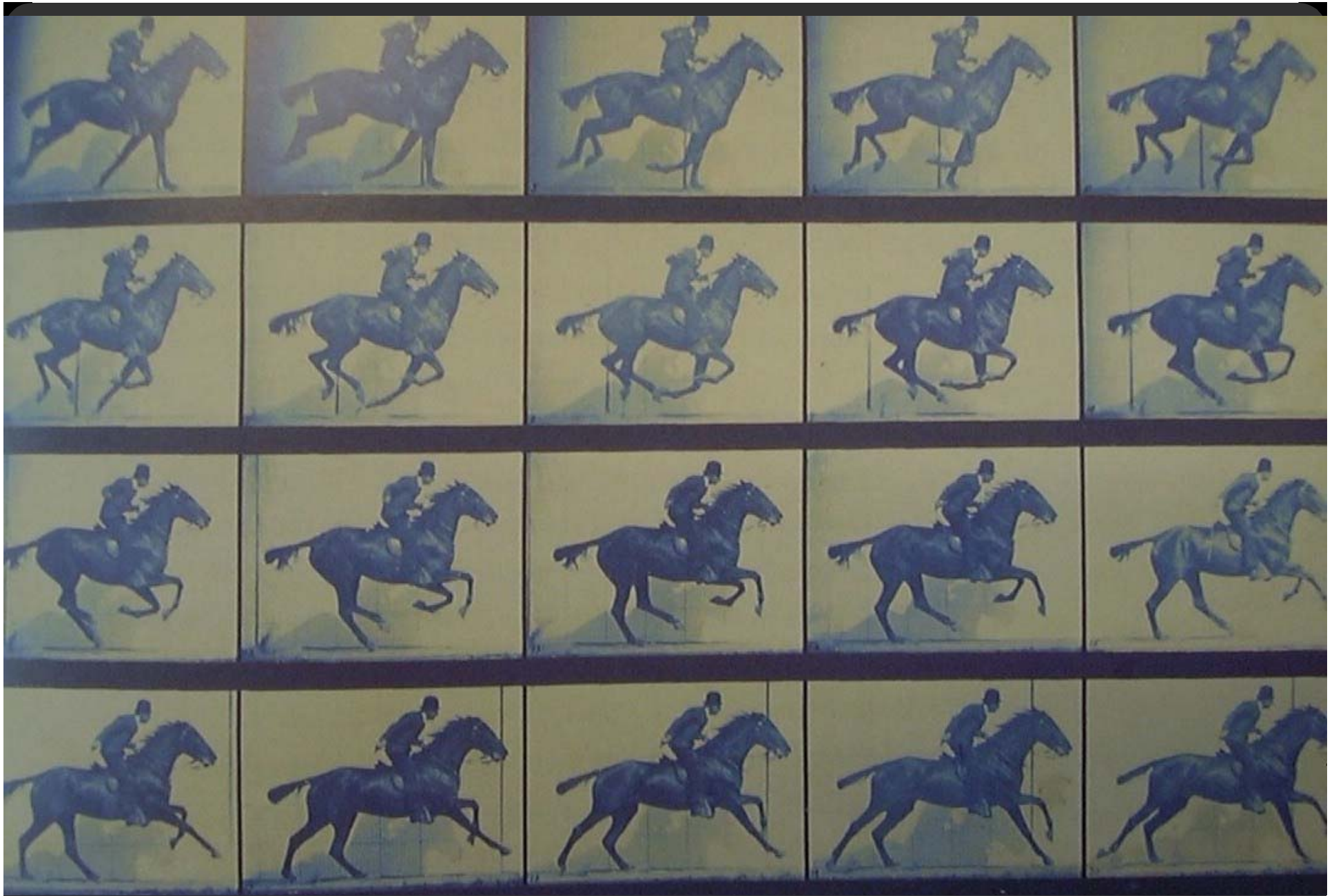
The Value of Visualization

Three functions of visualizations

Record: store information

- Photographs, blueprints, ...





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

Three functions of visualizations

Record: store information

- Photographs, blueprints, ...

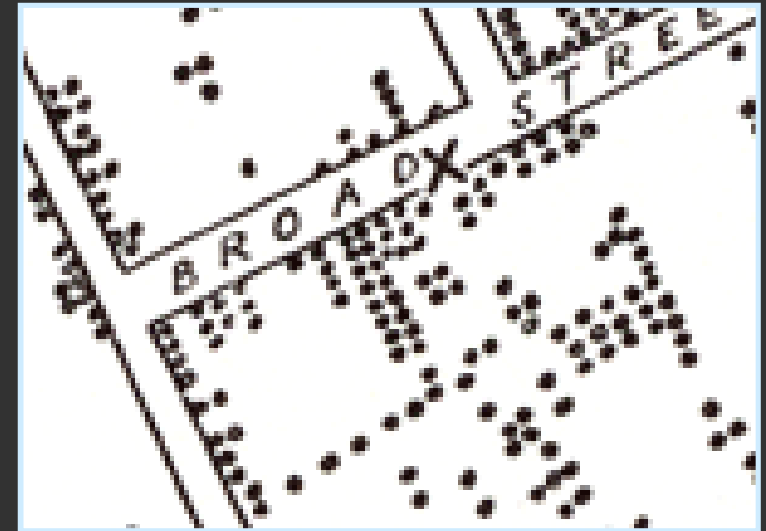
Analyze: support reasoning about information

- Process and calculate
- Reason about data
- Develop models and hypotheses



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

Cholera outbreak



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

Three functions of visualizations

Record: store information

- Photographs, blueprints, ...

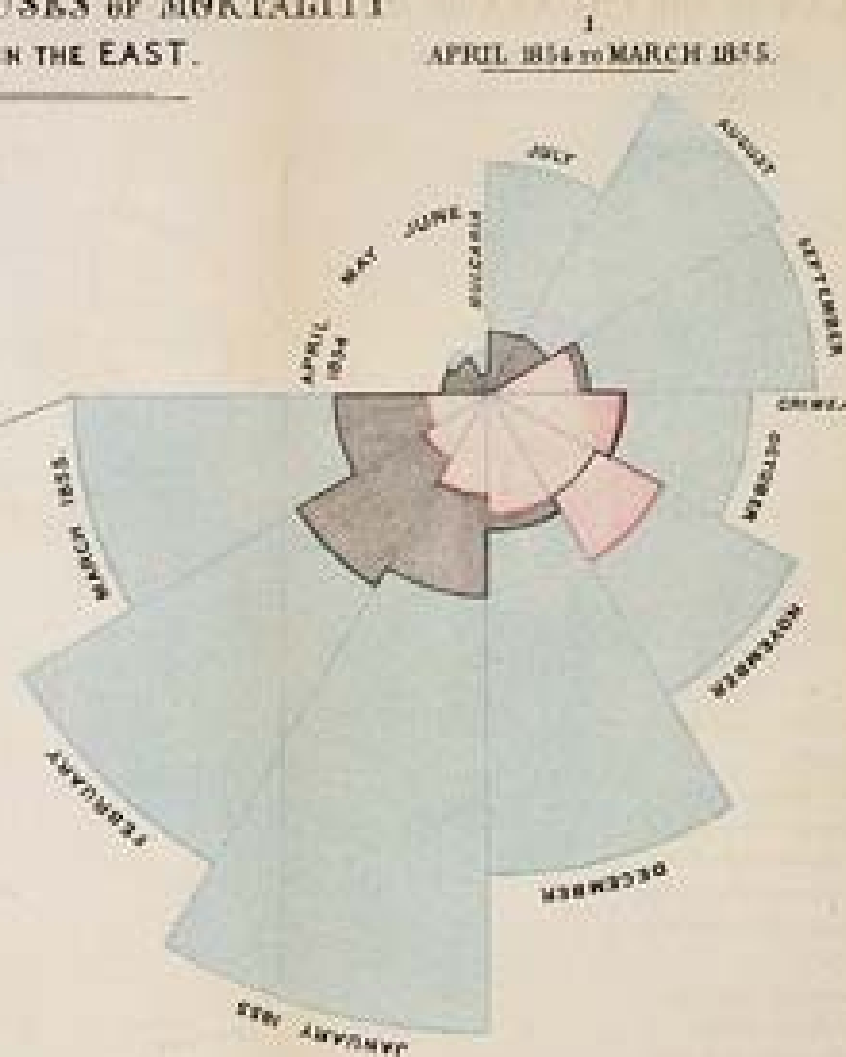
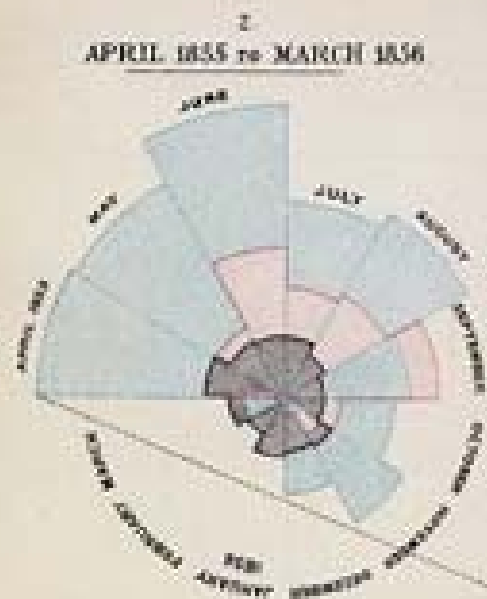
Analyze: support reasoning about information

- Process and calculate
- Reason about data
- Feedback and interaction

Communicate: convey information to others

- Share and persuade
- Collaborate and revise
- Emphasize important aspects of data

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

The Language of Visualization

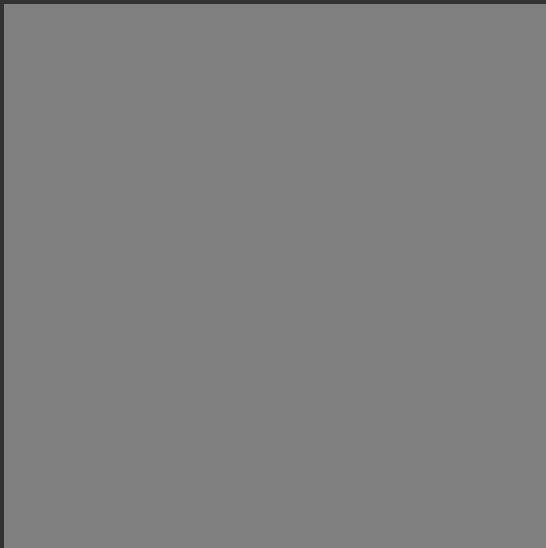
LES VARIABLES DE L'IMAGE

	POINTS			LIGNES			ZONES	
XY 2 DIMENSIONS DU PLAN								
Z TAILLE								
VALEUR								

LES VARIABLES DE SÉPARATION DES IMAGES

GRAIN								
COULEUR								
ORIENTATION								
FORME								

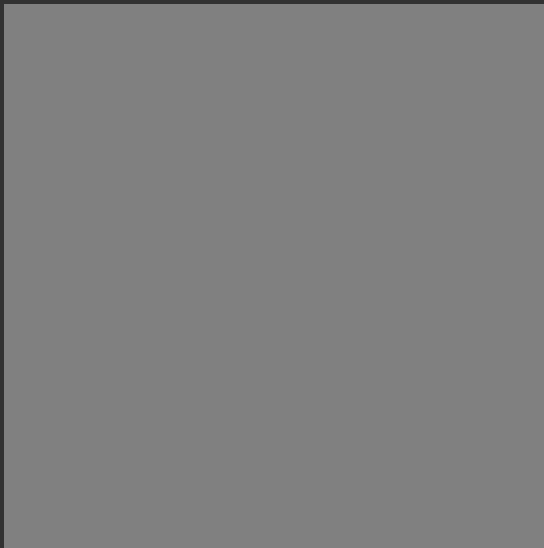
Detecting Brightness



Which is brighter?

Detecting Brightness

(128, 128, 128)



(144, 144, 144)



Which is brighter?



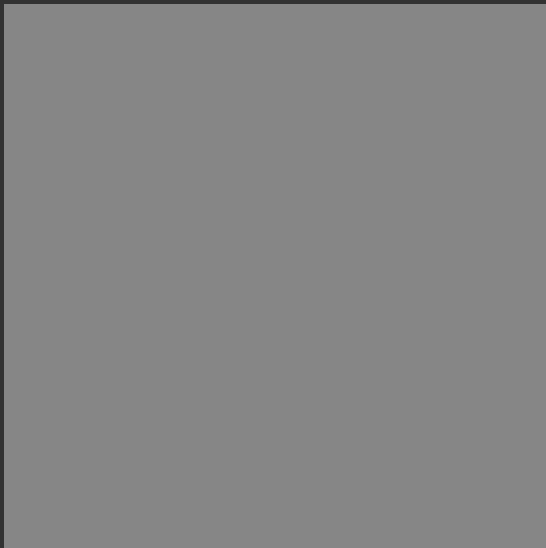
Detecting Brightness



Which is brighter?

Detecting Brightness

(134, 134, 134)

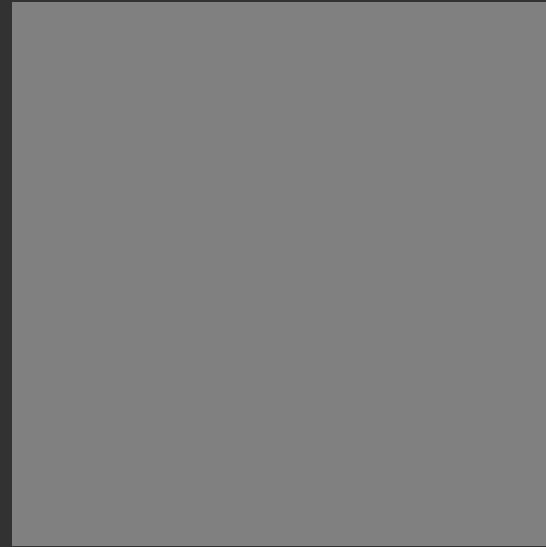
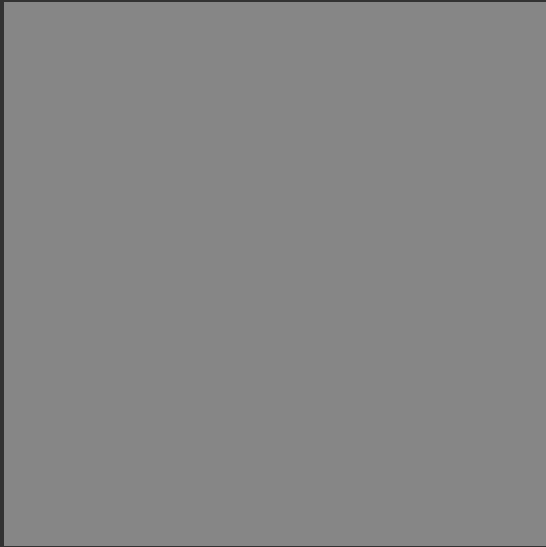


(128, 128, 128)



Which is brighter?

Just Noticeable Difference



Many continuous variations are perceived in discrete steps



Steps in font size

Sizes standardized in 16th century

a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a
6	7	8	9	10	11	12	14	16	18	21	24	36	48	60	72	

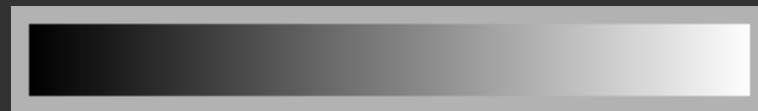
Information in color and value

Value is perceived as ordered

→ Encode ordered values



→ Encode continuous variables [but not as well]



Hue is normally perceived as unordered

→ Encode categories using color



Which best encodes quantities?

Position

Length

Area

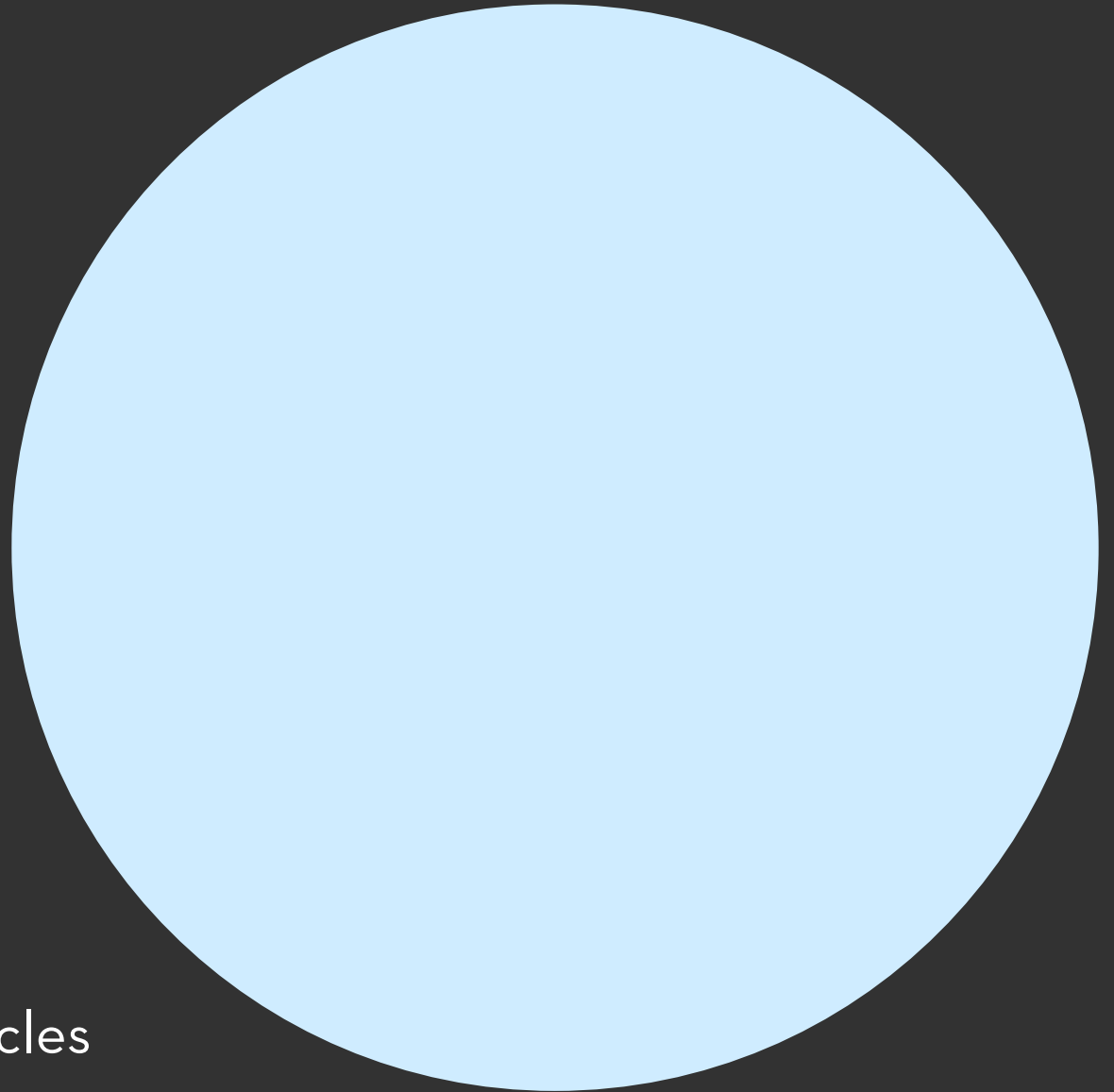
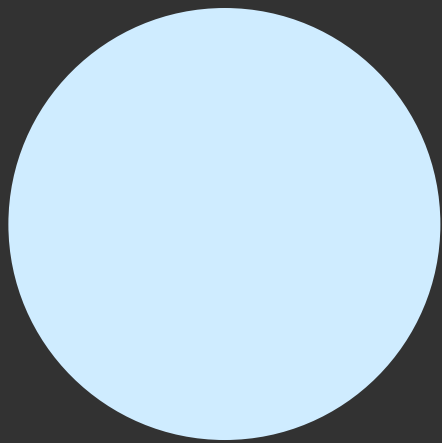
Volume

Value (Brightness)

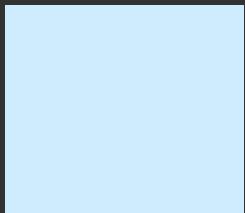
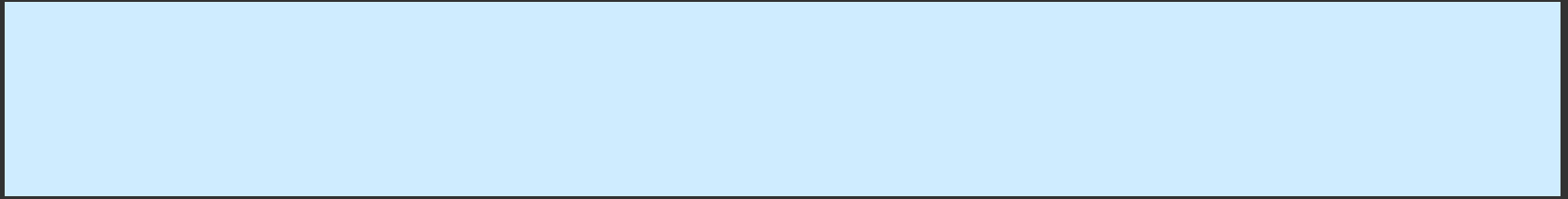
Color Hue

Orientation (Angle)

Shape



Compare area of circles

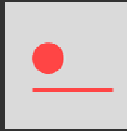


Compare length of bars

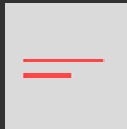
Most accurate



Least accurate



Position



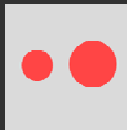
Length



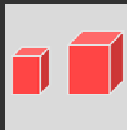
Slope



Angle



Area



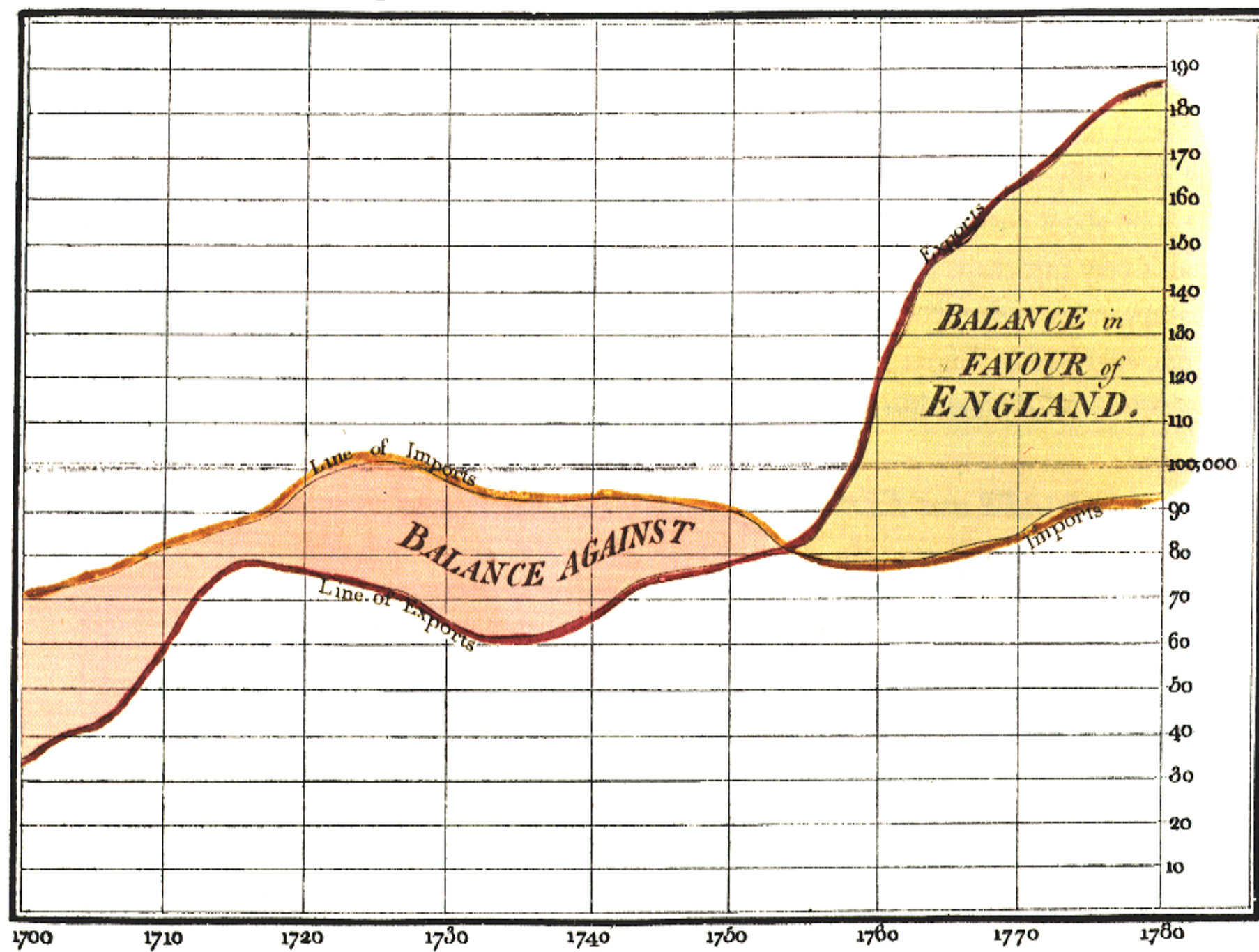
Volume



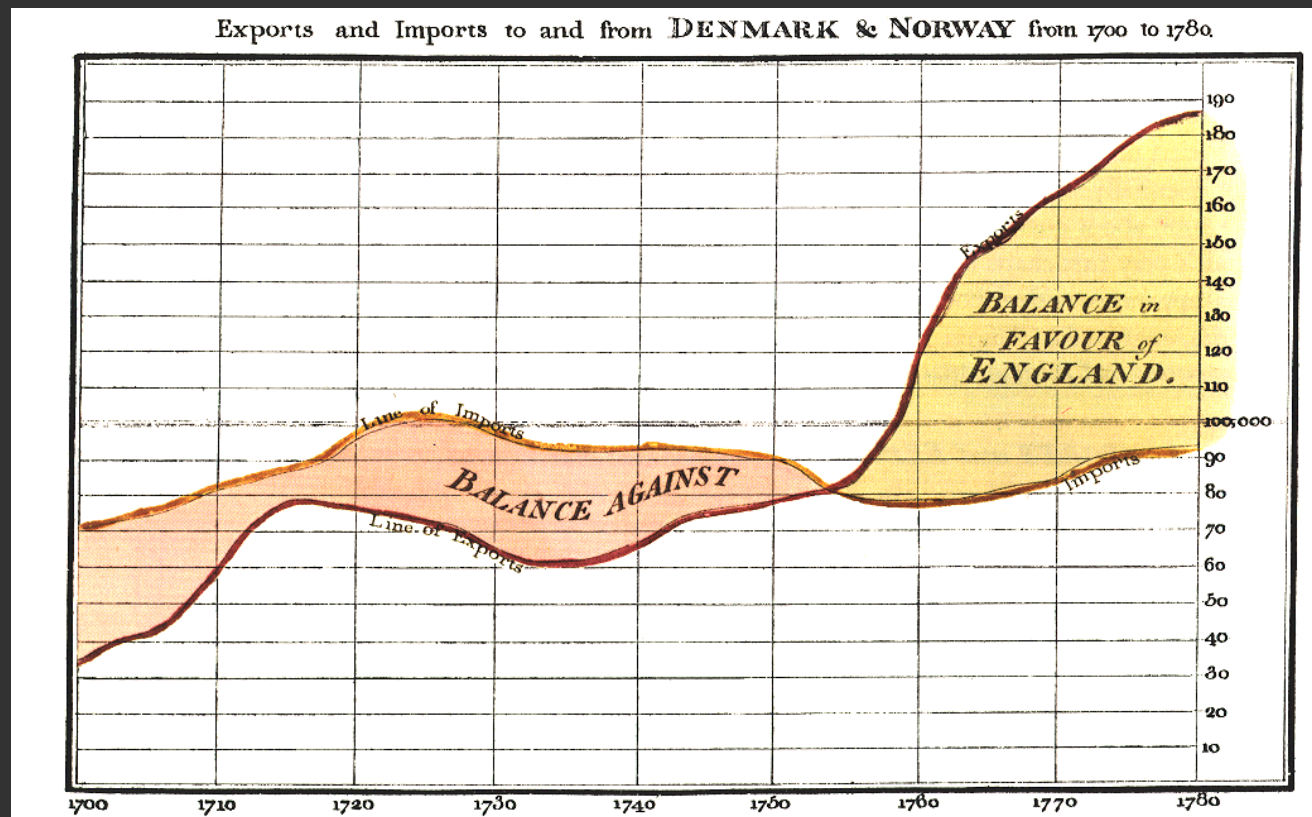
Color hue-saturation-density

Deconstructing Visualizations

Exports and Imports to and from DENMARK & NORWAY from 1700 to 1780.



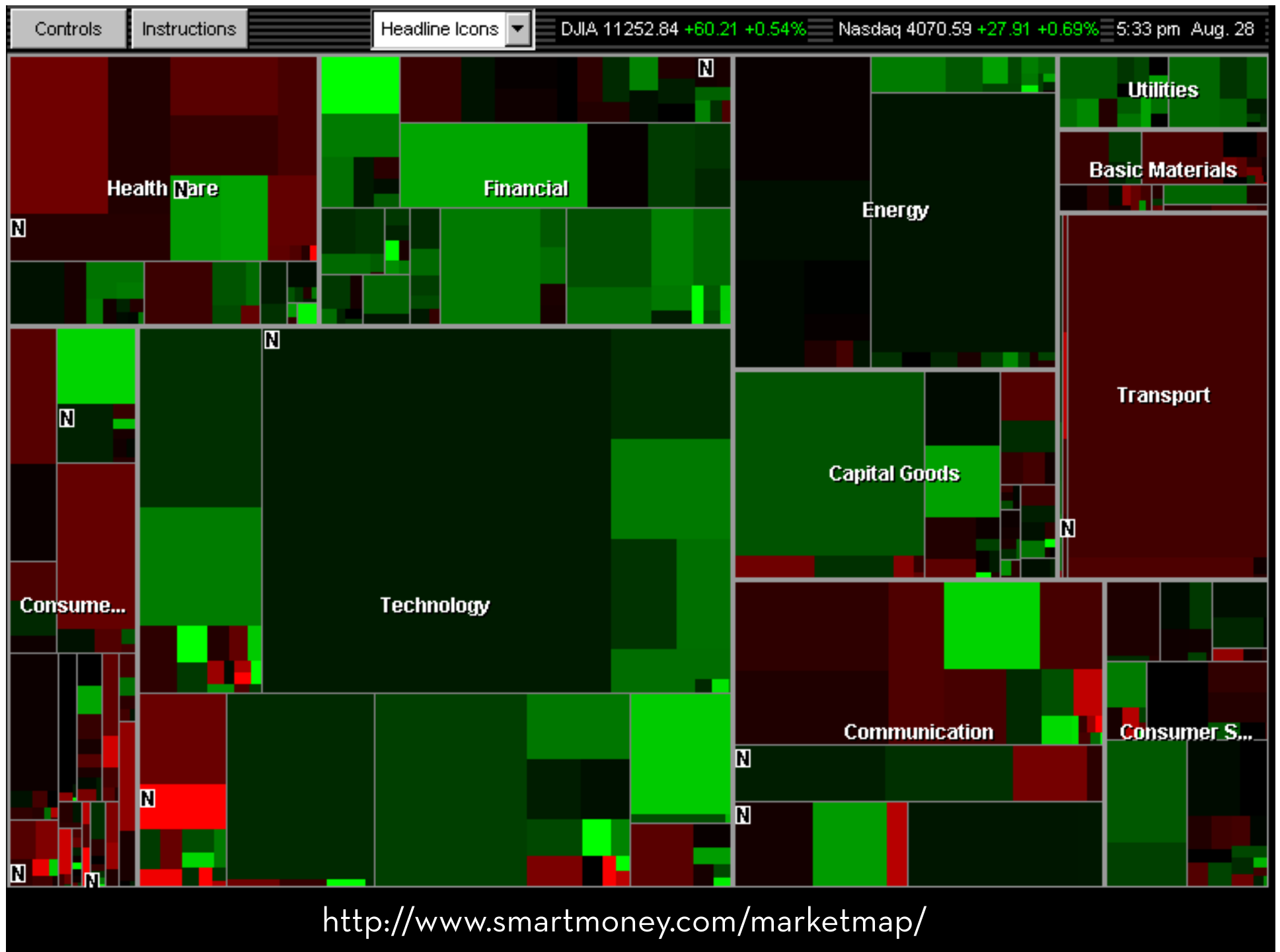
Time-Series Chart



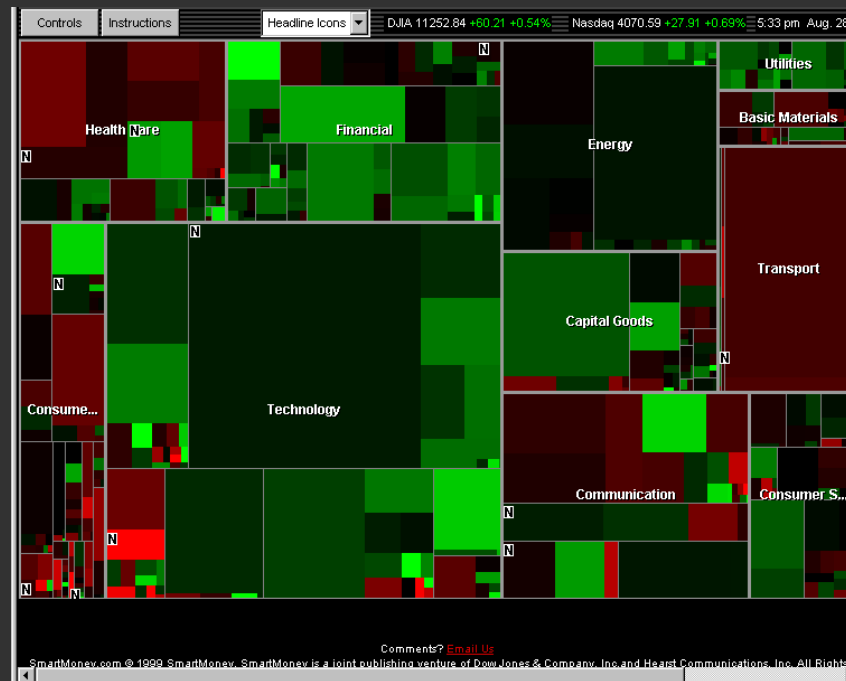
x-axis position: year

y-axis position: currency

color: imports/exports ratio



Treemap of the Stock Market



rectangle area: market capitalization

rectangle position: market sector, market cap

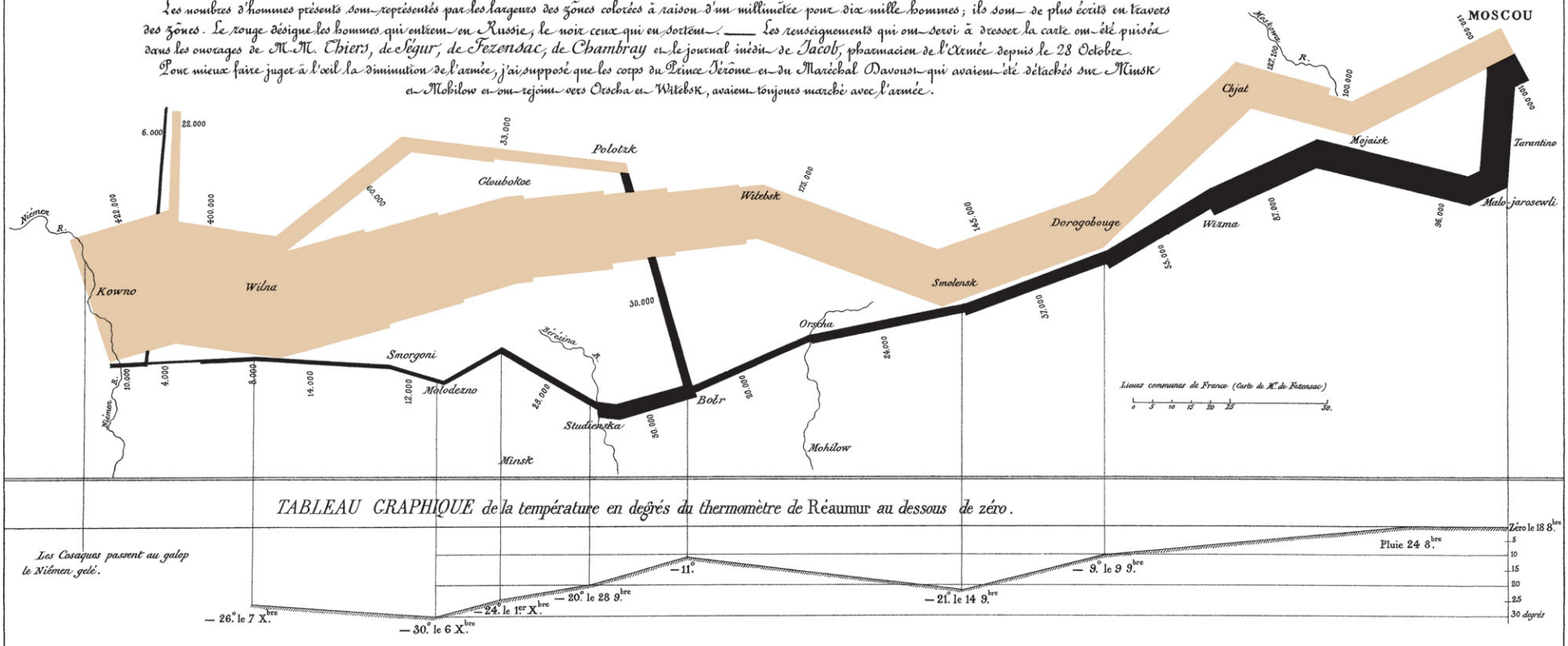
color hue: loss vs. gain

color value: magnitude of loss or gain

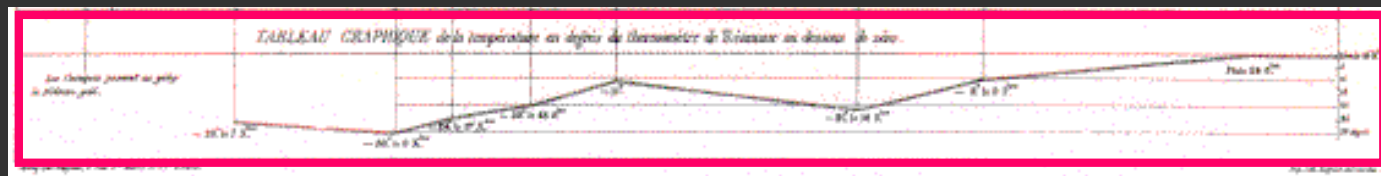
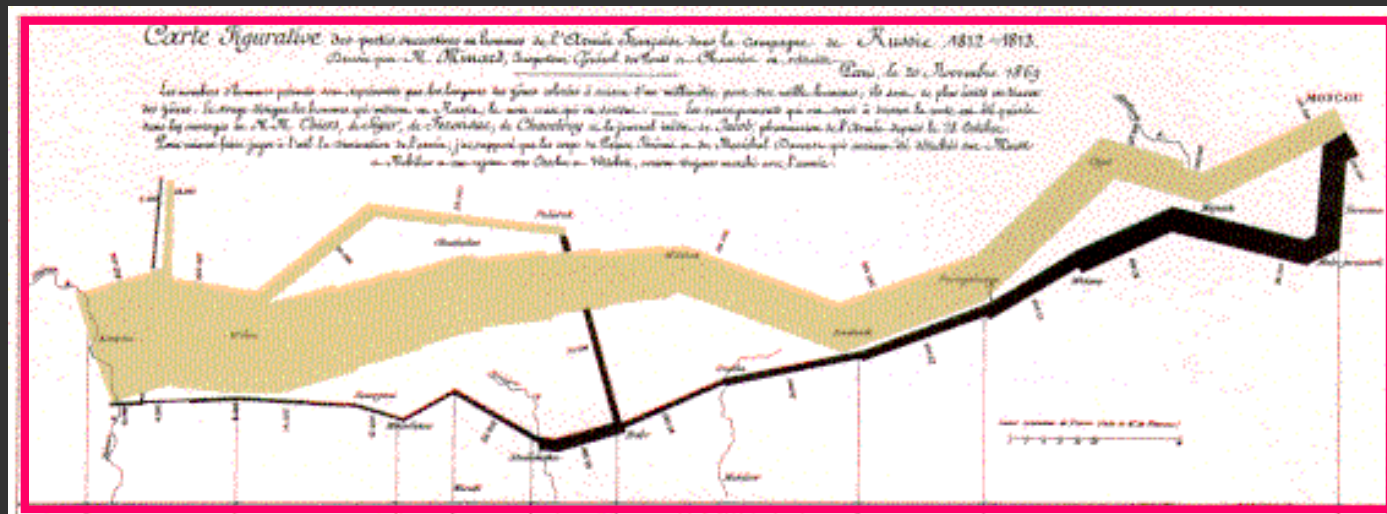
Minard 1869: Napoleon's march

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.
Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite Paris, le 20 Novembre 1869.

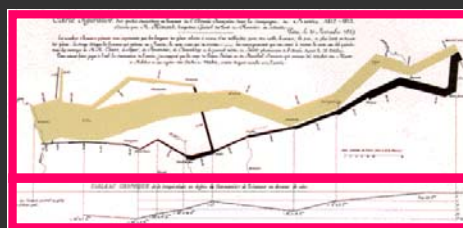
Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Léger, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davoust qui avaient été détachés sur Minsk et Mohilow et qui rejoignent vers Orscha et Witebsk, avaient toujours marché avec l'armée.



Single axis composition



2



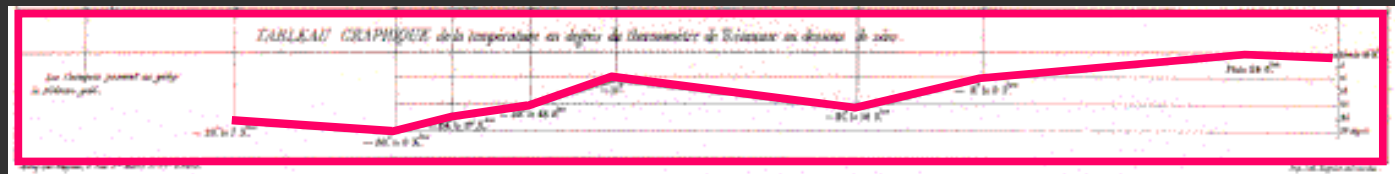
Mark composition

y-axis: temperature

+

x-axis: longitude / time

=



temperature over space/time

Mark composition

y-axis: longitude

+

x-axis: latitude

+

width: army size

=

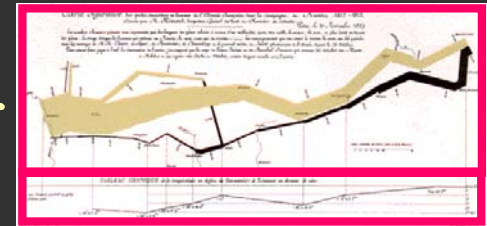
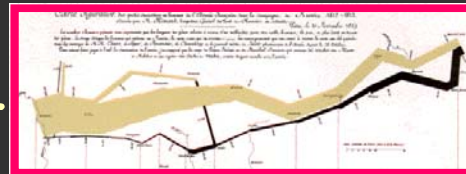


army position (lat/lon) and army size (width)

longitude

latitude

army size

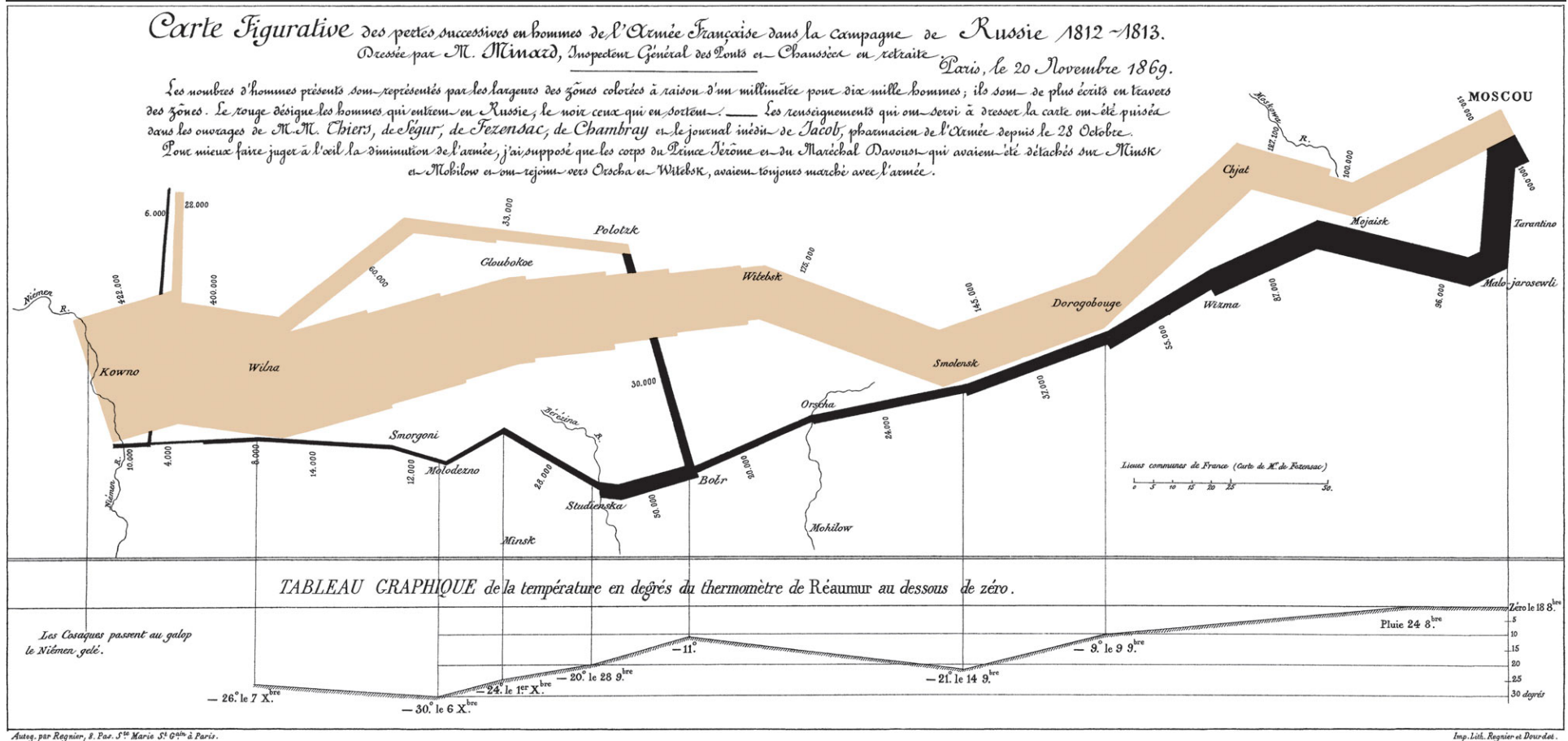


temperature

latitude / time



Minard 1869: Napoleon's march



Depicts at least 5 quantitative variables. Any others?

Summary

Effective visualizations can help us **record**, **analyze**, and **communicate** data

Creating visualizations requires **modeling data** and applying **appropriate visual encodings** and **interaction techniques**.

As you encounter visualizations in the world, try to **deconstruct what you see**. What are the underlying data and visual encodings?