

introduction to information graphics & data visualisation

4.0

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(@emax)

University of Southampton for
Open Data Institute Short Course

0:28 EST

part one!

biological basis of information design

what visualisations can do for us

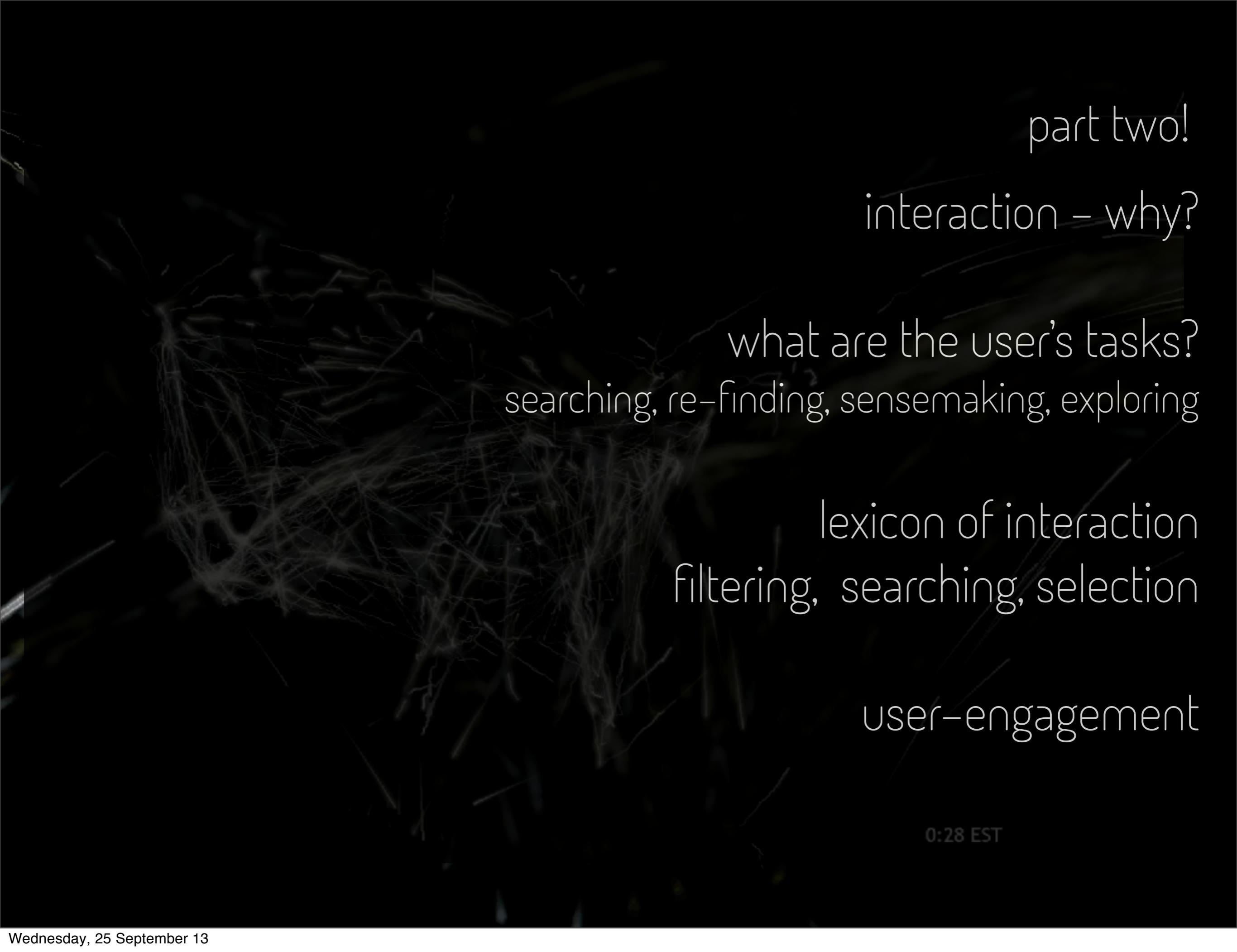
purpose – what is your (specific) goal?

data – what kind of data do you have?

visual dimensions – representing data visually

communication – deception and bad
infographics

0:28 EST



part two!

interaction – why?

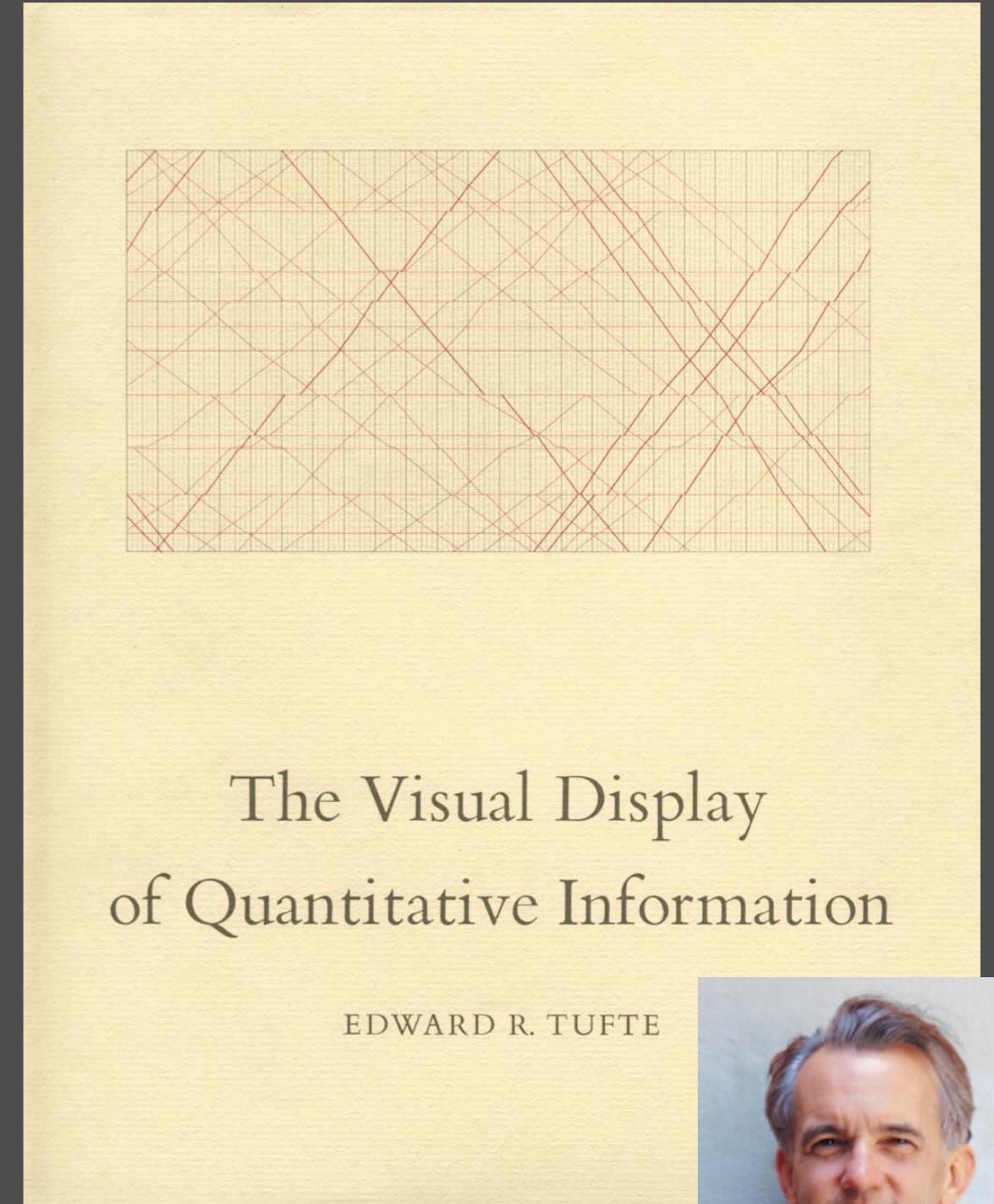
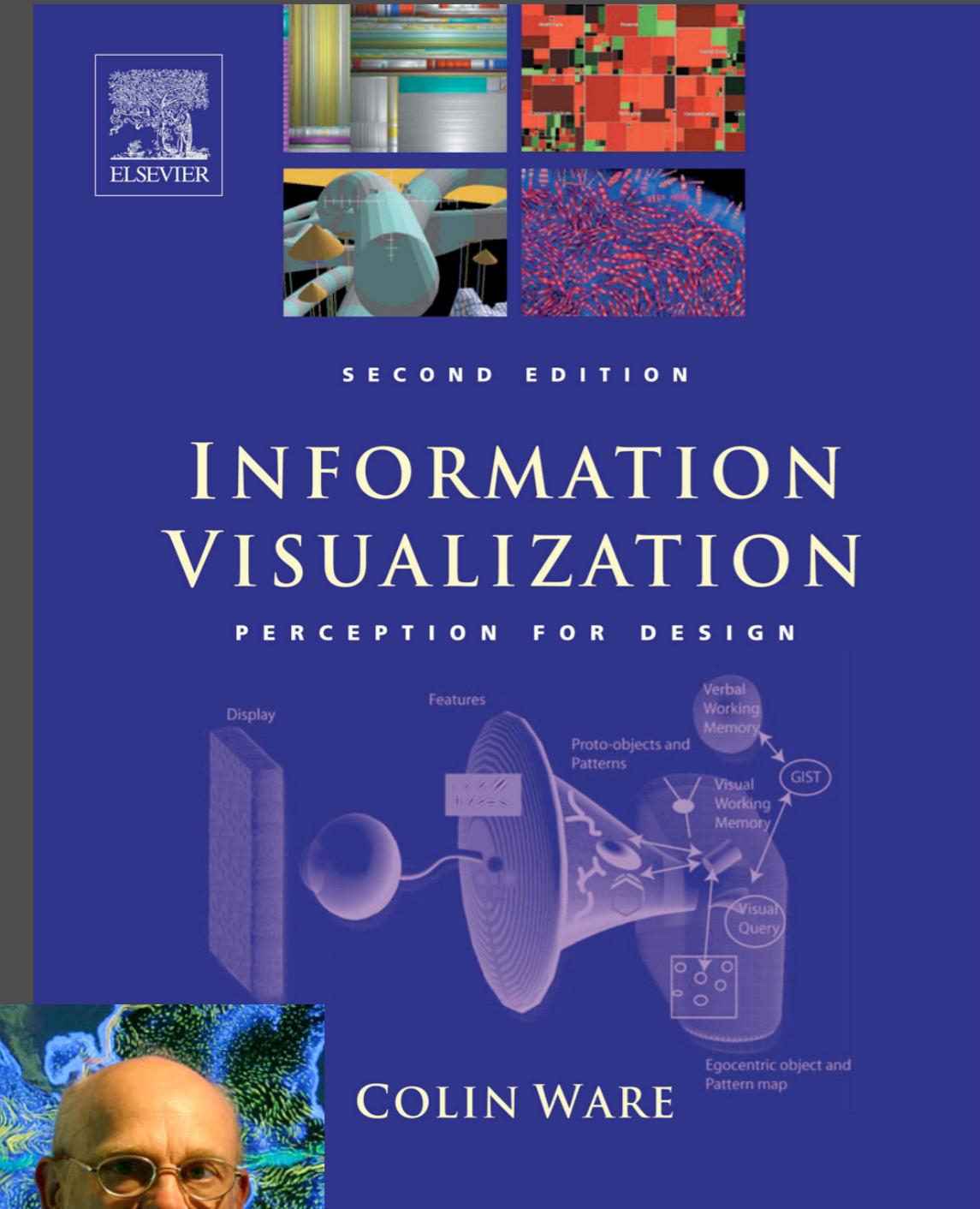
what are the user's tasks?
searching, re-finding, sensemaking, exploring

lexicon of interaction
filtering, searching, selection

user-engagement

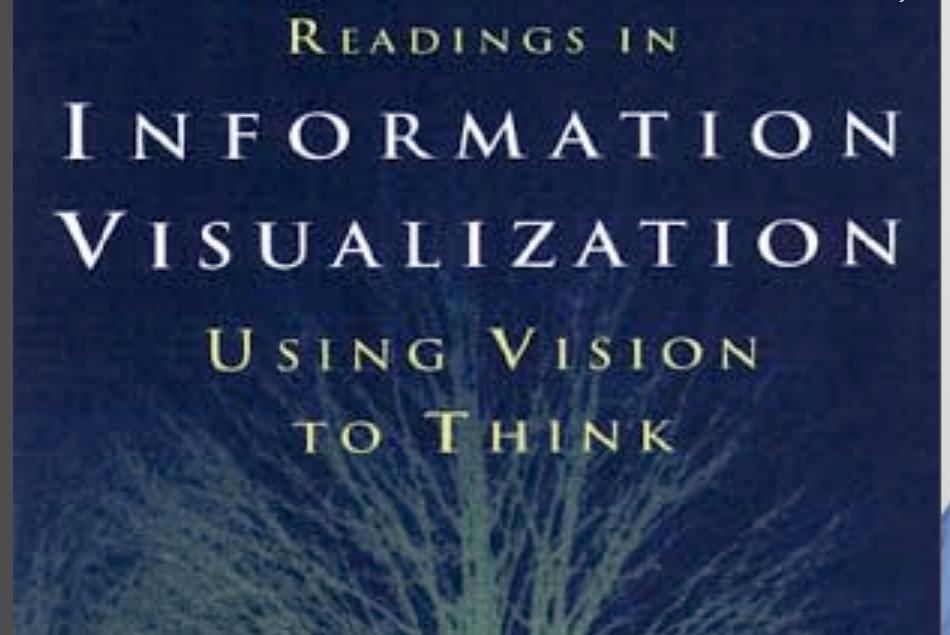
0:28 EST

theory

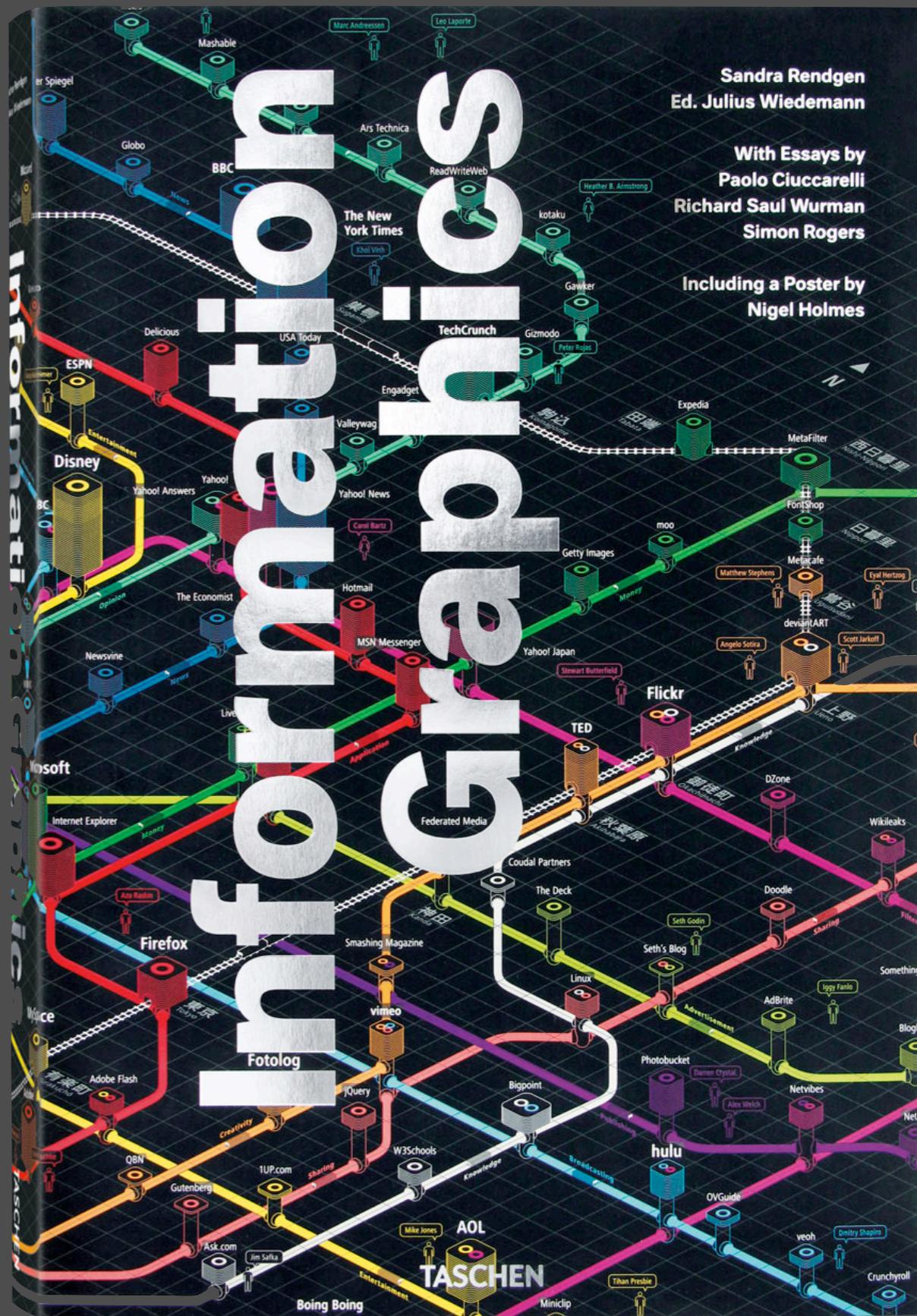
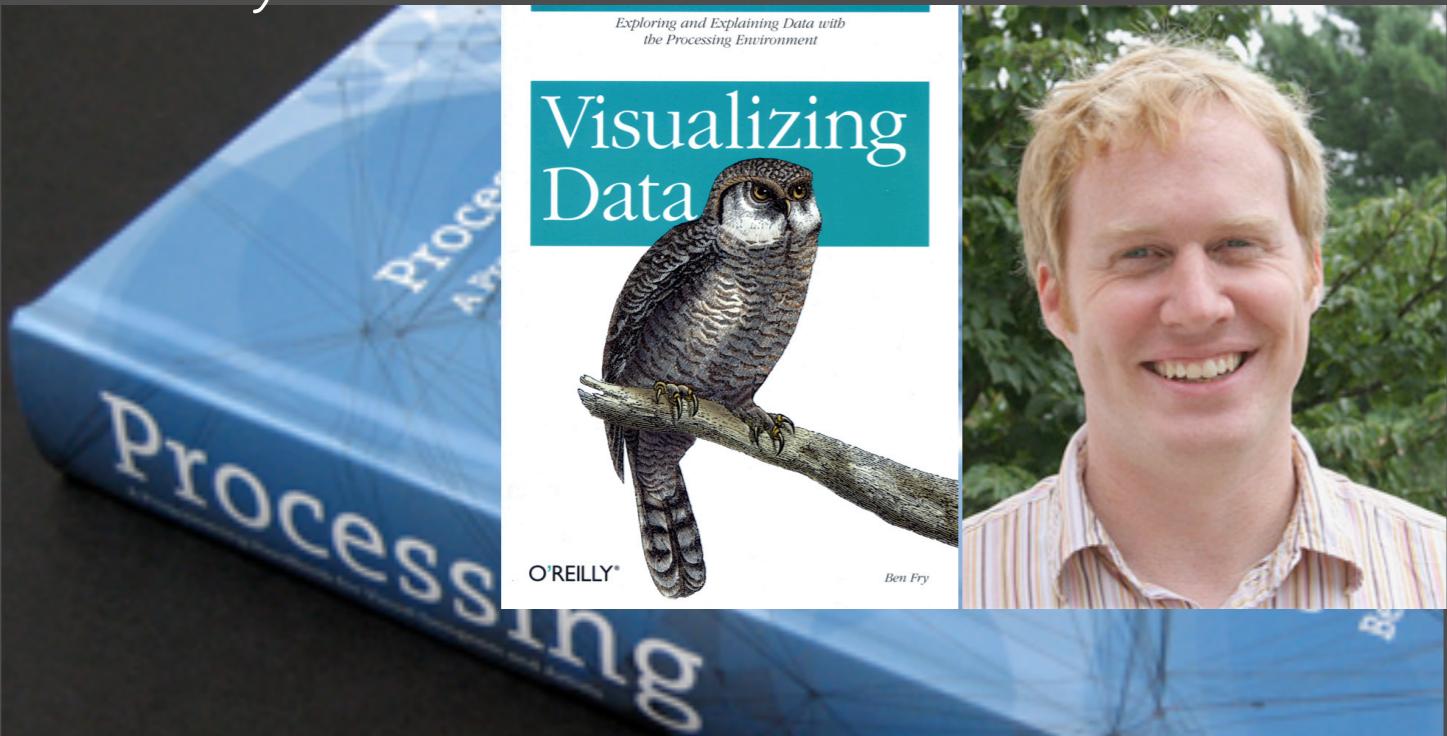


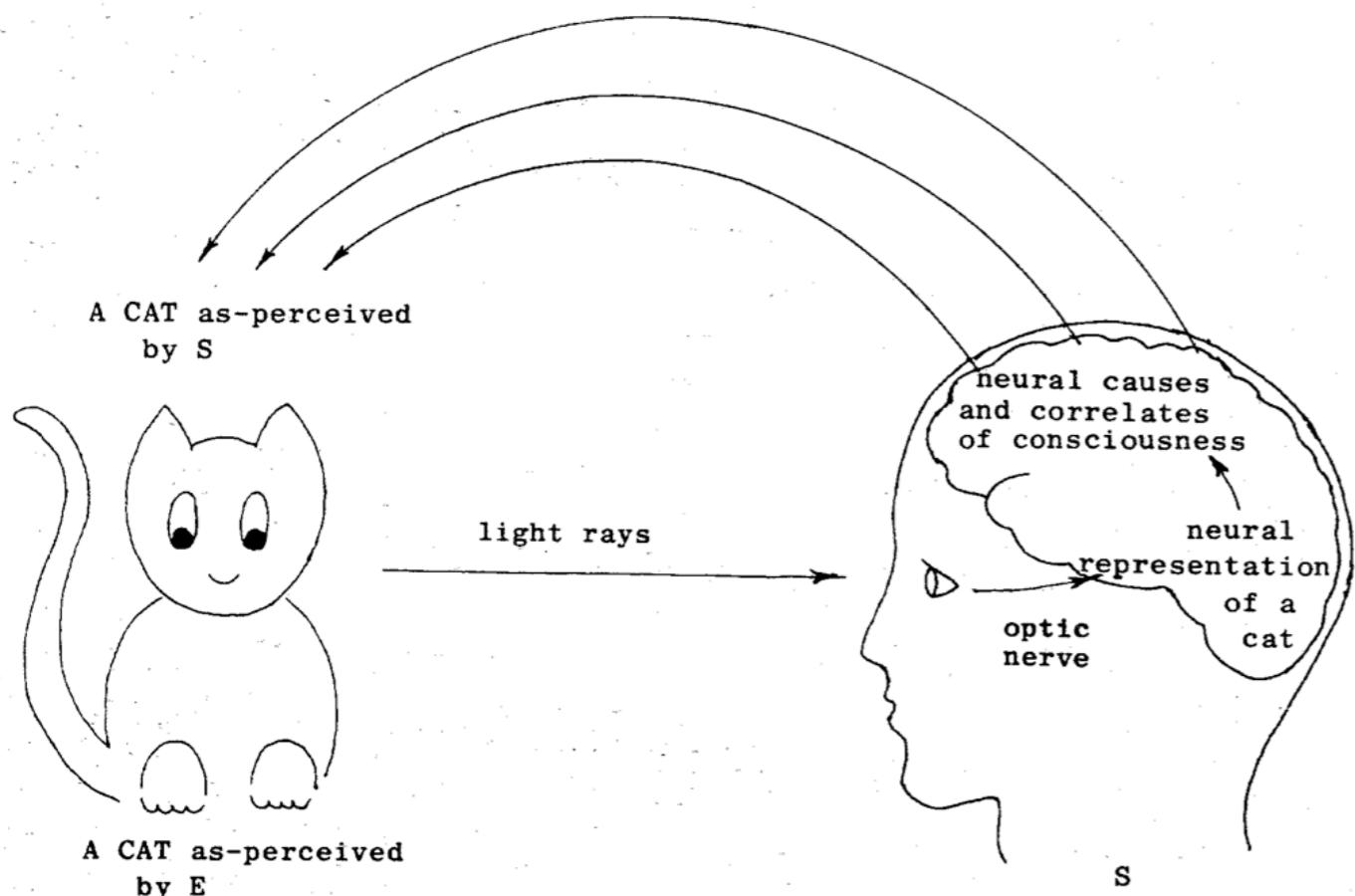
praxis

ben shneiderman. University of Maryland

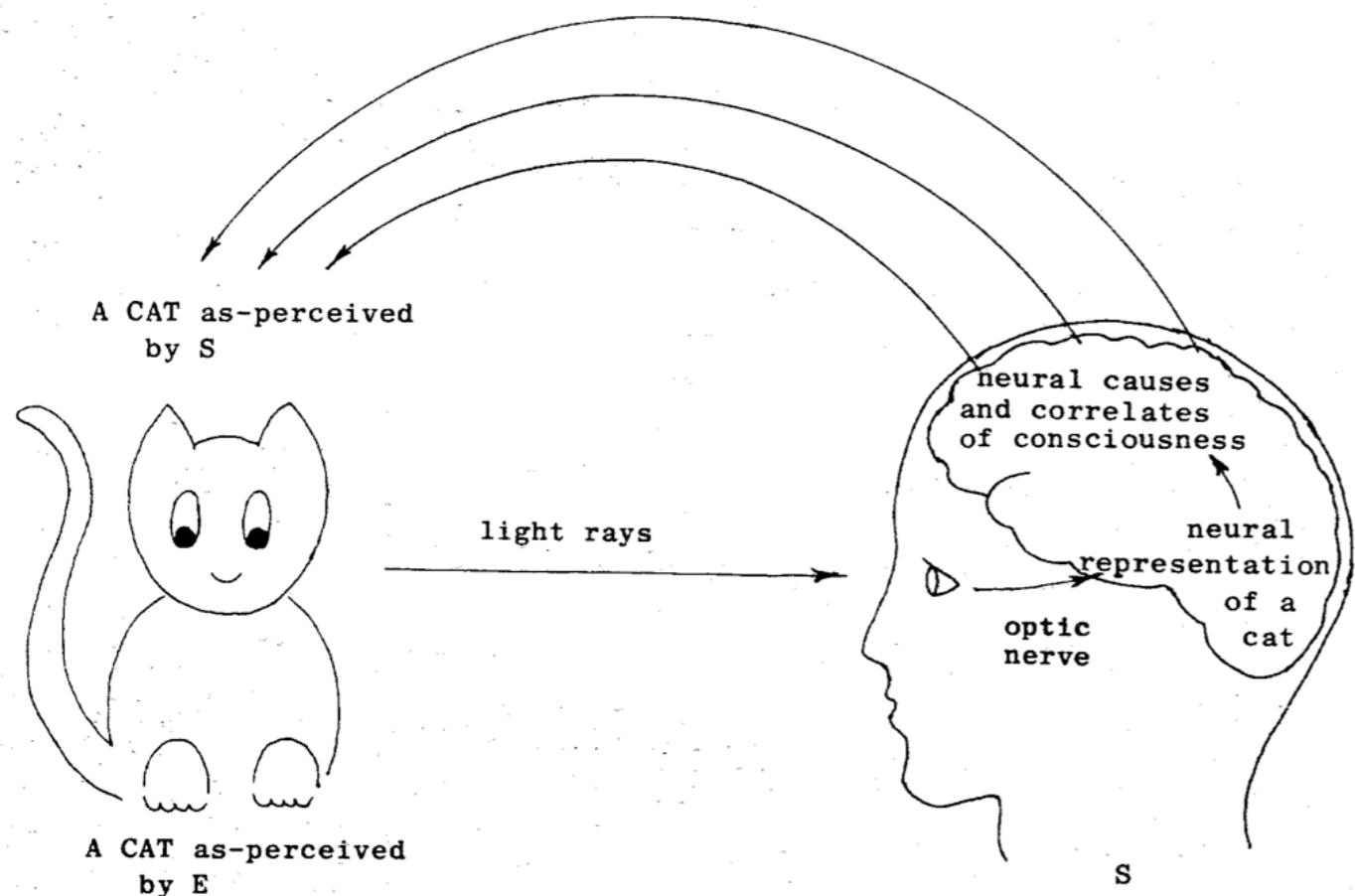


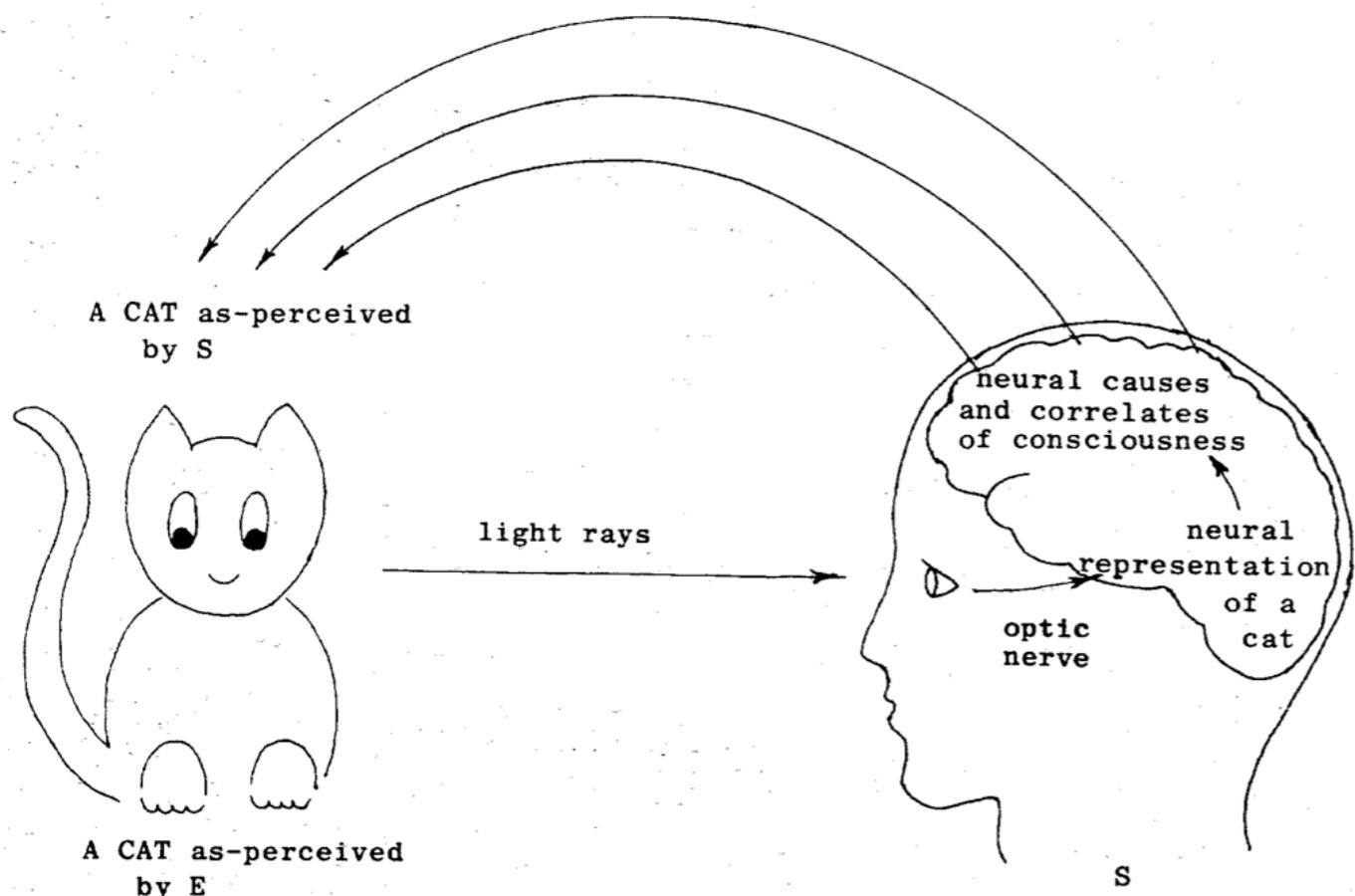
ben fry, MIT Media Lab/fathom.info





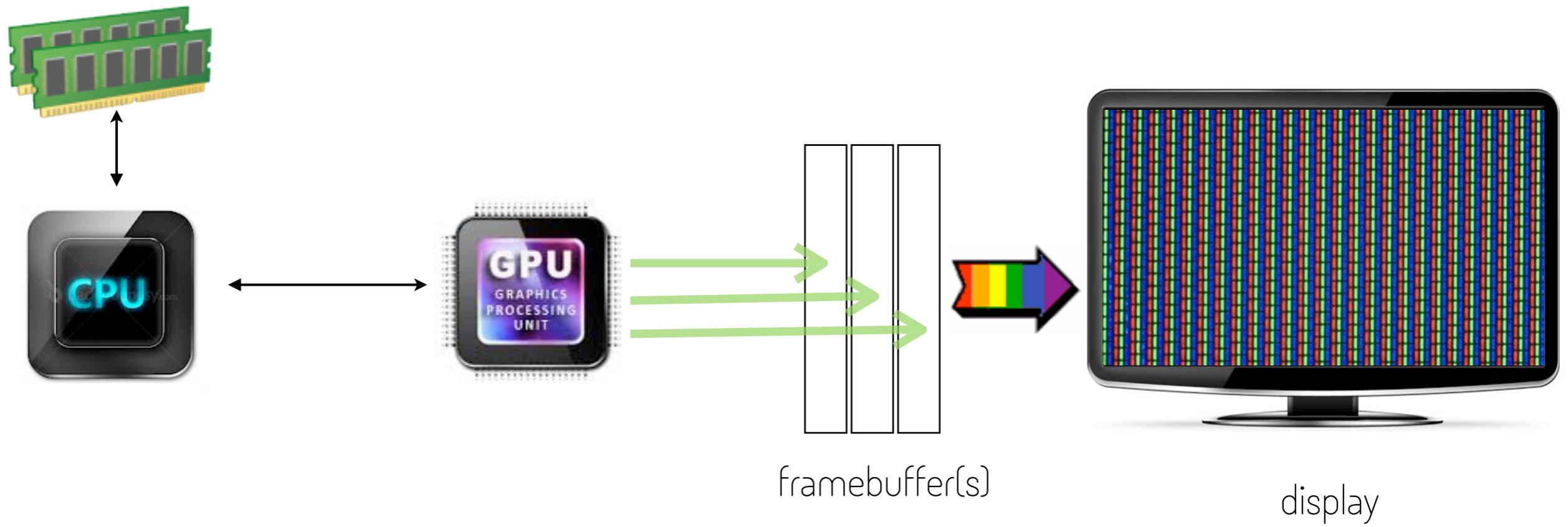
what is the goal
of information design?

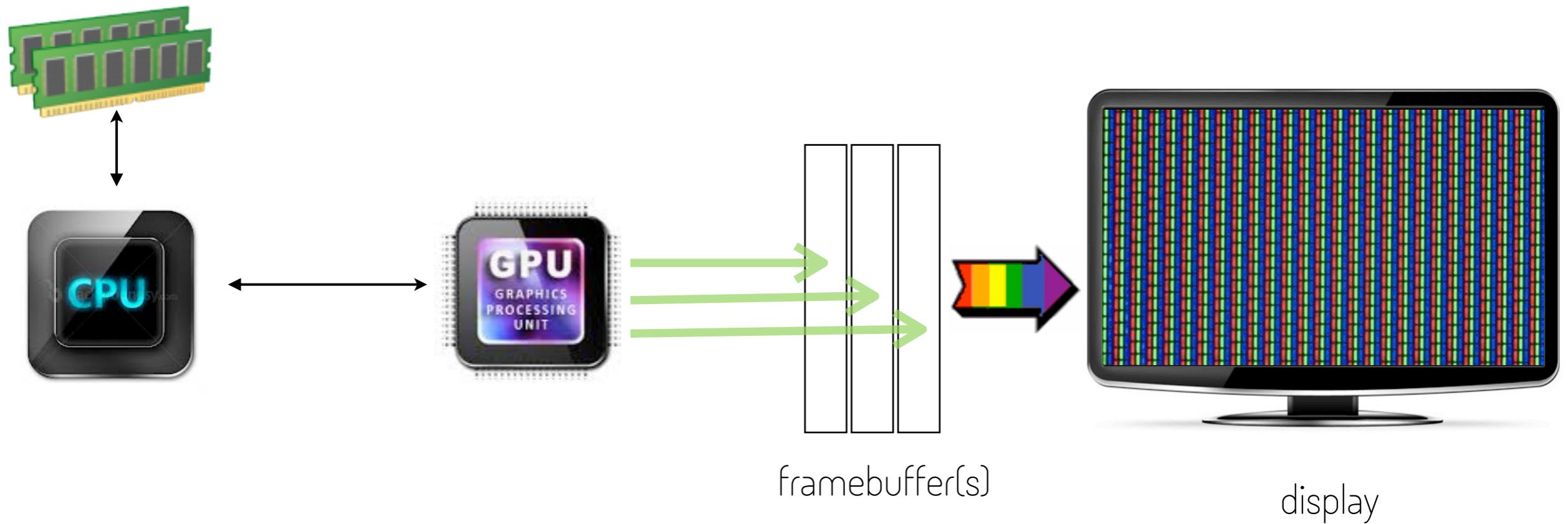




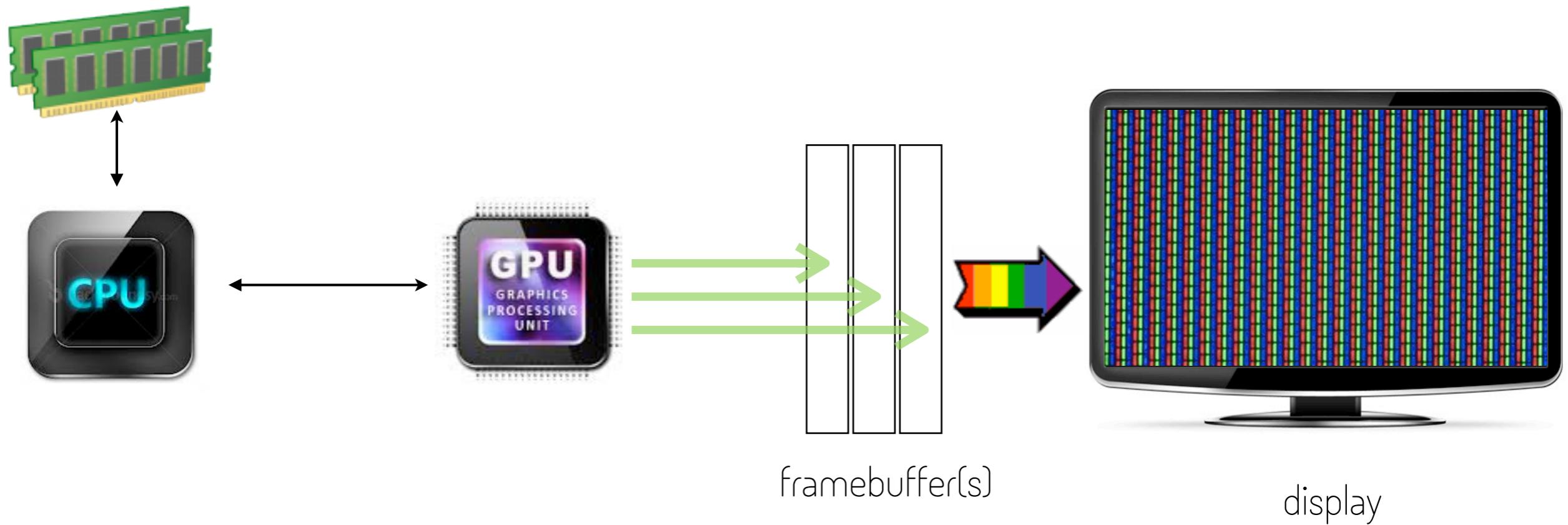
what is the goal
of information design?

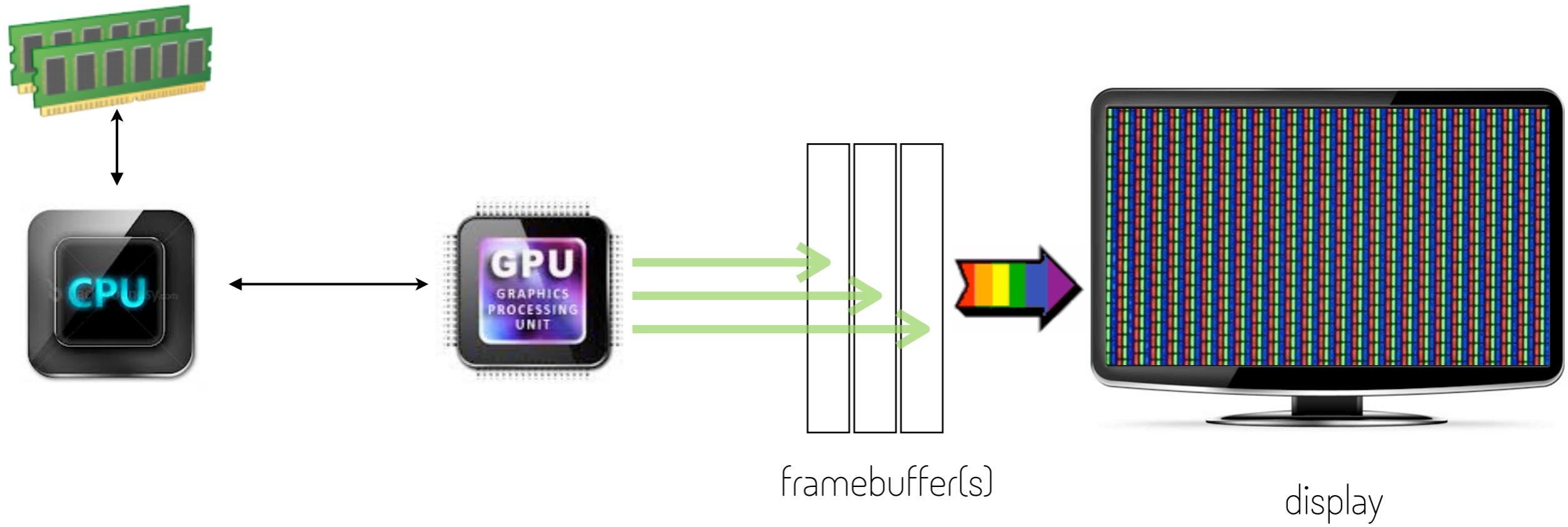
to let us better
think and communicate
about data





typical computer architecture

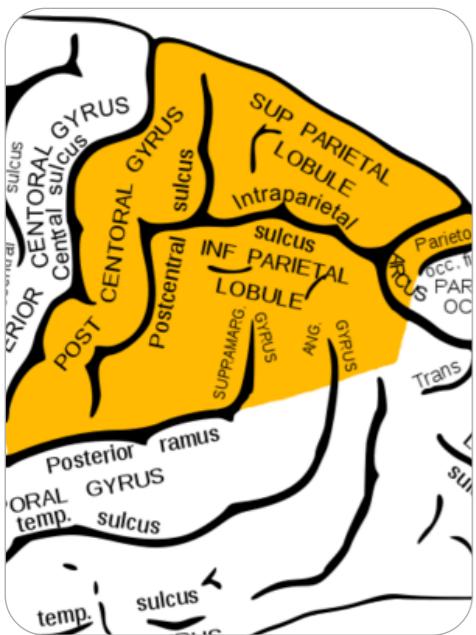




framebuffer(s)

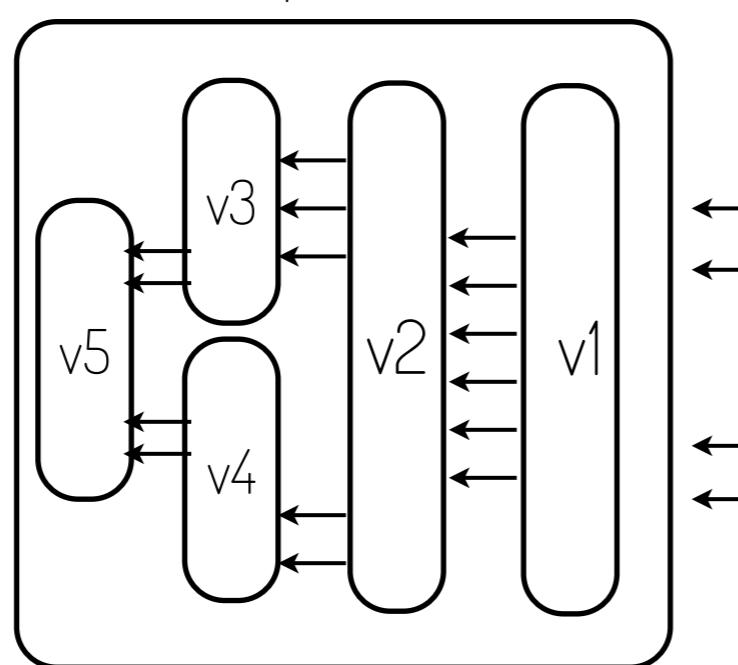
display

parietal lobe + frontal cortex

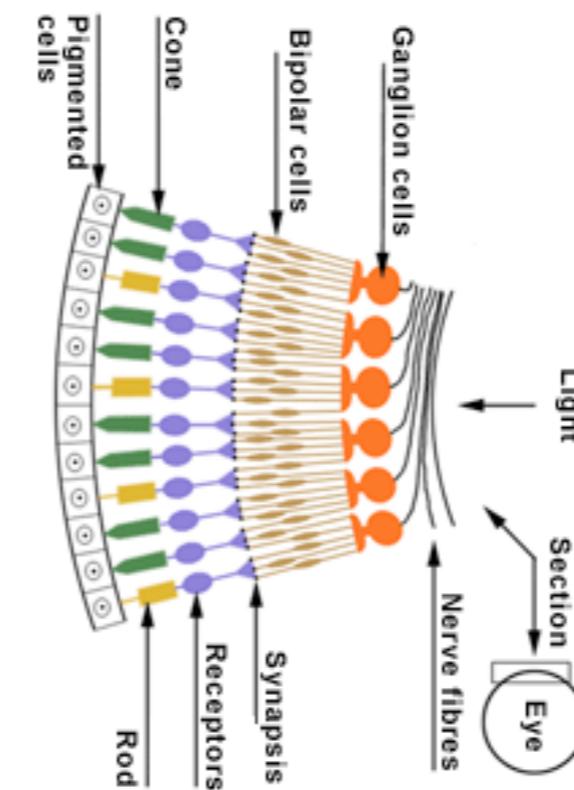


spatial orientation
focus of attention
eye control,
perceptual fusion

occipital lobe



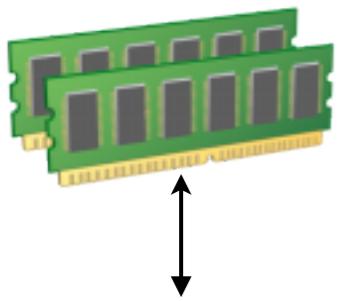
visual cortex
(pattern detection)



retina
(sensing)

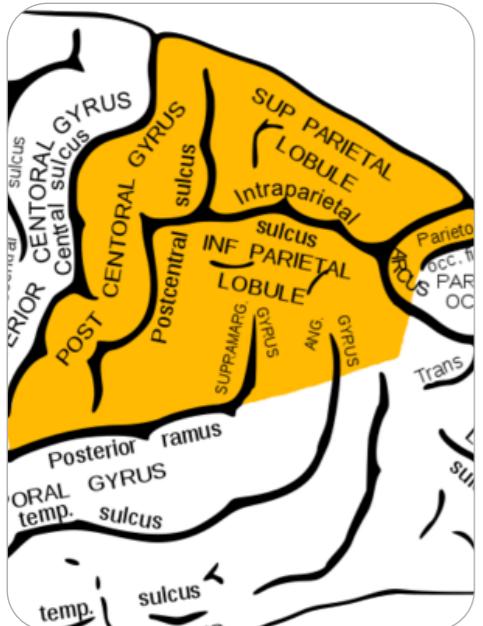


eye / iris / fovea



serial /
deliberative
processing
“attention-focused”

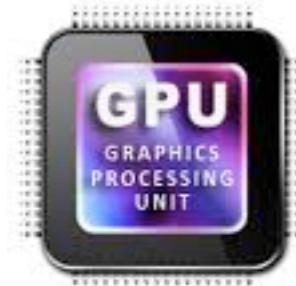
parietal lobe + frontal cortex



access to
long term memory

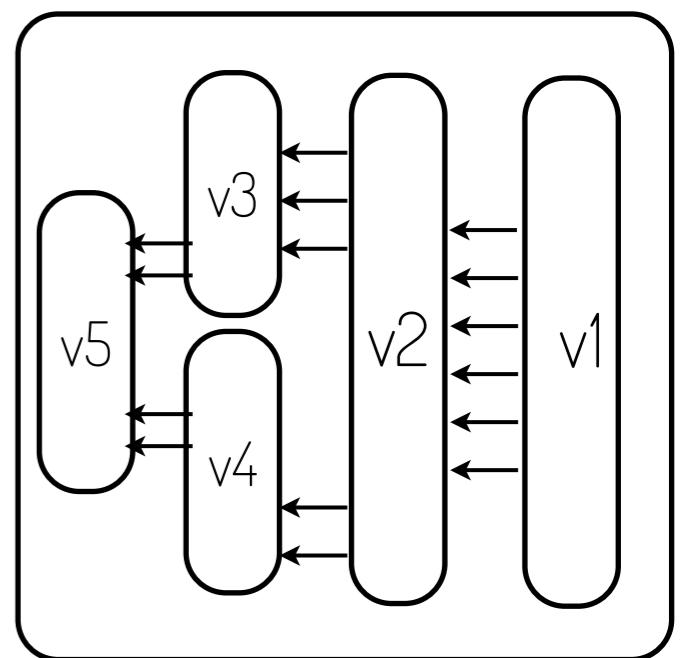
spatial orientation
focus of attention
eye control,
perceptual fusion

highly parallel



visual processing
routines
optimised for
purpose

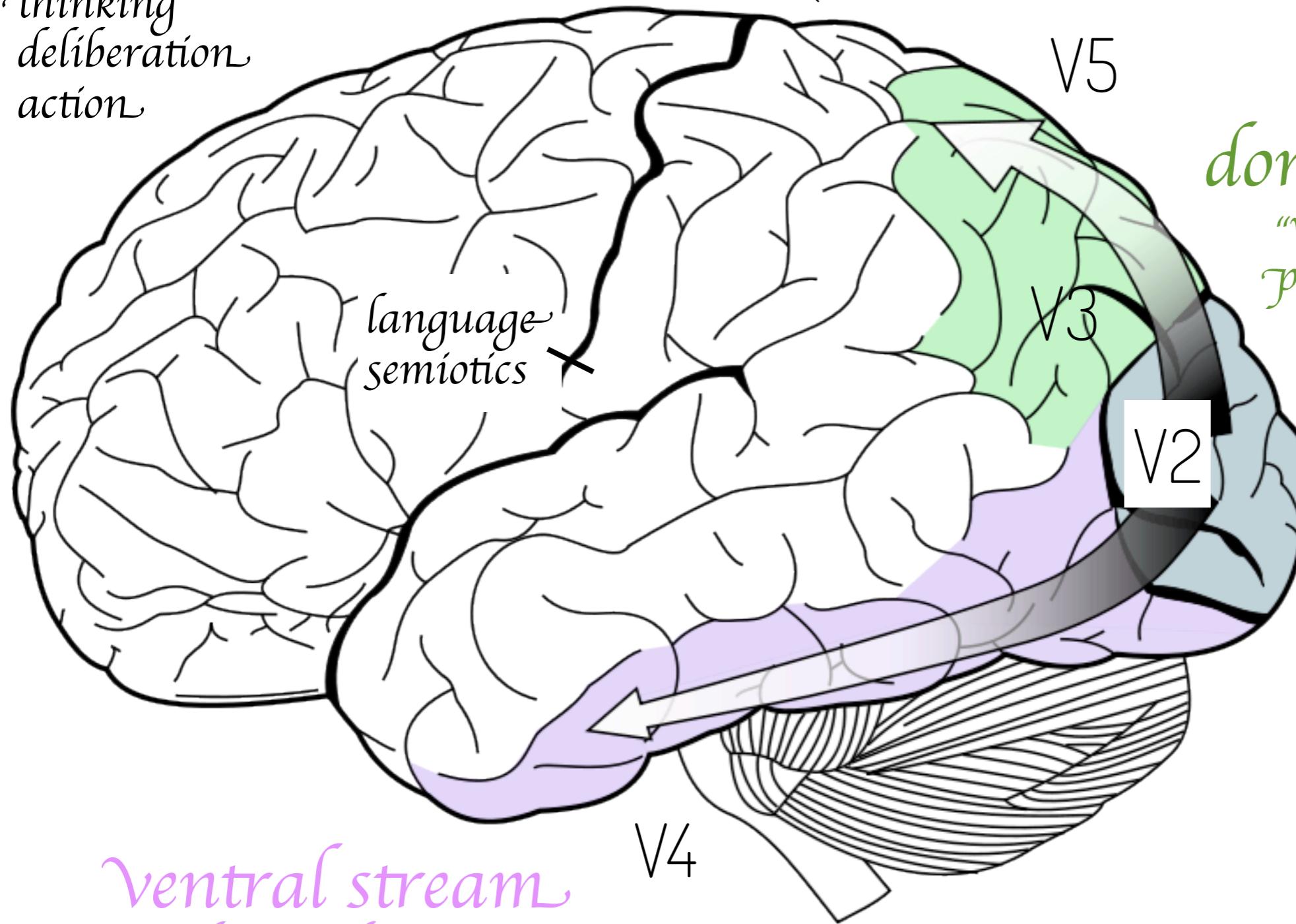
occipital lobe



visual cortex
(pattern detection)

frontal lobe

*planning
thinking
deliberation
action*



*ventral stream
"what" pathway*

parietal lobe
*spatial reasoning
perceptual fusion*

*dorsal stream
"where/how"
pathways*

V1
occipital lobe

V4

V5

V3

V2

a

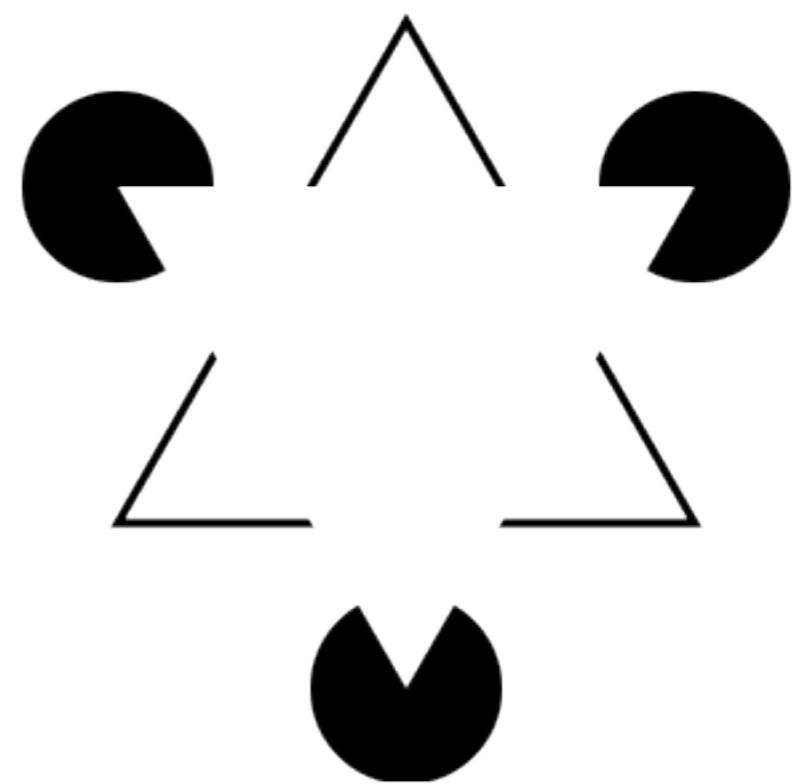
b

C

A large grid of handwritten cursive 's' characters, arranged in 15 rows and 15 columns. The characters are written in a black ink-like font on a light background, showing a variety of styles and slants.

d

A large grid of 100 small black Y-shaped symbols arranged in a 10x10 pattern. The symbols are evenly spaced and form a continuous, repeating pattern across the entire area.



50 0 50 100 150 200

X Pump • Deaths from cholera



John Snow, 1854
London Cholera Outbreak

50 0 50 100 150 200

X Pump • Deaths from cholera

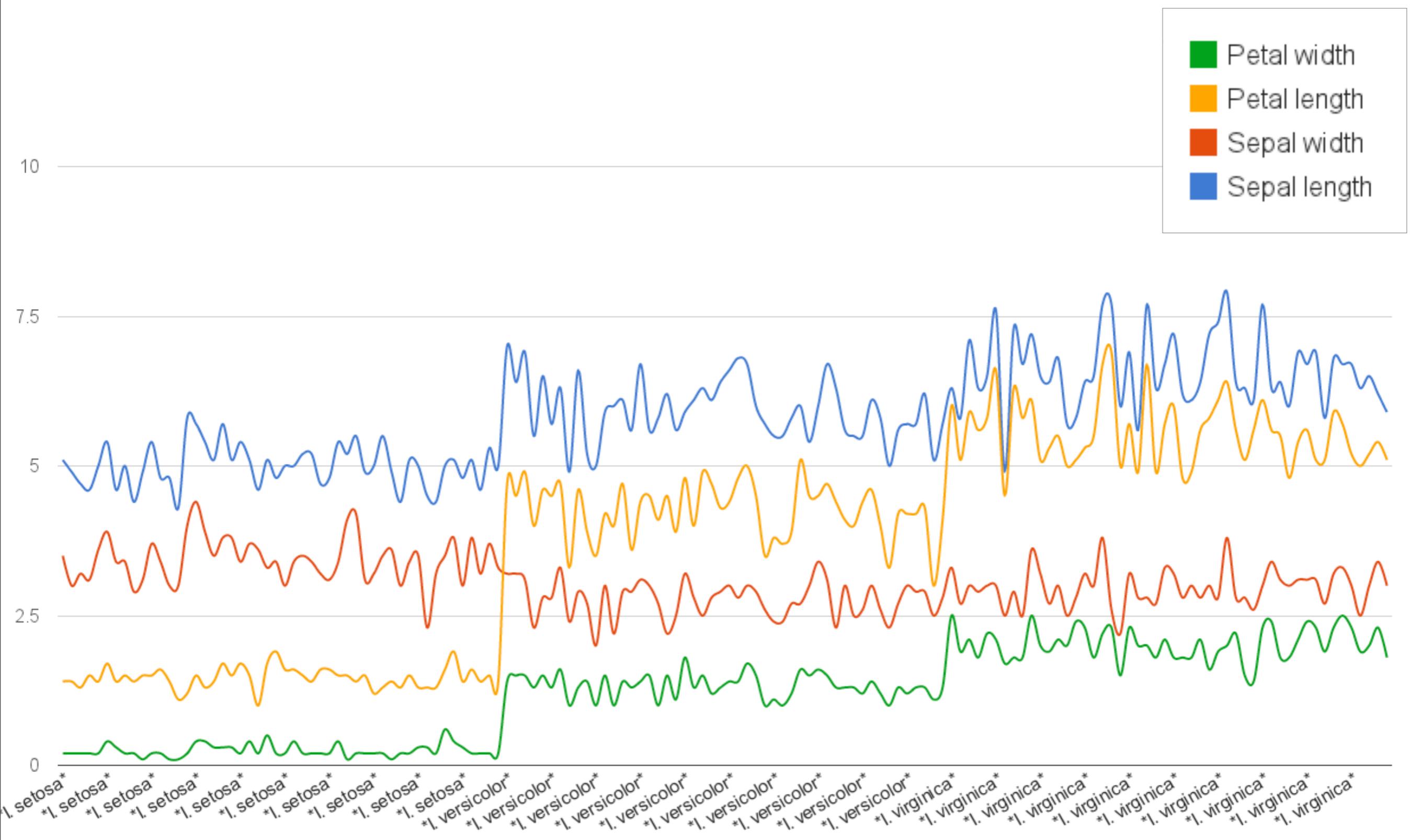


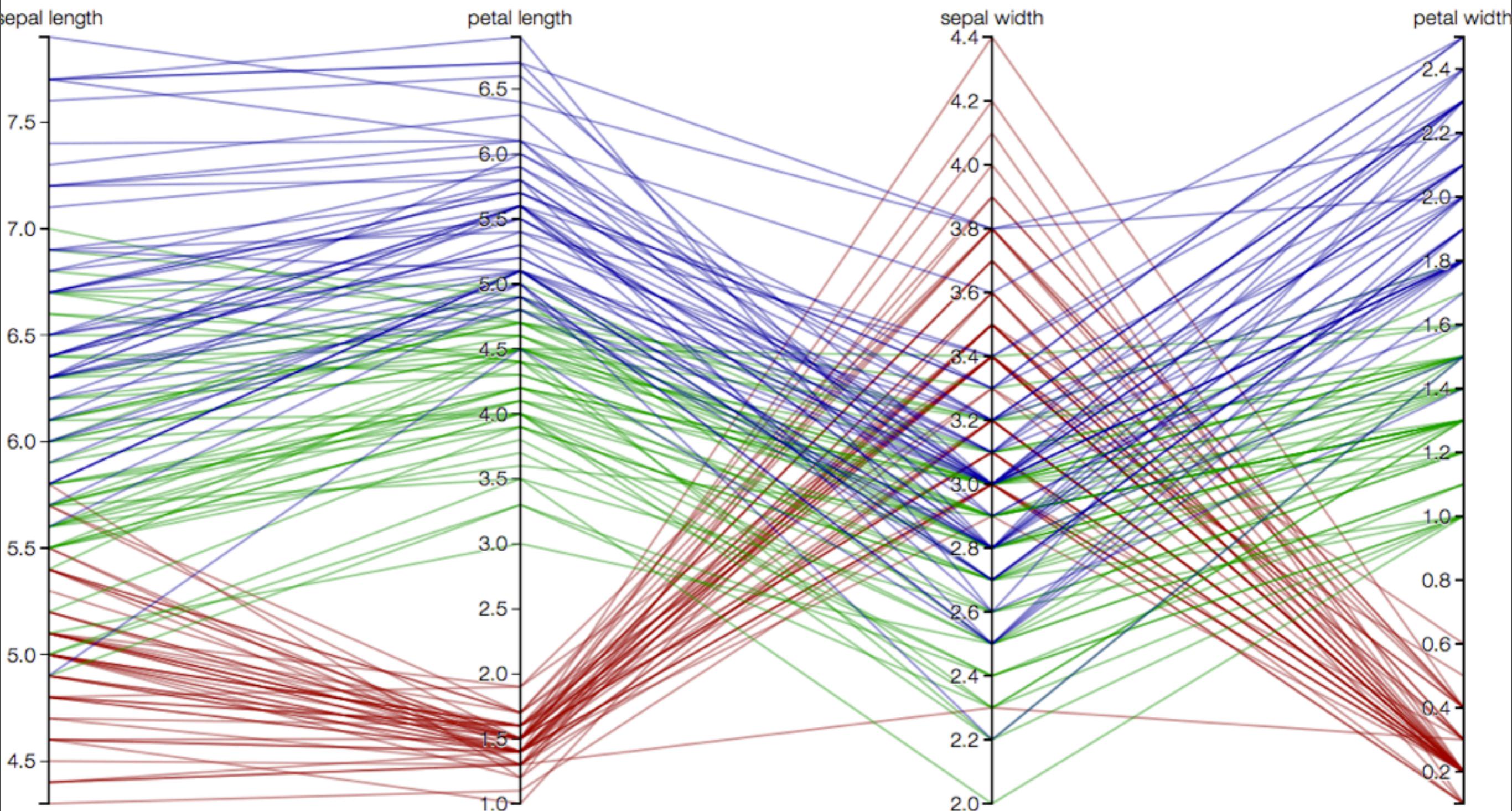
John Snow, 1854
London Cholera Outbreak

"There was one significant anomaly - none of the monks in the adjacent monastery contracted cholera. Investigation showed that this was not an anomaly, but further evidence, for they drank only beer, which they brewed themselves."

Sepal length	Sepal width	Petal length	Petal width	Species	Sepal length	Sepal width	Petal length	Petal width	Species	Sepal length	Sepal width	Petal length	Petal width	Species
5.1	3.5	1.4	0.2	*I. setosa*	5.4	3.4	1.5	0.4	*I. setosa*	5.4	3.4	1.5	0.4	*I. setosa*
4.9	3	1.4	0.2	*I. setosa*	5.2	4.1	1.5	0.1	*I. setosa*	5.2	4.1	1.5	0.1	*I. setosa*
4.7	3.2	1.3	0.2	*I. setosa*	5.5	4.2	1.4	0.2	*I. setosa*	5.5	4.2	1.4	0.2	*I. setosa*
4.6	3.1	1.5	0.2	*I. setosa*	4.9	3.1	1.5	0.2	*I. setosa*	4.9	3.1	1.5	0.2	*I. setosa*
5	3.6	1.4	0.2	*I. setosa*	5	3.2	1.2	0.2	*I. setosa*	5	3.2	1.2	0.2	*I. setosa*
5.4	3.9	1.7	0.4	*I. setosa*	5.5	3.5	1.3	0.2	*I. setosa*	5.5	3.5	1.3	0.2	*I. setosa*
4.6	3.4	1.4	0.3	*I. setosa*	4.9	3.6	1.4	0.1	*I. setosa*	4.9	3.6	1.4	0.1	*I. setosa*
5	3.4	1.5	0.2	*I. setosa*	4.4	3	1.3	0.2	*I. setosa*	4.4	3	1.3	0.2	*I. setosa*
4.4	2.9	1.4	0.2	*I. setosa*	5.1	3.4	1.5	0.2	*I. setosa*	5.1	3.4	1.5	0.2	*I. setosa*
4.9	3.1	1.5	0.1	*I. setosa*	5	3.5	1.3	0.3	*I. setosa*	5	3.5	1.3	0.3	*I. setosa*
5.4	3.7	1.5	0.2	*I. setosa*	4.5	2.3	1.3	0.3	*I. setosa*	4.5	2.3	1.3	0.3	*I. setosa*
4.8	3.4	1.6	0.2	*I. setosa*	4.4	3.2	1.3	0.2	*I. setosa*	4.4	3.2	1.3	0.2	*I. setosa*
4.8	3	1.4	0.1	*I. setosa*	5	3.5	1.6	0.6	*I. setosa*	5	3.5	1.6	0.6	*I. setosa*
4.3	3	1.1	0.1	*I. setosa*	5.1	3.8	1.9	0.4	*I. setosa*	5.1	3.8	1.9	0.4	*I. setosa*
5.8	4	1.2	0.2	*I. setosa*	4.8	3	1.4	0.3	*I. setosa*	4.8	3	1.4	0.3	*I. setosa*
5.7	4.4	1.5	0.4	*I. setosa*	5.1	3.8	1.6	0.2	*I. setosa*	5.1	3.8	1.6	0.2	*I. setosa*
5.4	3.9	1.3	0.4	*I. setosa*	4.6	3.2	1.4	0.2	*I. setosa*	4.6	3.2	1.4	0.2	*I. setosa*
5.1	3.5	1.4	0.3	*I. setosa*	5.3	3.7	1.5	0.2	*I. setosa*	5.3	3.7	1.5	0.2	*I. setosa*
5.7	3.8	1.7	0.3	*I. setosa*	5	3.3	1.4	0.2	*I. setosa*	5	3.3	1.4	0.2	*I. setosa*
5.1	3.8	1.5	0.3	*I. setosa*	7	3.2	4.7	1.4	*I. versicolor*	7	3.2	4.7	1.4	*I. versicolor*
5.4	3.4	1.7	0.2	*I. setosa*	6.4	3.2	4.5	1.5	*I. versicolor*	6.4	3.2	4.5	1.5	*I. versicolor*
5.1	3.7	1.5	0.4	*I. setosa*	6.9	3.1	4.9	1.5	*I. versicolor*	6.9	3.1	4.9	1.5	*I. versicolor*
4.6	3.6	1	0.2	*I. setosa*	5.5	2.3	4	1.3	*I. versicolor*	5.5	2.3	4	1.3	*I. versicolor*
5.1	3.3	1.7	0.5	*I. setosa*	6.5	2.8	4.6	1.5	*I. versicolor*	6.5	2.8	4.6	1.5	*I. versicolor*
4.8	3.4	1.9	0.2	*I. setosa*	5.7	2.8	4.5	1.3	*I. versicolor*	5.7	2.8	4.5	1.3	*I. versicolor*
5	3	1.6	0.2	*I. setosa*	6.3	3.3	4.7	1.6	*I. versicolor*	6.3	3.3	4.7	1.6	*I. versicolor*
5	3.4	1.6	0.4	*I. setosa*	4.9	2.4	3.3	1	*I. versicolor*	4.9	2.4	3.3	1	*I. versicolor*
5.2	3.5	1.5	0.2	*I. setosa*	6.6	2.9	4.6	1.3	*I. versicolor*	6.6	2.9	4.6	1.3	*I. versicolor*
5.2	3.4	1.4	0.2	*I. setosa*	5.2	2.7	3.9	1.4	*I. versicolor*	5.2	2.7	3.9	1.4	*I. versicolor*
4.7	3.2	1.6	0.2	*I. setosa*	5	2	3.5	1	*I. versicolor*	5	2	3.5	1	*I. versicolor*
4.8	3.1	1.6	0.2	*I. setosa*	5.9	3	4.2	1.5	*I. versicolor*	5.9	3	4.2	1.5	*I. versicolor*

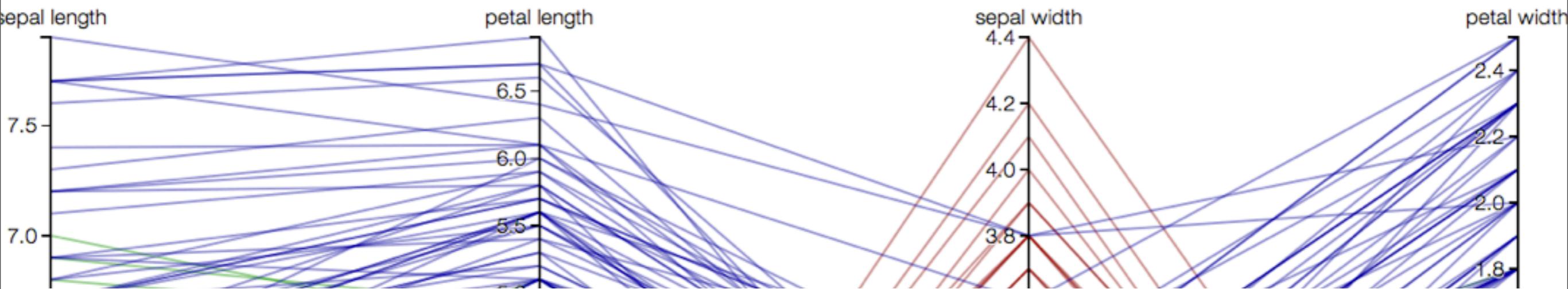
Sepal length	Sepal width	Petal length	Petal width	Species	Sepal length	Sepal width	Petal length	Petal width	Species	Sepal length	Sepal width	Petal length	Petal width	Species
5.1	3.5	1.4	0.2	*I. setosa*	5.4	3.4	1.5	0.4	*I. setosa*	5.4	3.4	1.5	0.4	*I. setosa*
4.9	3	1.4	0.2	*I. setosa*	5.2	4.1	1.5	0.1	*I. setosa*	5.2	4.1	1.5	0.1	*I. setosa*
4.7	3.2	1.3	0.2	*I. setosa*	5.5	4.2	1.4	0.2	*I. setosa*	5.5	4.2	1.4	0.2	*I. setosa*
4.6	3.1	1.5	0.2	*I. setosa*	4.9	3.1	1.5	0.2	*I. setosa*	4.9	3.1	1.5	0.2	*I. setosa*
5	3.6	1.4	0.2	*I. setosa*	5	3.2	1.2	0.2	*I. setosa*	5	3.2	1.2	0.2	*I. setosa*
5.4	3.9	1.7	0.4	*I. setosa*	5.5	3.5	1.3	0.2	*I. setosa*	5.5	3.5	1.3	0.2	*I. setosa*
4.6	3.4	1.4	0.3	*I. setosa*	4.9	3.6	1.4	0.1	*I. setosa*	4.9	3.6	1.4	0.1	*I. setosa*
5	3.4	1.5	0.2	*I. setosa*	4.4	3	1.3	0.2	*I. setosa*	4.4	3	1.3	0.2	*I. setosa*
4.4	2.9	1.4	0.2	*I. setosa*	5.1	3.4	1.5	0.2	*I. setosa*	5.1	3.4	1.5	0.2	*I. setosa*
4.9	3.1	1.5	0.1	*I. setosa*	5	3.5	1.3	0.3	*I. setosa*	5	3.5	1.3	0.3	*I. setosa*
5.4	3.7	1.5	0.2	*I. setosa*	4.5	2.3	1.3	0.3	*I. setosa*	4.5	2.3	1.3	0.3	*I. setosa*
4.8	3.4	1.6	0.2	*I. setosa*	4.4	3.2	1.3	0.2	*I. setosa*	4.4	3.2	1.3	0.2	*I. setosa*
4.8	3	1.4	0.1	*I. setosa*	5	3.5	1.6	0.6	*I. setosa*	5	3.5	1.6	0.6	*I. setosa*
4.3	3	1.1	0.1	*I. setosa*	5.1	3.8	1.9	0.4	*I. setosa*	5.1	3.8	1.9	0.4	*I. setosa*
5.8	4	1.2	0.2	*I. setosa*	4.8	3	1.4	0.3	*I. setosa*	4.8	3	1.4	0.3	*I. setosa*
5.7	4.4	1.5	0.4	*I. setosa*	5.1	3.8	1.6	0.2	*I. setosa*	5.1	3.8	1.6	0.2	*I. setosa*
5.4	3.9	1.3	0.4	*I. setosa*	4.6	3.2	1.4	0.2	*I. setosa*	4.6	3.2	1.4	0.2	*I. setosa*
5.1	3.5	1.4	0.3	*I. setosa*	5.3	3.7	1.5	0.2	*I. setosa*	5.3	3.7	1.5	0.2	*I. setosa*
5.7	3.8	1.7	0.3	*I. setosa*	5	3.3	1.4	0.2	*I. setosa*	5	3.3	1.4	0.2	*I. setosa*
5.1	3.8	1.5	0.3	*I. setosa*	7	3.2	4.7	1.4	*I. versicolor*	7	3.2	4.7	1.4	*I. versicolor*
5.4	3.4	1.7	0.2	*I. setosa*	6.4	3.2	4.5	1.5	*I. versicolor*	6.4	3.2	4.5	1.5	*I. versicolor*
5.1	3.7	1.5	0.4	*I. setosa*	6.9	3.1	4.9	1.5	*I. versicolor*	6.9	3.1	4.9	1.5	*I. versicolor*
4.6	3.6	1	0.2	*I. setosa*	5.5	2.3	4	1.3	*I. versicolor*	5.5	2.3	4	1.3	*I. versicolor*
5.1	3.3	1.7	0.5	*I. setosa*	6.5	2.8	4.6	1.5	*I. versicolor*	6.5	2.8	4.6	1.5	*I. versicolor*
4.8	3.4	1.9	0.2	*I. setosa*	5.7	2.8	4.5	1.3	*I. versicolor*	5.7	2.8	4.5	1.3	*I. versicolor*
5	3	1.6	0.2	*I. setosa*	6.3	3.3	4.7	1.6	*I. versicolor*	6.3	3.3	4.7	1.6	*I. versicolor*
5	3.4	1.6	0.4	*I. setosa*	4.9	2.4	3.3	1	*I. versicolor*	4.9	2.4	3.3	1	*I. versicolor*
5.2	3.5	1.5	0.2	*I. setosa*	6.6	2.9	4.6	1.3	*I. versicolor*	6.6	2.9	4.6	1.3	*I. versicolor*
5.2	3.4	1.4	0.2	*I. setosa*	5.2	2.7	3.9	1.4	*I. versicolor*	5.2	2.7	3.9	1.4	*I. versicolor*
4.7	3.2	1.6	0.2	*I. setosa*	5	2	3.5	1	*I. versicolor*	5	2	3.5	1	*I. versicolor*
4.8	3.1	1.6	0.2	*I. setosa*	5.9	3	4.2	1.5	*I. versicolor*	5.9	3	4.2	1.5	*I. versicolor*



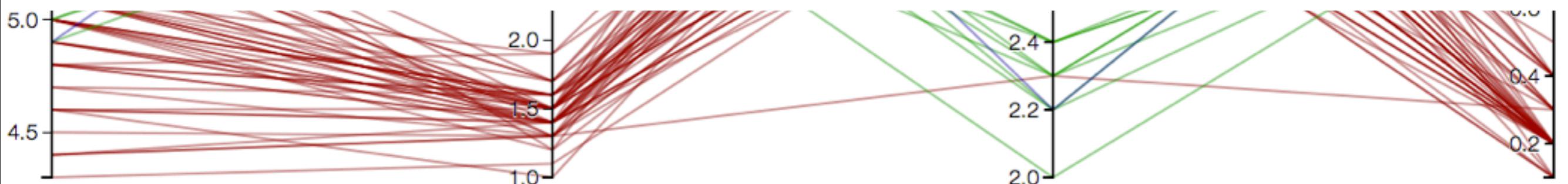


- *Iris setosa*
- *Iris versicolor*
- *Iris virginica*

Edgar Anderson's *Iris* data set
parallel coordinates



so how do we choose a good
visual representation
for our data?



- *Iris setosa*
- *Iris versicolor*
- *Iris virginica*

Edgar Anderson's *Iris* data set
parallel coordinates

1. purpose

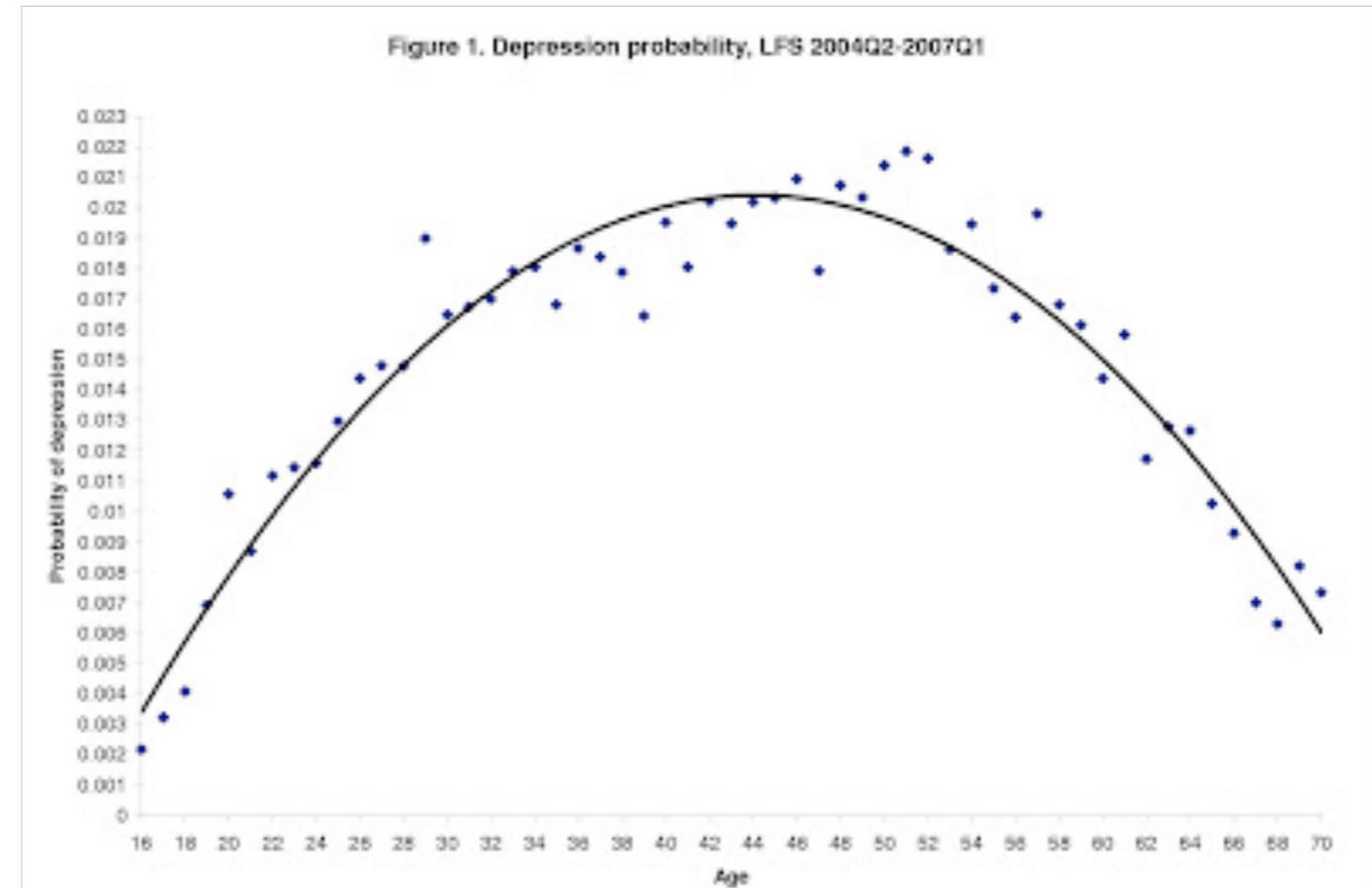
1. purpose

1. understand

2. communicate

1. purpose

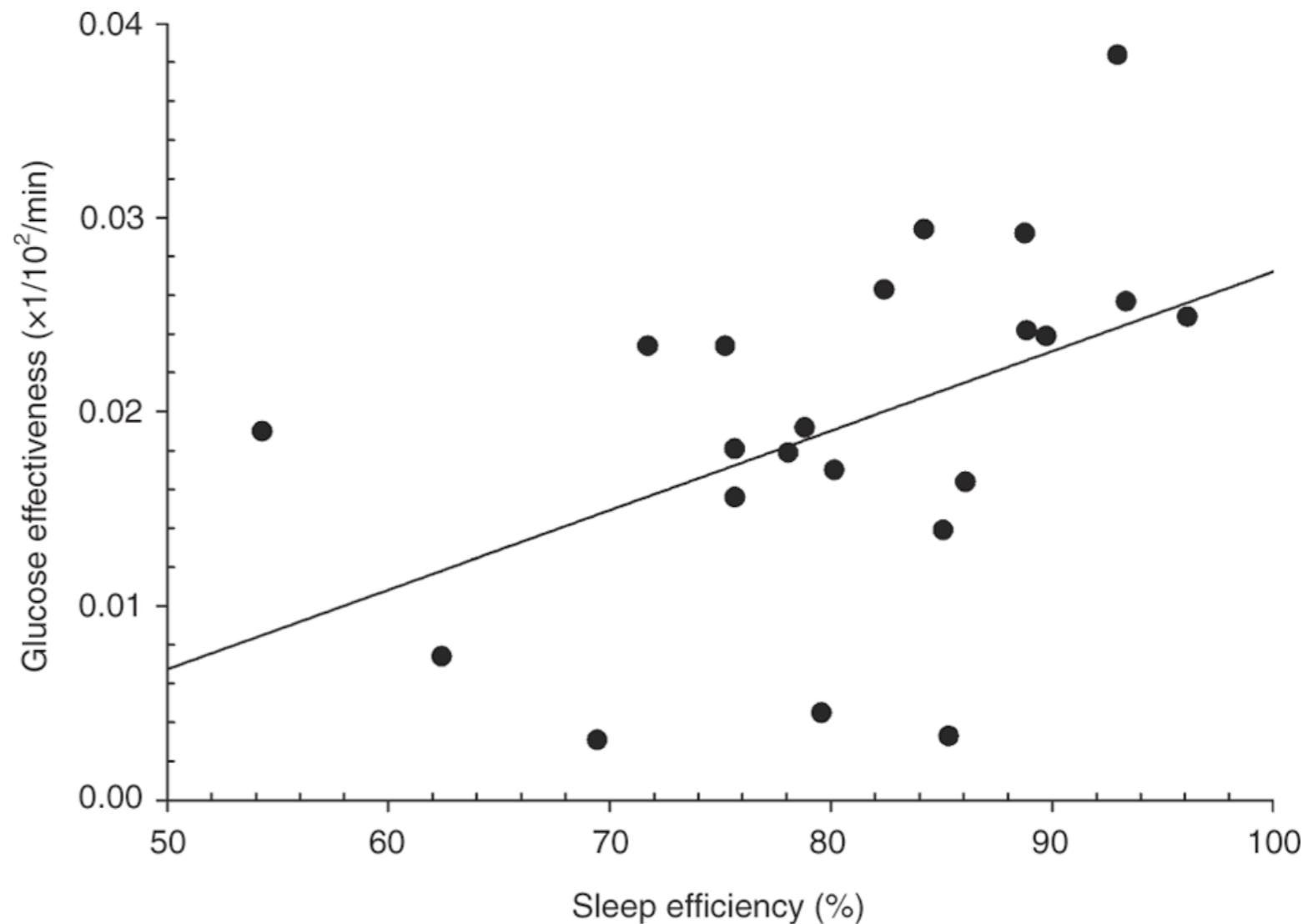
1. understand



2. communicate

1. purpose

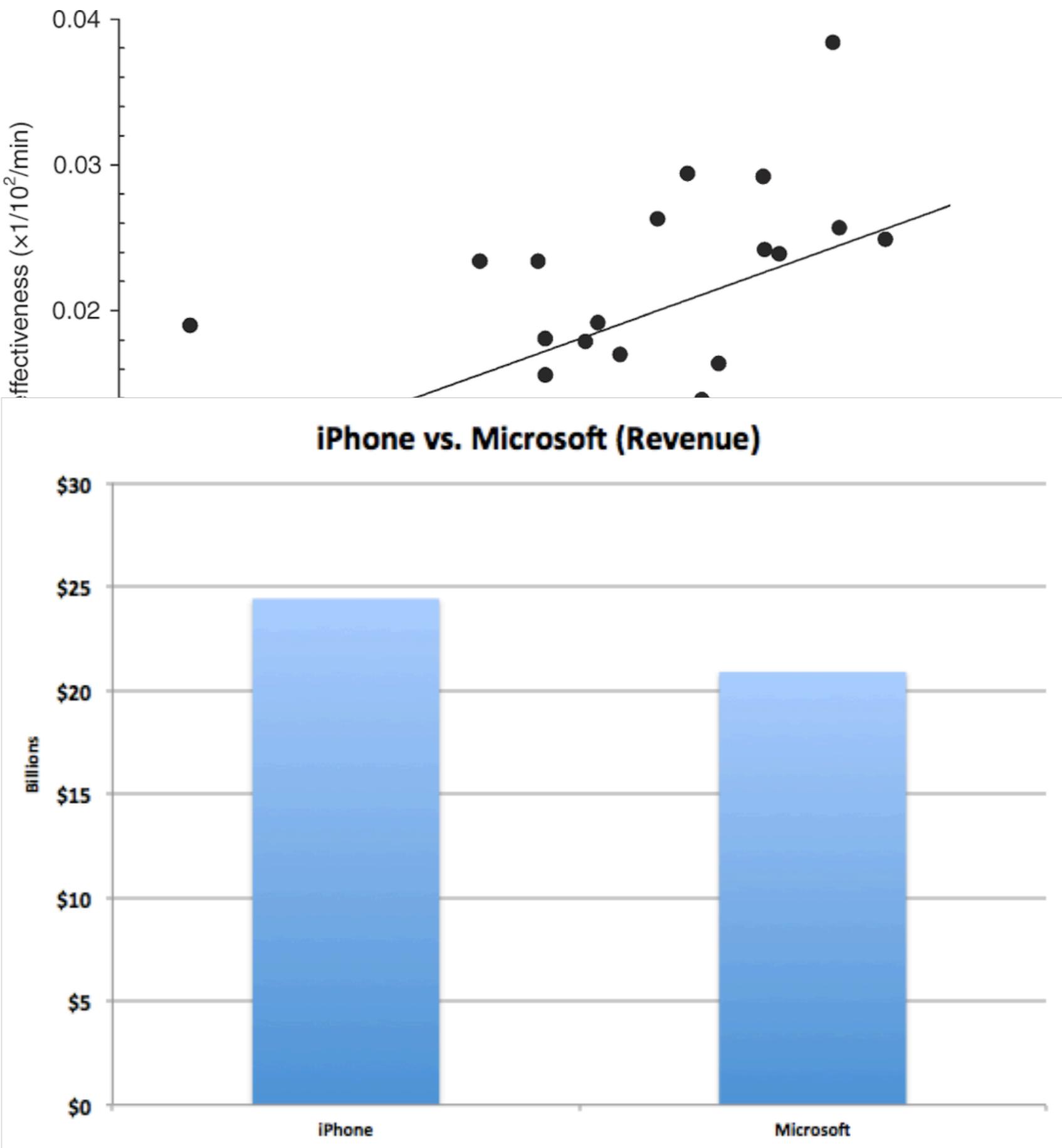
1. understand



2. communicate

1. purpose

1. understand

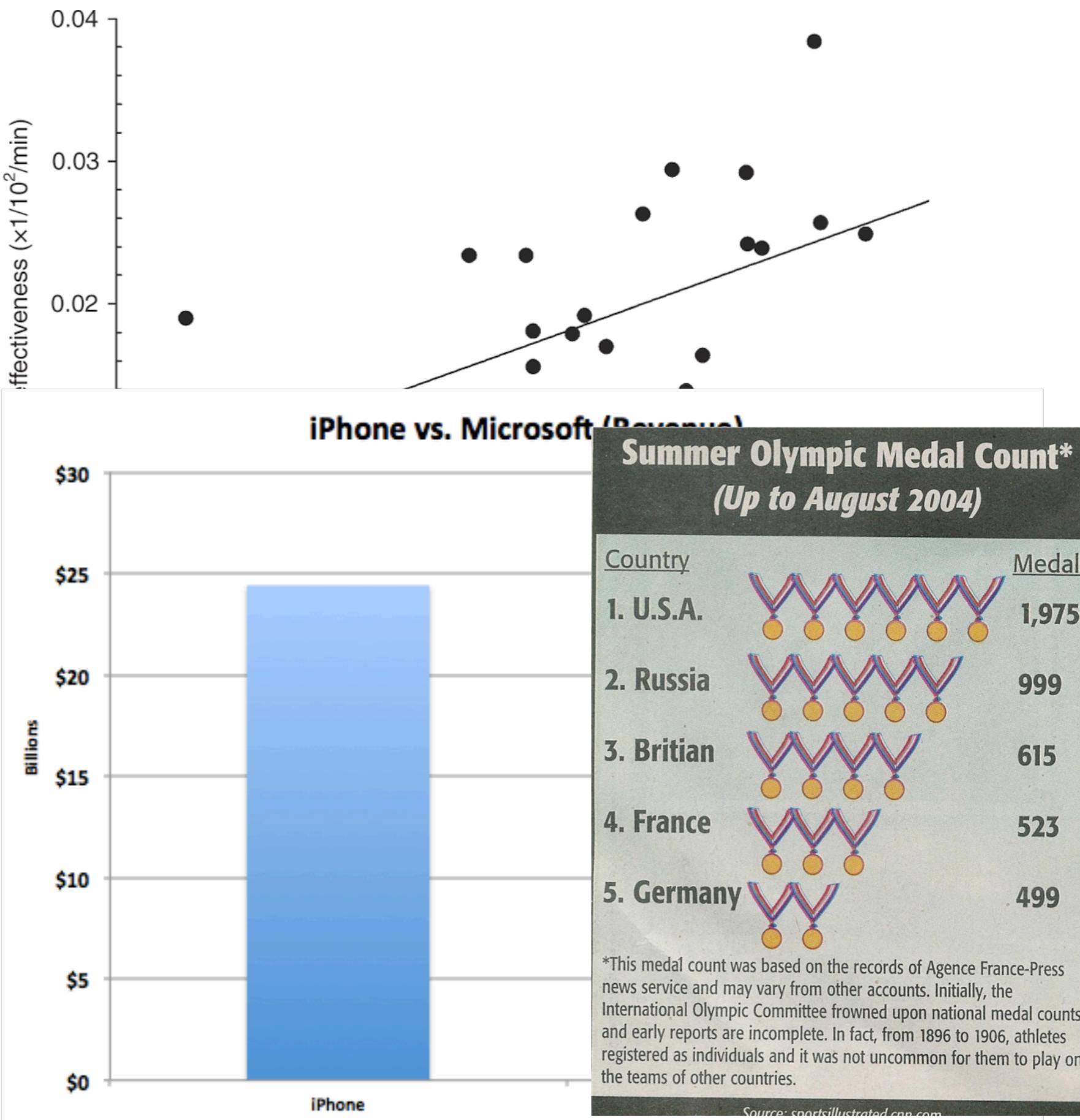


2. communicate

1. purpose

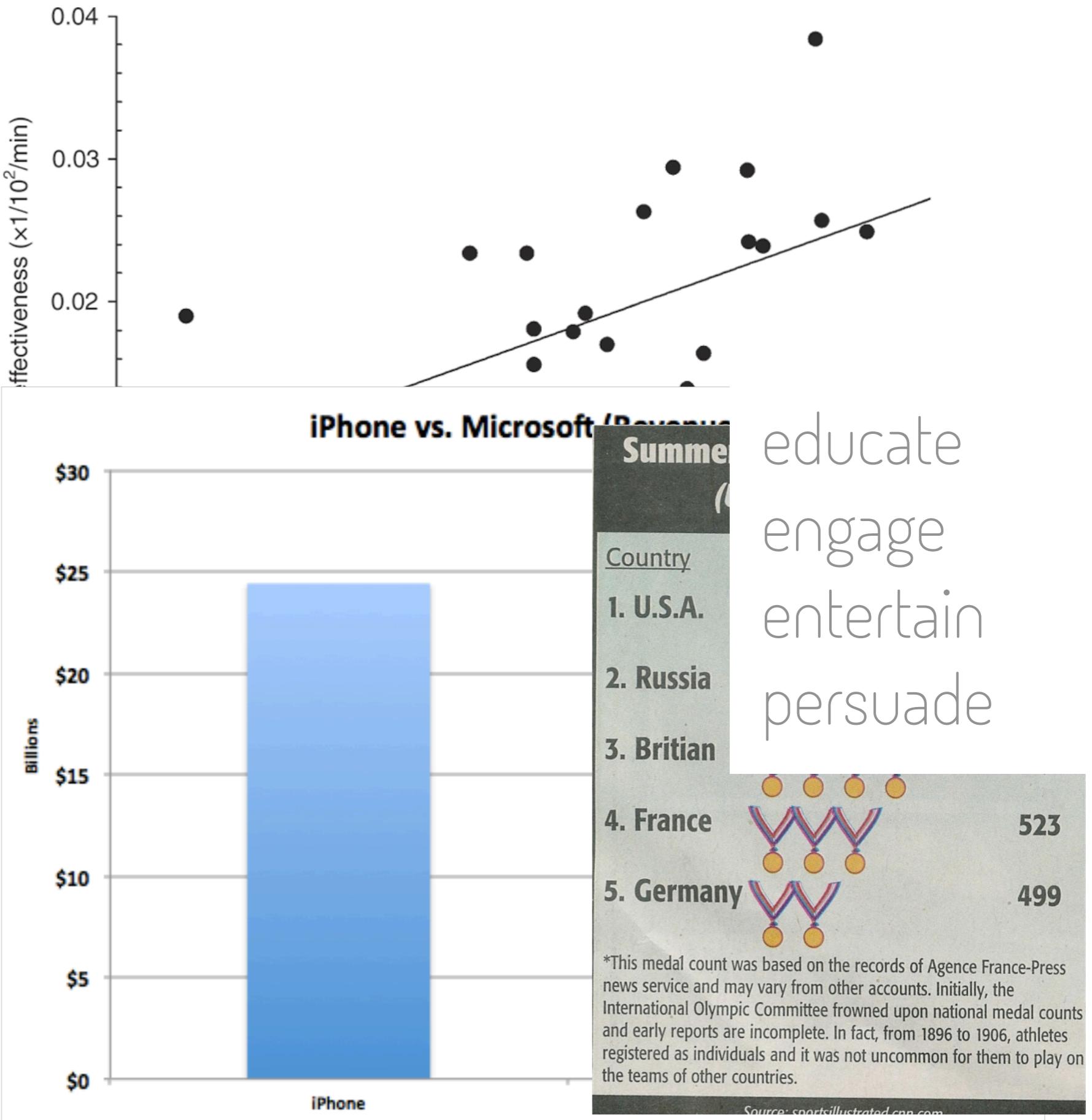
1. understand

2. communicate



1. purpose

1. understand



2. communicate

2. data

$\{x_1, x_2, x_3, x_4, \dots\}$ x_i is...

2. data

$\{x_1, x_2, x_3, x_4, \dots\}$	x_i is...
$\{1, 200, 5, 6, \dots\}$	integral
$\{1.0, 2.0, 1.2, 4, \dots\}$	fixed point
$\{'a', 'b', '12c', 'd', \dots\}$	alpha(-numeric)
$\{20\%, 30\%, 1\%, 5\%, \dots\}$	fractions of a population
$\{\text{pear}, \text{apple}, \text{kiwi}, \text{pineapple}, \dots\}$	categorical
$\{f(\text{pear}, \text{apple}), g(\text{apple}, \text{kiwi}), q(\text{kiwi}, \text{pineapple}), \dots\}$	relational

2. data

$\{x_1, x_2, x_3, x_4, \dots\}$	x_i is...
$\{1, 200, 5, 6, \dots\}$	integral
$\{1.0, 2.0, 1.2, 4, \dots\}$	fixed point
$\{'a', 'b', '12c', 'd', \dots\}$	alpha(-numeric)
$\{20\%, 30\%, 1\%, 5\%, \dots\}$	fractions of a population
$\{\text{pear}, \text{apple}, \text{kiwi}, \text{pineapple}, \dots\}$	categorical
$\{f(\text{pear}, \text{apple}), g(\text{apple}, \text{kiwi}), q(\text{kiwi}, \text{pineapple}), \dots\}$	relational

understanding objective - help the user to understand relationships **among the elements of the set**

2. data

an example

$\{x_1, x_2, x_3, x_4, \dots\}$ x_i is...

$\{1, 200, 5, 6, \dots\}$ integral

$\{1.0, 2.0, 1.2, 4, \dots\}$ fixed point

$\{'a', 'b', '12c', 'd' \dots\}$ alpha(-numeric)

$\{20\%, 30\%, 1\%, 5\% \dots\}$ fractions of a population

$\{\text{apple}, \text{orange}, \text{kiwi}, \text{pear}, \text{pineapple} \dots\}$ categorical

$\{f(\text{apple}, \text{orange}), g(\text{apple}, \text{kiwi}), q(\text{apple}, \text{pear}) \dots\}$ relational

understanding objective - help the user to understand
relationships among the elements of the set

4

4

9

7

4

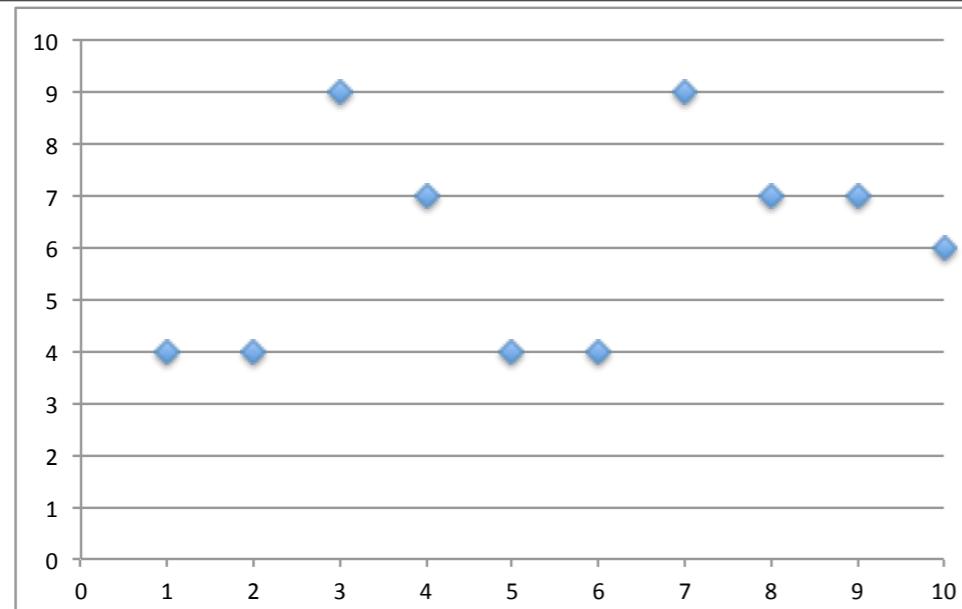
4

9

7

7

6



4

4

9
7

4

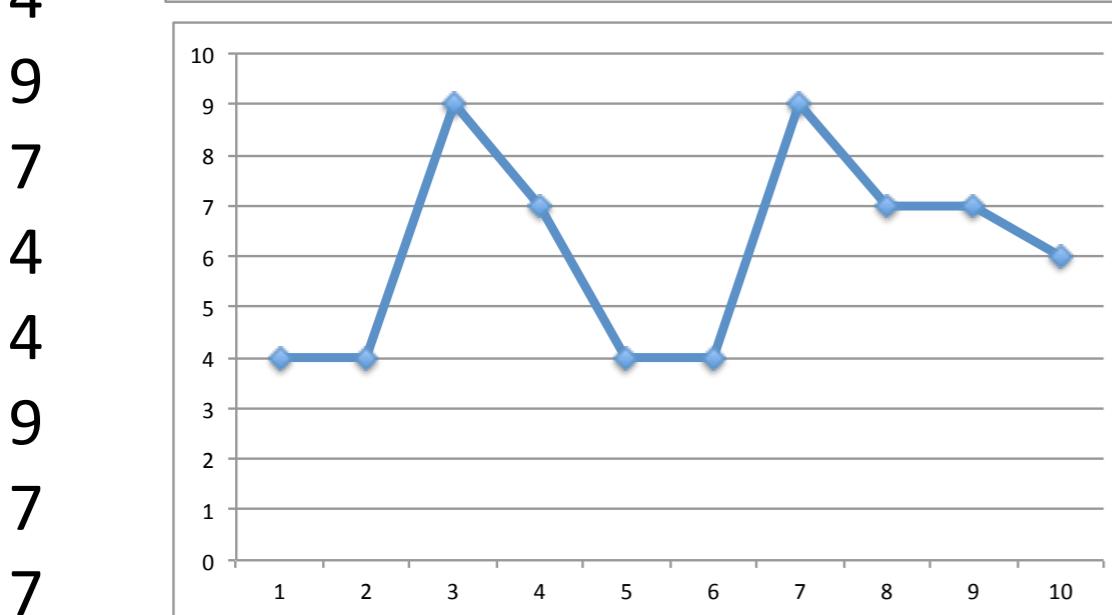
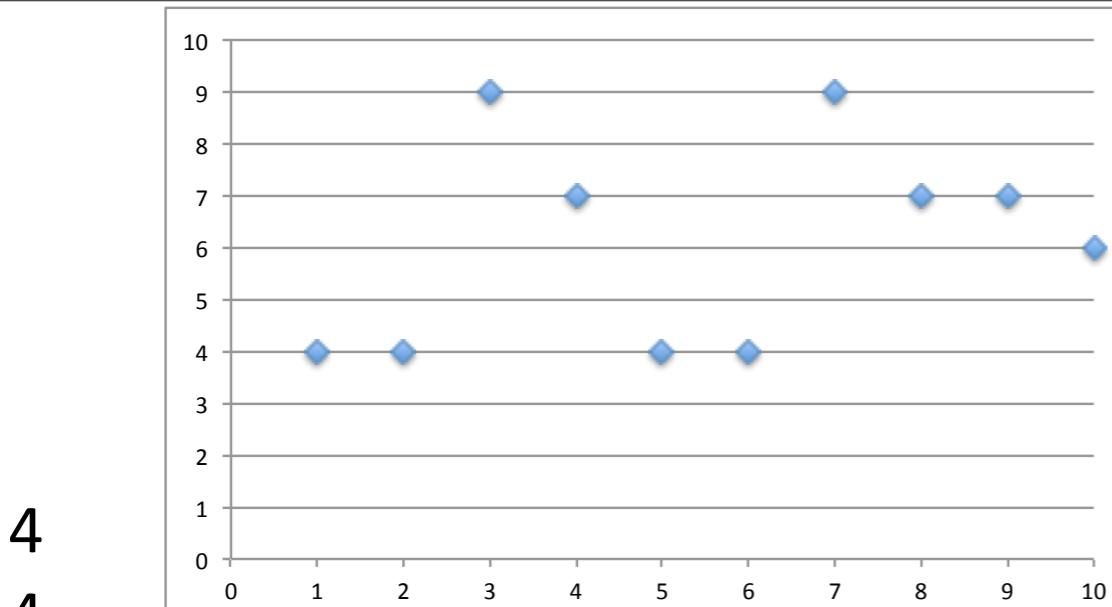
4

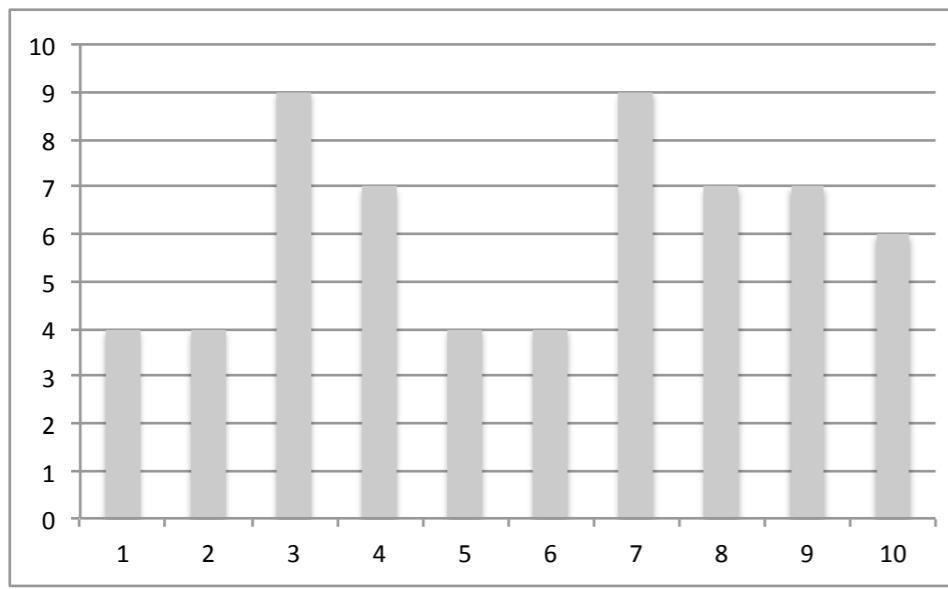
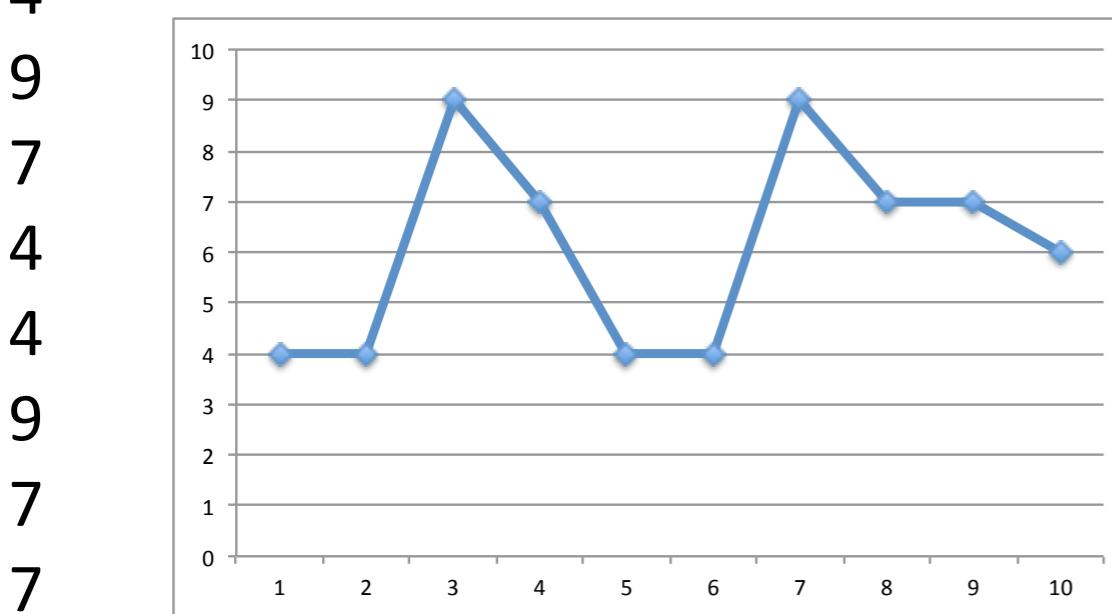
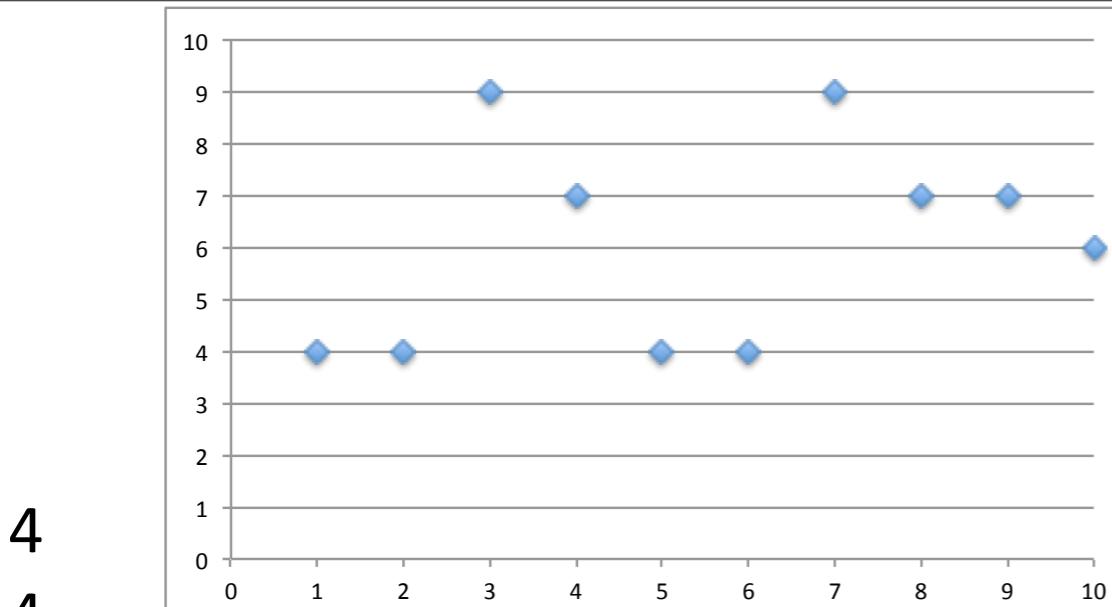
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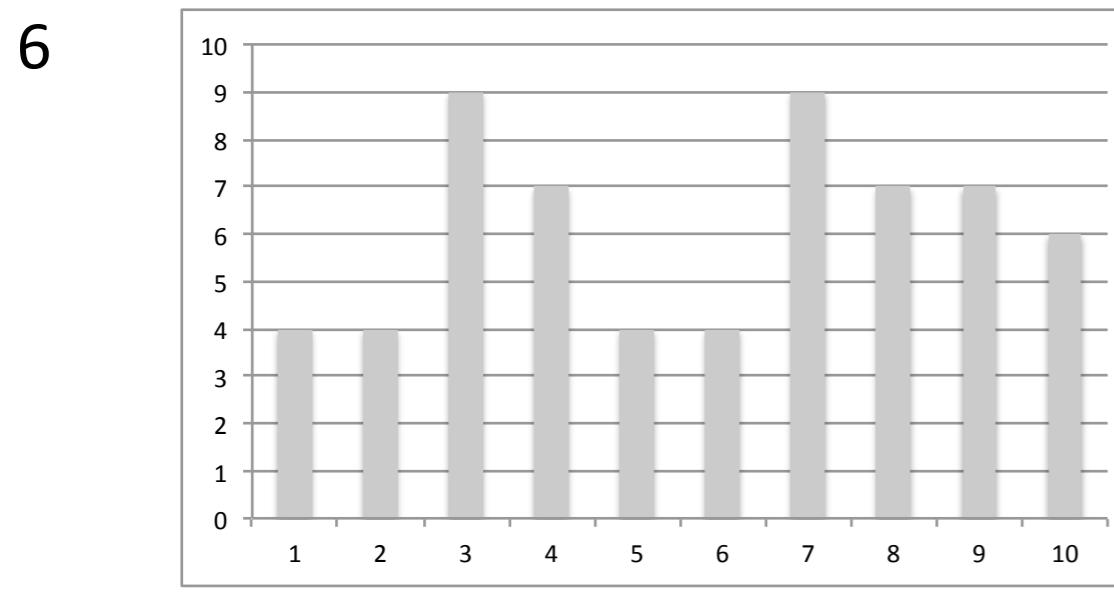
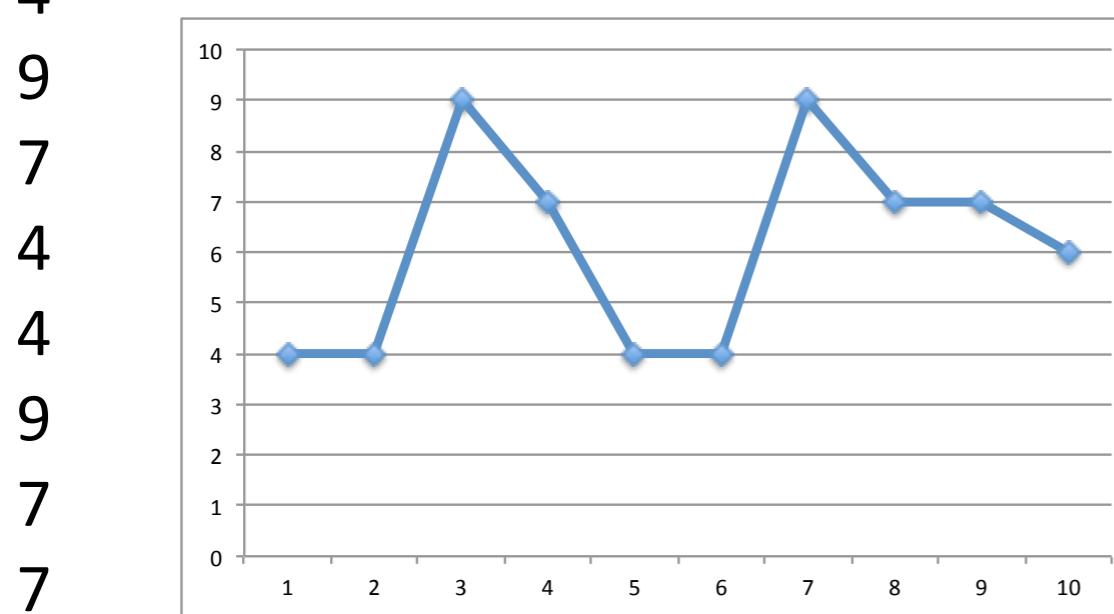
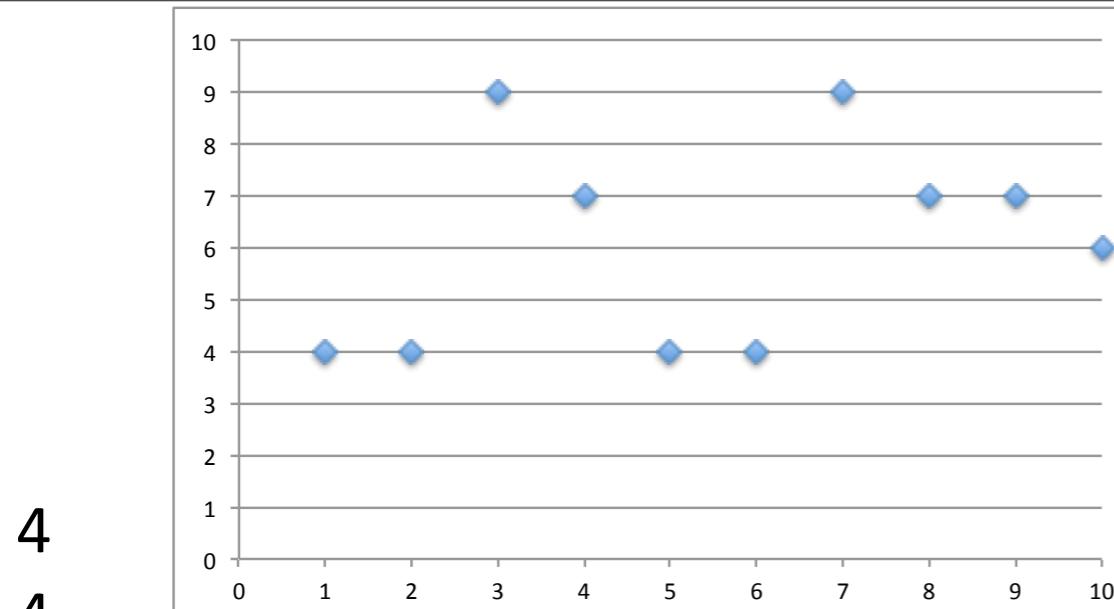
7

7

6





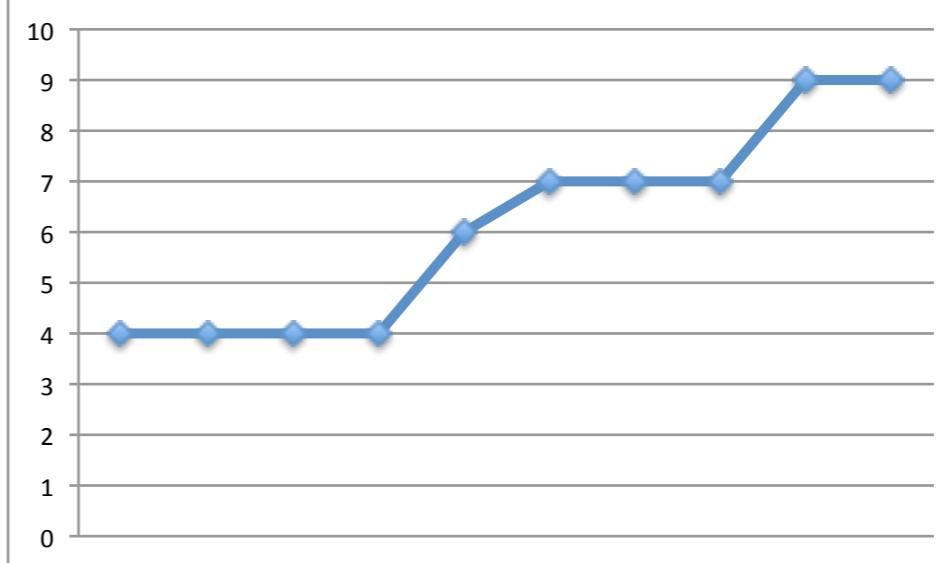
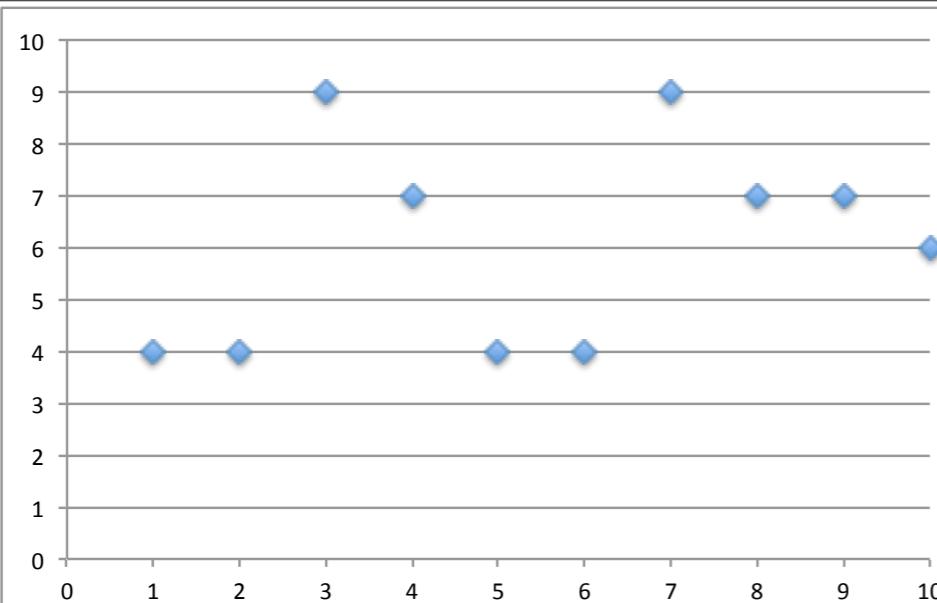


ordering significant

order insignificant

4

4



9

7

4

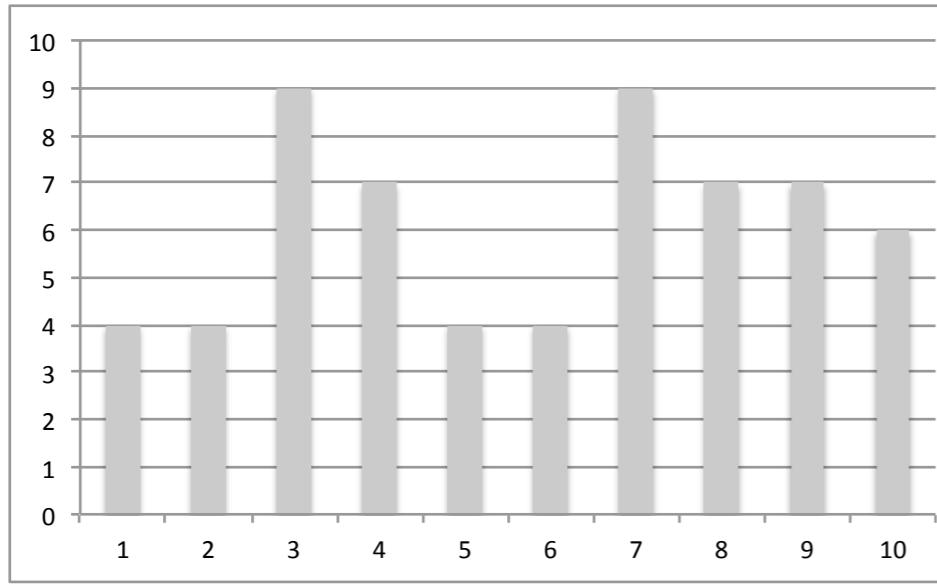
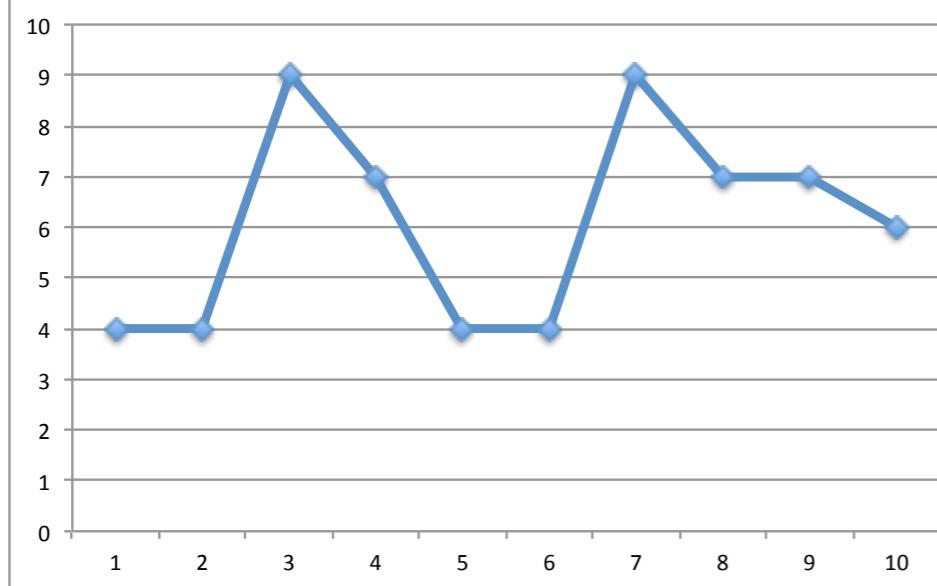
4

9

7

7

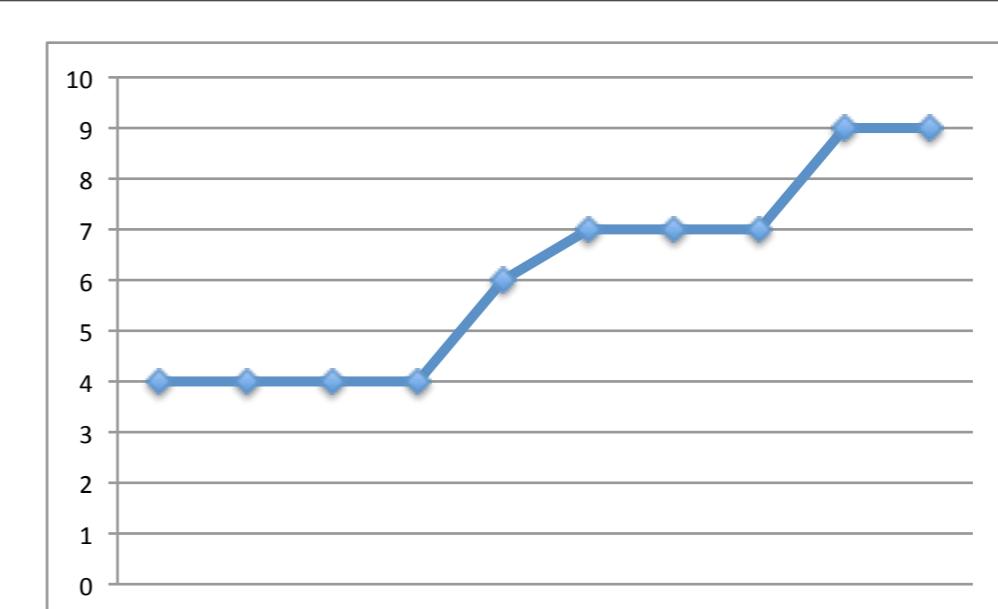
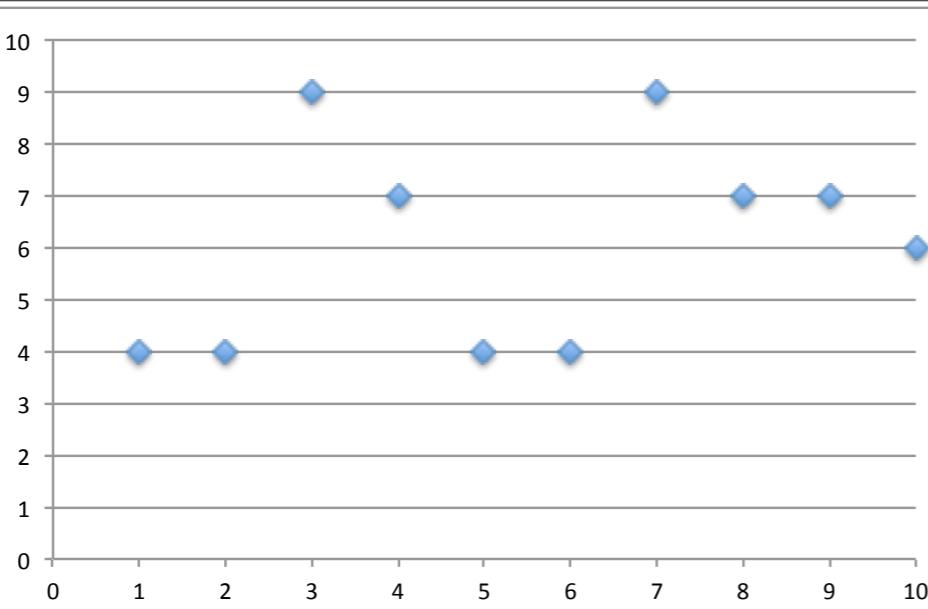
6



ordering significant

order insignificant

histogram



4

4

9

7

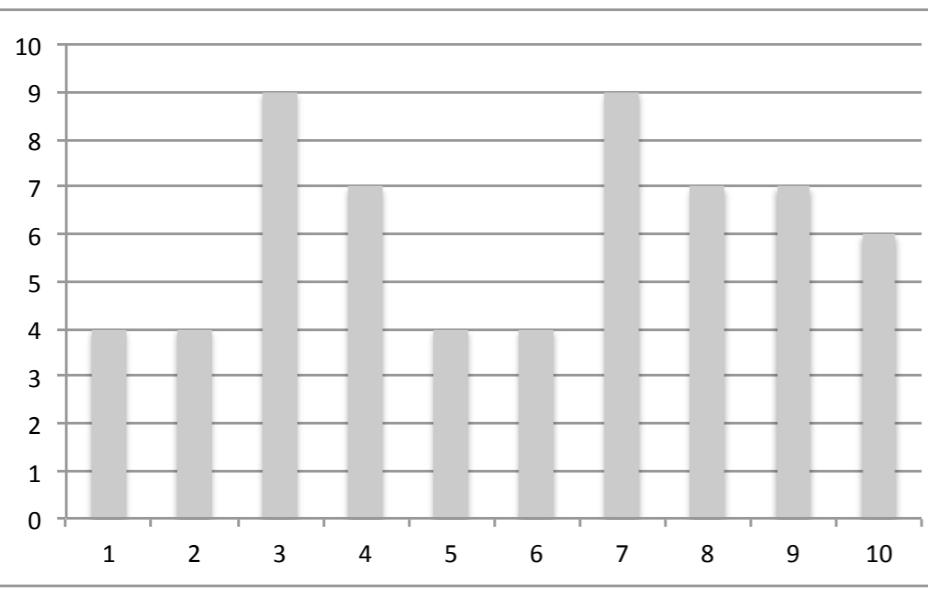
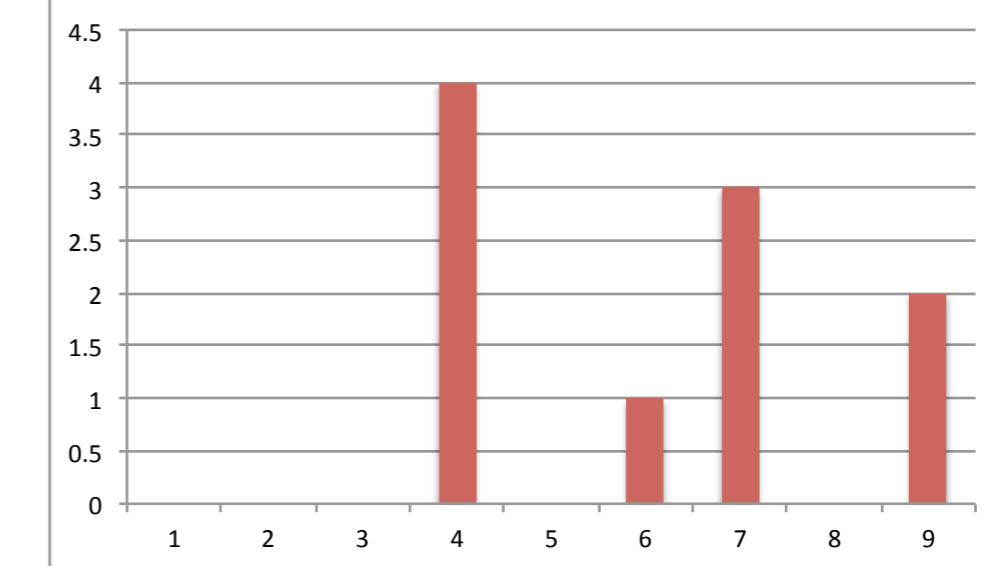
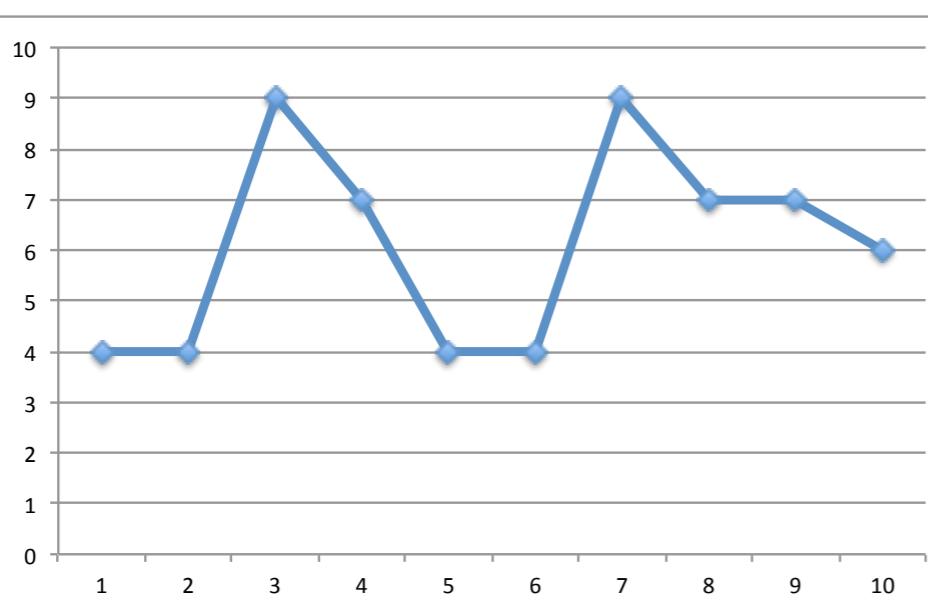
4

9

7

7

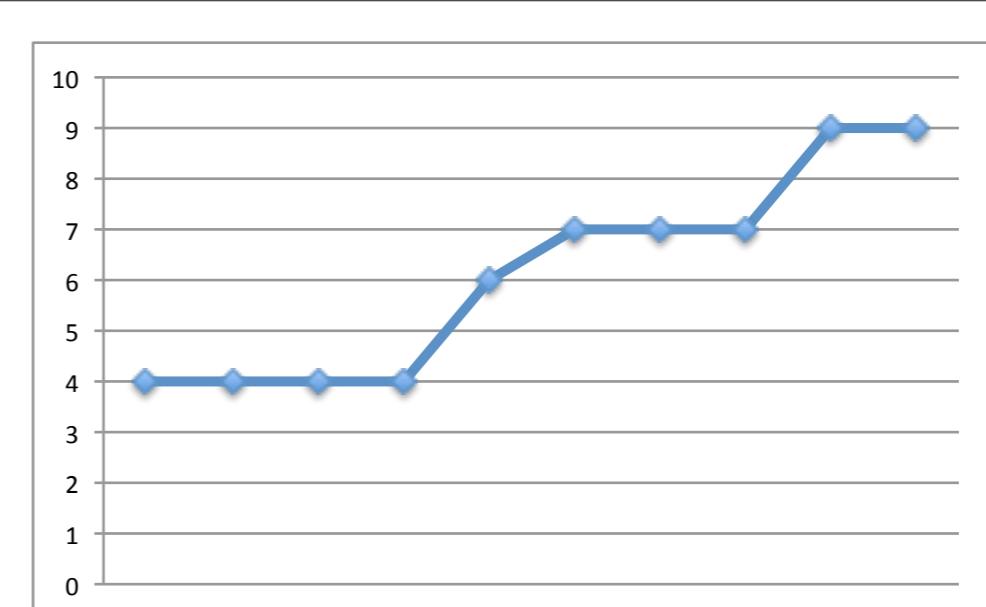
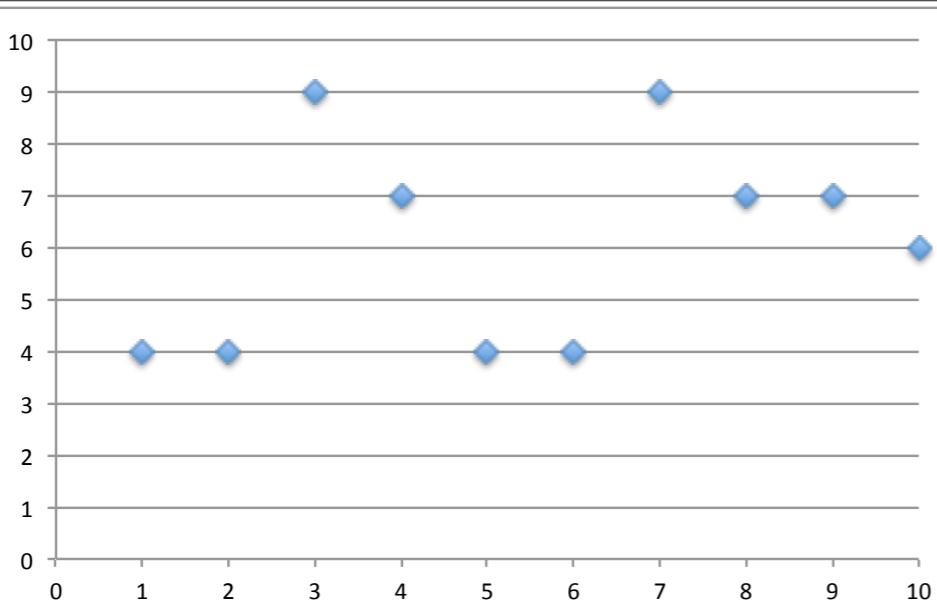
6



ordering significant

order insignificant

histogram



4

4

9

7

4

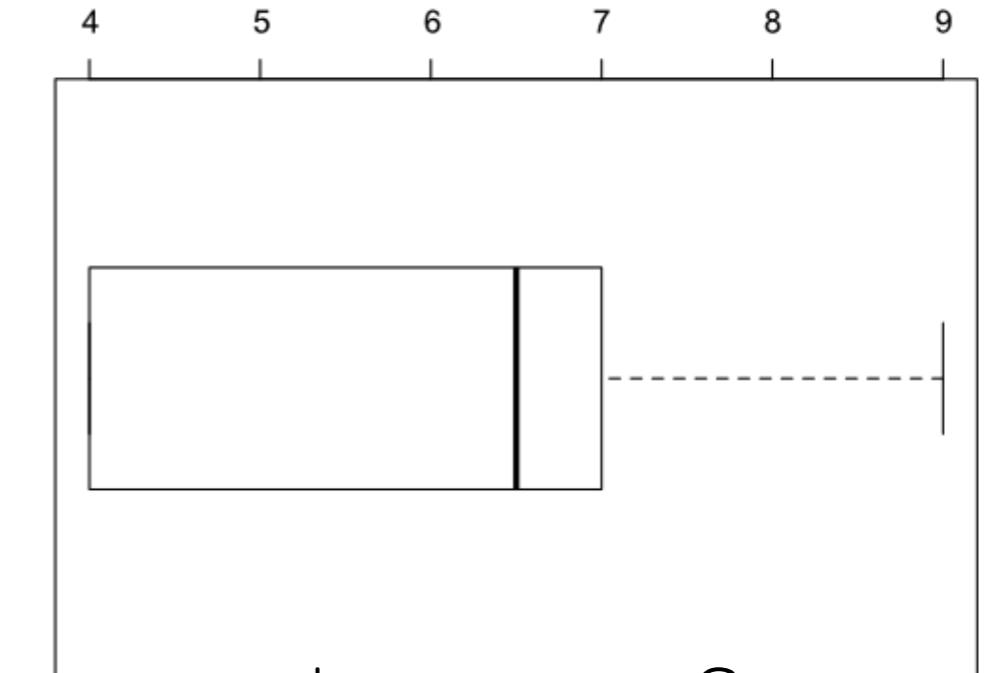
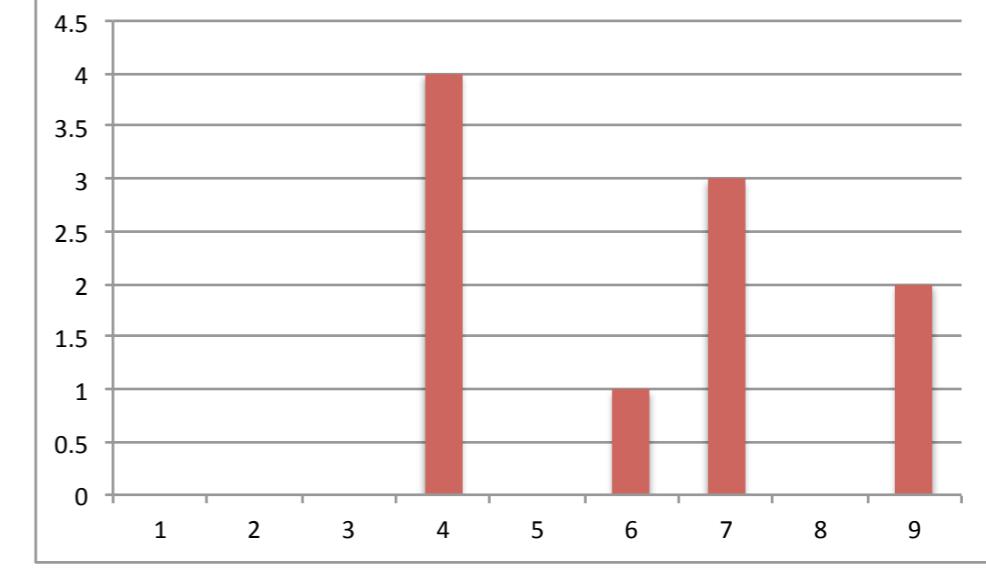
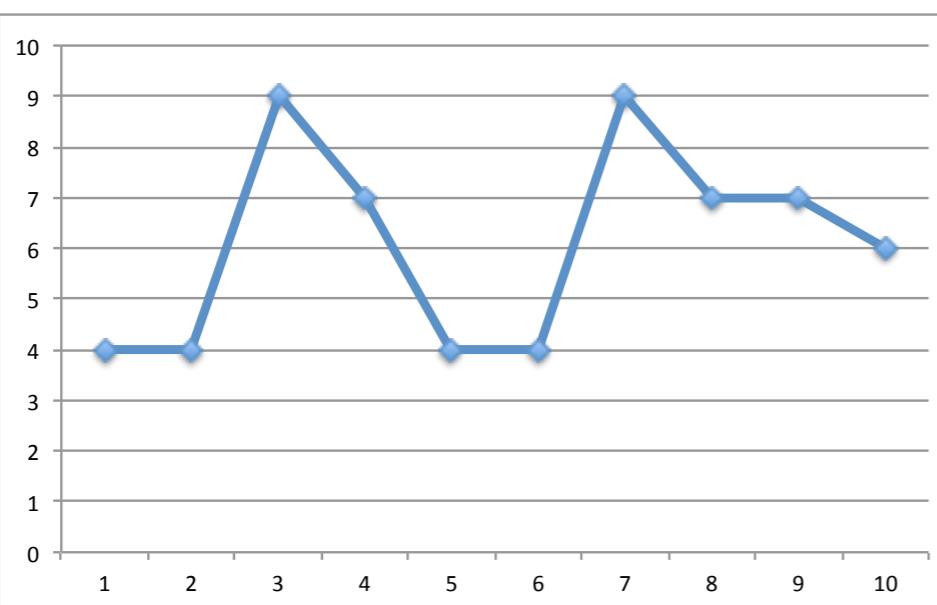
9

7

7

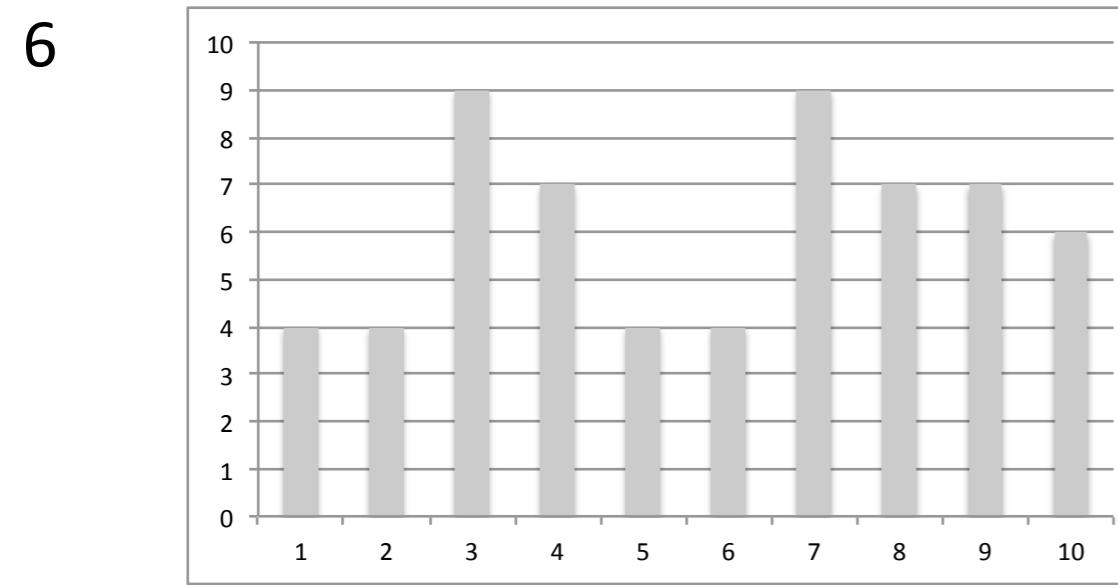
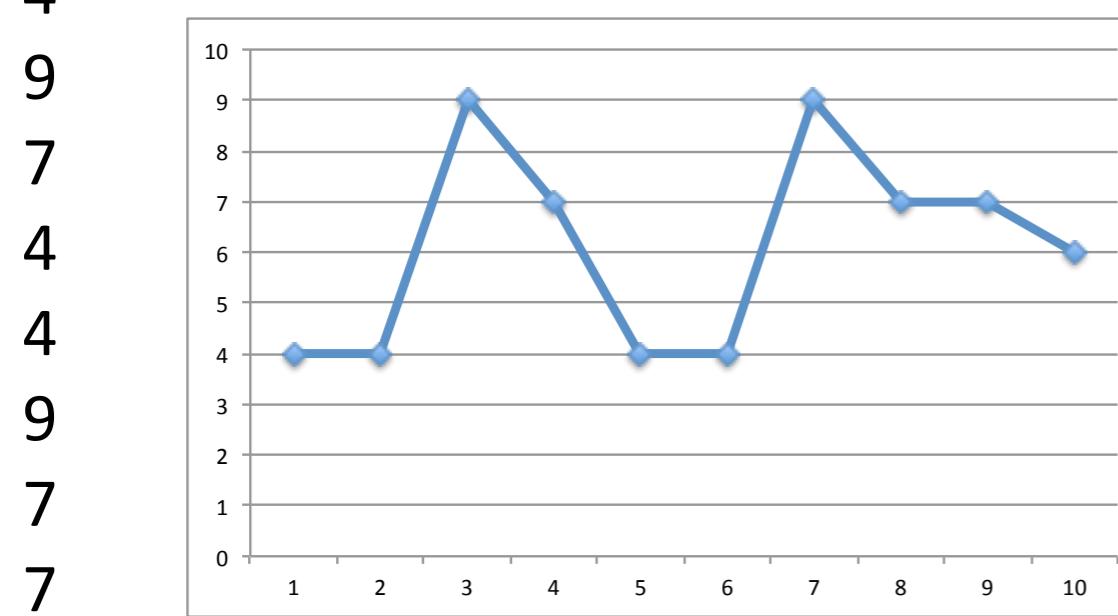
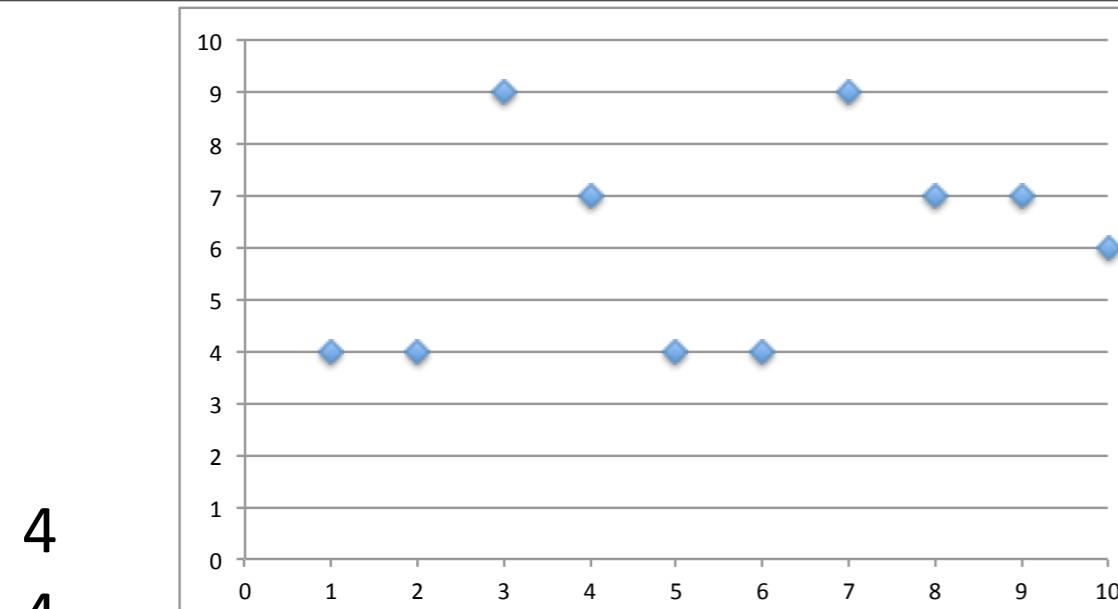
7

6

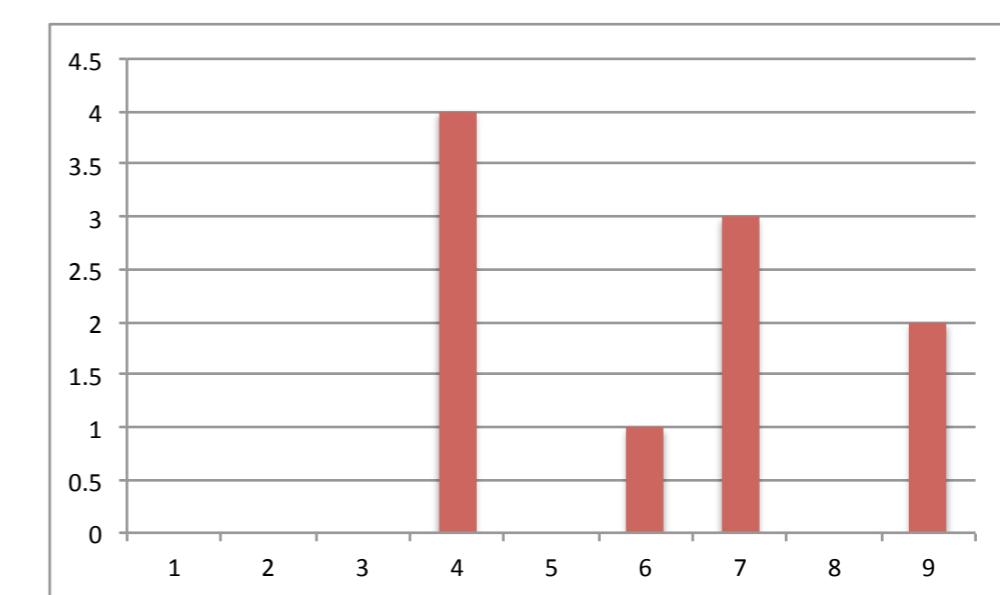
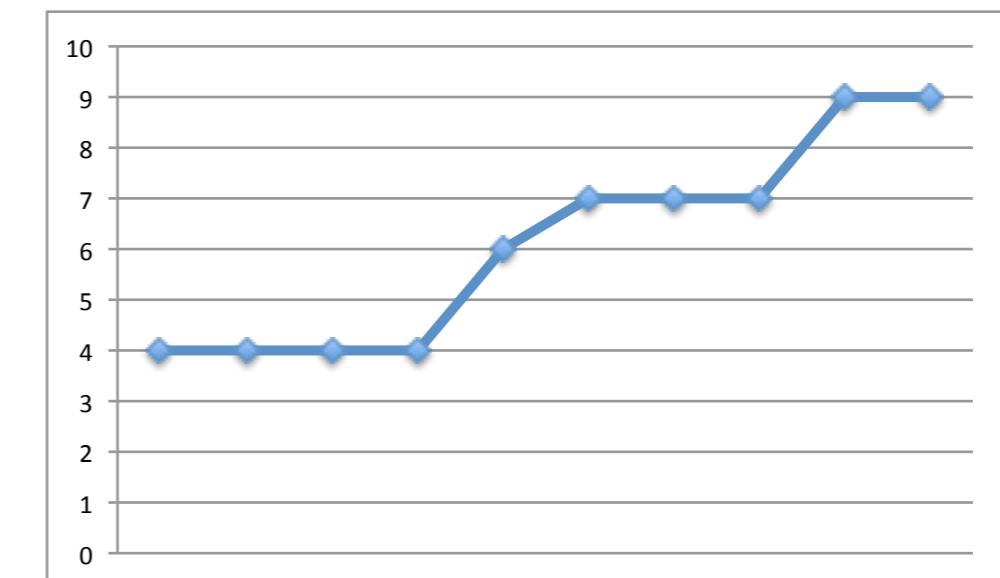


ordering significant

order insignificant



ordering significant



median (middle)

Quartiles

order insignificant

sorted

histogram

box & whisker

extrema
(whiskers)

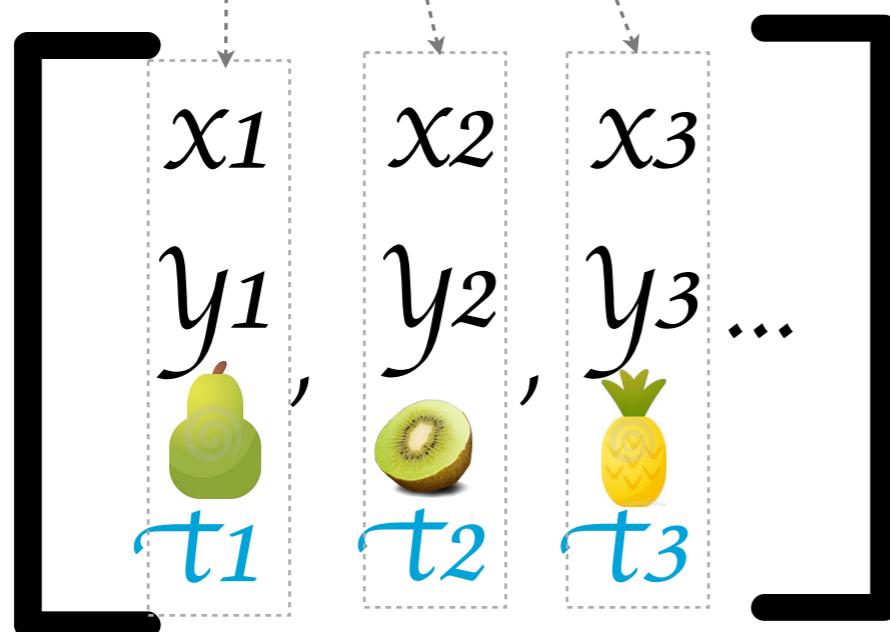
so you have a dataset...

it's probably multivariate

$\mathcal{X} =$

$\{\vec{x}_1, \vec{x}_2, \vec{x}_3, \vec{x}_4, \dots\}$

$\mathcal{X} =$



if these are observations of the
(same) object(s) over time
“time series”

if these are observations of different
things at a single point in time
“population”

if these are observations of different
things at different points in time
“observations”

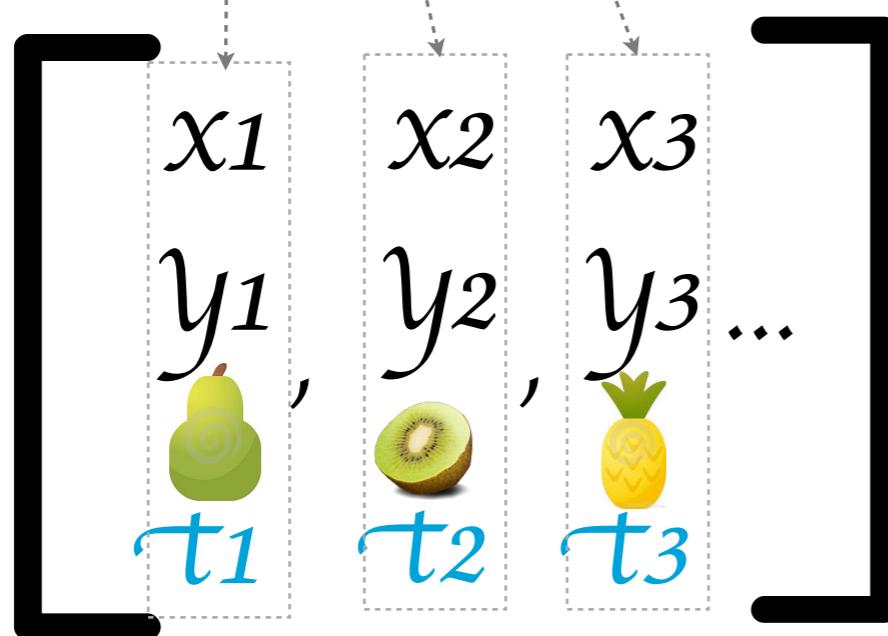
so you have a dataset...

it's probably multivariate

$\mathcal{X} =$

$\{\vec{x}_1, \vec{x}_2, \vec{x}_3, \vec{x}_4, \dots\}$

$\mathcal{X} =$



if these are observations of the
(same) of object(s) over time
“time series”

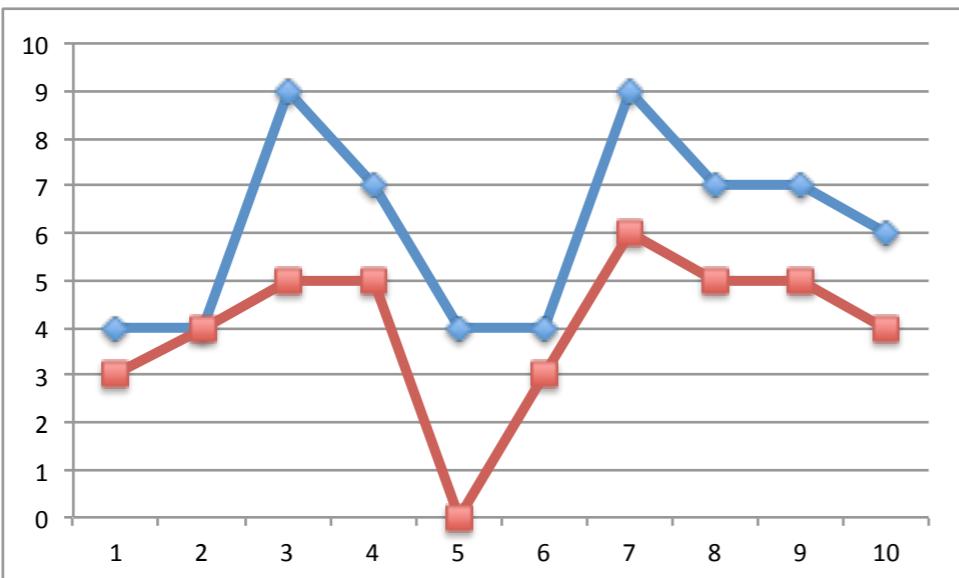
if these are observations of different
things at a single point in time
“population”

if these are observations of different
things at a different points in time
“observations”

understanding objective(s) :

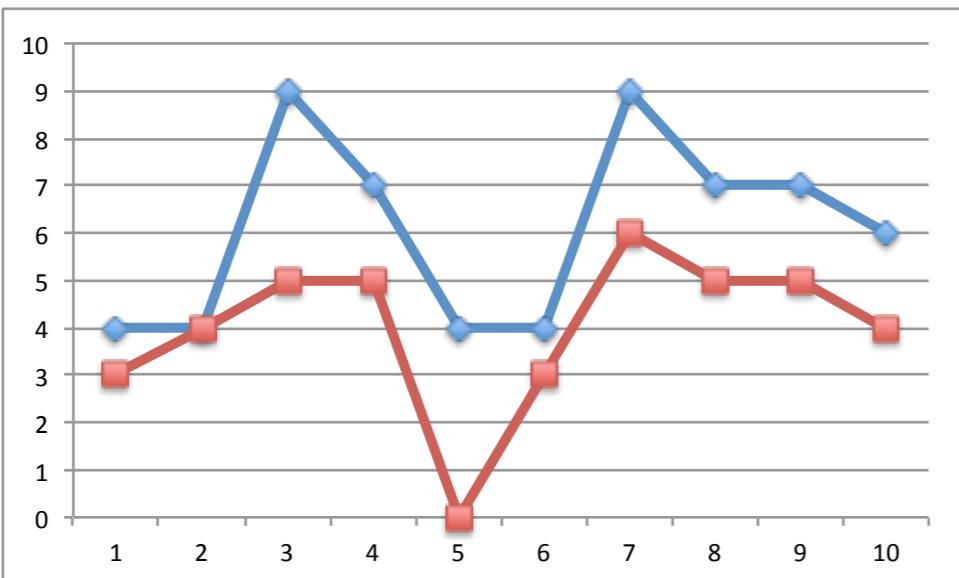
1. relations among dimensions of each example (multivariate)
2. relations among examples/observations (multidimensional)

4	3
4	4
9	5
7	5
4	0
4	3
9	6
7	5
7	5
6	4

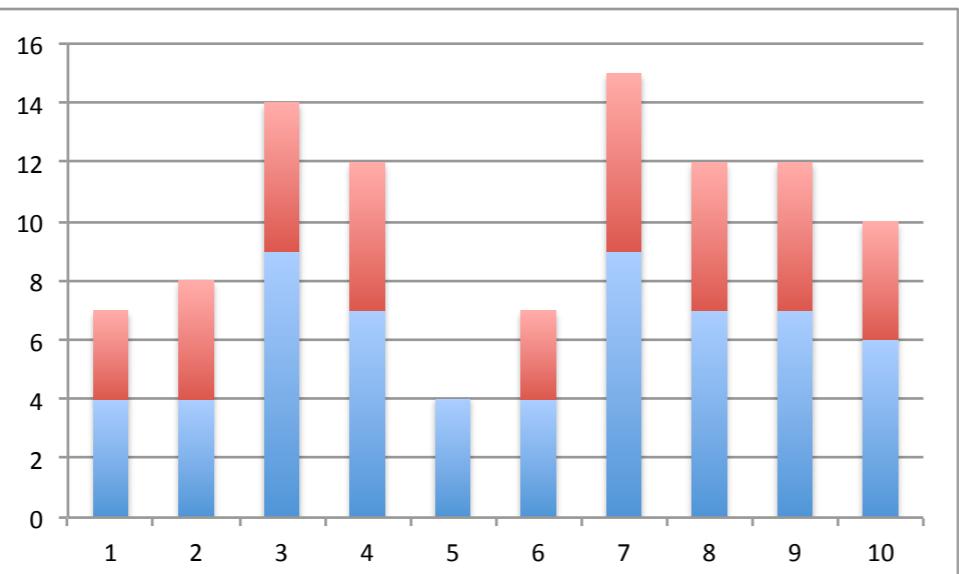


lines

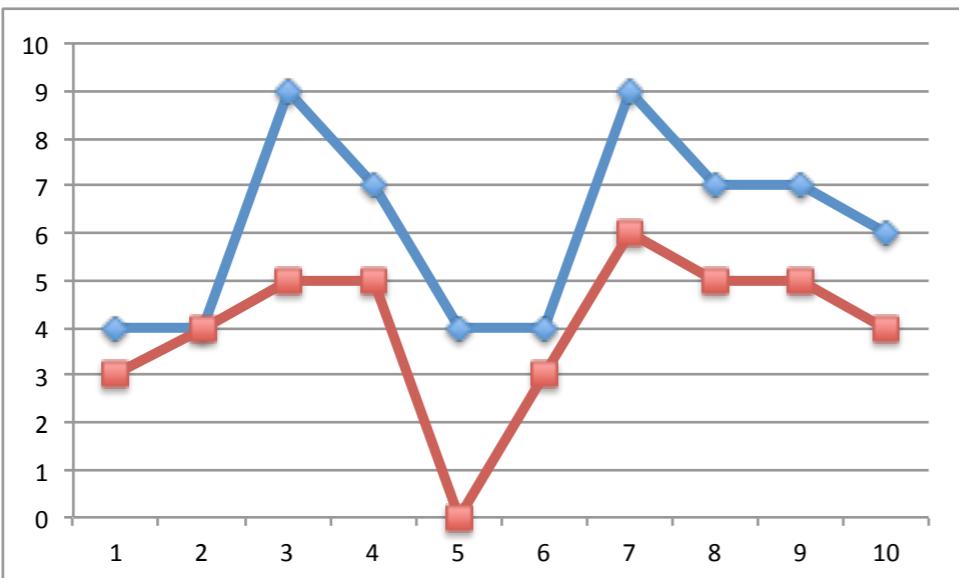
4	3
4	4
9	5
7	5
4	0
4	3
9	6
7	5
7	5
6	4



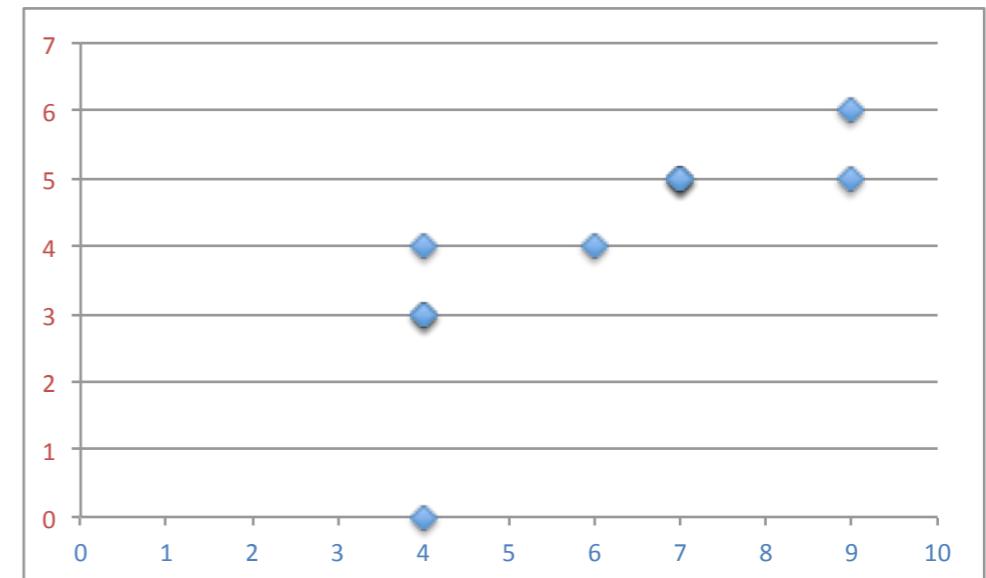
lines



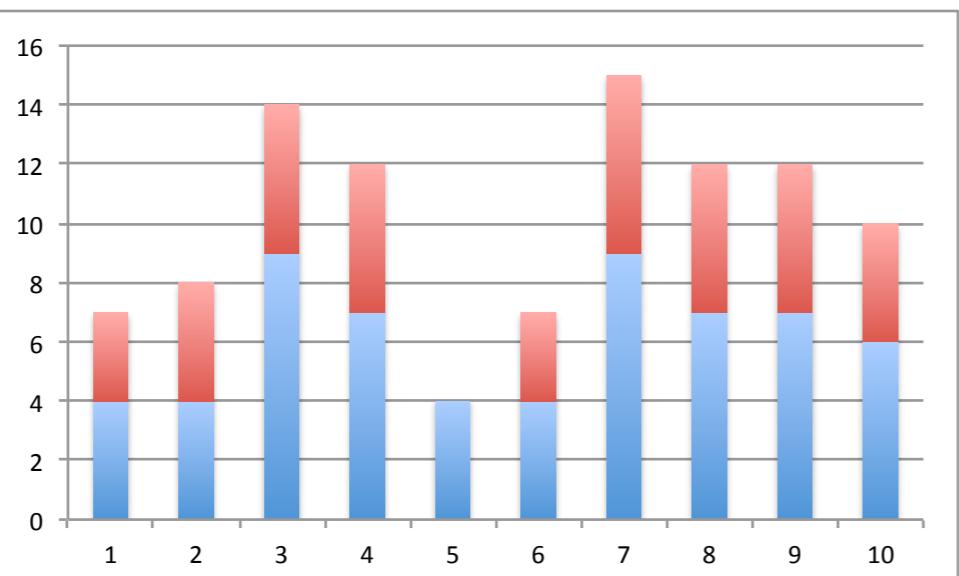
stacked bar



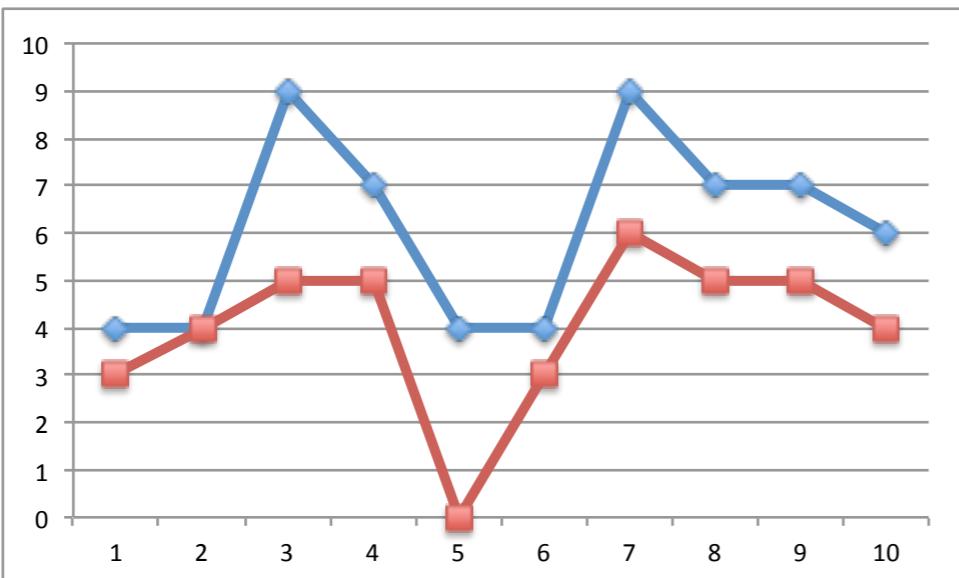
lines



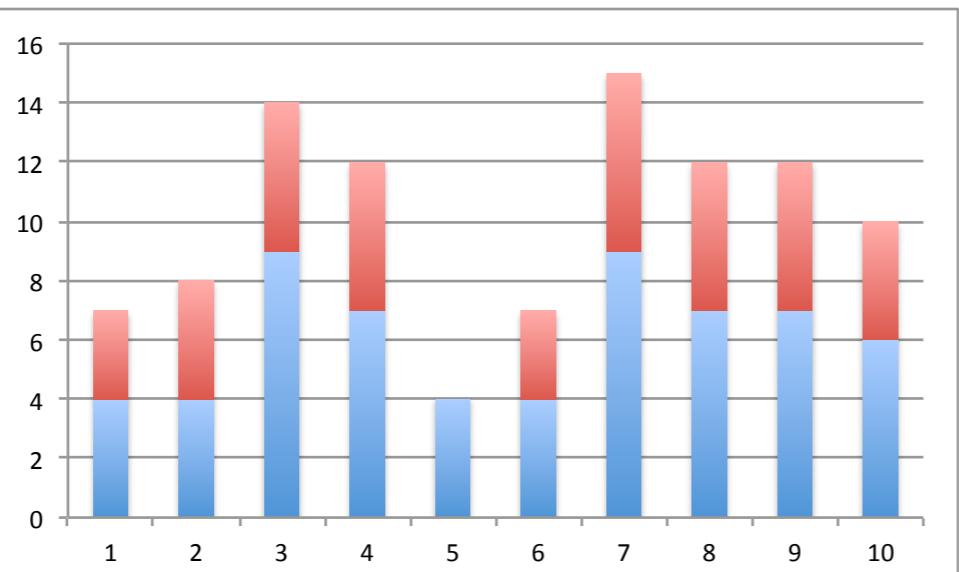
scatter



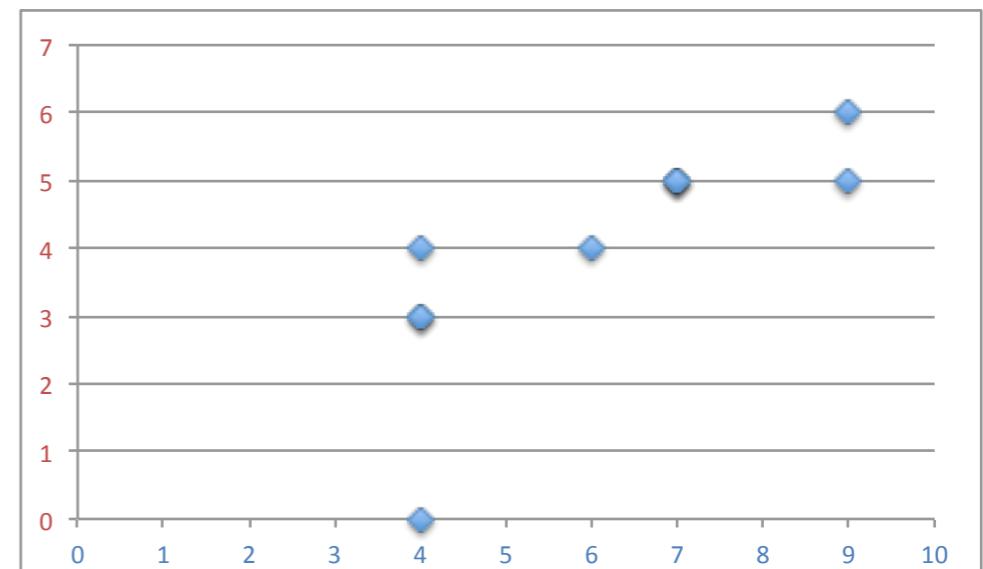
stacked bar



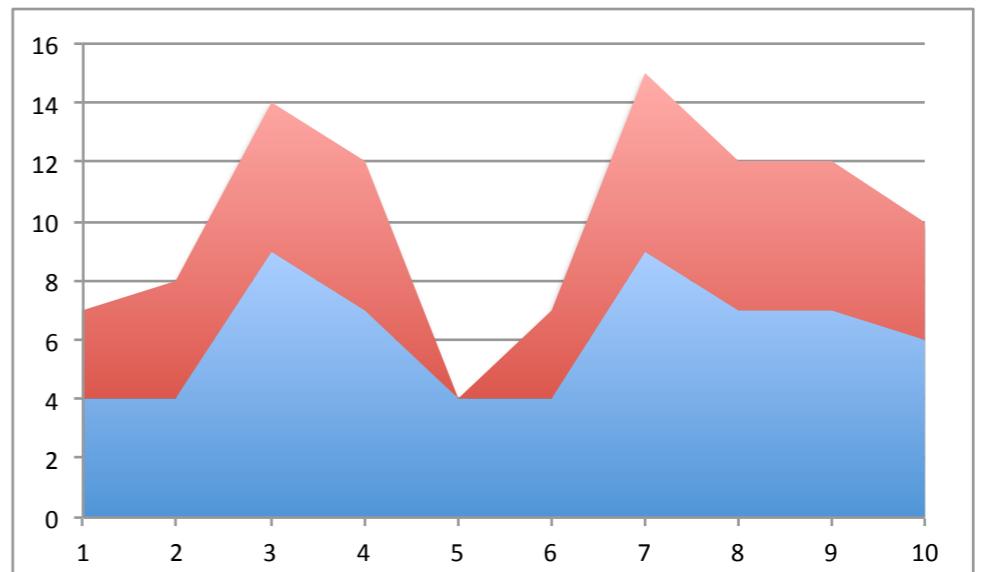
lines



stacked bar

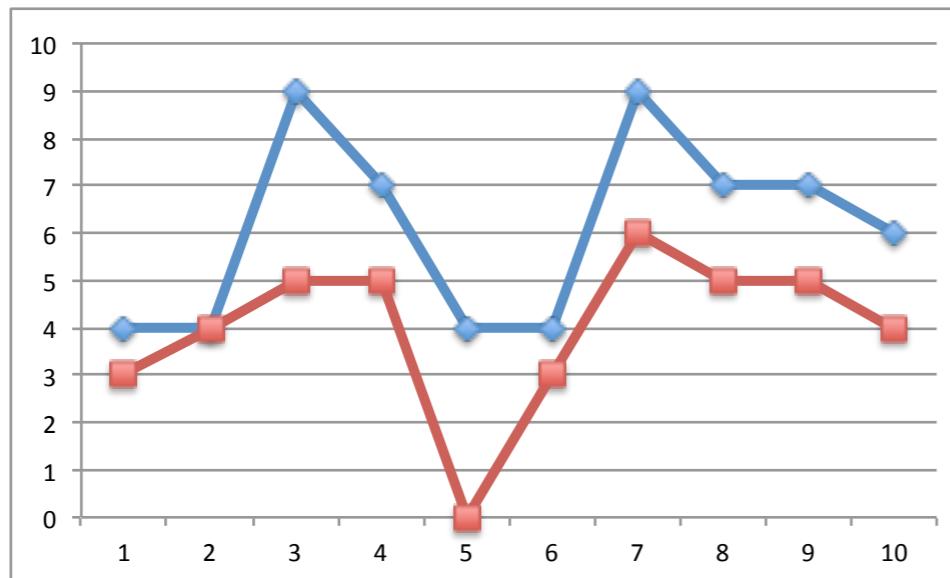


scatter

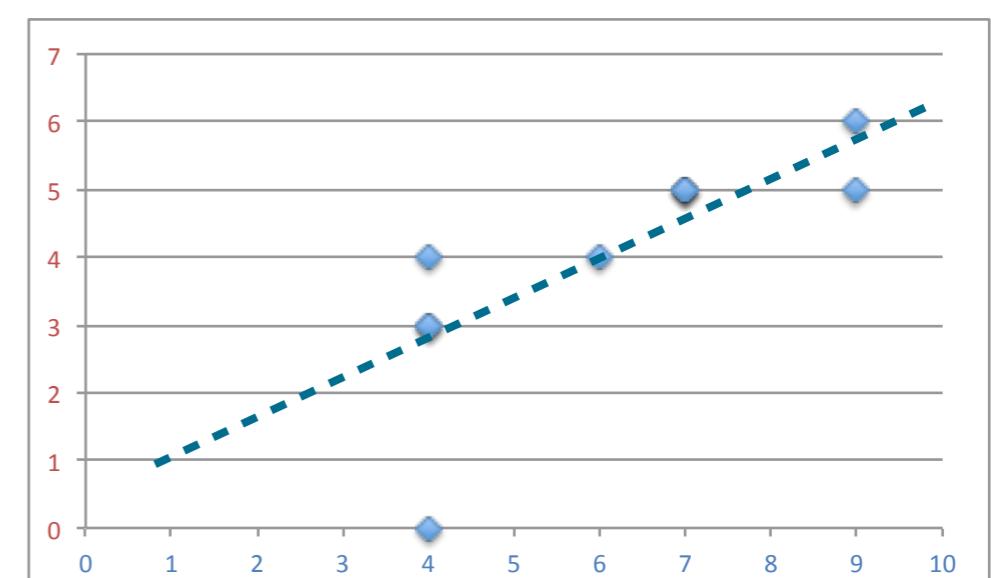


stacked area

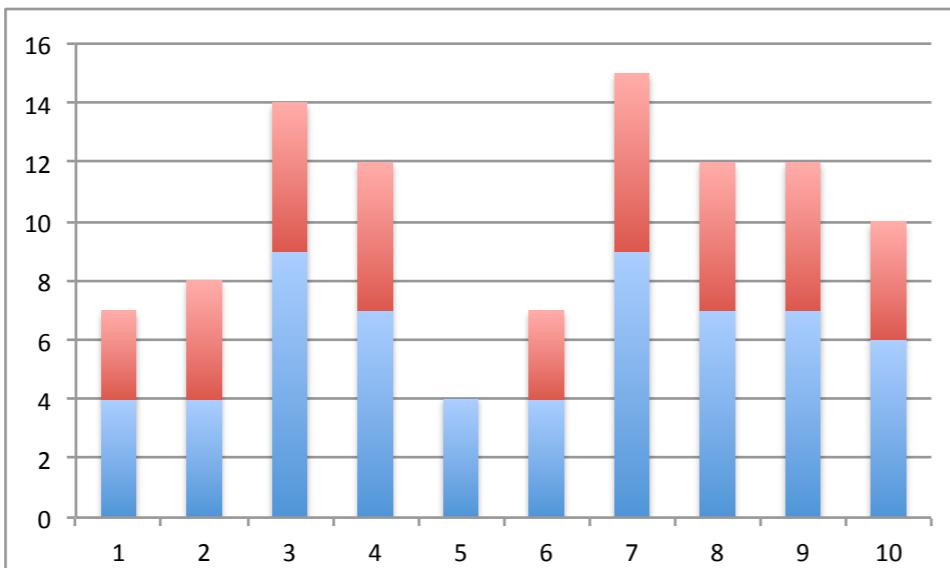
4	3
4	4
9	5
7	5
4	0
4	3
9	6
7	5
7	5
6	4



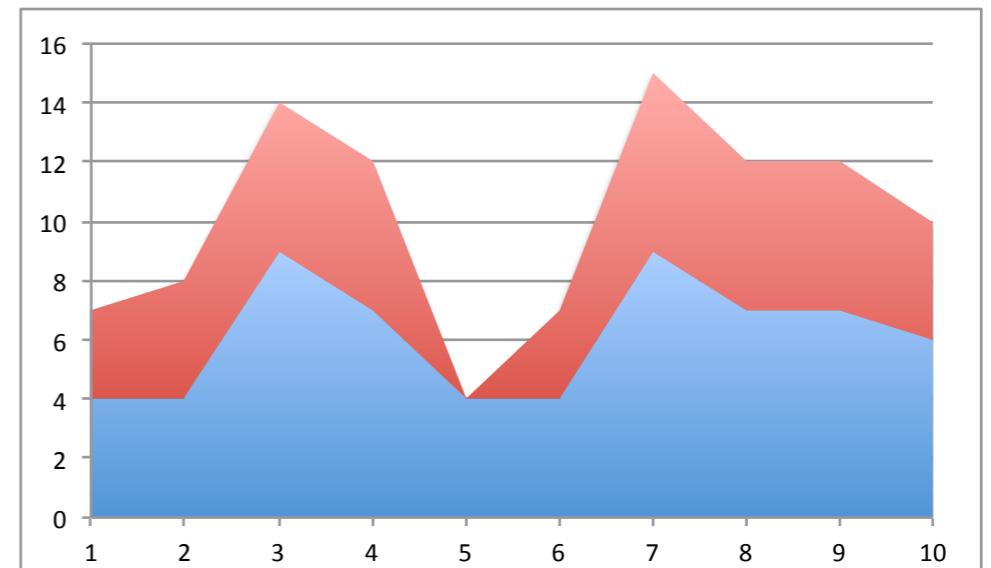
lines



scatter

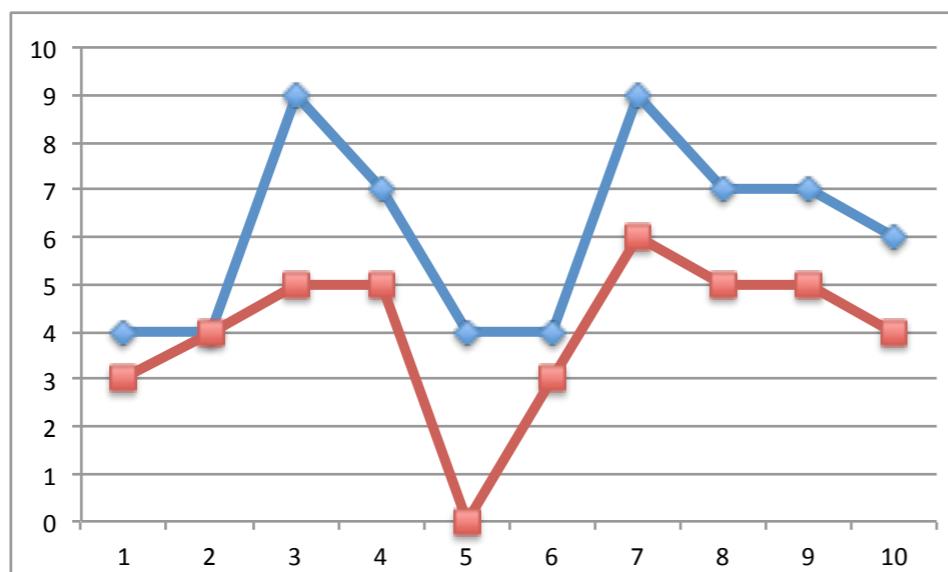


stacked bar

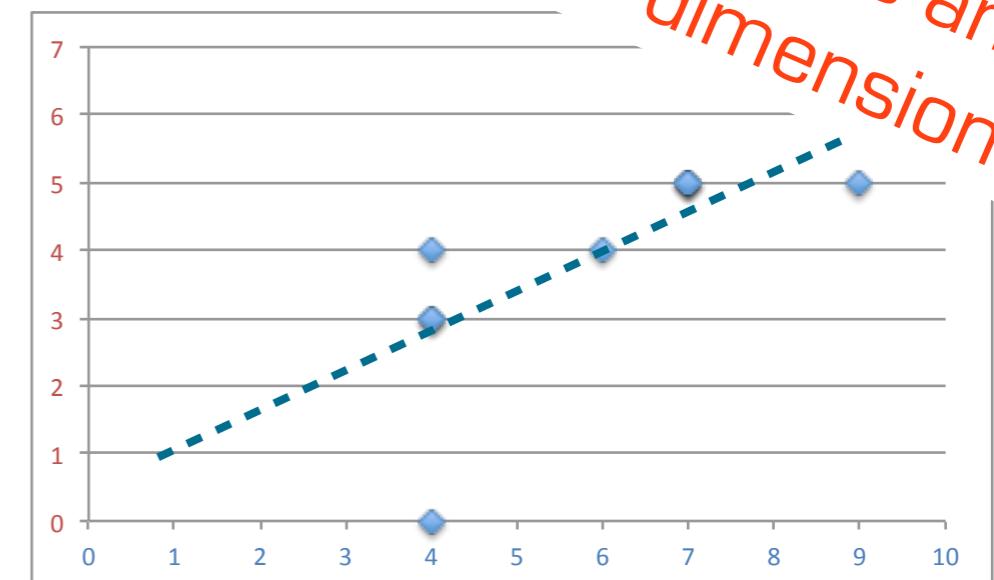


stacked area

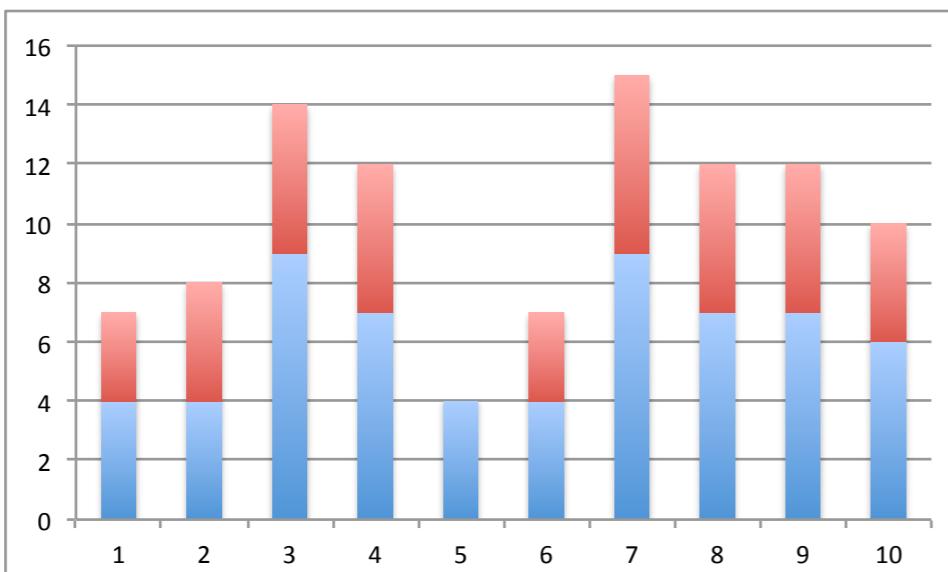
relations among dimensions



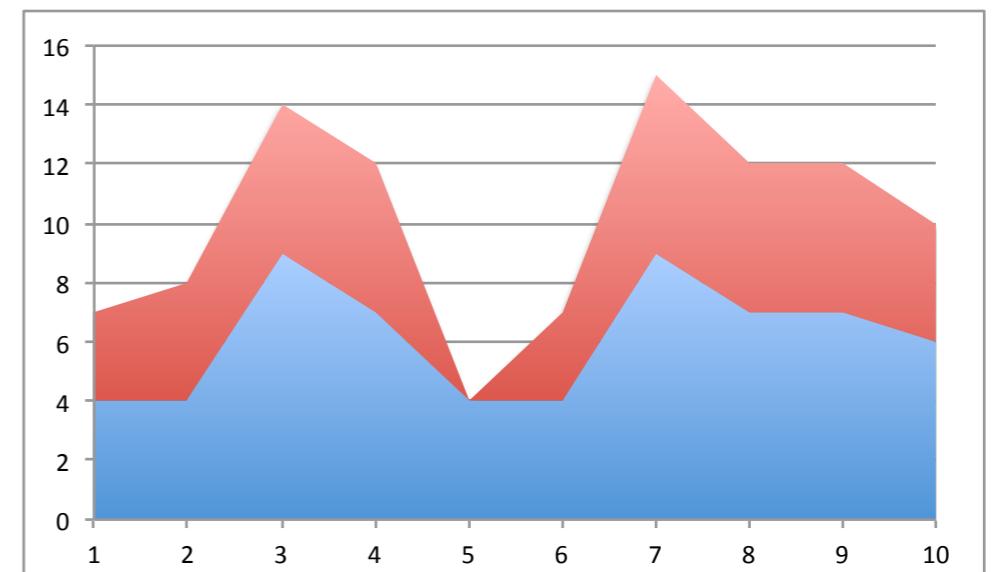
lines



scatter

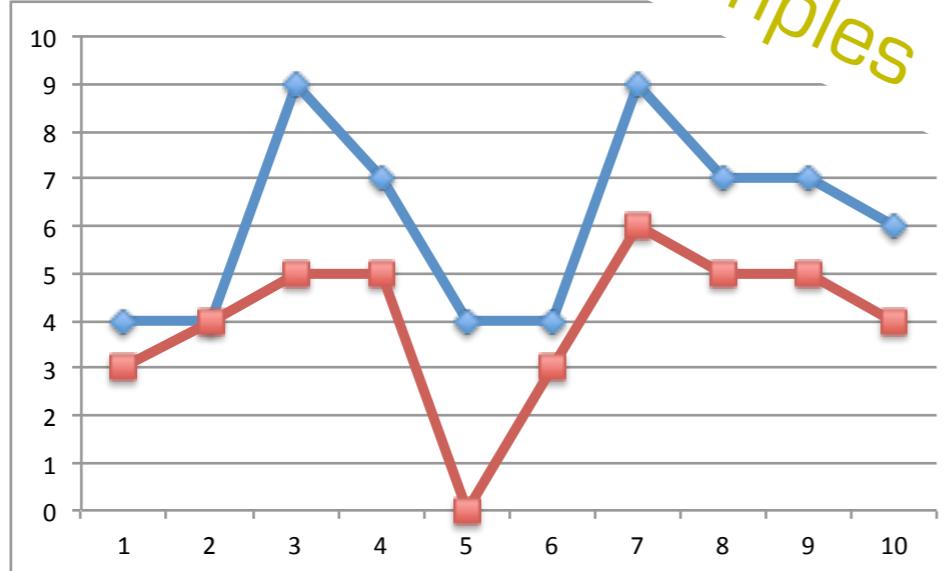


stacked bar

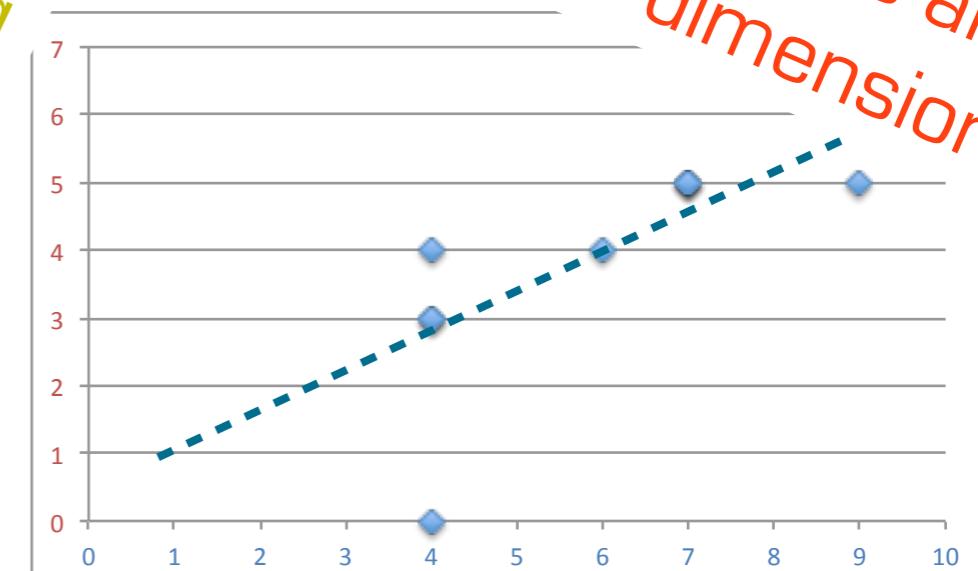


stacked area

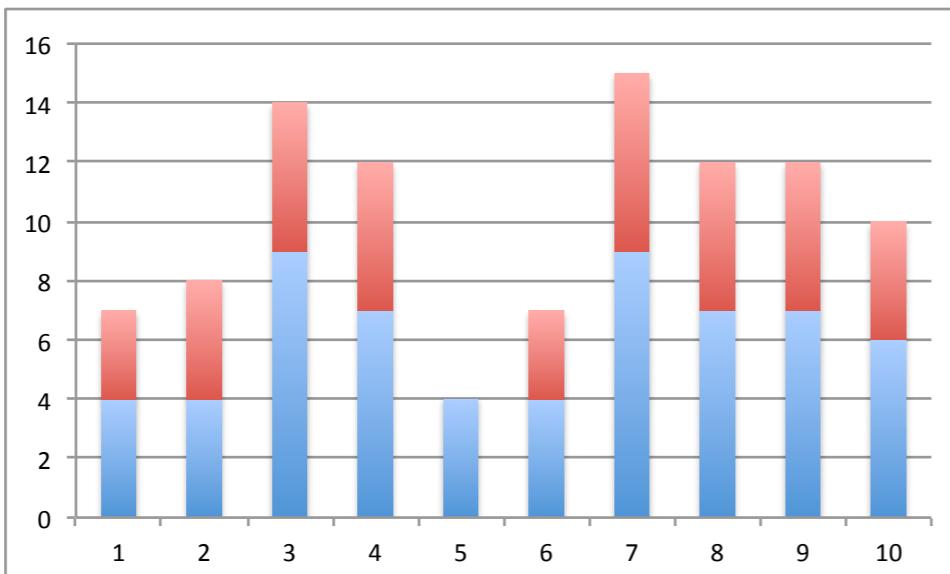
4	3
4	4
9	5
7	5
4	0
4	3
9	6
7	5
7	5
6	4



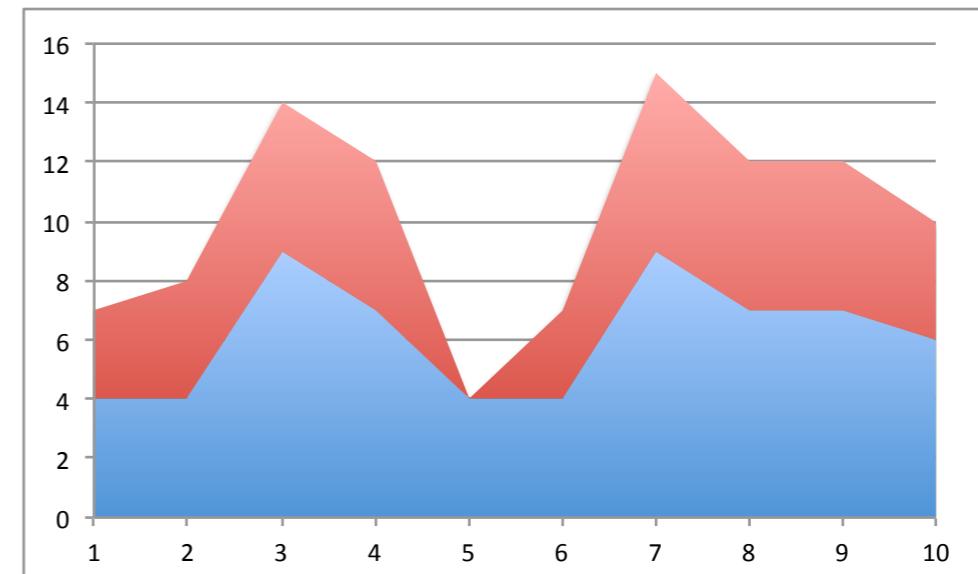
lines



scatter

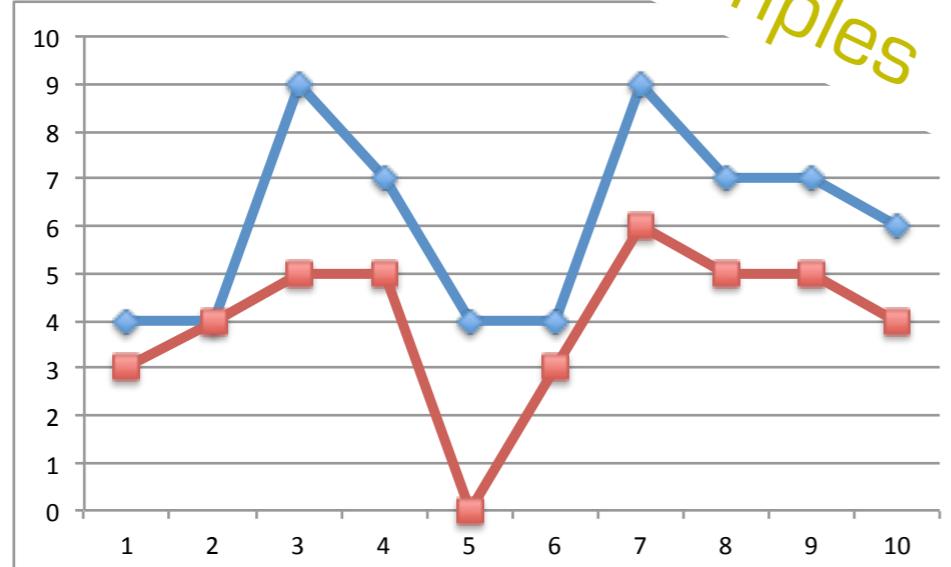


stacked bar

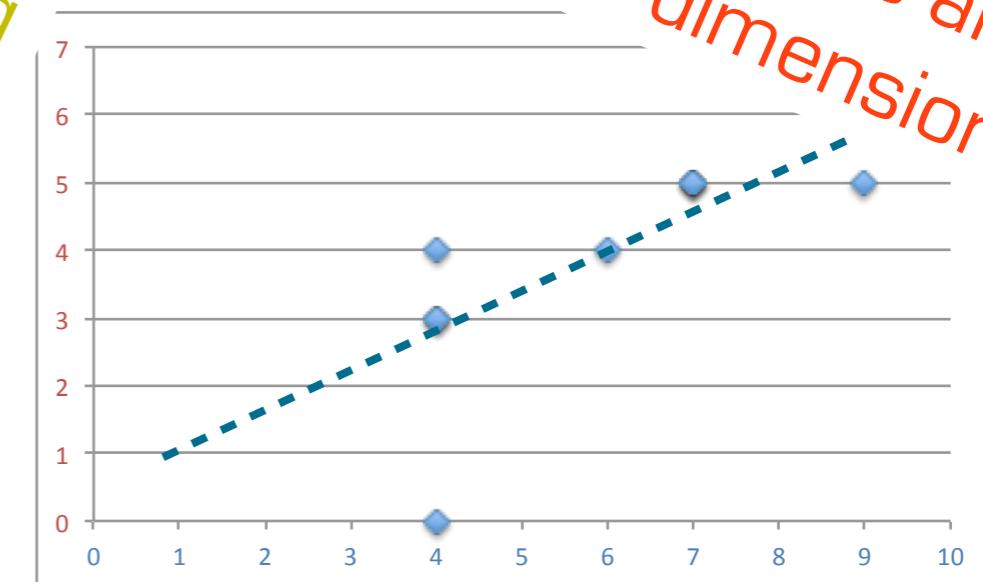


stacked area

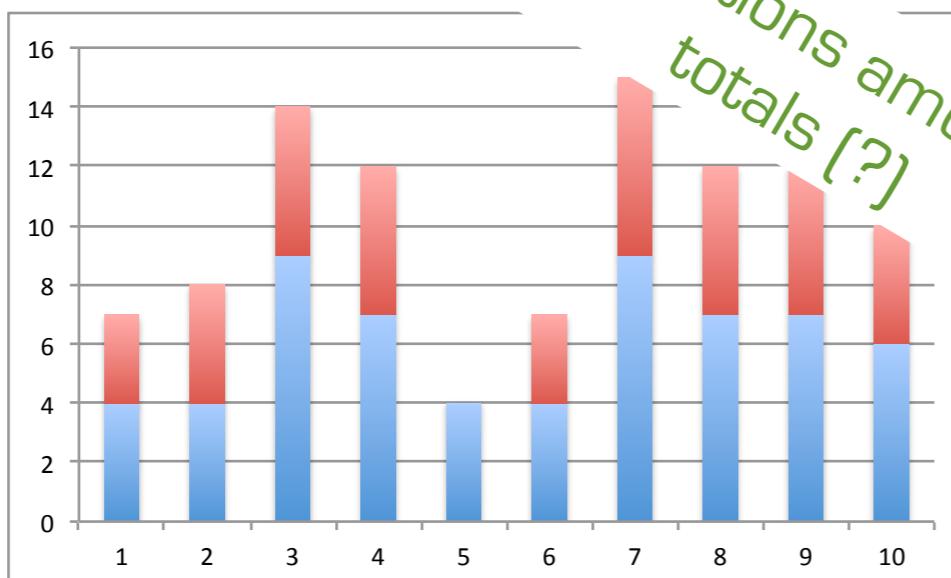
4	3
4	4
9	5
7	5
4	0
4	3
9	6
7	5
7	5
6	4



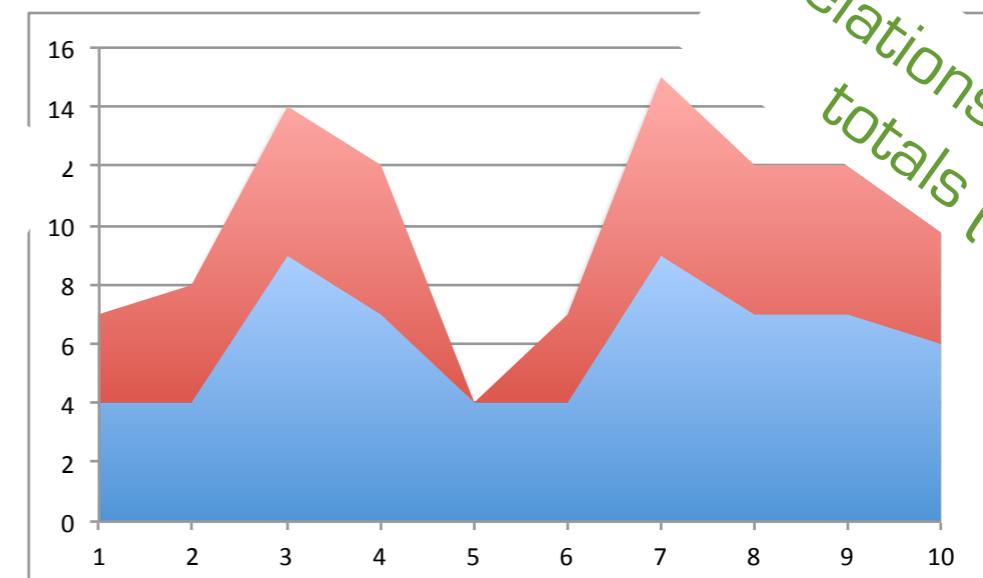
lines



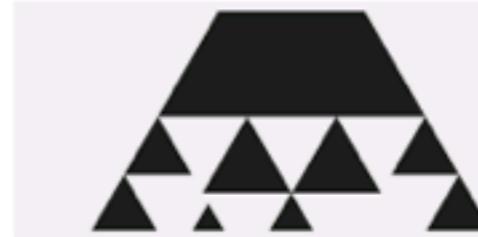
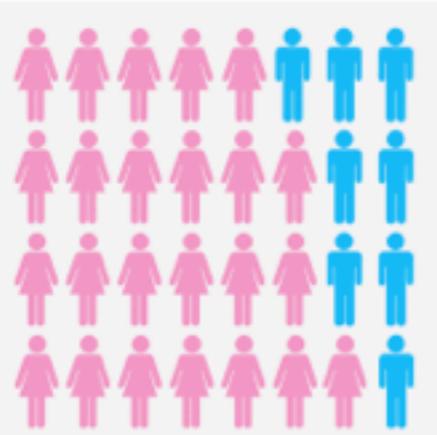
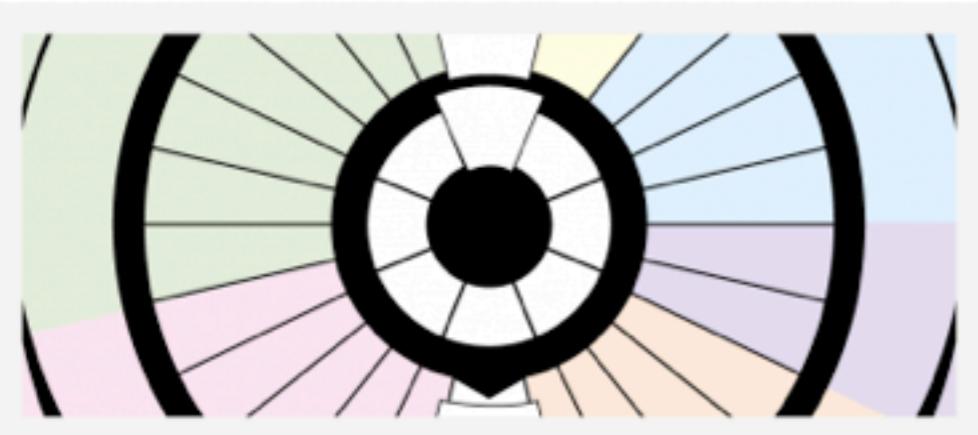
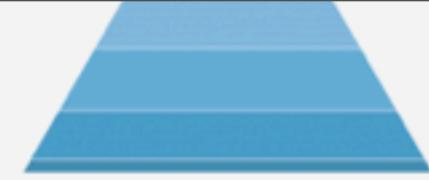
scatter



stacked bar

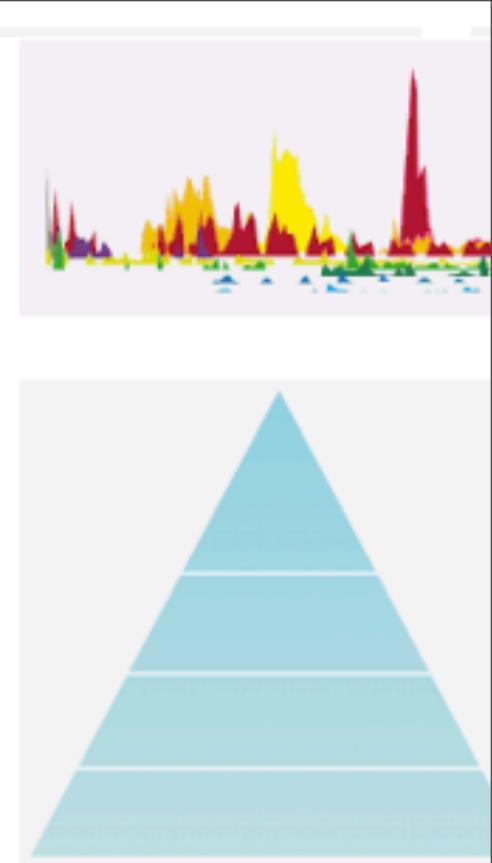


stacked area



The Stranger Remembrance of Things Pa
 Lord of the Flies Or
 His Dark Materials One Hundred
 note the Pock The Sound and the Fury The Name of the Rose One Flew Out
 e Adventures of Huckleberry Finn
 the Rings To Kill a Mock

3. Visual Dimensions



data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

position

relative location
centrality

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

position

relative location
centrality

shape

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

position

relative location
centrality

shape

colour

saturation
opacity

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

position

relative location
centrality

shape

colour

saturation
opacity

size

width
height

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

position

relative location
centrality

shape

colour

saturation
opacity

size

width
height

orientation

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

visual dimension type

position

relative location
centrality

shape

colour

saturation
opacity

size

width
height

orientation

stroke

colour
pattern,
thickness

...

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

visual dimension type

position

relative location
centrality

shape

colour

saturation
opacity

size

width
height

orientation

stroke

colour
pattern,
thickness

opacity

...

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

visual dimension type

position

shape

colour

size

orientation

stroke

opacity

texture

relative location
centrality

saturation
opacity

width
height

colour
pattern,
thickness

...

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

relational

...

visual dimension type

position

relative location
centrality

shape

colour

saturation
opacity

size

width
height

orientation

stroke

colour
pattern,
thickness

opacity

texture

movement

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

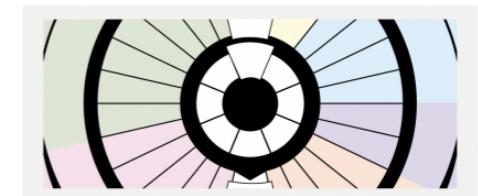
relational

...

visual dimension type

position

relative location
centrality



shape



colour

saturation
opacity

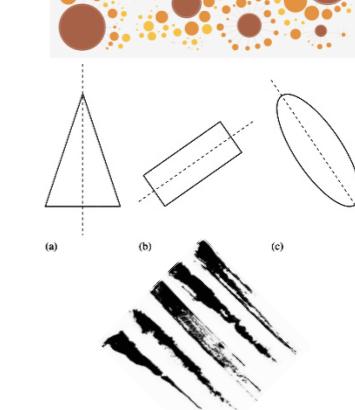


size

width
height



orientation

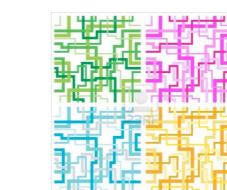


stroke

colour
pattern,
thickness

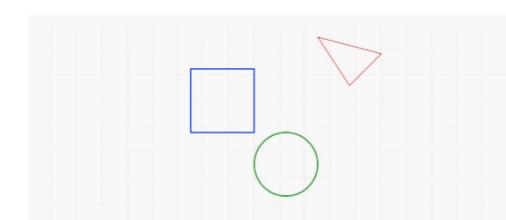


opacity



texture

movement



juxtaposition

data dimension types

integral

fixed point

alpha(-numeric)

fractions of a population

categorical

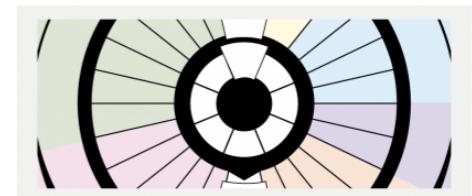
relational

...

visual dimension type

position

relative location
centrality



shape



colour

saturation
opacity

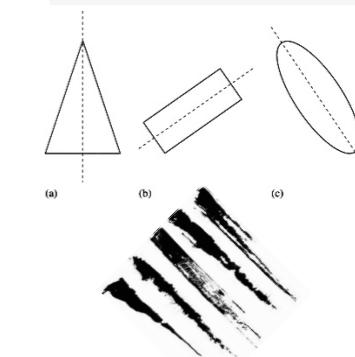


size

width
height



orientation

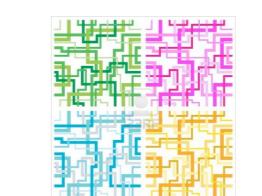


stroke

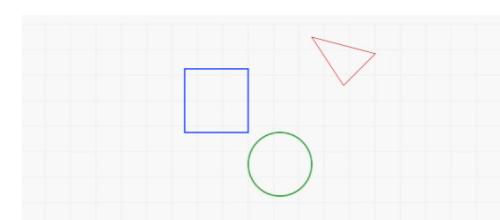
colour
pattern,
thickness



opacity



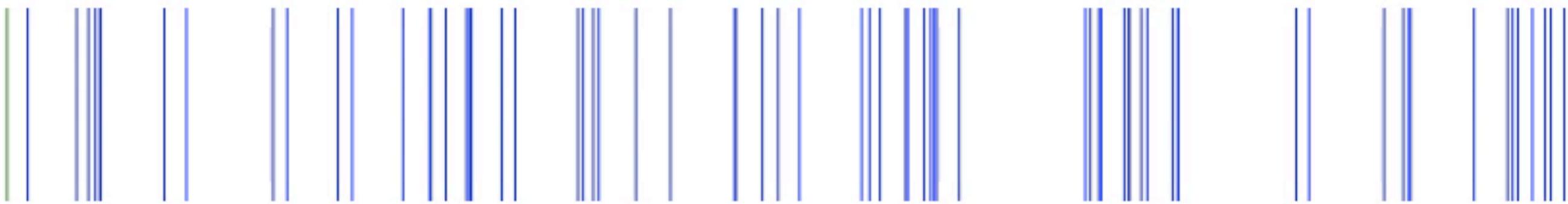
texture



movement

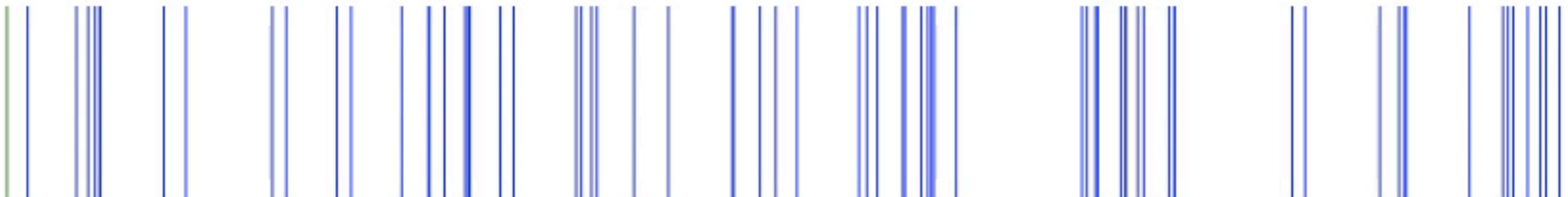
juxtaposition

position

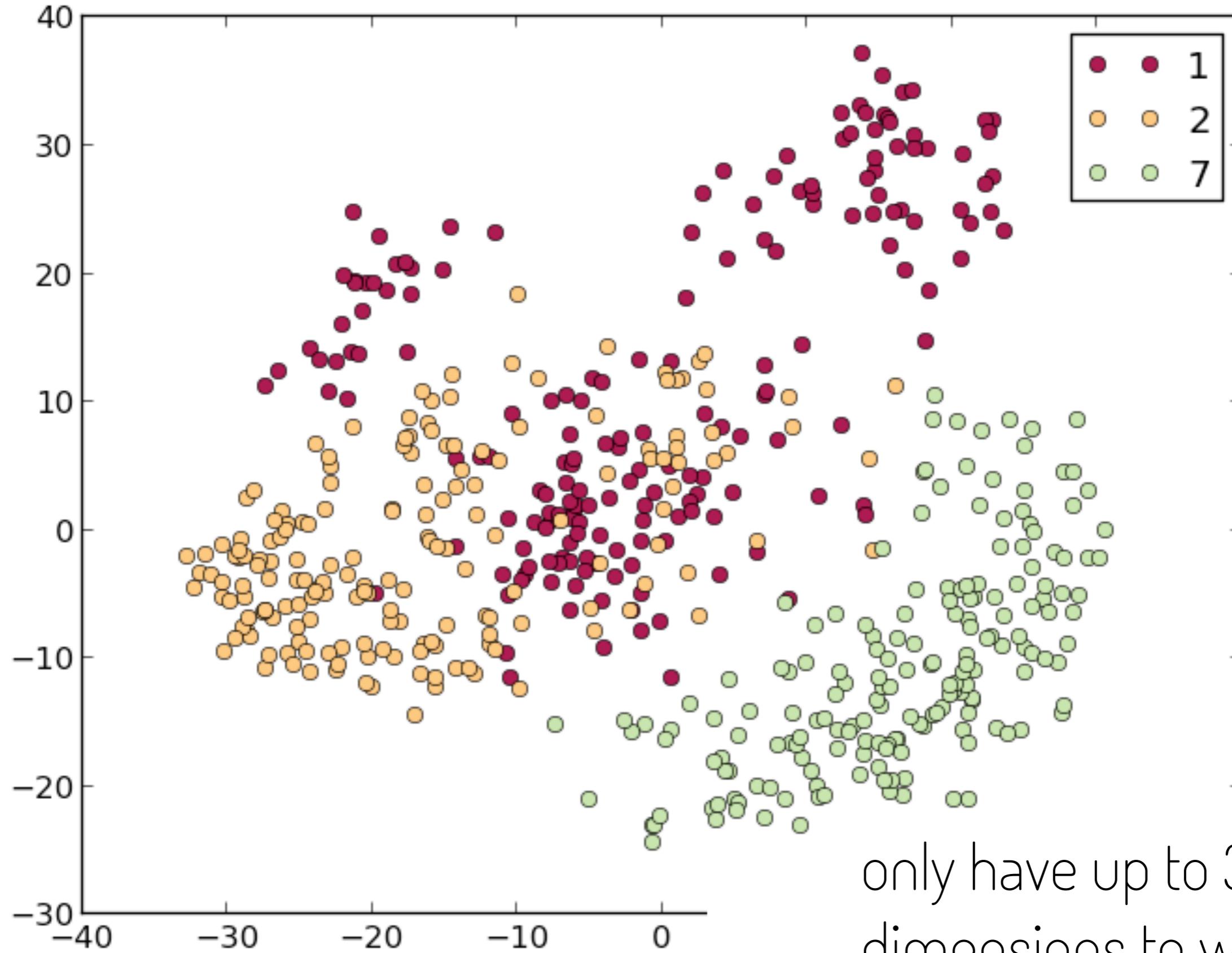


position

linear mapping of values
logarithmic..
bin and count..



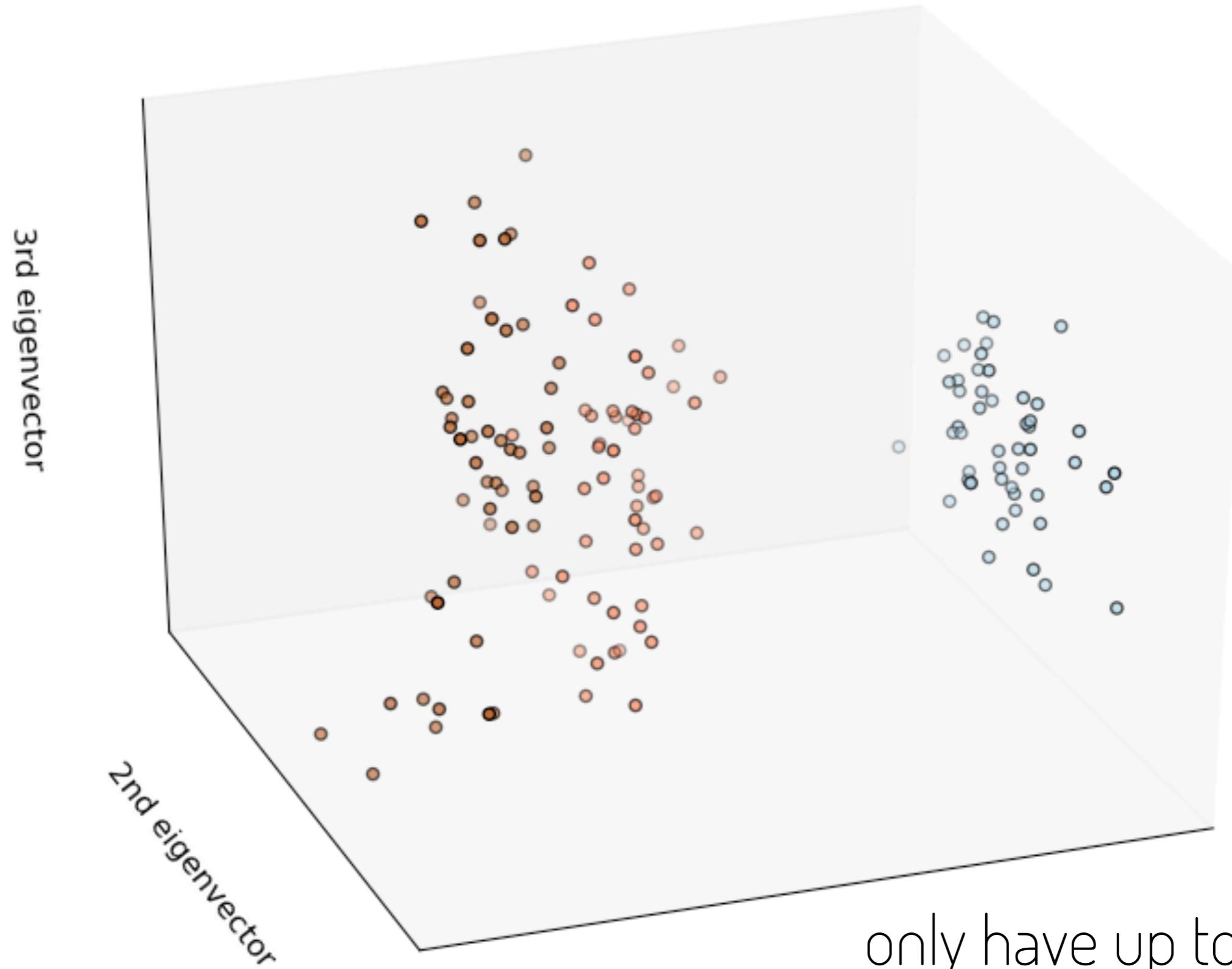
position



only have up to 3 spatial
dimensions to work with

position

First three PCA directions



only have up to 3 spatial dimensions to work with

orientation

orientation

range-limited

orientation

range-limited



orientation

range-limited

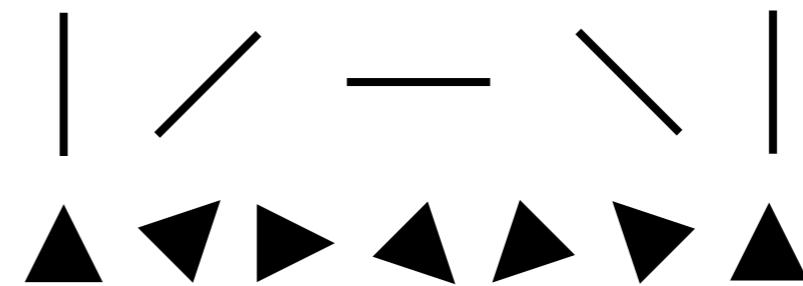
symmetry properties of the
geometry



orientation

range-limited

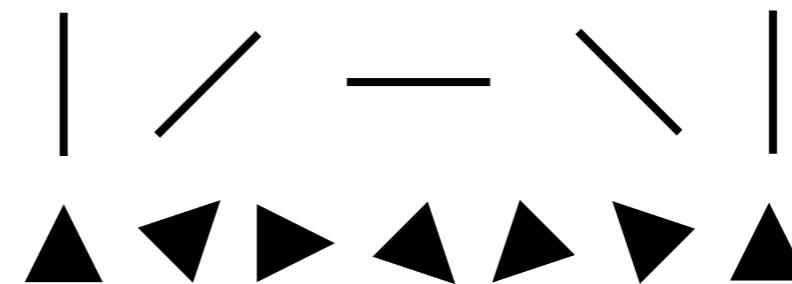
symmetry properties of the
geometry



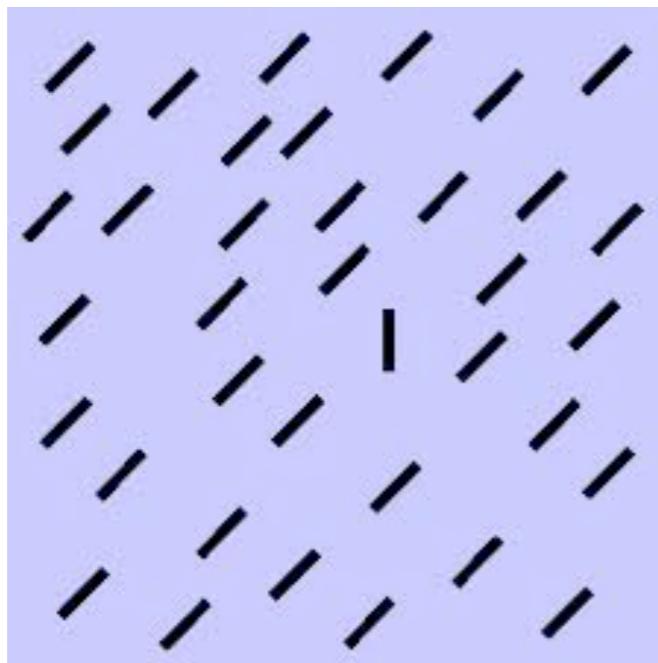
orientation

range-limited

symmetry properties of the
geometry



pop-out



TTTT
TTTT
TTTT
TTTT

TTTT
T~~T~~TT
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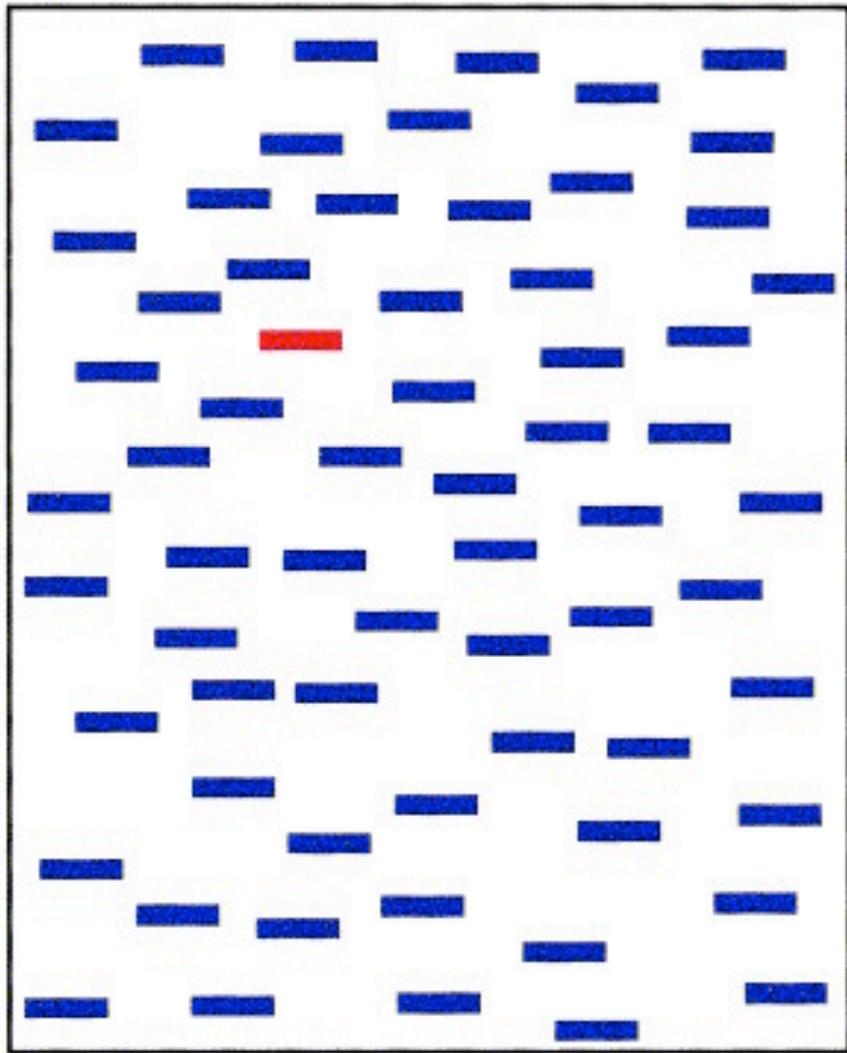
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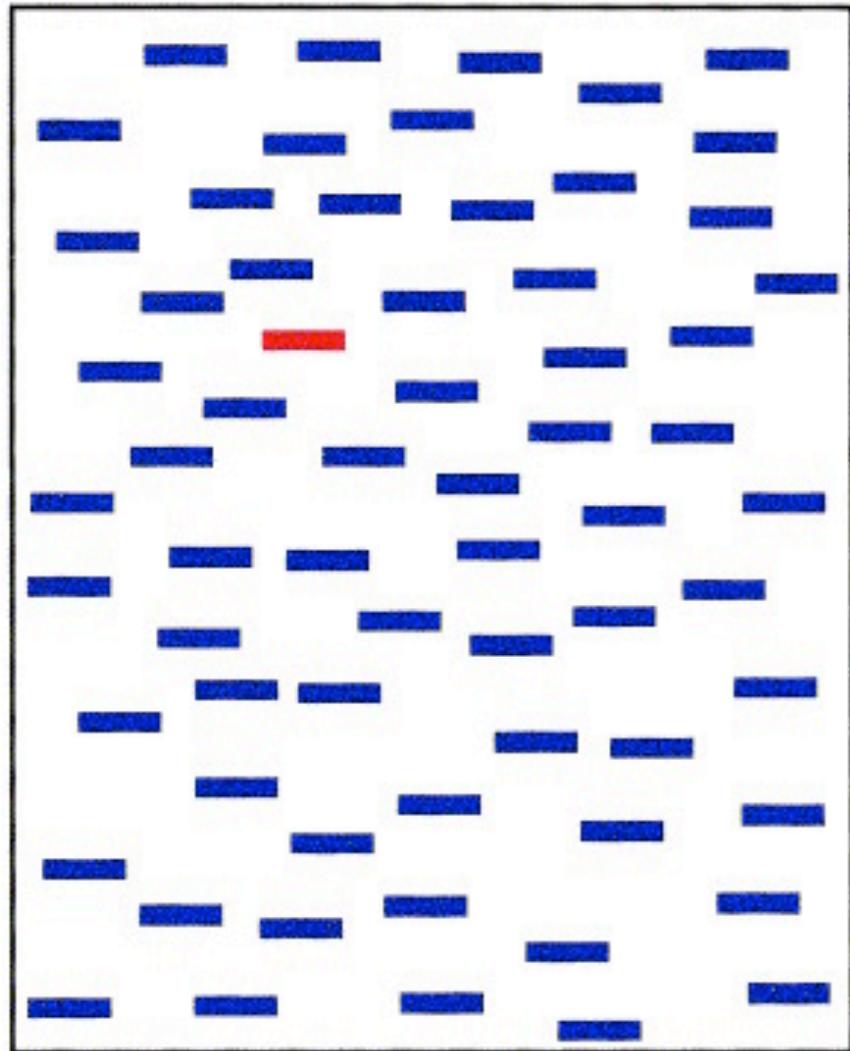
orientation
popouts using multiple dimensions

orientation
popouts using multiple dimensions

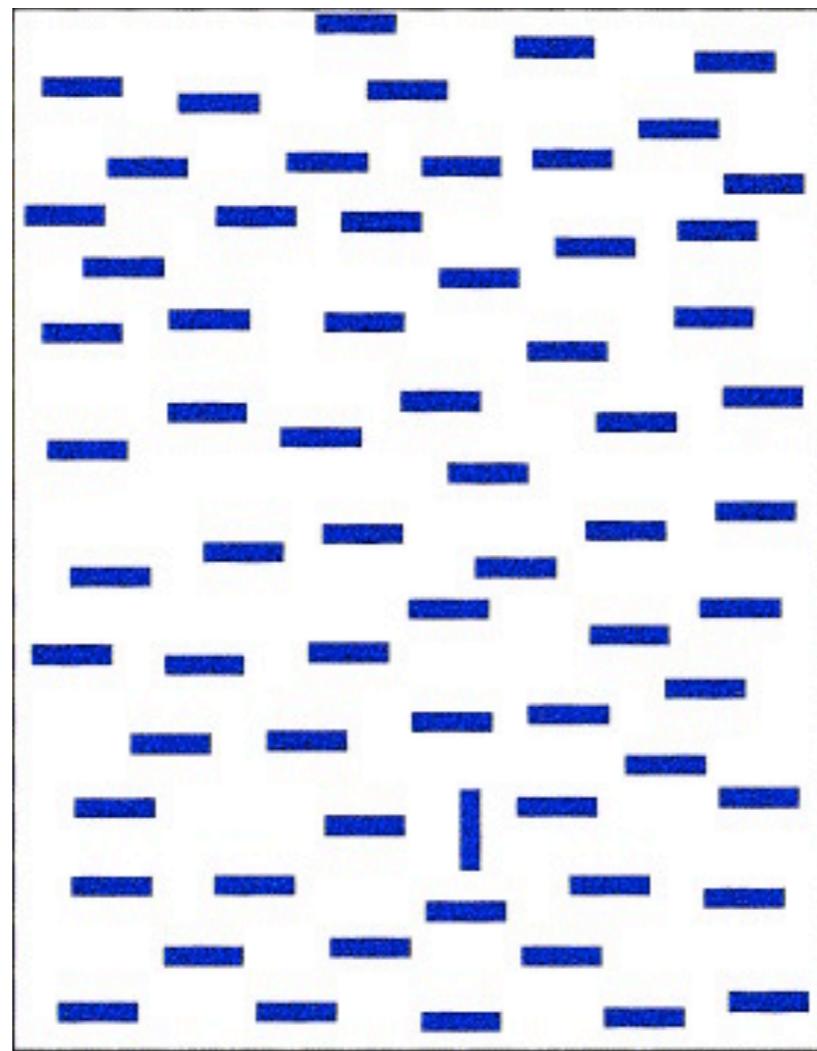


1D colour

orientation
popouts using multiple dimensions

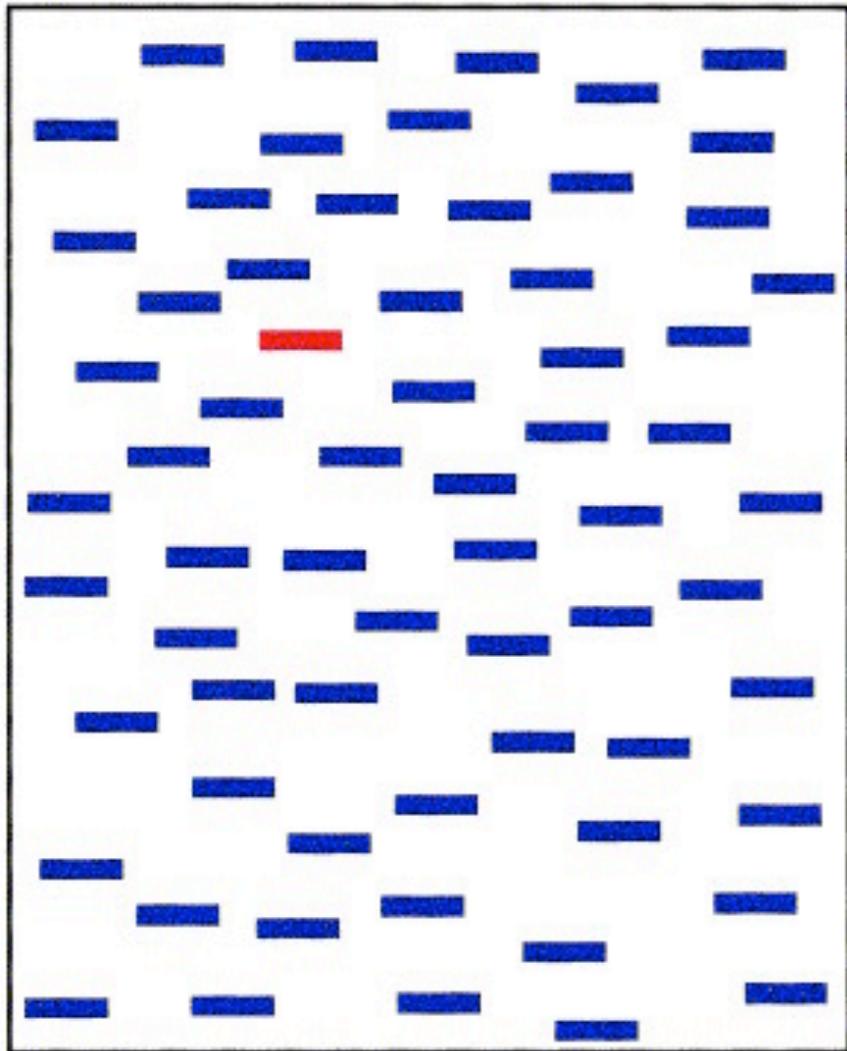


1D colour

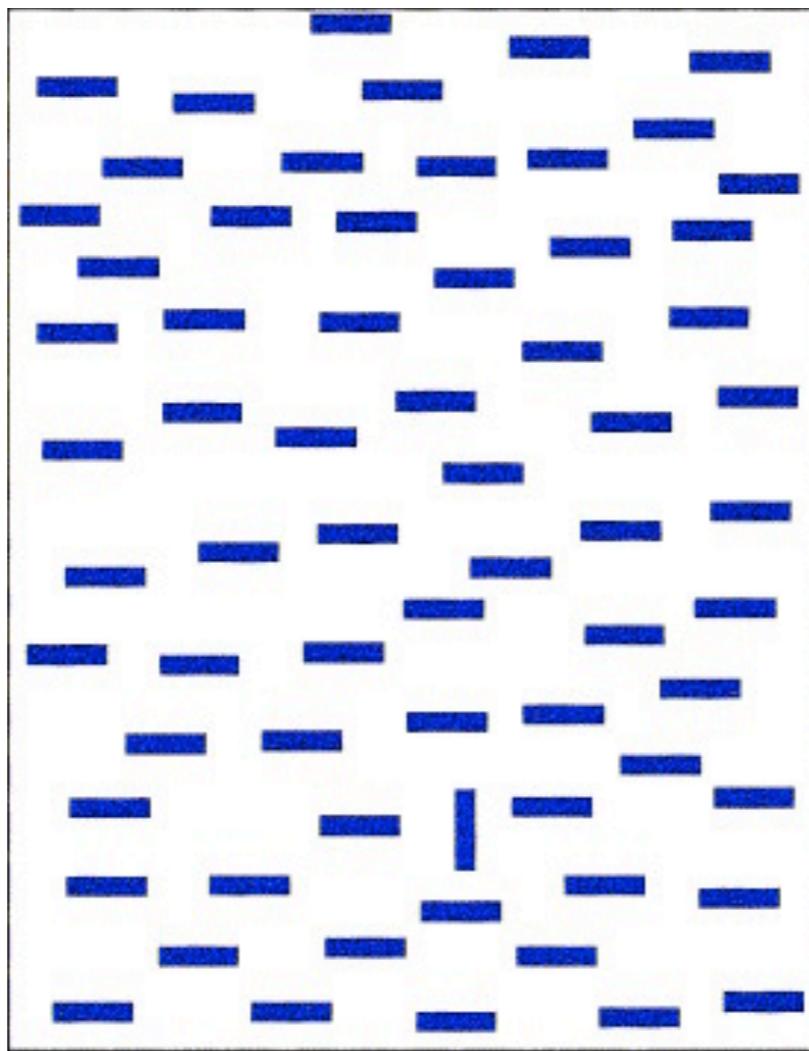


1D orientation

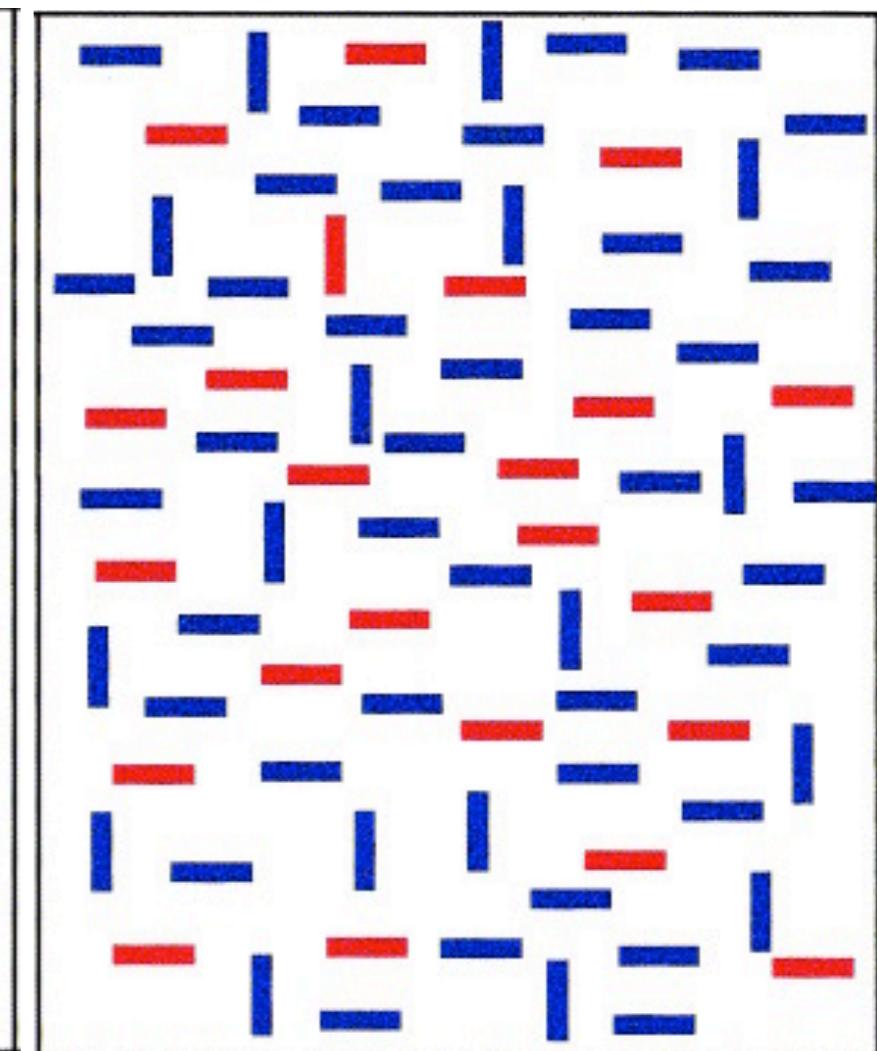
orientation
popouts using multiple dimensions



1D colour

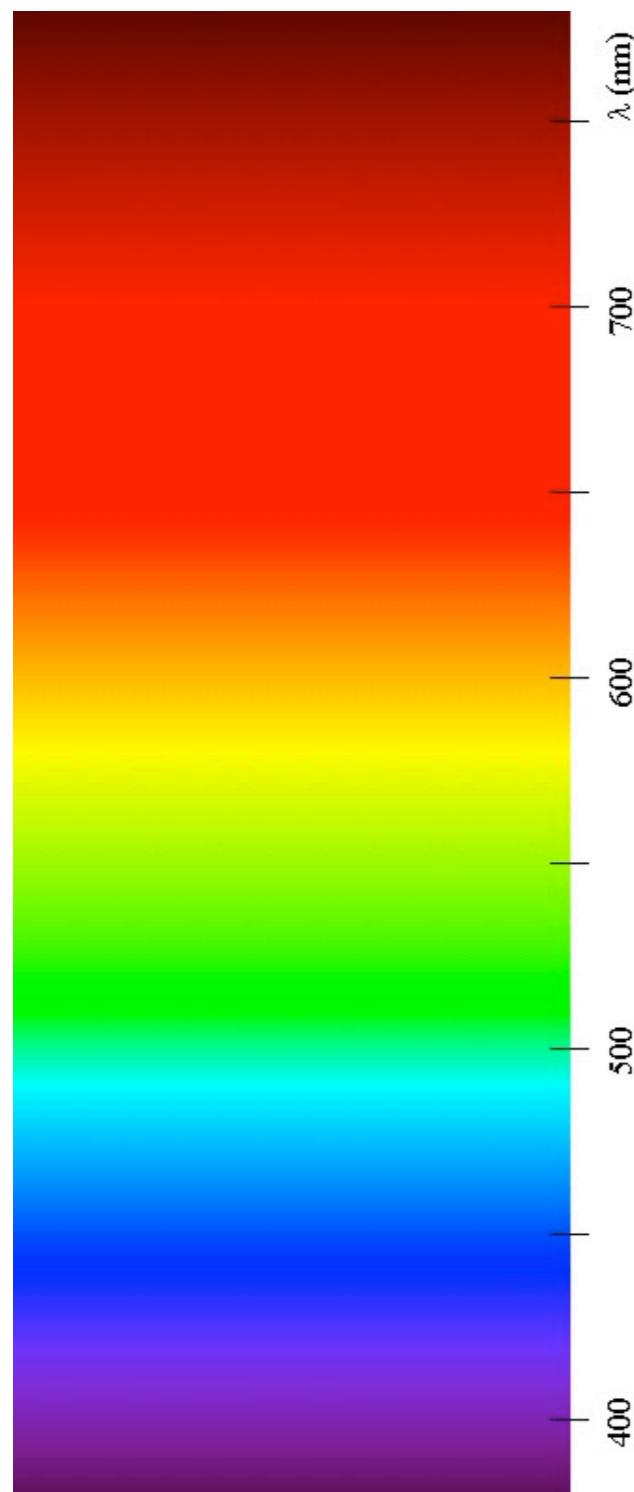


1D orientation

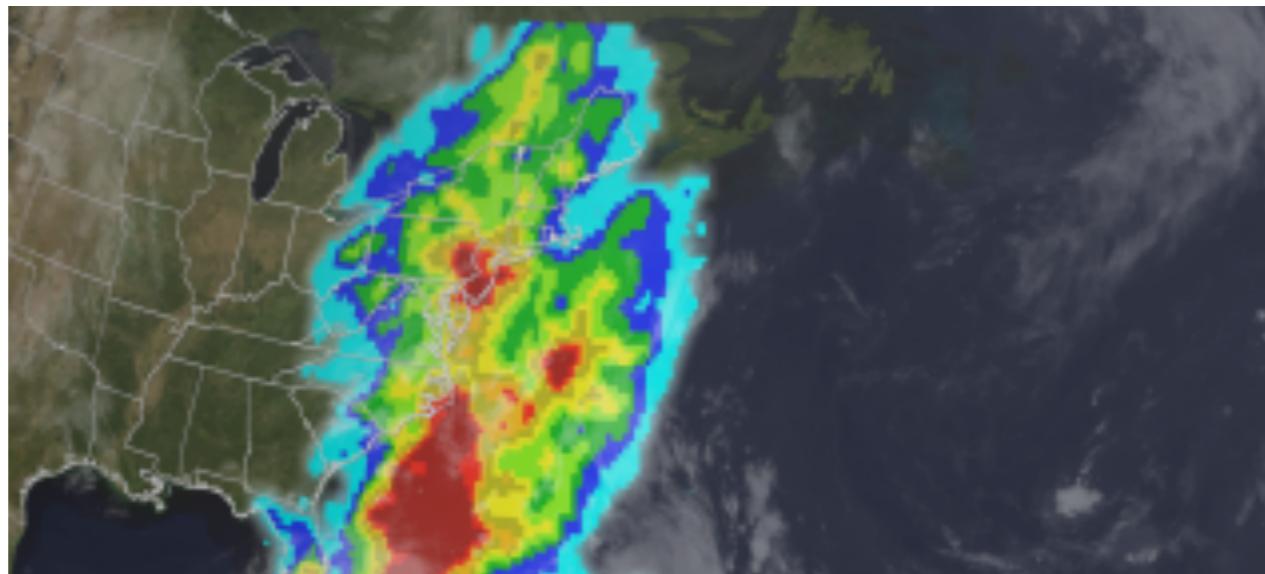
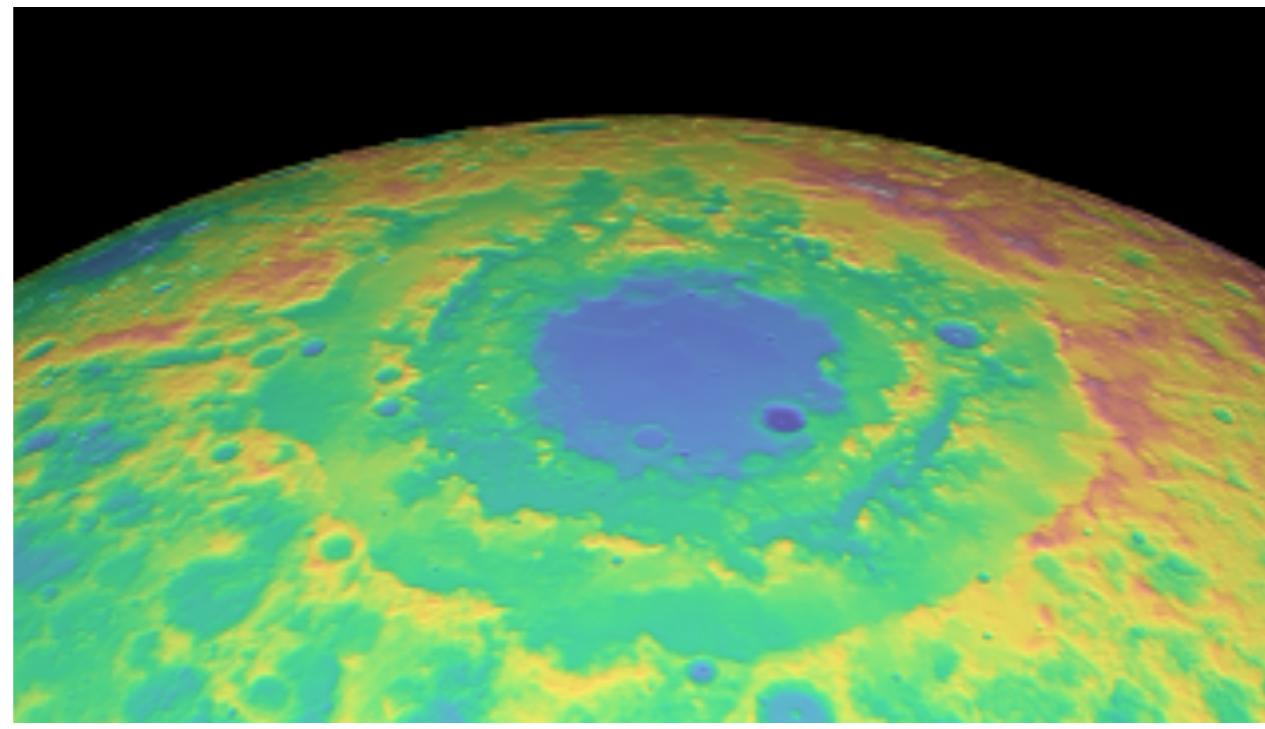
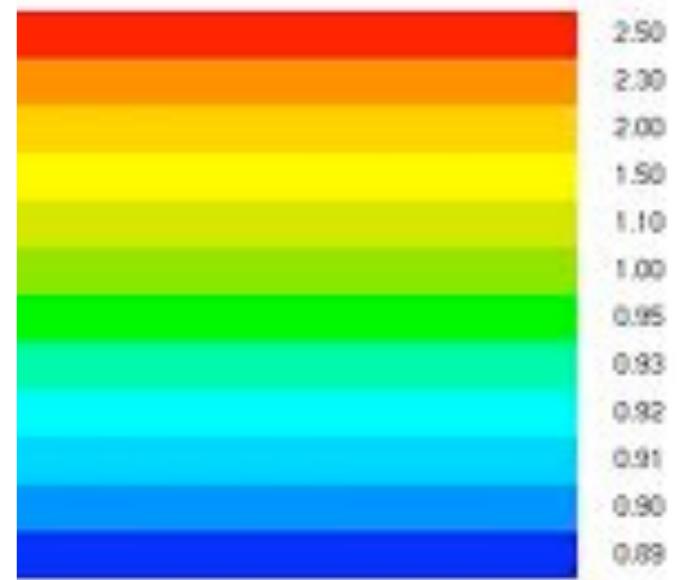
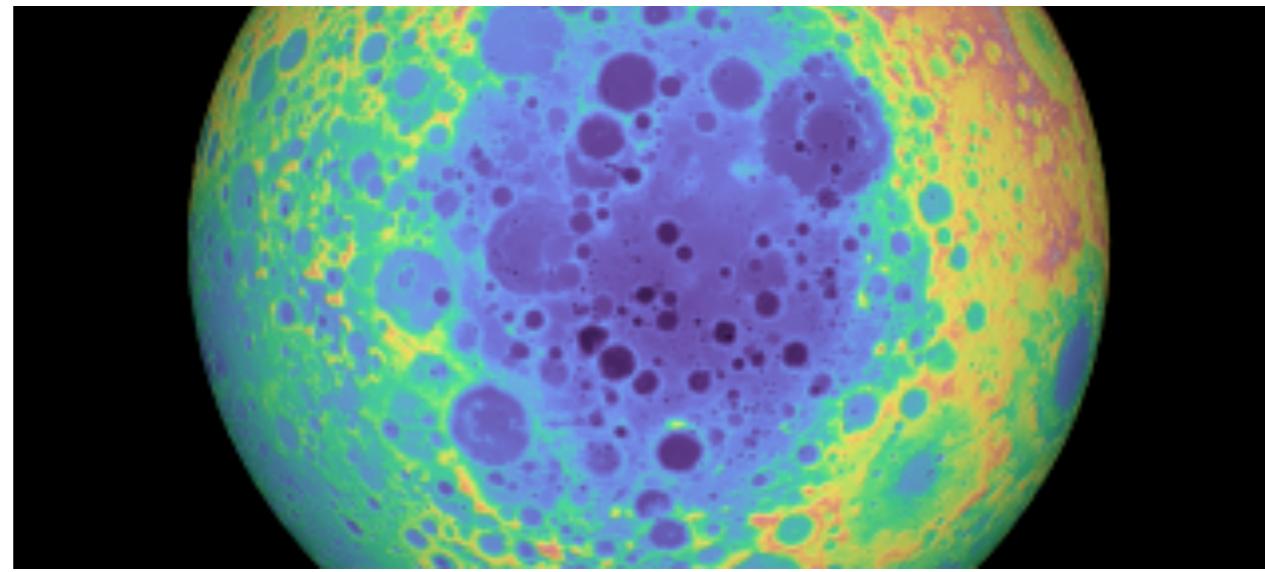
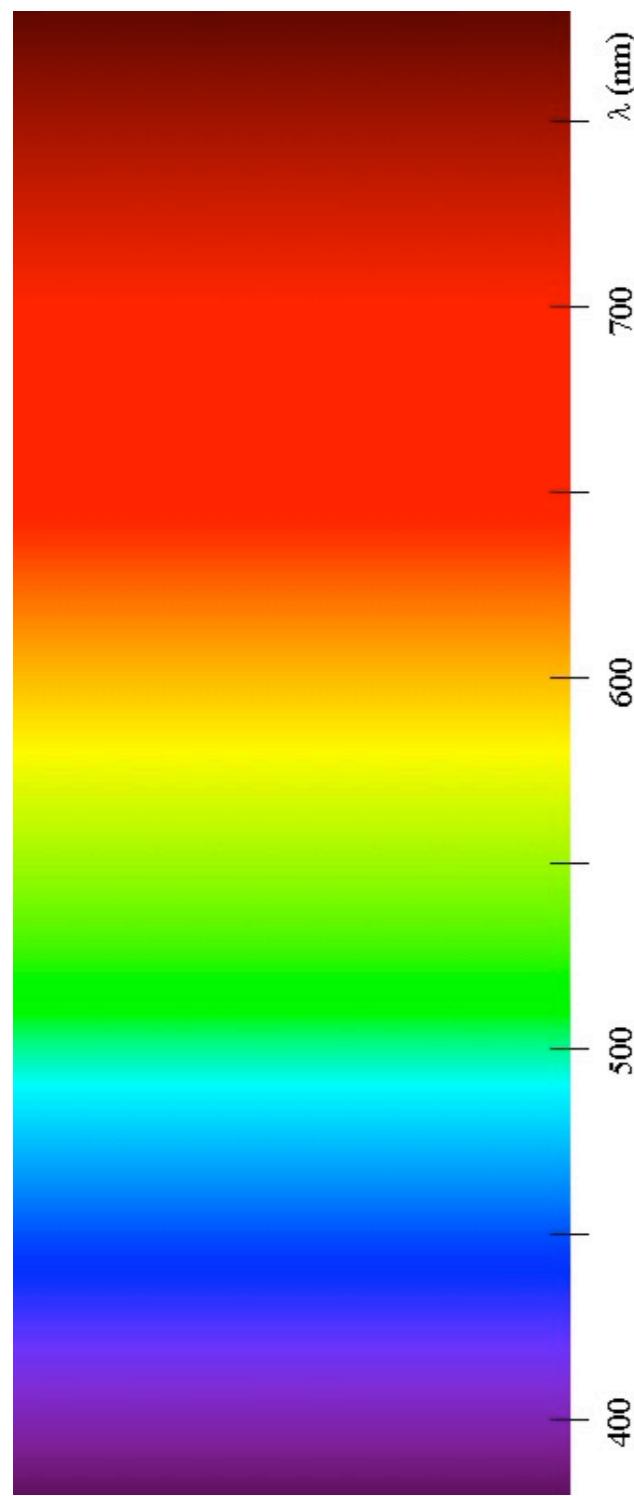


2D color/
orientation

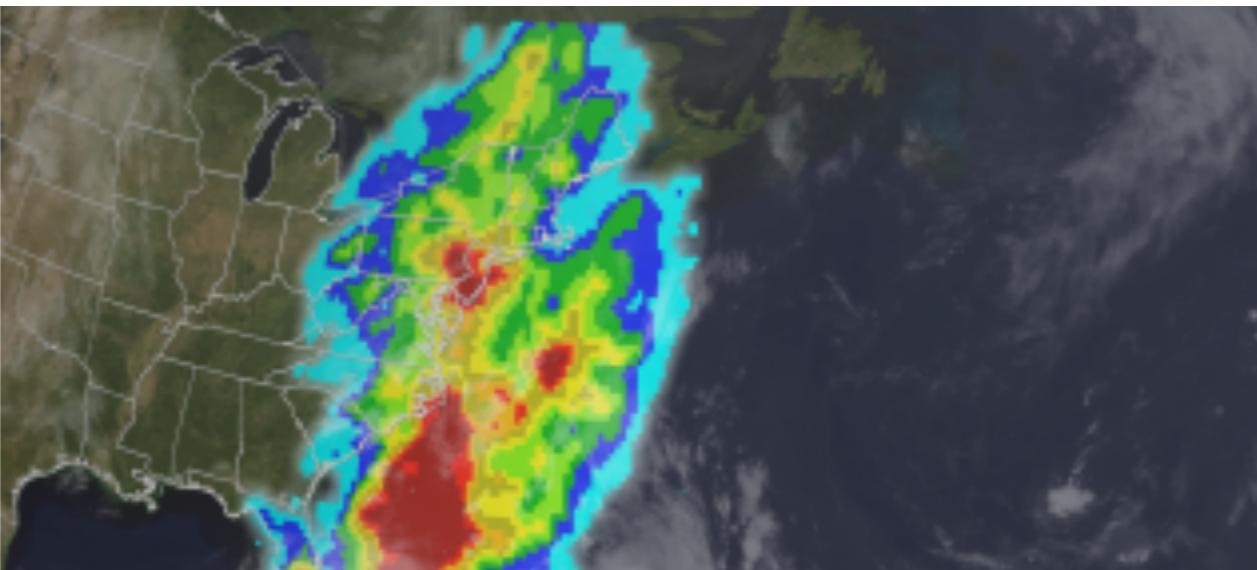
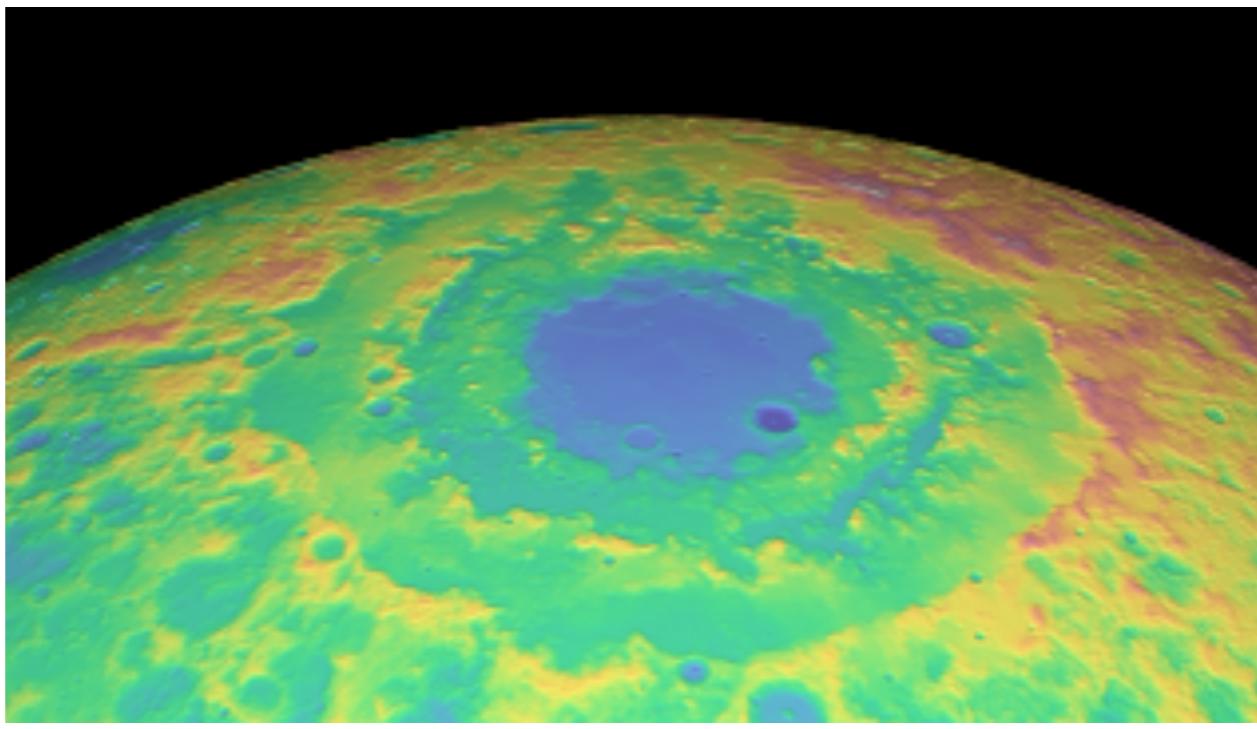
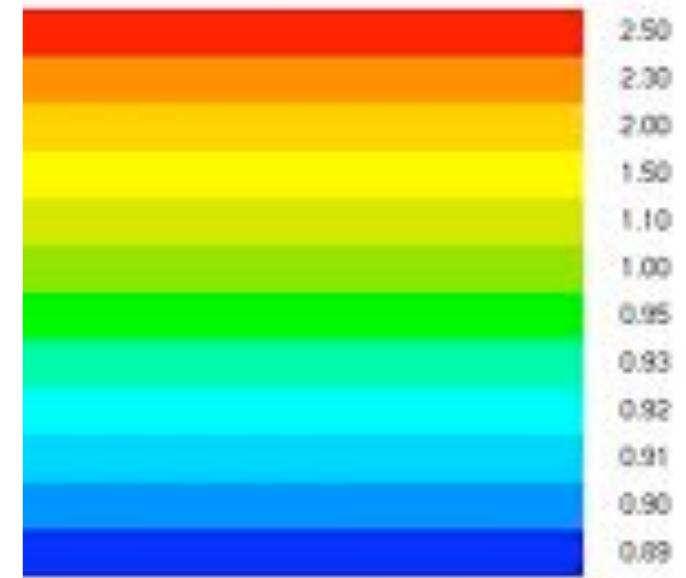
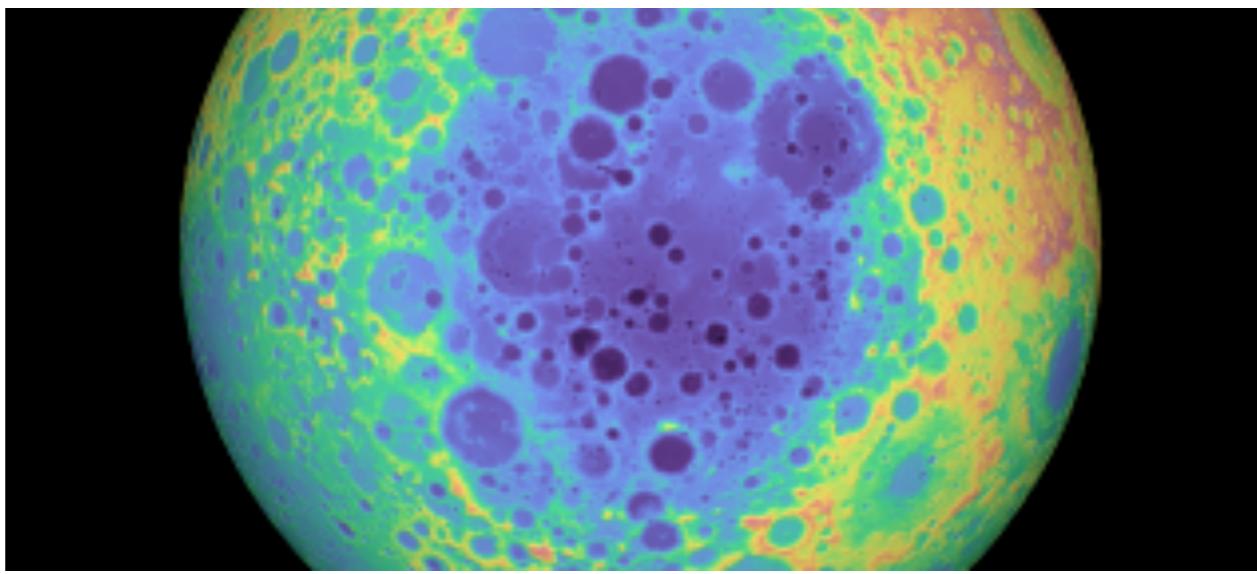
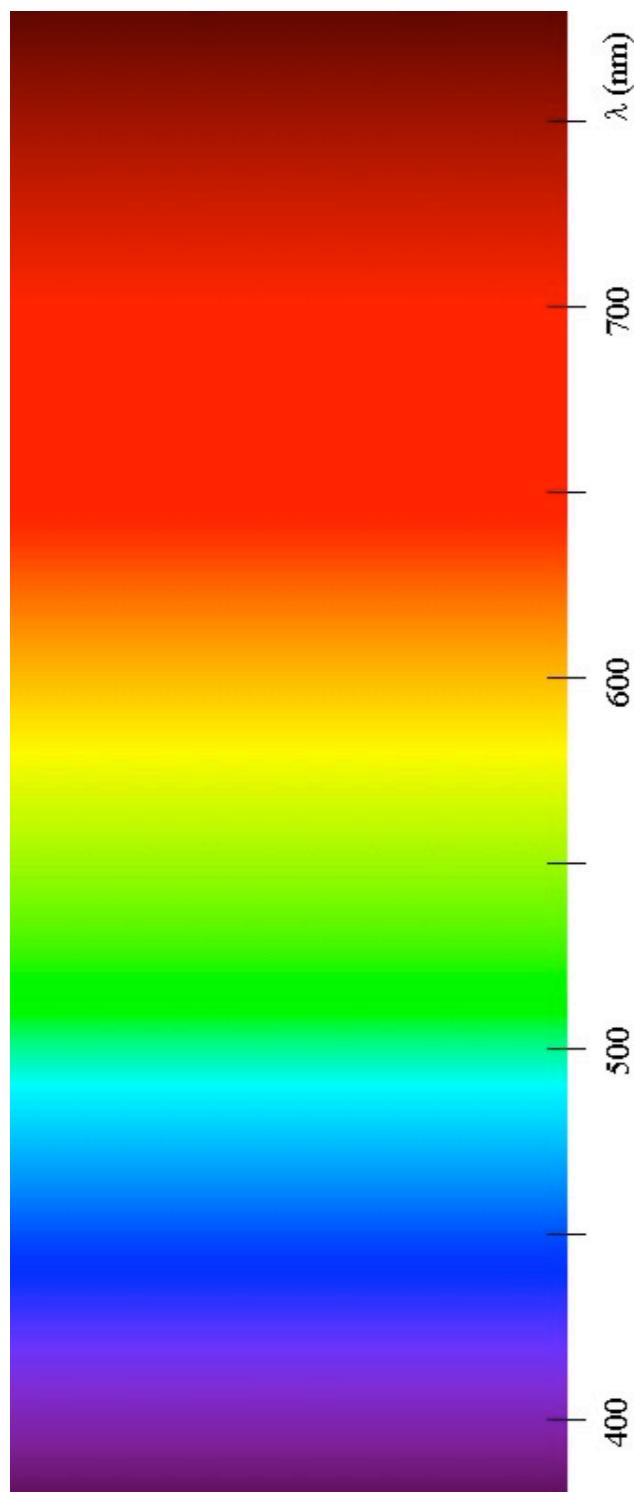
Using colour for continuous values



Using colour for continuous values



Using colour for continuous values



Using colour for continuous values

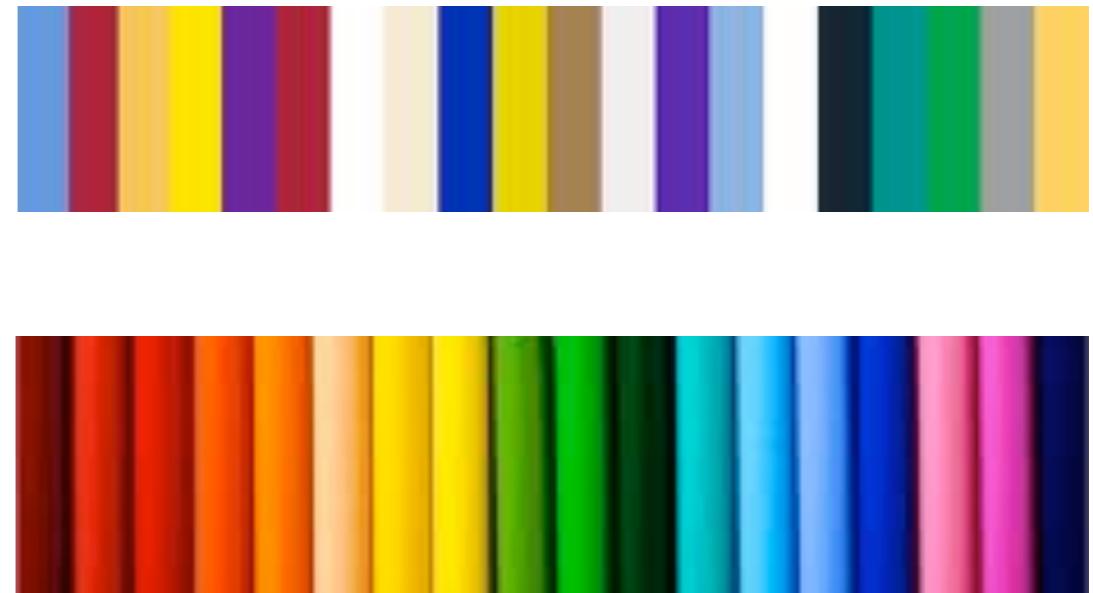
problem 1: No natural ordering

Using colour for continuous values



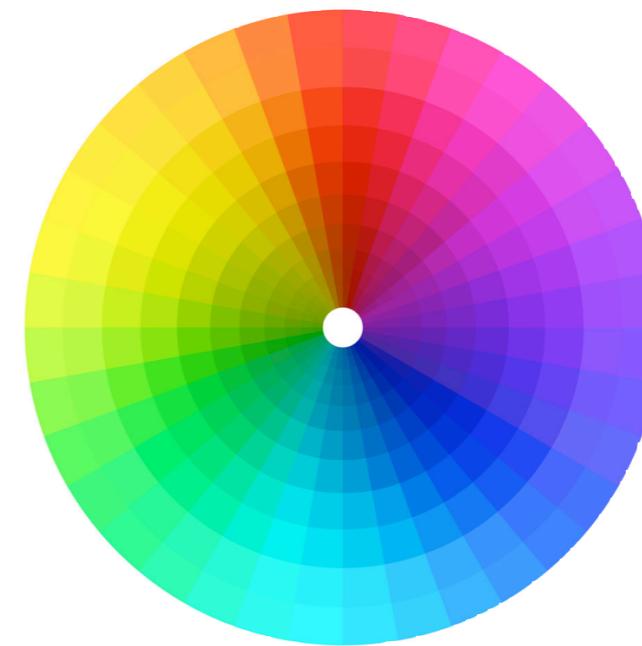
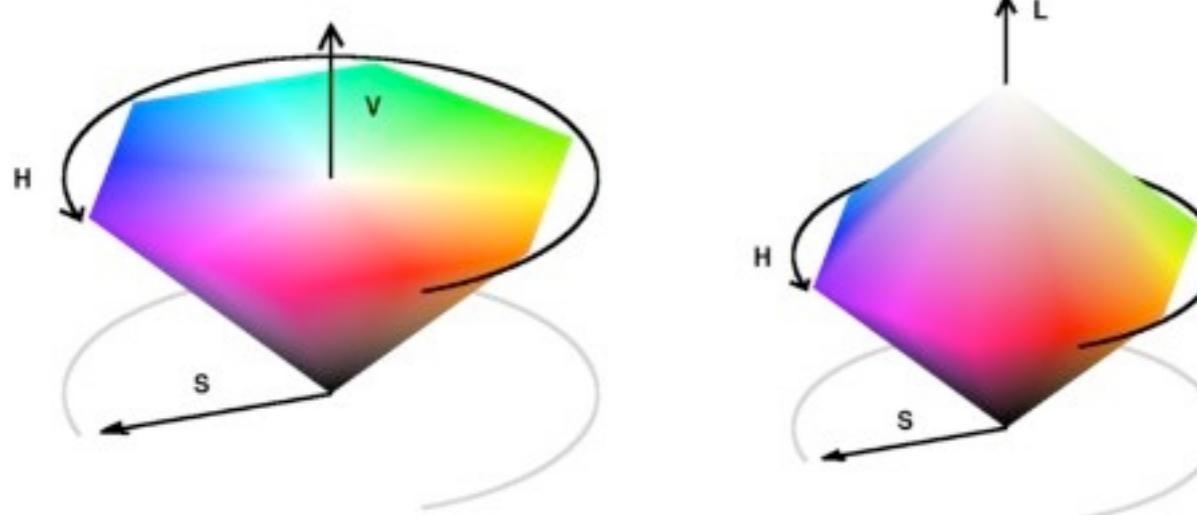
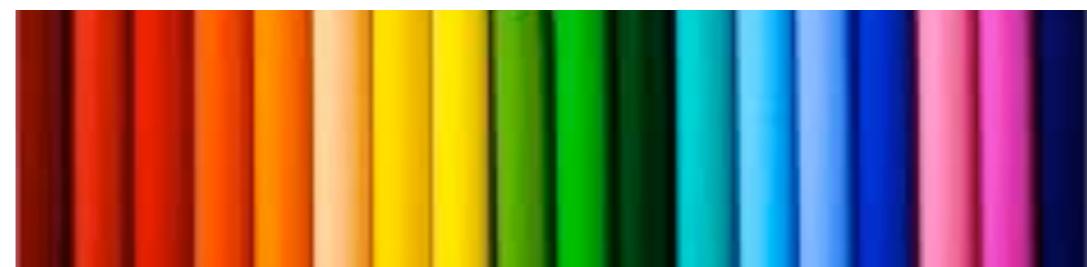
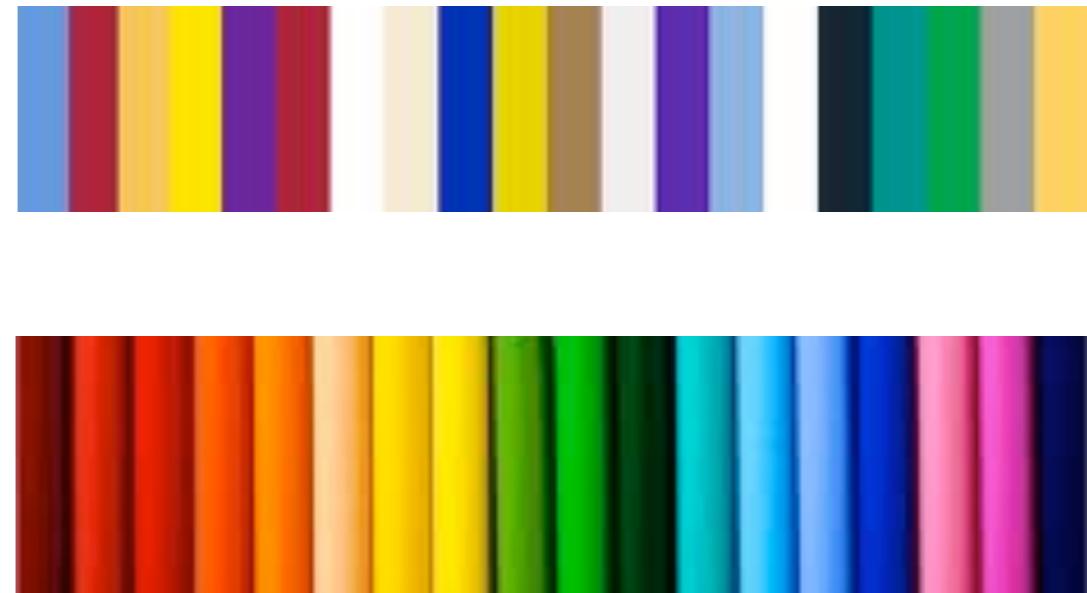
problem 1: No natural ordering

Using colour for continuous values



problem 1: No natural ordering

Using colour for continuous values

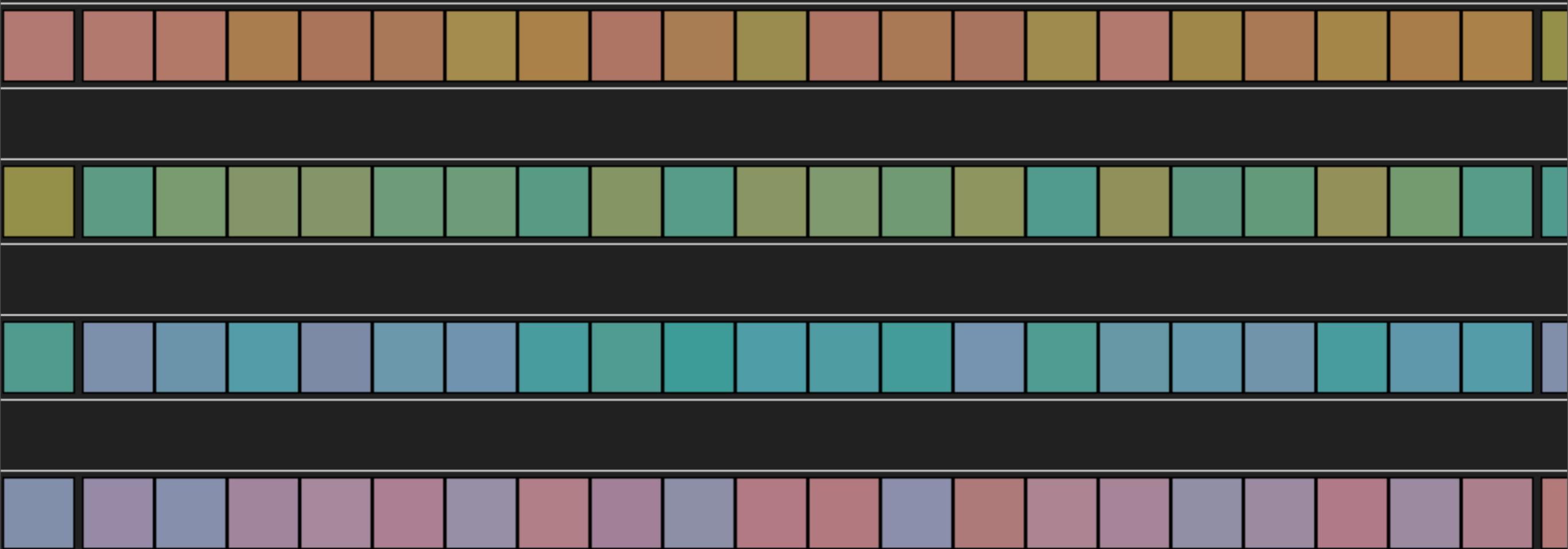


problem 1: No natural ordering

Using colour for continuous values

Drag and drop the colors in each row to arrange them by hue order.

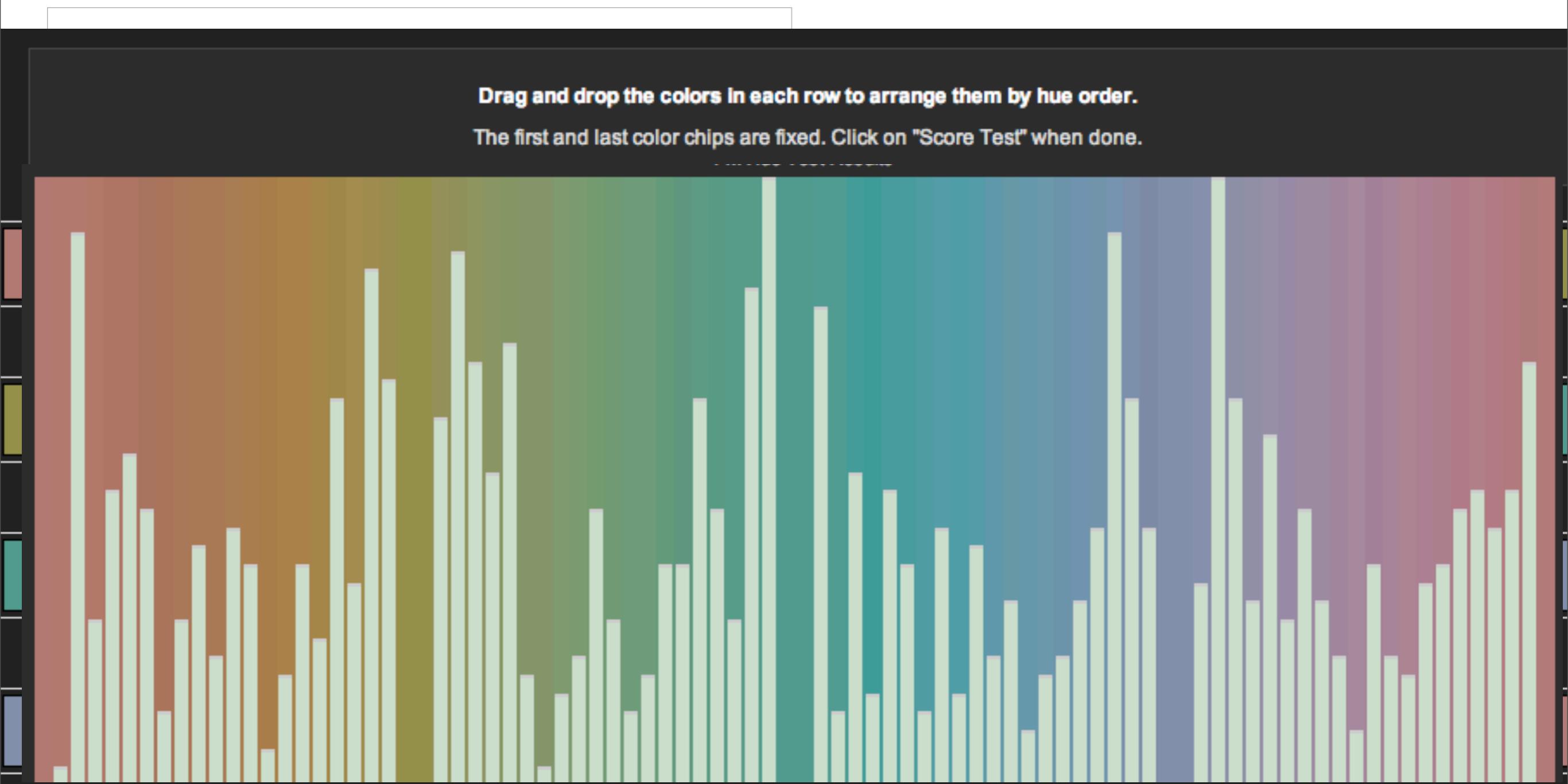
The first and last color chips are fixed. Click on "Score Test" when done.



http://www.colormunki.com/game/huetest_kiosk

problem 1: No natural ordering

Using colour for continuous values

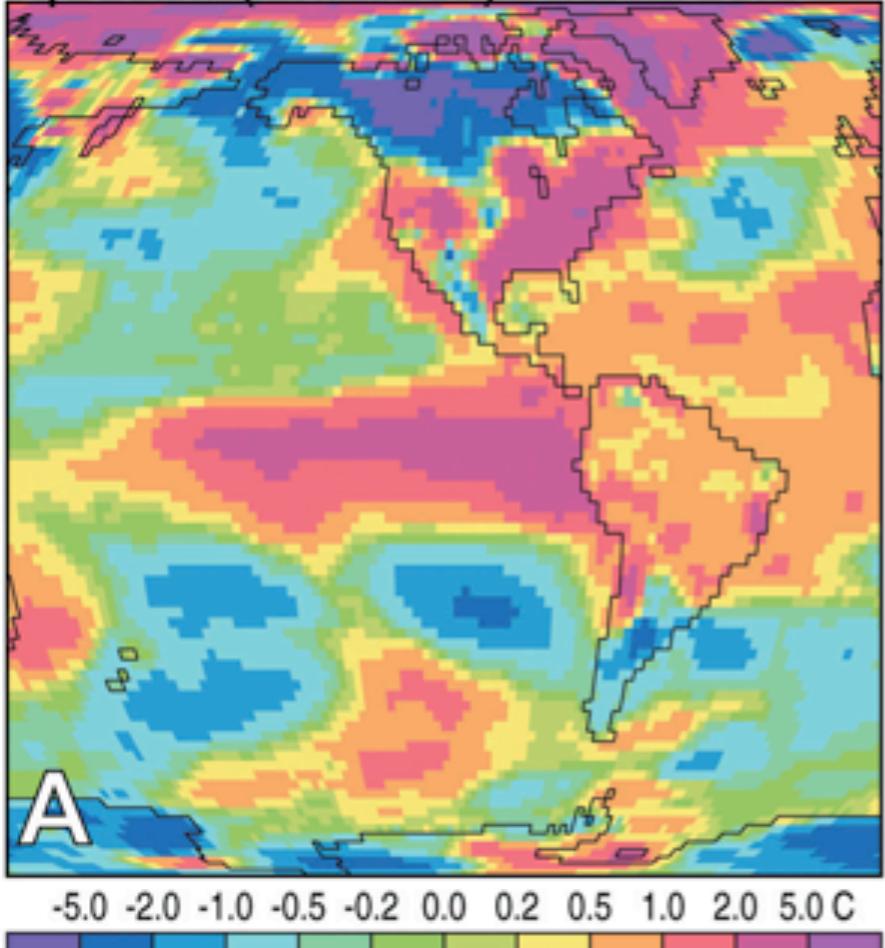


http://www.colormunki.com/game/huetest_kiosk

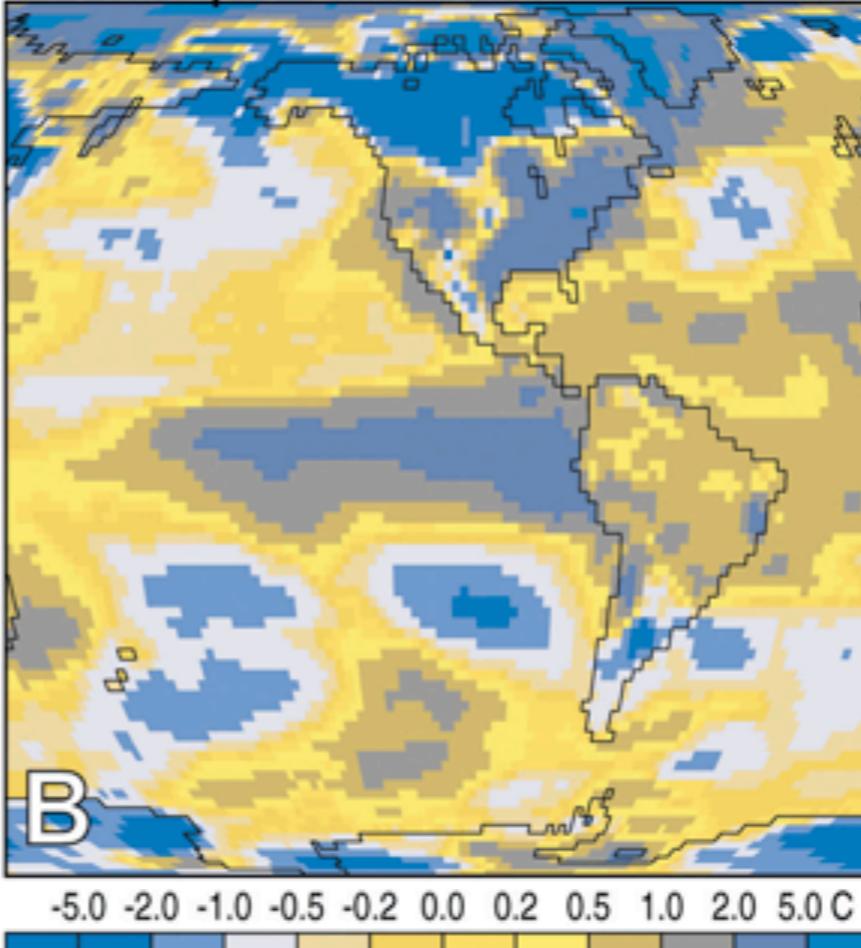
problem 1: No natural ordering

Using colour for continuous values

Spectral (Rainbow) Color Scale



Protanopic Simulation



protanopia



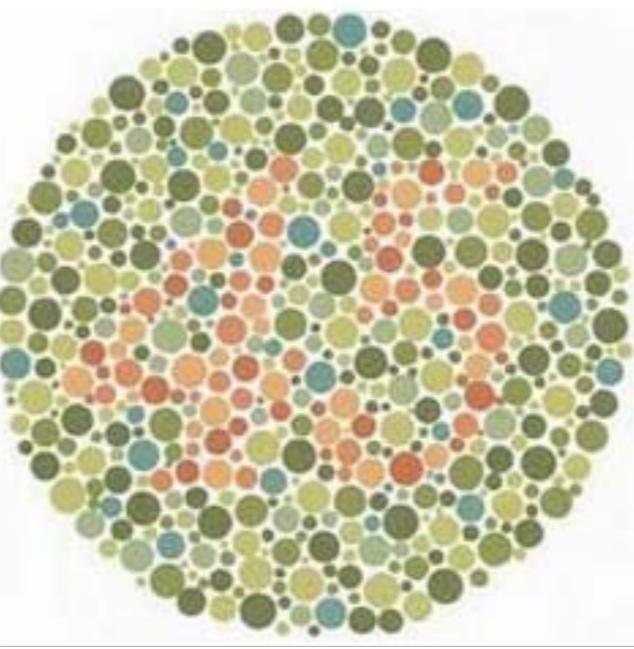
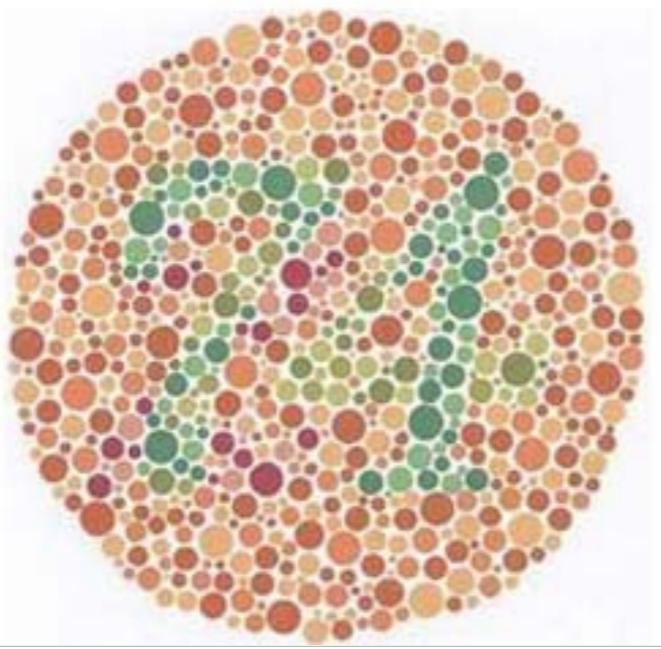
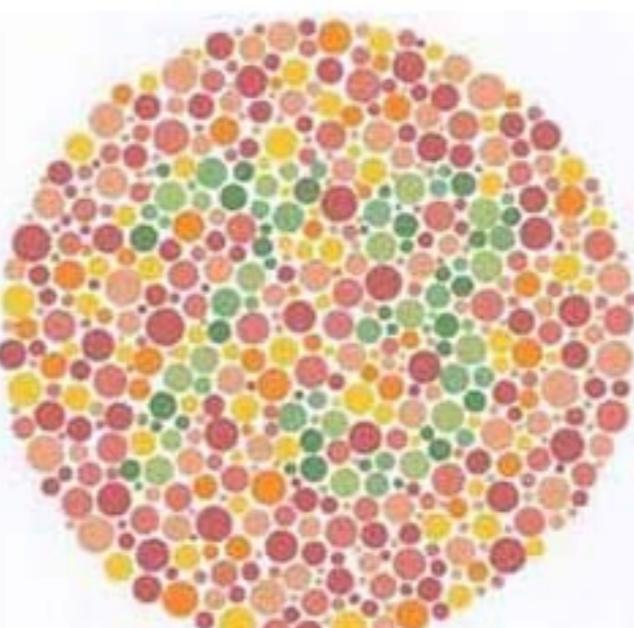
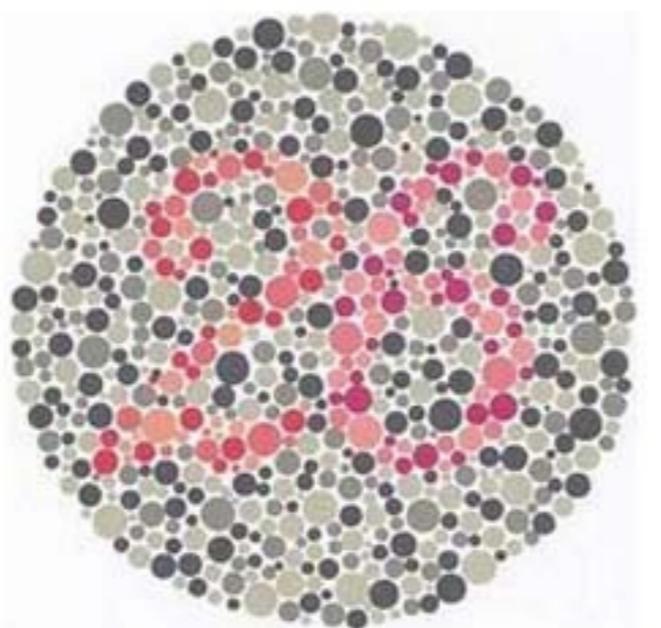
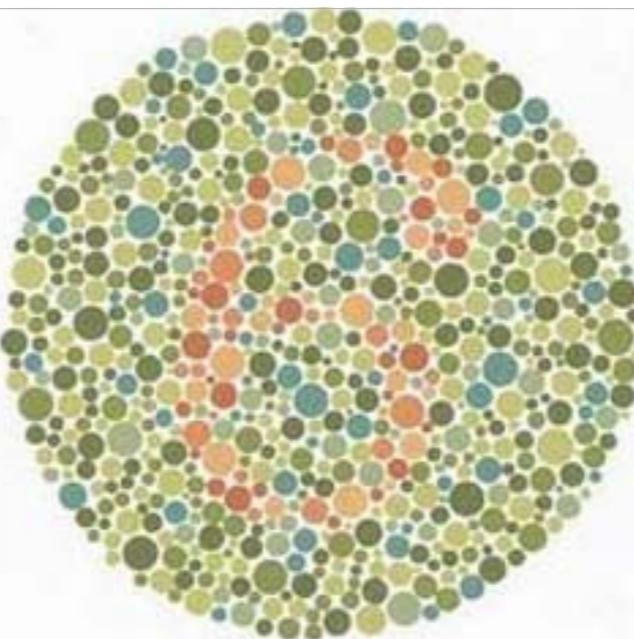
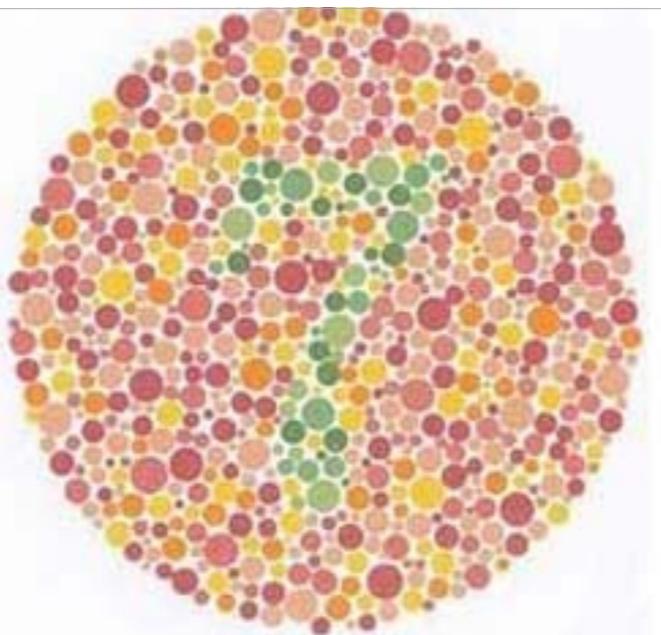
deutanopia



tritanopia

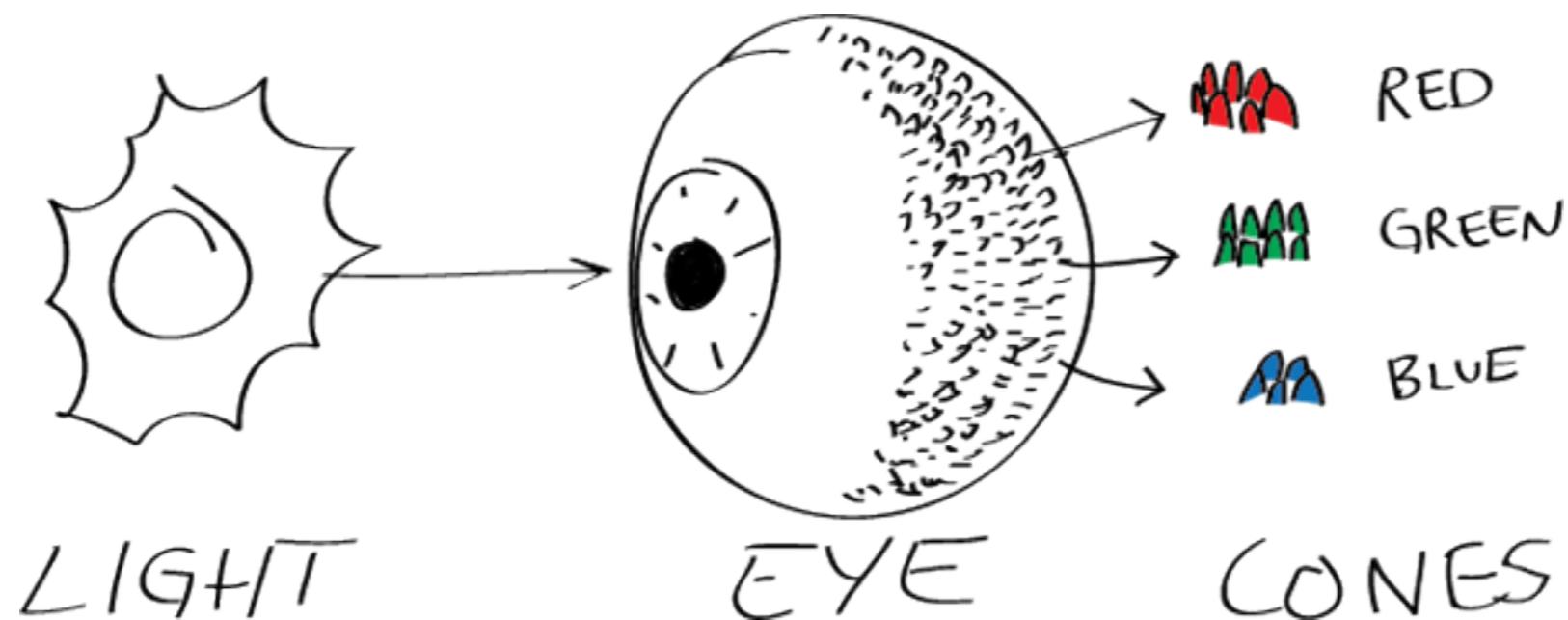
Protanopia affects 8% of males, 0.5% females
of Northern European ancestry

problem 2: colour sensitivity



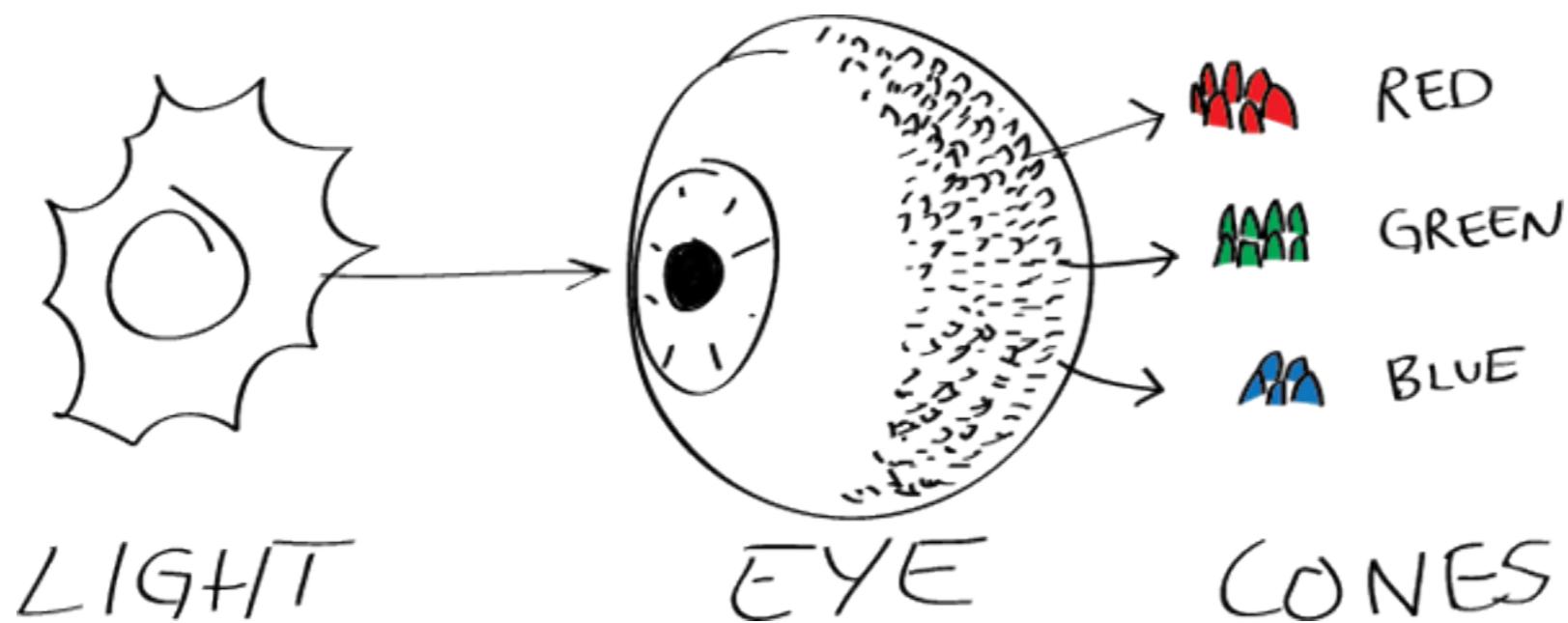
Using colour for continuous values

problem 3: yellow is special

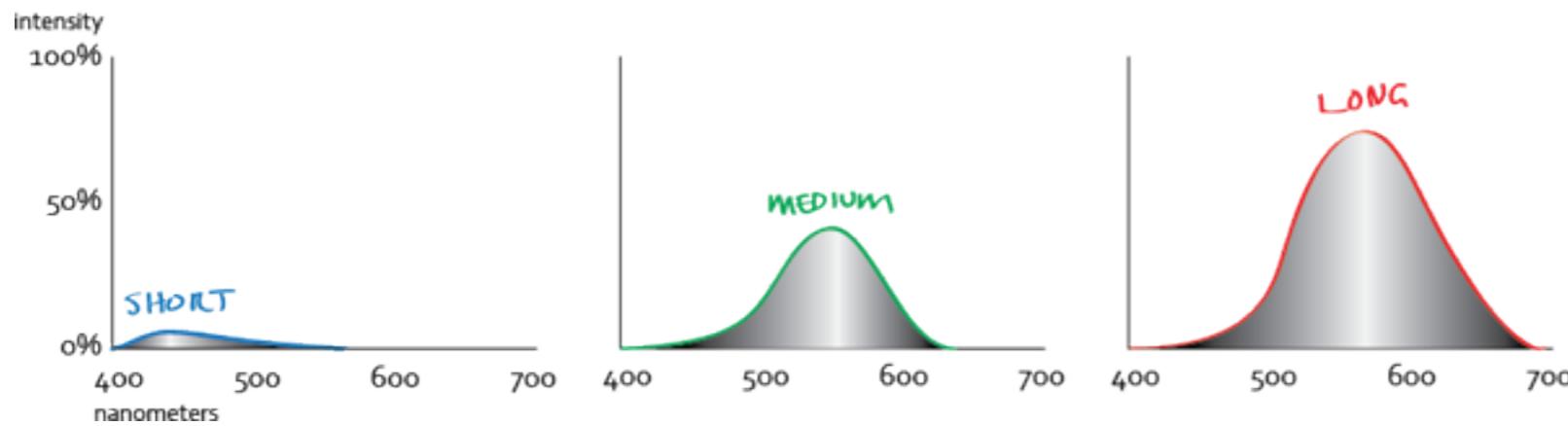


Using colour for continuous values

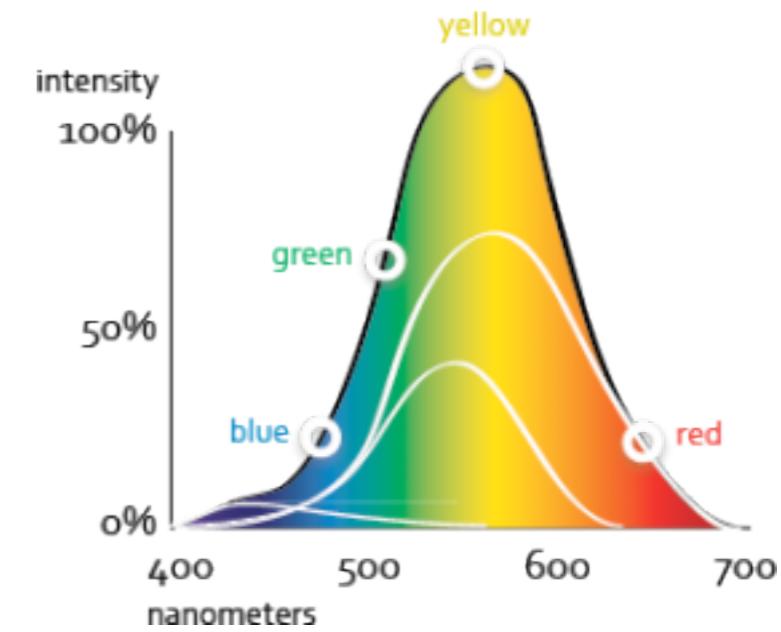
problem 3: yellow is special



RELATIVE SENSITIVITY TO LIGHT WAVELENGTHS

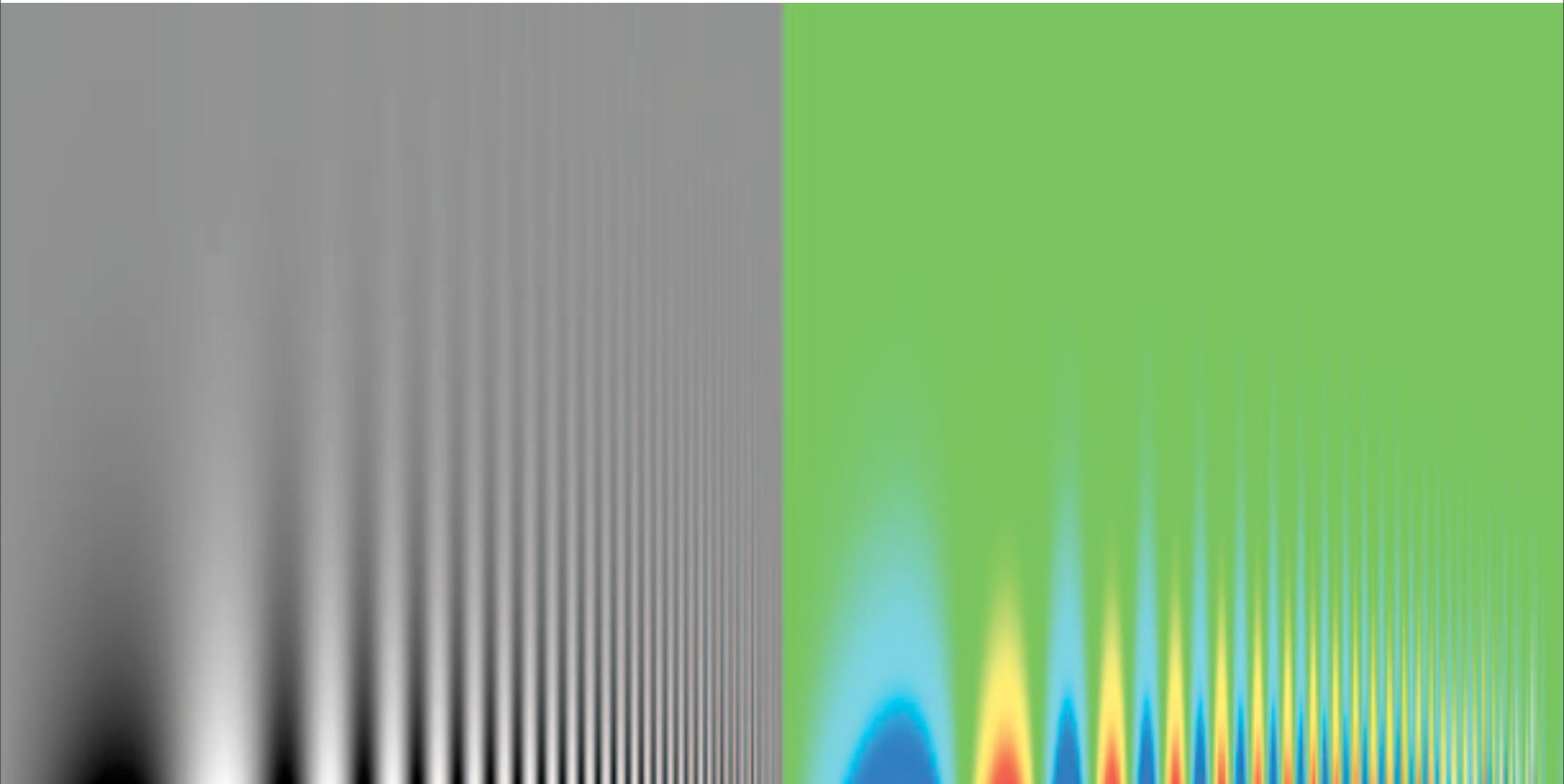


PUTTING IT ALL TOGETHER



Using colour for continuous values

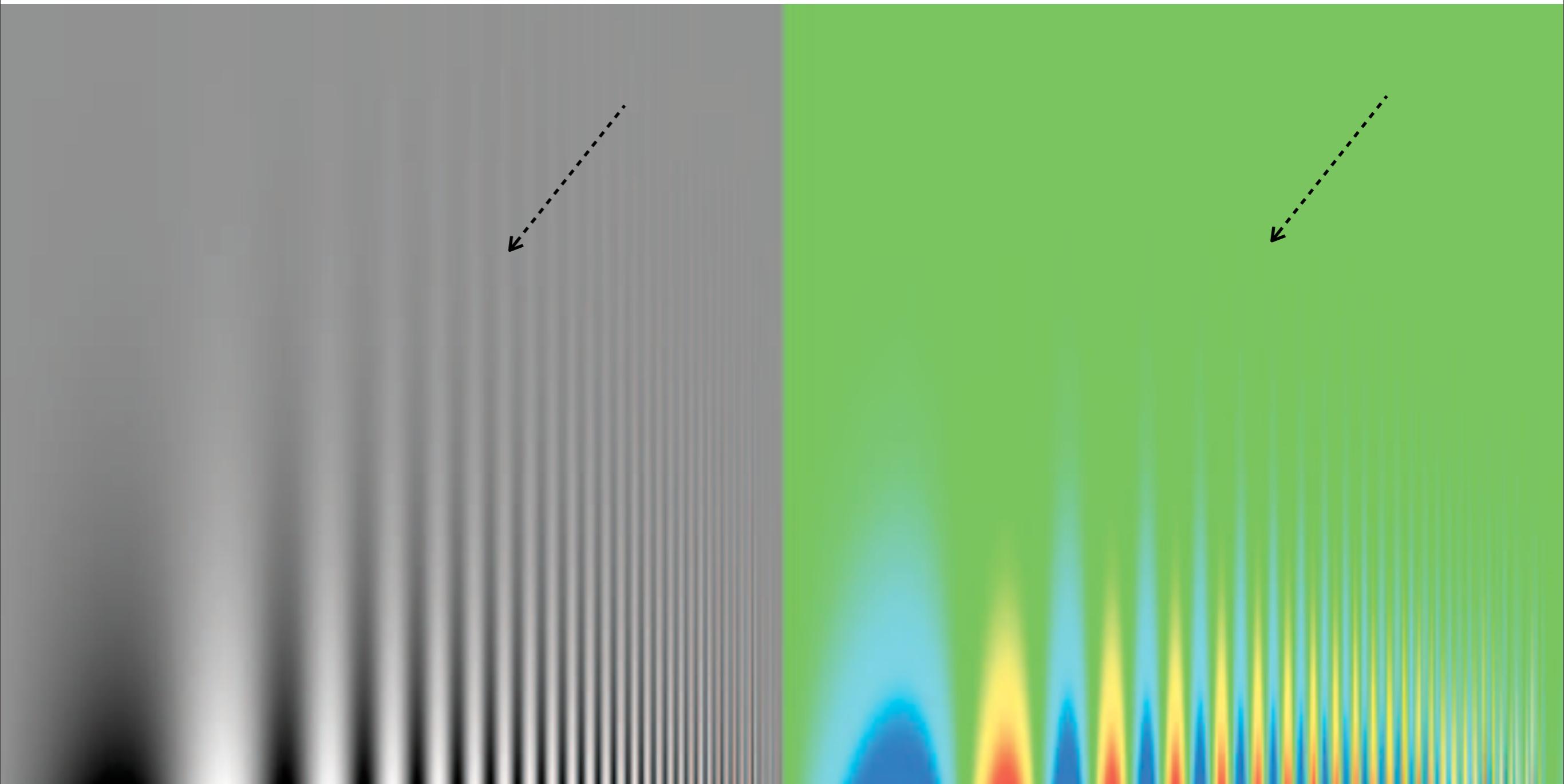
problem 4: Details: overemphasised or obscured



hue ‘borders’ overemphasise small changes, hue ‘middles’ blend potentially important details

Using colour for continuous values

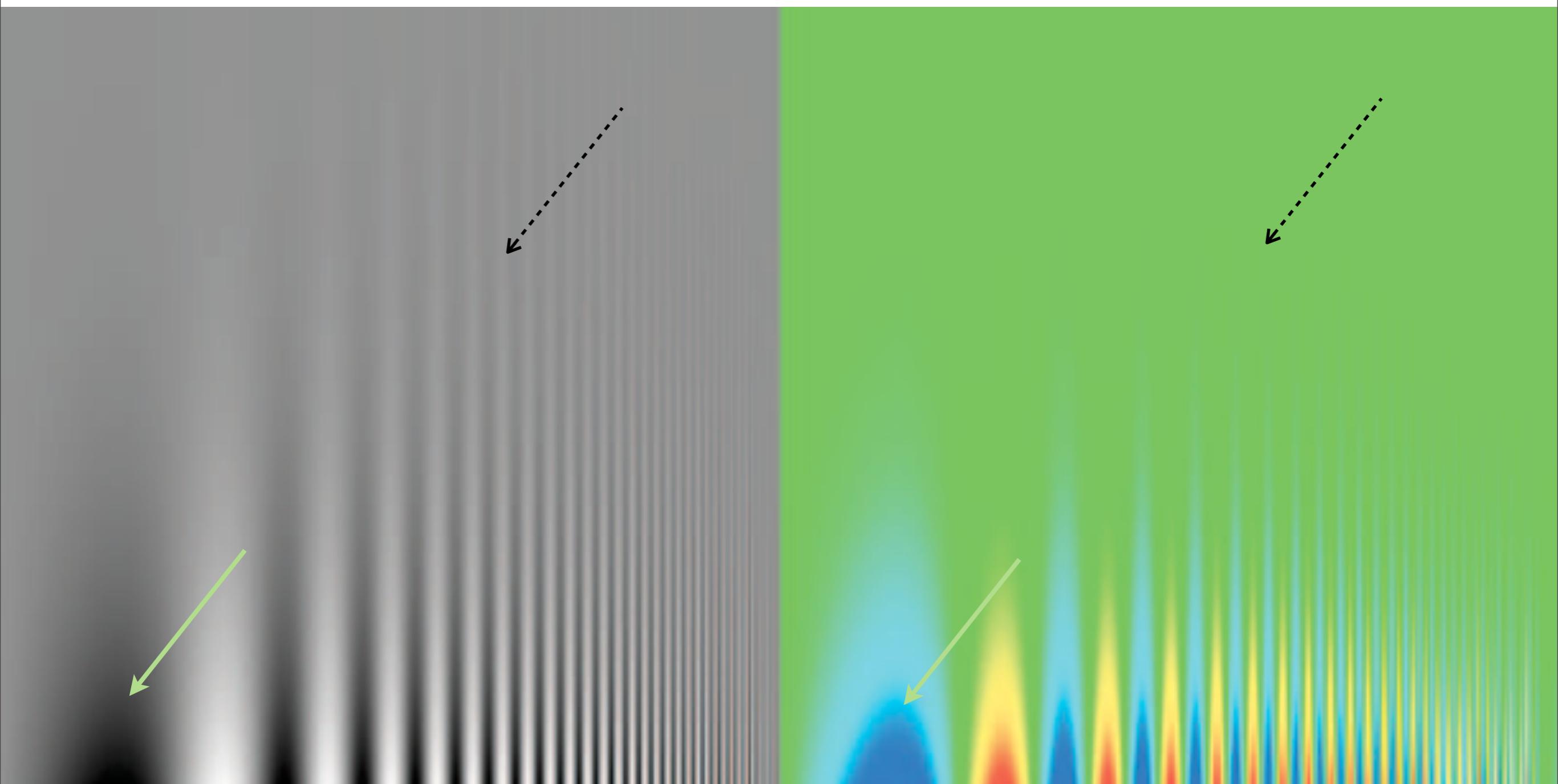
problem 4: Details: overemphasised or obscured



hue ‘borders’ overemphasise small changes, hue ‘middles’ blend potentially important details

Using colour for continuous values

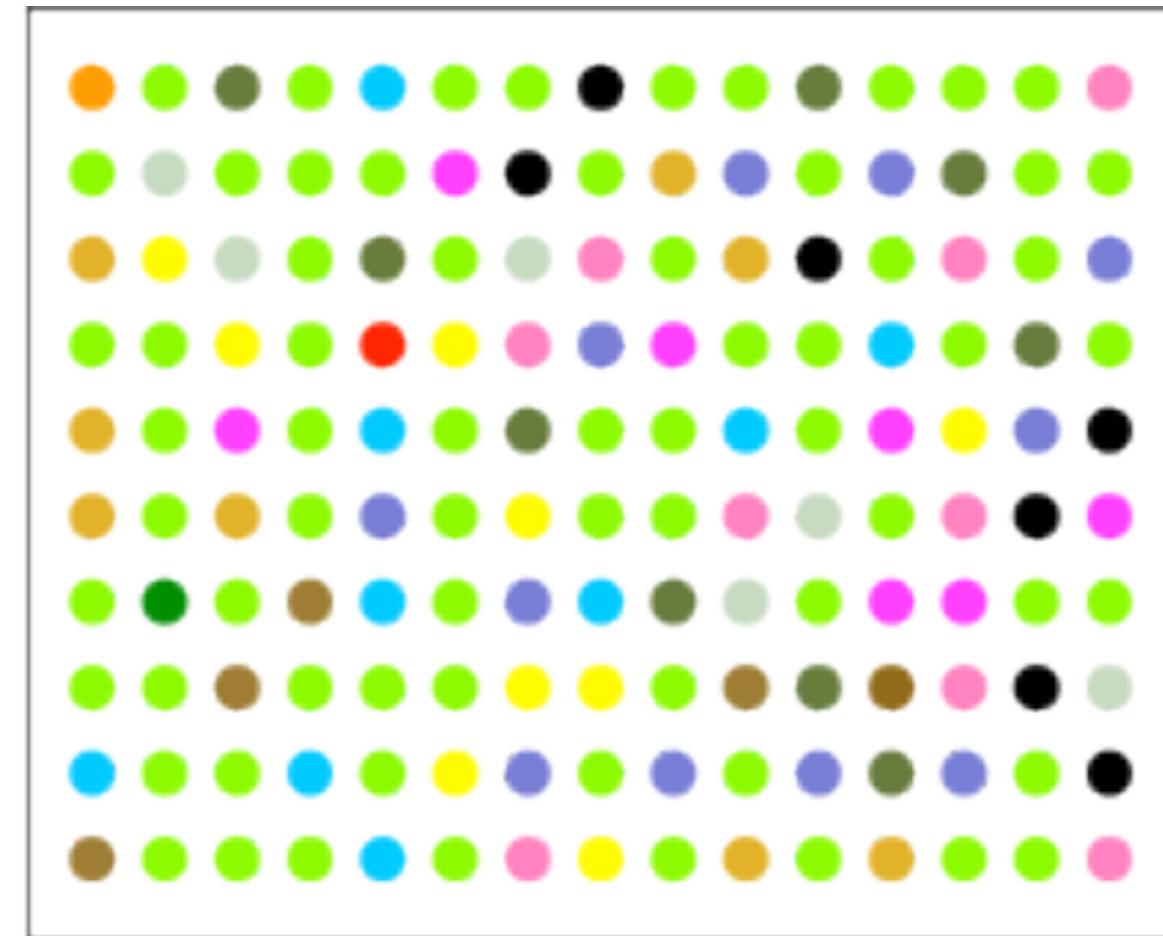
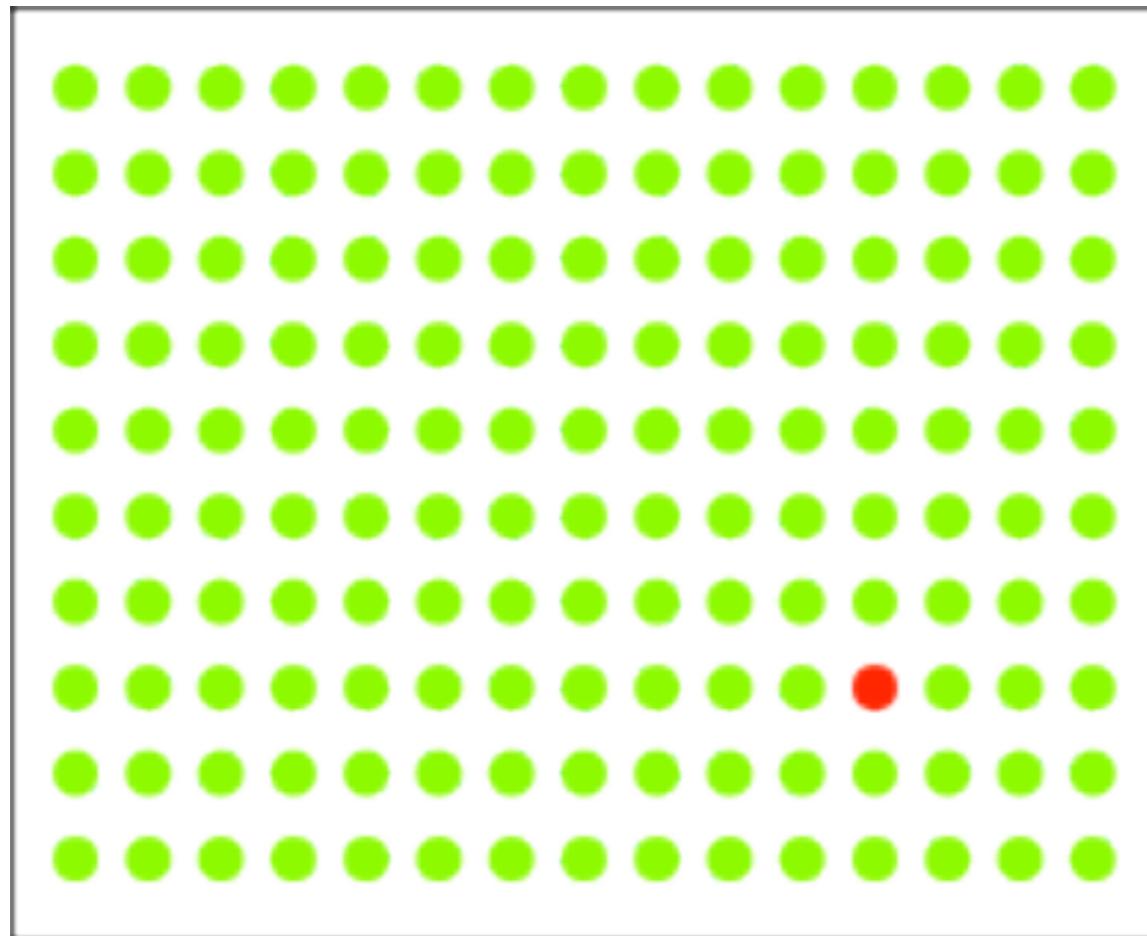
problem 4: Details: overemphasised or obscured

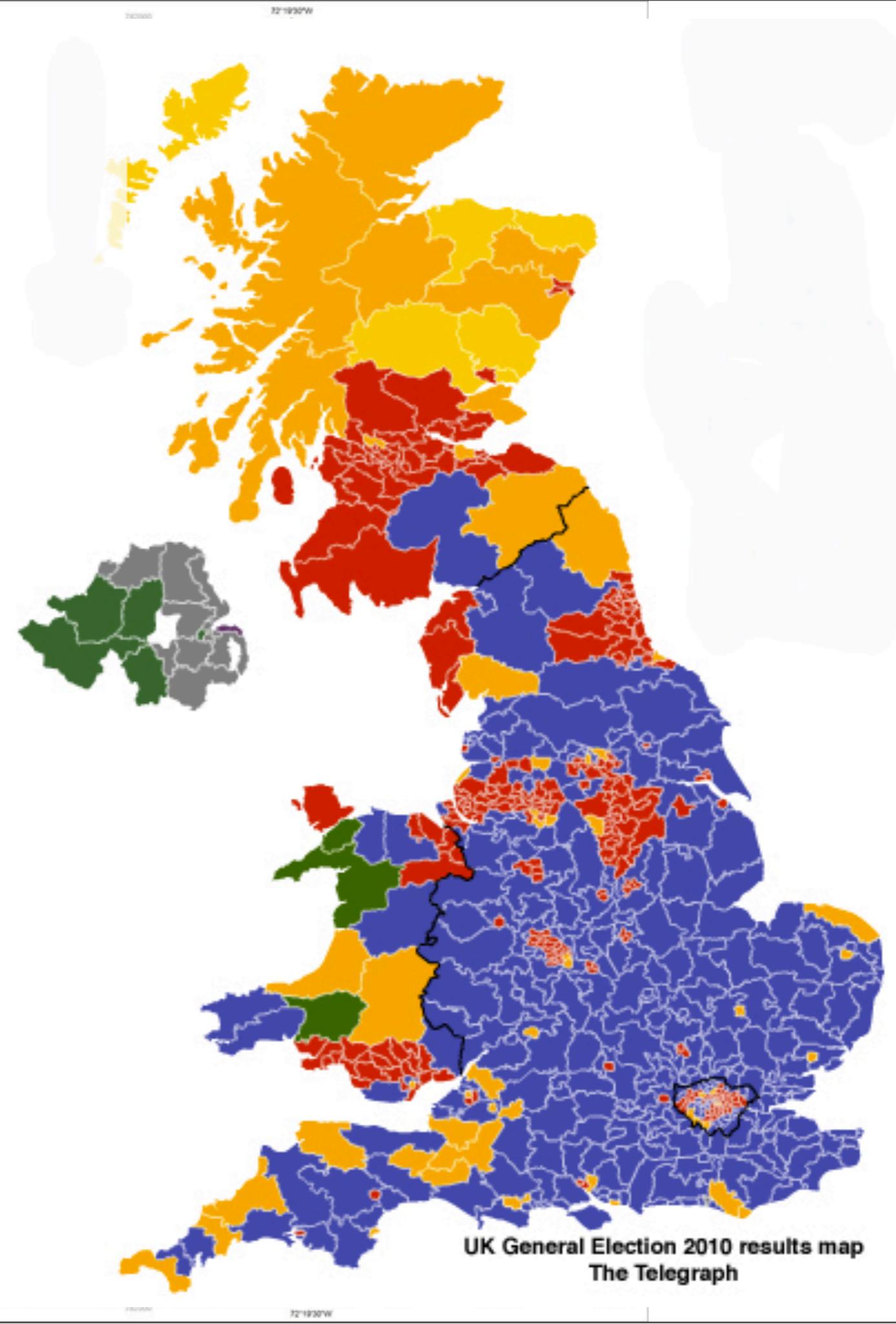
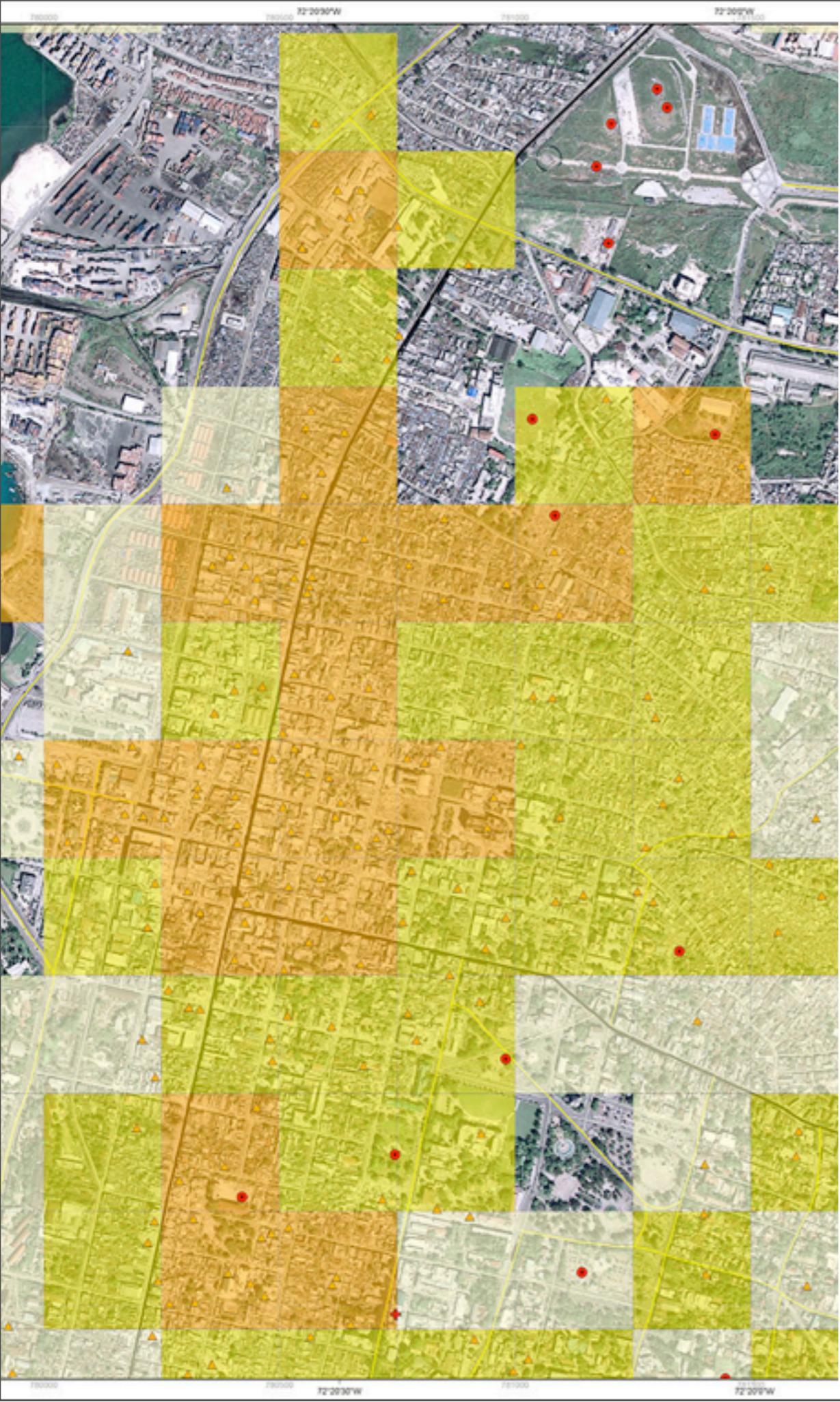


hue ‘borders’ overemphasise small changes, hue ‘middles’ blend potentially important details

Using colour for continuous values

problem 5: **pop out** can drown out





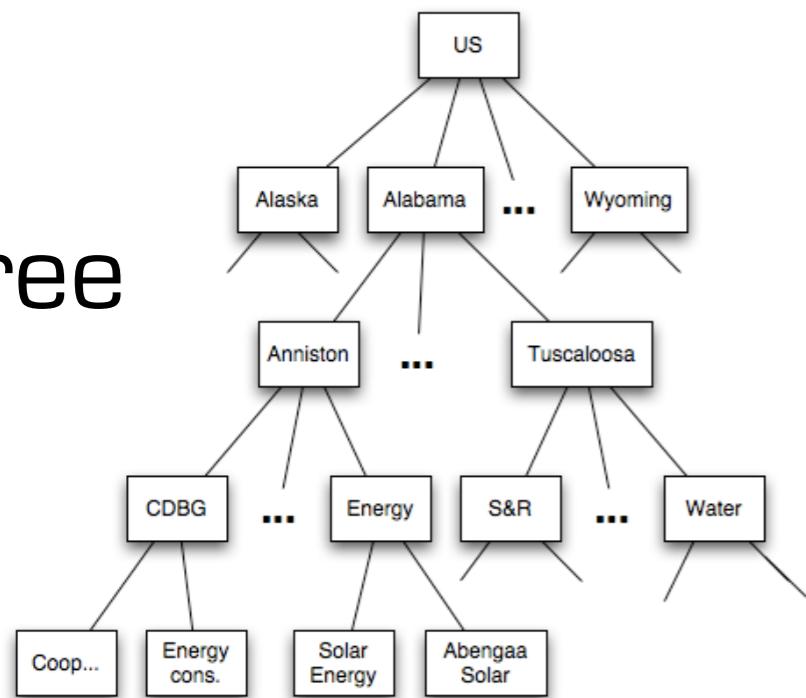
visual dimensions for
categorical & hierarchical values?



multivariate relational data: hierarchical

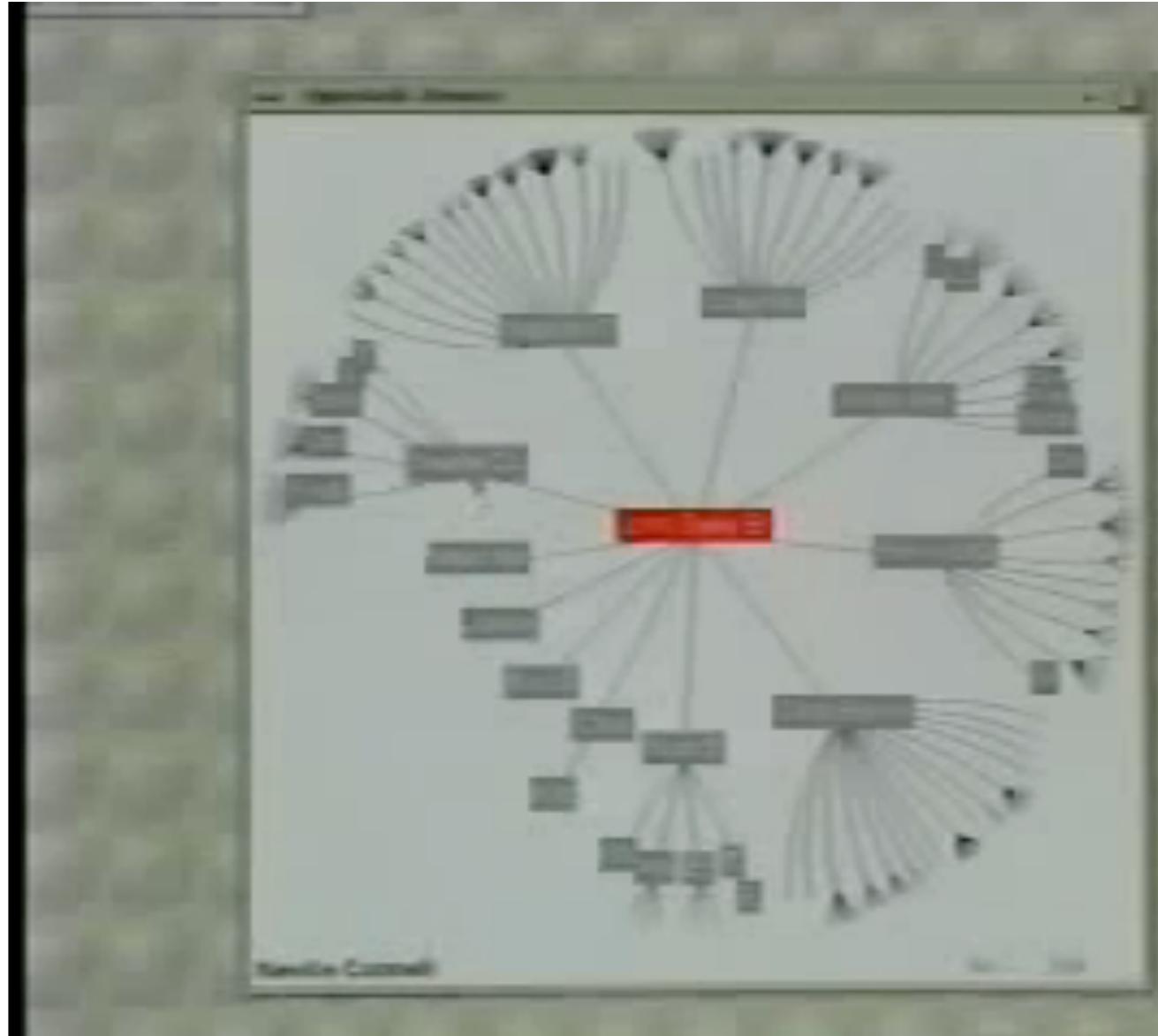
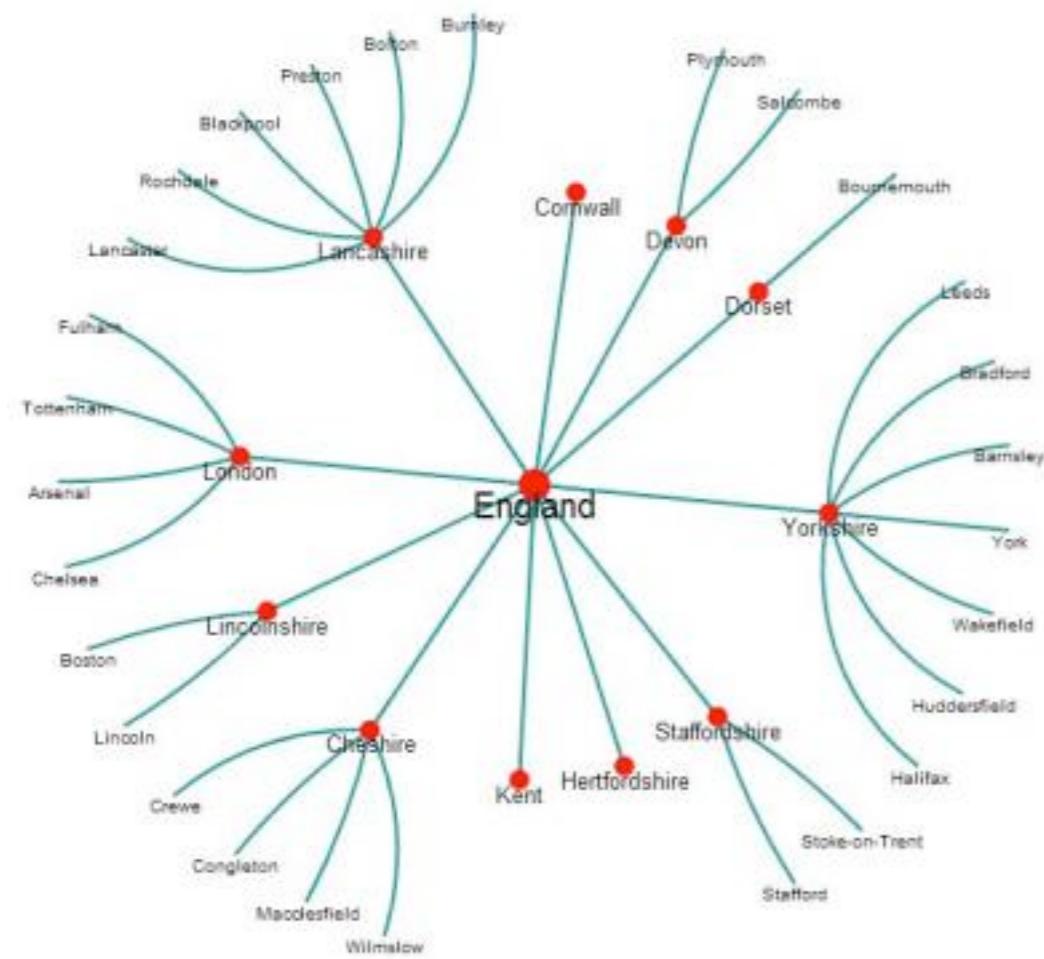
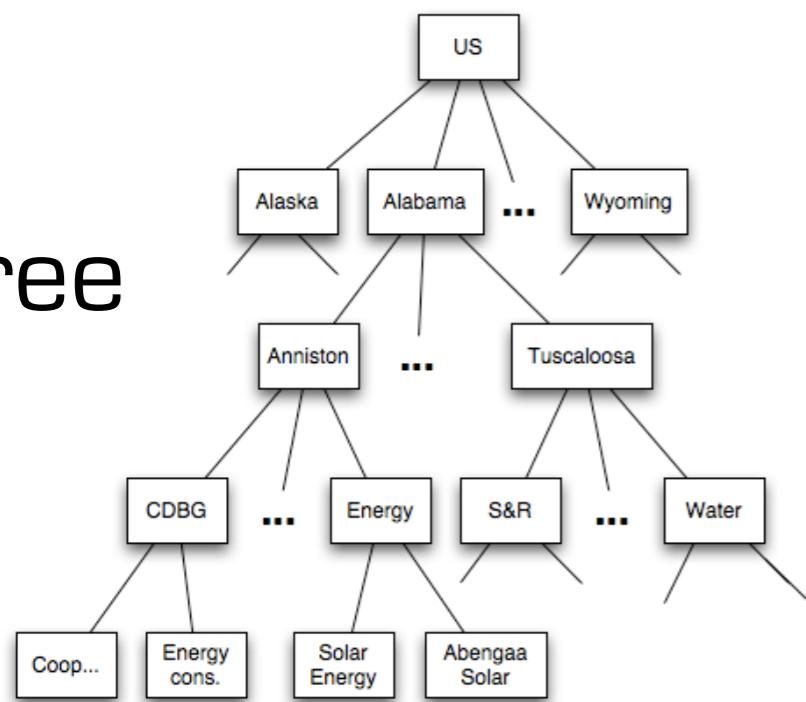
multivariate relational data: hierarchical

tree



multivariate relational data: hierarchical

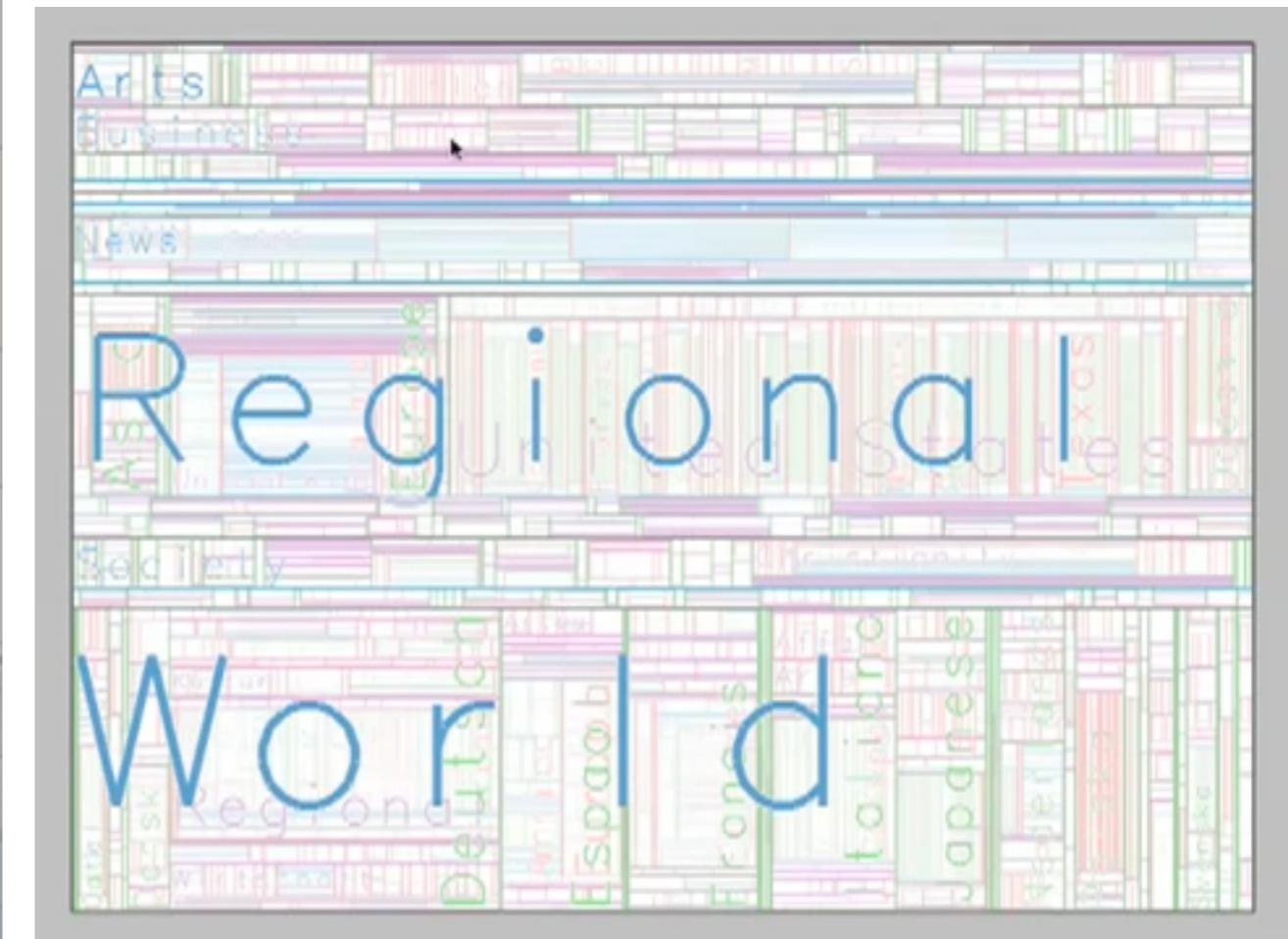
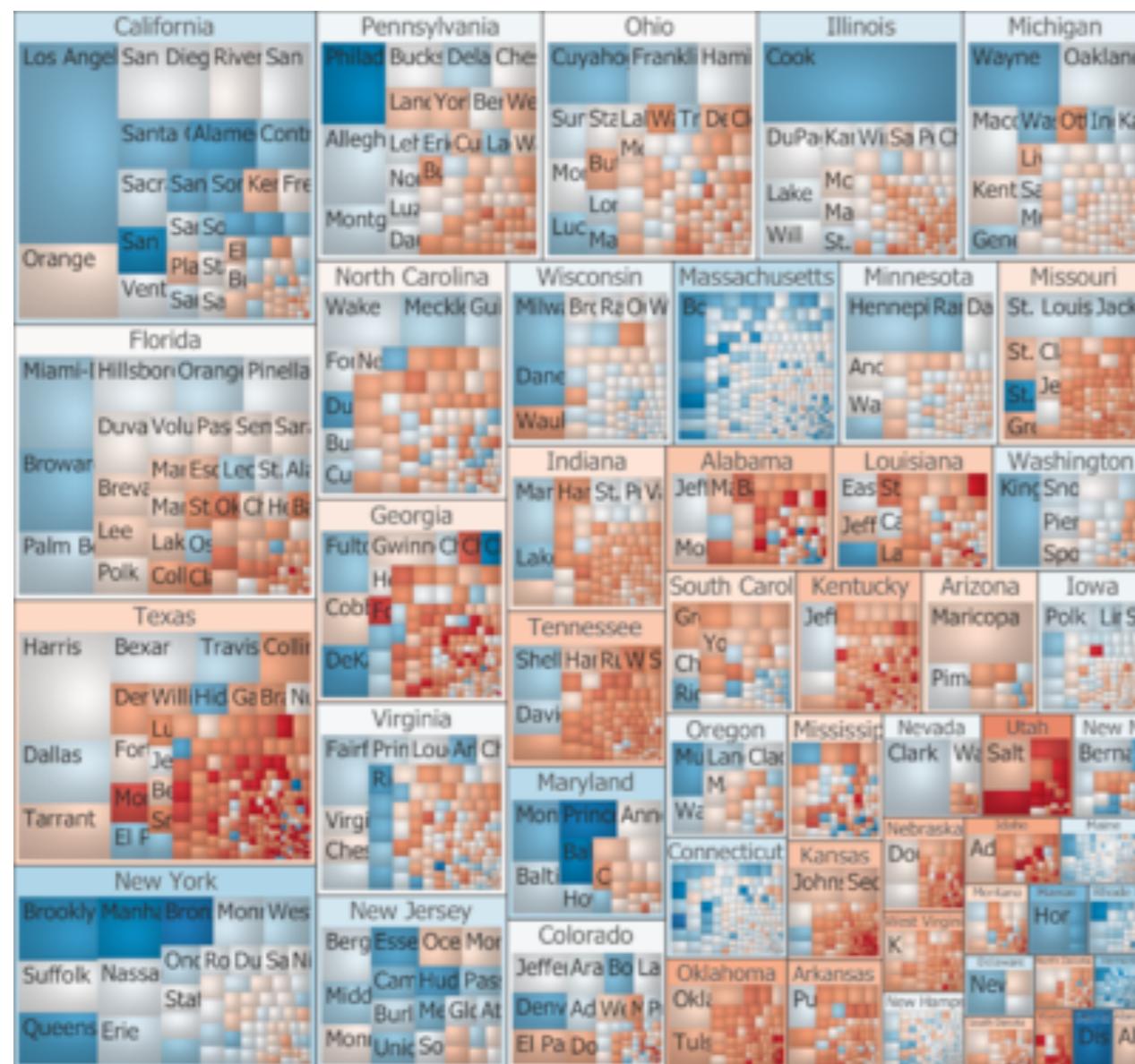
tree



hyperbolic tree

multivariate relational data: hierarchical

treemap

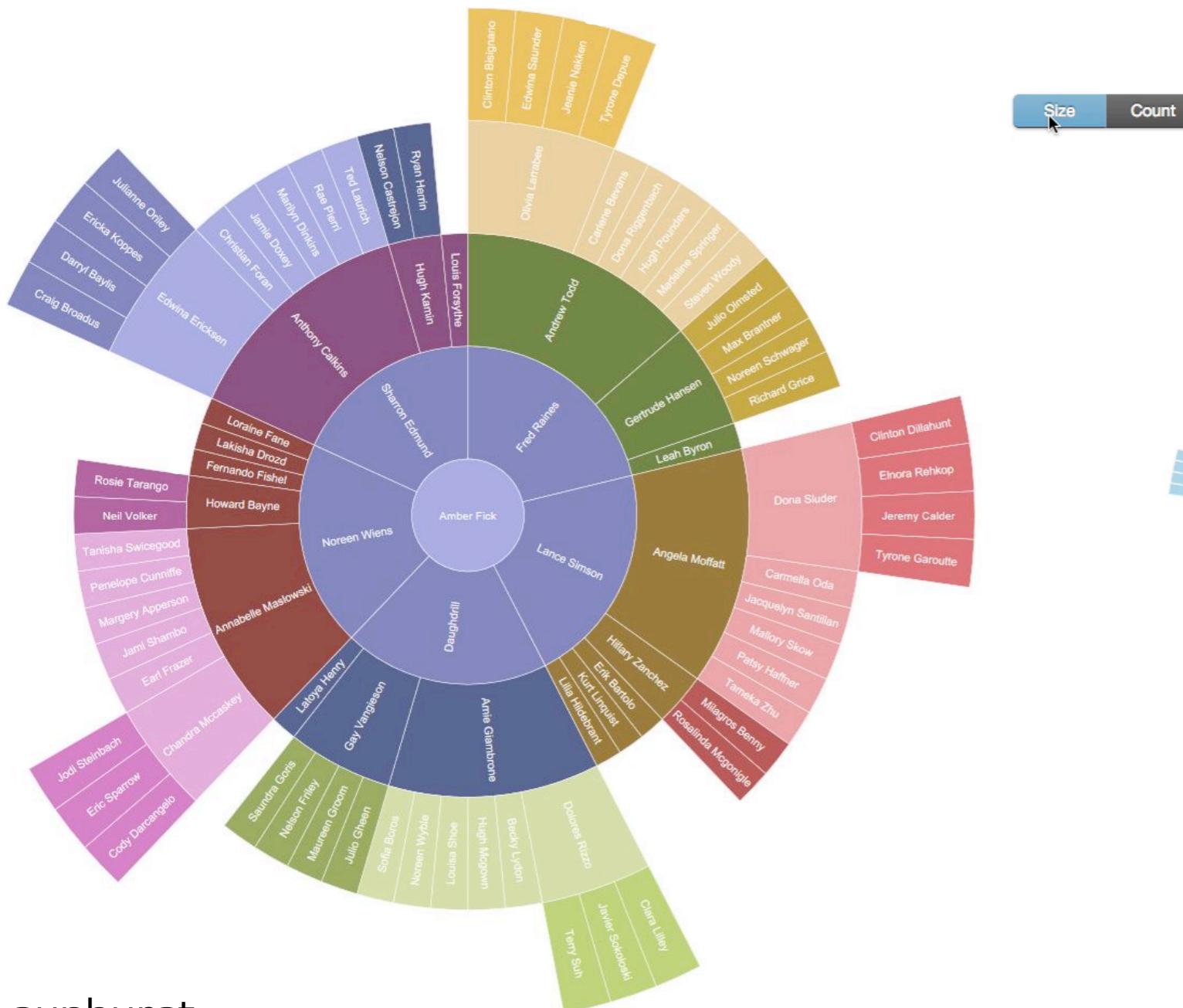


multivariate relational data: hierarchical



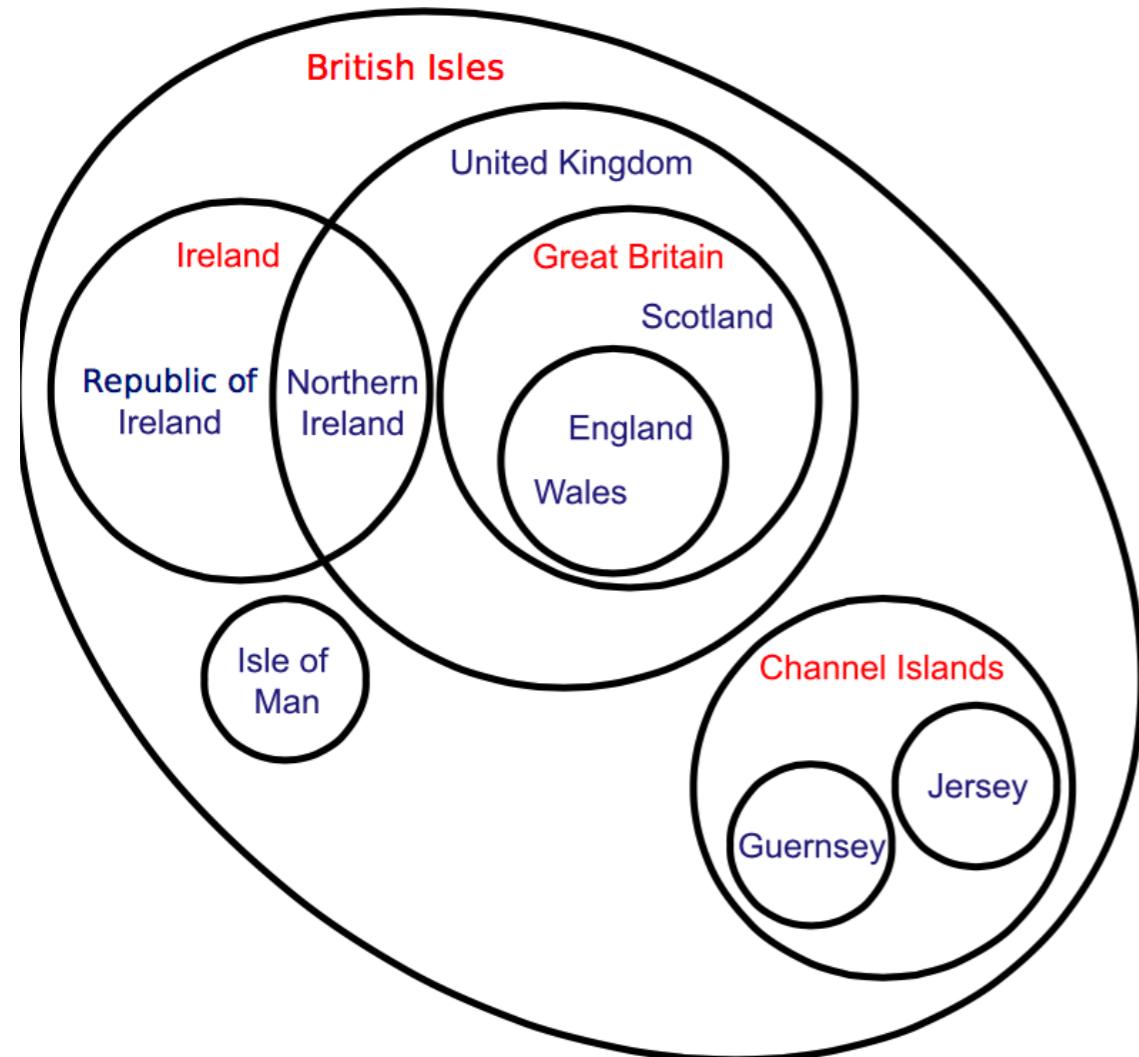
sunburst

multivariate relational data: hierarchical



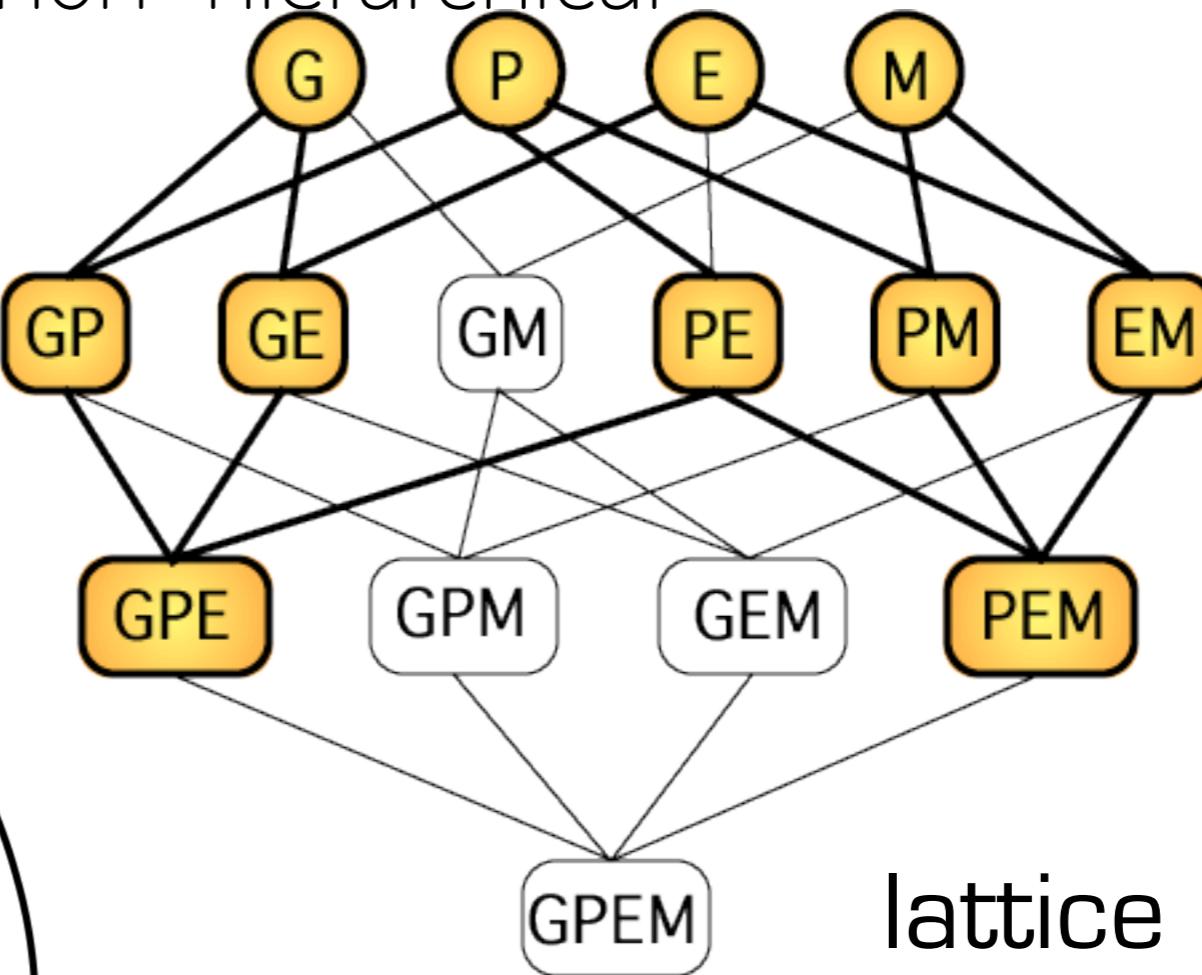
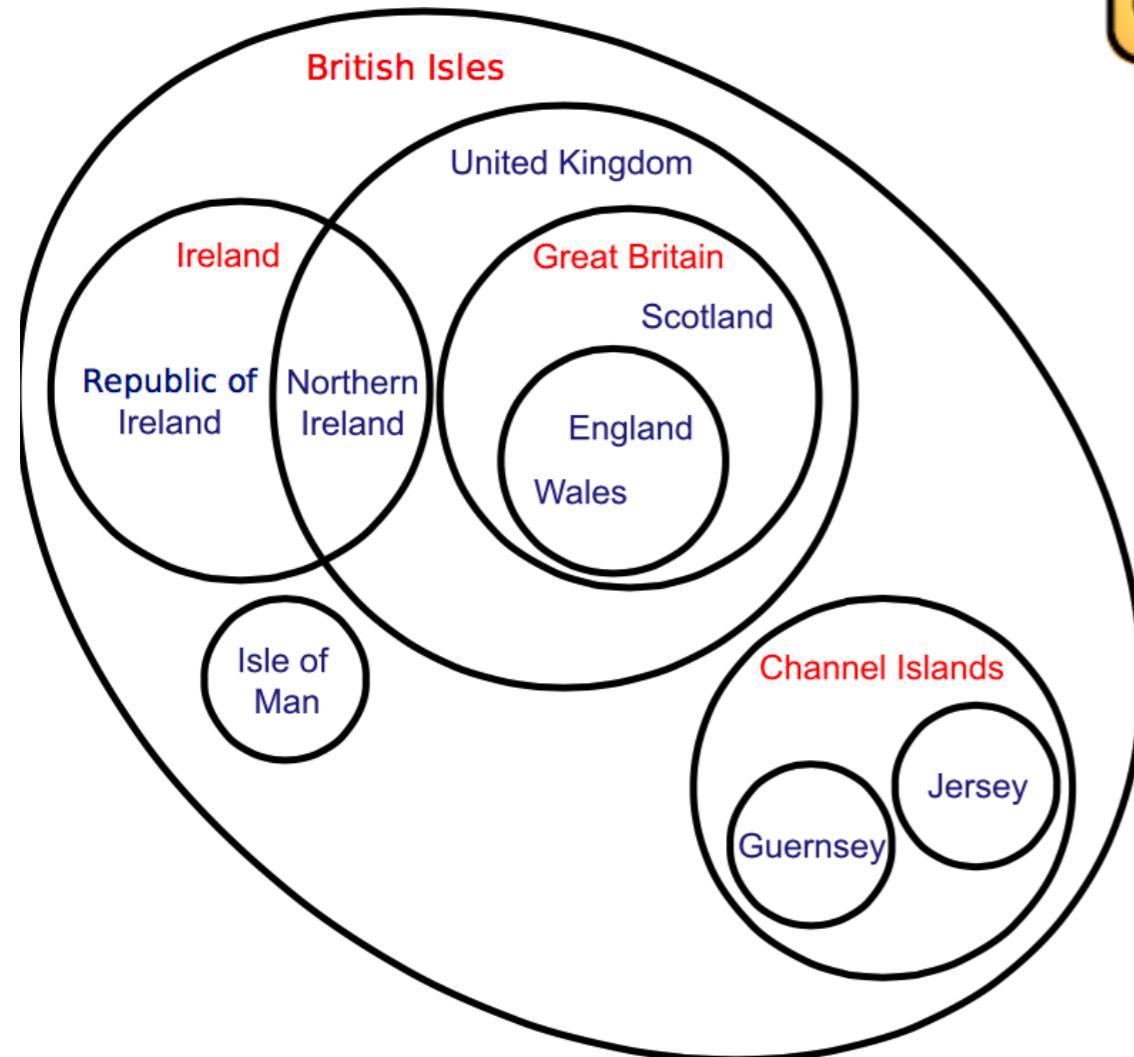
sunburst

multivariate relational data: non-hierarchical



venn diagram

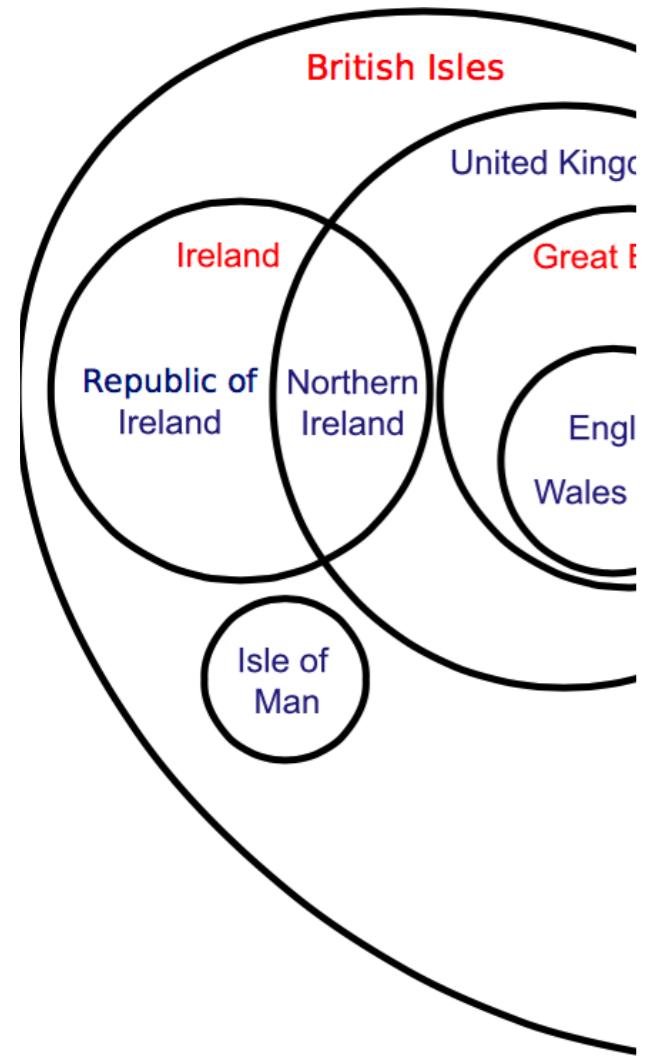
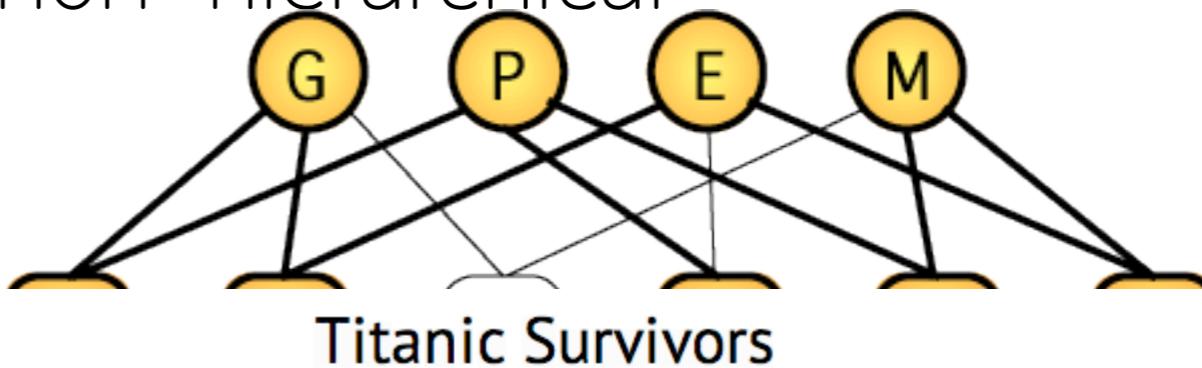
multivariate relational data: non-hierarchical



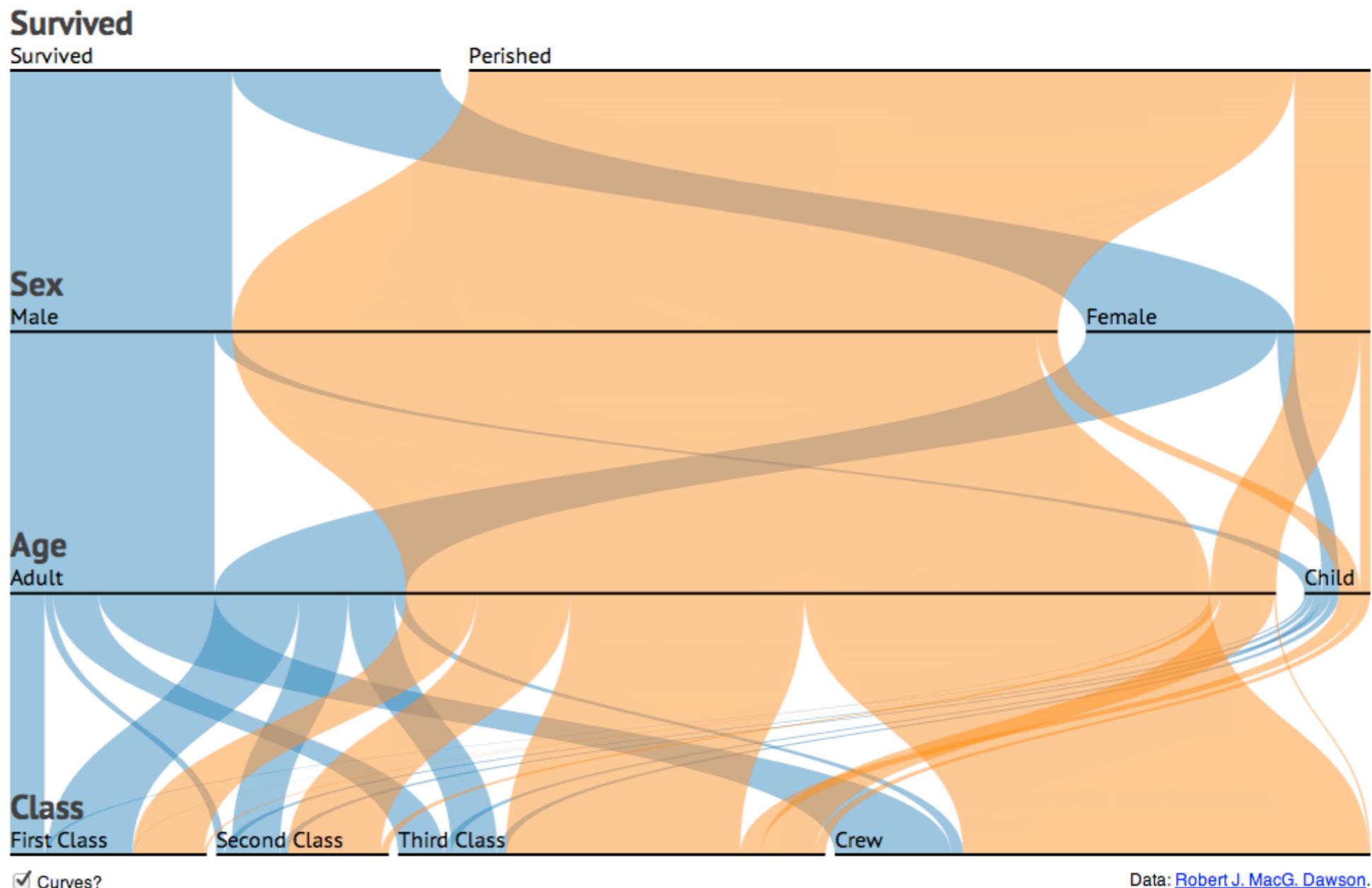
lattice

venn diagram

multivariate relational data: non-hierarchical

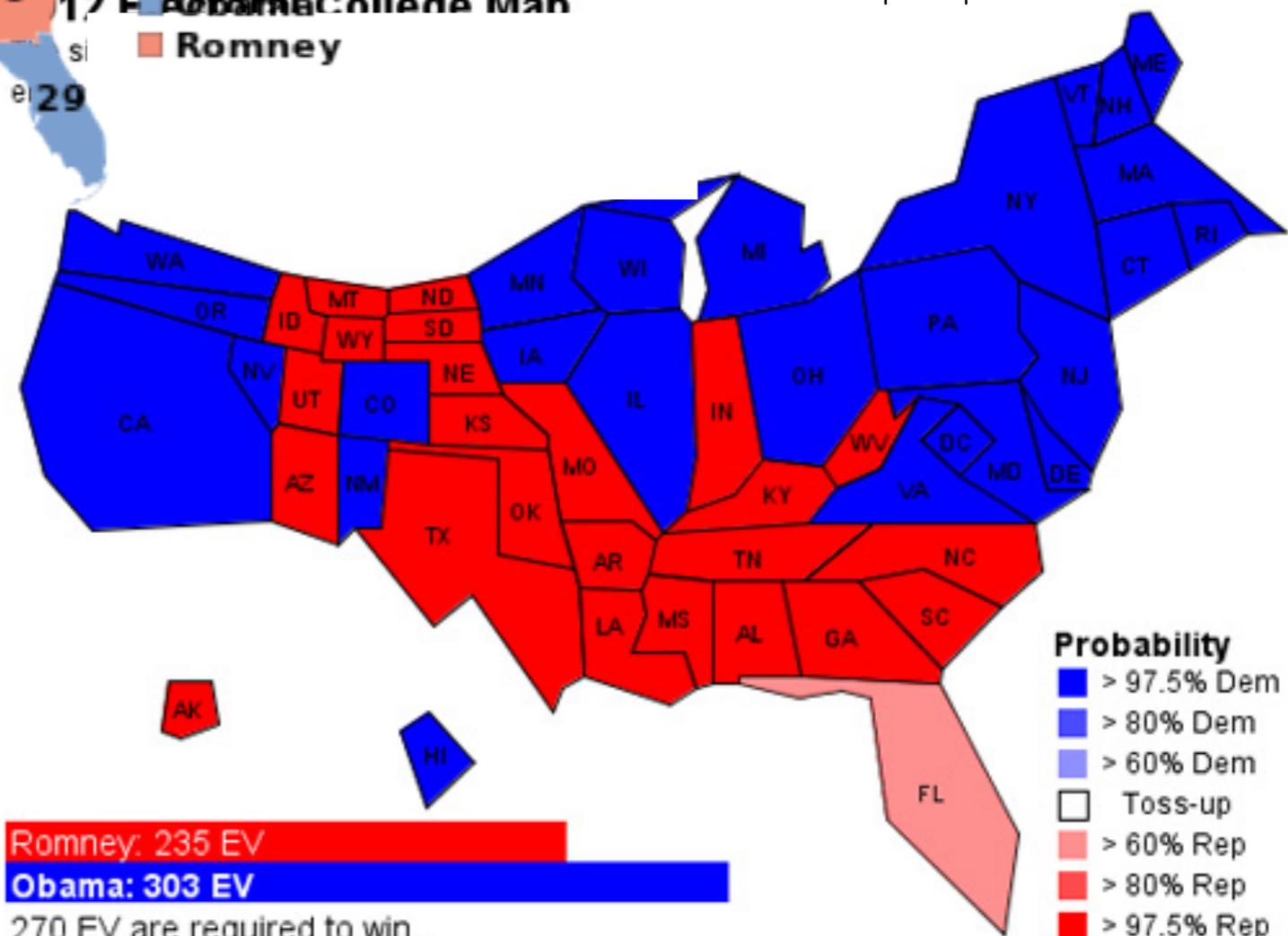
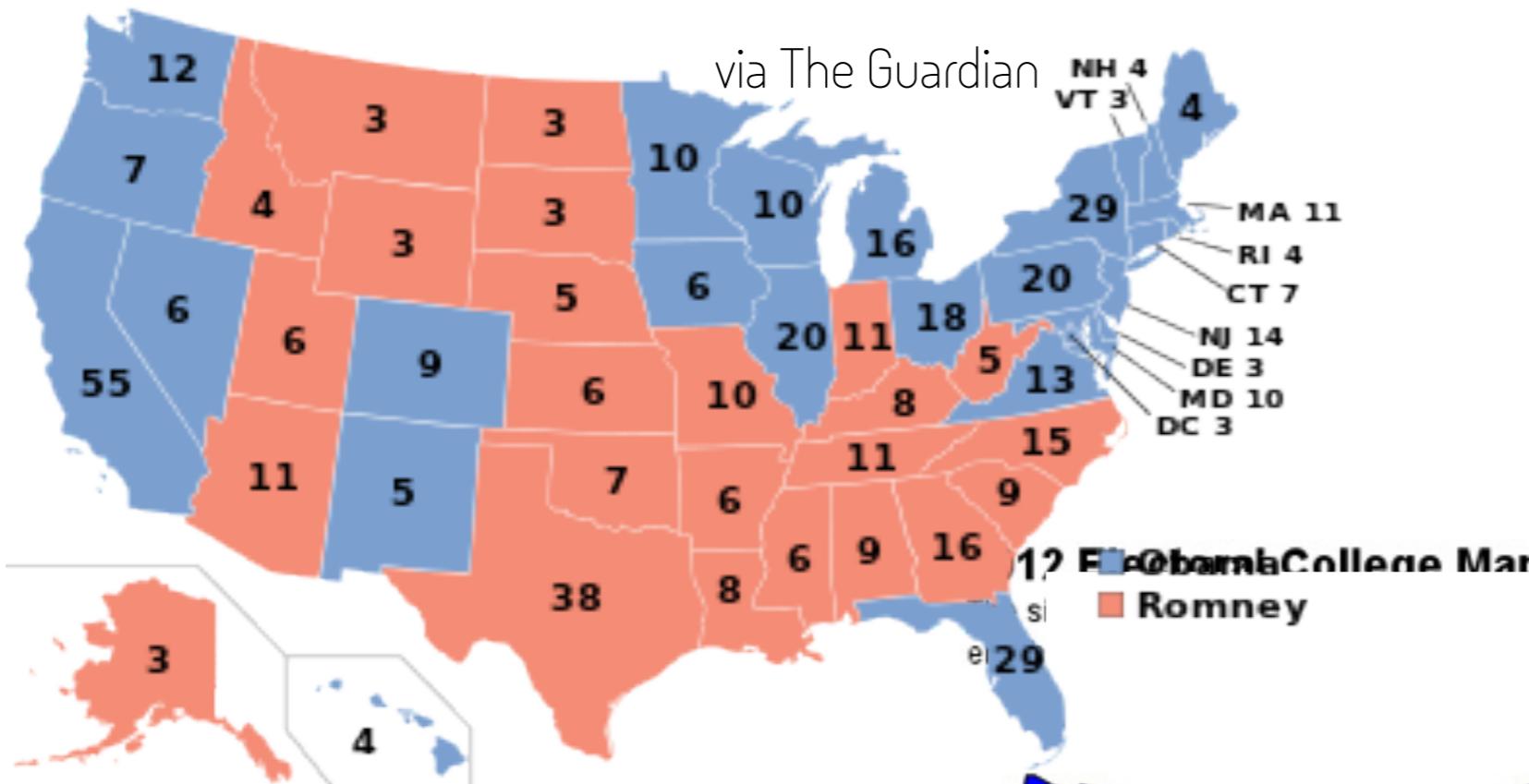


venn diagram



parallel sets

multivariate geospatial data

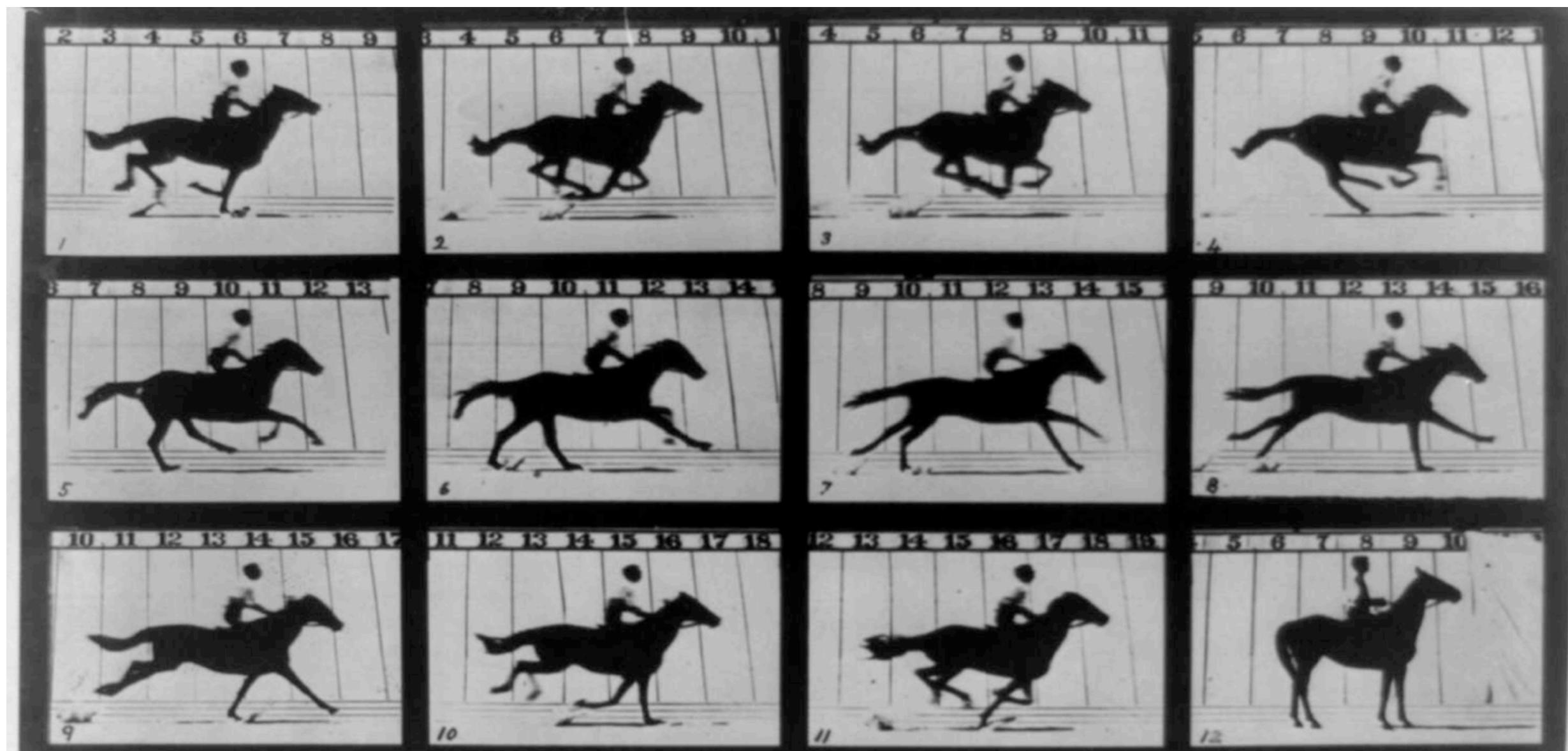
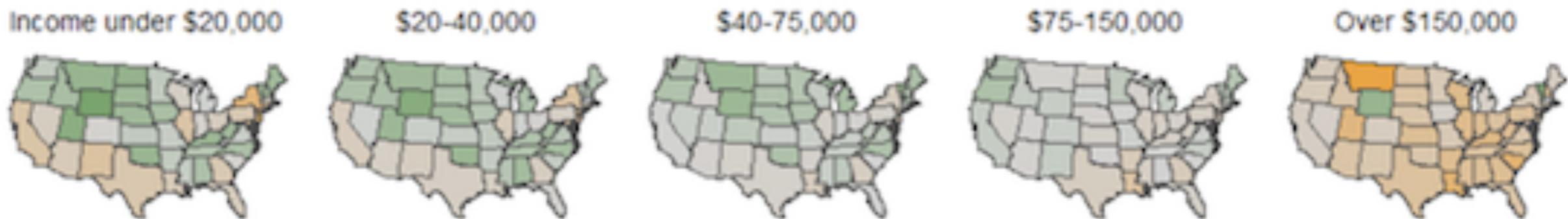


(via <http://zompist.wordpress.com/>)

Obama-Romney 2012
victories by state

distortion added to make
area proportional to votes

time series (static) – small multiples



Copyright, 1878, by MUYBRIDGE.

MORSE'S Gallery, 417 Montgomery St., San Francisco

THE HORSE IN MOTION.

Illustrated by

MUYBRIDGE

Patent for apparatus applied for

INTERNATIONAL EXHIBITION, PHILADELPHIA

time series (animation)



aaron koblin - flight patterns

Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.

Dessiné par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite — Paris, le 20 Novembre 1869.

Les nombres d'hommes perdus sont représentés par les largures des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres des zones. Le rouge désigne les hommes qui ont péri en Russie; le noir ceux qui en sont sortis. — Les renseignements qui ont servi à dresser la carte ont été pris dans les ouvrages de M. M. Chiers, de Segur, de Fezensac, de Chambray et le journal intime 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 Davout qui avaient été détachés sur Minsk et Malibow aient rejoint vers Ossaka en Witlob, avant de toujours marcher avec l'armée.

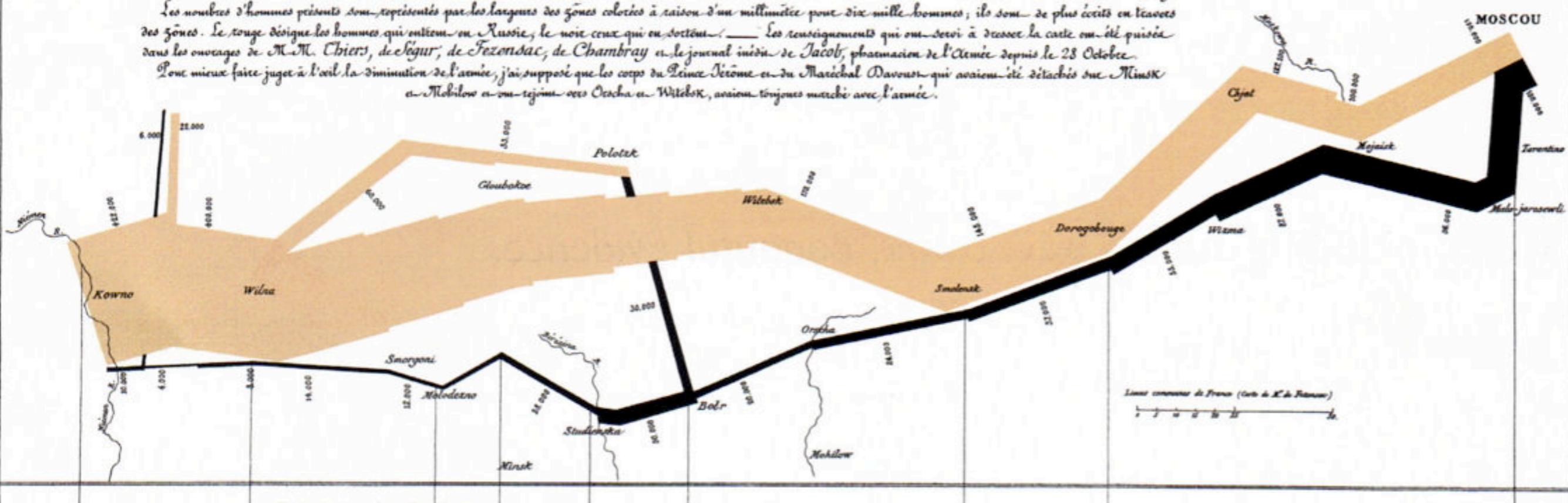


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les Cosaques passent au galop
le Nilovka gelé.



Avant par Regnier, 8 Rue J^e Marie S^e 6^e à Paris.

Imp. Litt. Regnier et Bourdet.

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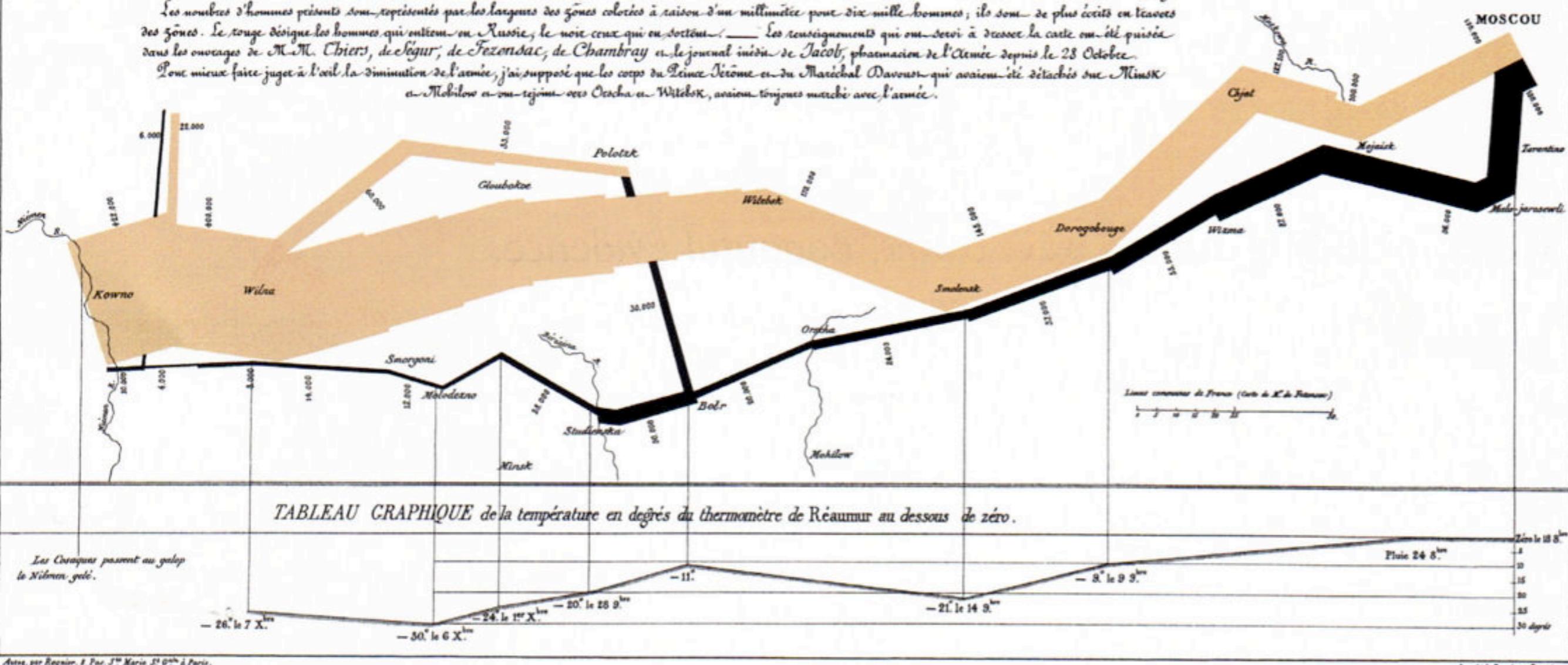


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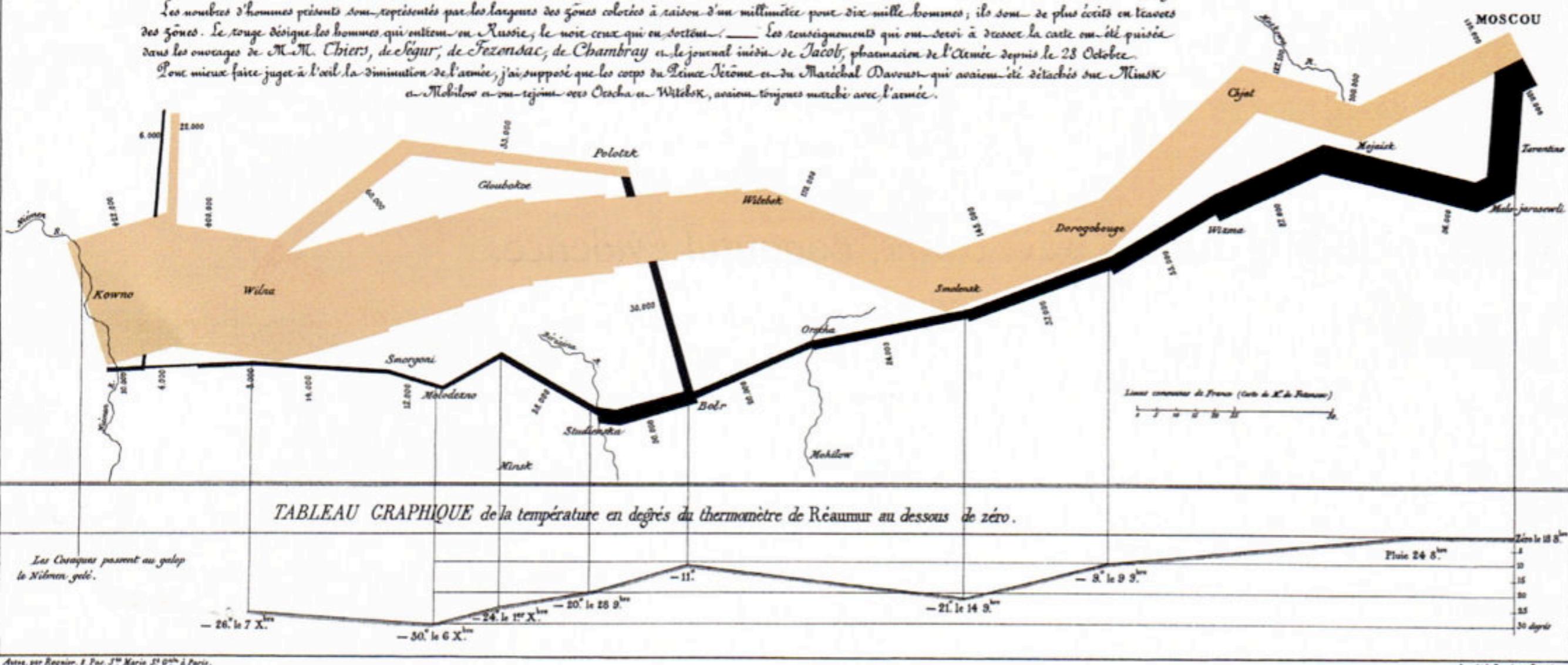
napoleon's march to moscow
charles joseph minard

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 perdus sont représentés par les larges des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres des zones. Le rouge désigne les hommes qui ont péri en Russie; le noir ceux qui en sont sortis. — Les renseignements qui ont servi à dresser la carte ont été pris dans les ouvrages de M. Chiers, de Segur, de Fezensac, de Chambray et le journal intime 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 Davout qui avaient été détachés sur Minsk et Malibow aient rejoint vers Ossaka en Witlob, avant de toujours marcher avec l'armée.



how many dimensions can you find?

napoleon's march to moscow
charles joseph minard

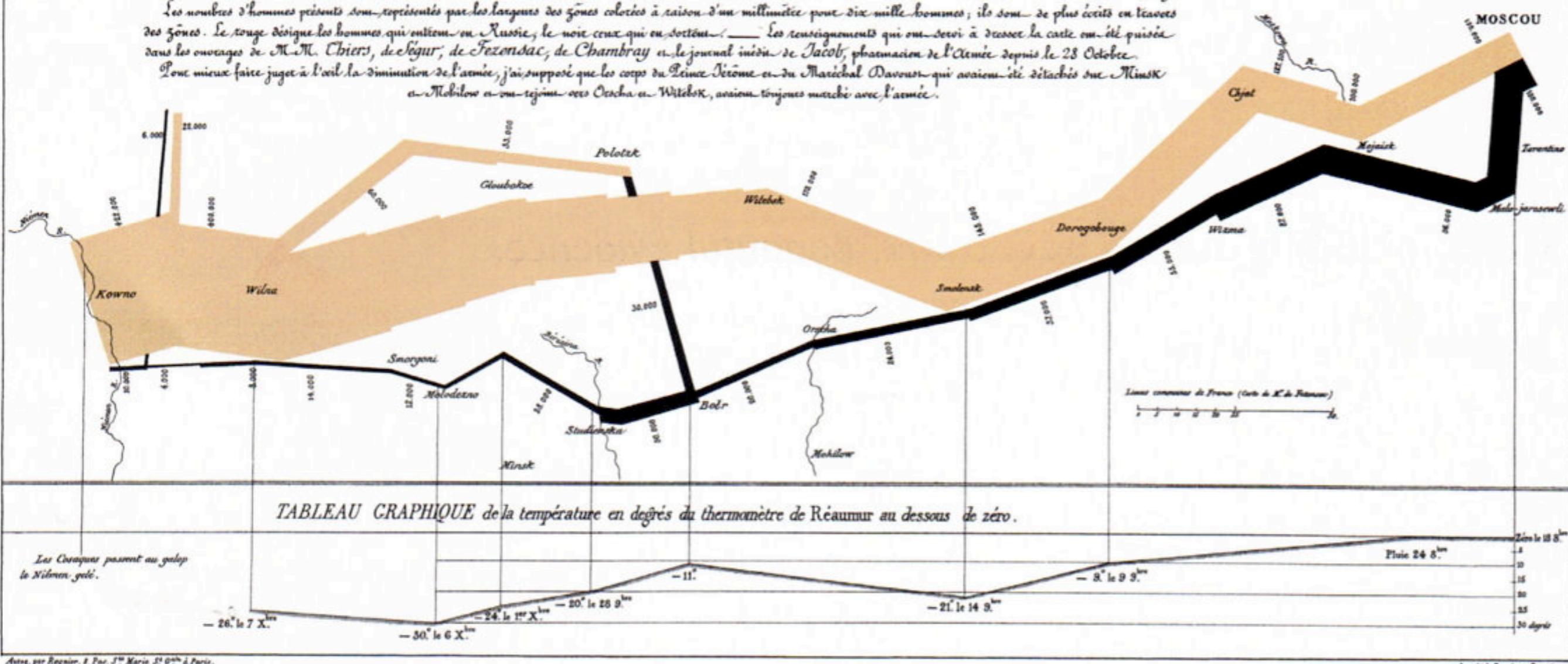
Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.

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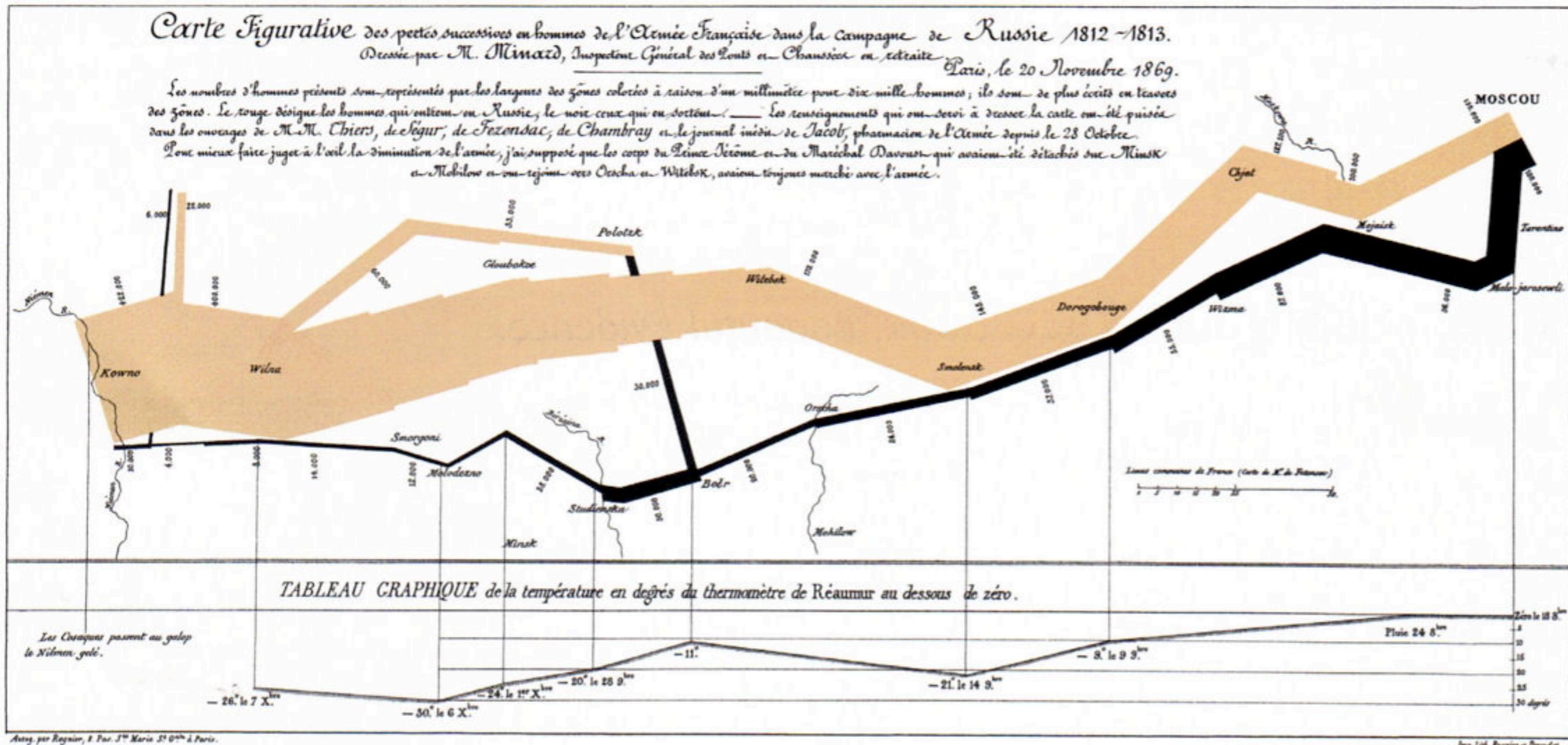


how many dimensions can you find?

- ans: 1) size of the army 2-3) path (lat/lng) taken on a map
- 4) direction army was traveling 5) temperature 6) dates army reached particular locations

napoleon's march to moscow
charles joseph minard

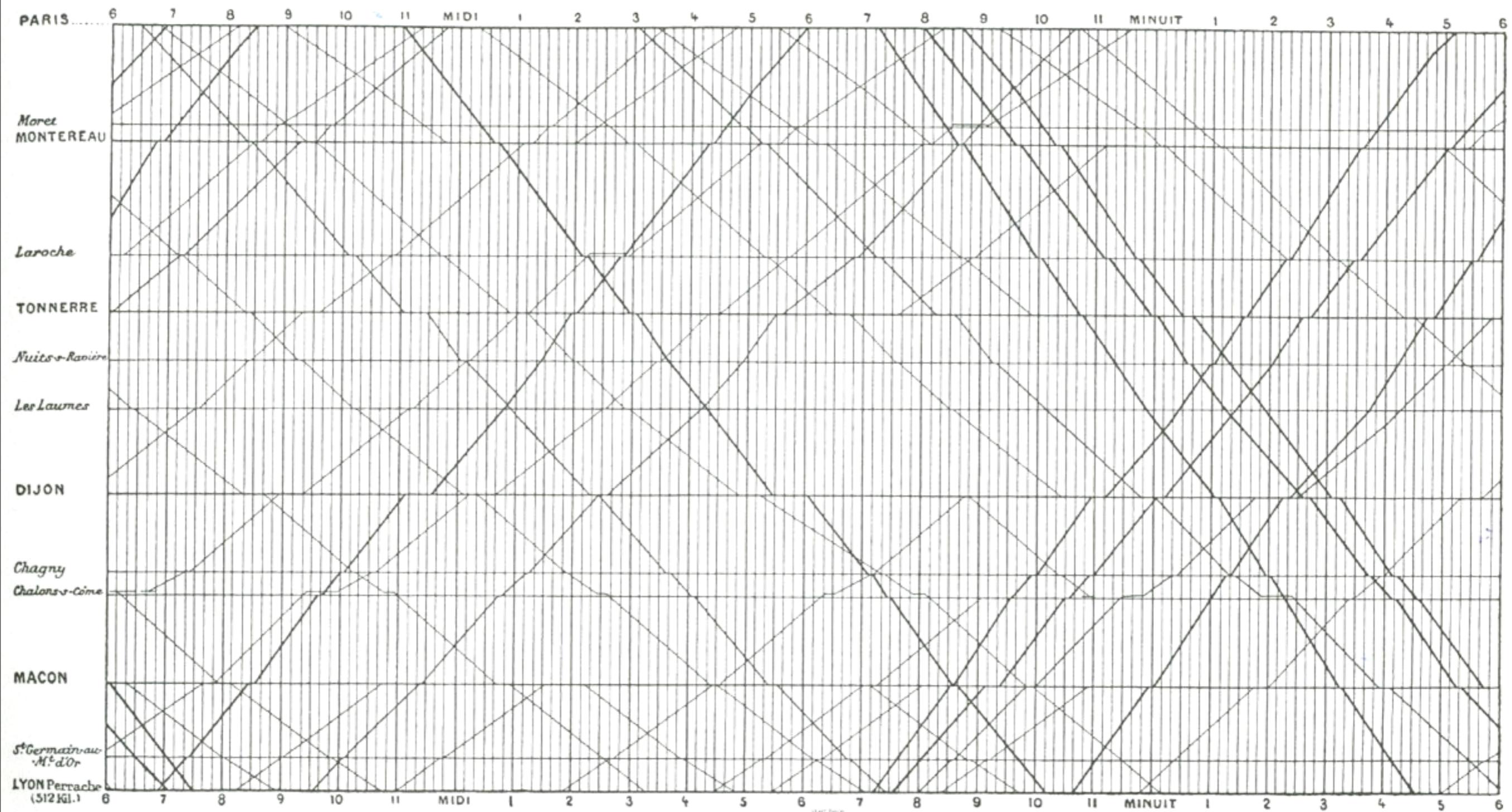
geo-temporal-relational-continuous multivariate?!



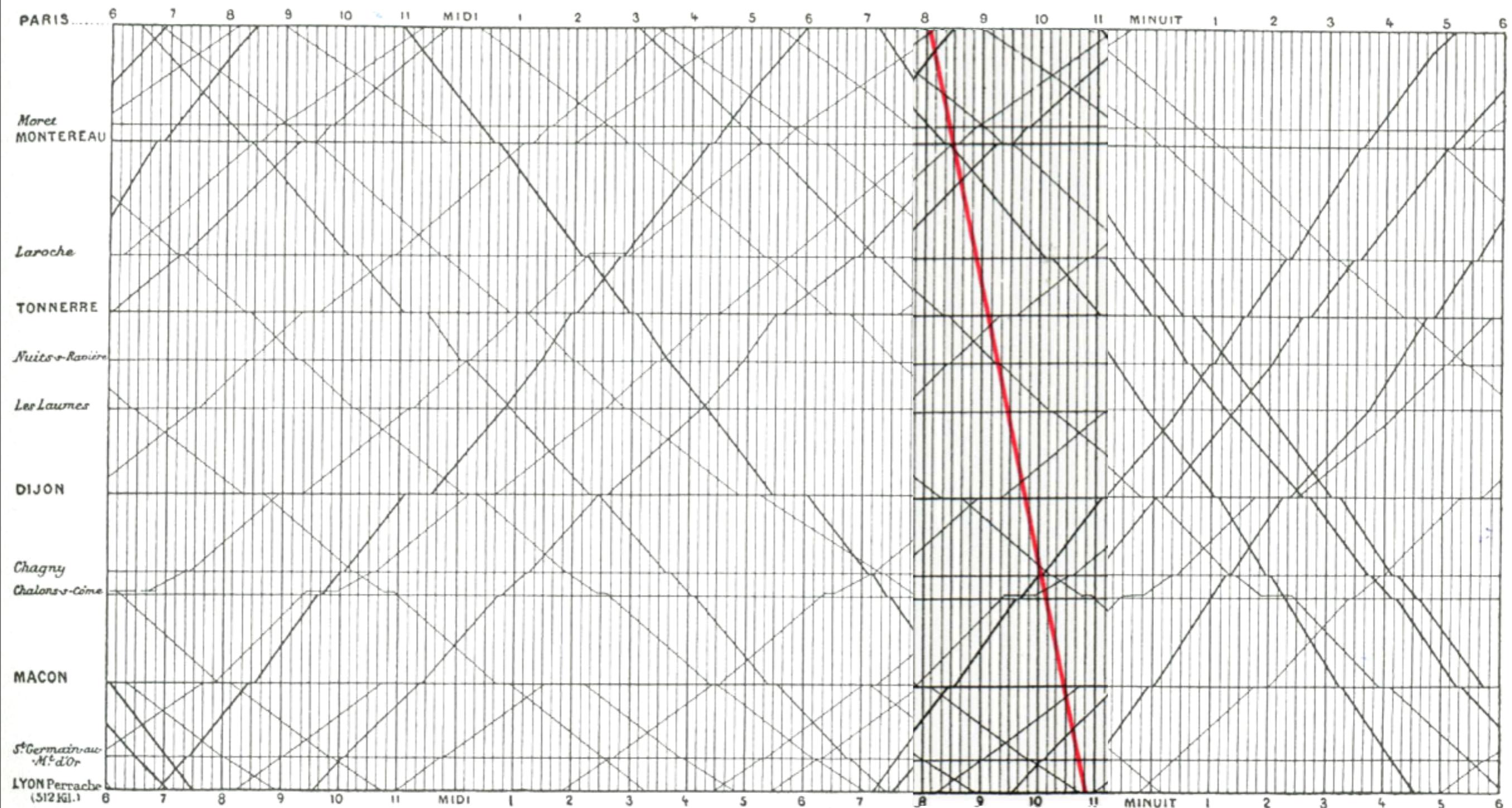
how many dimensions can you find?

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- 3) direction army was traveling
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- 5) dates army reached particular locations

napoleon's march to moscow
 charles joseph minard

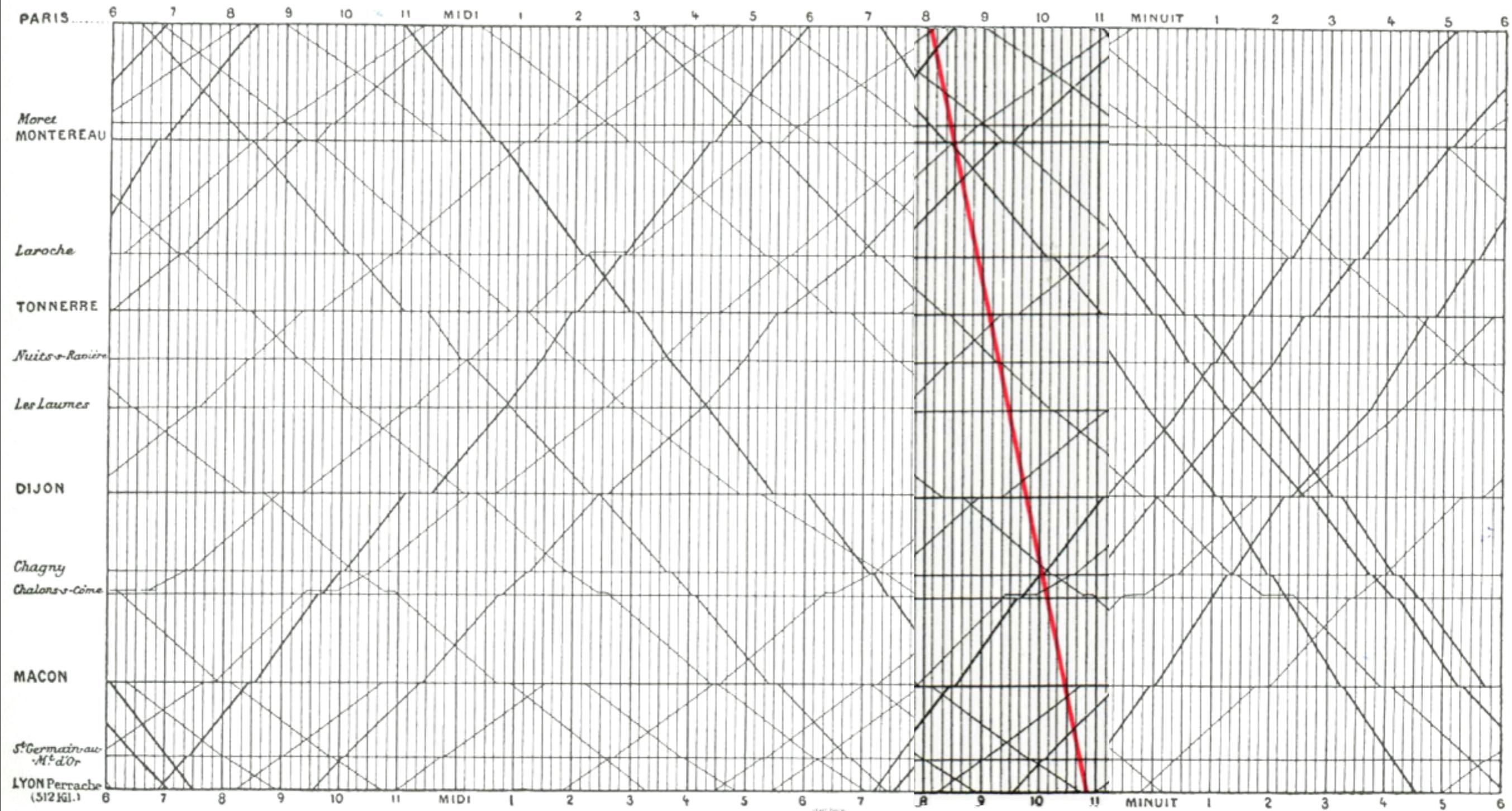


E.J. Marey
La méthode graphique
(1885)



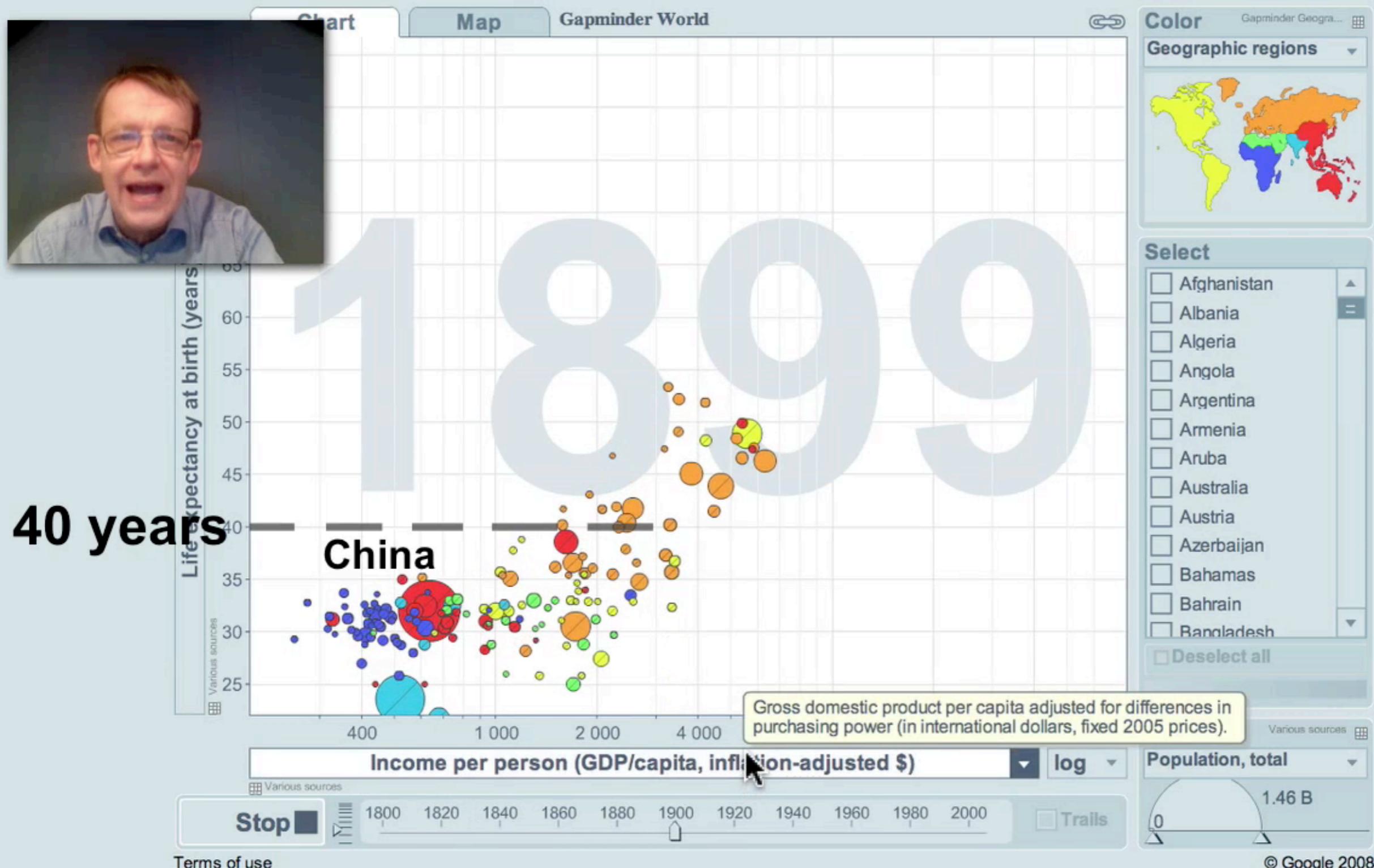
E.J. Marey
La méthode graphique
(1885)

TGV Paris-Lyon



E.J. Marey
La méthode graphique
(1885)

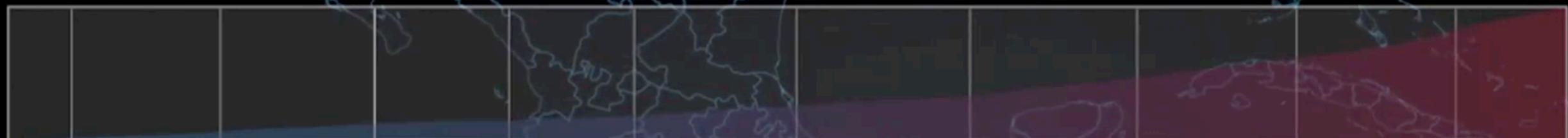
time series (animation)



// MOTOROLA DROID LAUNCH IN...5 //

ANDROID ACTIVATIONS

2009:08:22: SAT



2009

Android Global Activations Oct'08-Jan '11

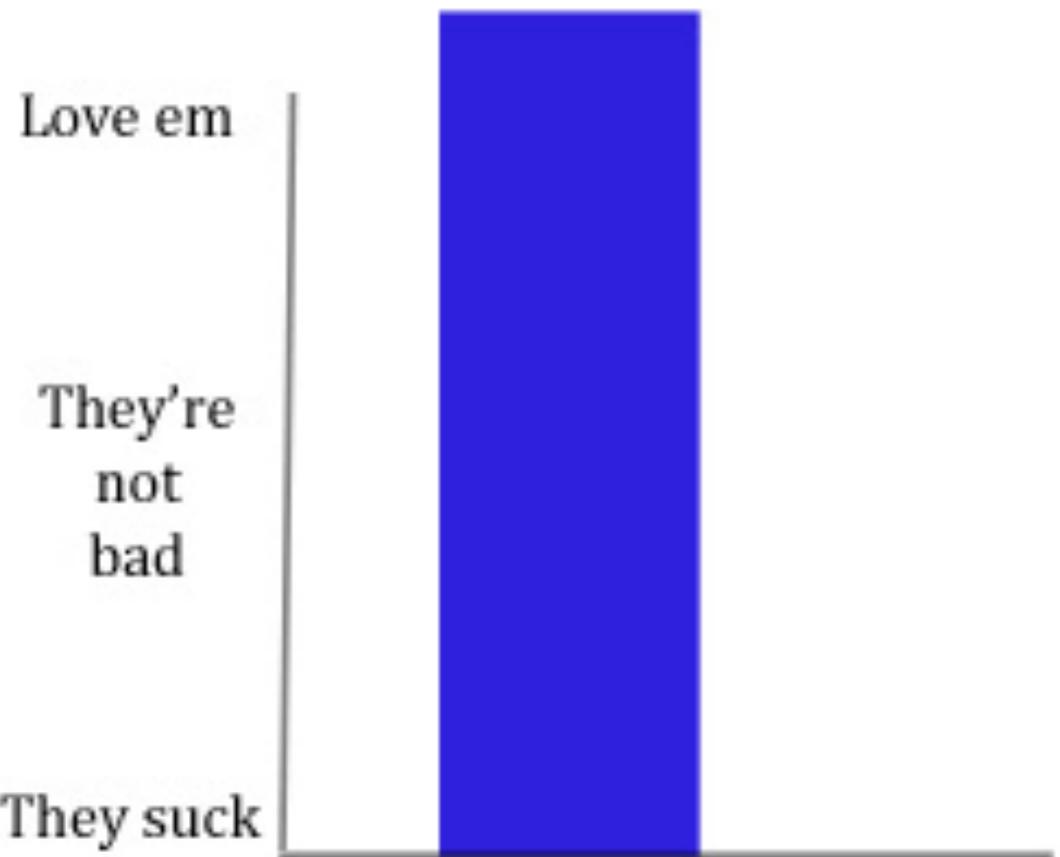
Plenty of other interesting visualisations....

Some favourites I didn't mention?

send them to: max@hip.cat

and I'll compile a list on a datavis wiki

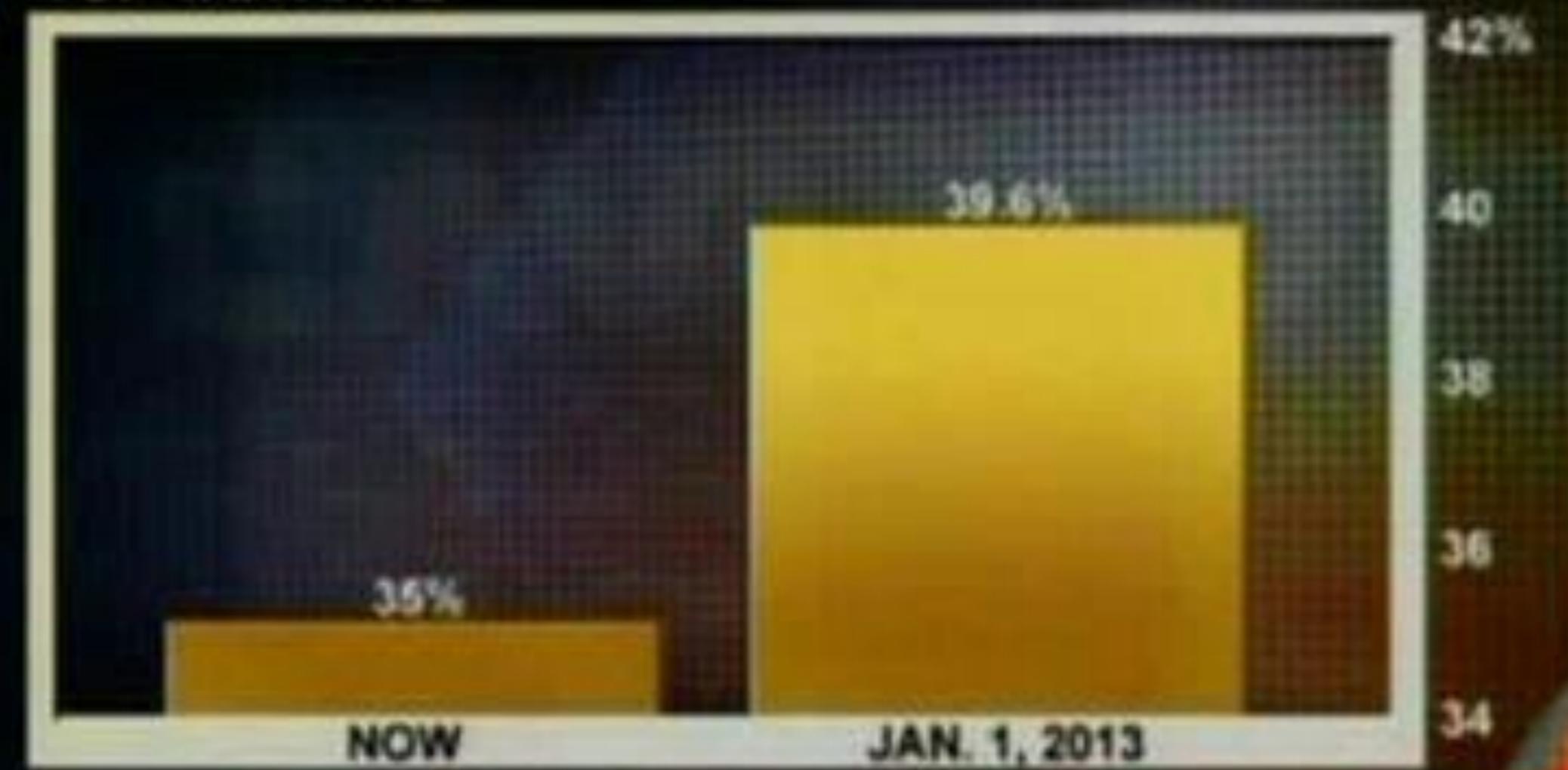
How You Feel About Bar Charts



communicating
through infographics:
visual + statistical sleight of
hand to mislead the audience

IF BUSH TAX CUTS EXPIRE

TOP TAX RATE



8:01 p ET

FOX
BUSINESS

TOP STORIES

TECHNOLOGY

CONSUMER

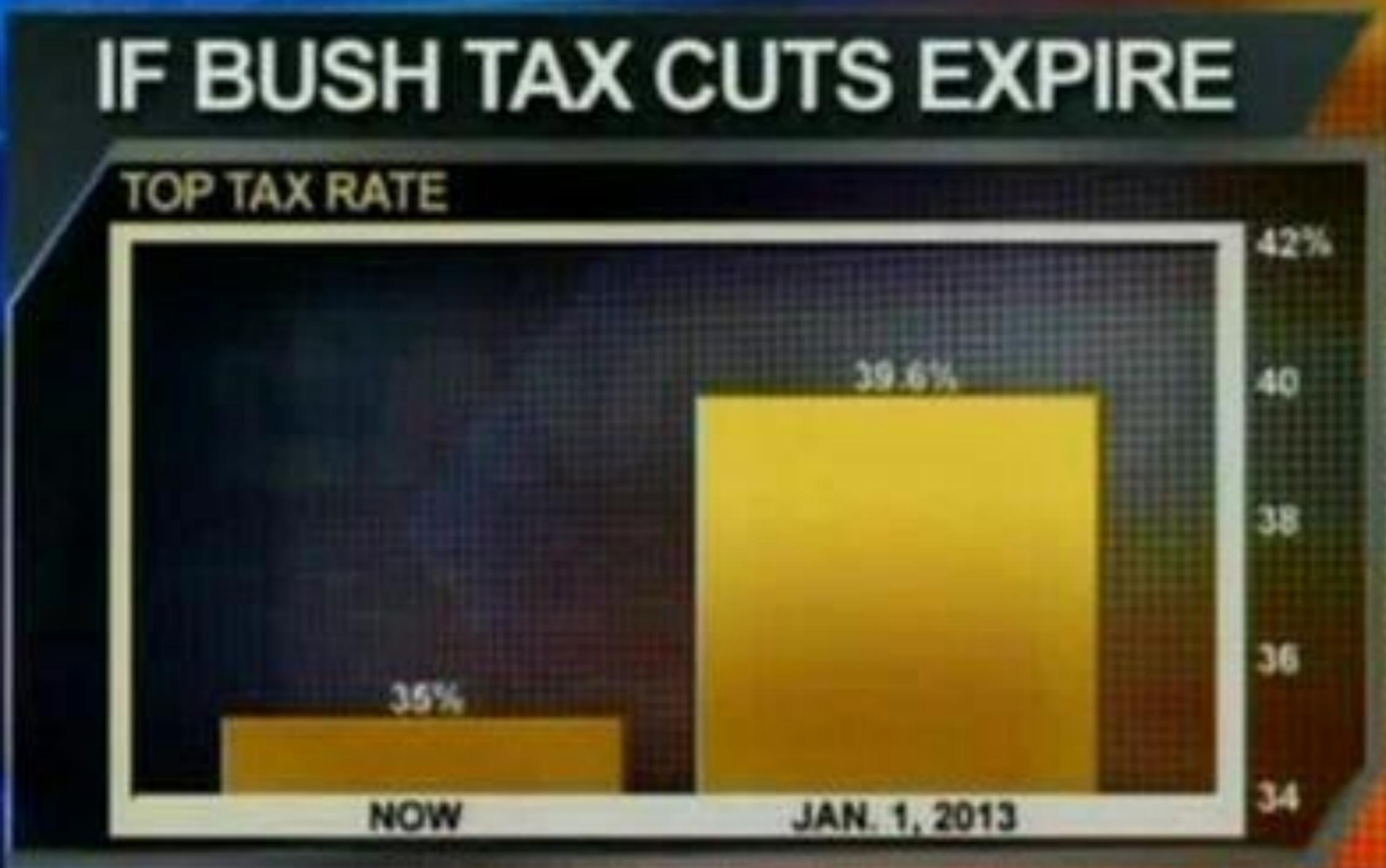
WITH THE JUSTICE DEPARTMENT AND ACQUIRES FULL T

DOW 13008.68 ▲ 64.33

S&P 1379.32 ▲ 5.98

NASDAQ 2939.52 ▲ 6.32

1. Barchart baseline fail



8:01 p ET

FOX
BUSINESS

TOP STORIES

TECHNOLOGY

CONSUMER

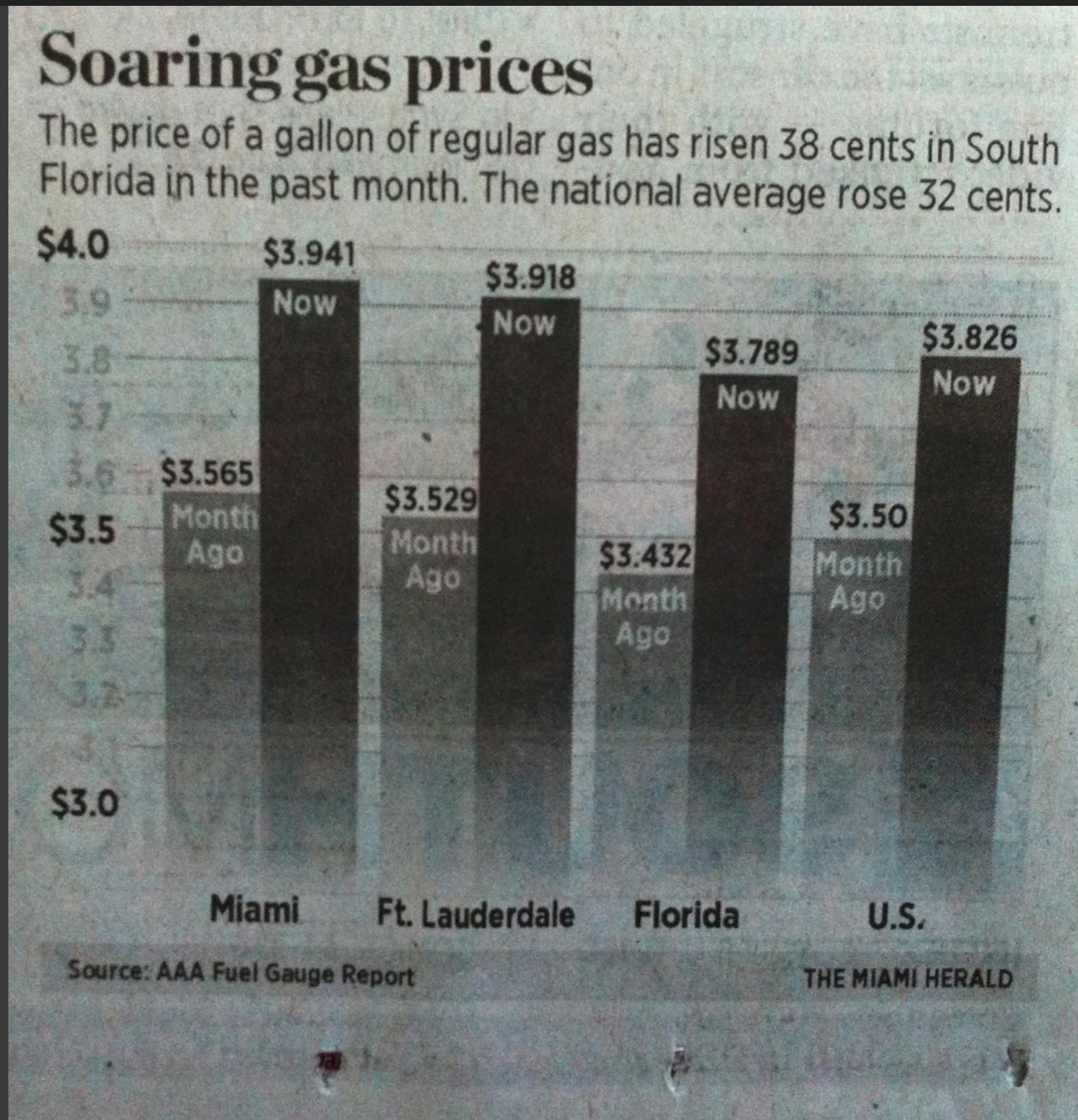
WITH THE JUSTICE DEPARTMENT AND ACQUIRES FULL T

DOW 13008.68 ▲ 64.33

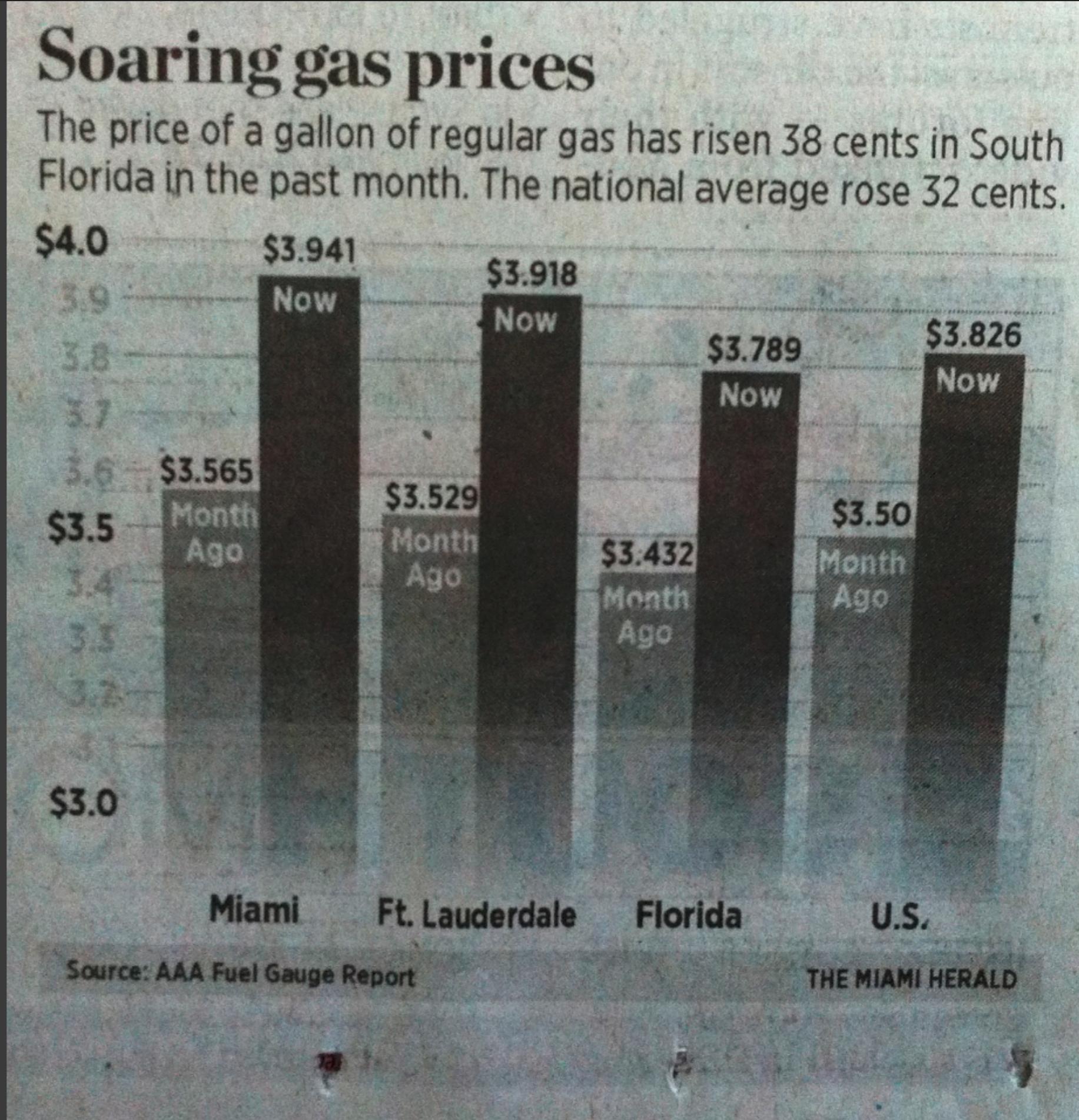
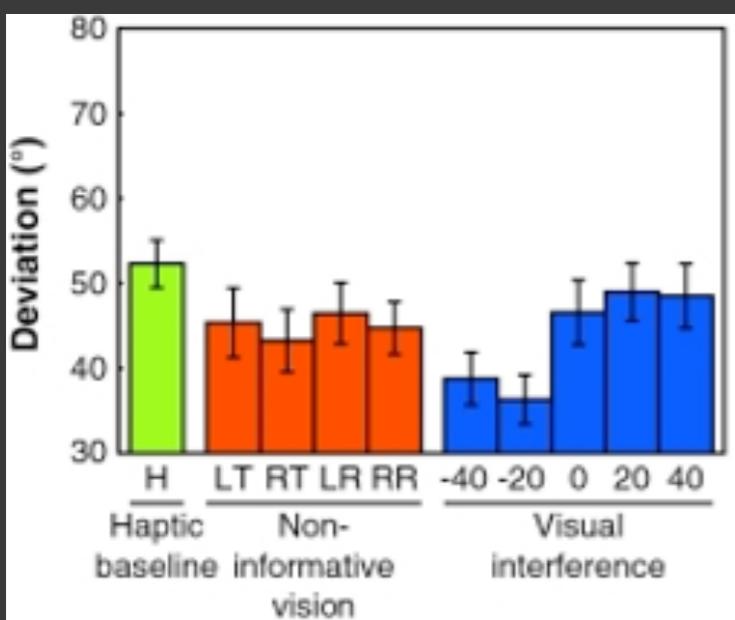
S&P 1379.32 ▲ 5.98

NASDAQ 2939.52 ▲ 6.32

1. Barchart baseline fail



1. Barchart baseline fail



New York State Total Budget Expenditures and Aid to Localities

In billions of dollars

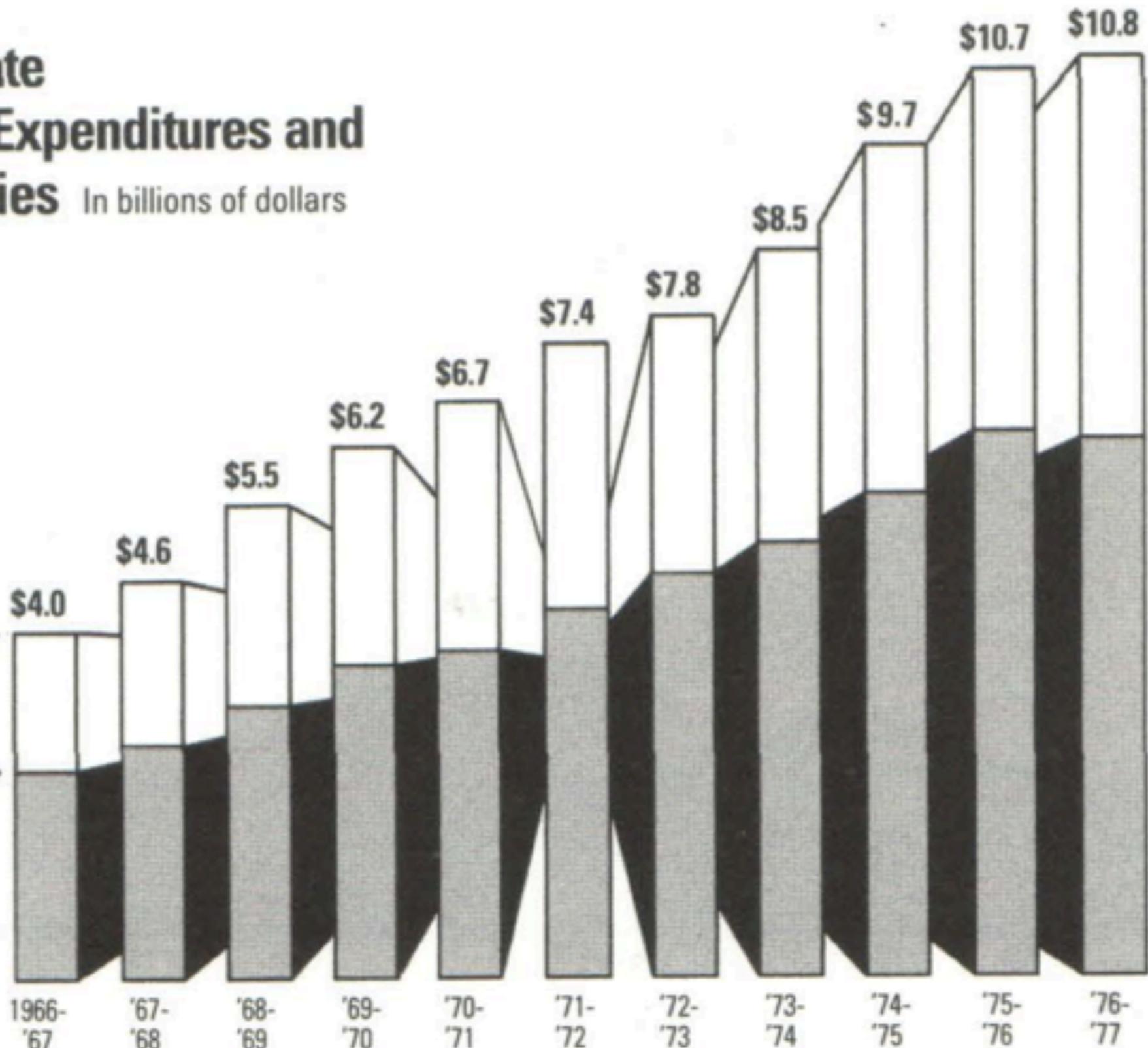
Fiscal 1966-1976

Total Budget →

\$4.0

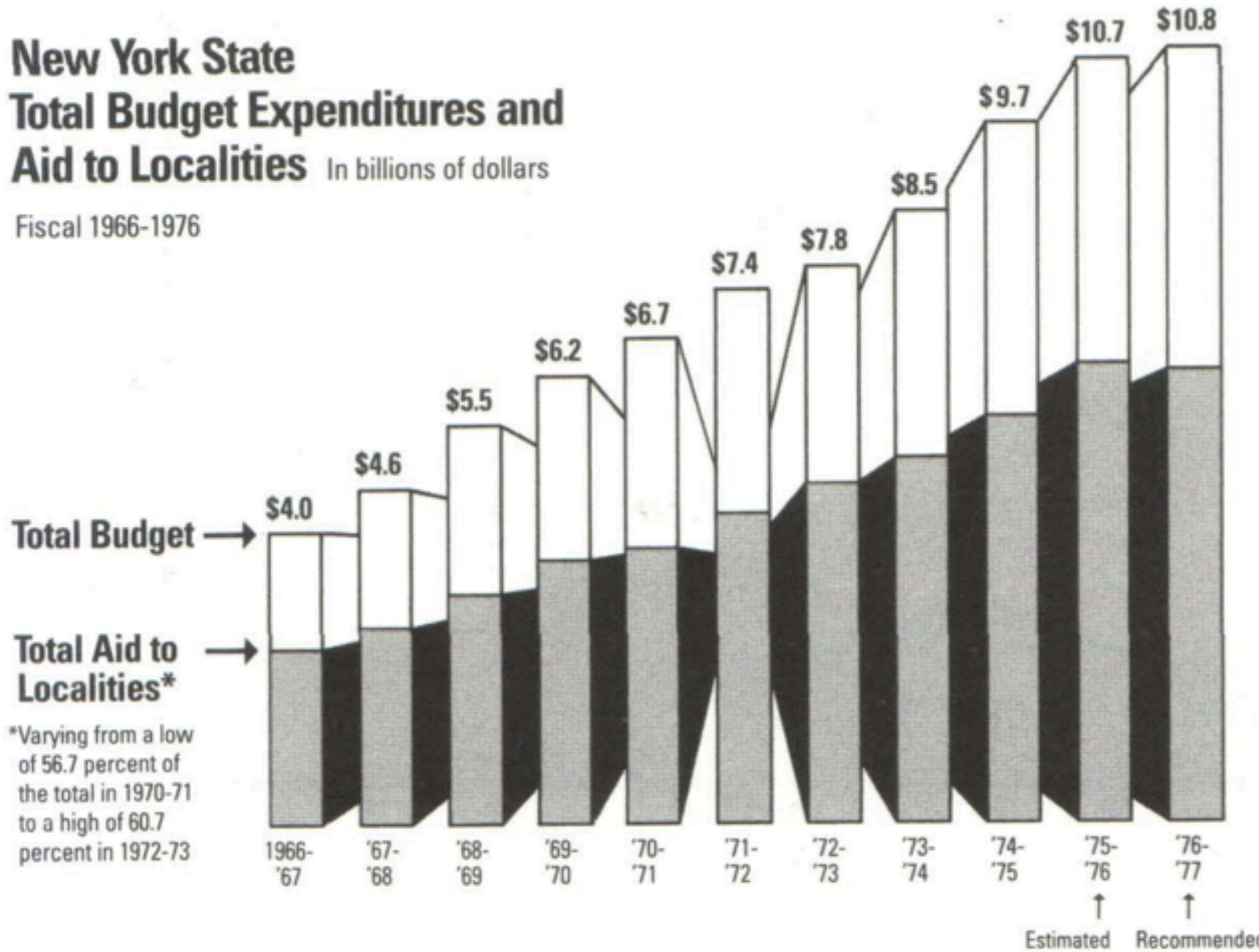
Total Aid to
Localities*

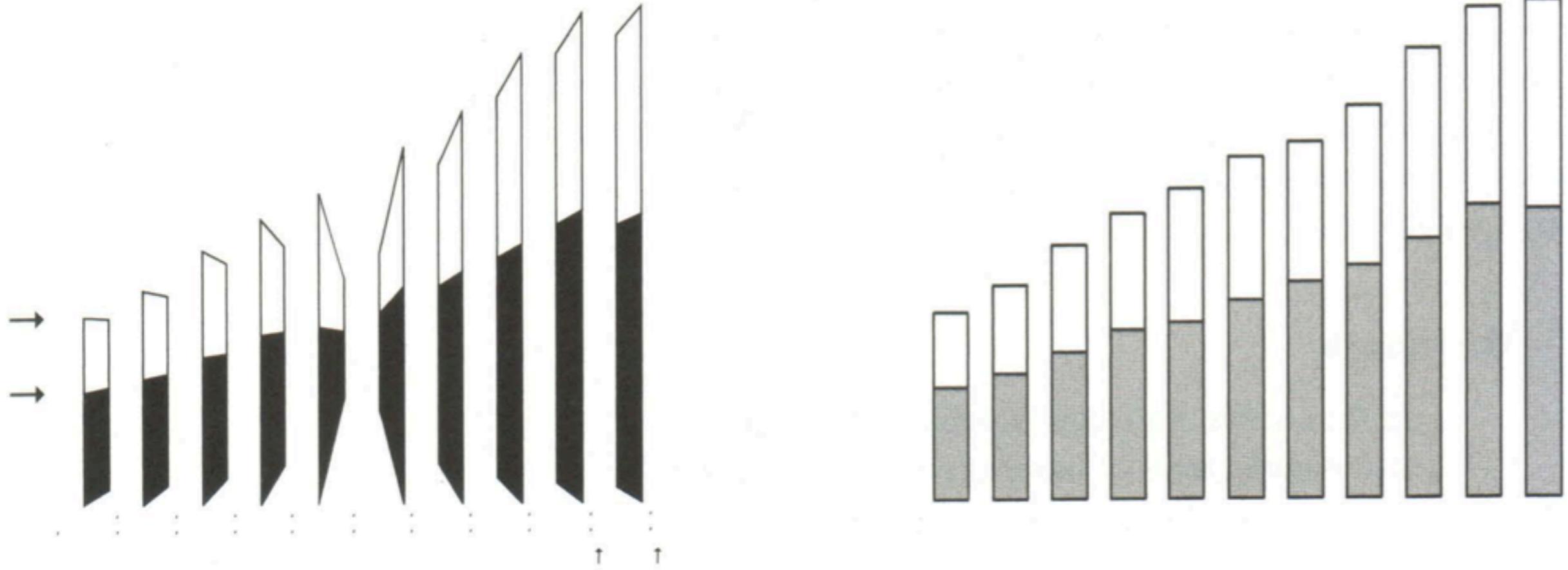
*Varying from a low
of 56.7 percent of
the total in 1970-71
to a high of 60.7
percent in 1972-73

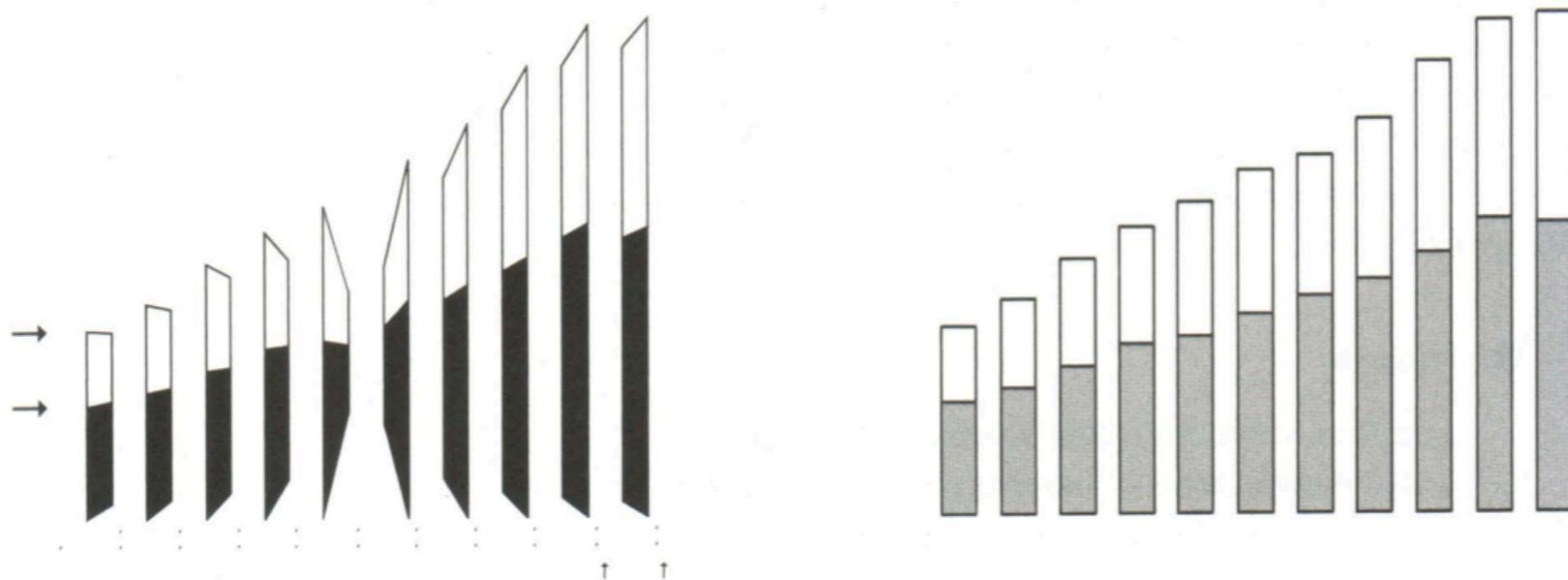


Estimated Recommended

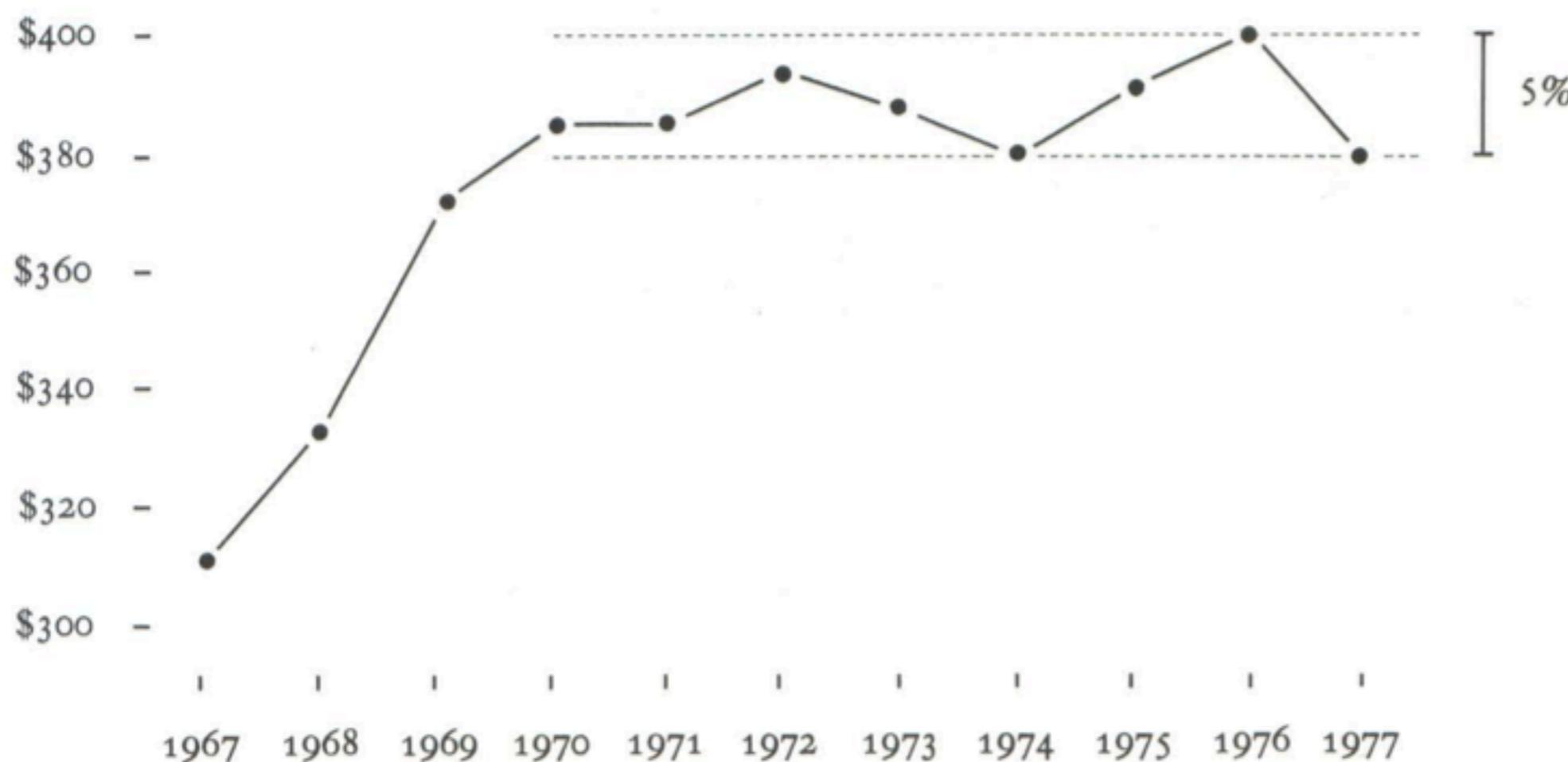
2. Perspective and measurement fail







Per capita
budget expenditures,
in constant dollars

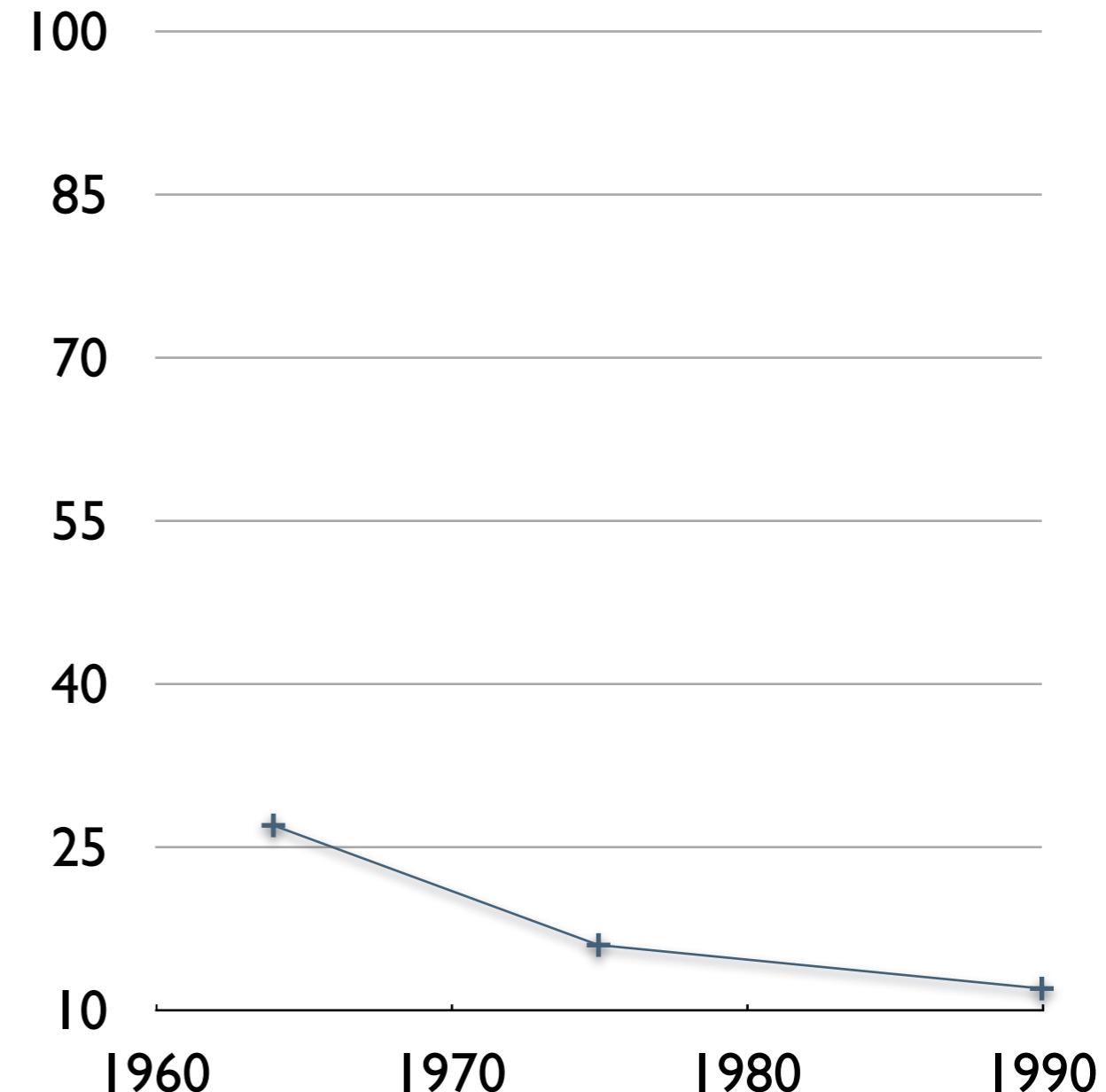
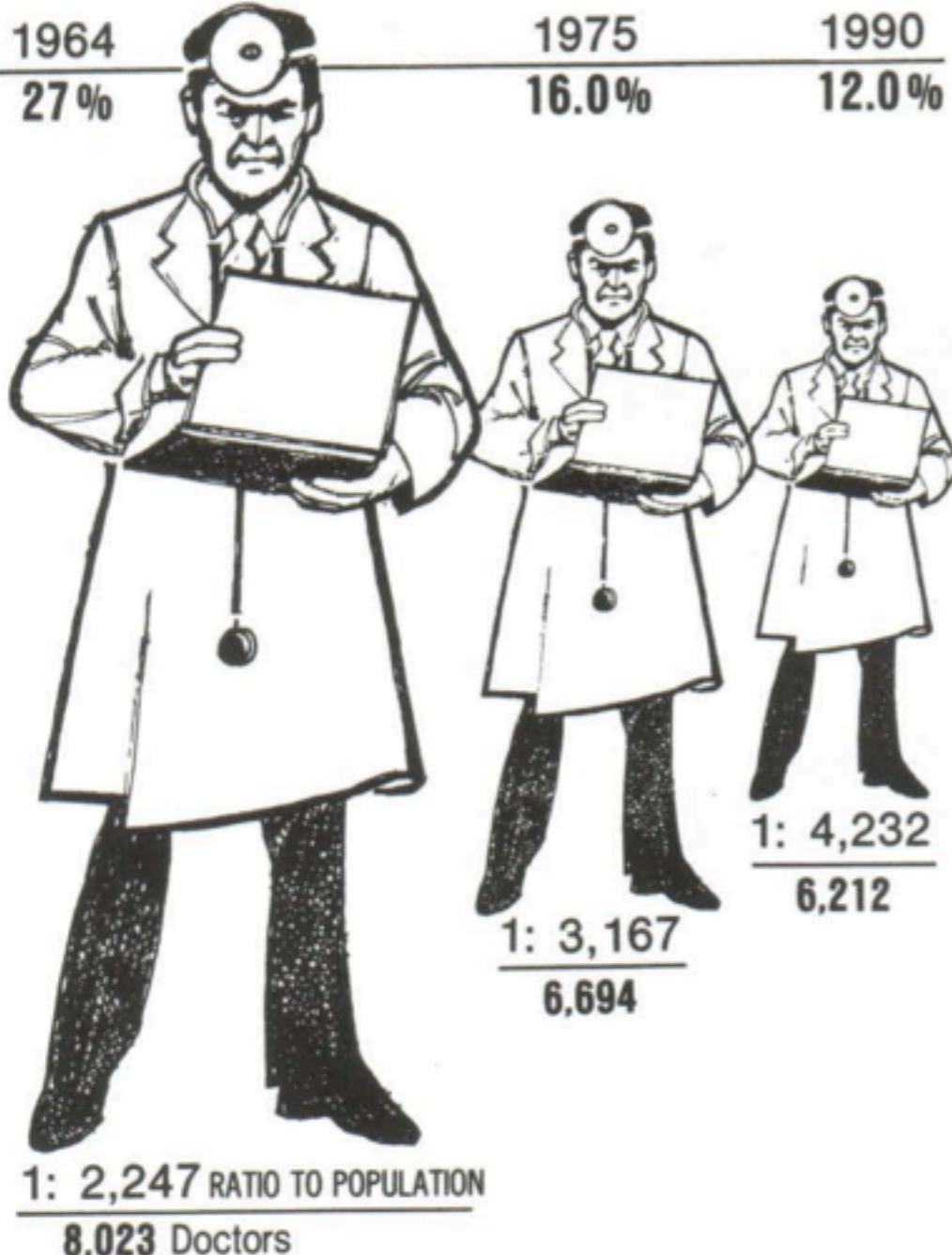


2. “Huge differences” fail

THE SHRINKING FAMILY DOCTOR In California

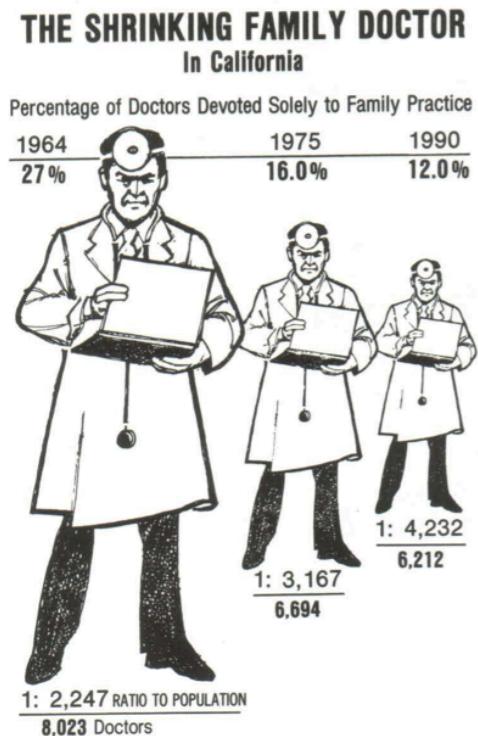
Percentage of Doctors Devoted Solely to Family Practice

1964	1975	1990
27%	16.0%	12.0%



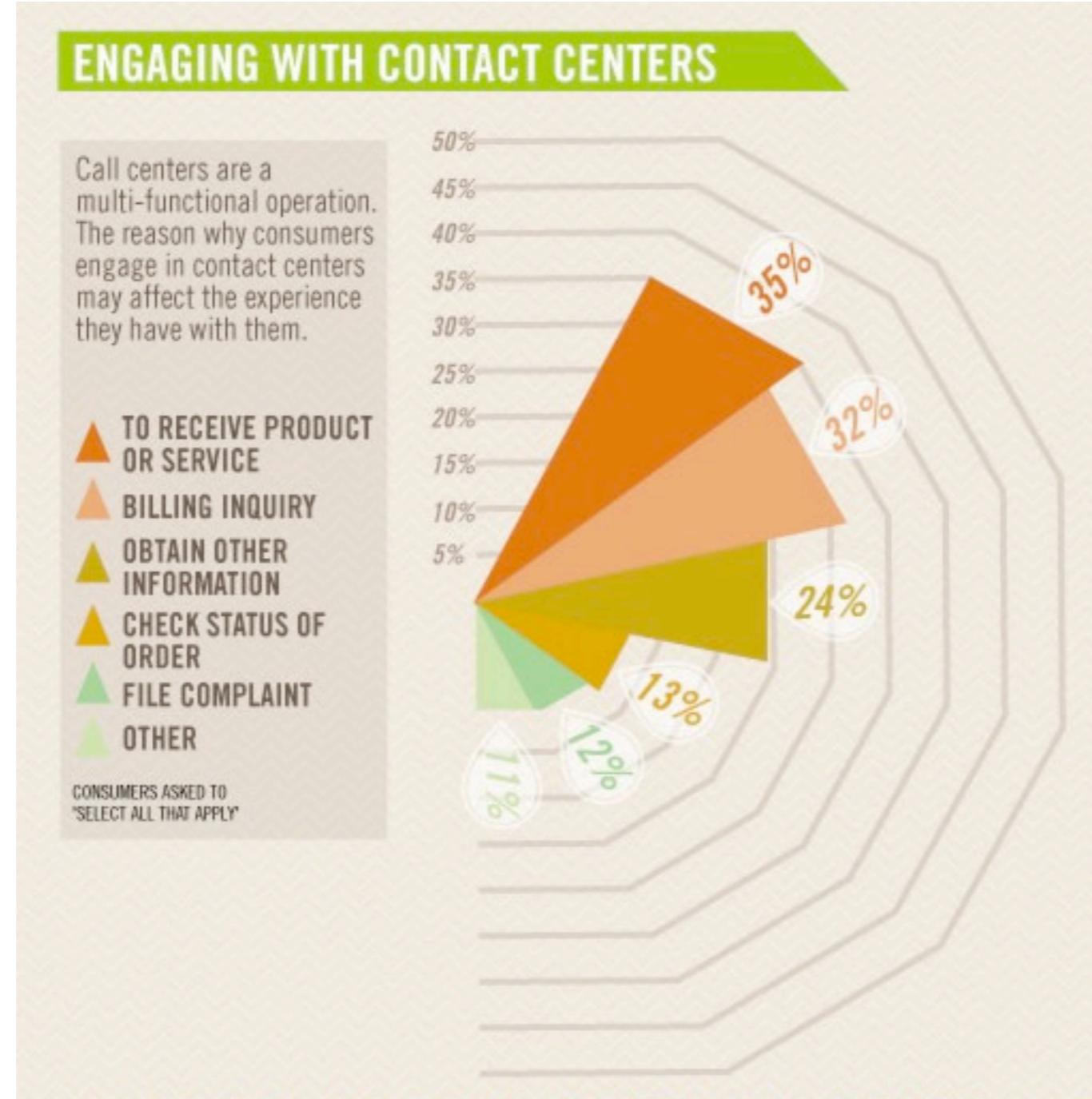
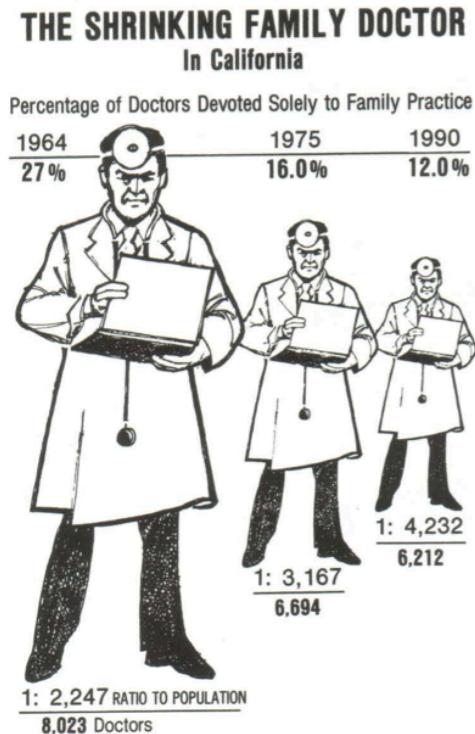
using area (2 dimensions) to represent one dimension

2. “Huge differences” fail



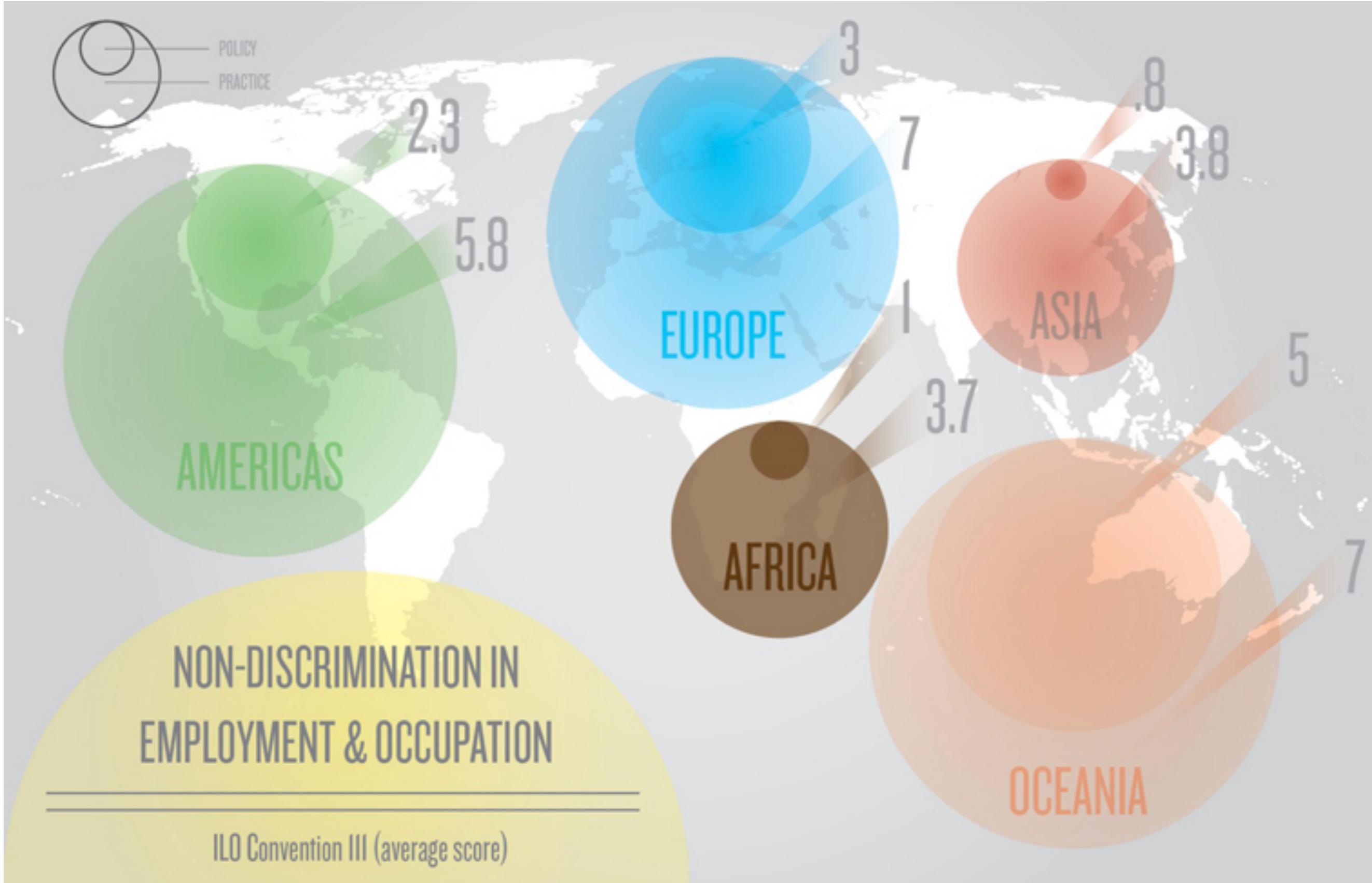
using area to represent one dimension

2. “Huge differences” fail



using area to represent one dimension

2. “Huge differences” fail



using area to represent one dimension

Quiz: How does this fail?

THE ISSUE OF TRUST

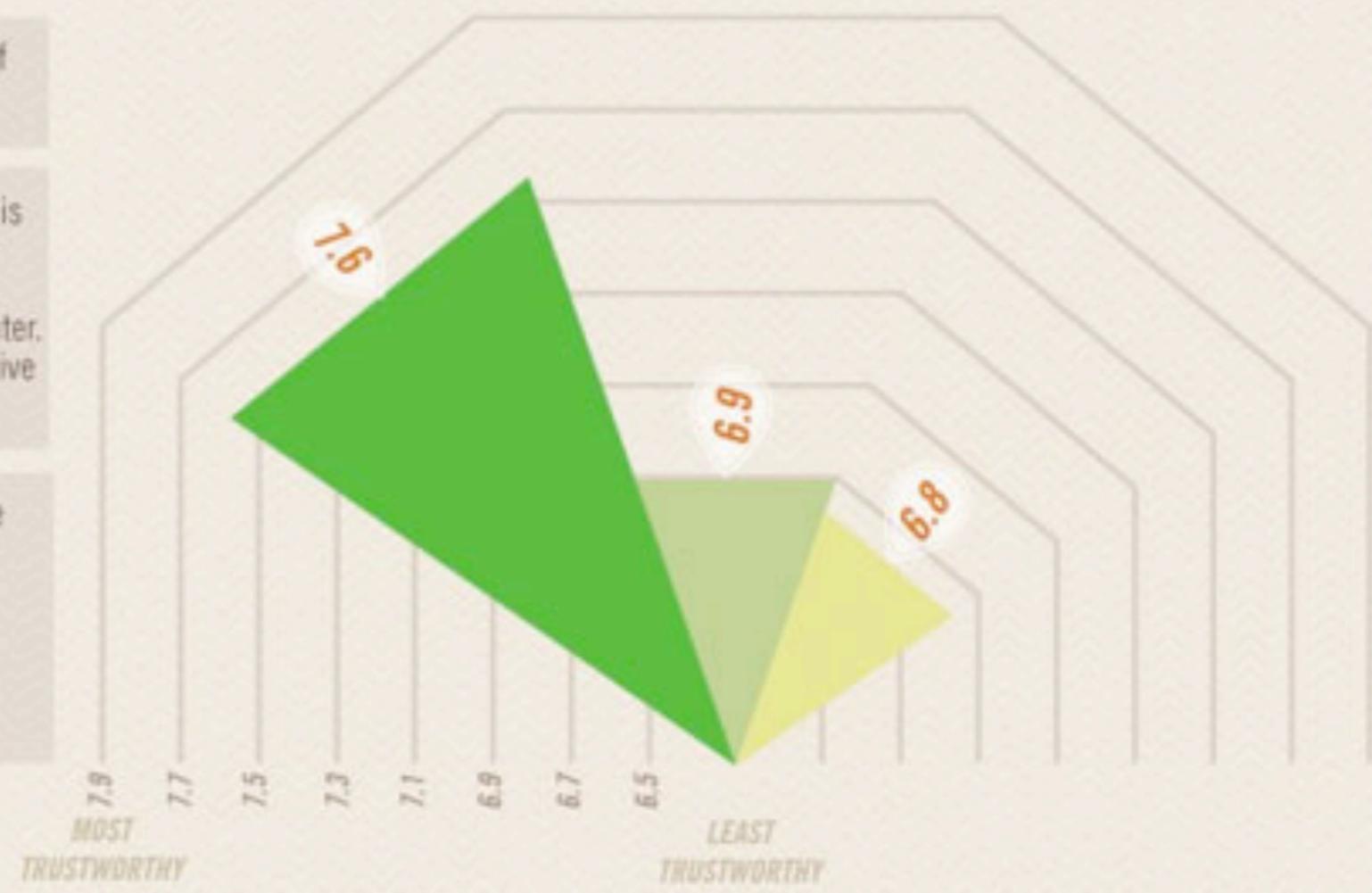
ACCENTS AND DISTRUST

Another reason why accents affects customer service is the question of credibility. If I can not understand you, then I can not trust you.

An experiment conducted by the University of Chicago demonstrated this aspect. The question posed, do trivia statements sound less true when spoken by a non-native speaker? Furthermore, listeners were told in advance that all of the trivia questions were provided by the experimenter. This way, even listeners who were knowingly prejudice against non-native accents should not have been affected.

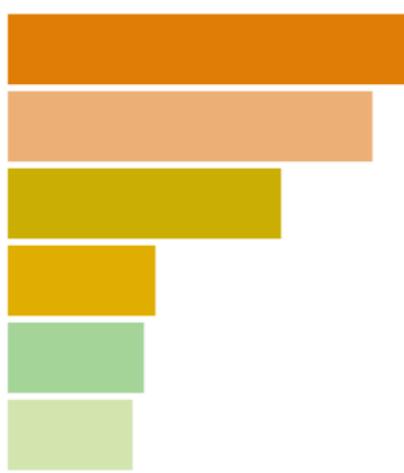
The results showed that the heavier the accent the less trust worthy the person became.

- ▲ NATIVE ACCENT
- ▲ MILD ACCENT
- ▲ HEAVY ACCENT





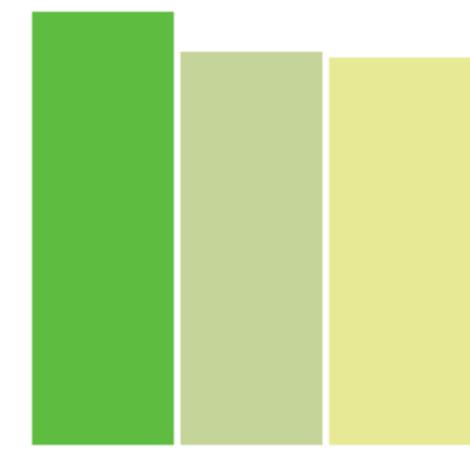
Distortion factor: 2.5



True data



Distortion factor: 5.0



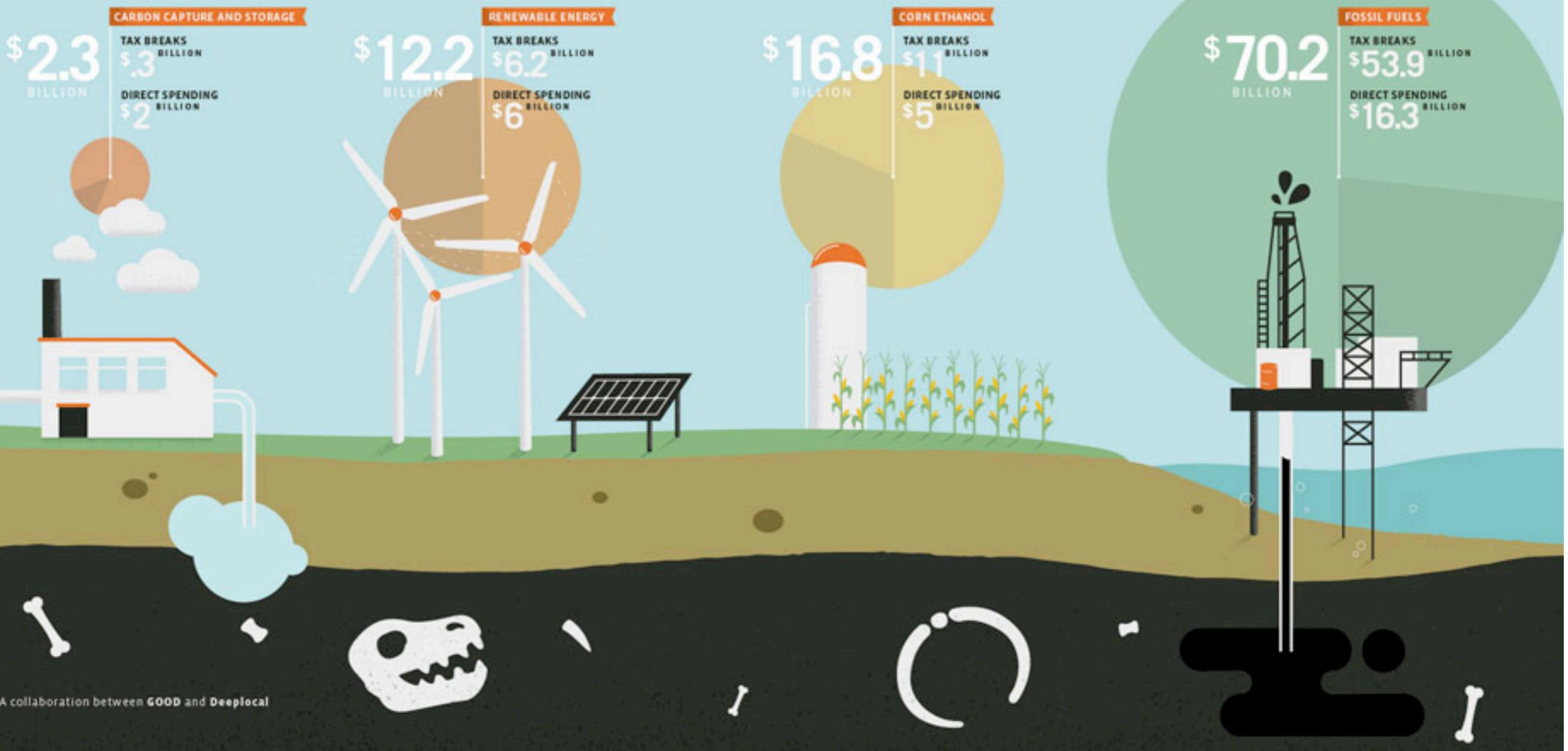
True data

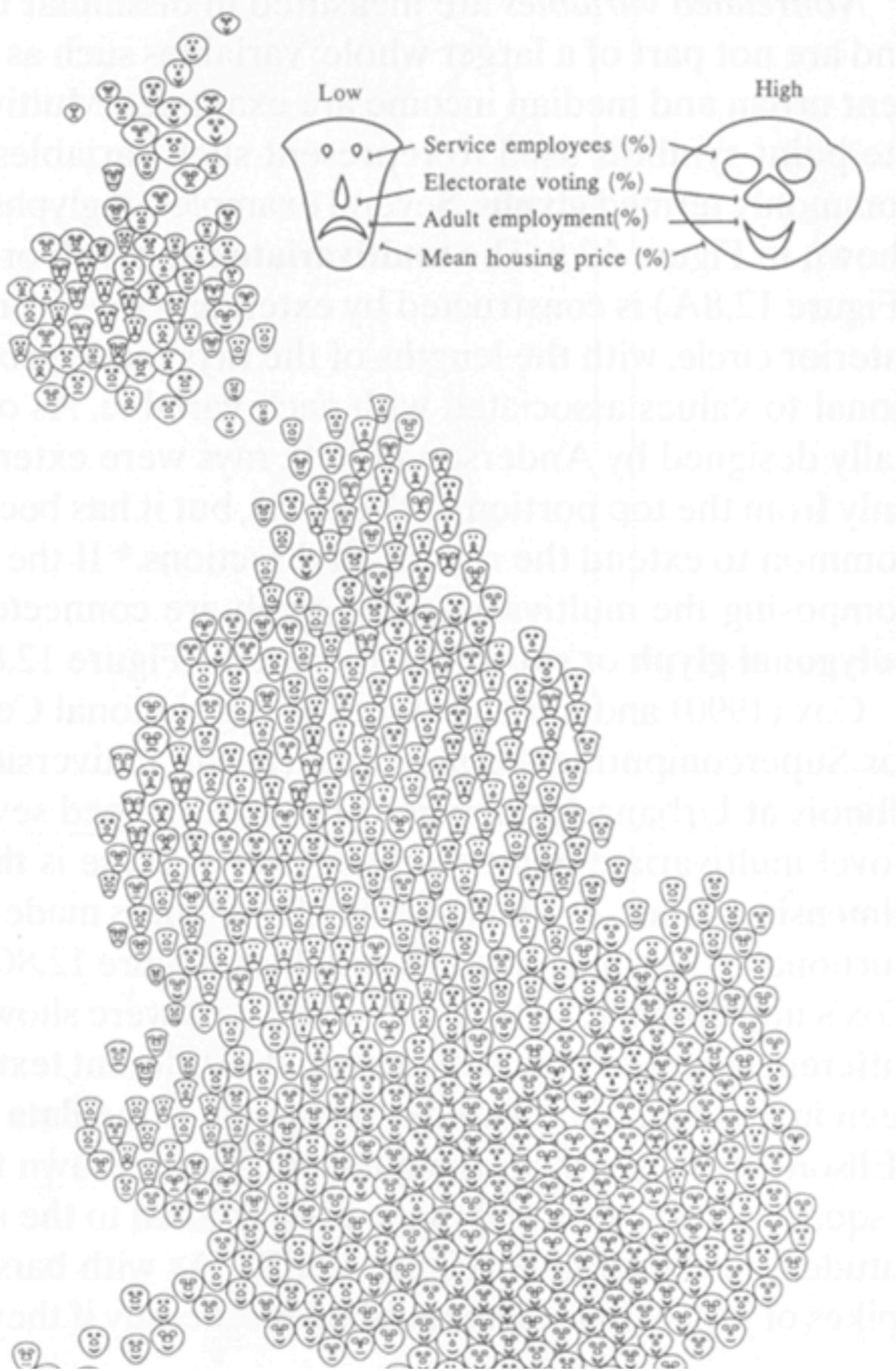
SUBSIDIZE THIS

THE PRICE THAT YOU PAY FOR ENERGY—WHETHER ELECTRICITY AT YOUR HOUSE OR GAS AT THE PUMP—isn't actually the price that the market would set for that energy.

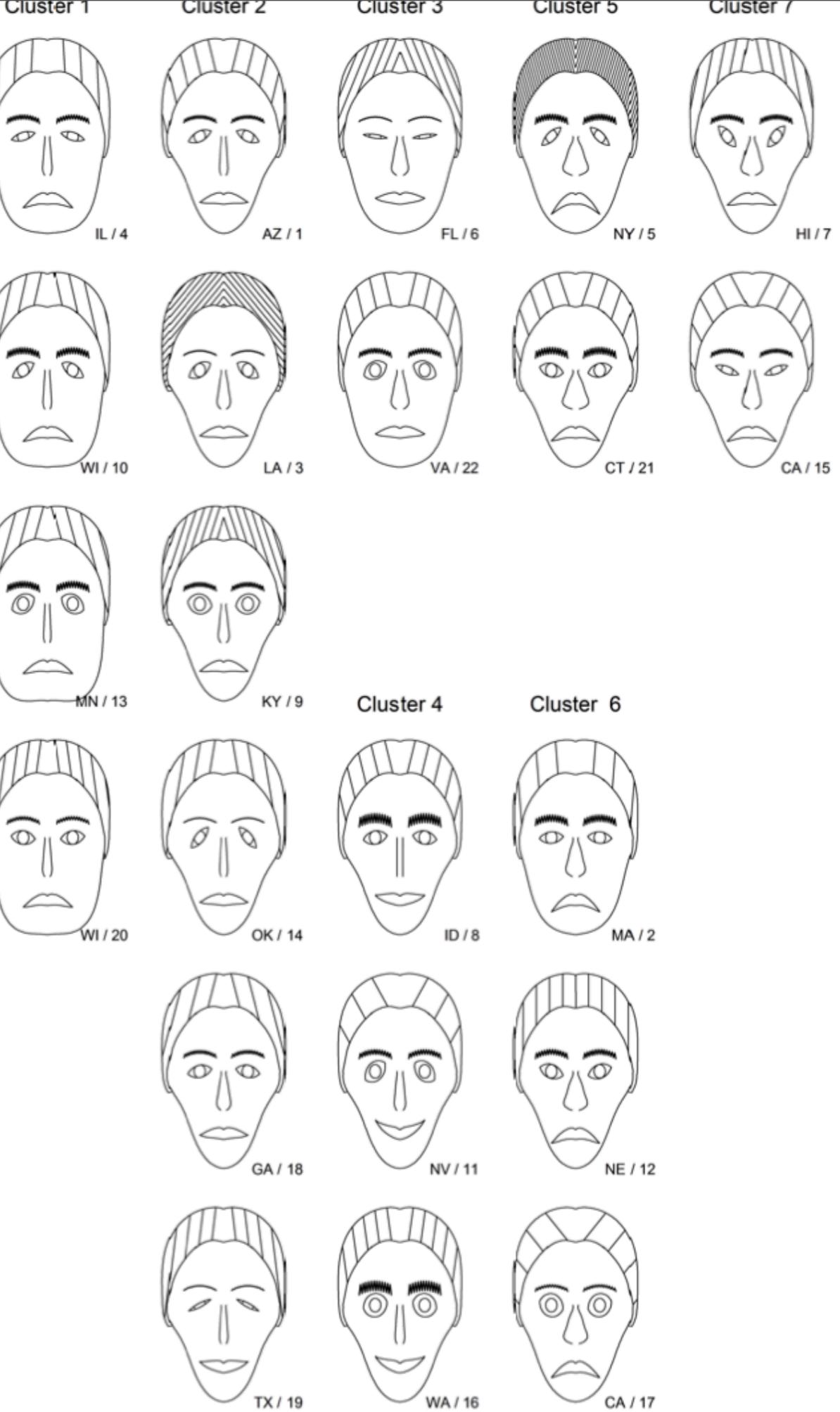
The government spends billions of dollars to support the energy industry, which allows it to make energy cheaper than it should cost on the open market. These subsidies—either in the form of tax breaks or direct funding—favor some types of energy over others, giving our country a skewed sense of what each gallon of gas or wind-powered electron costs. This is a look at where the government directed its subsidy dollars from 2002 to 2008.

SOURCE "Estimating U.S. Government Subsidies to Energy Sources" by the Environmental Law Institute



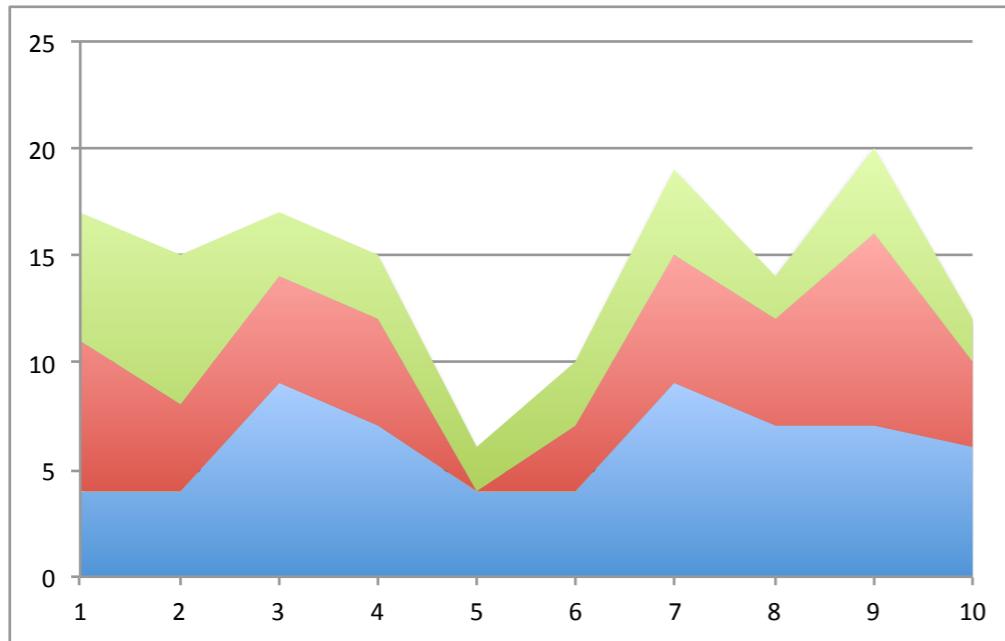


Chernoff Faces

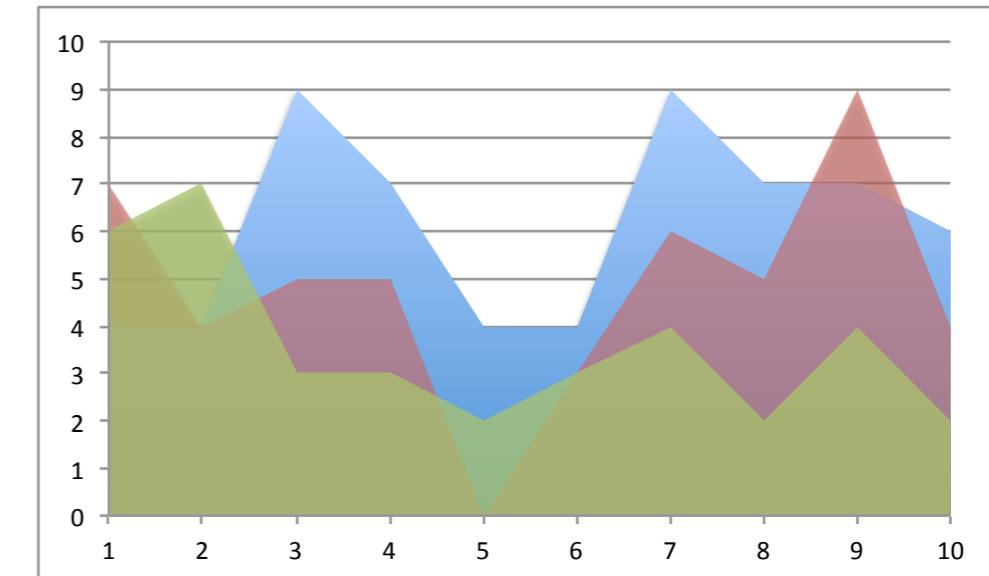
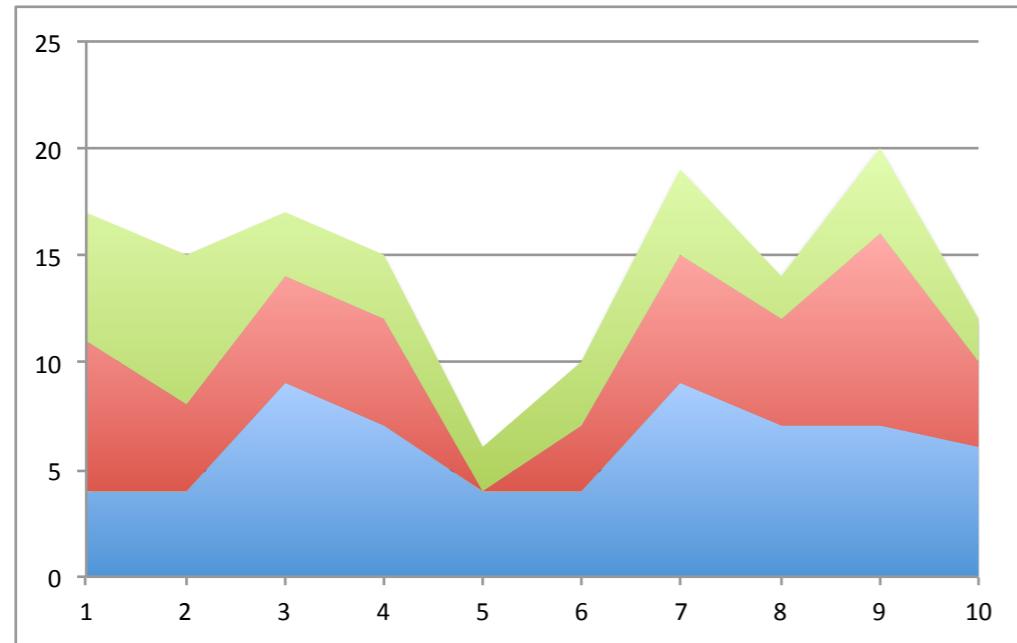


“streamgraphs”: double-stacked areas of horror

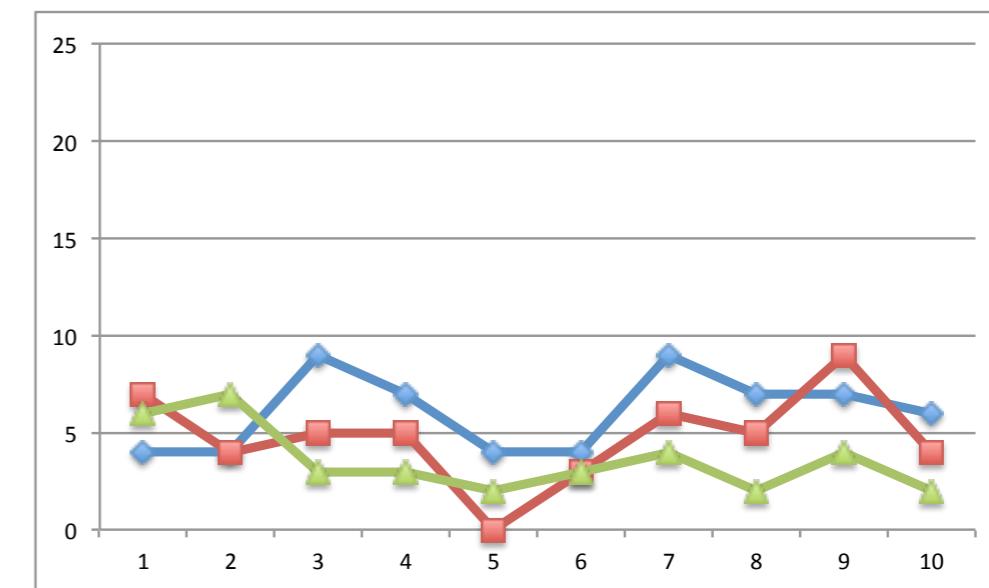
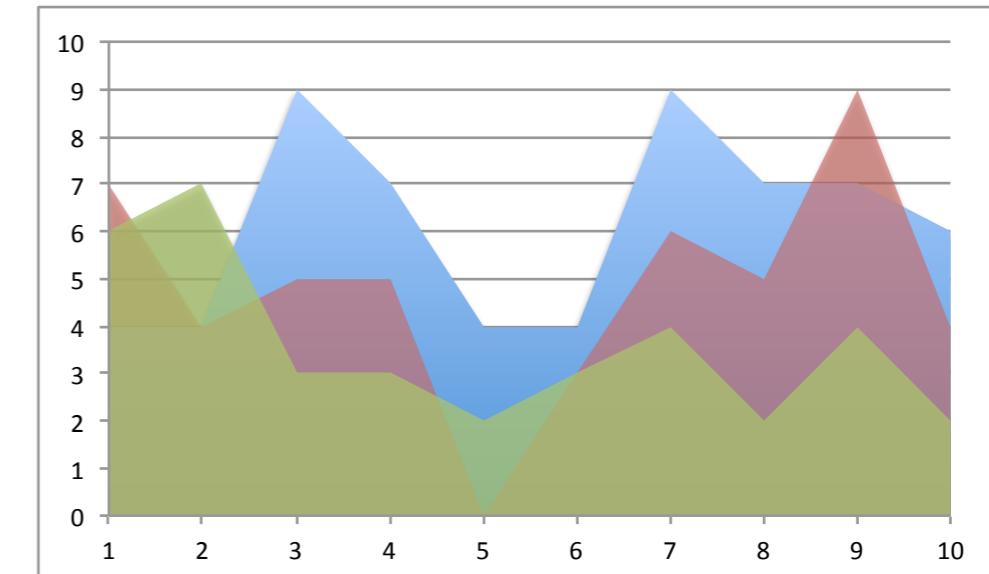
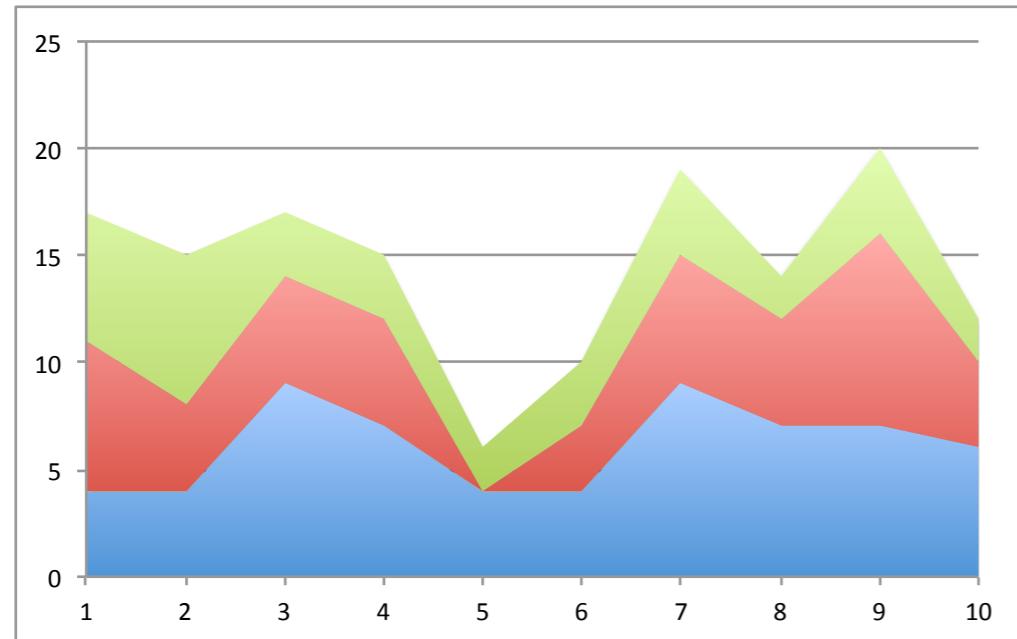
“streamgraphs”: double-stacked areas of horror



“streamgraphs”: double-stacked areas of horror

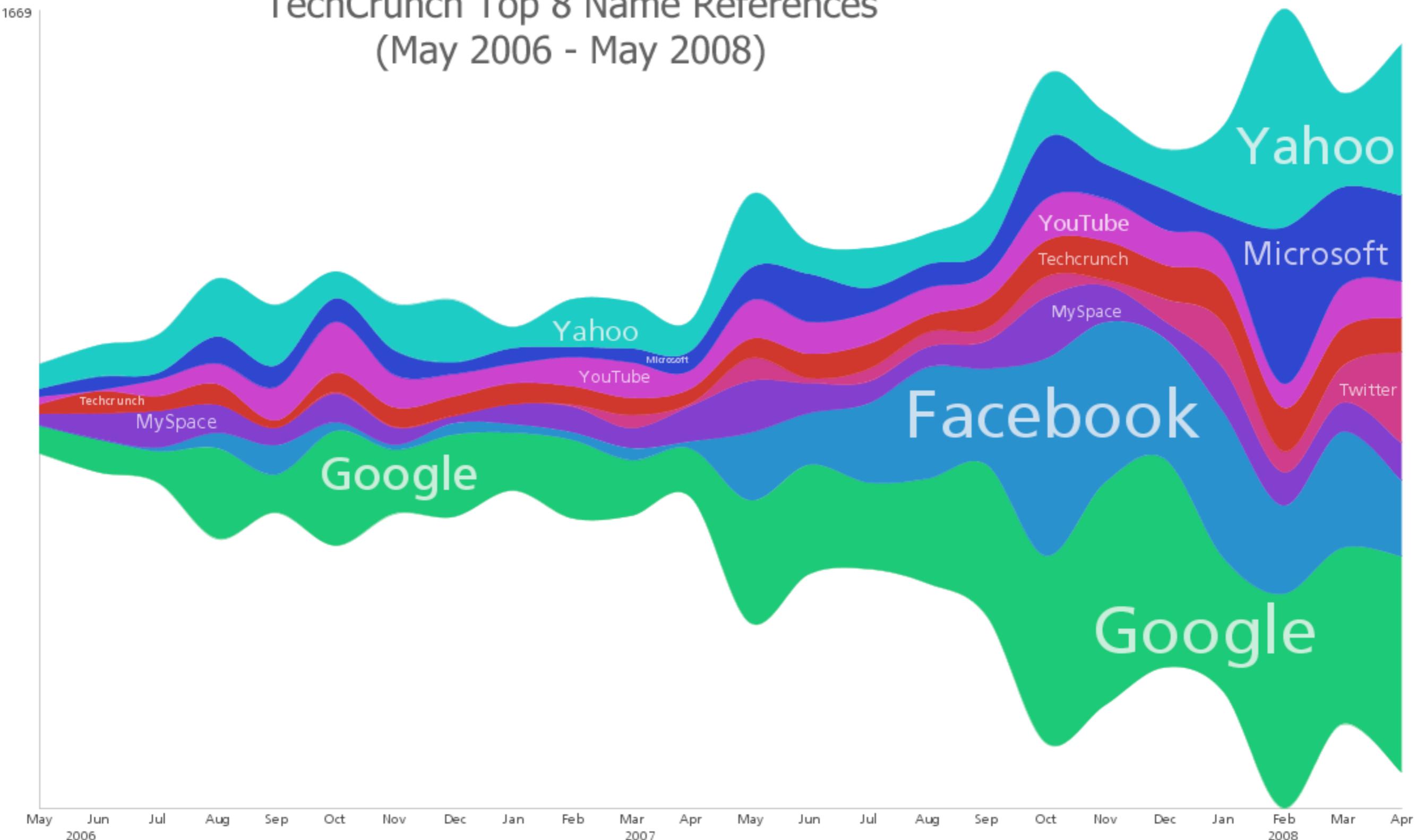


“streamgraphs”: double-stacked areas of horror



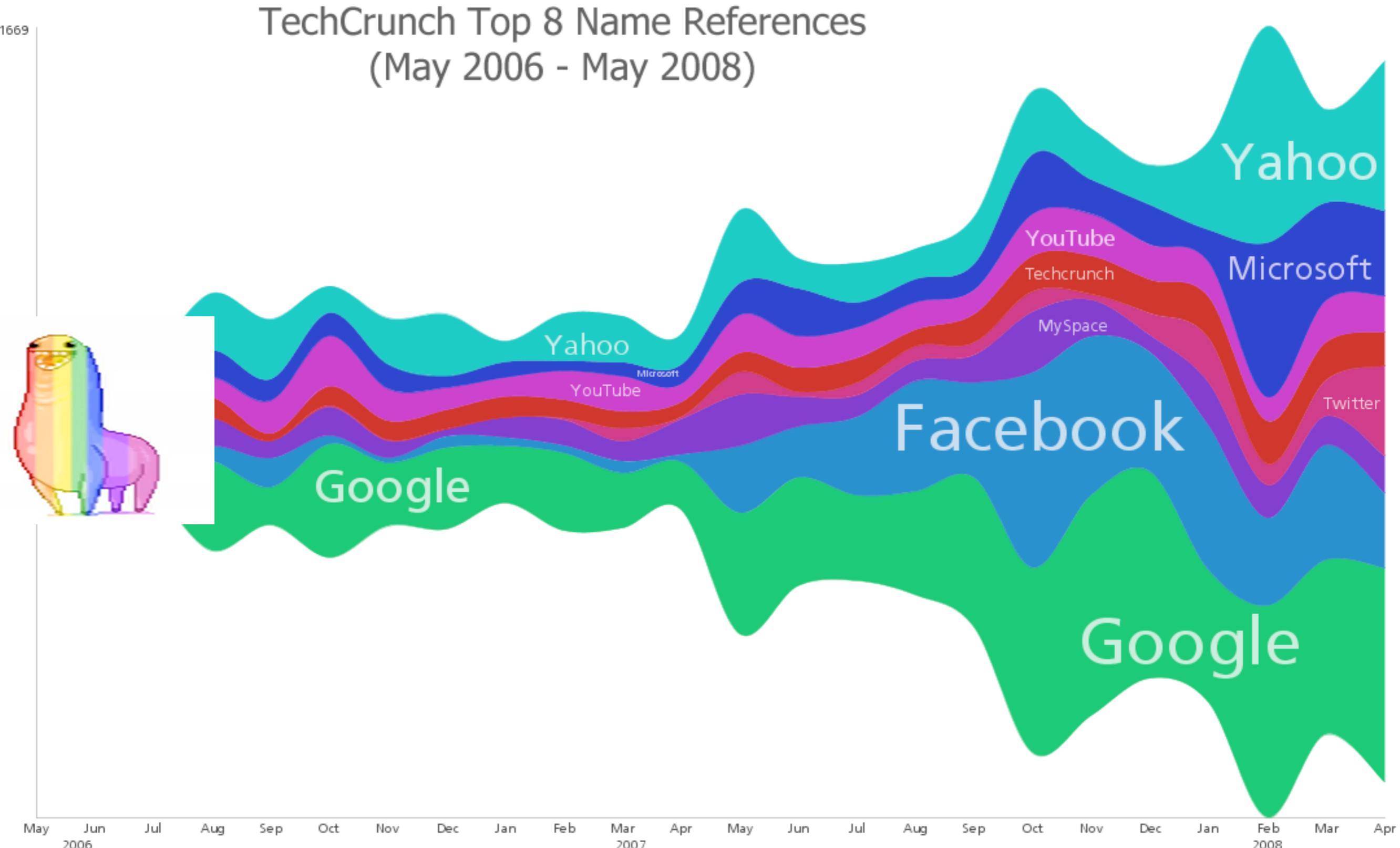
“streamgraphs”: double-stacked areas of horror

TechCrunch Top 8 Name References
(May 2006 - May 2008)

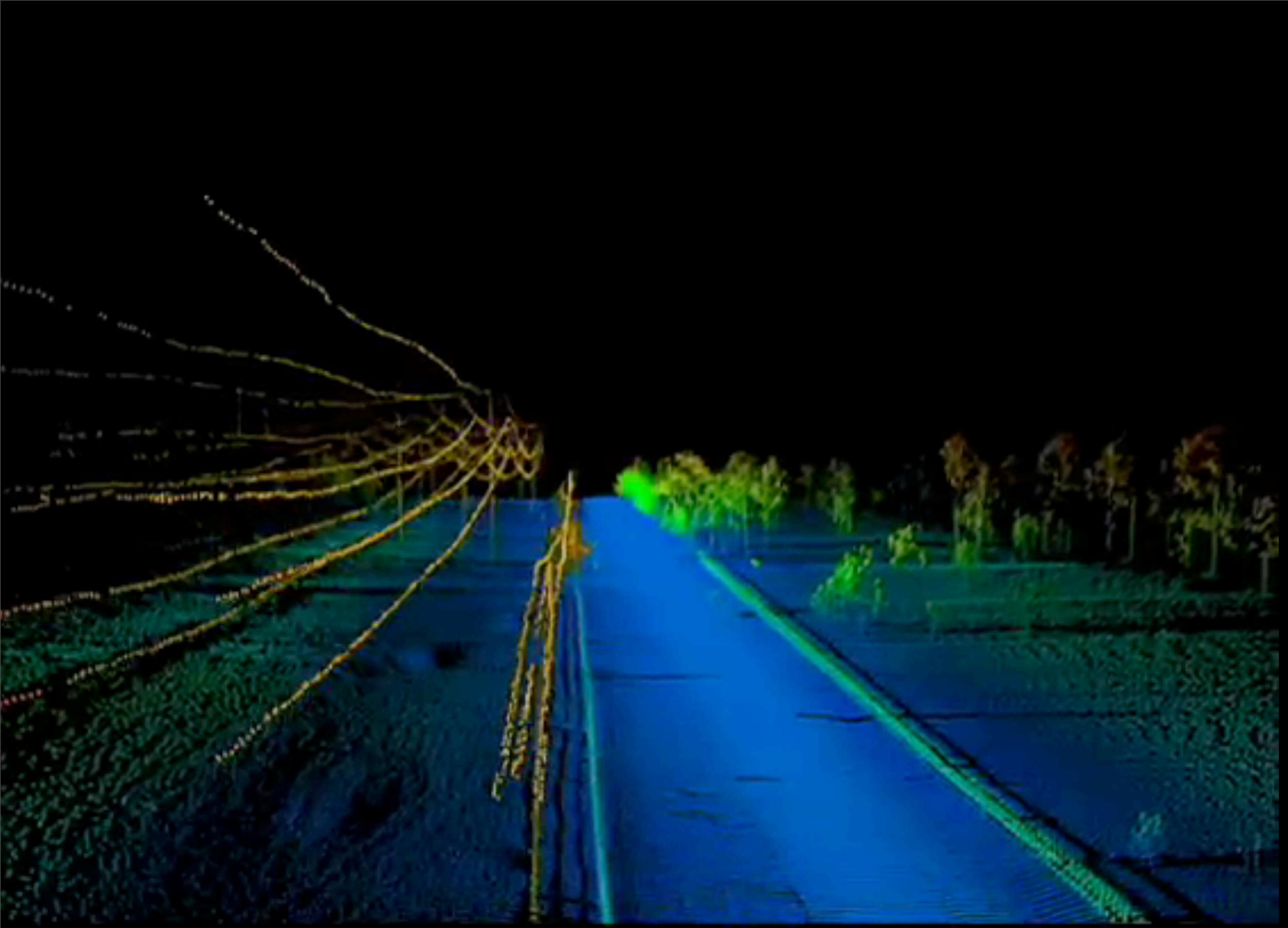


“abandon all hope ye who vieweth”

“streamgraphs”: double-stacked areas of horror



“abandon all hope ye who vieweth”



In conclusion

Designing effective infographics

is about effectively conveying or facilitating an understanding of relationships in data

offloading “heavy lifting” to our trained neural circuitry.

While still an art, many design principles grounded in usability can provide guidance: natural mappings, simplicity, & avoiding distortion

