Quiz

- Discuss pros & cons of scatterplot matrix. When do you want to use it? When do you **not** want to use it?
- How about the radar (spider) chart?
- Explain why dimensionality reduction is possible in practice.

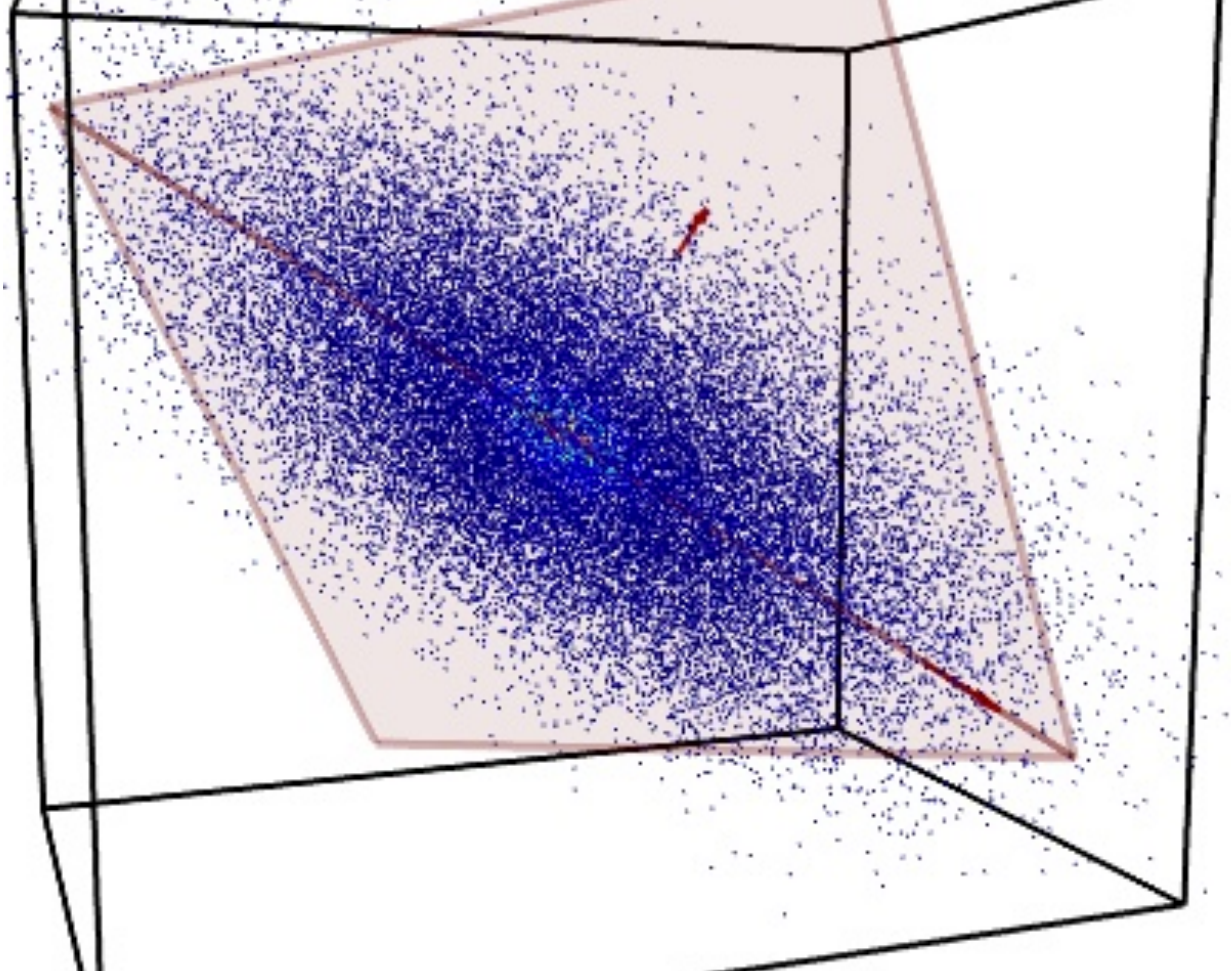
Dimensionality Reduction

Many dimensions

↓

Few (~2) dimensions

How is this even *possible*?

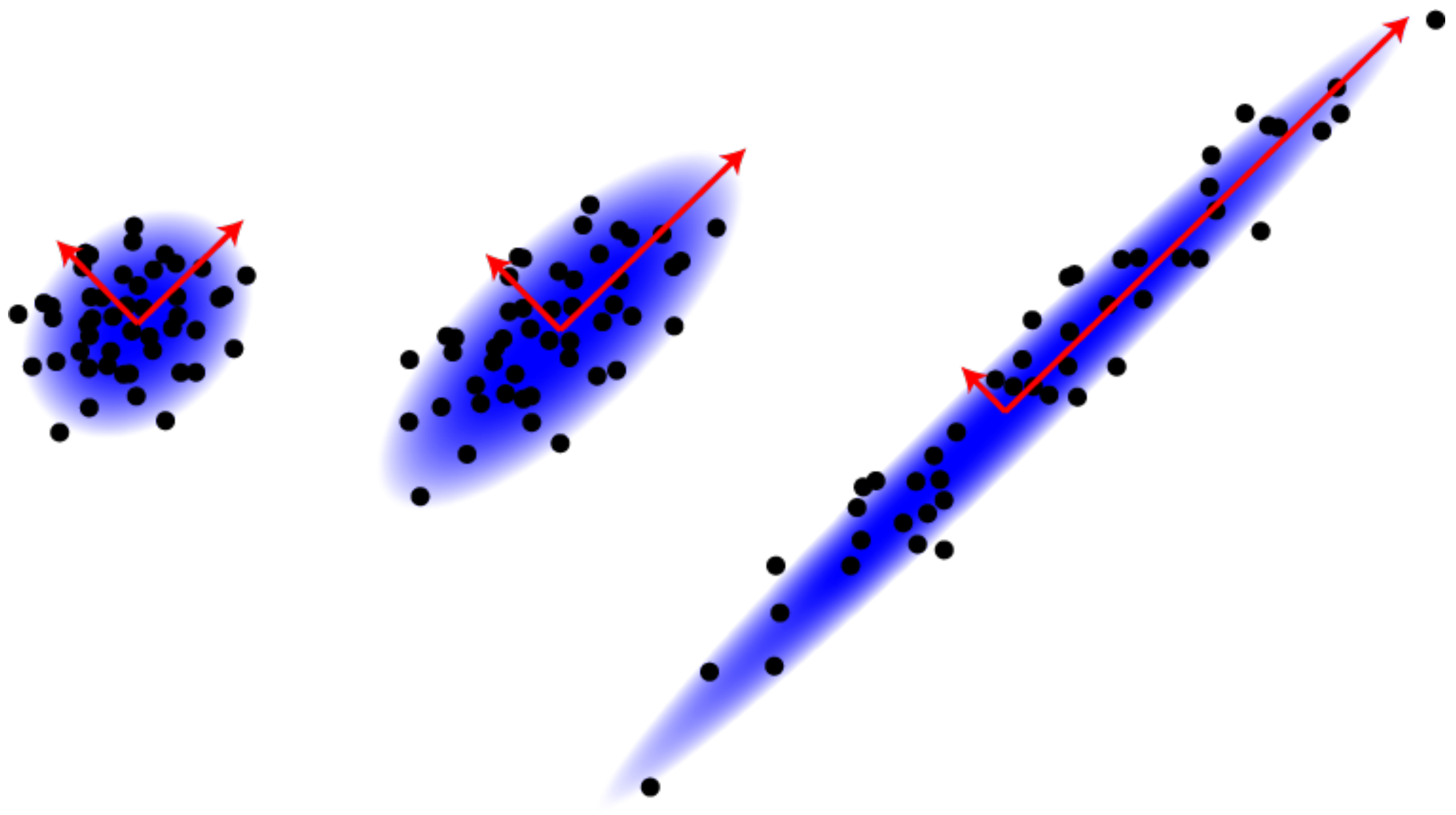


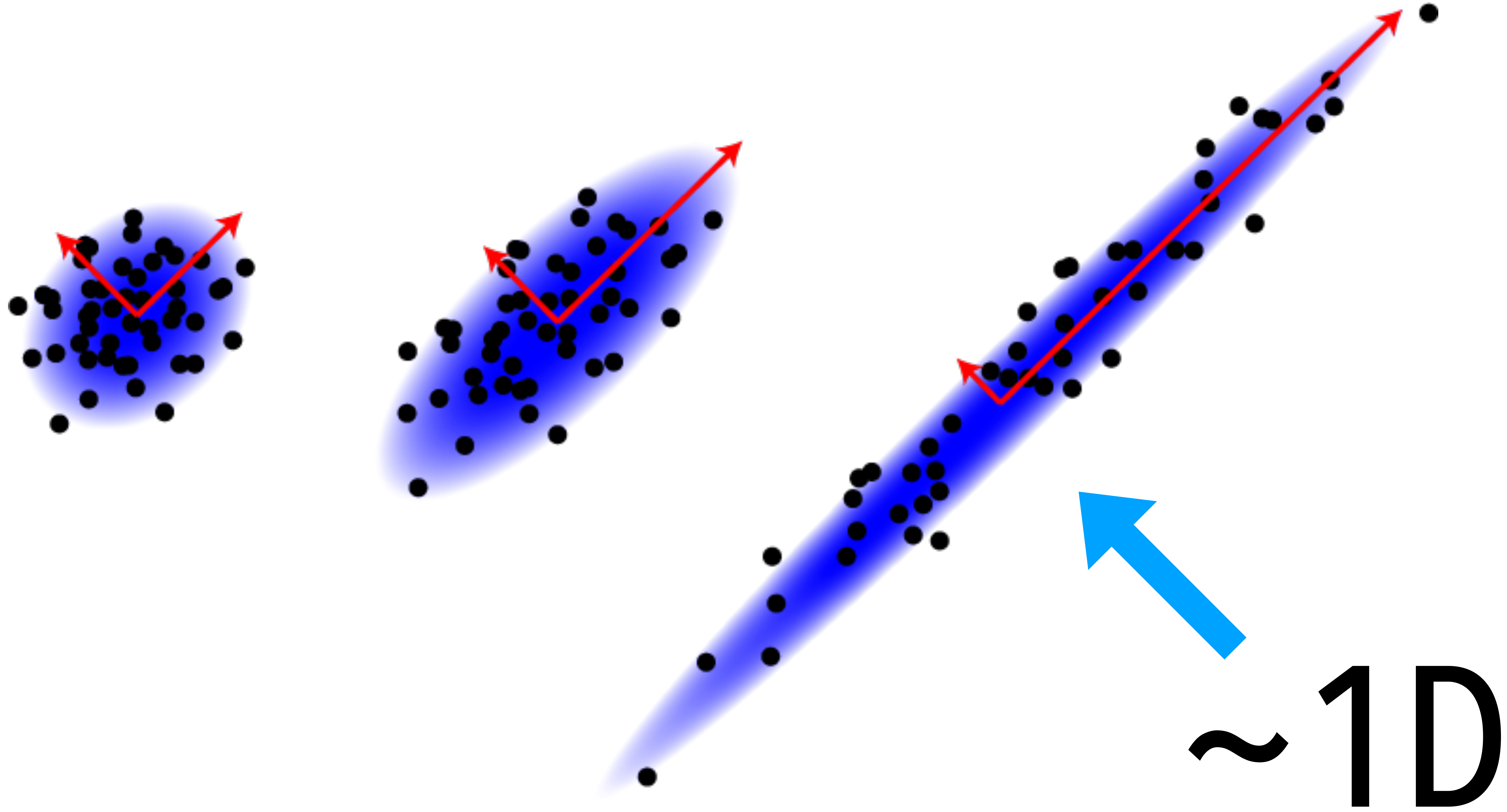
Dimensions?

Dimensions

↓

How many numbers do we need?

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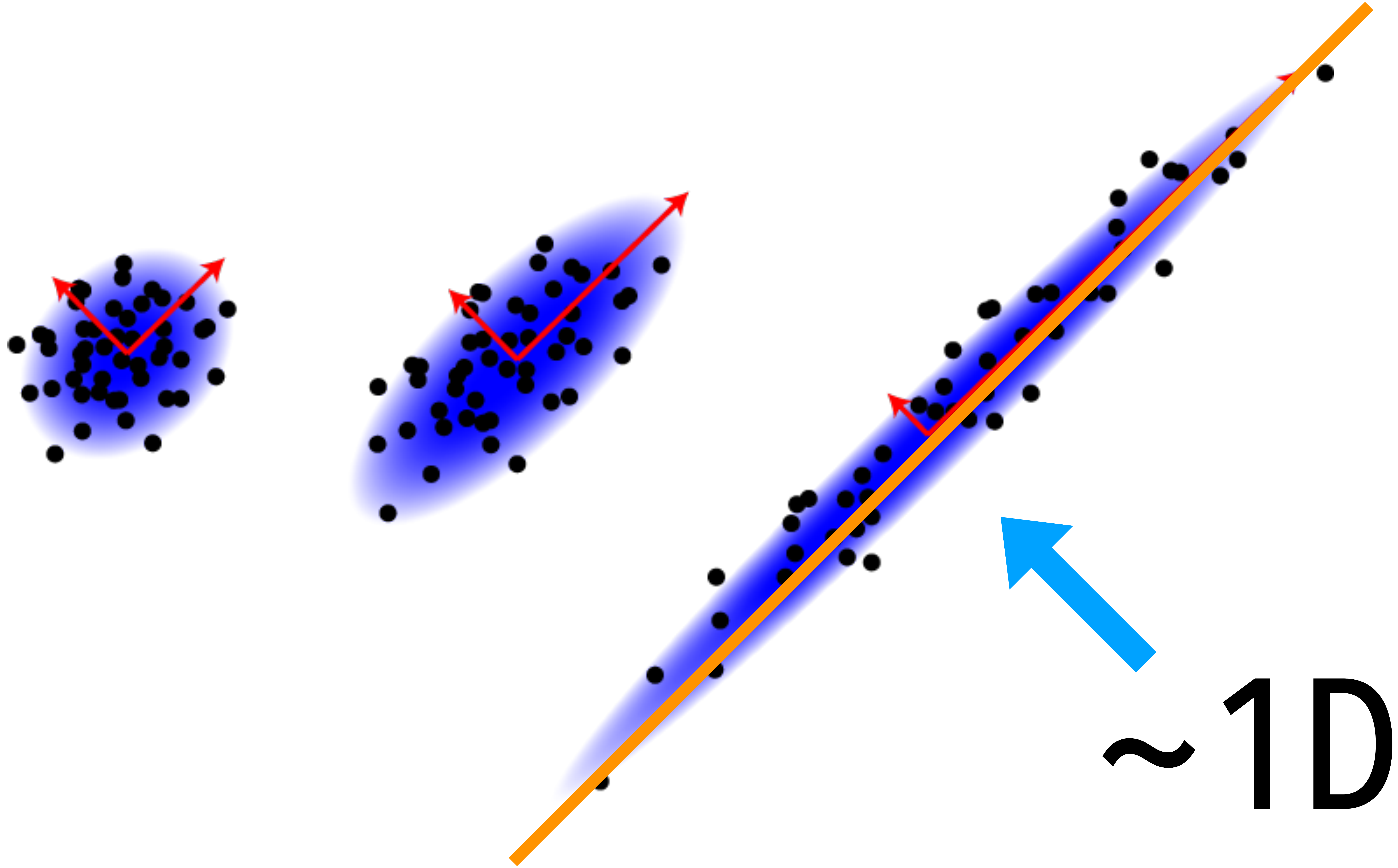
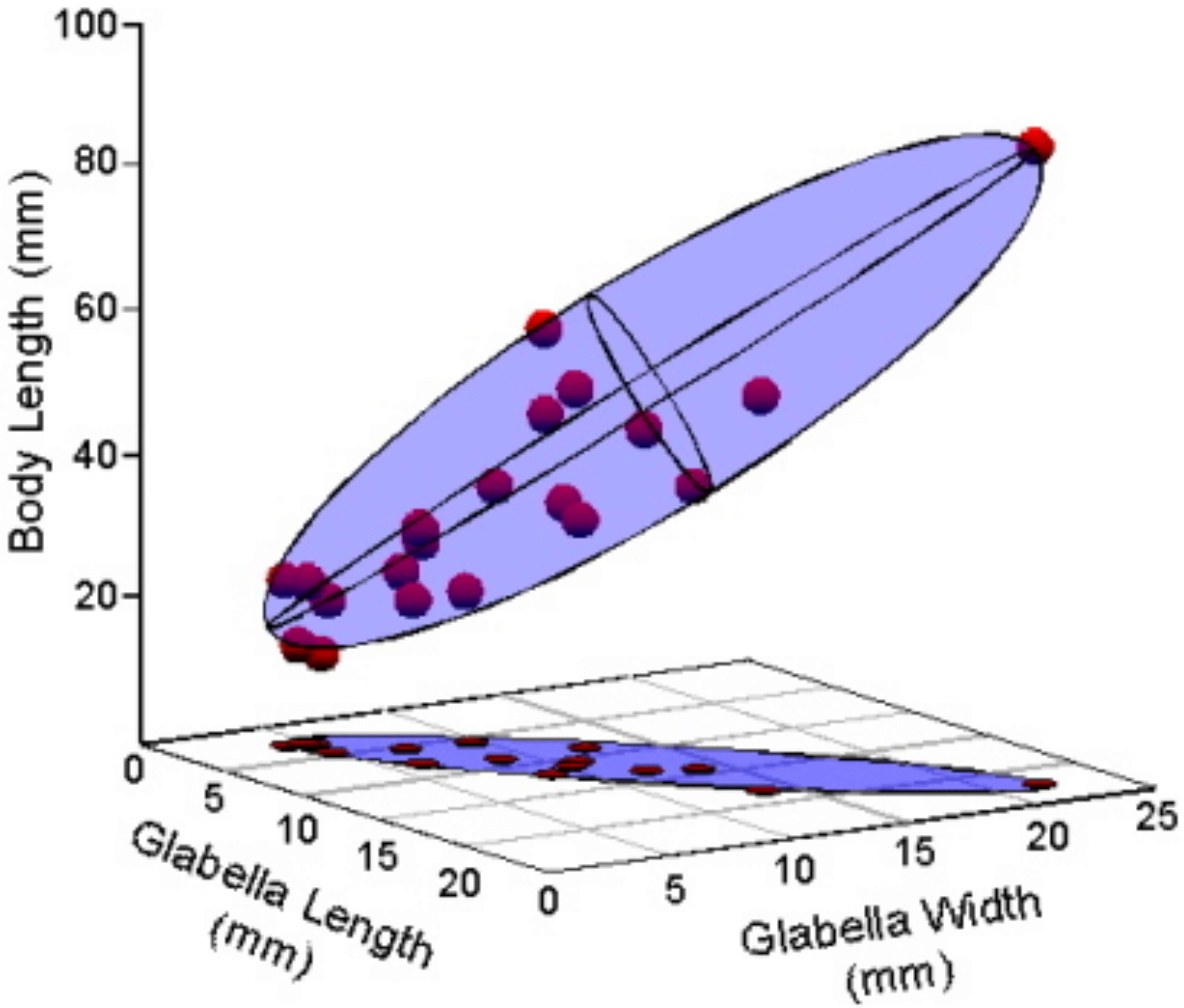

~1D

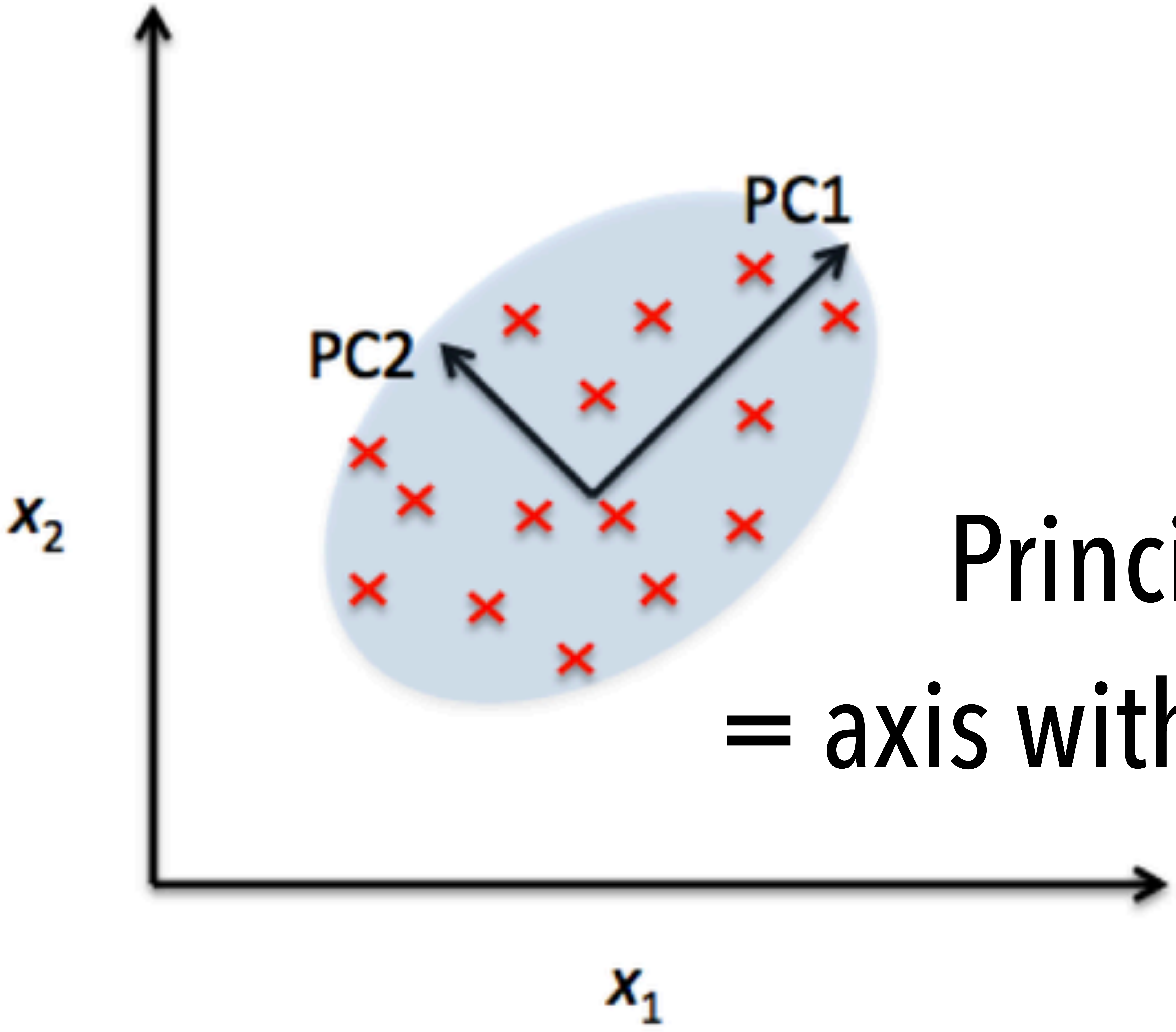
Find the low dimensional subspace!

Some Dimensionality Reduction Methods

Principal Component Analysis (PCA)

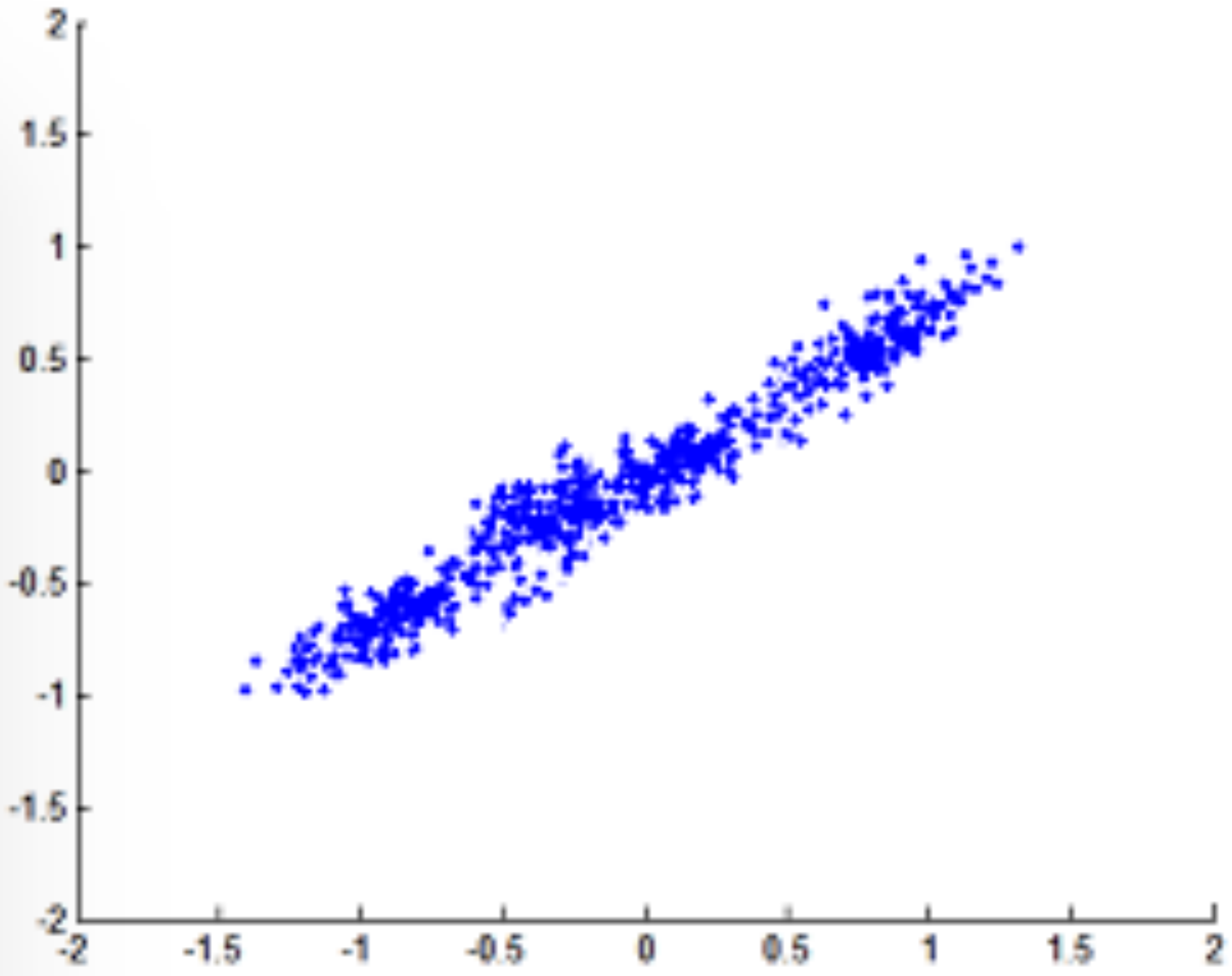


http://www.palass.org/publications/newsletter/palaeomath-101/palaeomath-part-5-pca-eigenanalysis-regression-v



Principal component
= axis with the largest variance

Why large variance?
How can we do that?



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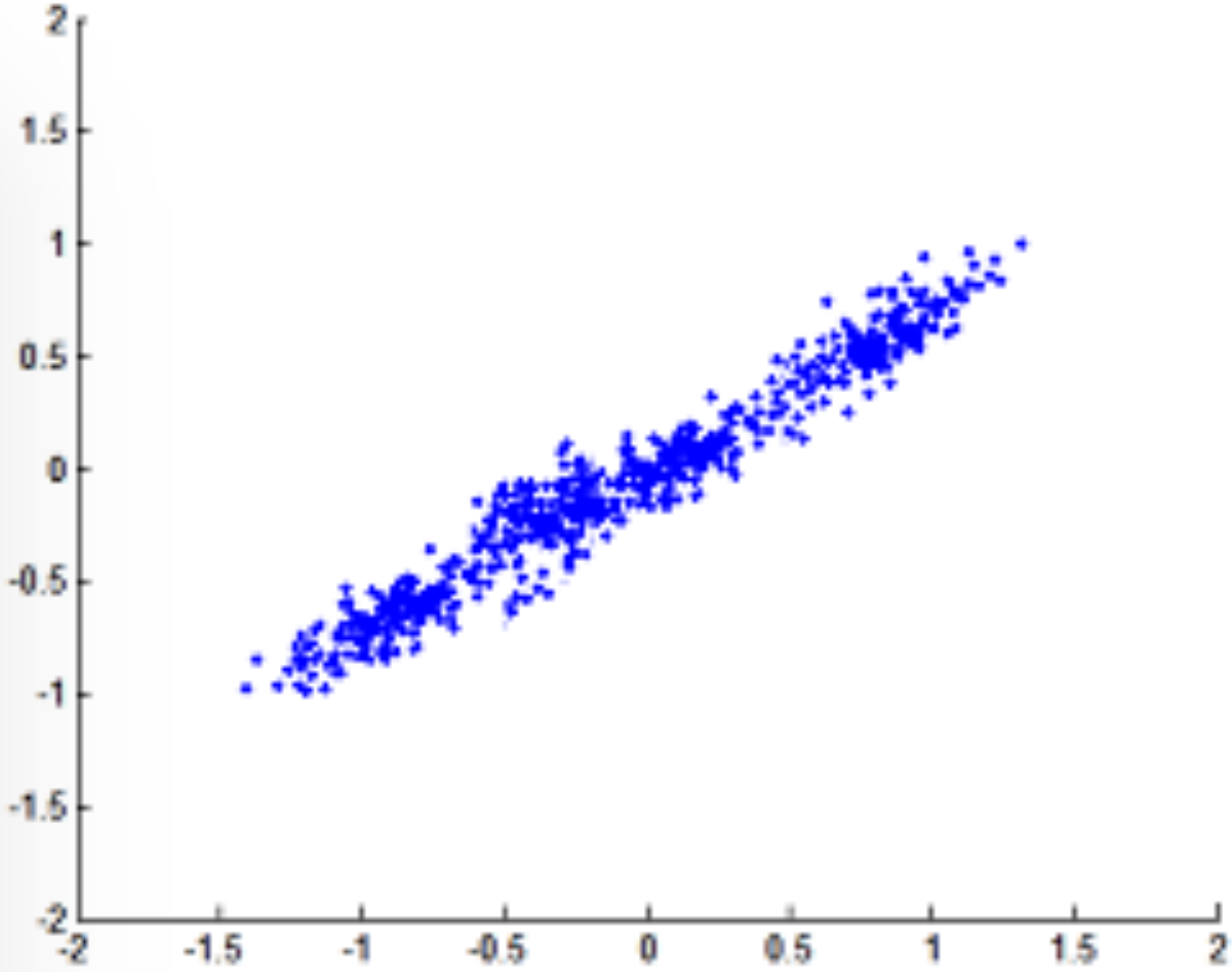
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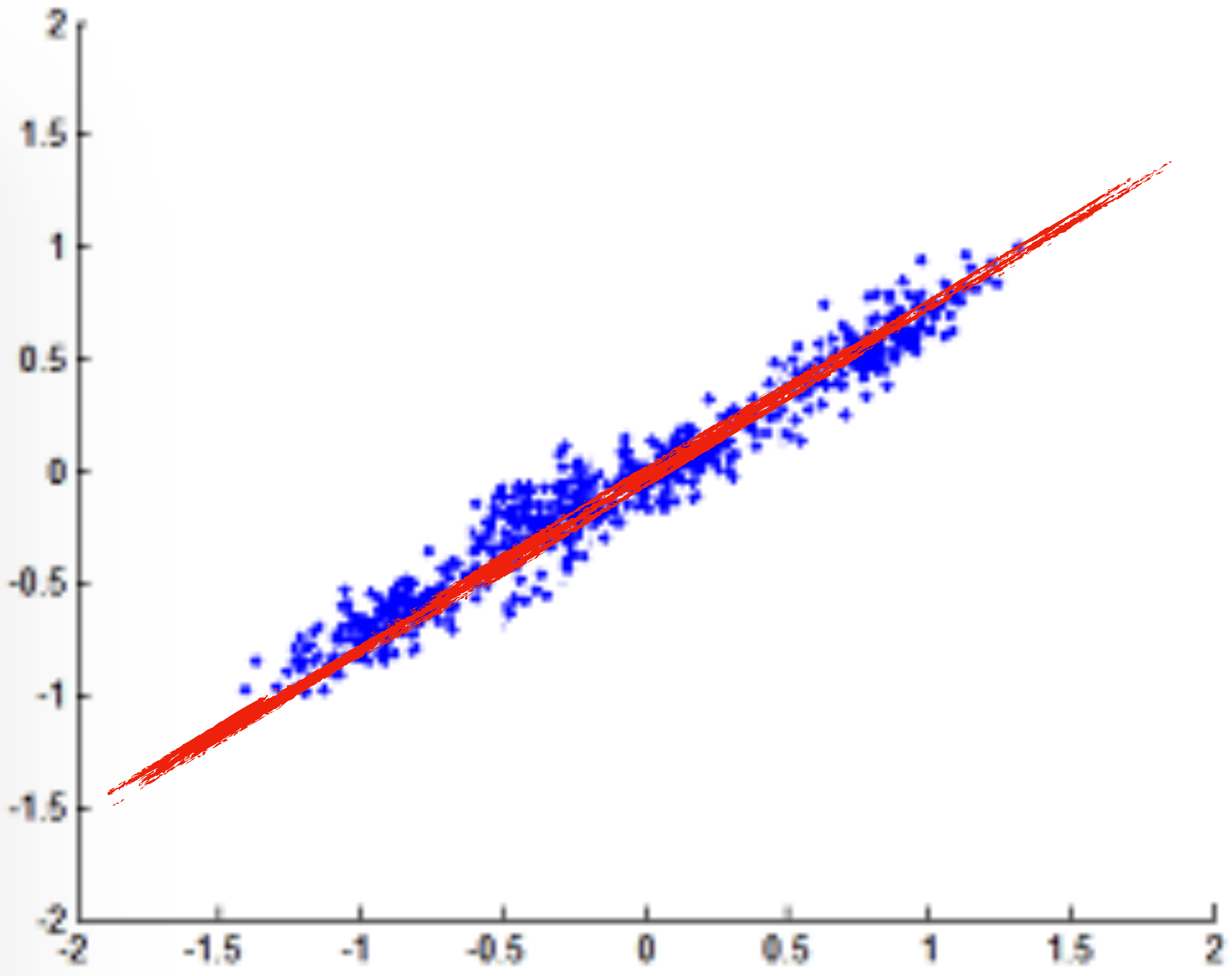
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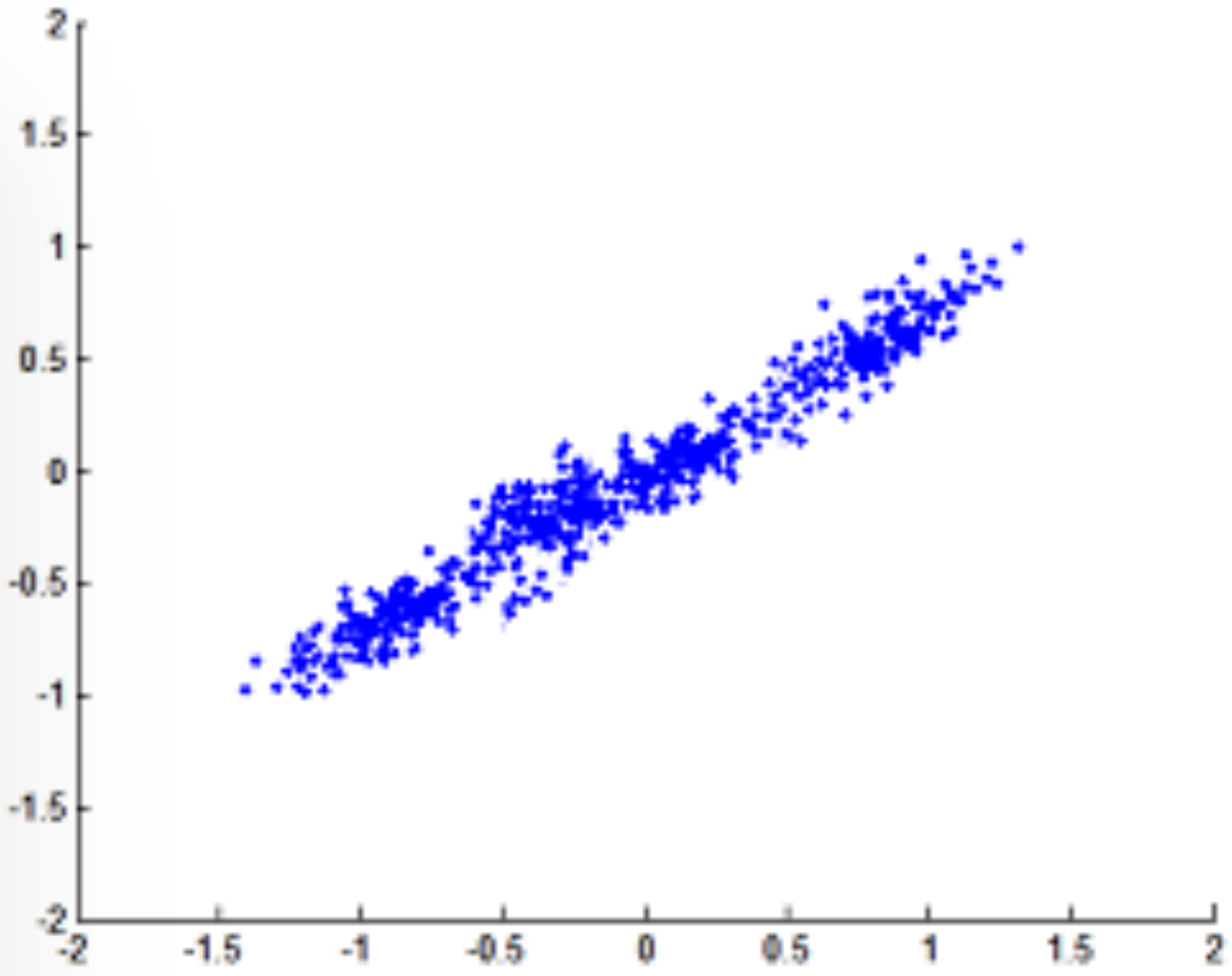
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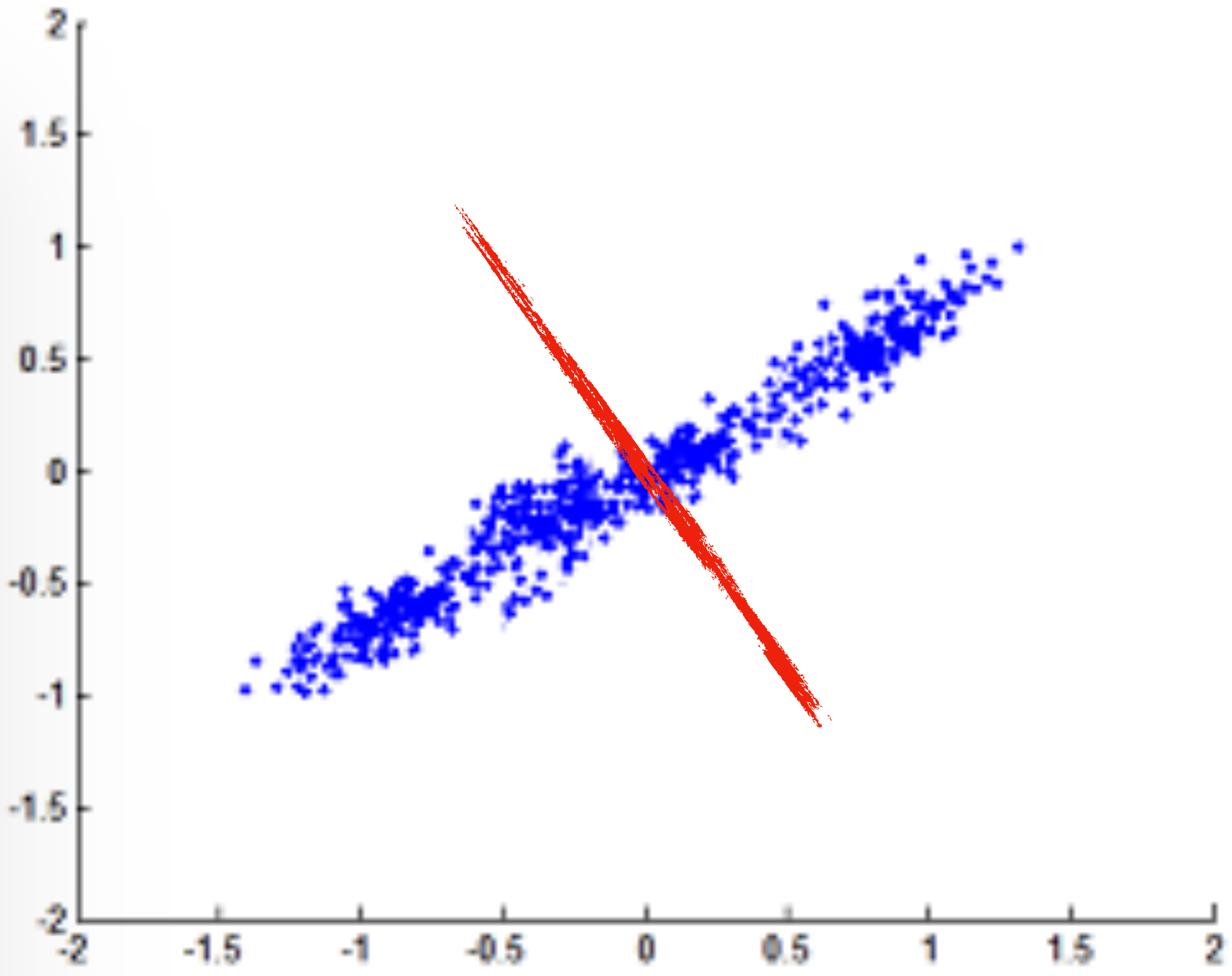

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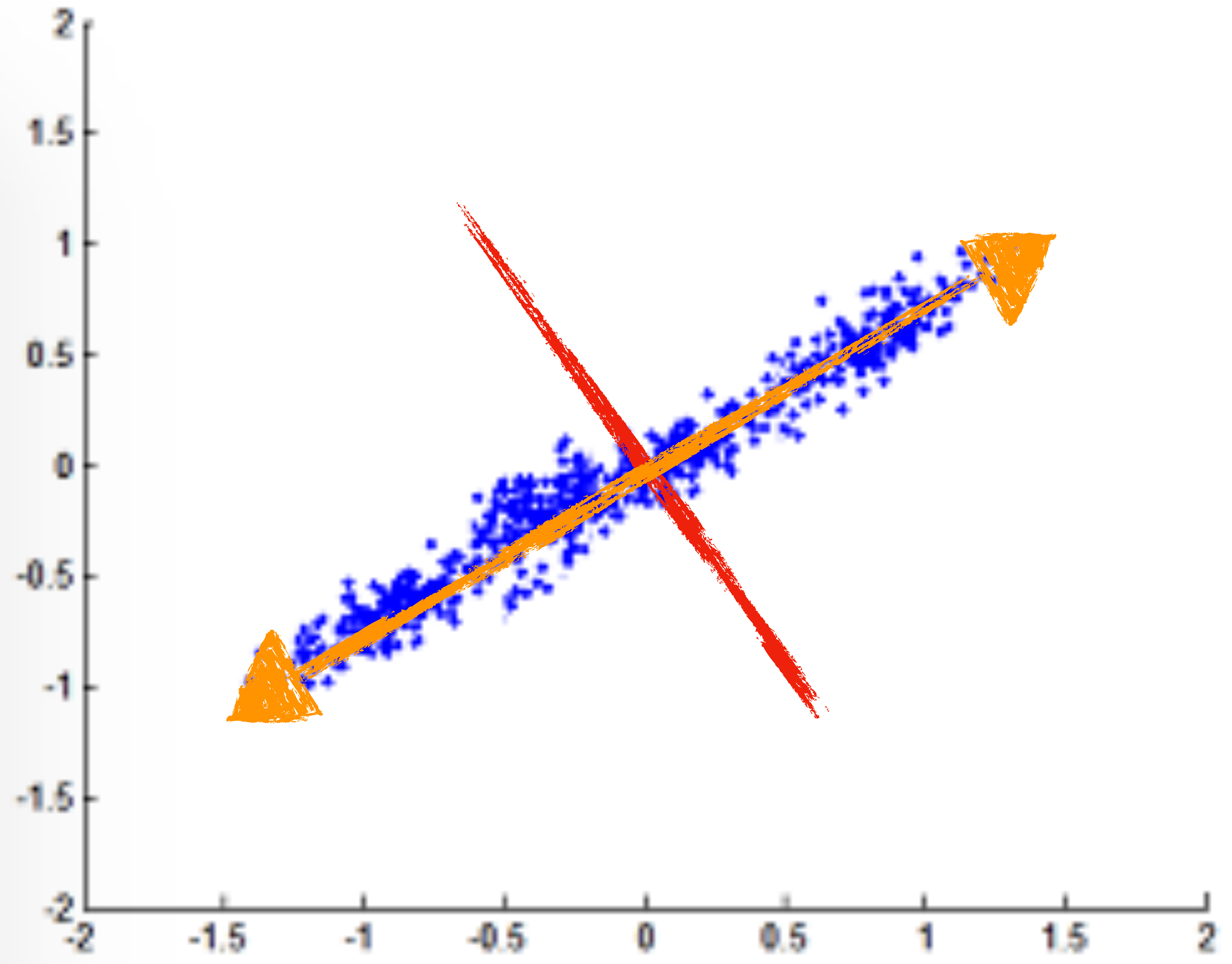

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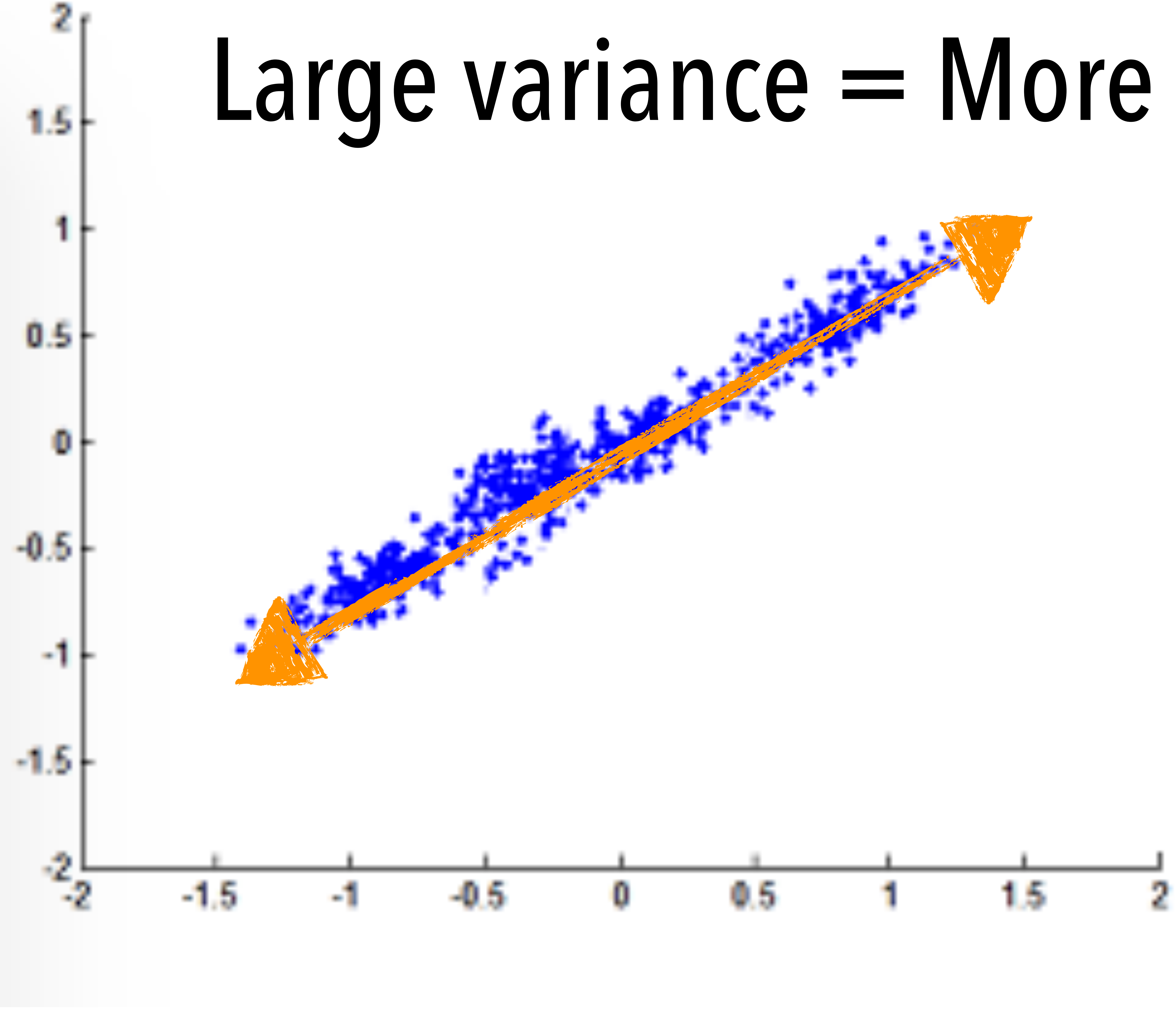
2

Large variance = More information



Google w "setosa PCA"

Principal Component Analysis

Explained Visually

Tweet | Like 1.6K | Share

By Victor Powell

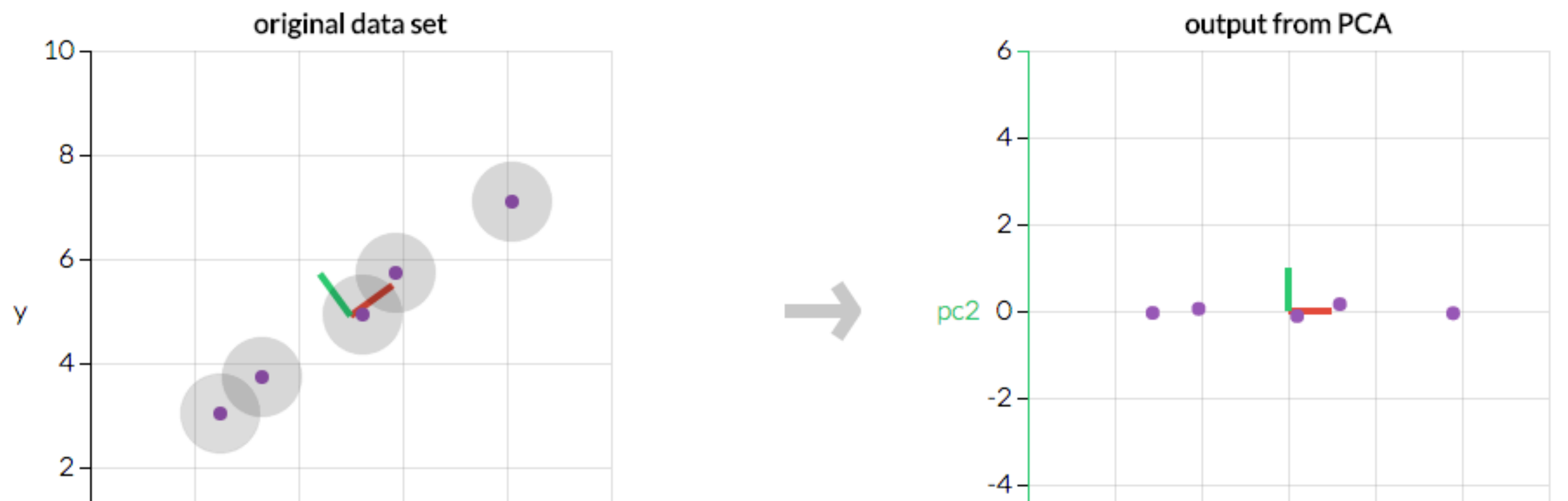
with text by Lewis Lehe

Principal component analysis (PCA) is a technique used to emphasize variation and bring out strong patterns in a dataset. It's often used to make data easy to explore and visualize.

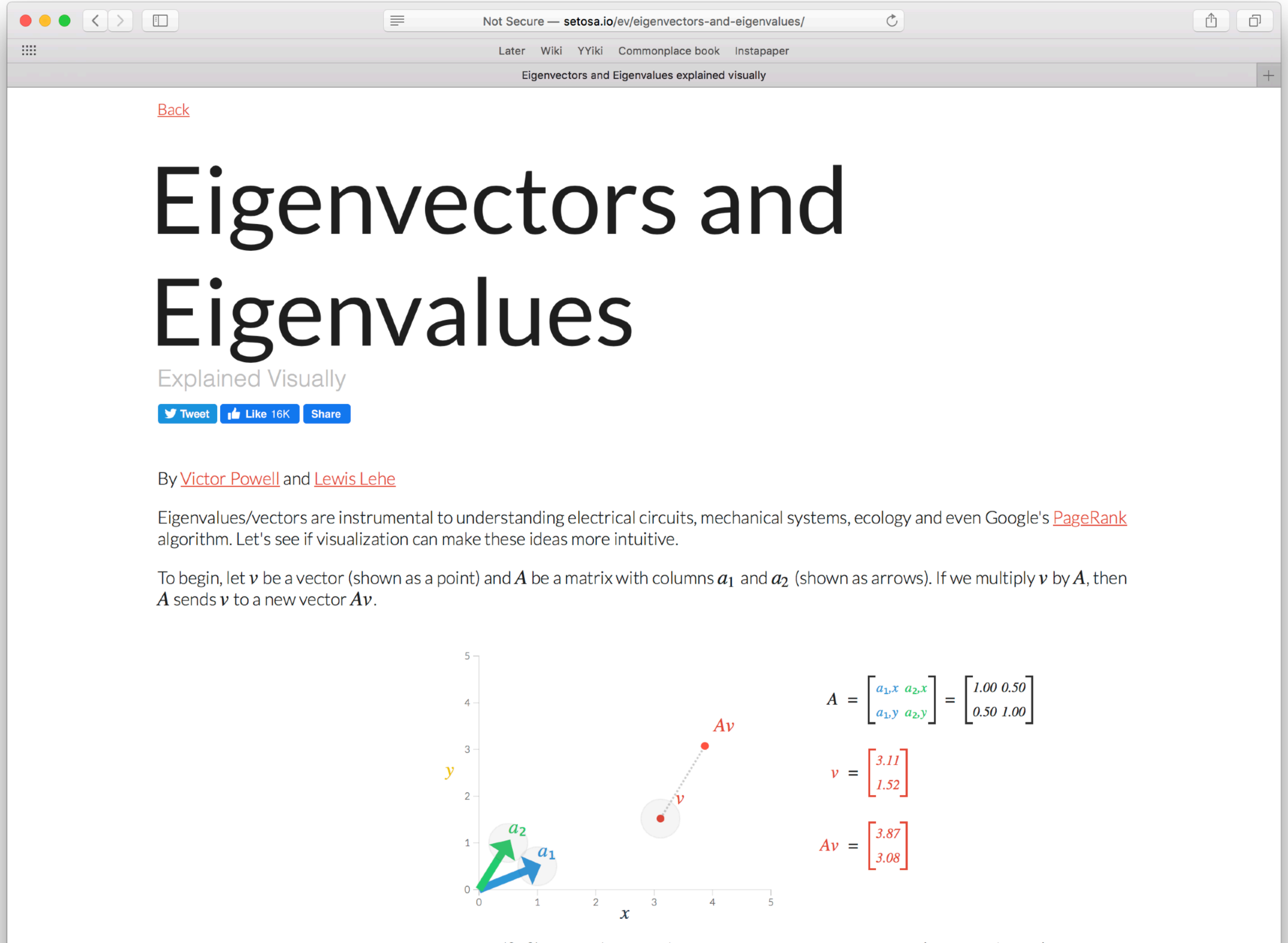
2D example

First, consider a dataset in only two dimensions, like (height, weight). This dataset can be plotted as points in a plane. But if we want to tease out variation, PCA finds a new coordinate system in which every point has a new (x,y) value. The axes don't actually mean anything physical; they're combinations of height and weight called "principal components" that are chosen to give one axes lots of variation.

Drag the points around in the following visualization to see PC coordinate system adjusts.



Also check out


Not Secure — setosa.io/ev/eigenvectors-and-eigenvalues/

Later Wiki YYiki Commonplace book Instapaper

Eigenvectors and Eigenvalues explained visually

Back

Eigenvectors and Eigenvalues

Explained Visually

Tweet Like 16K Share

By Victor Powell and Lewis Lehe

Eigenvalues/vectors are instrumental to understanding electrical circuits, mechanical systems, ecology and even Google's PageRank algorithm. Let's see if visualization can make these ideas more intuitive.

To begin, let v be a vector (shown as a point) and A be a matrix with columns a_1 and a_2 (shown as arrows). If we multiply v by A, then A sends v to a new vector Av.

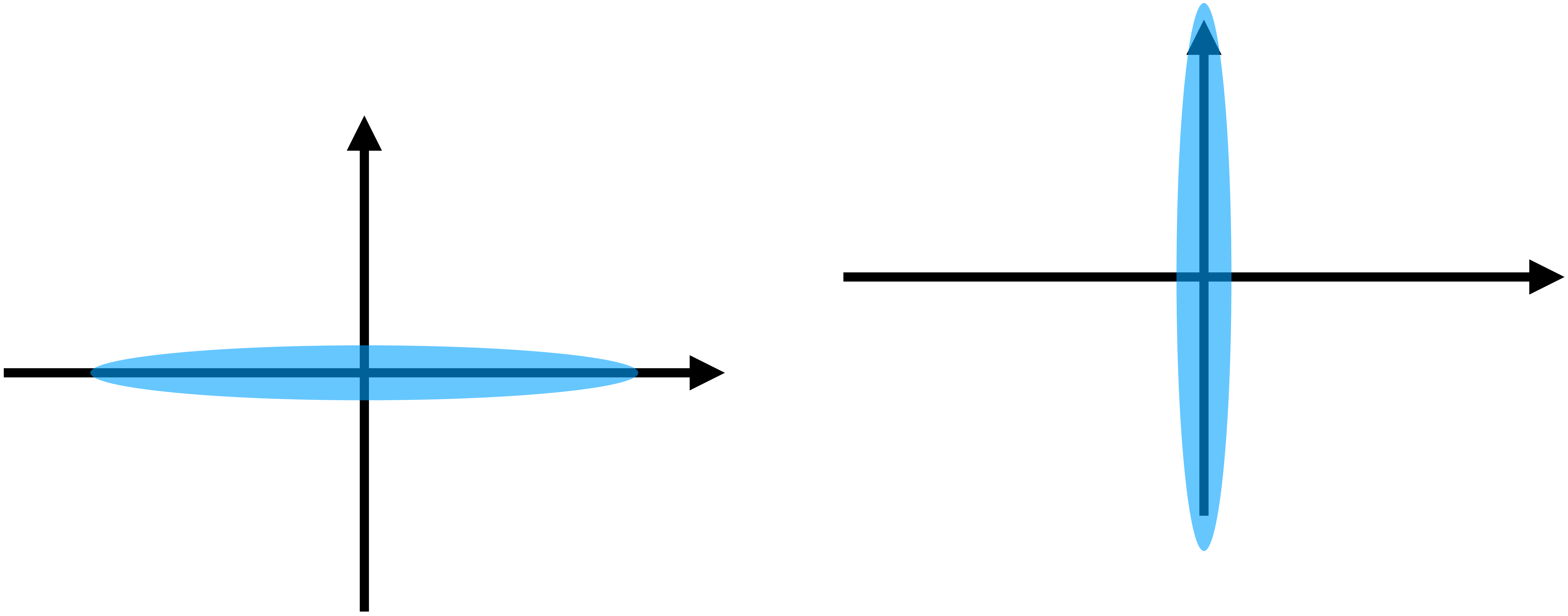
$$A = \begin{bmatrix} a_{1,x} & a_{2,x} \\ a_{1,y} & a_{2,y} \end{bmatrix} = \begin{bmatrix} 1.00 & 0.50 \\ 0.50 & 1.00 \end{bmatrix}$$

$$v = \begin{bmatrix} 3.11 \\ 1.52 \end{bmatrix}$$

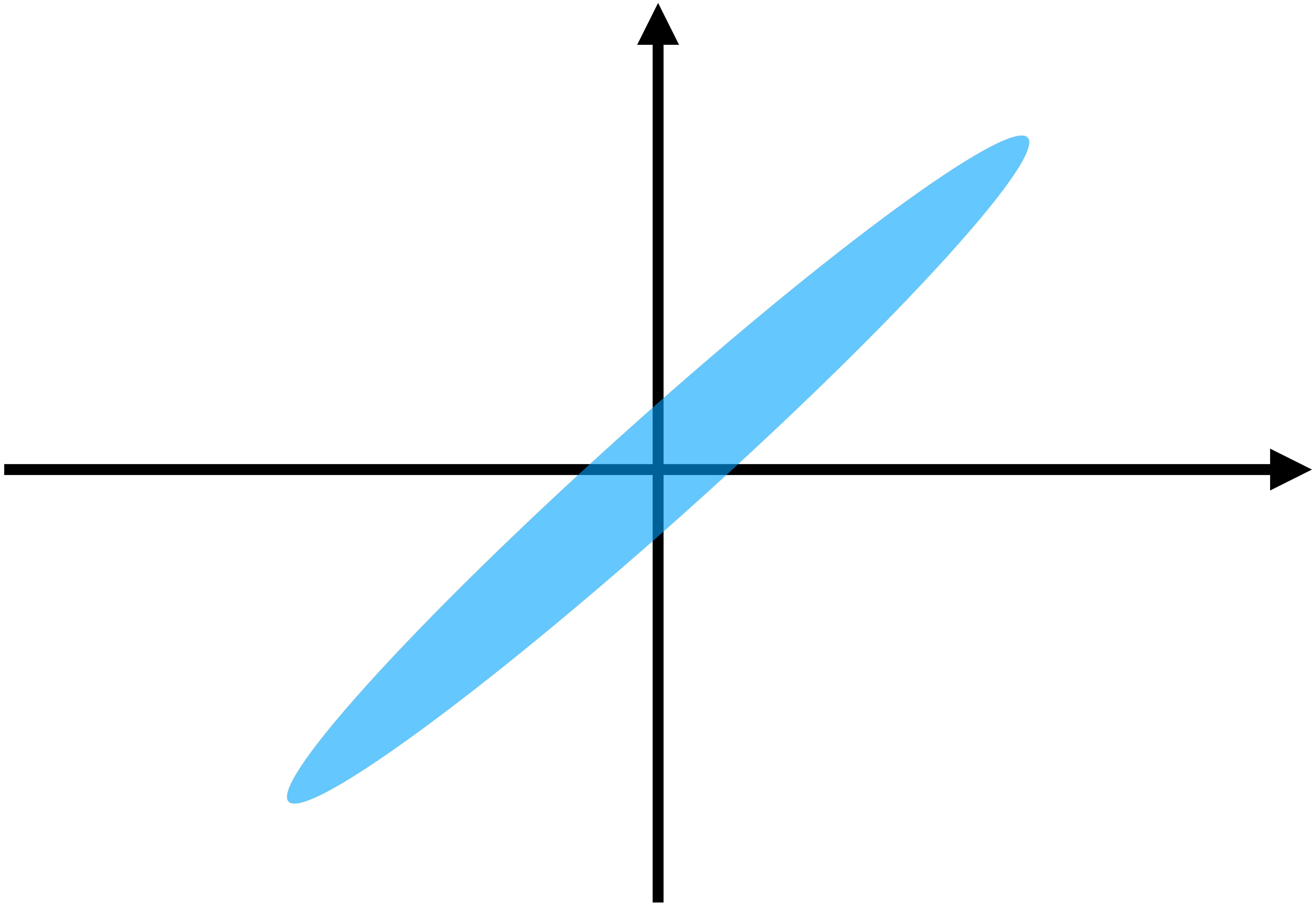
$$Av = \begin{bmatrix} 3.87 \\ 3.08 \end{bmatrix}$$

Principal components:
the axes that capture the largest amount
of information about the dataset.

What is “variance”?



What is “covariance”?

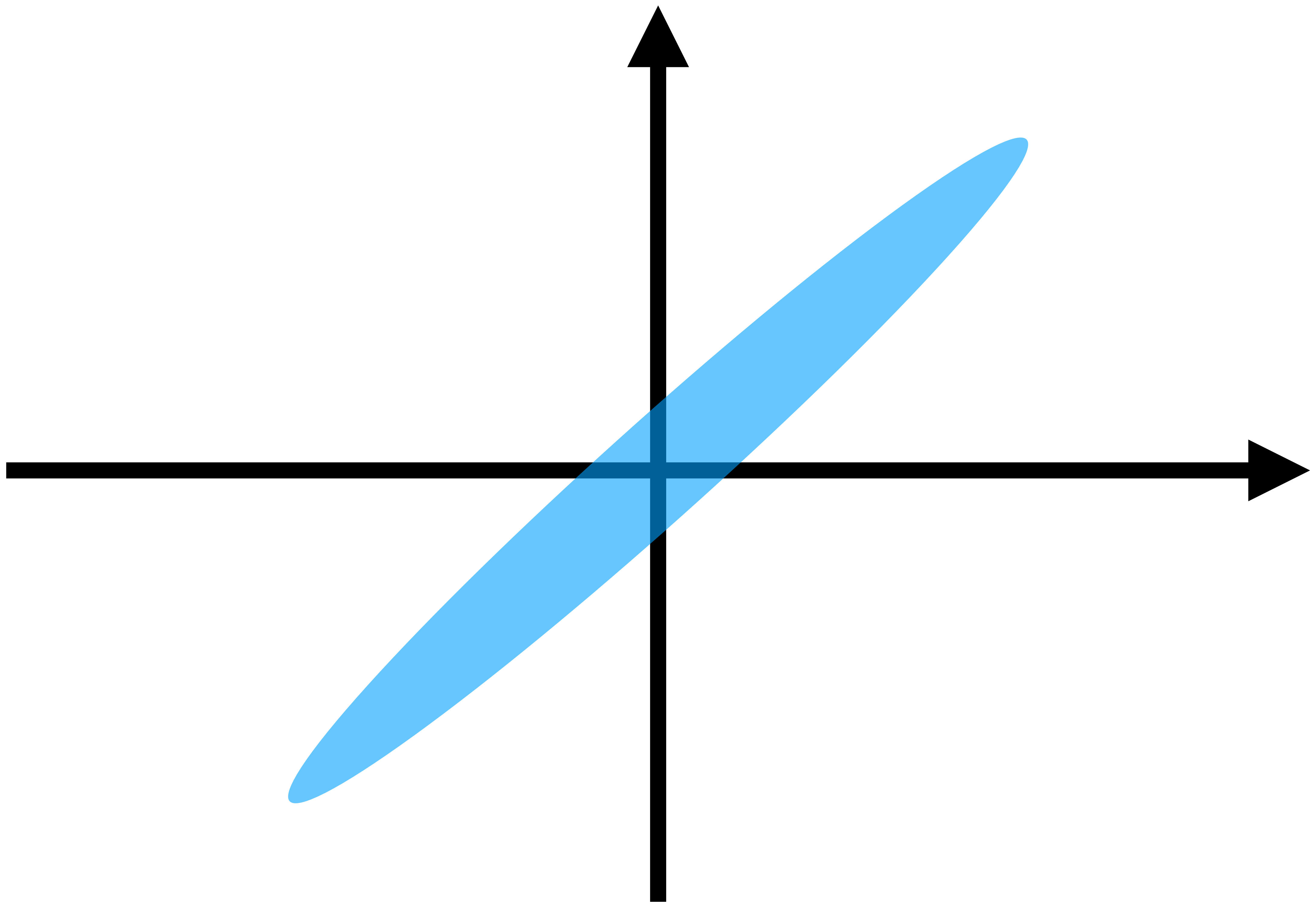


Covariance matrix

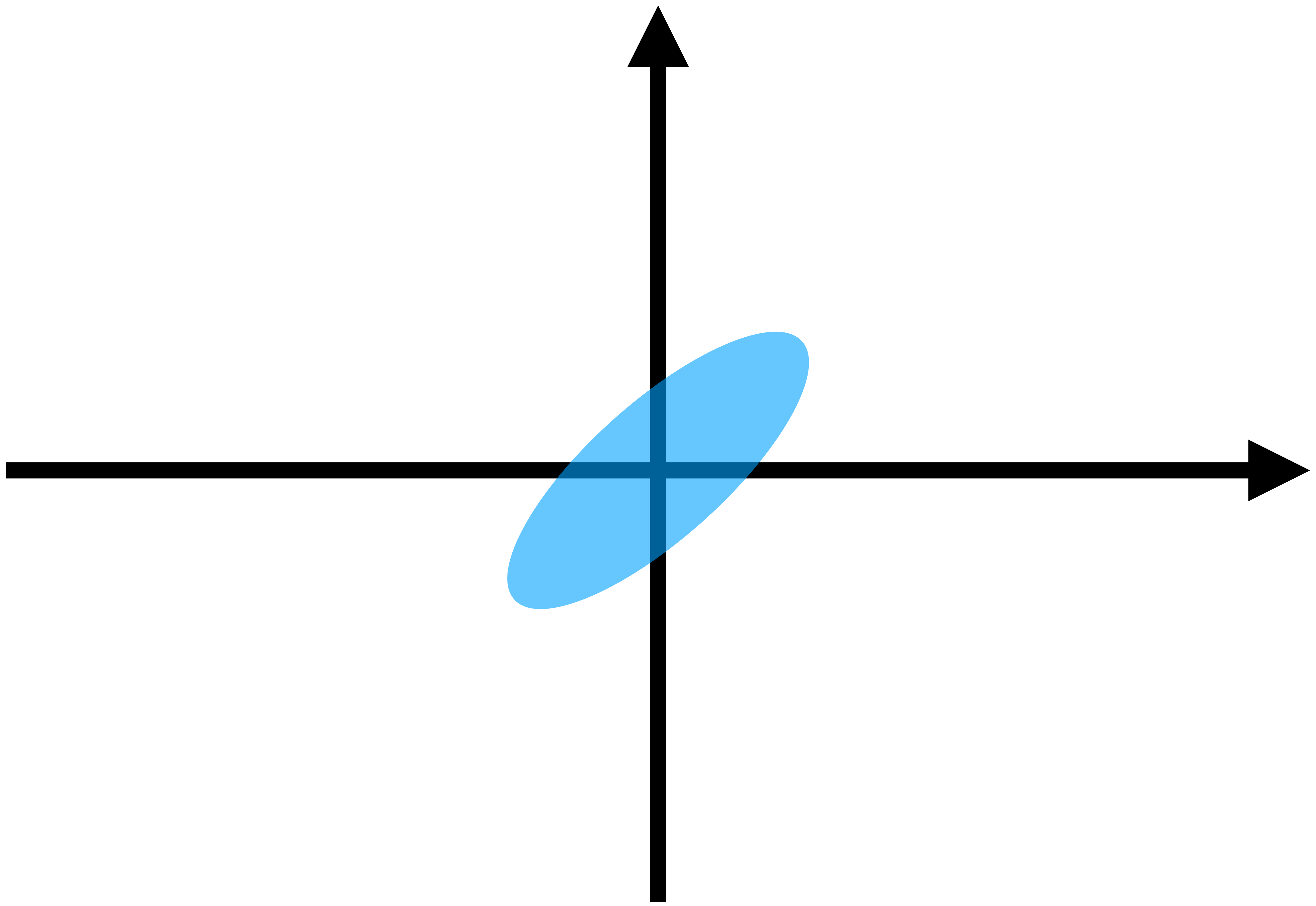
$$\mathrm{Cov}(A) = \begin{bmatrix} \dfrac{\sum (x_i - \bar{X})(x_i - \bar{X})}{N} & \dfrac{\sum (x_i - \bar{X})(y_i - \bar{Y})}{N} \\ \dfrac{\sum (x_i - \bar{X})(y_i - \bar{Y})}{N} & \dfrac{\sum (y_i - \bar{Y})(y_i - \bar{Y})}{N} \end{bmatrix}$$

$$= \begin{bmatrix} \mathrm{Cov}(X, X) & \mathrm{Cov}(Y, X) \\ \mathrm{Cov}(X, Y) & \mathrm{Cov}(X, Y) \end{bmatrix}$$

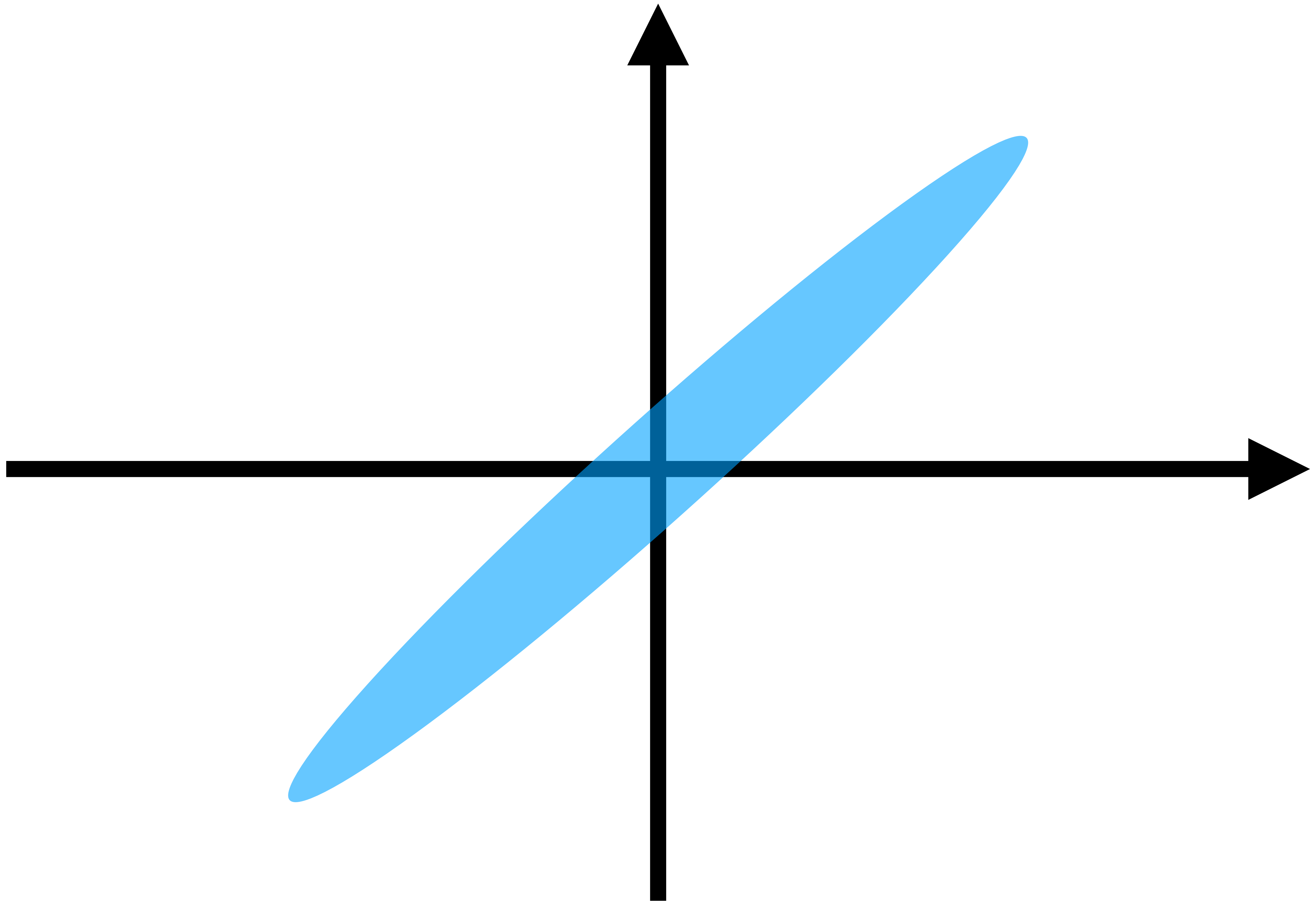
Larger covariance



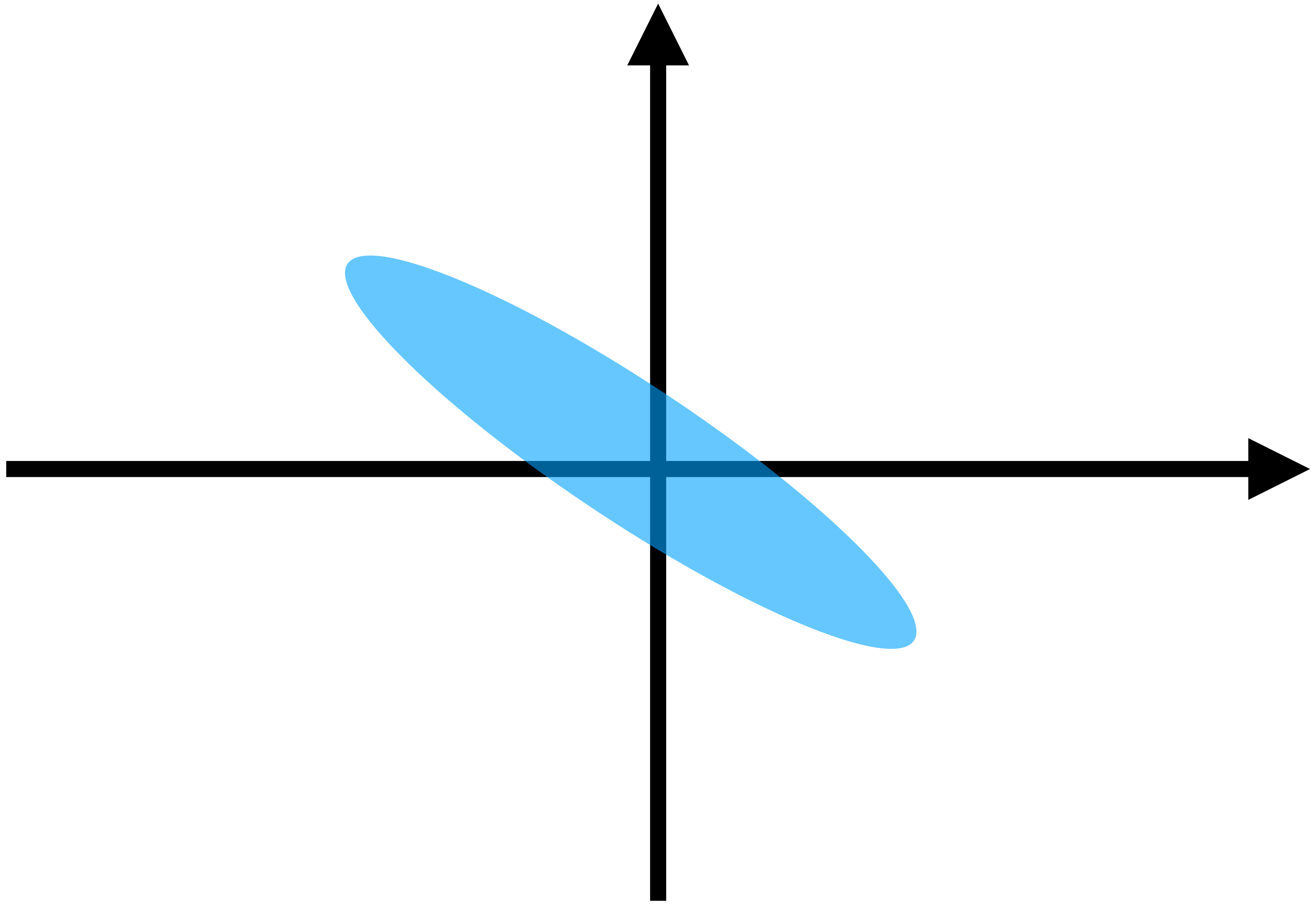
Smaller covariance

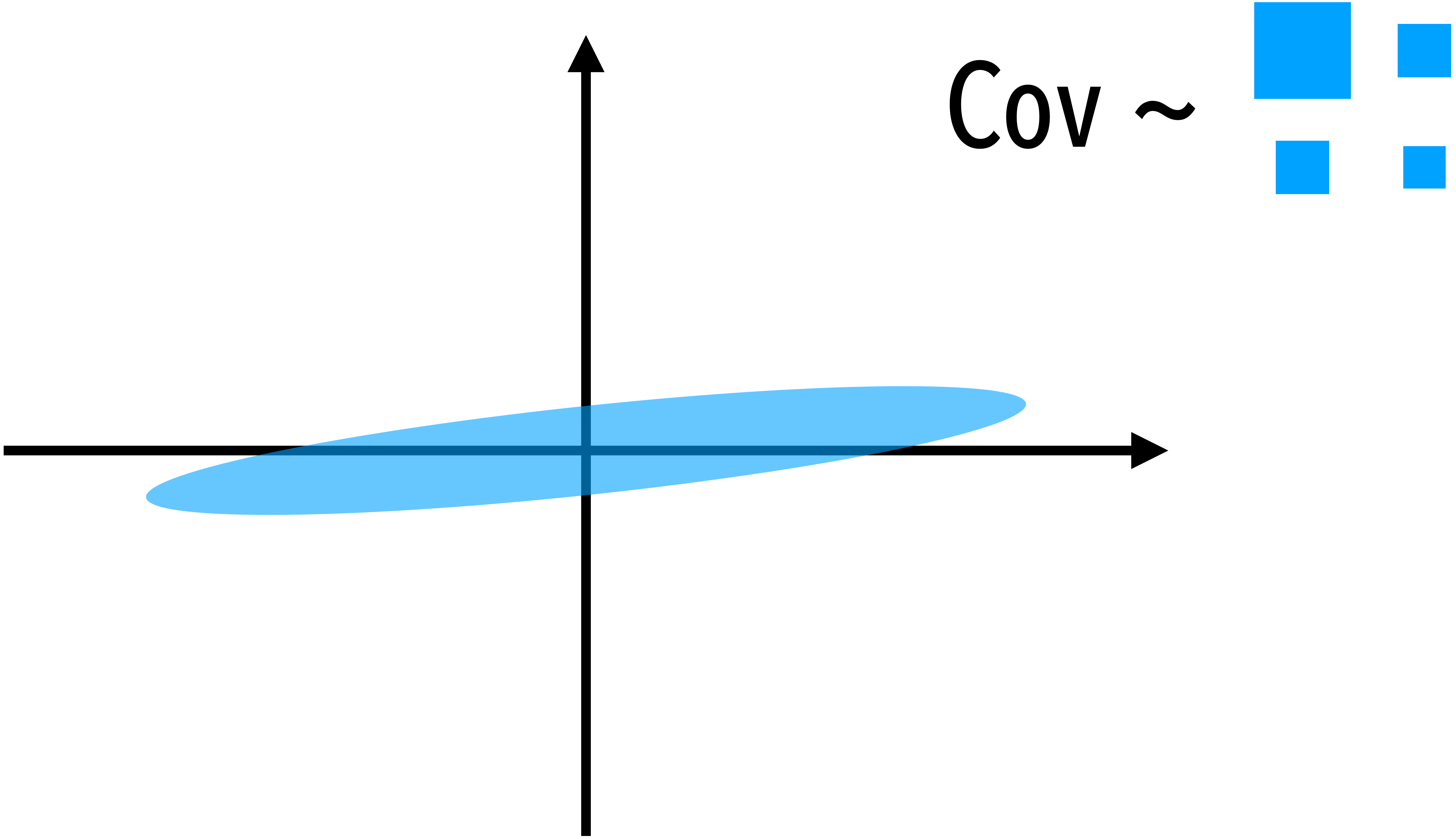


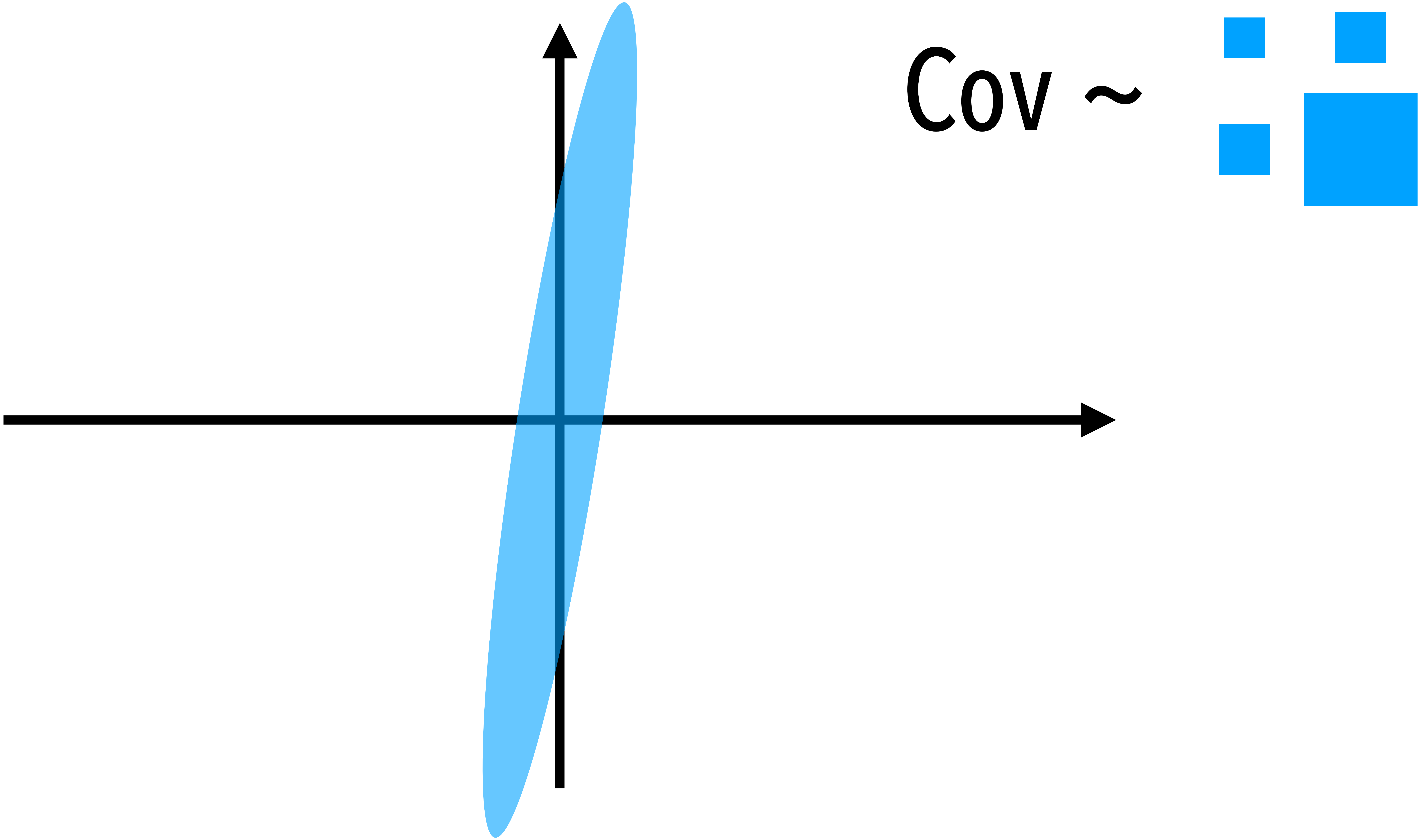
Positive covariance

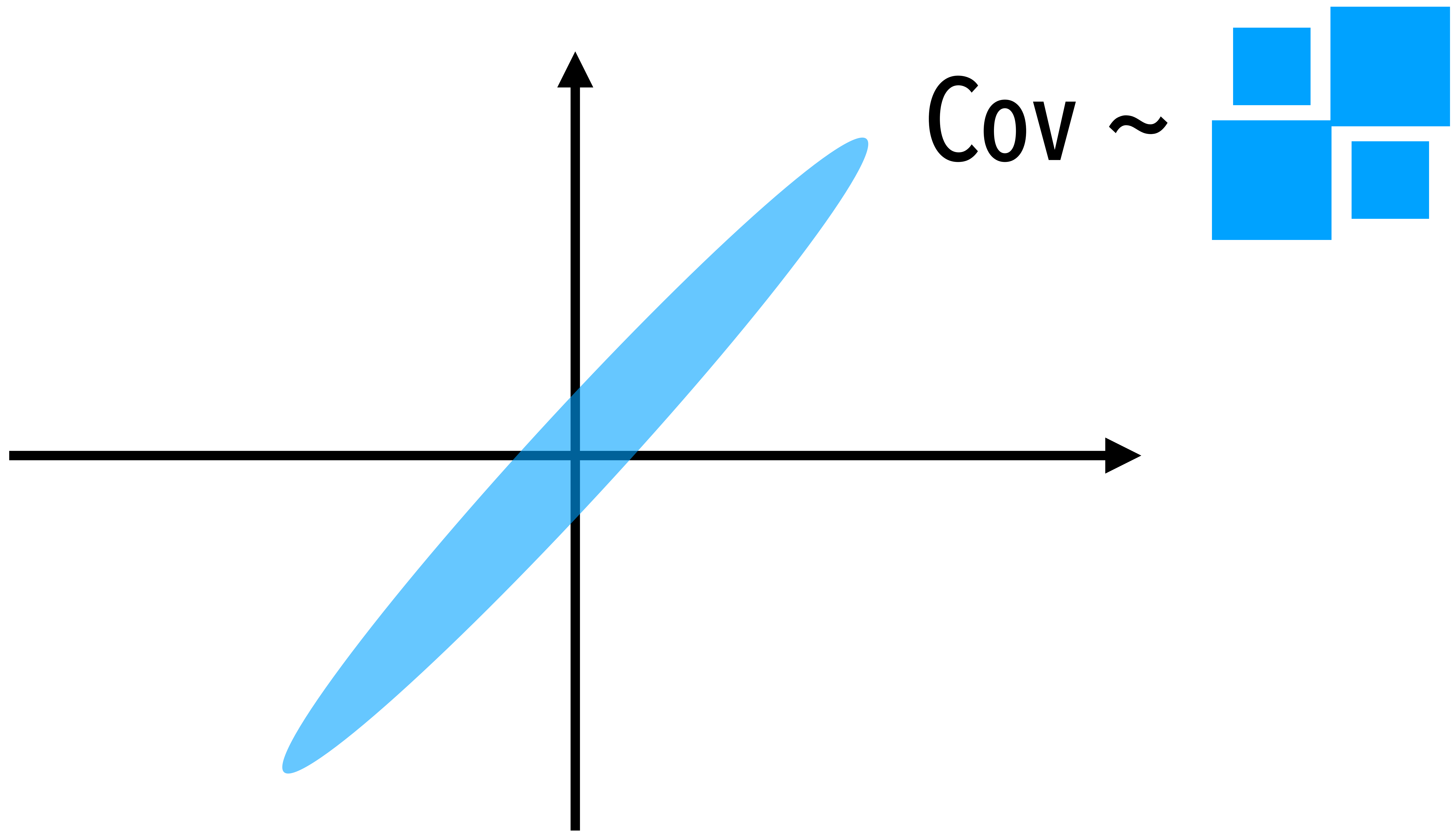


Negative covariance




Cov ~

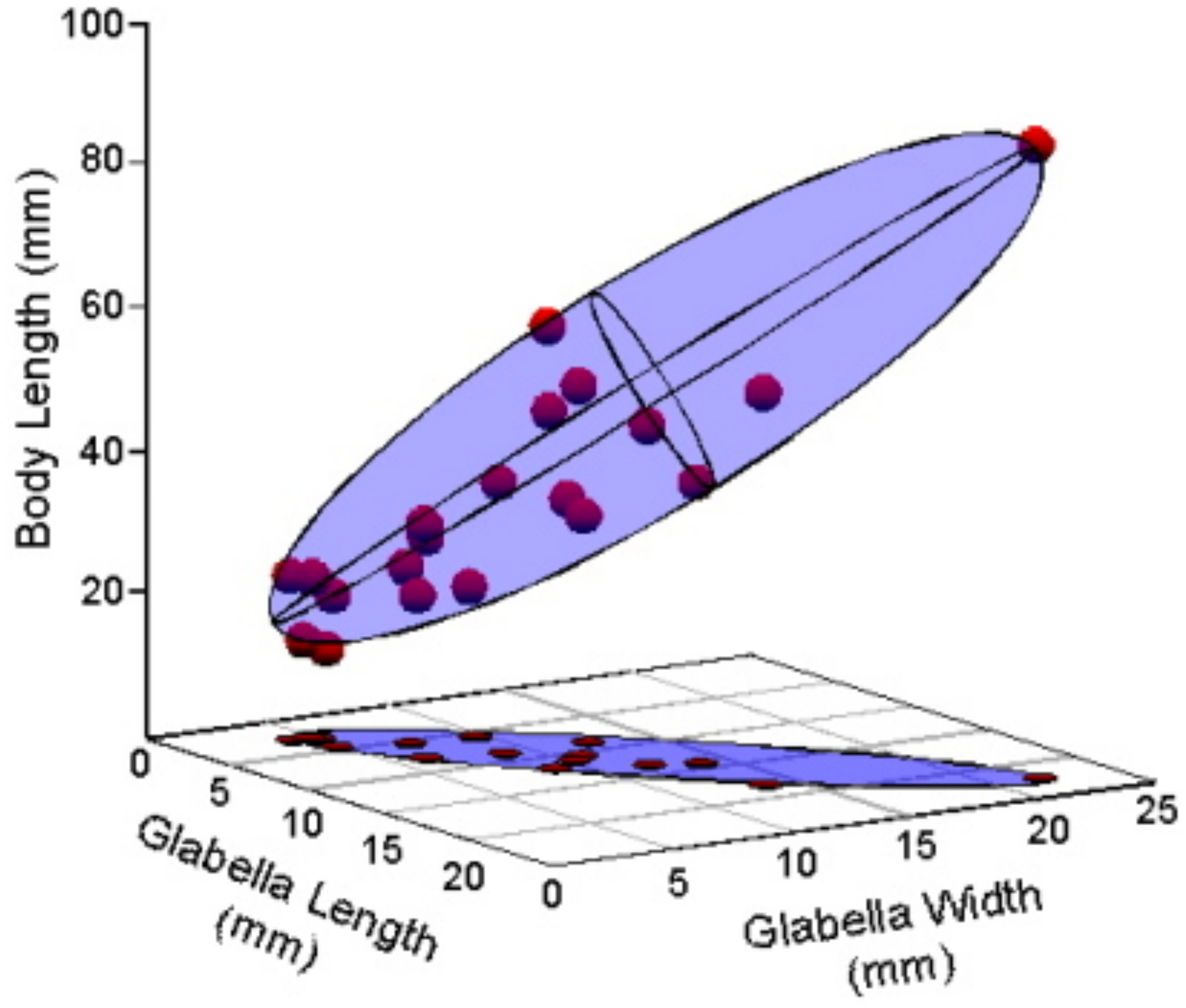

Cov ~


Cov ~

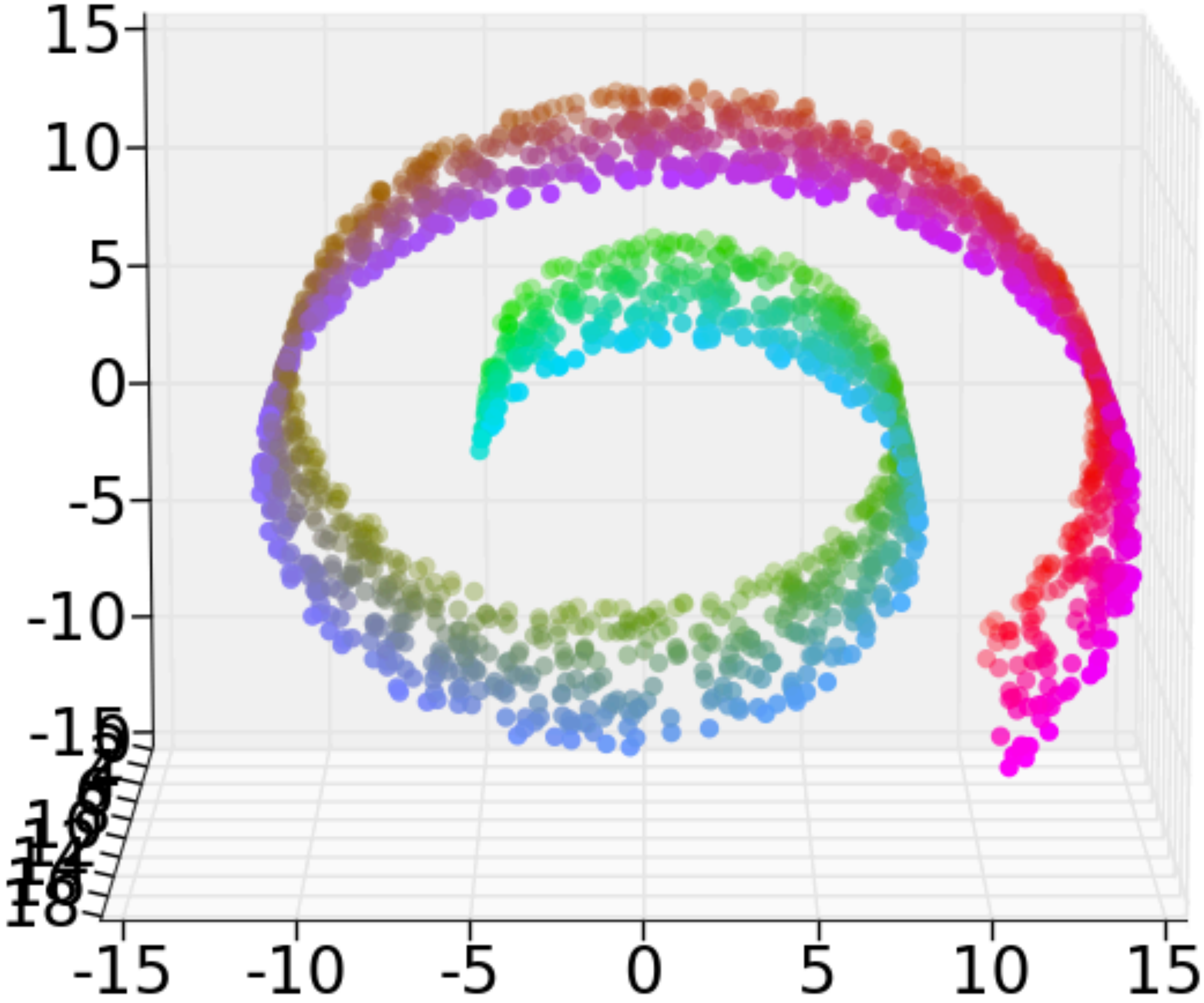
PCA: calculate the eigenvectors of the covariance matrix

PCA: simple, deterministic, fast, and highly interpretable.

When would PCA fail?



http://www.palass.org/publications/newsletter/palaeomath-101/palaeomath-part-5-pca-eigenanalysis-regression-v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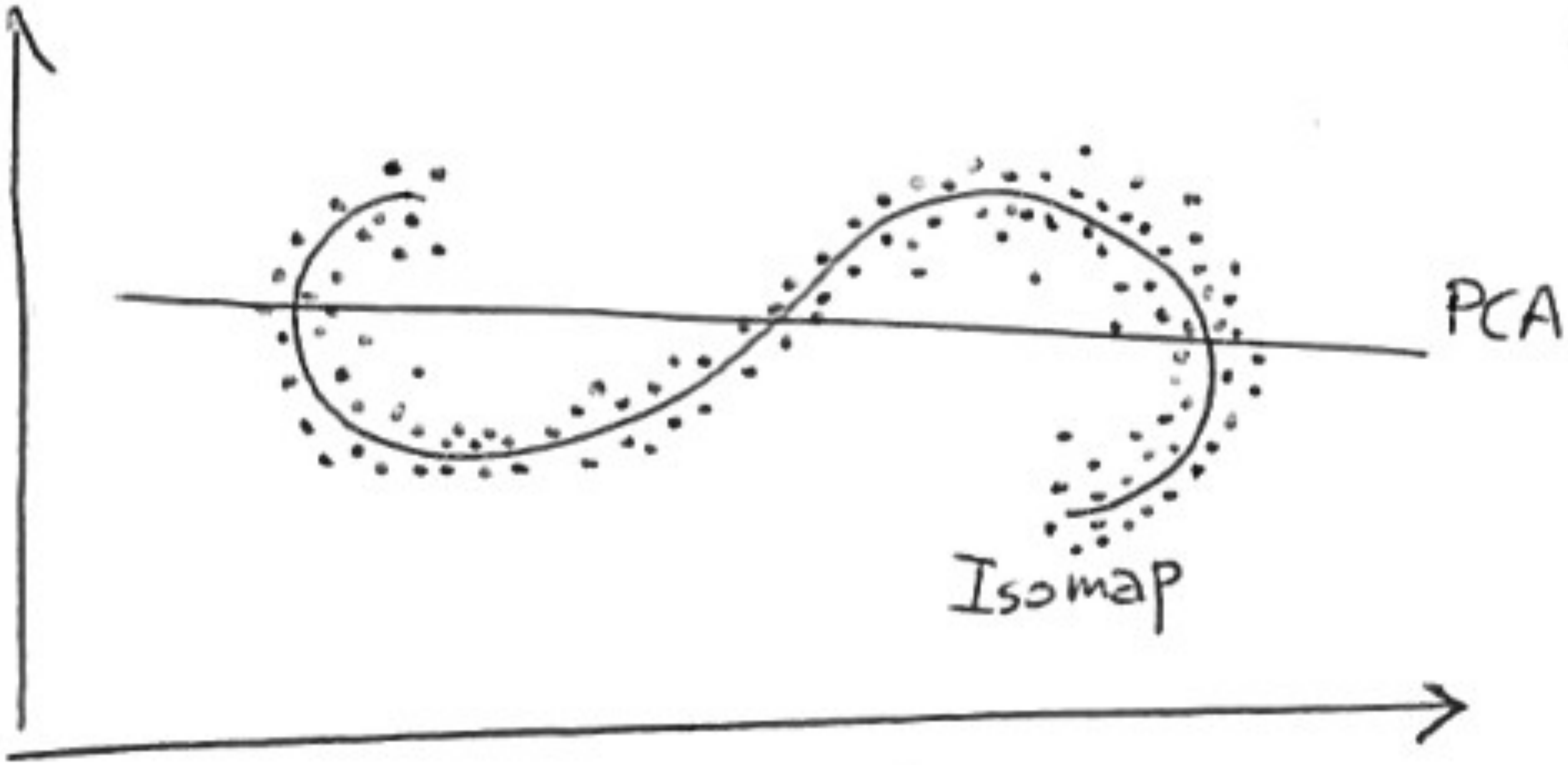
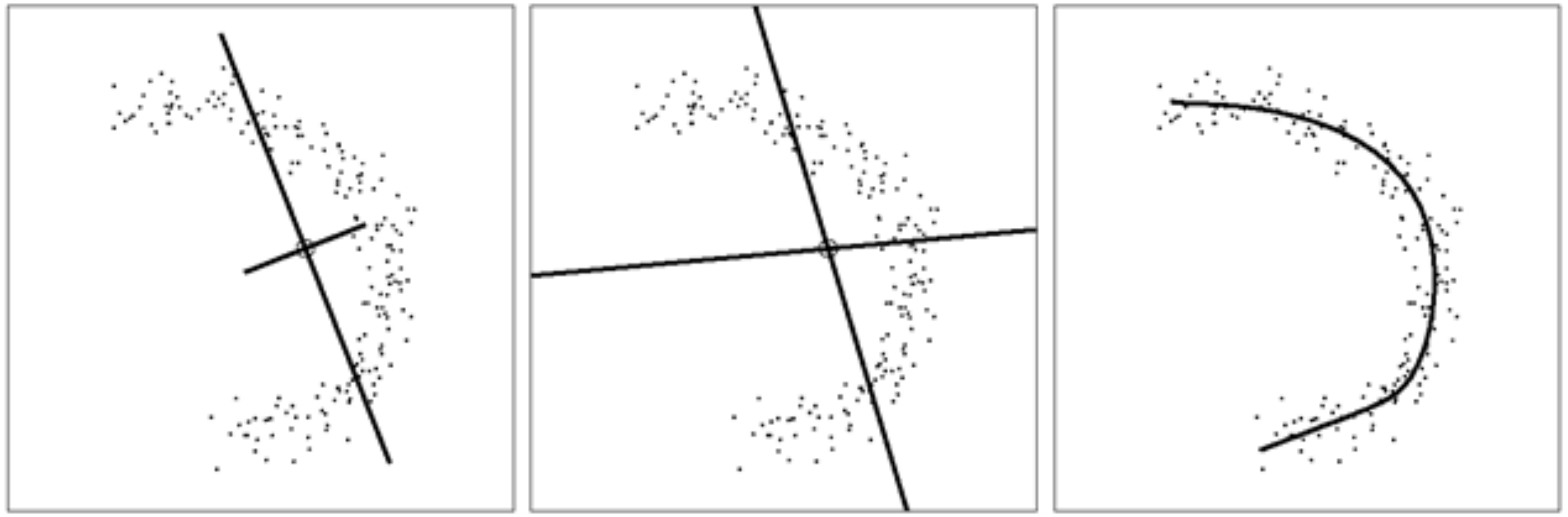


https://stats.stackexchange.com/questions/124534/how-to-understand-nonlinear-as-in-nonlinear-dimensionality-reduction

Sometimes the “axis” may not be **linear**. (it’s called “**manifold**”)



(a) (b) (c)

a **Manifold**: a topological space that locally resemble Euclidean space (imagine curved space)

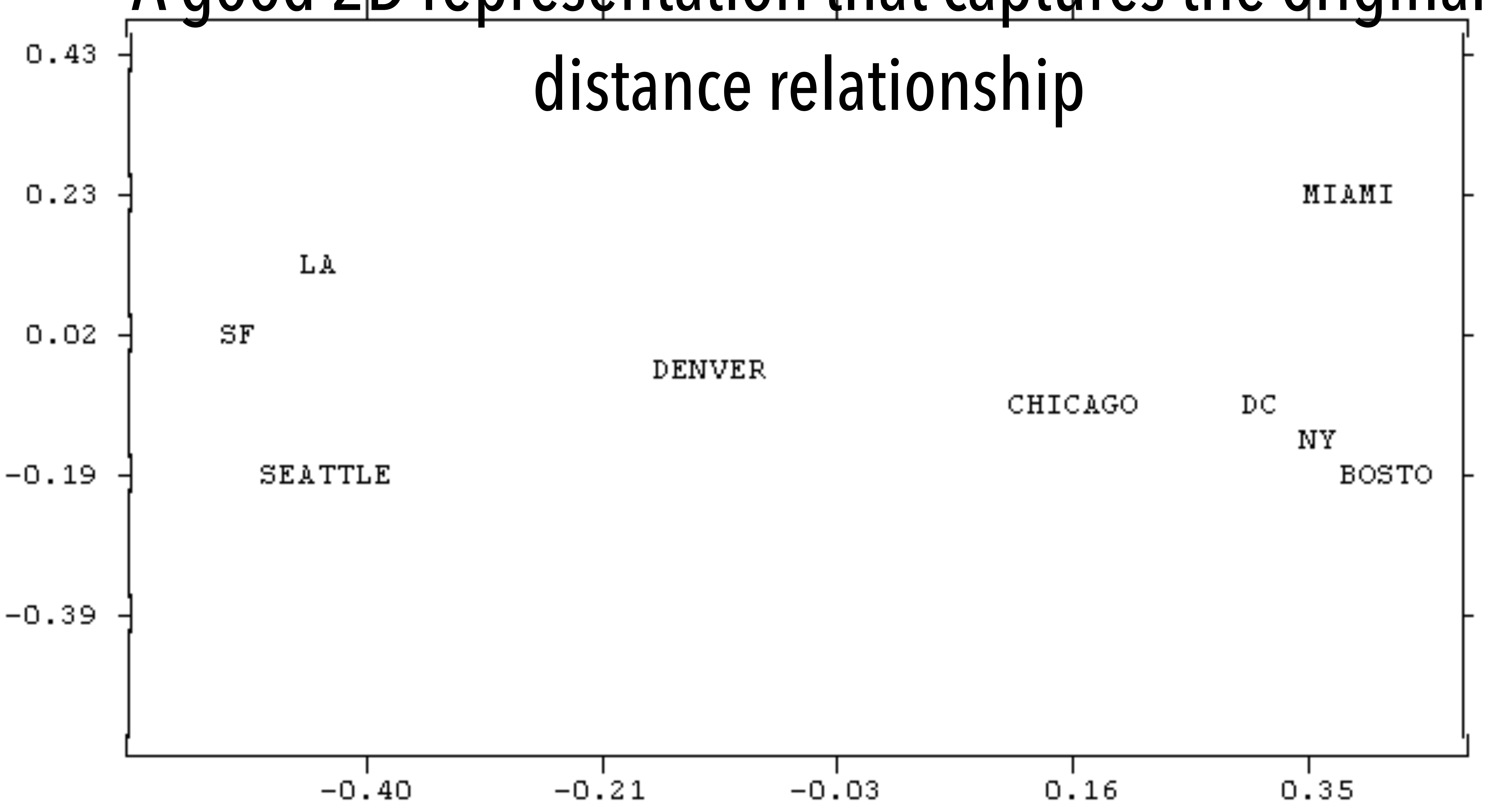
Other methods:
MDS, Isomap, t-SNE, and UMAP

Multi-**D**imensional **S**caling

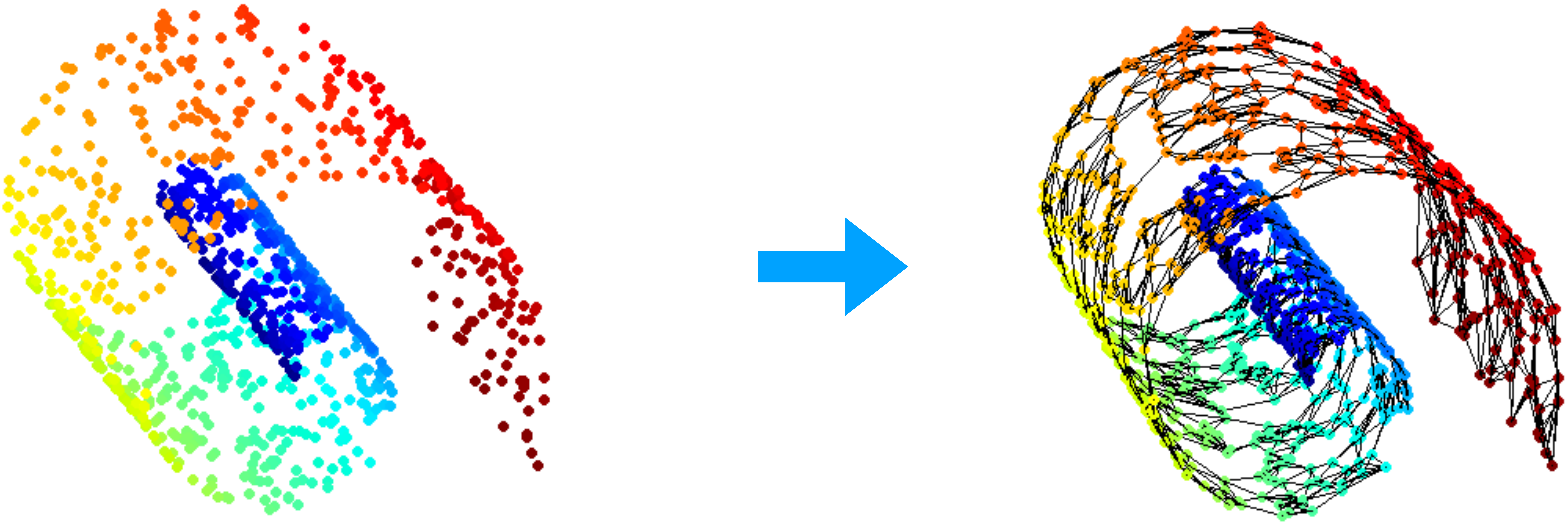
(MDS)

e.g. Distances between cities in 3D

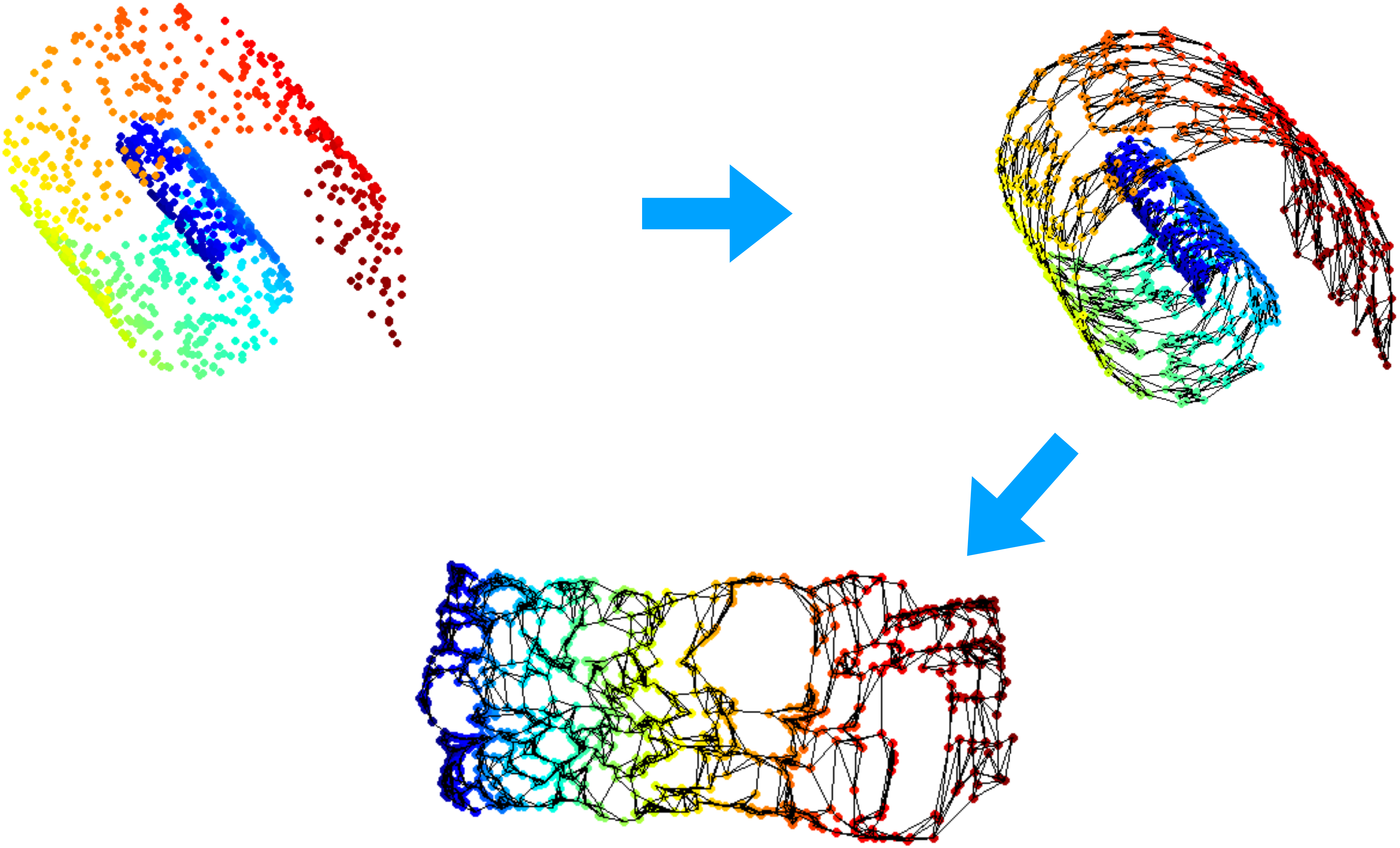
A good 2D representation that captures the original distance relationship



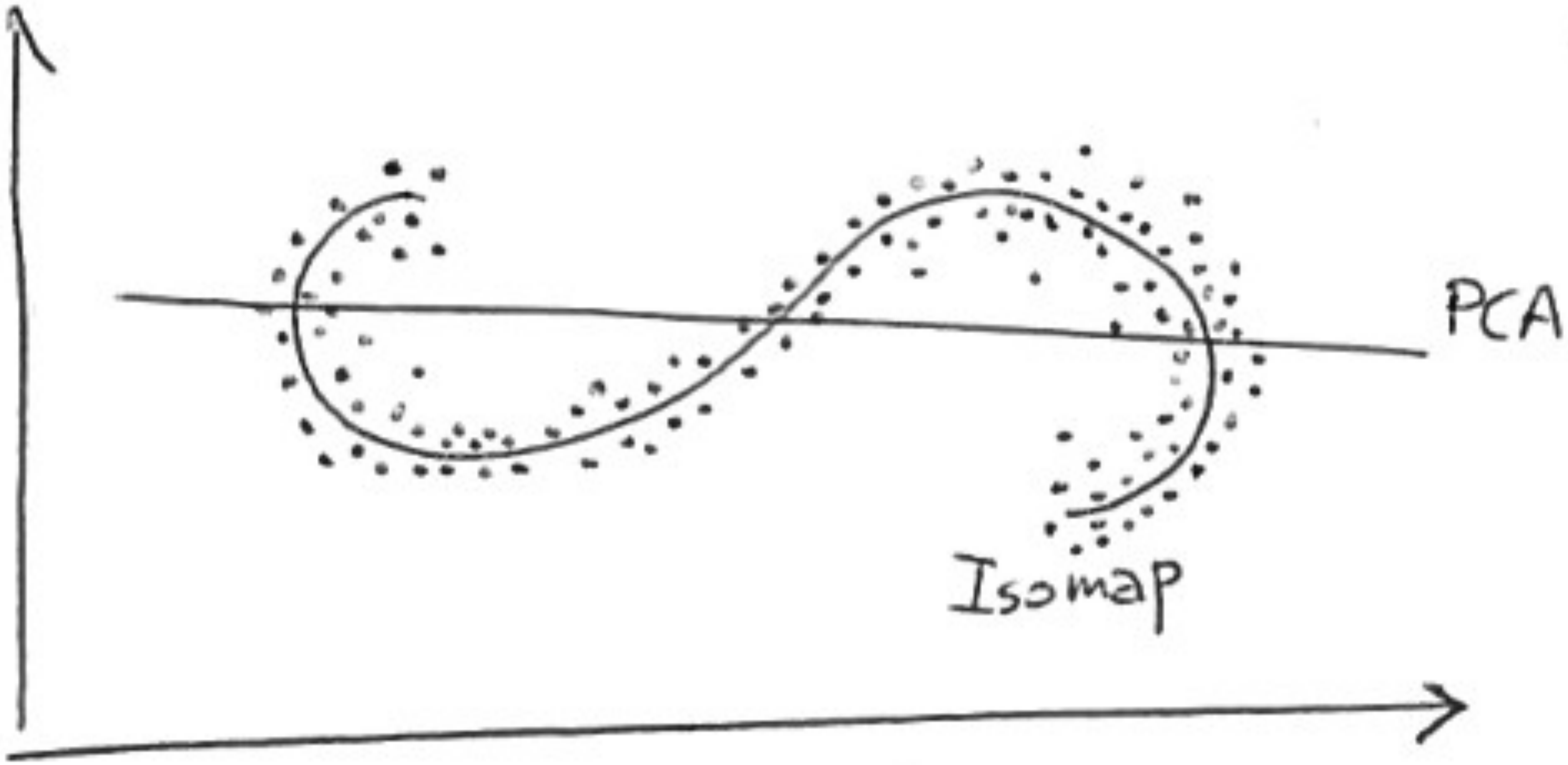
Isomap



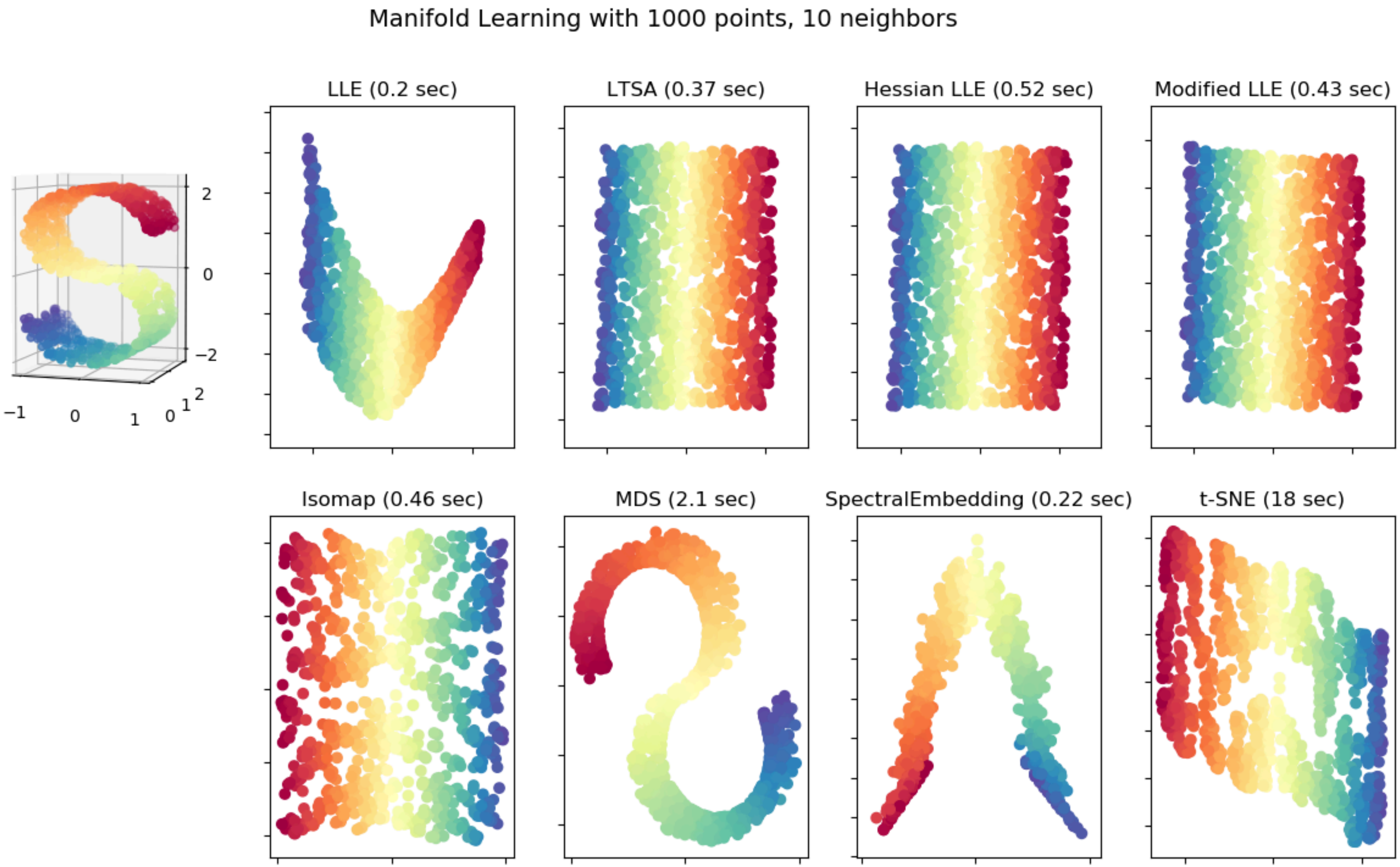
http://www.numerical-tours.com/matlab/shapes_7_isomap/



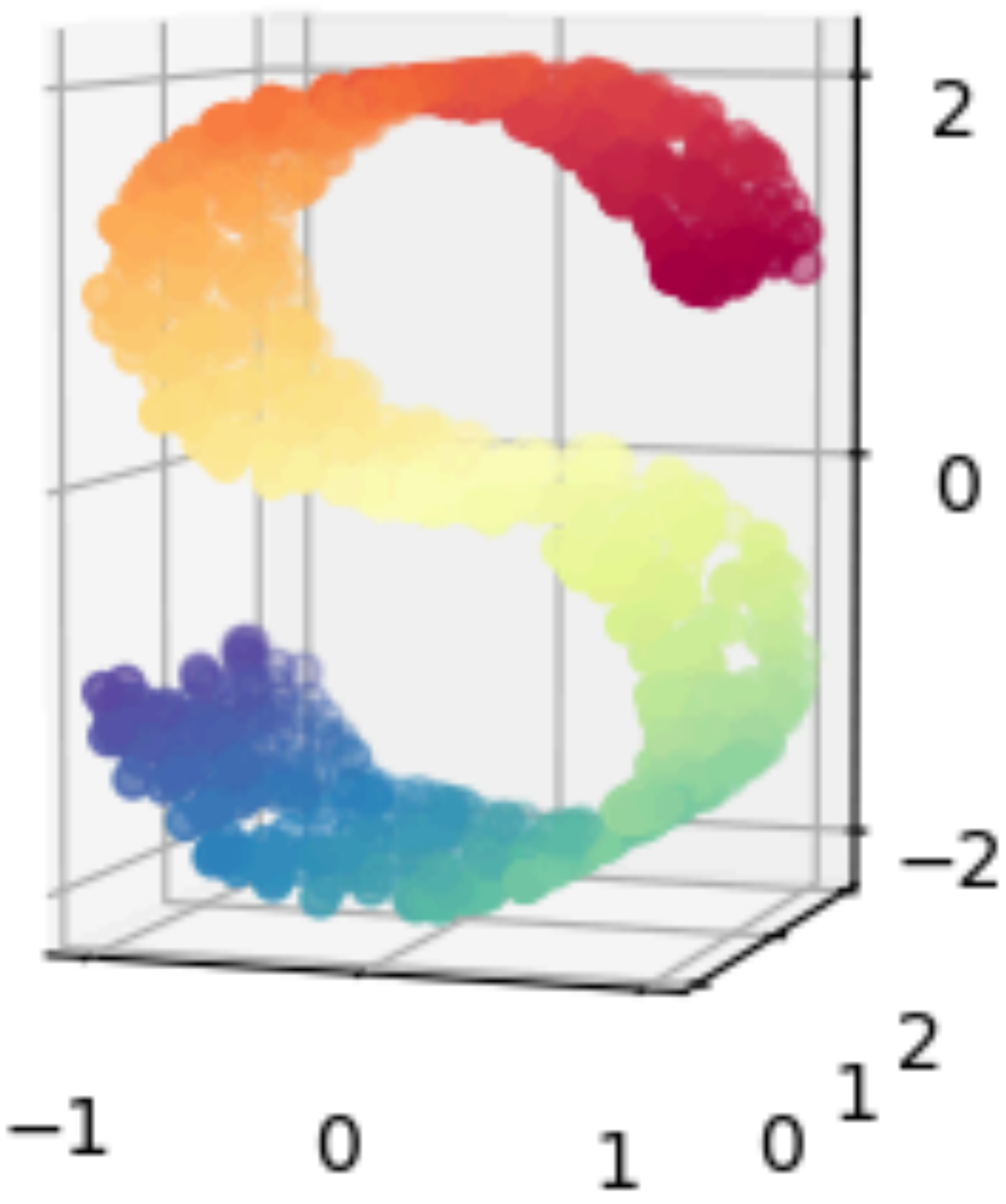
http://www.numerical-tours.com/matlab/shapes_7_isomap/

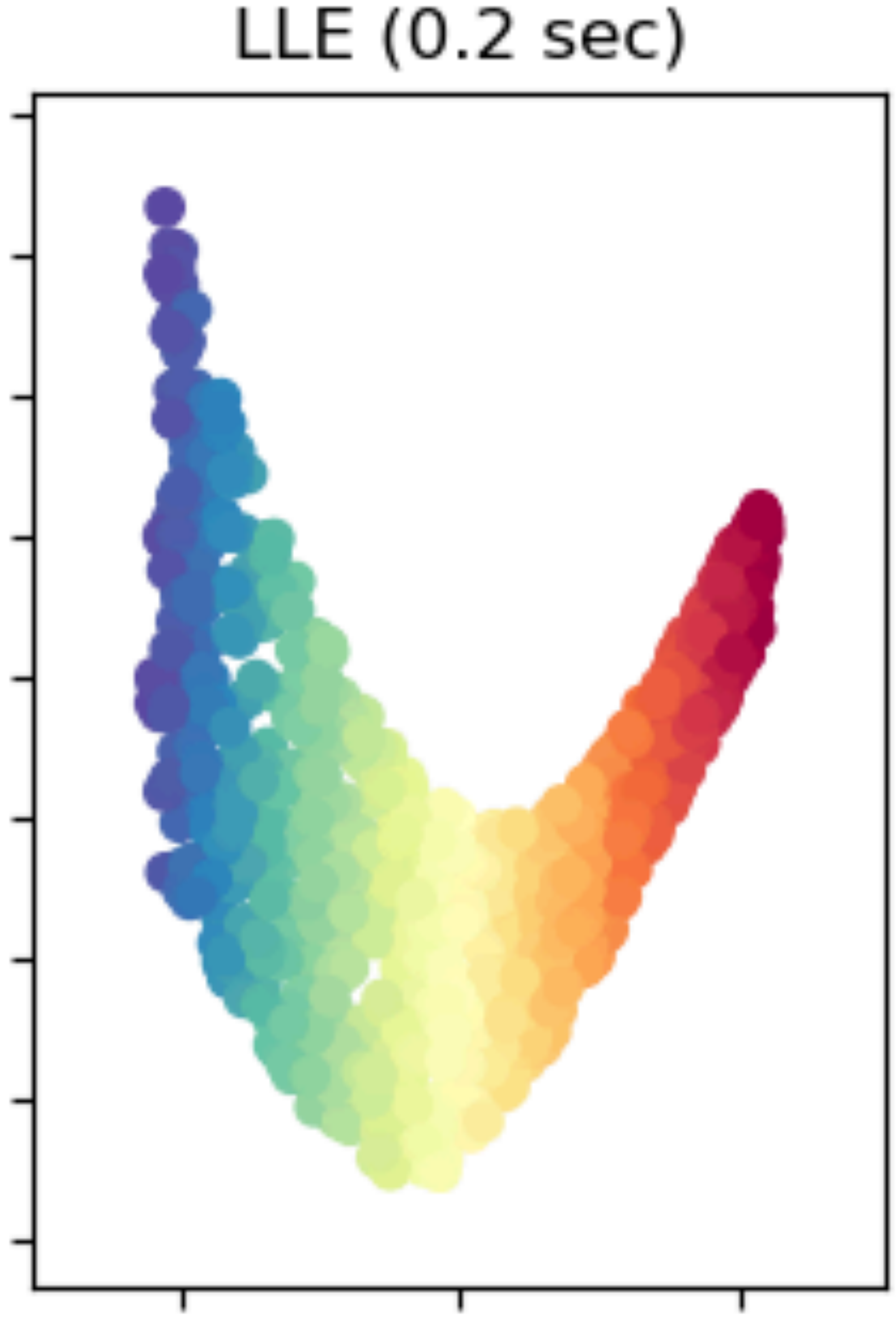


https://stats.stackexchange.com/questions/124534/how-to-understand-nonlinear-as-in-nonlinear-dimensionality-reduction



http://scikit-learn.org/stable/modules/manifold.html





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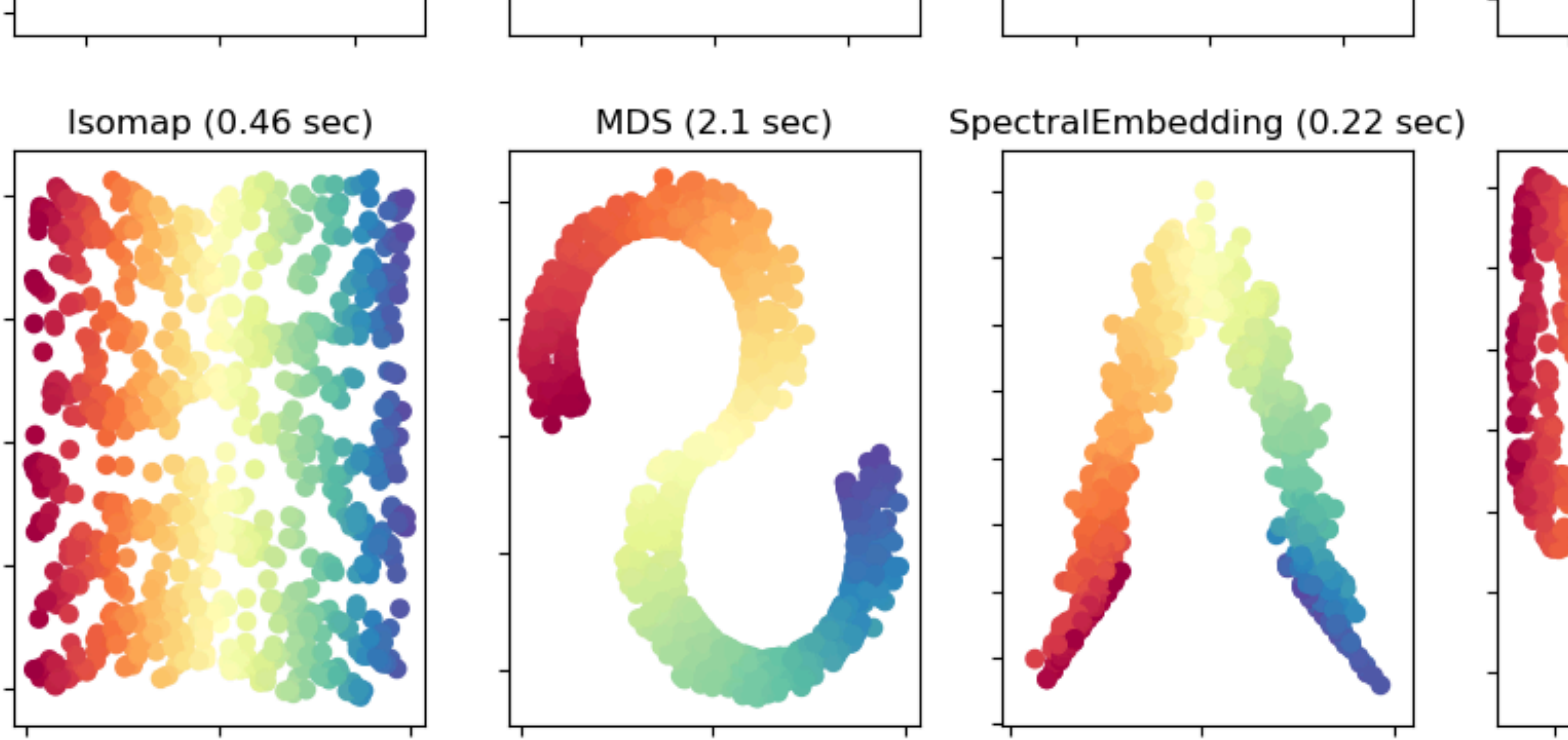

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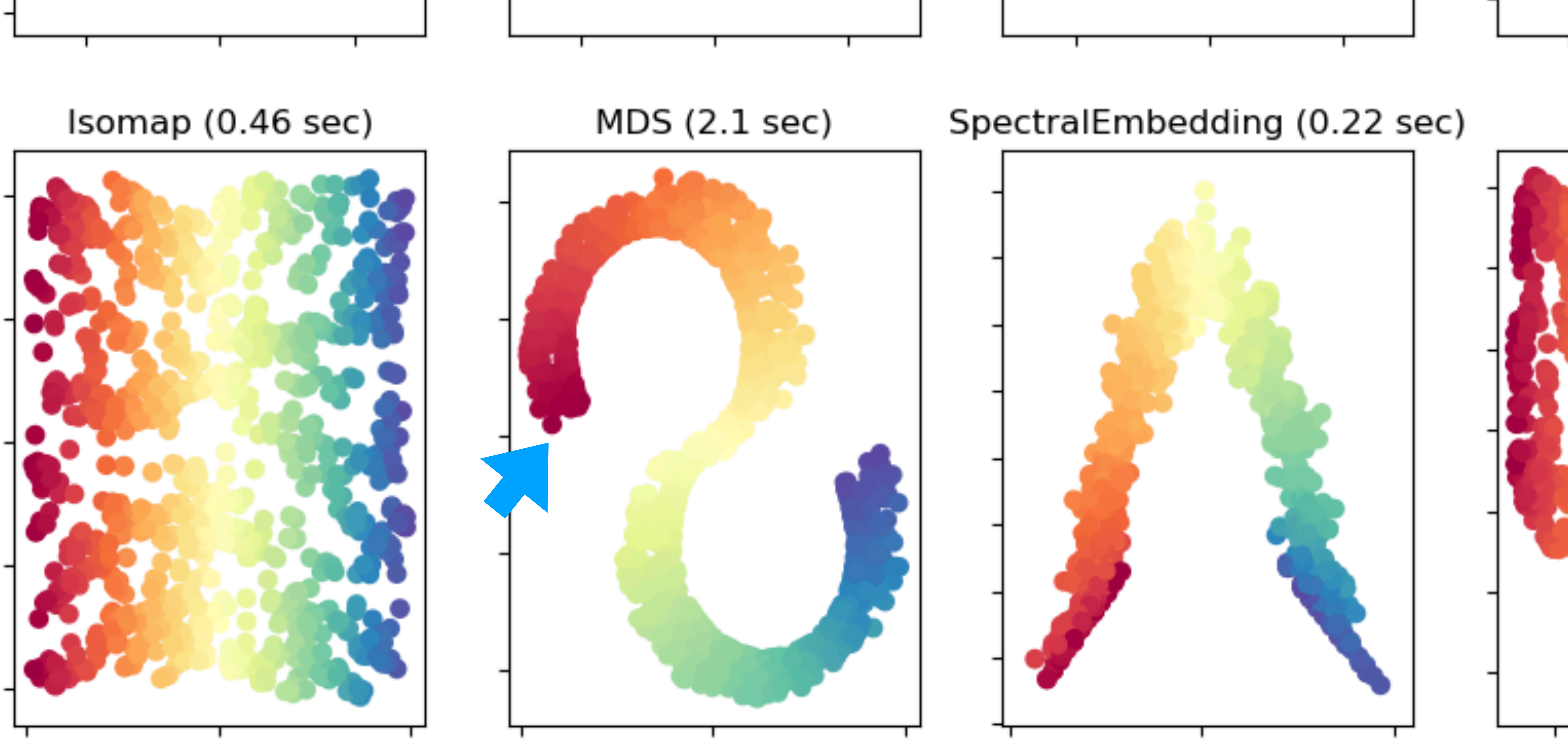

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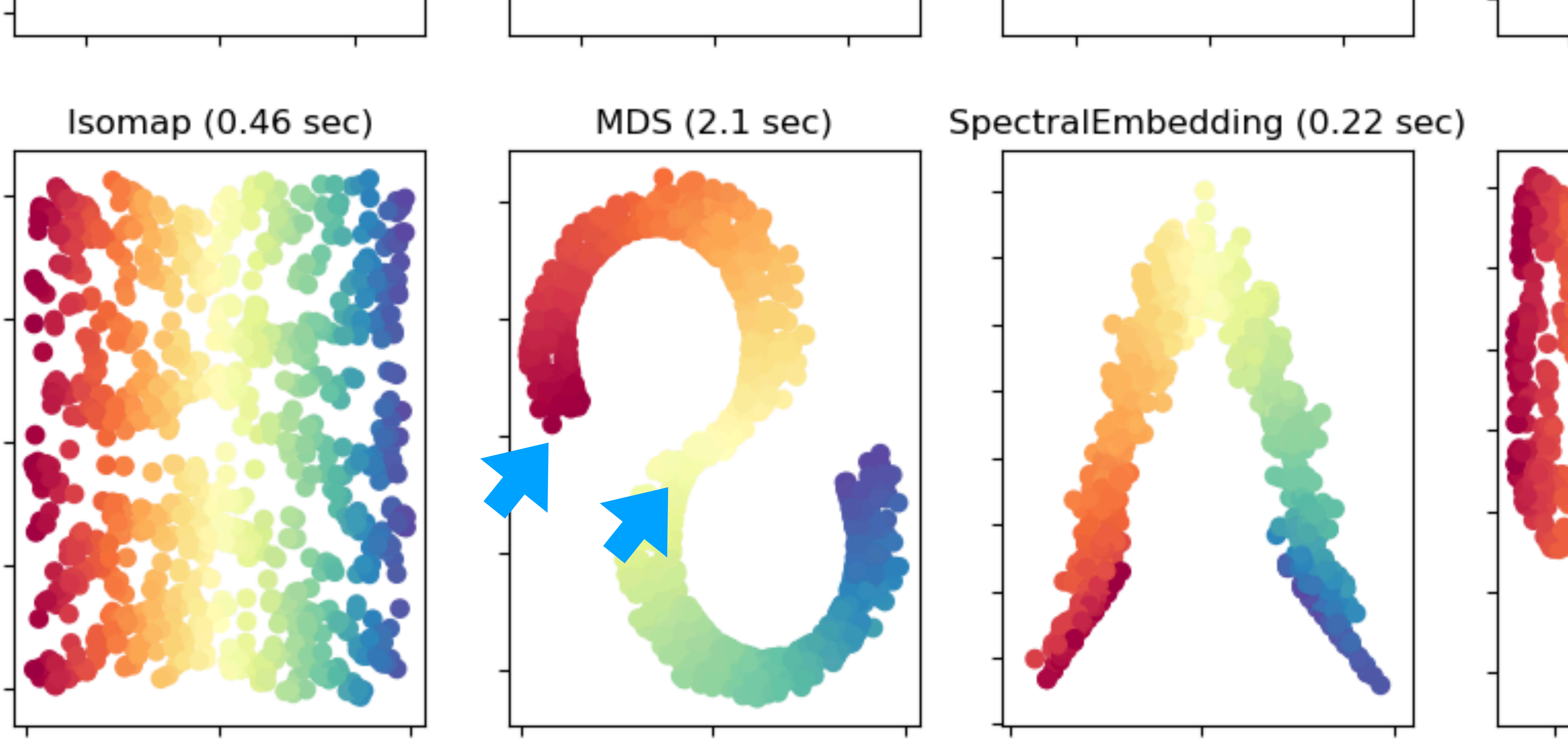

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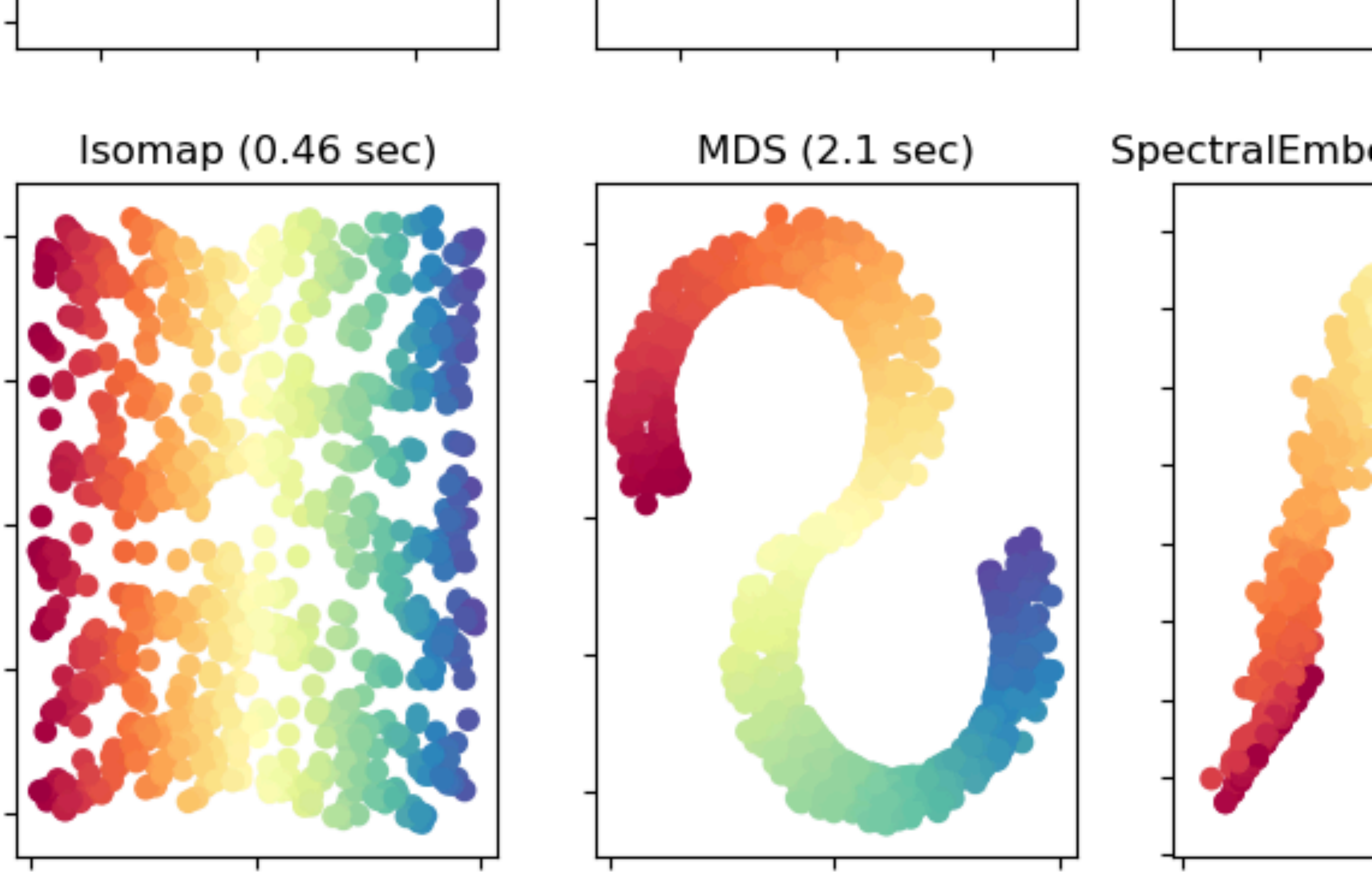
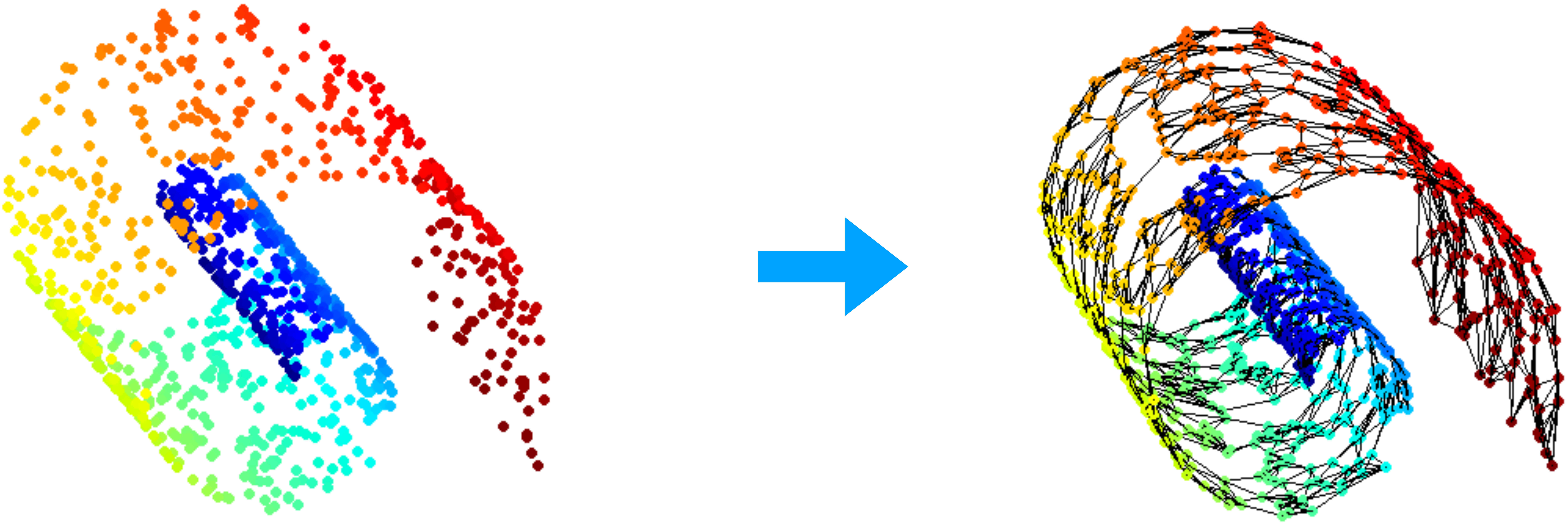
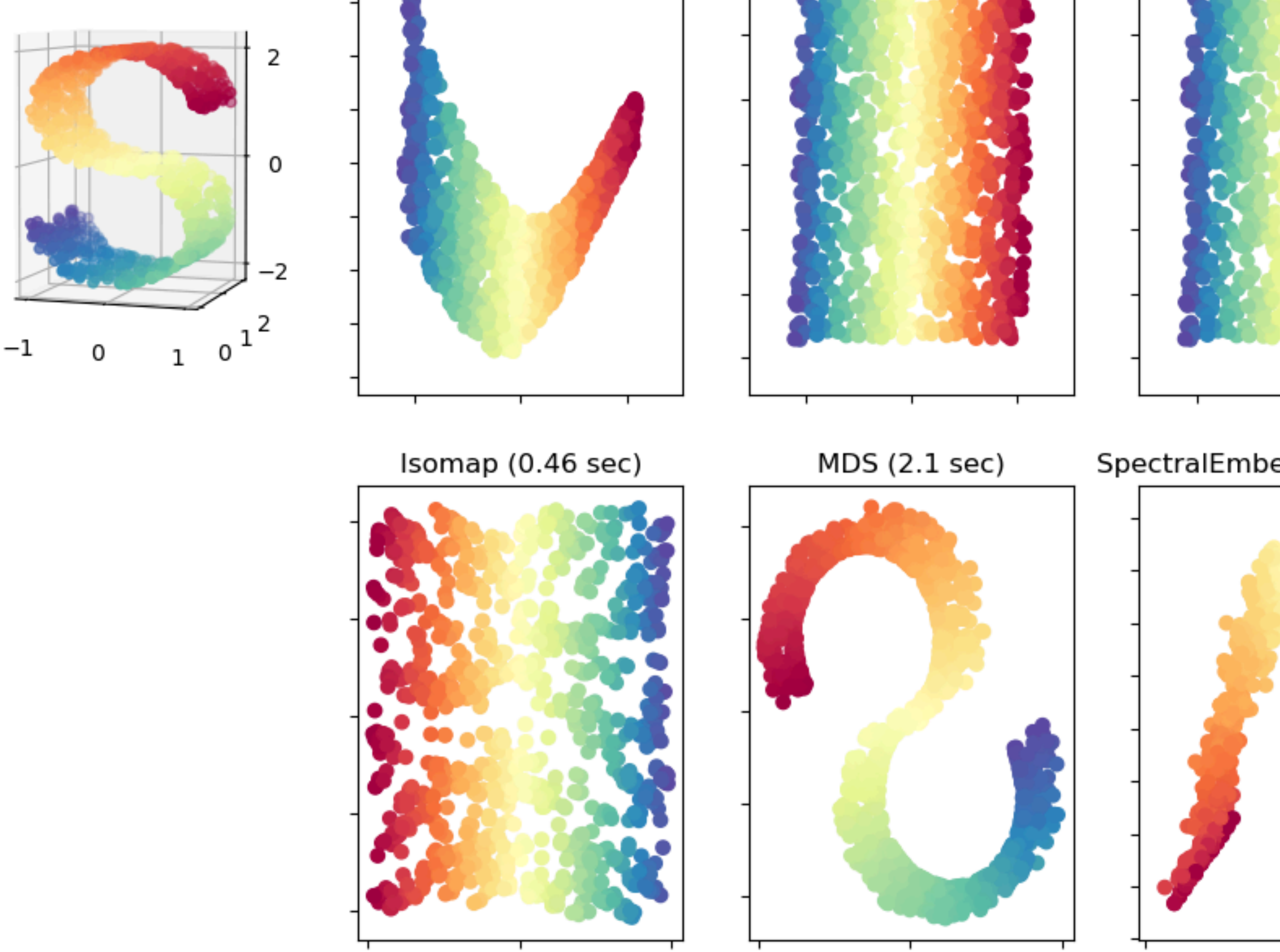


http://scikit-learn.org/stable/modules/manifold.html



http://www.numerical-tours.com/matlab/shapes_7_isomap/



http://scikit-learn.org/stable/modules/manifold.html

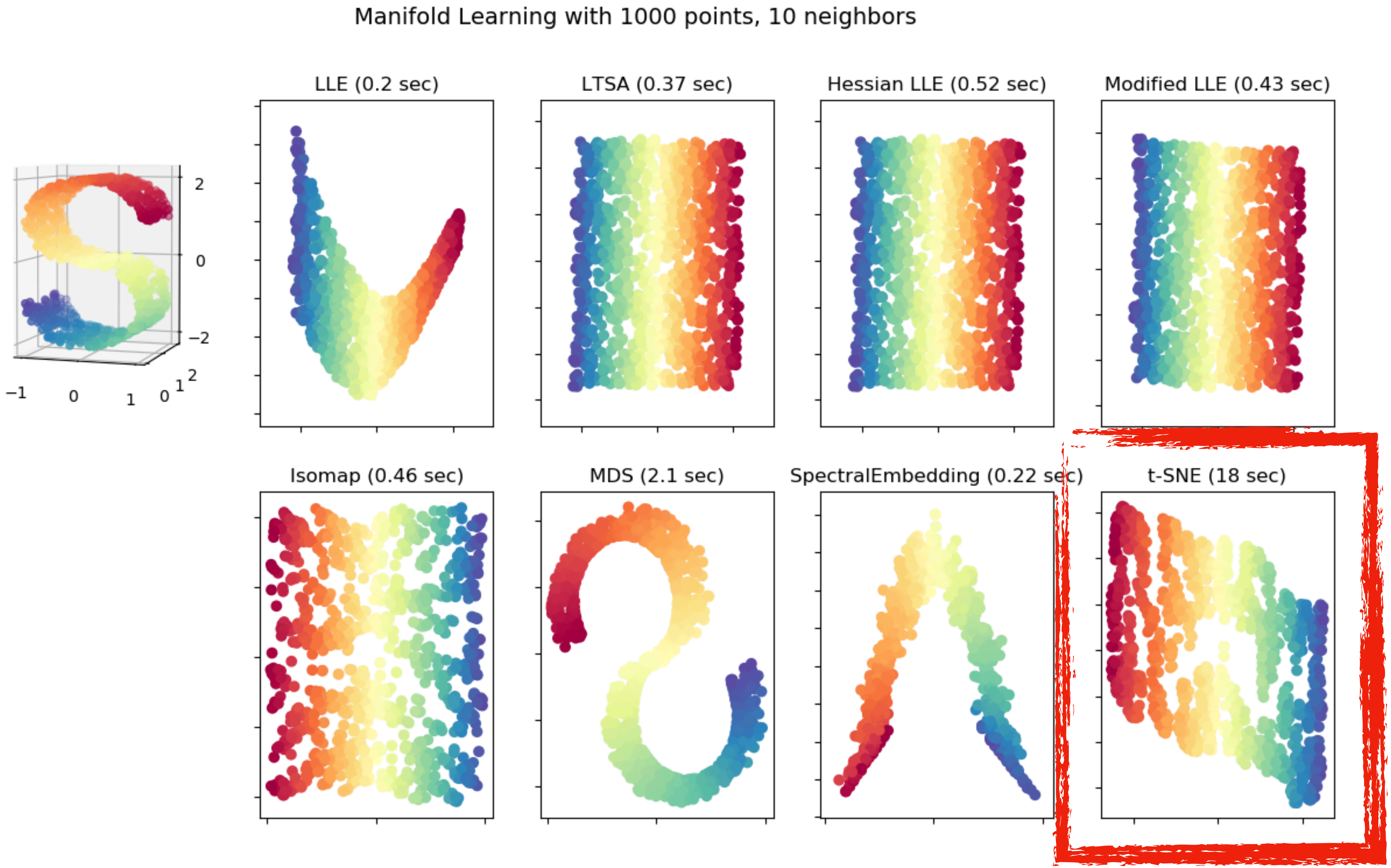
MDS: global

?

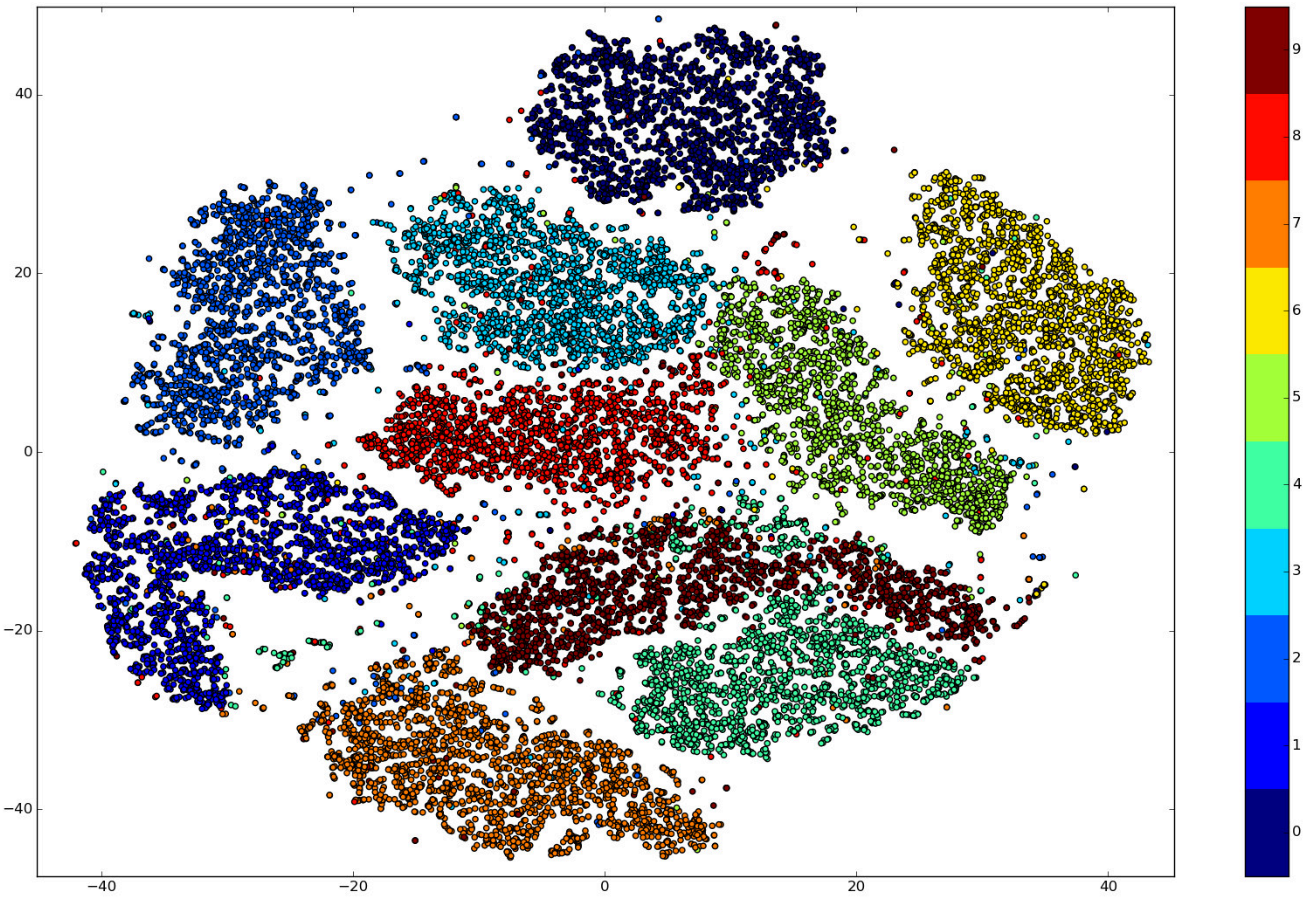
Isomap: local

t-SNE

t-distributed **S**tochastic **N**eighbor **E**mbedding



http://scikit-learn.org/stable/modules/manifold.html



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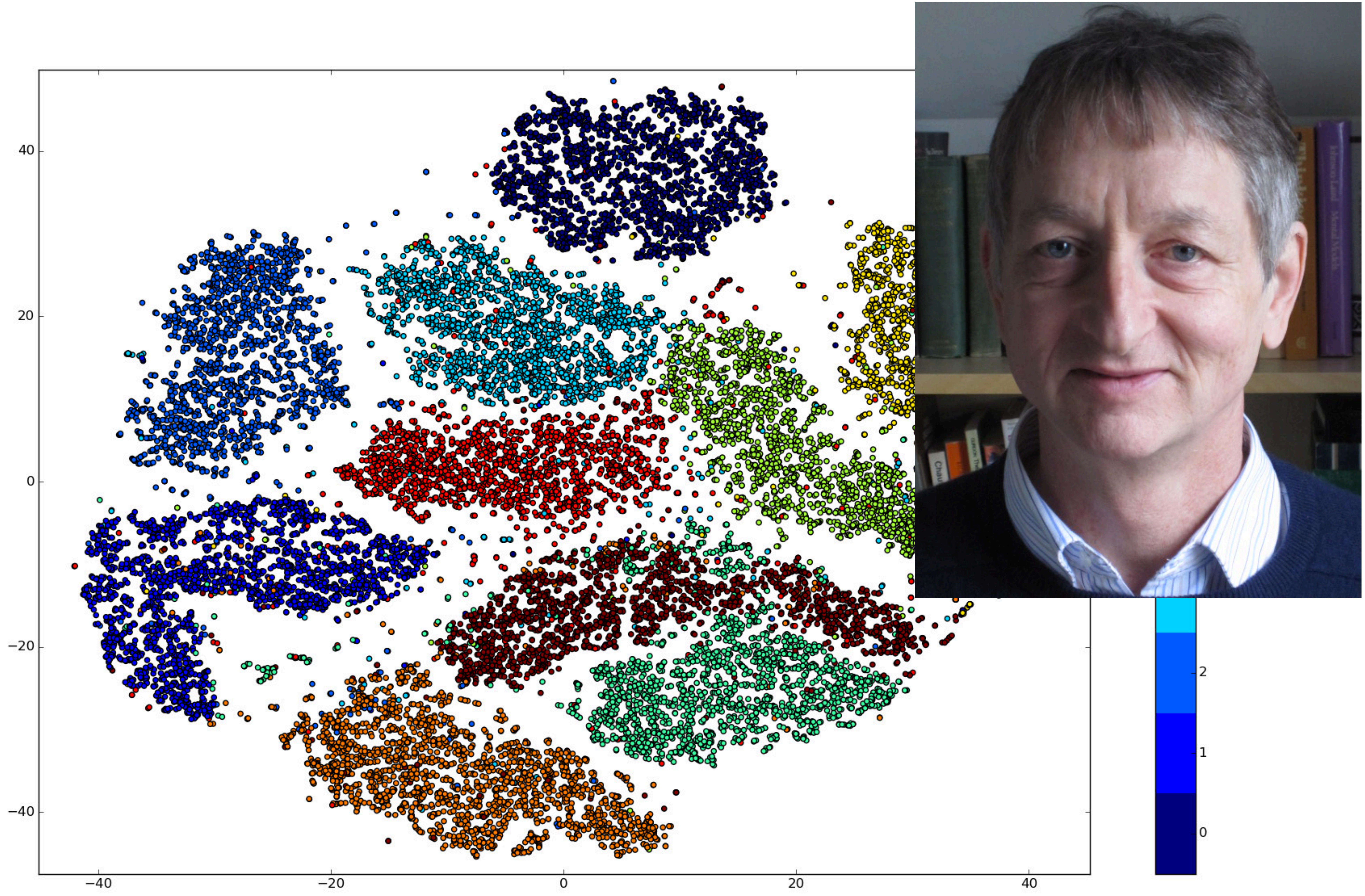
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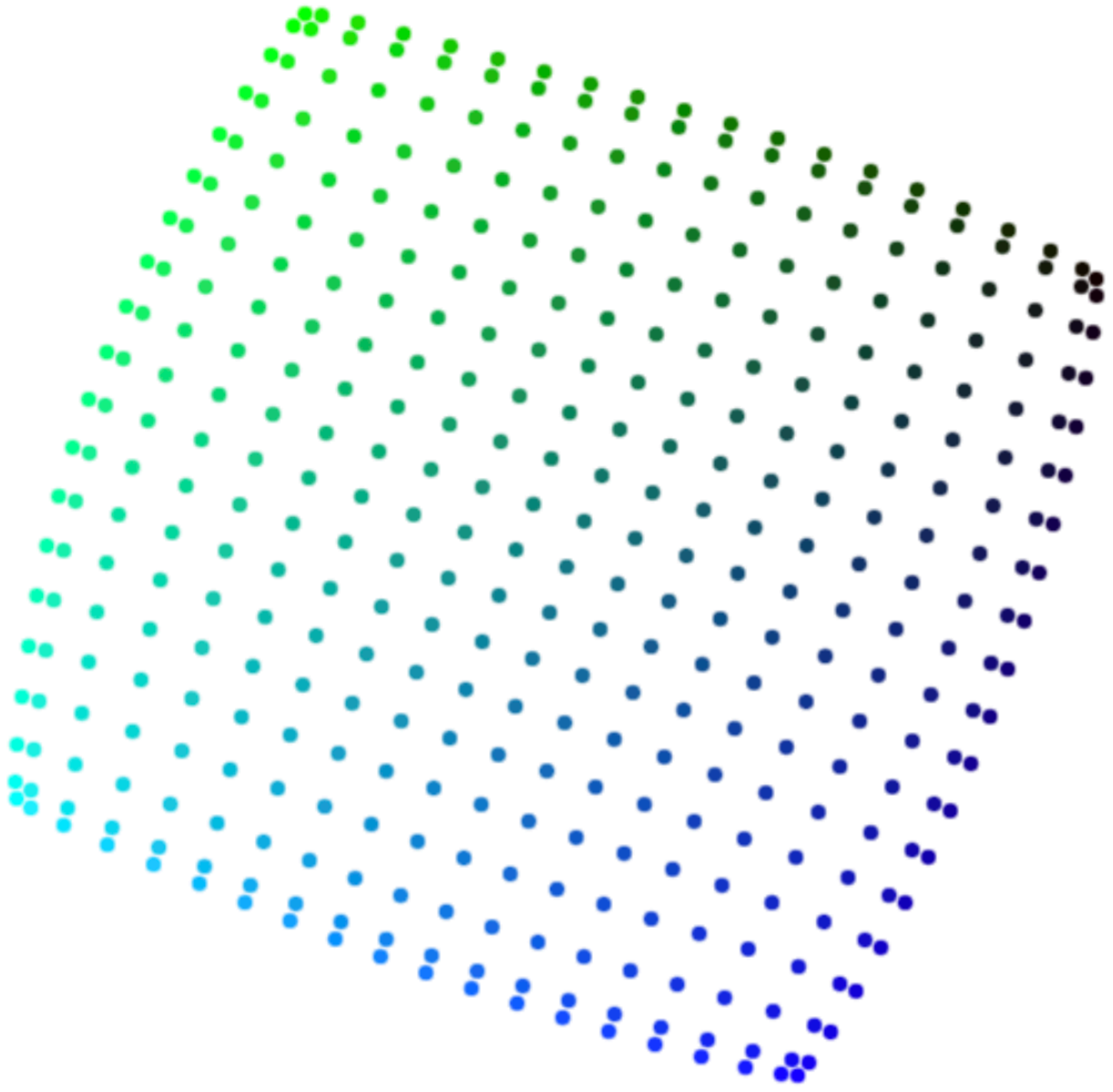
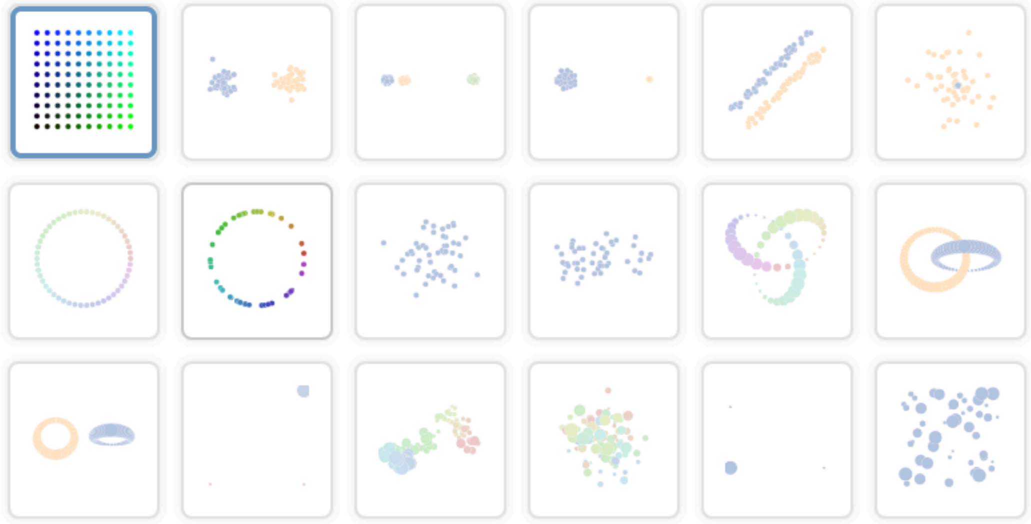
How to Use t-SNE Effectively

Although extremely useful for visualizing high-dimensional data, t-SNE plots can sometimes be mysterious or misleading. By exploring how it behaves in simple cases, we can learn to use it more effectively.





Step
187

A square grid with equal spacing between points. Try convergence at different sizes.

Points Per Side 20

Perplexity 10

Epsilon 5

MARTIN WATTENBERG
Google Brain

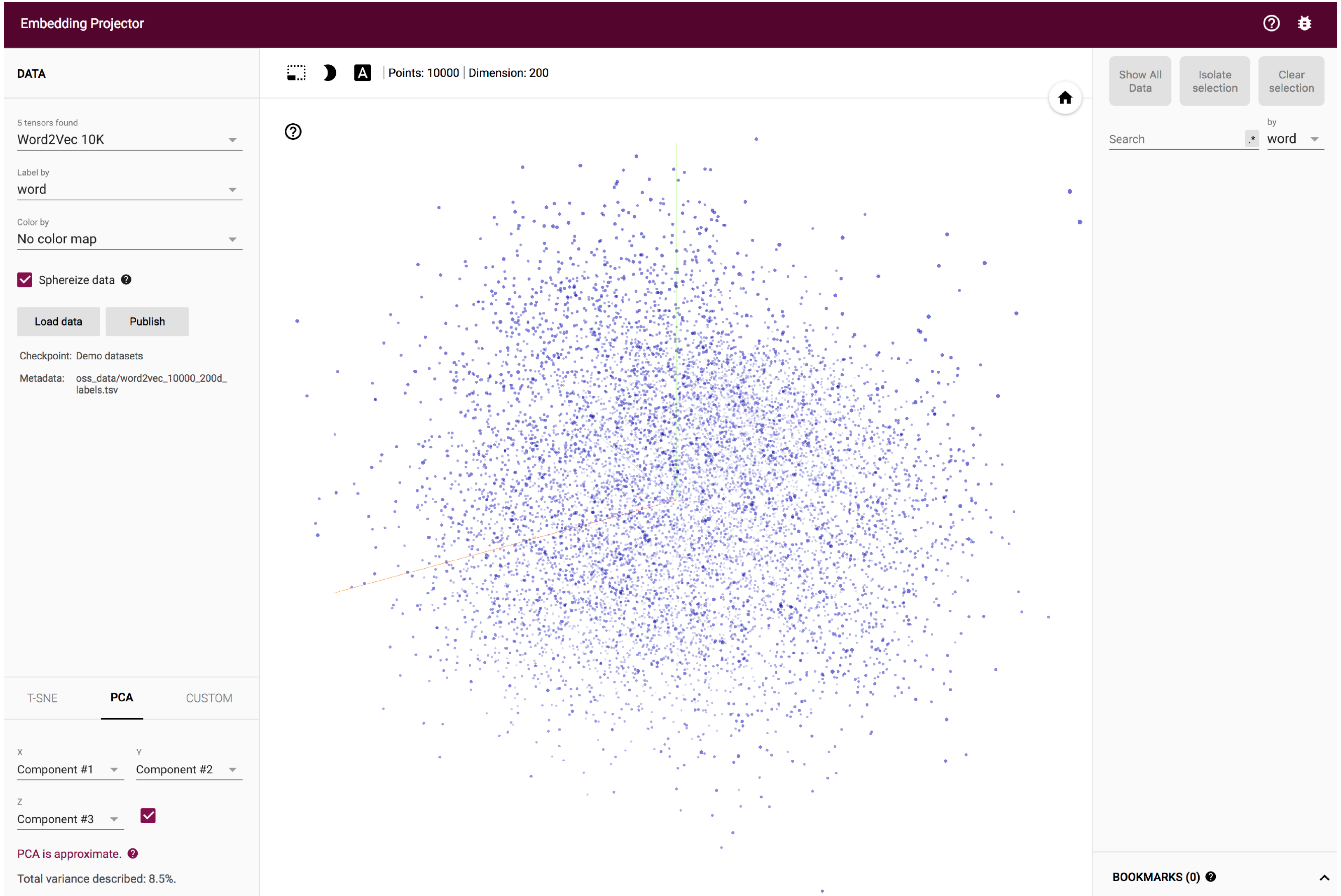
FERNANDA VIÉGAS
Google Brain

IAN JOHNSON
Google Cloud

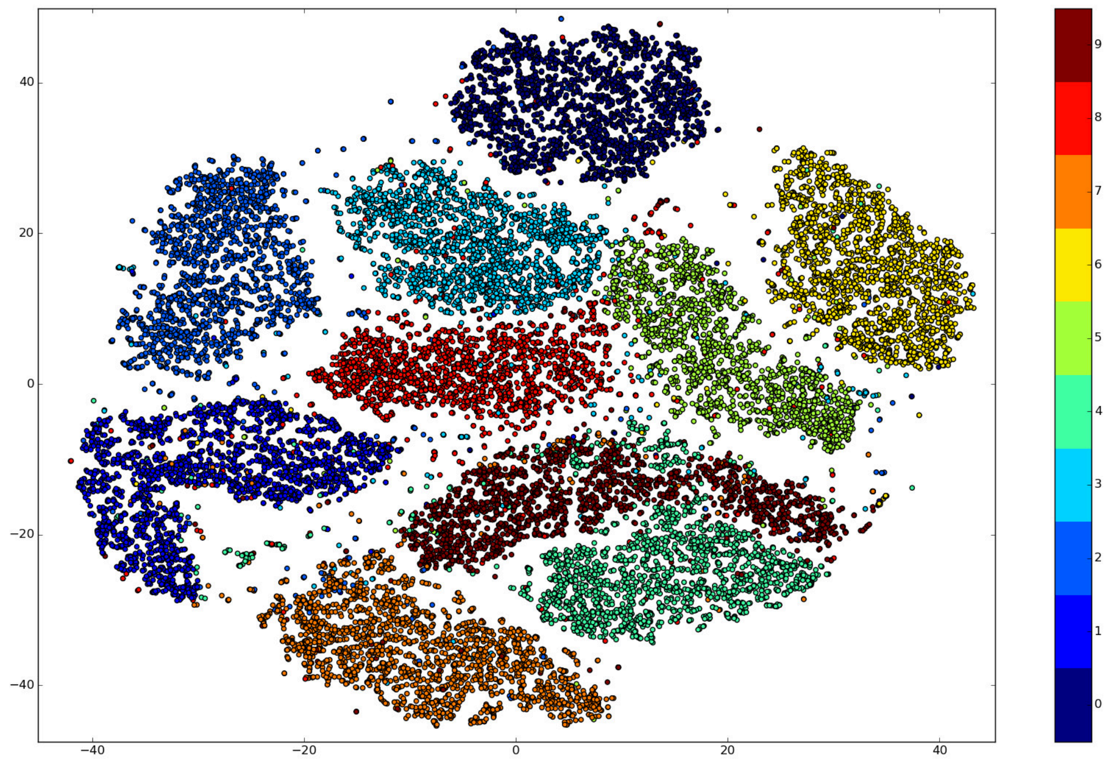
Oct. 13
2016

Citation:
Wattenberg, et al., 2016

https://projector.tensorflow.org/



UMAP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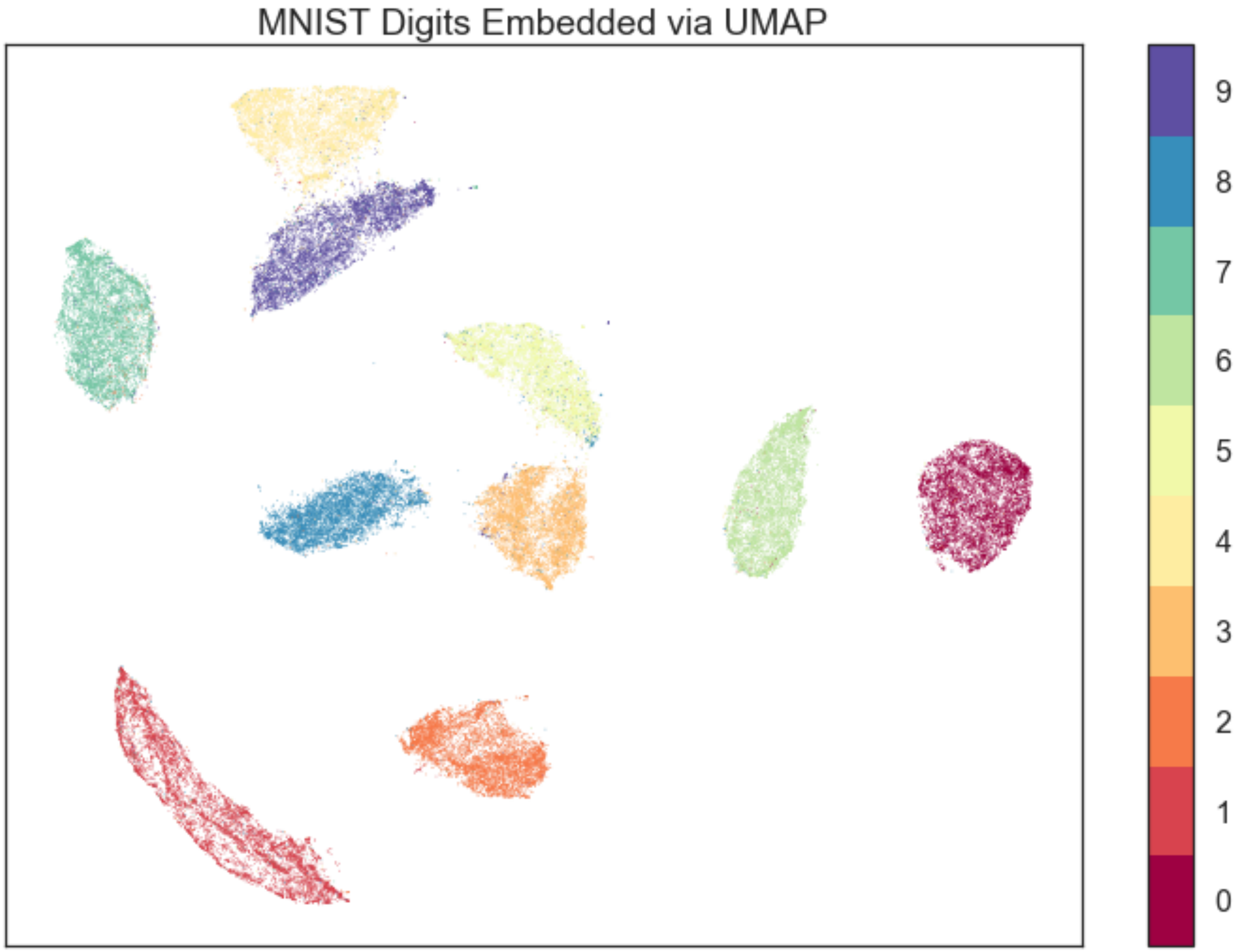
MNIST Digits Embedded via UMAP
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- PCA: linear, basic, simple, and transparent
- MDS – t-SNE/UMAP – Isomap

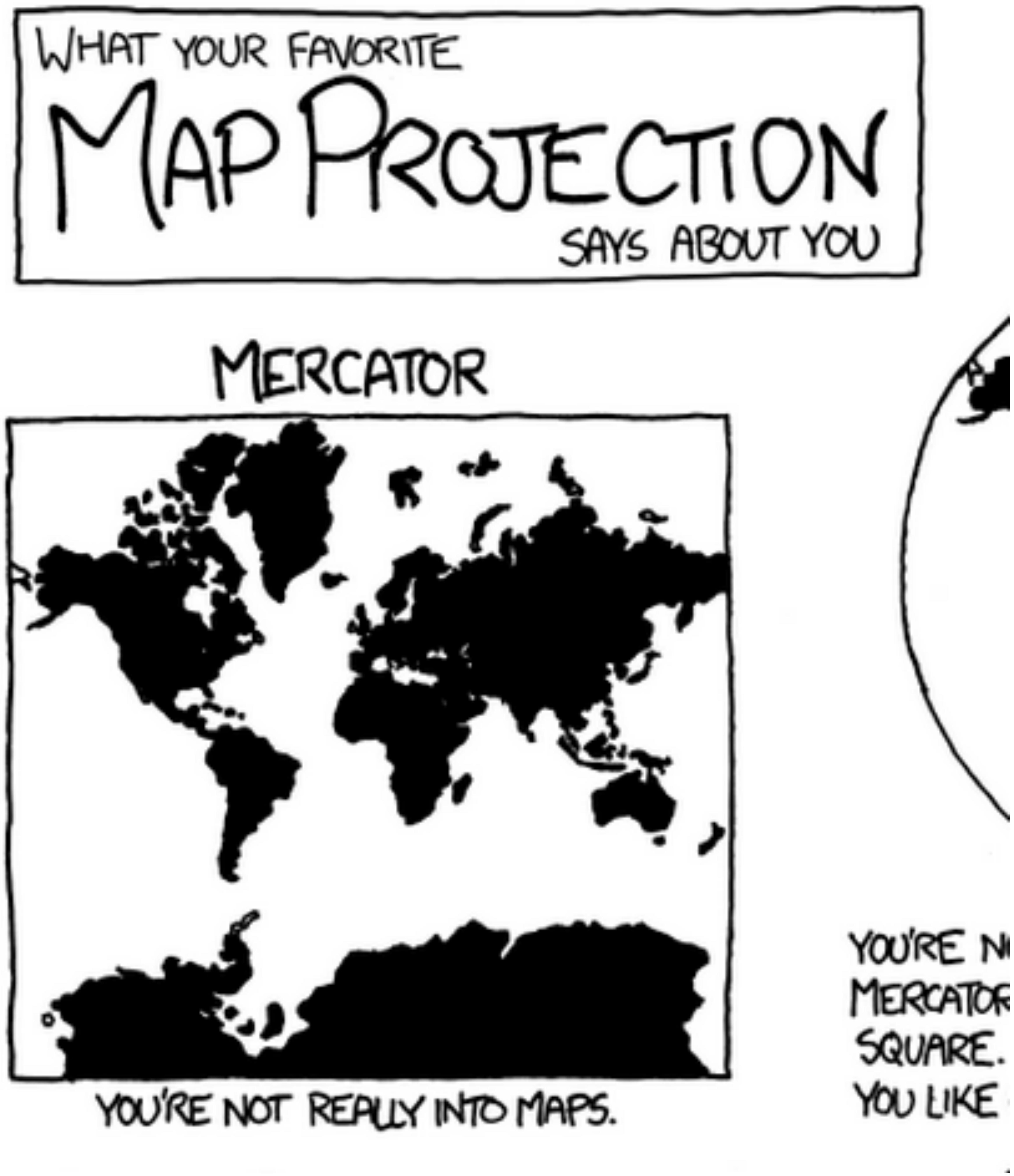
Maps

So what’s the challenges in drawing maps?

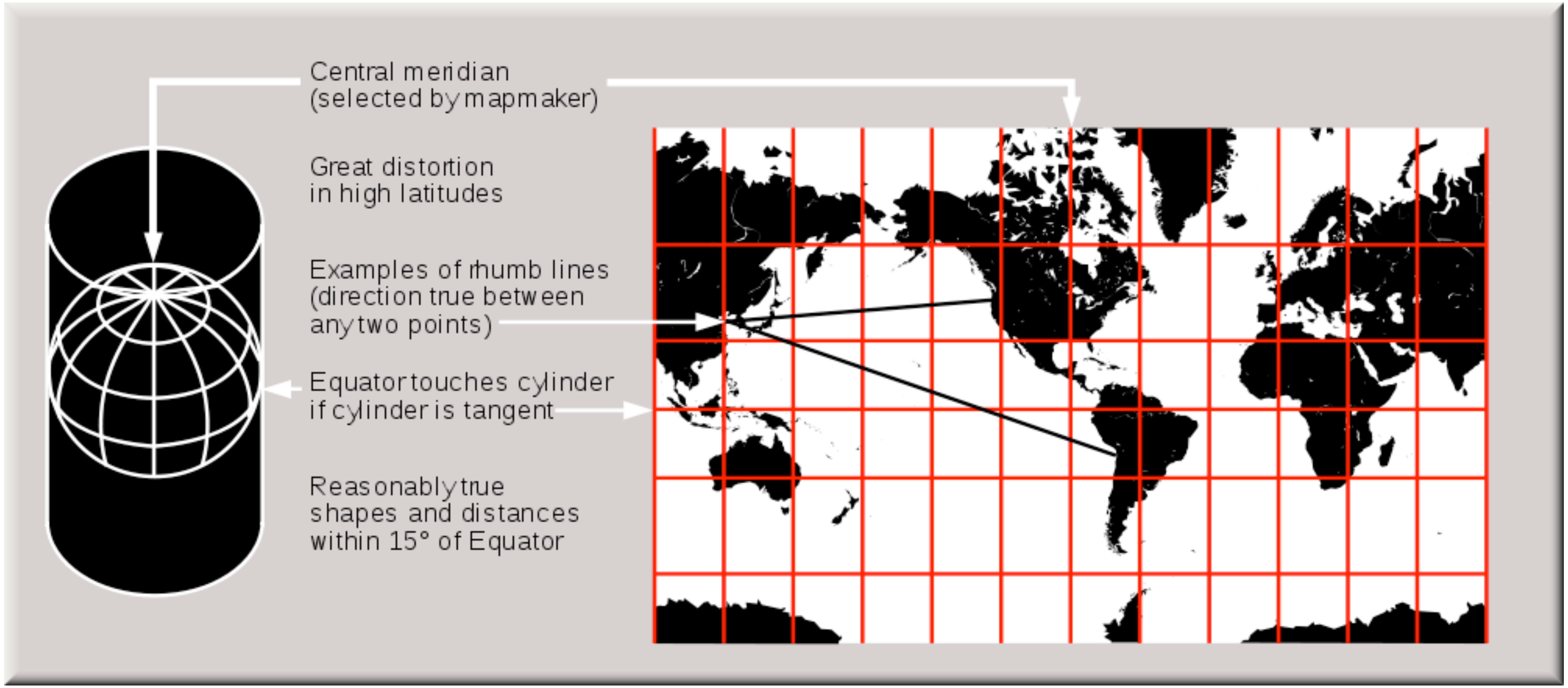
What is your favorite map projection?

1. Pick one and read about it.
2. Explain:
   1. What is the objective of the projection? What does it preserve?
   2. What does it ignore?
   3. Why is it cool?

www.jasondavies.com/maps/transition/


WHAT YOUR FAVORITE
MAP PROJECTION
SAYS ABOUT YOU
MERCATOR
YOU'RE NOT REALLY INTO MAPS.
YOU'RE
SQUARE.
YOU LIKE

How is it created?

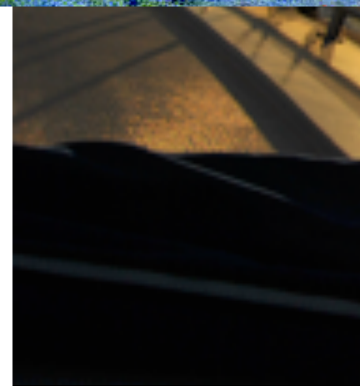


http://en.wikipedia.org/wiki/Mercator_projection

How do you navigate?

http://en.wikipedia.org/wiki/Age_of_Discovery

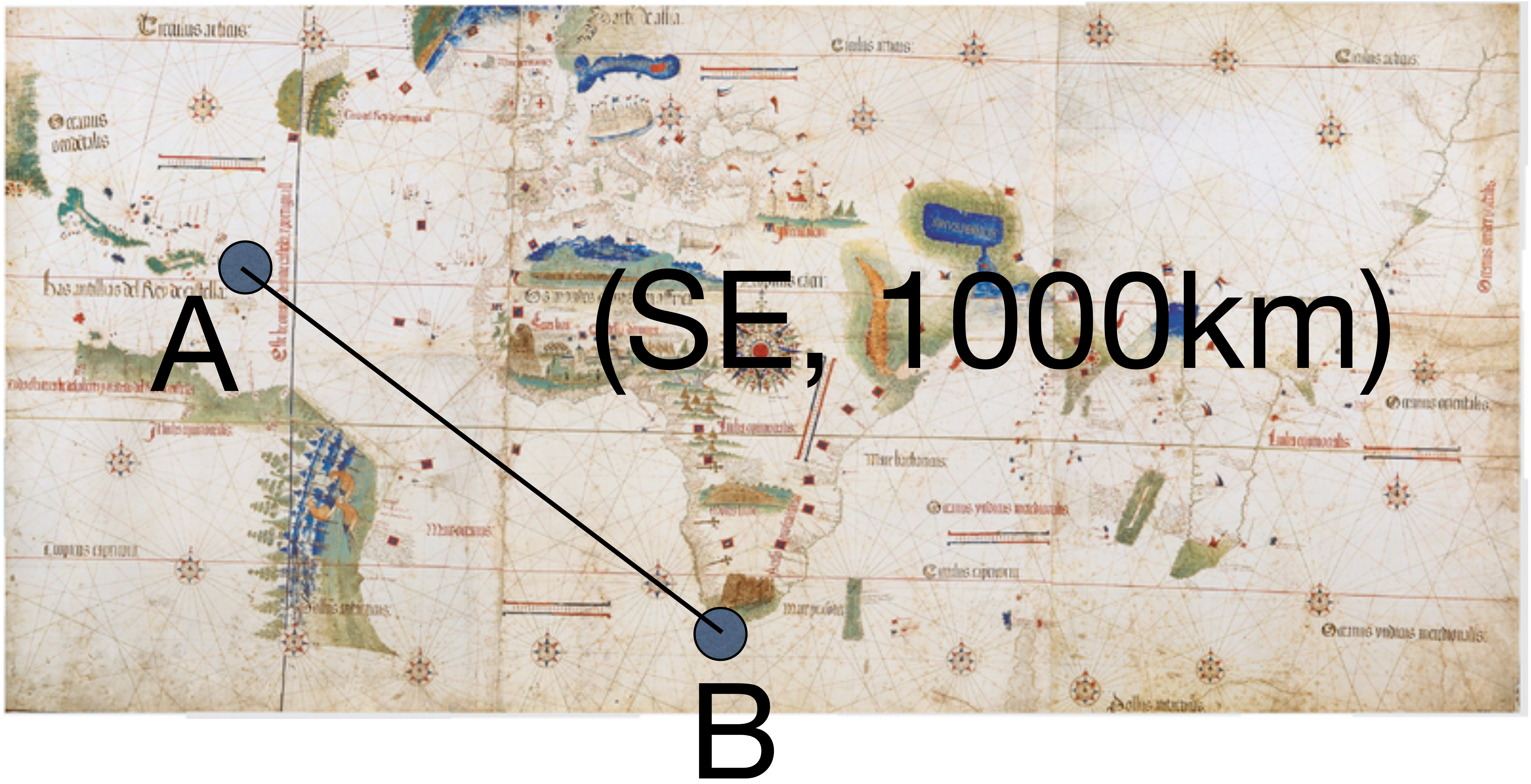
(SE, 1000km)



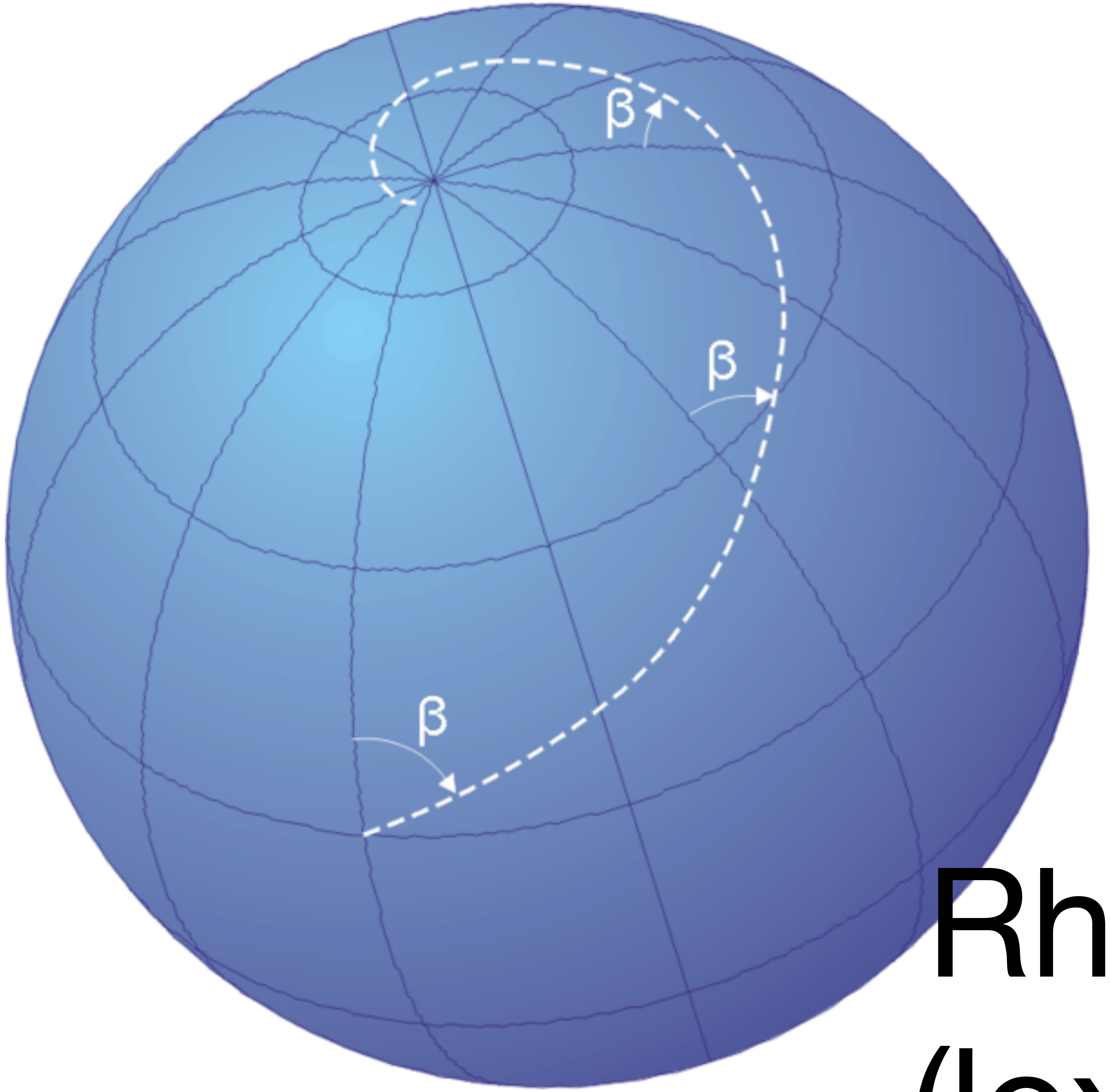
(SE, 1000km)

“Bearing”

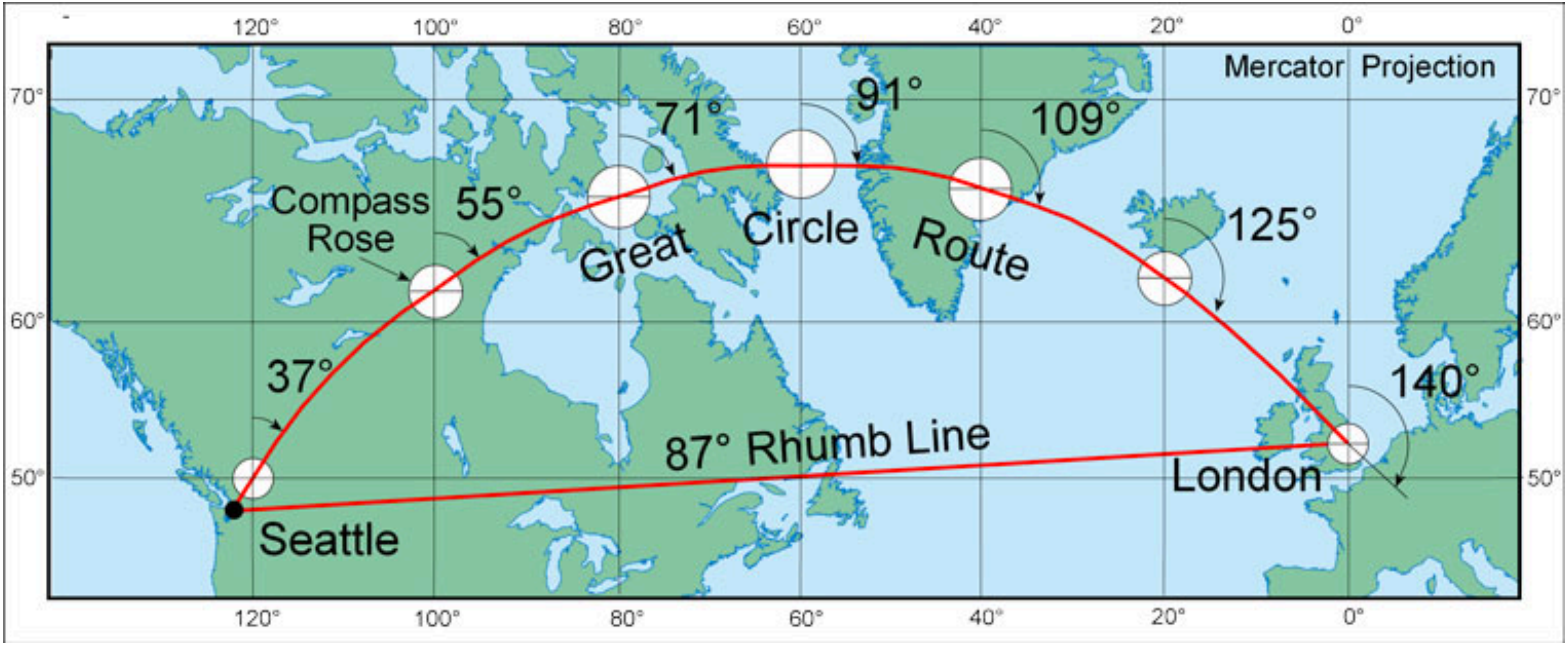
Best map for navigation?



Is this still the best for
air-routes?



Rhumb line (loxodrome)

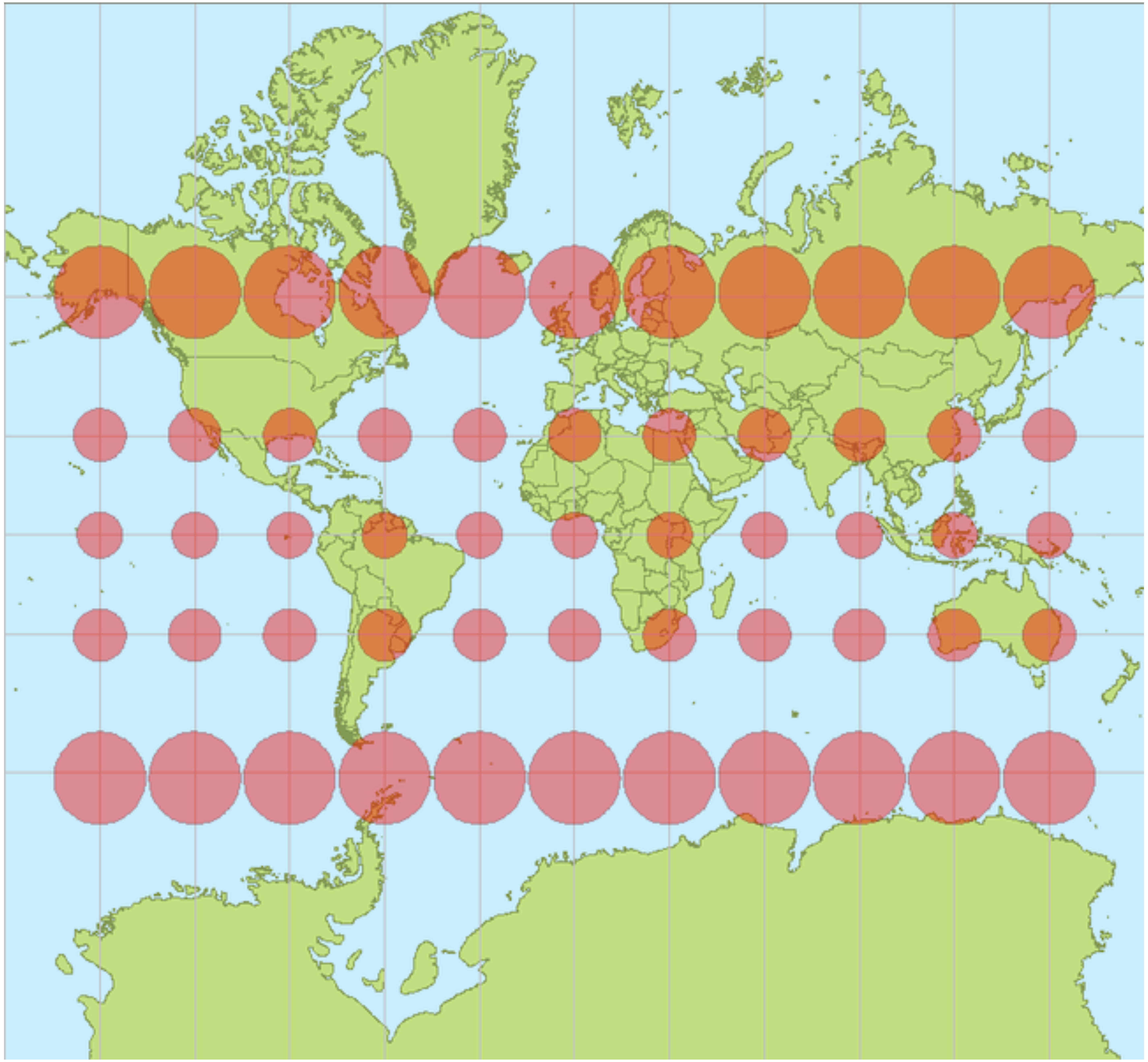


Mercator Projection
120°
100°
80°
60°
40°
20°
0°
70°
60°
50°
Compass Rose
37°
55°
71°
91°
109°
125°
140°
Great Circle Route
87° Rhumb Line
Seattle
London

Ok. Mercator projection is very good for navigation.

Any drawbacks?

It doesn’t preserve **area**.




GREENLAND
AUSTRALIA
0 250 500 750Km

The **True Size** of **Africa**

A small contribution in the fight against rampant *Immappancy*, by **Kai Krause**

Graphic layout for visualization only (some countries are cut and rotated)
But the conclusions are very accurate: refer to table below for exact data

COUNTRY	AREA x 1000 km²
China	9.597
USA	9.629
India	3.287
Mexico	1.964
Peru	1.285
France	633
Spain	506
Papua New Guinea	462
Sweden	441
Japan	378
Germany	357
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
TOTAL	**30.102**
AFRICA	**30.221**

In addition to the well known social issues of *illiteracy* and *innumeracy*, there also should be such a concept as "*immappancy*", meaning *insufficient geographical knowledge*.

A survey with random American schoolkids let them guess the population and land area of their country. Not entirely unexpected, but still rather unsettling, the majority chose *"1-2 billion"* and *"largest in the world"*, respectively.

Even with Asian and European college students, geographical estimates were often off by factors of *2-3*. This is partly due to the highly distorted nature of the predominantly used mapping projections (such as *Mercator*).

A particularly extreme example is the worldwide misjudgement of the true size of *Africa*. This single image tries to embody the massive scale, which is larger than the *USA*, *China*, *India*, *Japan* and *all of Europe*....... *combined!*

Top 100 Countries

Area in square kilometers, Percentage of World Total
Sources: Britannica, Wikipedia, Almanac 2010

		AREA km²	%
1	Russia	17.098.242	11,50
2	Canada	9.984.670	6,70
3	China	9.596.961	6,40
4	United States	9.629.091	6,40
5	Brazil	8.514.877	5,70
6	Australia	7.692.024	5,20
7	India	3.287.263	2,30
8	Argentina	2.780.400	2,00
9	Kazakhstan	2.724.900	1,80
10	Sudan	2.505.813	1,70
11	Algeria	2.381.741	1,60
12	Congo	2.344.858	1,60
13	Greenland	2.166.086	1,50
14	Saudi Arabia	2.149.690	1,40
15	Mexico	1.964.375	1,30
16	Indonesia	1.860.360	1,30
17	Libya	1.759.540	1,20
18	Iran	1.628.750	1,10
19	Mongolia	1.564.100	1,10
20	Peru	1.285.216	0,86
21	Chad	1.284.000	0,86
22	Niger	1.267.000	0,85
23	Angola	1.246.700	0,85
24	Mali	1.240.192	0,83
25	South Africa	1.221.037	0,82
26	Colombia	1.141.748	0,76
27	Ethiopia	1.104.300	0,74
28	Bolivia	1.098.581	0,74
29	Mauritania	1.025.520	0,69
30	Egypt	1.002.000	0,67
31	Tanzania	945.087	0,63
32	Nigeria	923.768	0,62
33	Venezuela	912.050	0,61
34	Namibia	824.116	0,55
35	Mozambique	801.590	0,54
36	Pakistan	796.095	0,53
37	Turkey	783.562	0,53
38	Chile	756.102	0,51
39	Zambia	752.612	0,51
40	Myanmar	676.578	0,45
41	Afghanistan	652.090	0,44
42	Somalia	637.657	0,43
43	France	632.834	0,43
44	C. African Rep	622.984	0,42
45	Ukraine	603.500	0,41
46	Madagascar	587.041	0,39
47	Botswana	582.000	0,39
48	Kenya	580.367	0,39
49	Yemen	527.968	0,35
50	Thailand	513.120	0,34
51	Spain	505.992	0,34
52	Turkmenistan	488.100	0,33
53	Cameroon	475.442	0,32
54	Papua New Guinea	462.840	0,31
55	Uzbekistan	447.400	0,30
56	Morocco	446.550	0,30
57	Sweden	441.370	0,30
58	Iraq	438.317	0,29
59	Paraguay	406.752	0,27
60	Zimbabwe	390.757	0,26
61	Japan	377.930	0,25
62	Germany	357.114	0,24
63	Rep o.t. Congo	342.000	0,23
64	Finland	338.419	0,23
65	Vietnam	331.212	0,22
66	Malaysia	330.803	0,22
67	Norway	323.802	0,22
68	Côte d'Ivoire	322.463	0,22
69	Poland	312.685	0,21
70	Oman	309.500	0,21
71	Italy	301.336	0,20
72	Philippines	300.000	0,20
73	Burkina Faso	274.222	0,18
74	New Zealand	270.467	0,18
75	Gabon	267.668	0,18
76	Western Sahara	266.000	0,18
77	Ecuador	256.369	0,20
78	Guinea	245.857	0,17
79	United Kingdom	242.900	0,16
80	Uganda	241.038	0,16
81	Ghana	238.539	0,16
82	Romania	238.391	0,16
83	Laos	236.800	0,16
84	Guyana	214.969	0,14
85	Belarus	207.600	0,14
86	Kyrgyzstan	199.951	0,13
87	Senegal	196.722	0,13
88	Syria	185.180	0,12
89	Cambodia	181.035	0,12
90	Uruguay	176.215	0,12
91	Suriname	163.820	0,11
92	Tunisia	163.610	0,11
93	Nepal	147.181	0,10
94	Bangladesh	143.998	0,10
95	Tajikistan	143.100	0,10
96	Greece	131.957	0,09
97	Nicaragua	130.373	0,09
98	North Korea	120.538	0,08
99	Malawi	118.484	0,08
100	Eritrea	117.600	0,08
	TOP 100 TOTAL	**132.632.524**	**89,34**

United States

Europe

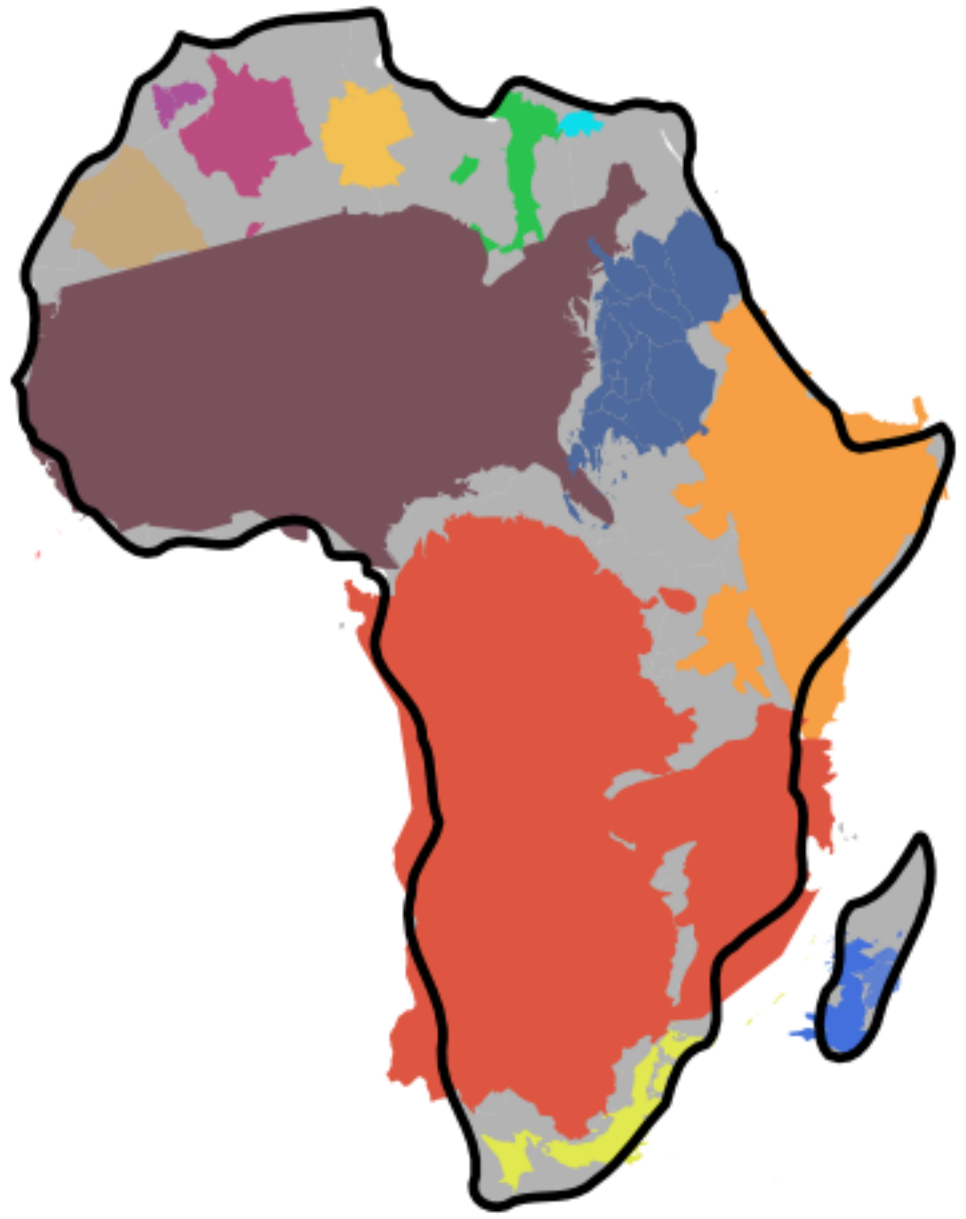
India

Japan

China

"The True Size of Africa"
infographic map

The *real* true size of these
areas, relative to Africa



How I might redo
the map

Every projection
preserves something
(area, distance from
center, Rhumb line, etc.)

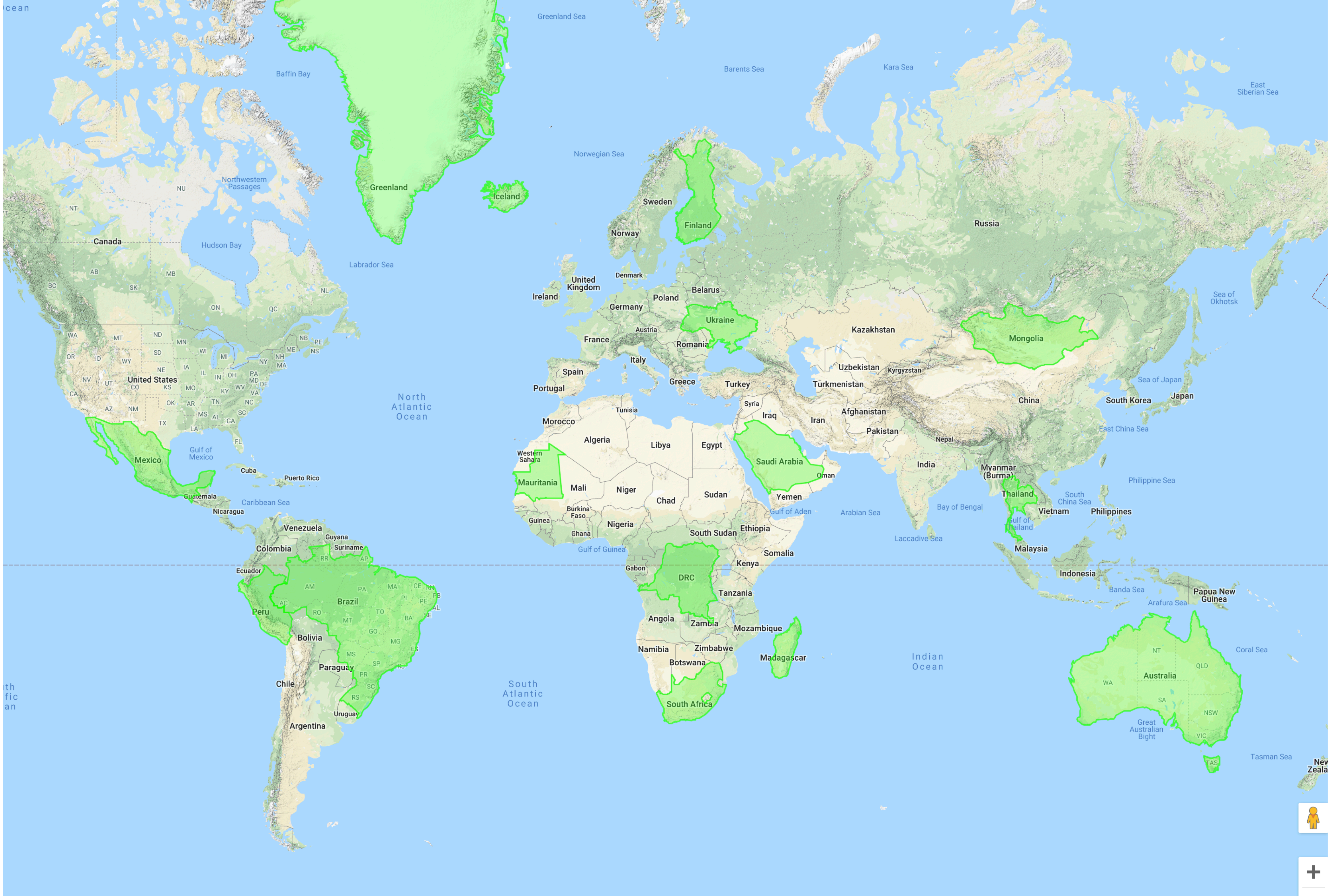
at the cost of others.

Mercator puzzle

http://hive.sewanee.edu/ldale/maps/10/06-LOCAL.html

https://bramus.github.io/mercator-puzzle-redux/

or google
“Mercator puzzle redux”



Greenland Sea
Baffin Bay
Barents Sea
Kara Sea
East Siberian Sea
Norwegian Sea
Greenland
Iceland
Northwestern Passages
NU
NT
Sweden
Finland
Russia
Canada
Hudson Bay
Norway
Labrador Sea
Ireland
United Kingdom
Denmark
Belarus
Poland
Germany
Sea of Okhotsk
AB
MB
BC
SK
NL
ON
QC
Ukraine
Kazakhstan
Mongolia
Austria
France
Romania
WA
MT
ND
MN
NB
PE
NS
OR
ID
WY
SD
WI
MI
NY
NH
ME
MA
Italy
Uzbekistan
Kyrgyzstan
Spain
NV
UT
United States
CO
NE
IA
IL
IN
OH
PA
MD
DE
KS
MO
KY
WV
VA
Sea of Japan
CA
Portugal
Greece
Turkey
Turkmenistan
AZ
NM
OK
AR
TN
NC
North Atlantic Ocean
China
South Korea
Japan
Syria
Tunisia
Afghanistan
MS
AL
GA
SC
Iraq
TX
LA
Morocco
Iran
Pakistan
East China Sea
FL
Algeria
Libya
Egypt
Nepal
Mexico
Gulf of Mexico
Western Sahara
Saudi Arabia
India
Myanmar (Burma)
Philippine Sea
Cuba
Puerto Rico
Oman
Mauritania
Mali
Niger
Guatemala
Caribbean Sea
Sudan
Yemen
Thailand
South China Sea
Chad
Bay of Bengal
Nicaragua
Burkina Faso
Gulf of Aden
Arabian Sea
Vietnam
Philippines
Guinea
Nigeria
Gulf of Thailand
Venezuela
Ghana
South Sudan
Ethiopia
Guyana
Suriname
Laccadive Sea
Colombia
Gulf of Guinea
Malaysia
Somalia
RR
AP
Ecuador
Gabon
Kenya
Indonesia
AM
PA
MA
CE
RN
PB
DRC
Banda Sea
Papua New Guinea
Brazil
PI
PE
Tanzania
Arafura Sea
AC
Peru
RO
TO
BA
AL
SE
MT
Angola
Zambia
GO
Mozambique
MG
Bolivia
Coral Sea
Namibia
Zimbabwe
MS
ES
Indian Ocean
NT
QLD
Madagascar
Paraguay
Botswana
Australia
PR
SP
RJ
WA
Chile
SC
South Atlantic Ocean
SA
RS
South Africa
NSW
Uruguay
Great Australian Bight
Argentina
VIC
Tasman Sea
TAS

thetruesize.com

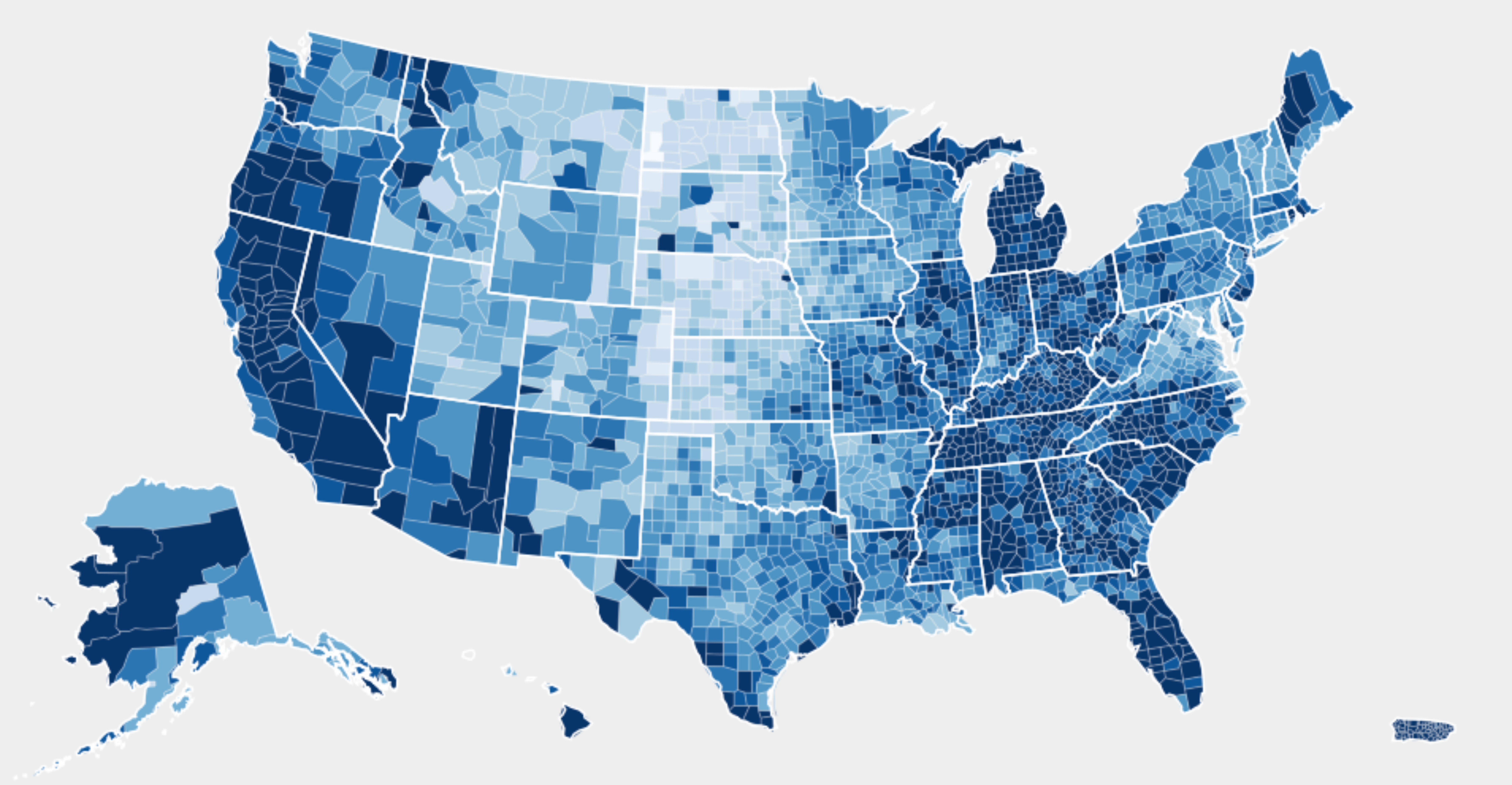
What is the most interesting example?
(you can check out individual states in US)

So, how to visualize data on the map?

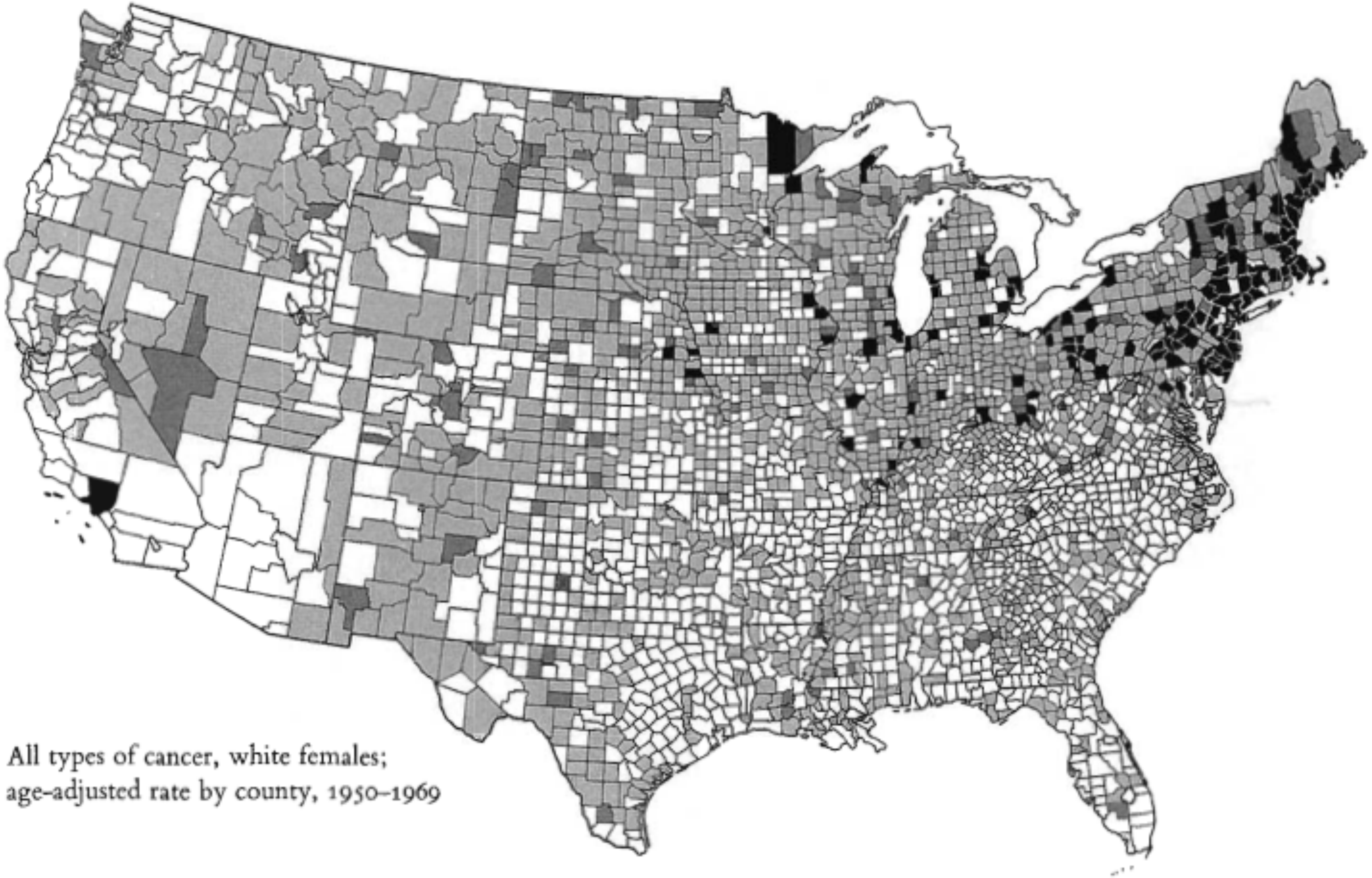
Choropleth Maps

χώρο– + πλήθ

“region” + “multitude”



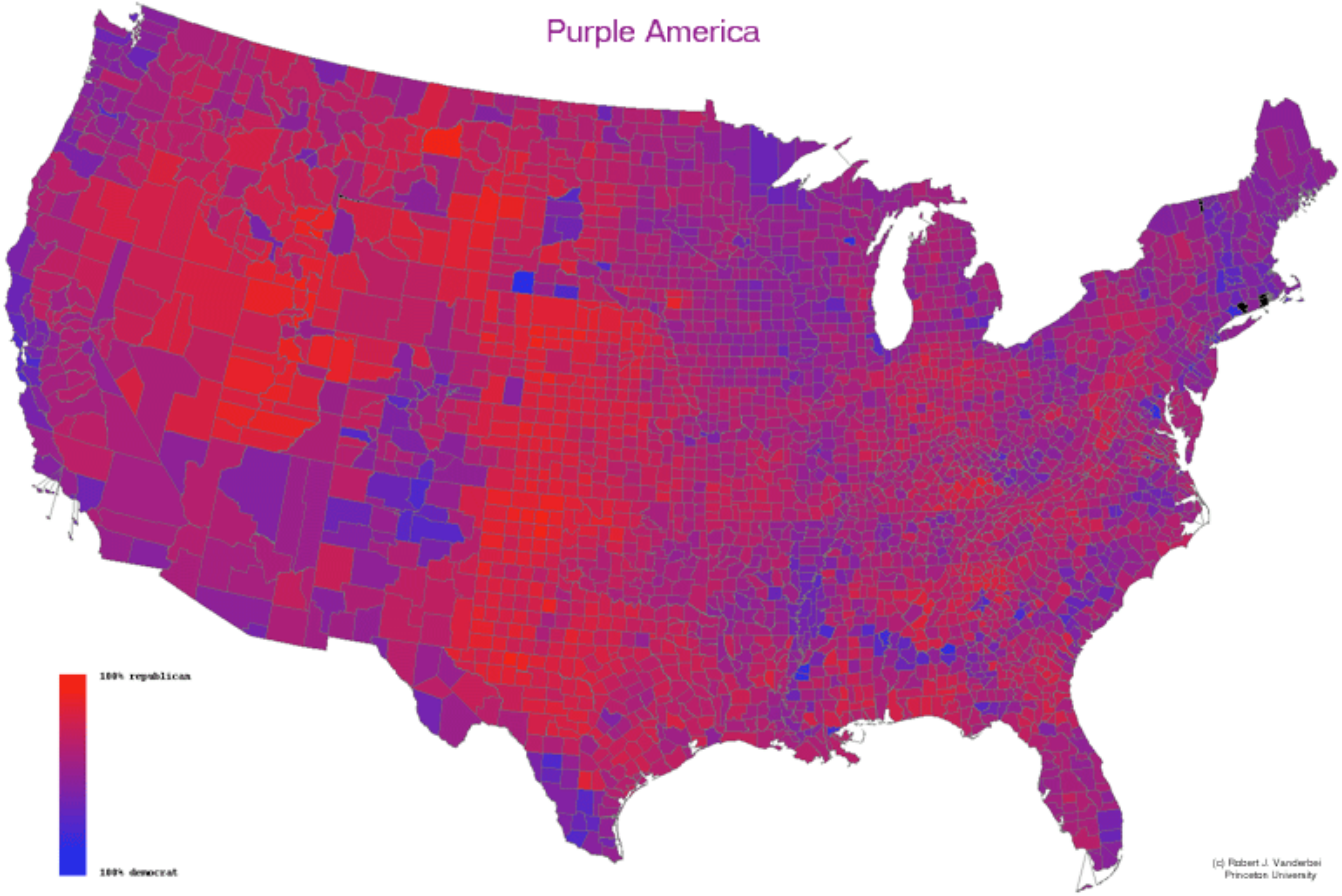
http://mbostock.github.com/d3/ex/choropleth.html

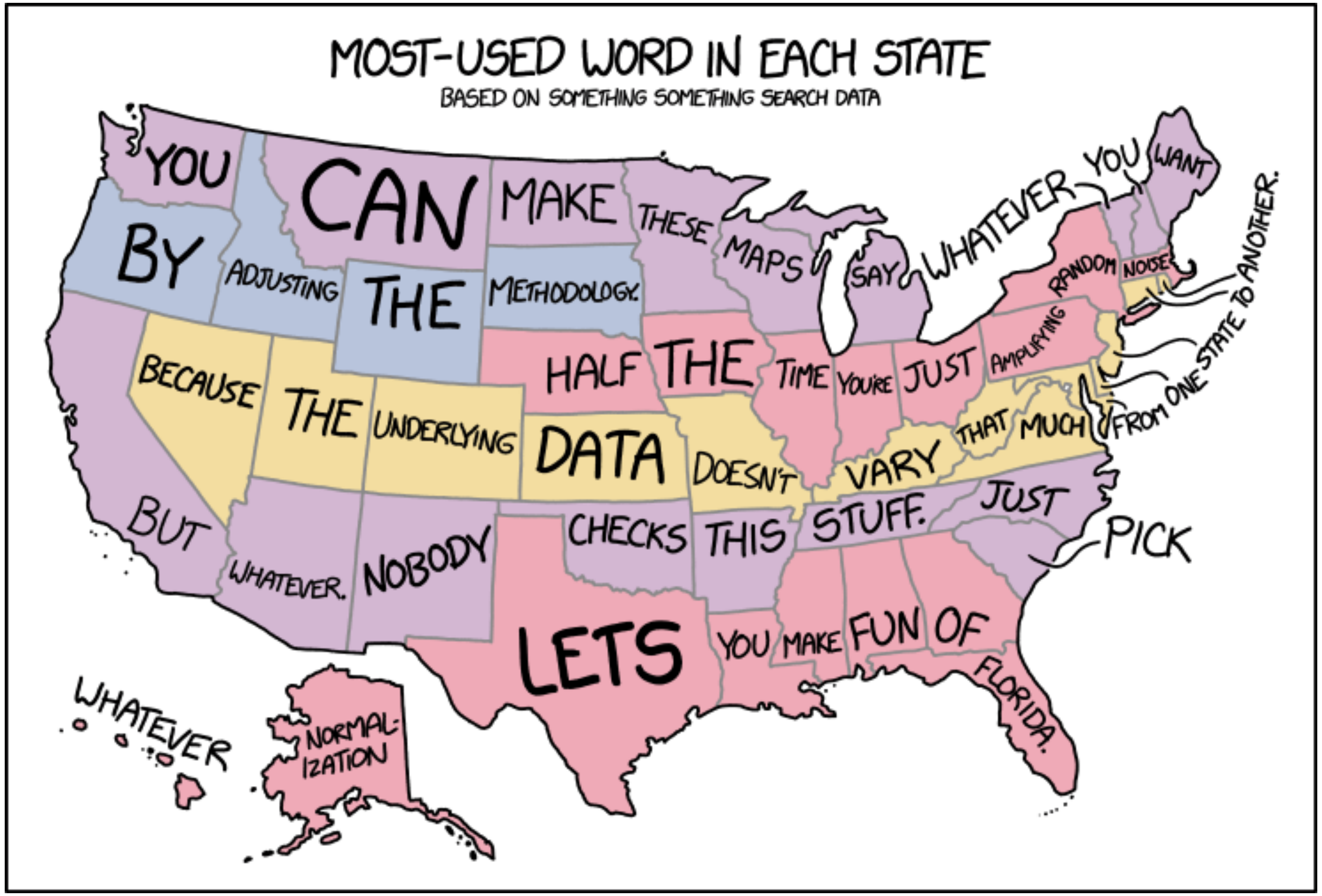


All types of cancer, white females;
age-adjusted rate by county, 1950–1969

2004 Presidential Election

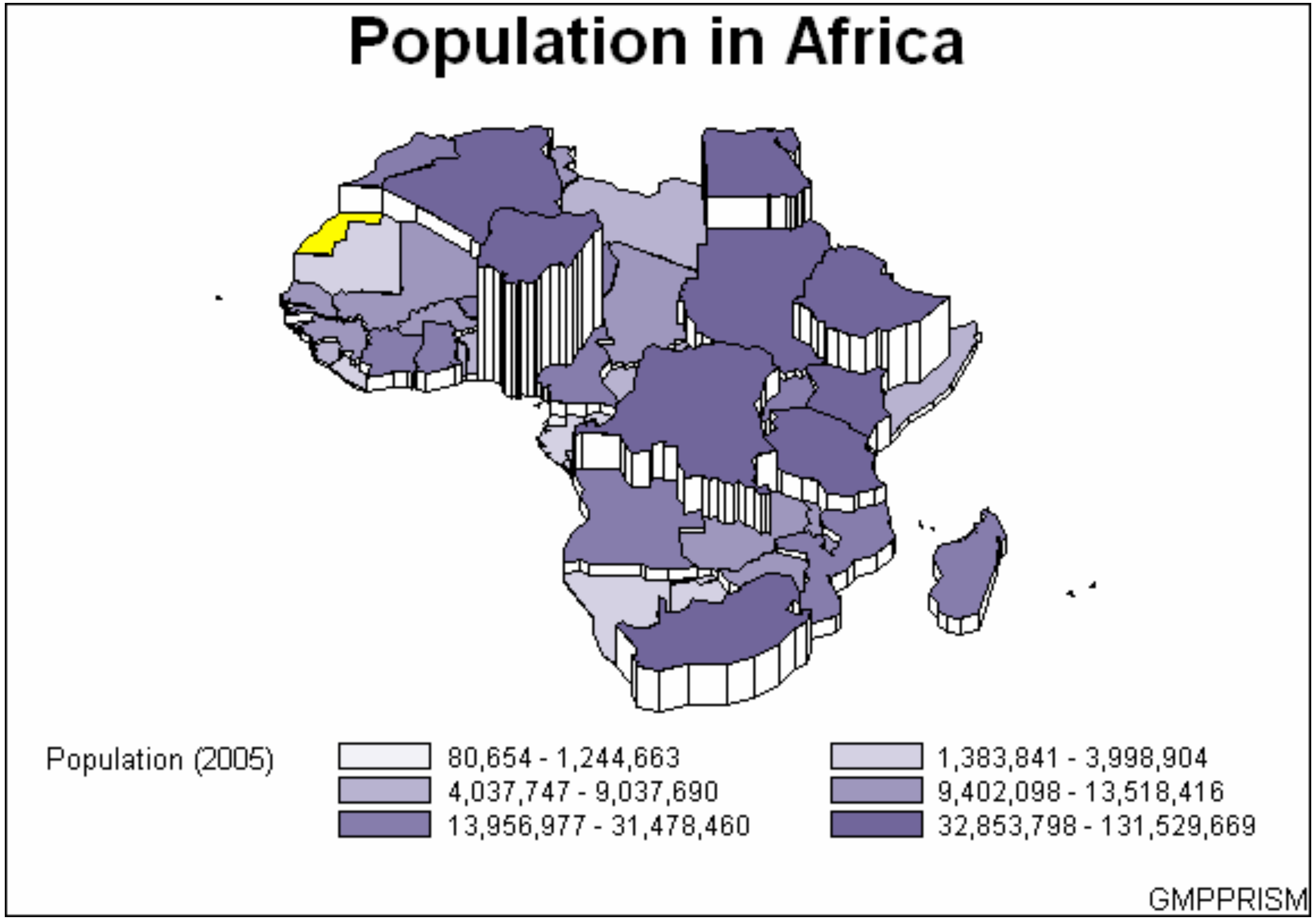
Purple America



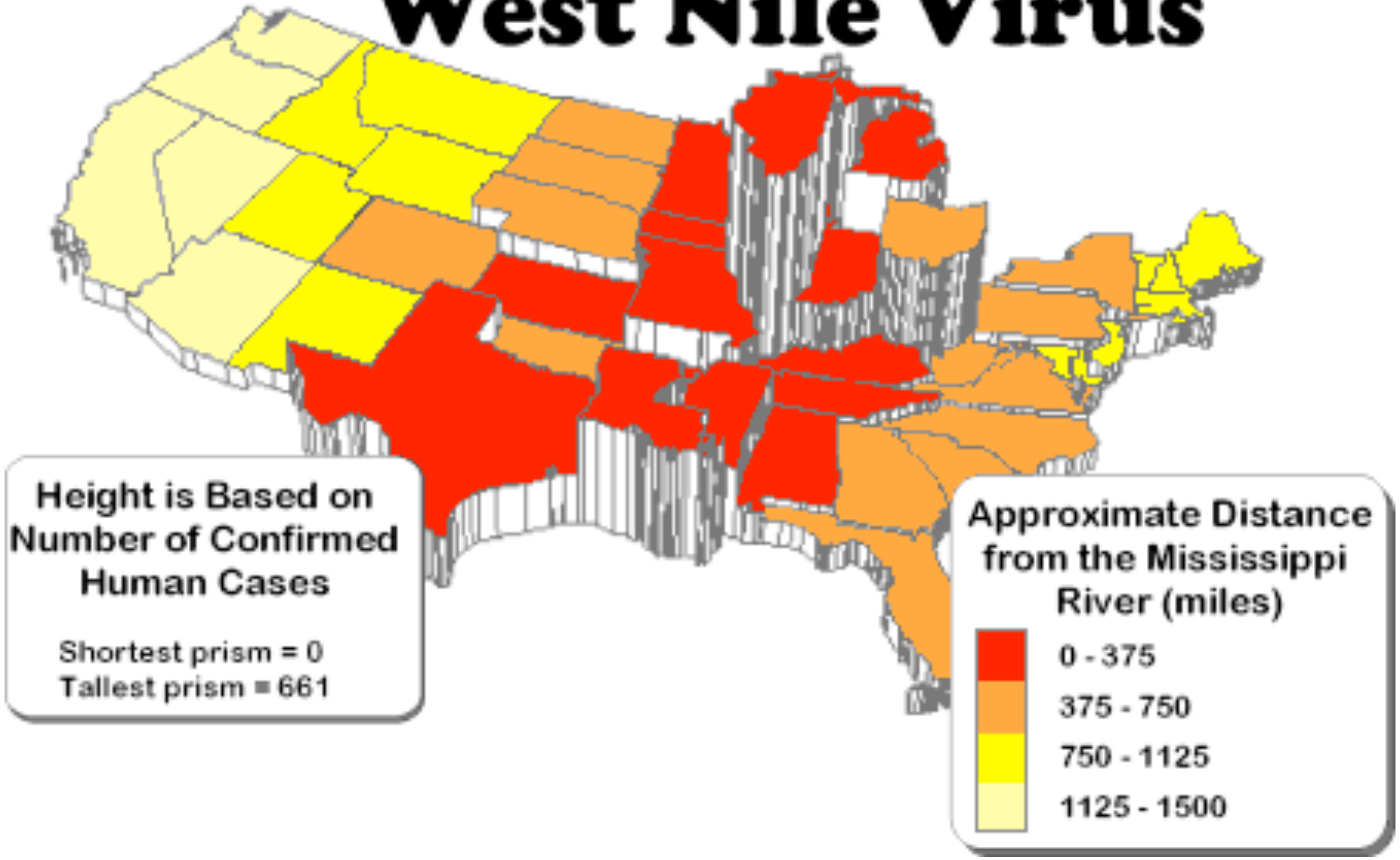


https://xkcd.com/1845/

Prism map


Population in Africa
Population (2005)
80,654 - 1,244,663
1,383,841 - 3,998,904
4,037,747 - 9,037,690
9,402,098 - 13,518,416
13,956,977 - 31,478,460
32,853,798 - 131,529,669
GMPPRISM

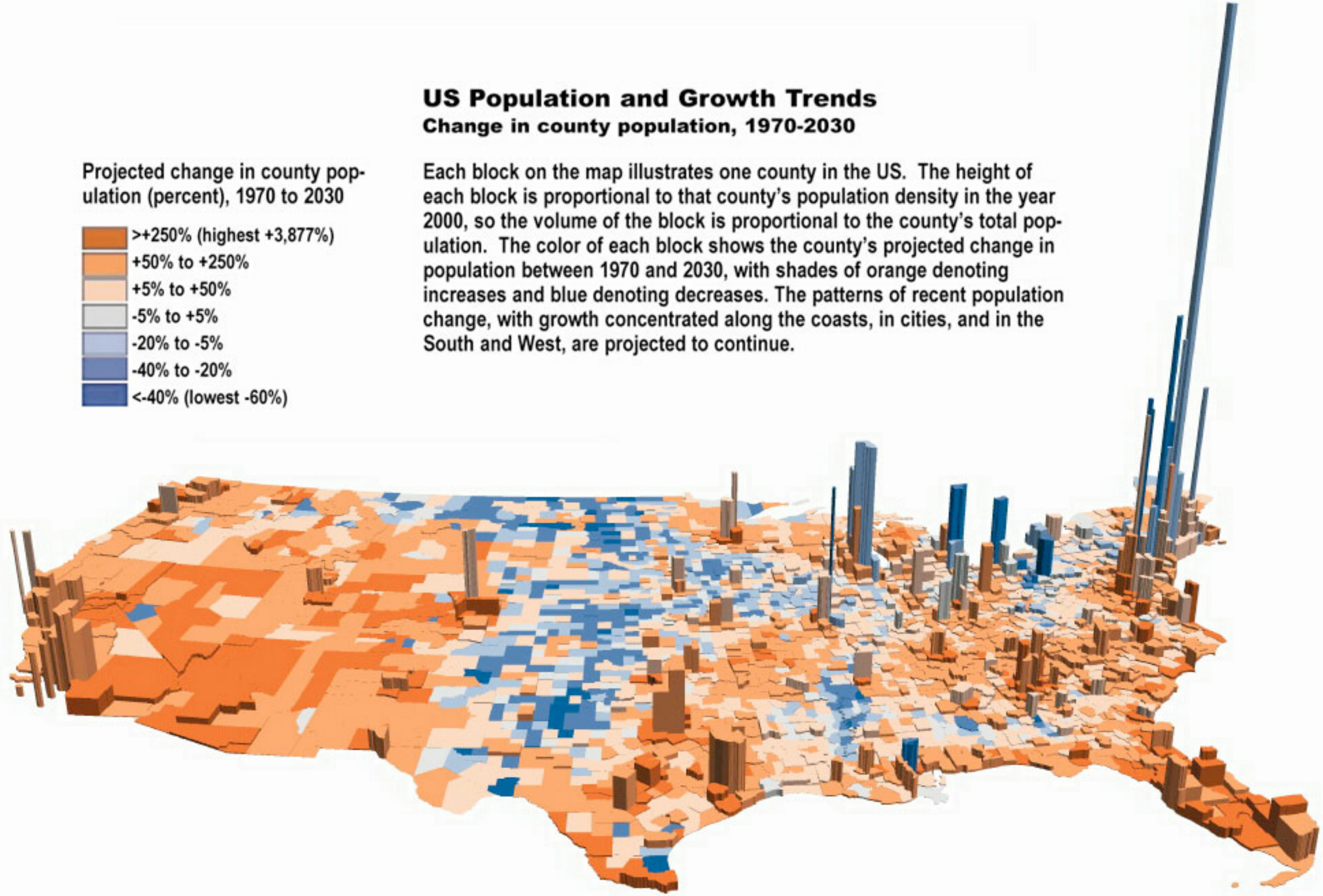
Tracking the West Nile Virus

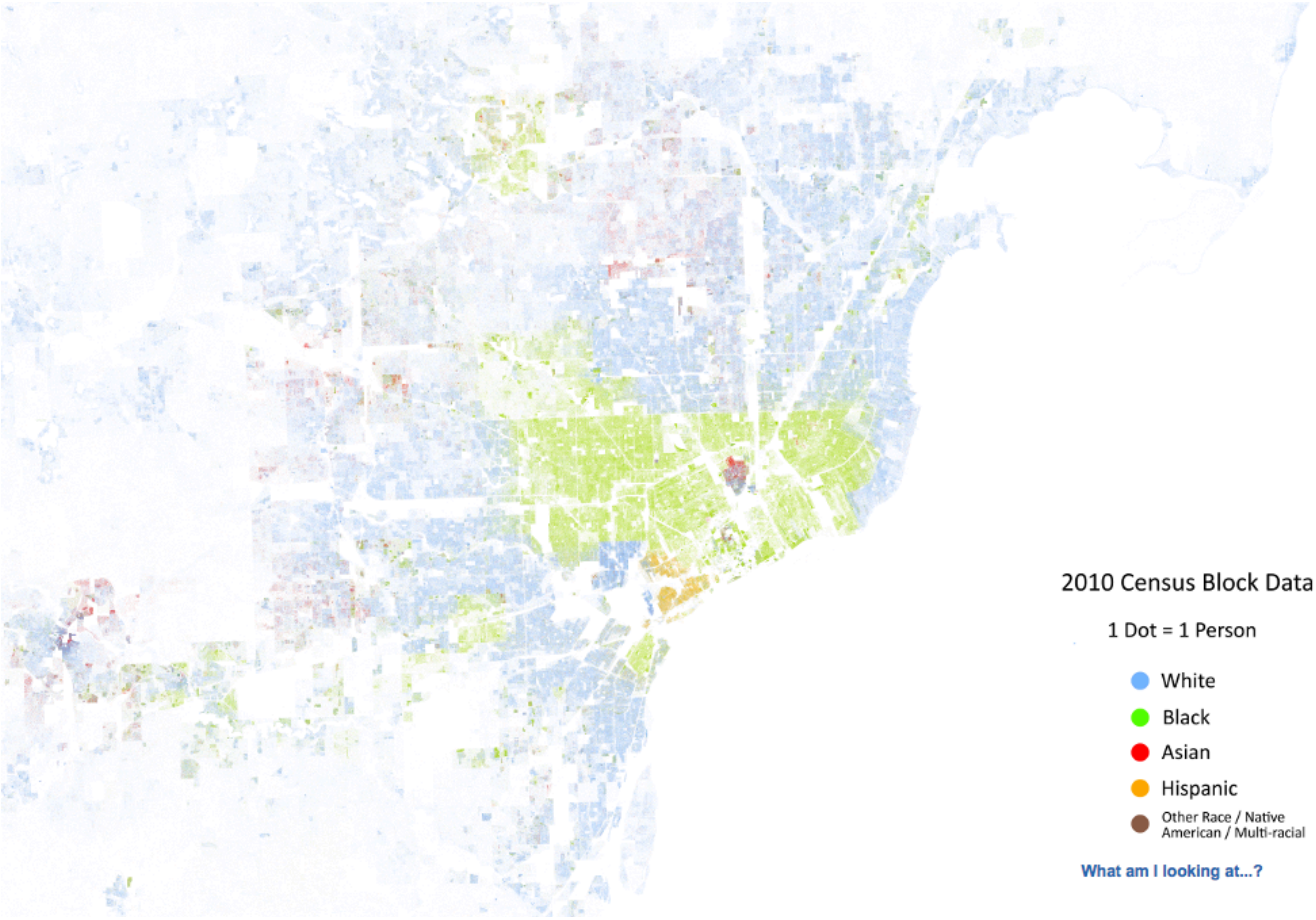


US Population and Growth Trends

Change in county population, 1970-2030

Each block on the map illustrates one county in the US. The height of each block is proportional to that county's population density in the year 2000, so the volume of the block is proportional to the county's total population. The color of each block shows the county's projected change in population between 1970 and 2030, with shades of orange denoting increases and blue denoting decreases. The patterns of recent population change, with growth concentrated along the coasts, in cities, and in the South and West, are projected to continue.

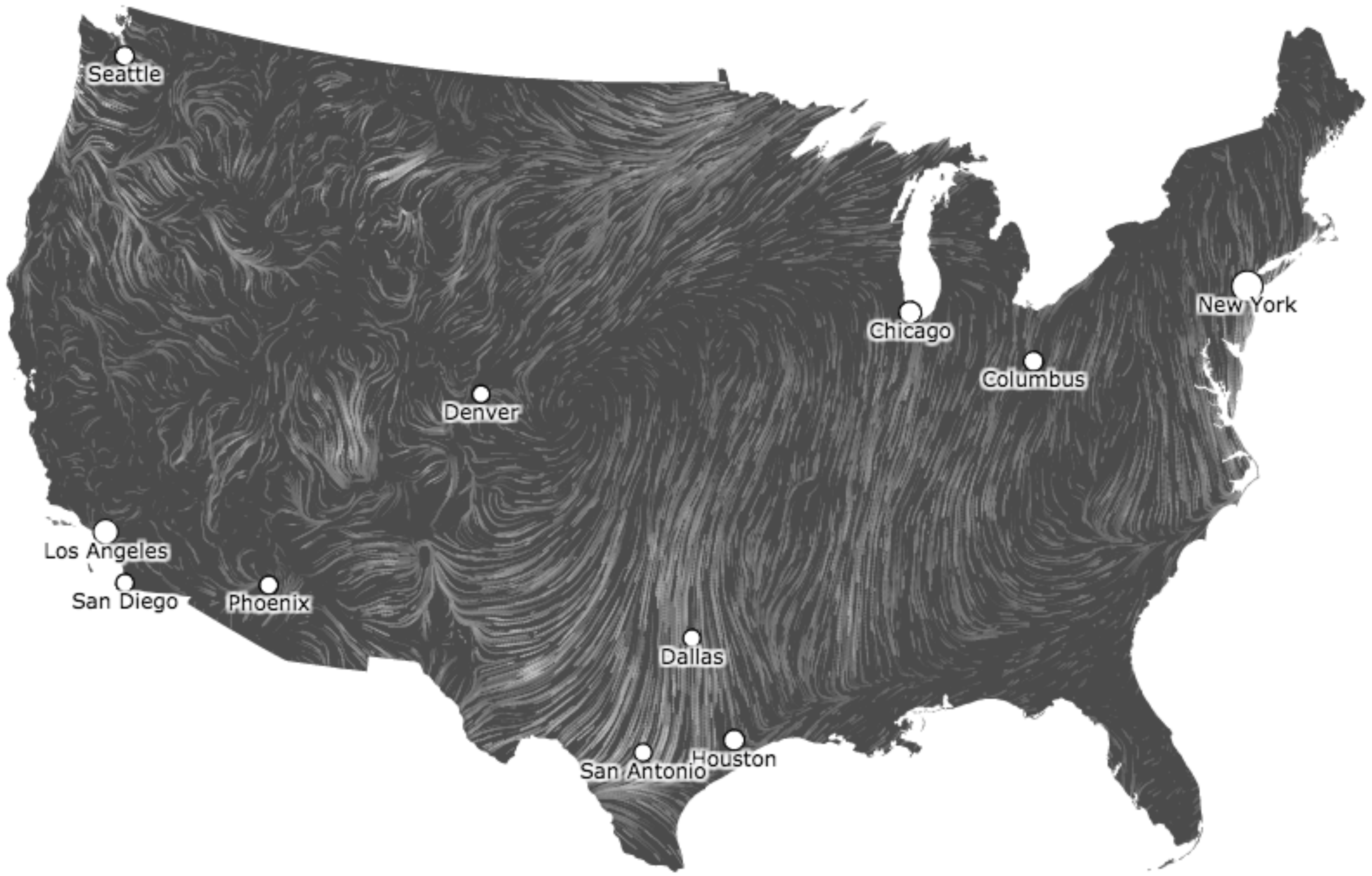


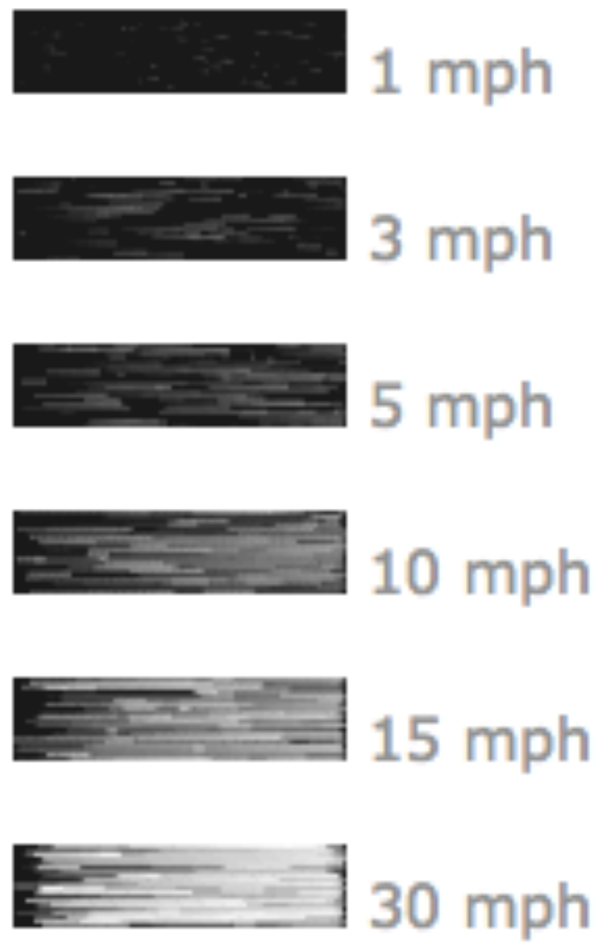

2010 Census Block Data
1 Dot = 1 Person
White
Black
Asian
Hispanic
Other Race / Native American / Multi-racial
What am I looking at...?

wind map

Nov. 7, 2017
10:36 pm EST
(time of forecast download)

top speed: **36.1 mph**
average: **7.1 mph**

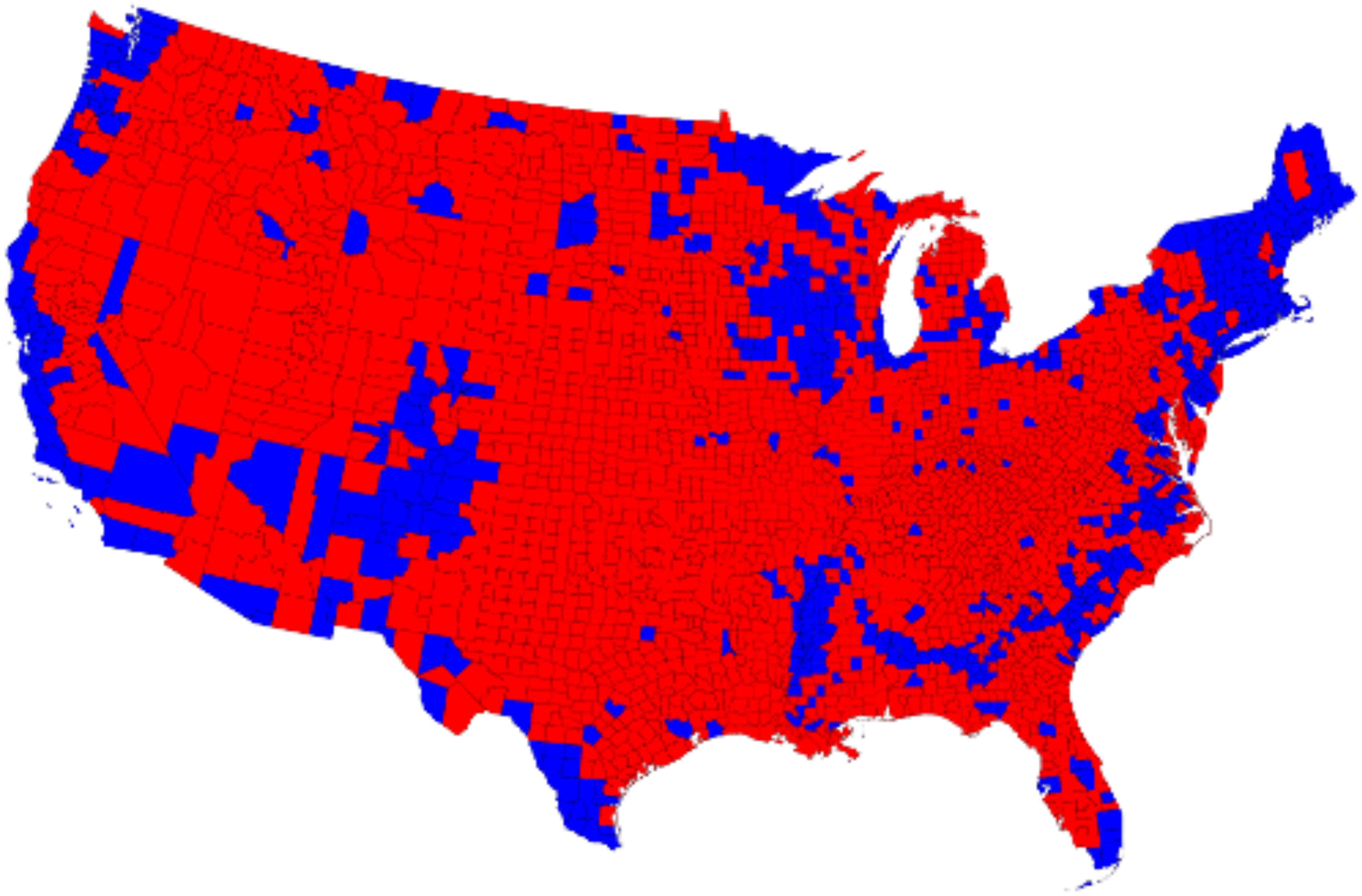




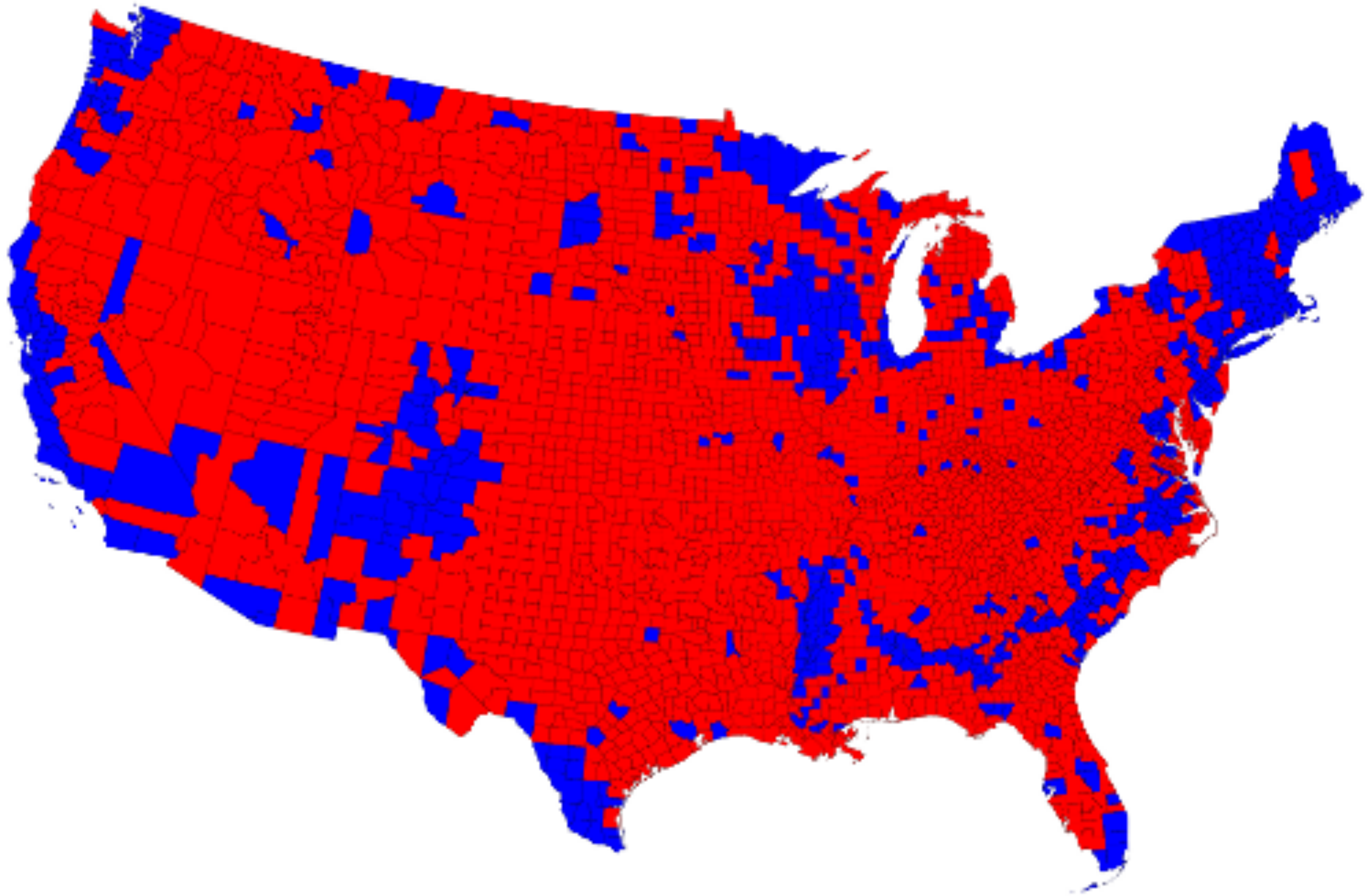
Lung cancer cases 1993-1997
(each dot represents 10 cases)

http://www-personal.umich.edu/~mejn/election/2012/

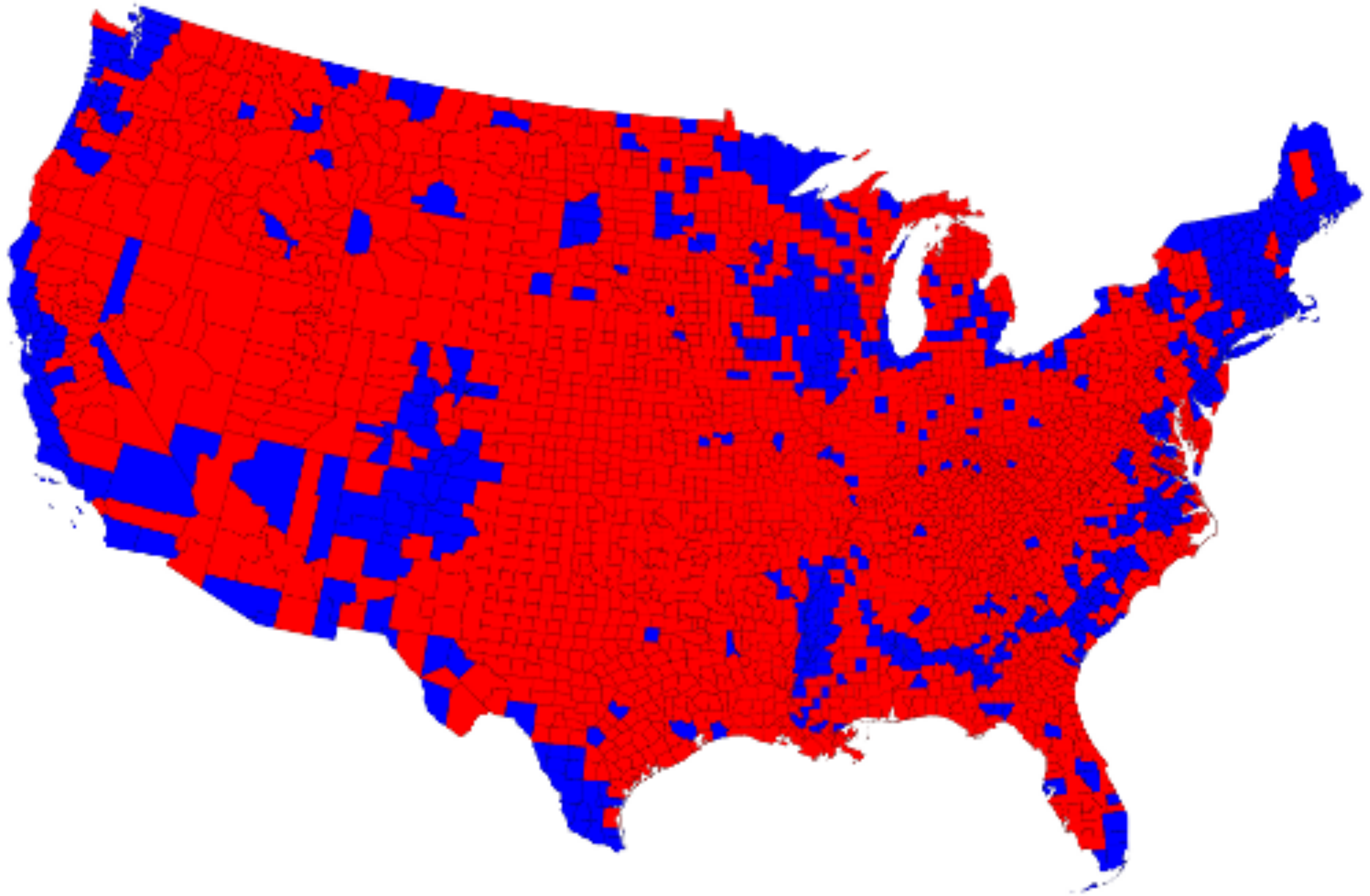
2012 Election result by counties



Any problem?



How can we mitigate the issue?



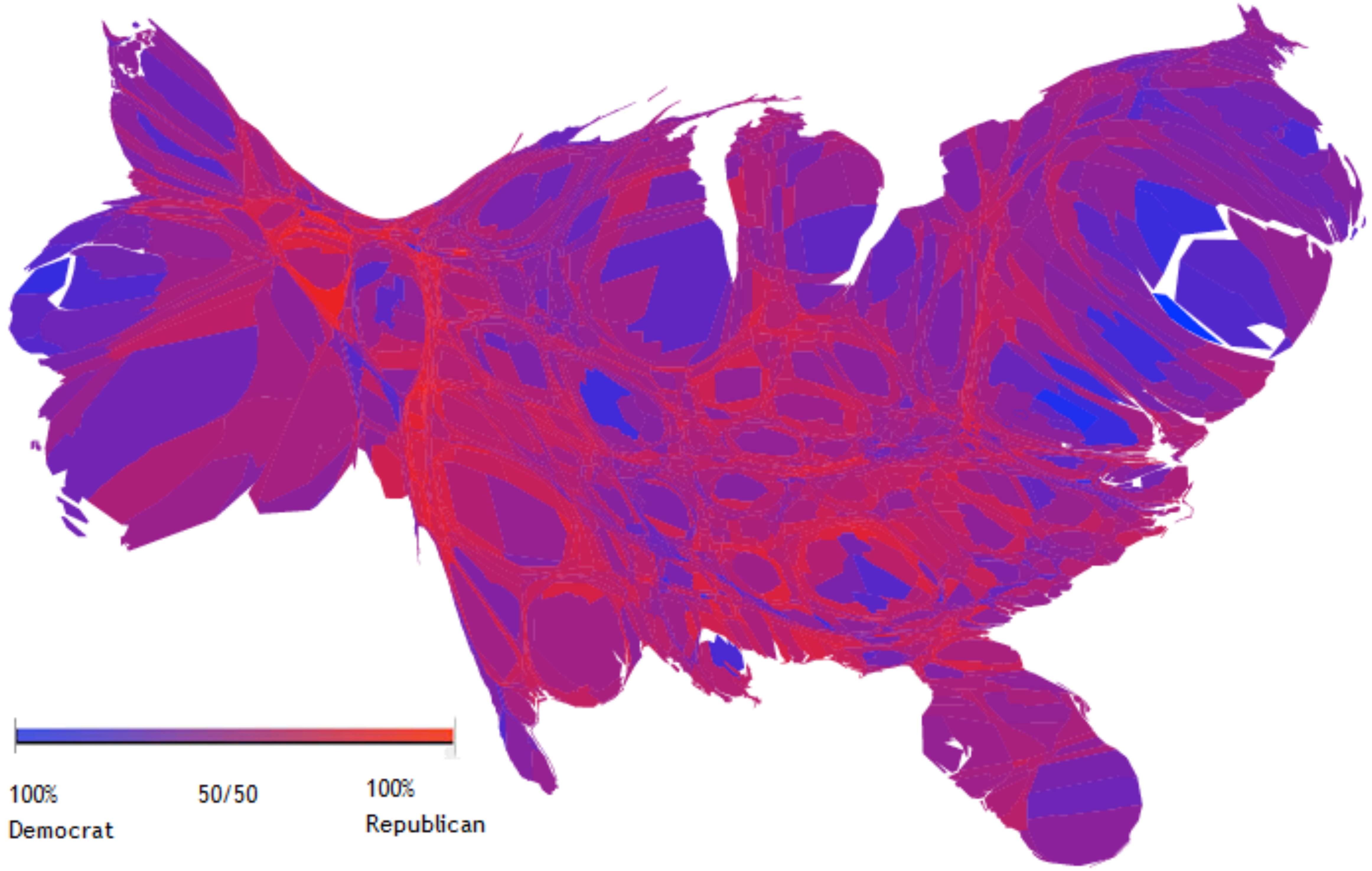
Many solutions!

Cartogram

“A **cartogram** is a map in which some thematic mapping variable – such as travel time, population, or Gross National Product – is substituted for land area or distance”

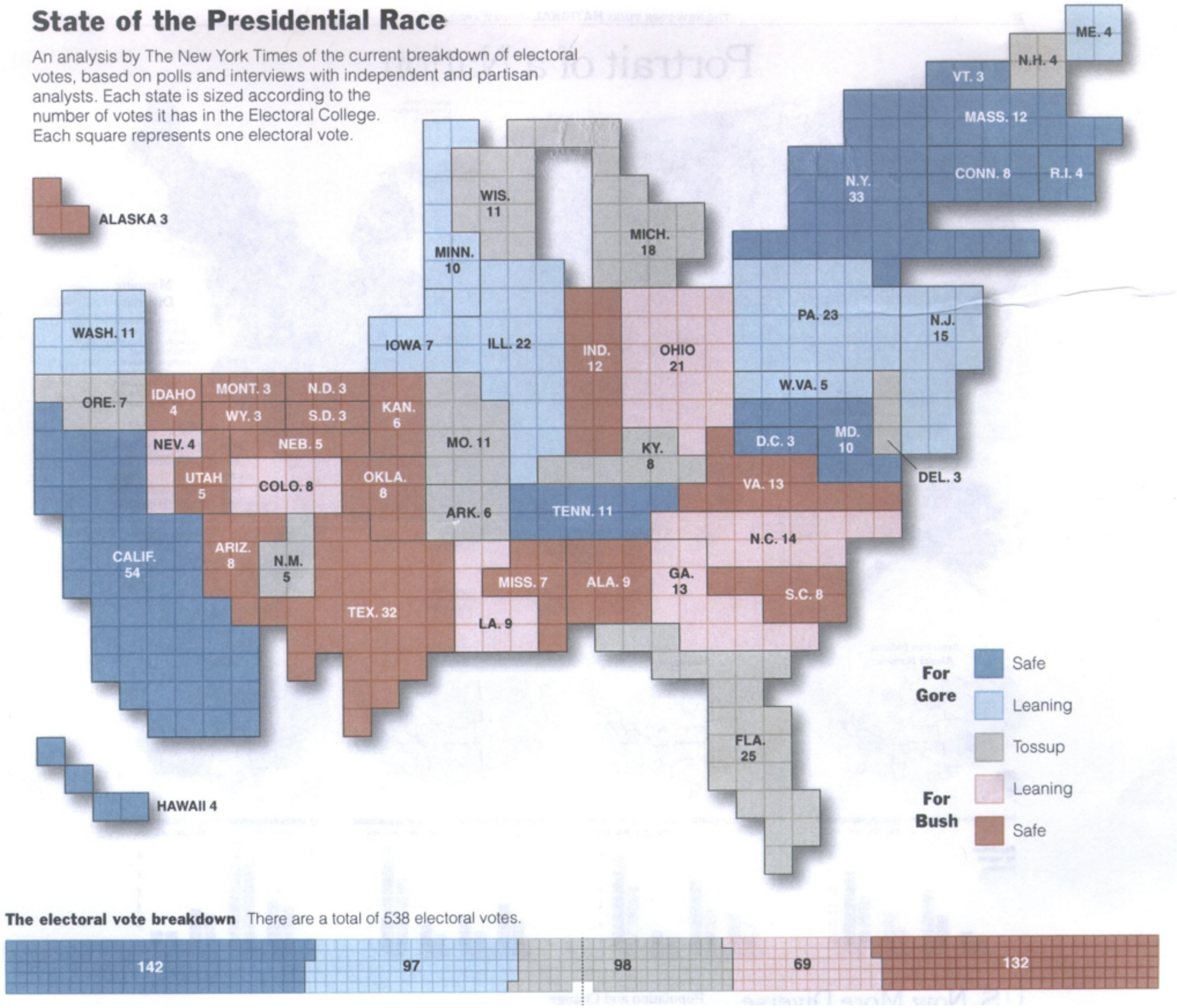
http://en.wikipedia.org/wiki/Cartogram

Area cartogram

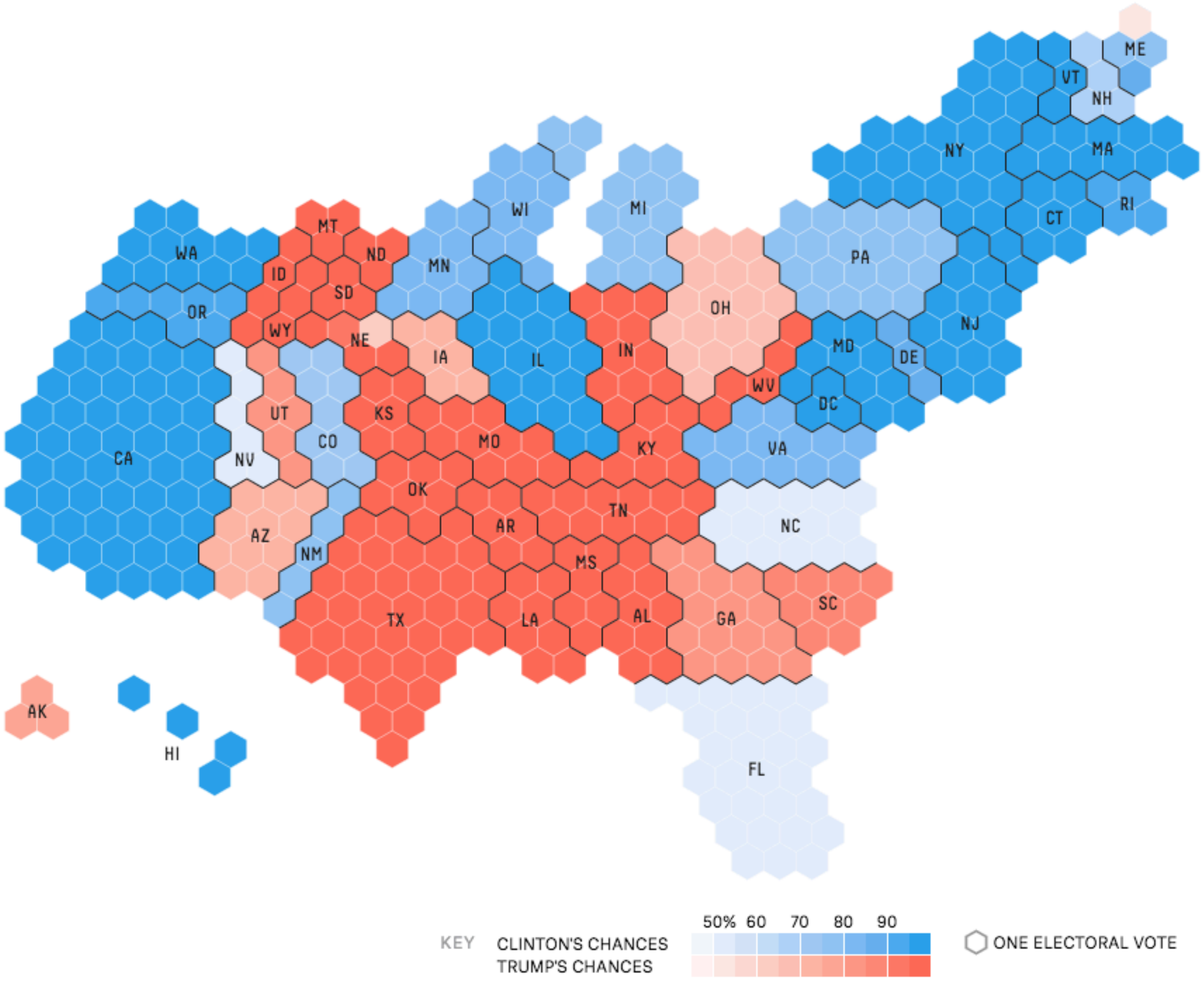


population -> area

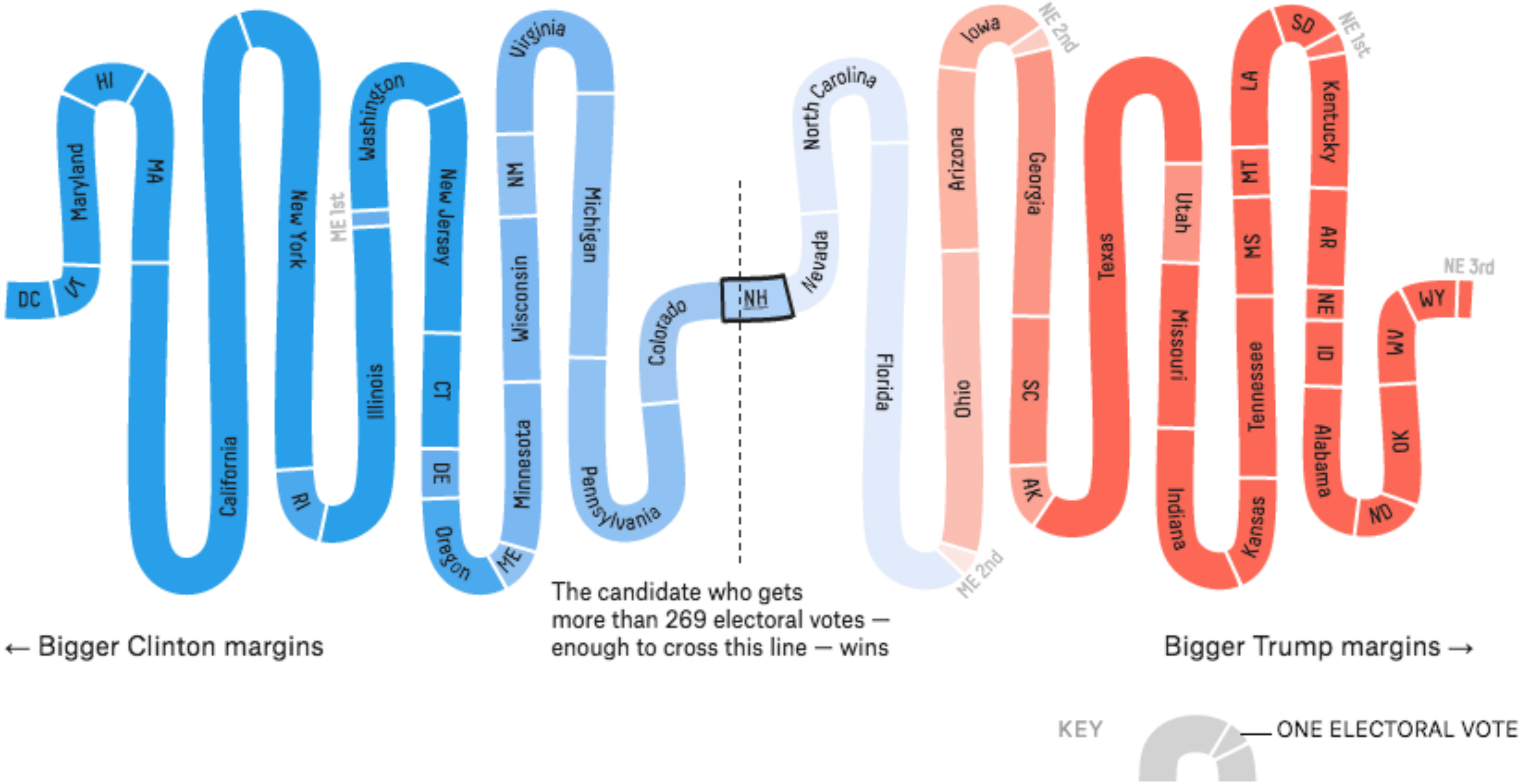
http://en.wikipedia.org/wiki/File:Cartlinearlarge.png

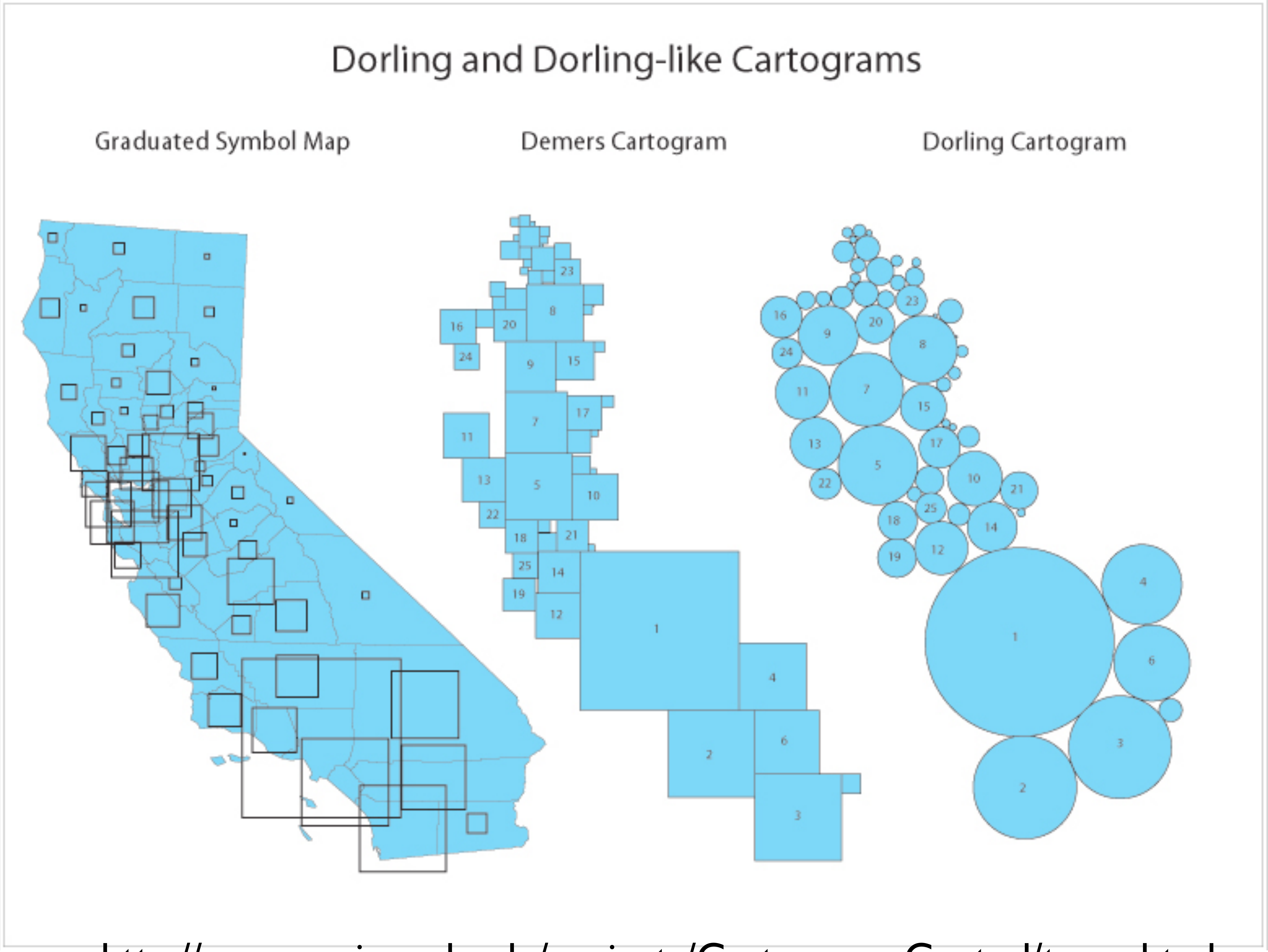


2000 election, nytimes



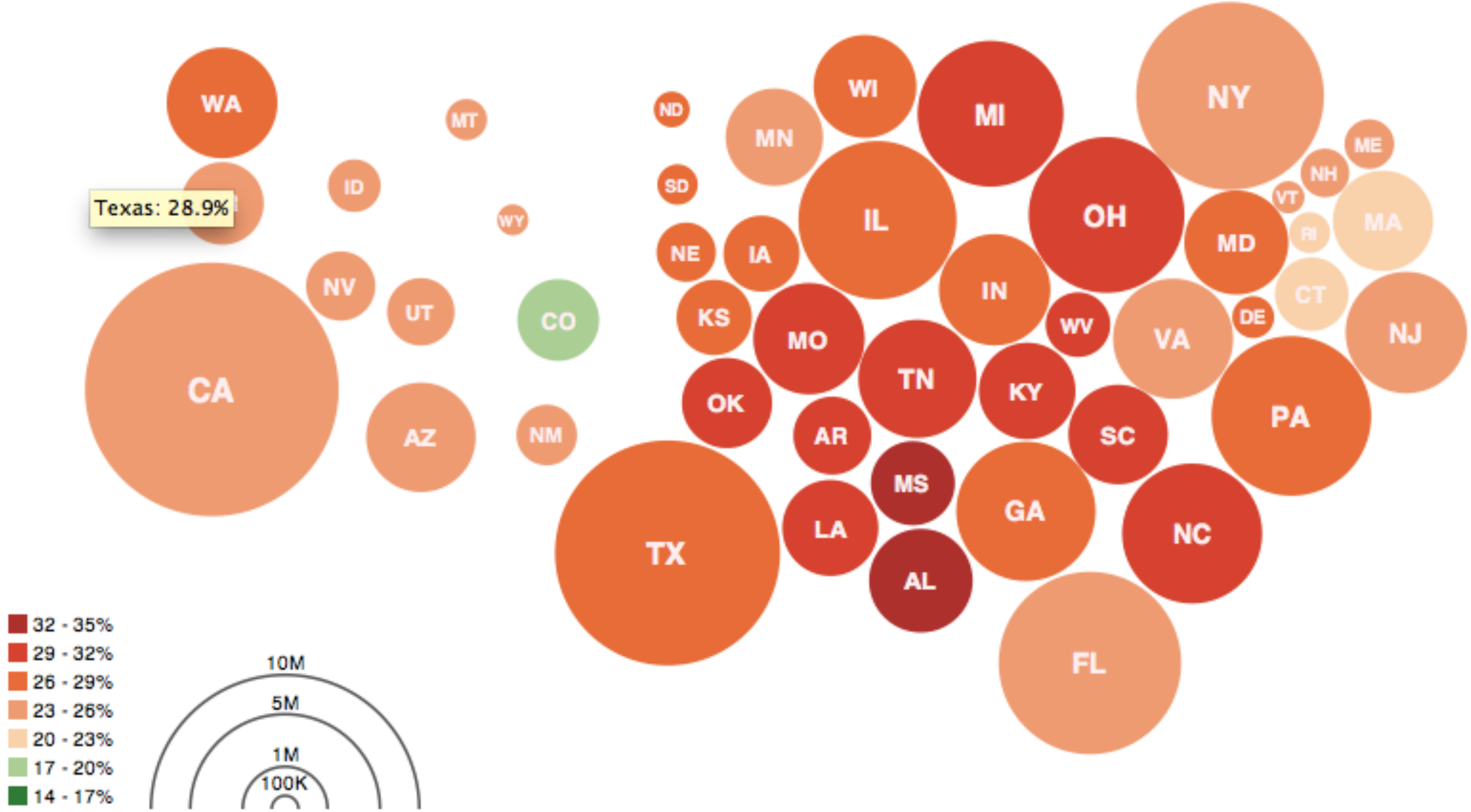
http://projects.fivethirtyeight.com/2016-election-forecast/?ex_cid=rrpromo


DC
VT
Maryland
HI
MA
California
New York
RI
ME 1st
Illinois
Washington
New Jersey
CT
DE
Oregon
ME
Minnesota
Wisconsin
NM
Virginia
Michigan
Pennsylvania
Colorado
NH
Nevada
North Carolina
Florida
ME 2nd
Ohio
Arizona
Iowa
NE 2nd
Georgia
SC
AK
Texas
Utah
Missouri
Indiana
Kansas
Tennessee
MS
MT
LA
SD
NE 1st
Kentucky
AR
NE
ID
Alabama
ND
OK
WV
WY
NE 3rd
The candidate who gets
more than 269 electoral votes —
enough to cross this line — wins
← Bigger Clinton margins
Bigger Trump margins →
KEY
ONE ELECTORAL VOTE



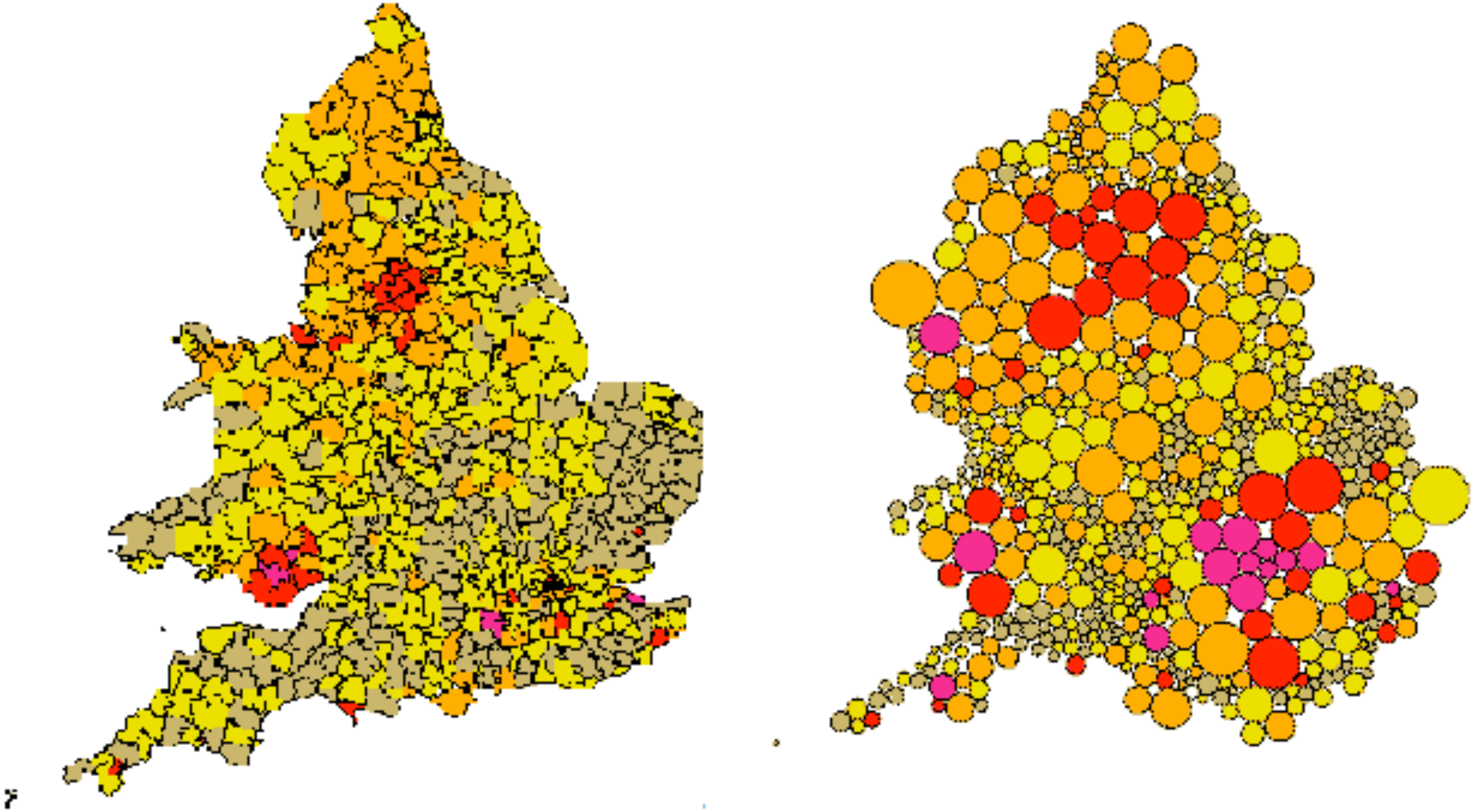
http://www.ncgia.ucsb.edu/projects/Cartogram_Central/types.html

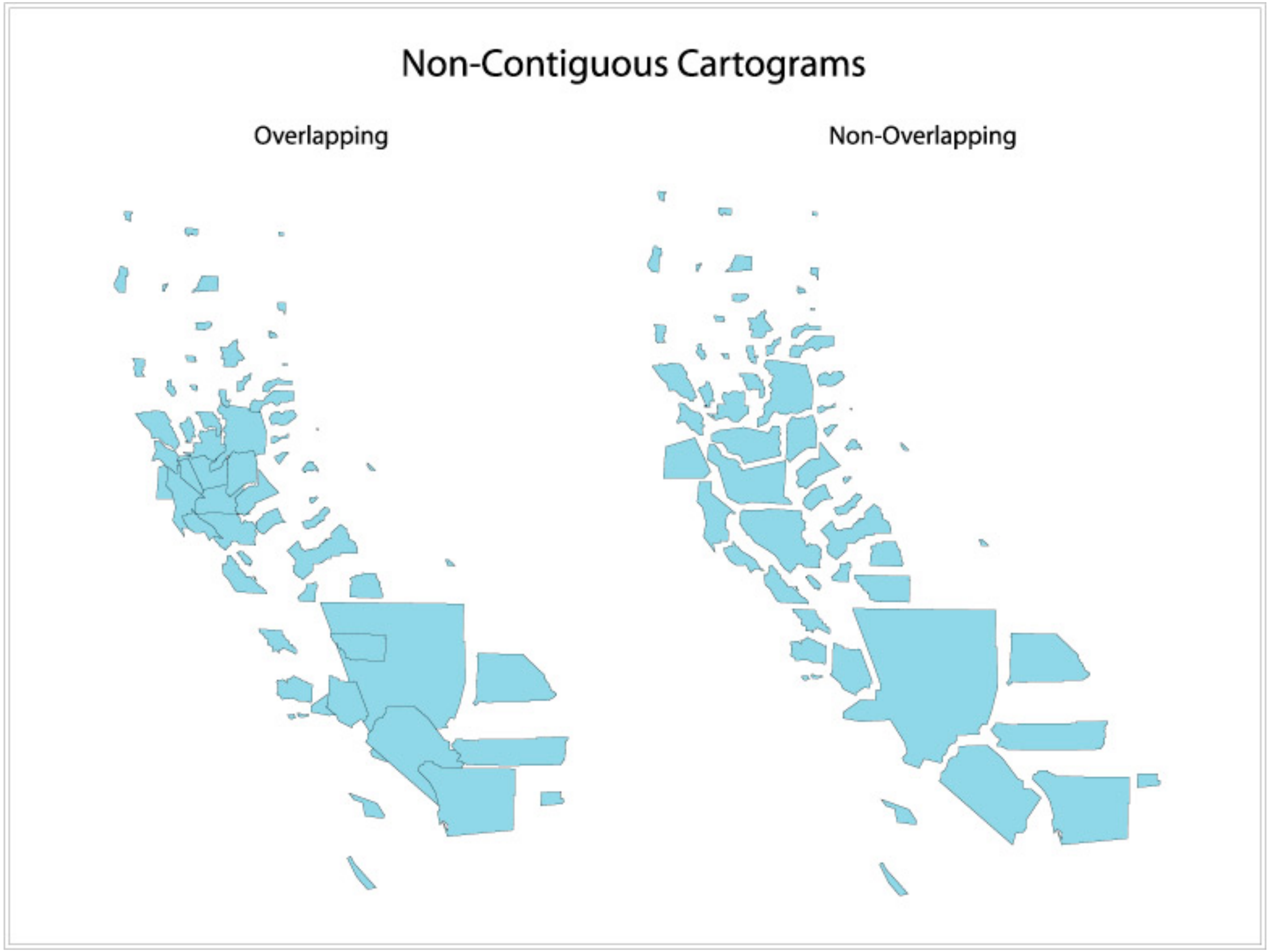
Dorling cartogram

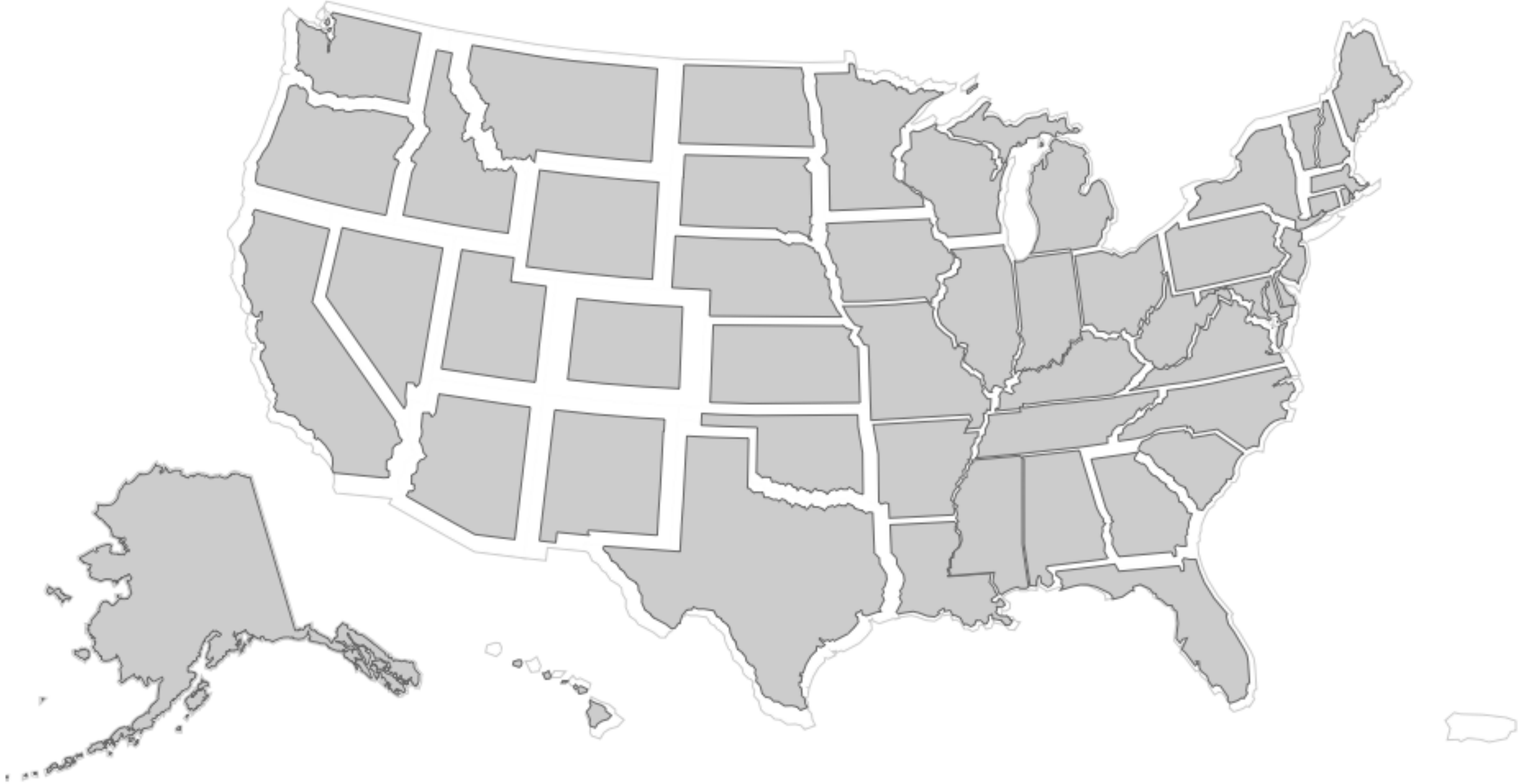


http://mbostock.github.io/protovis/ex/cartogram.html

COMPARISON OF A TRADITIONAL MAP AND CARTOGRAM REPRESENTATIONS OF THE PERCENTAGE OF THE MALE POPULATION OF WORKING AGE IN 1891



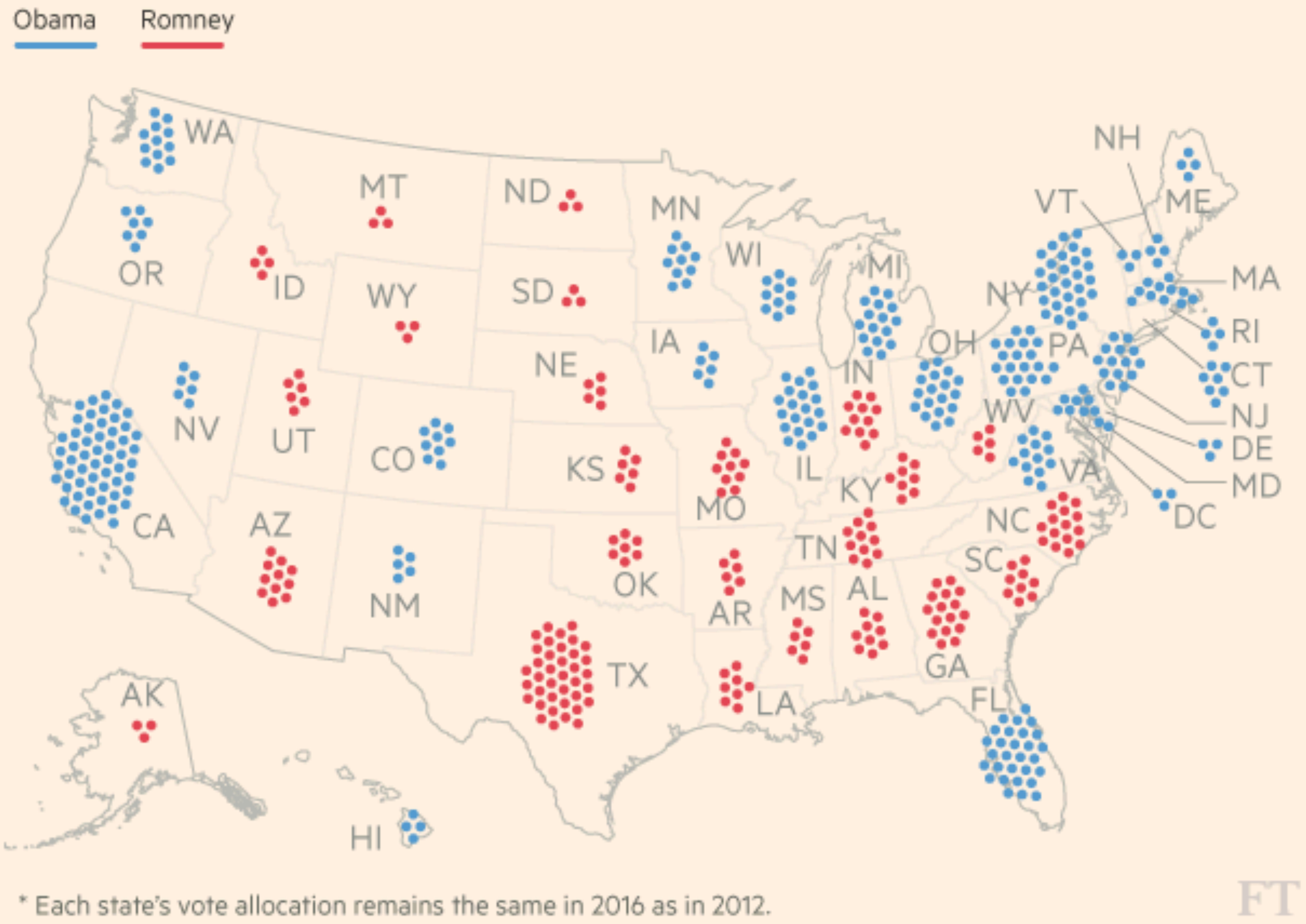

Non-Contiguous Cartograms
Overlapping
Non-Overlapping



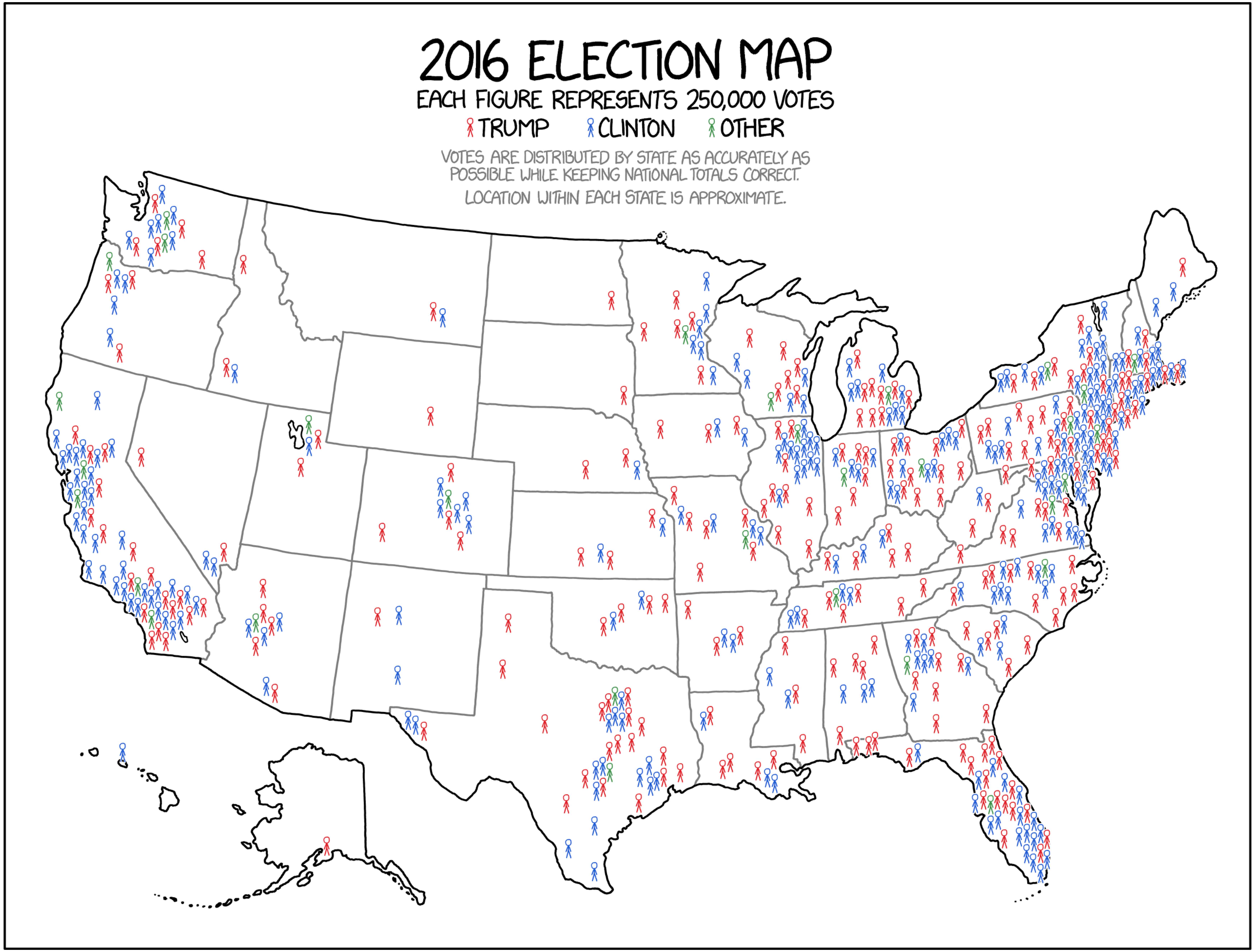
http://mbostock.github.io/d3/ex/cartogram.html

Electoral college votes by state

2012 presidential election results*



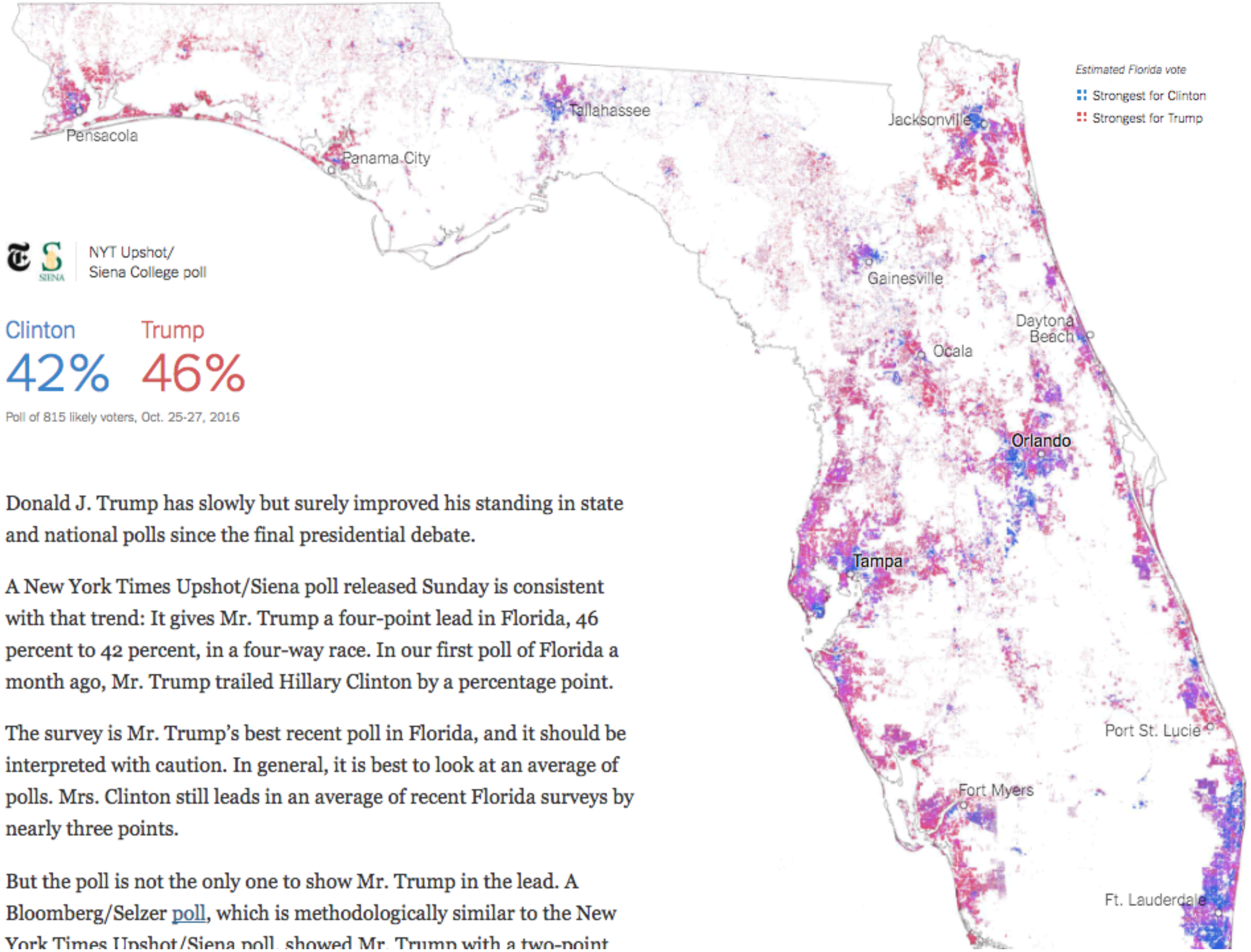
* Each state's vote allocation remains the same in 2016 as in 2012.



https://xkcd.com/1939/

Latest Upshot Poll Shows Trump With a Lead in Florida

By NATE COHN   OCT. 30, 2016

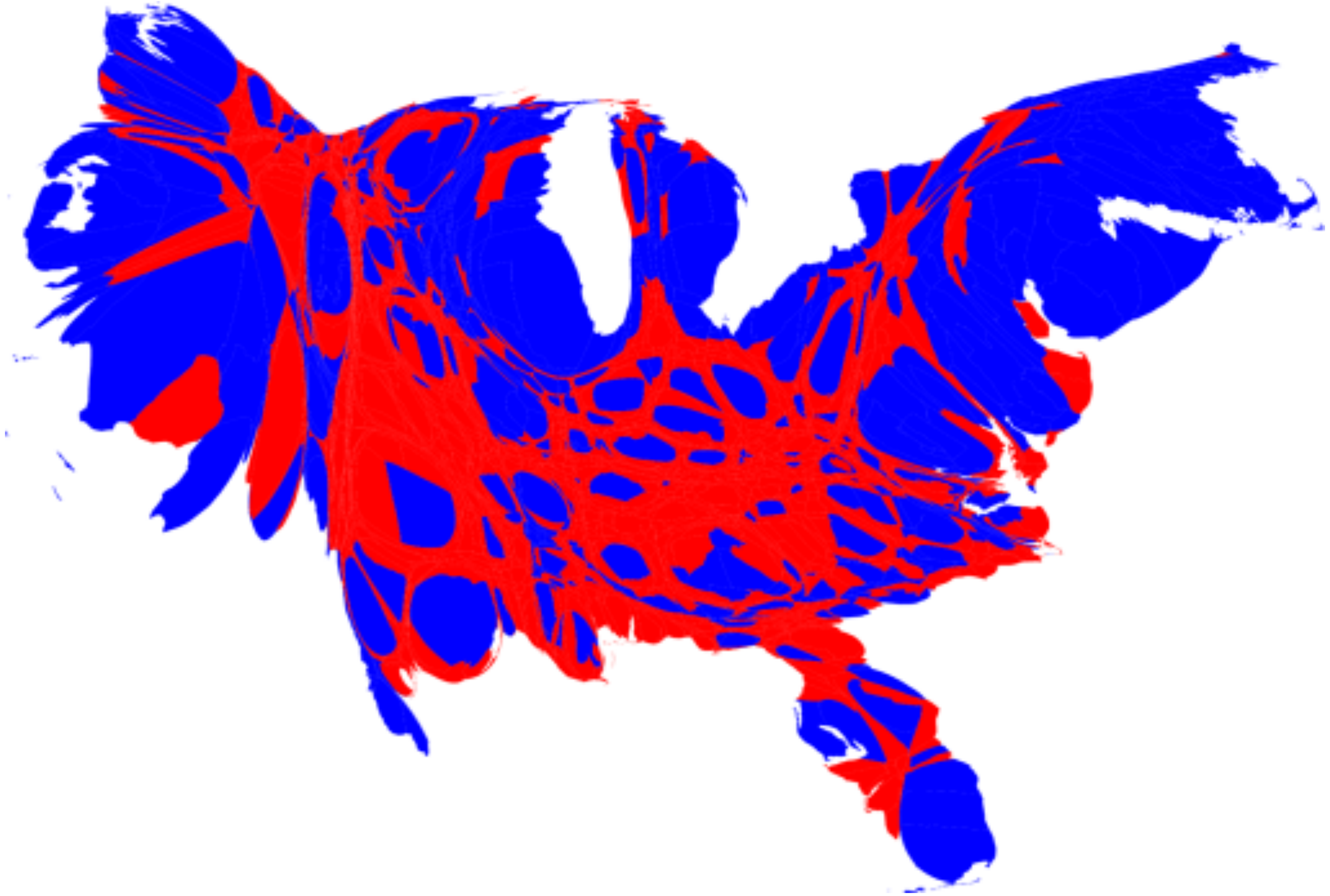


Donald J. Trump has slowly but surely improved his standing in state and national polls since the final presidential debate.

A New York Times Upshot/Siena poll released Sunday is consistent with that trend: It gives Mr. Trump a four-point lead in Florida, 46 percent to 42 percent, in a four-way race. In our first poll of Florida a month ago, Mr. Trump trailed Hillary Clinton by a percentage point.

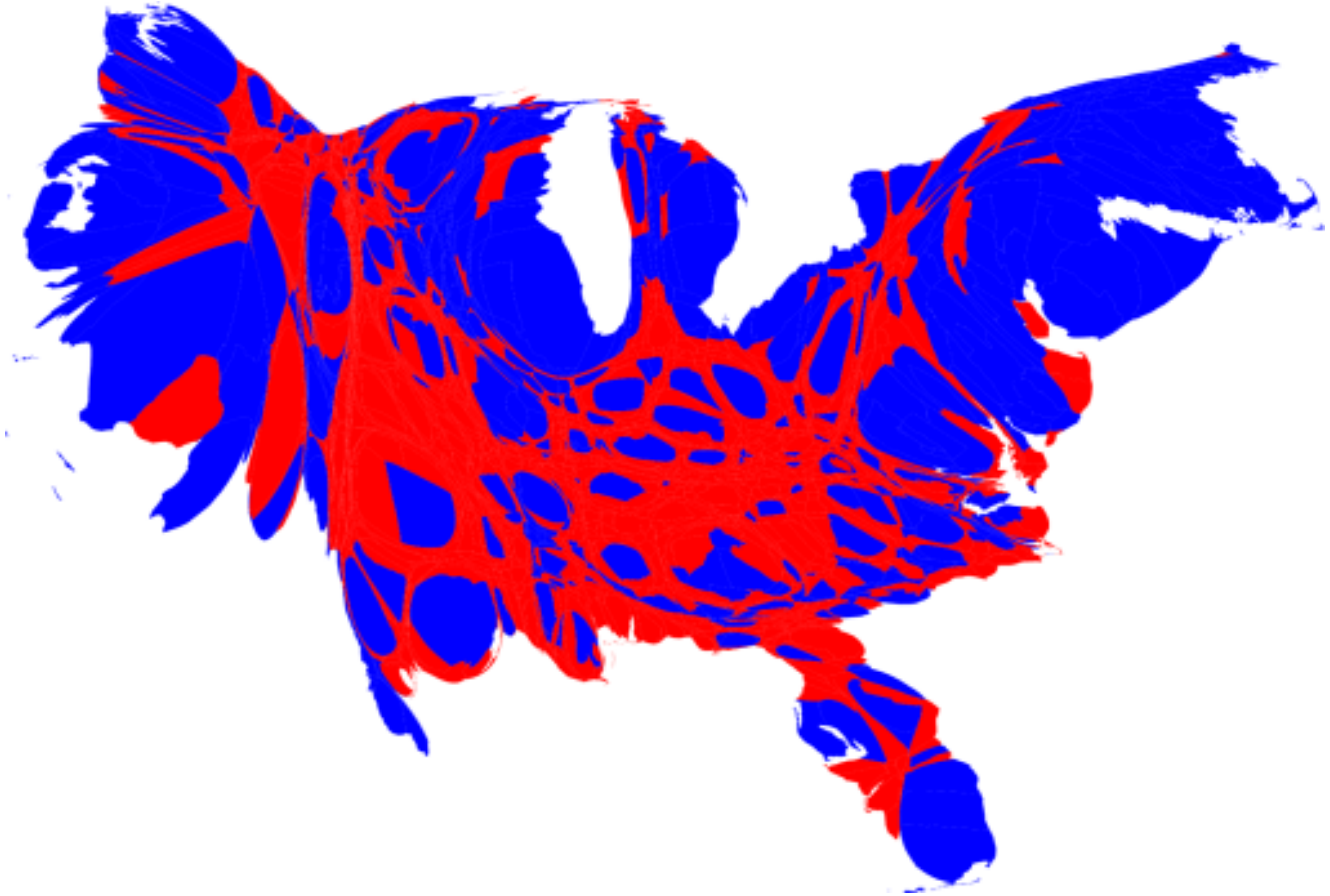
The survey is Mr. Trump's best recent poll in Florida, and it should be interpreted with caution. In general, it is best to look at an average of polls. Mrs. Clinton still leads in an average of recent Florida surveys by nearly three points.

But the poll is not the only one to show Mr. Trump in the lead. A Bloomberg/Selzer poll, which is methodologically similar to the New York Times Upshot/Siena poll, showed Mr. Trump with a two-point

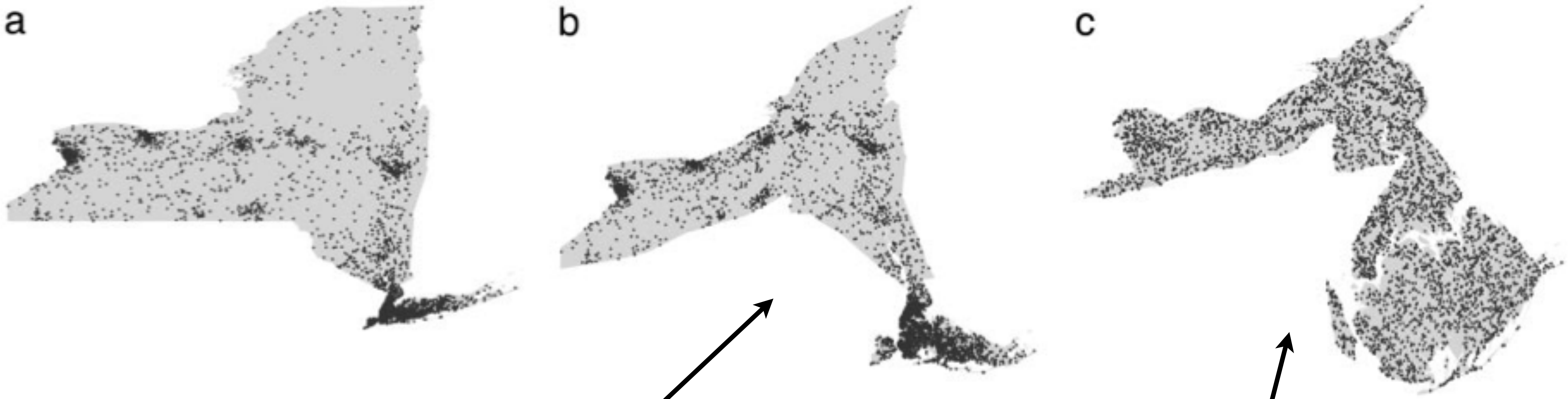


Michael T. Gastner and M. E. J. Newman, Diffusion-based method for producing density-equalizing maps
http://www.pnas.org/content/101/20/7499.abstract

Density-equalizing cartogram



Michael T. Gastner and M. E. J. Newman, Diffusion-based method for producing density-equalizing maps
http://www.pnas.org/content/101/20/7499.abstract



Cartogram with **coarse-grained** density data

Cartogram with **fine-grained** density data

C


RUSSIA
CANADA
UNITED STATES
U.K.
GERMANY
UKRAINE
FRANCE
ITALY
TURKEY
IRAN
PAKISTAN
CHINA
S. KOREA
JAPAN
MEXICO
EGYPT
INDIA
BANGLADESH
MYANMAR
THAILAND
PHILIPPINES
NIGERIA
ETHIOPIA
DR CONGO
COLOMBIA
BRAZIL
PERU
ARGENTINA
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
INDONESIA
SOUTH AFRICA
AUSTRALIA
NEW ZEALAND
ANTARCTICA


RUSSIA
CANADA
UNITED STATES
U.K.
GERMANY
UKRAINE
CHINA
FRANCE
ITALY
TURKEY
IRAN
PAKISTAN
S. KOREA
JAPAN
MEXICO
EGYPT
INDIA
NIGERIA
ETHIOPIA
MYANMAR
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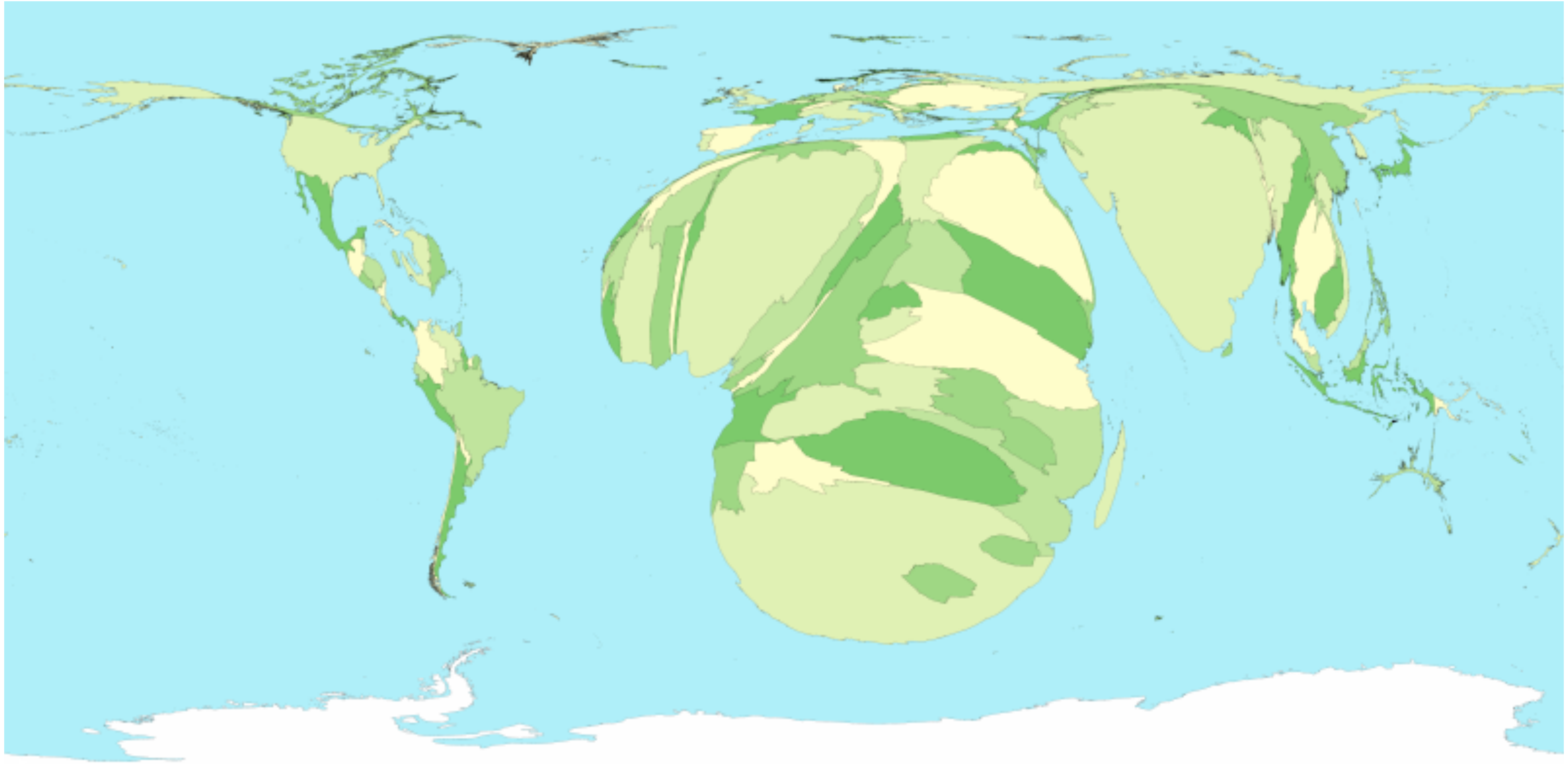
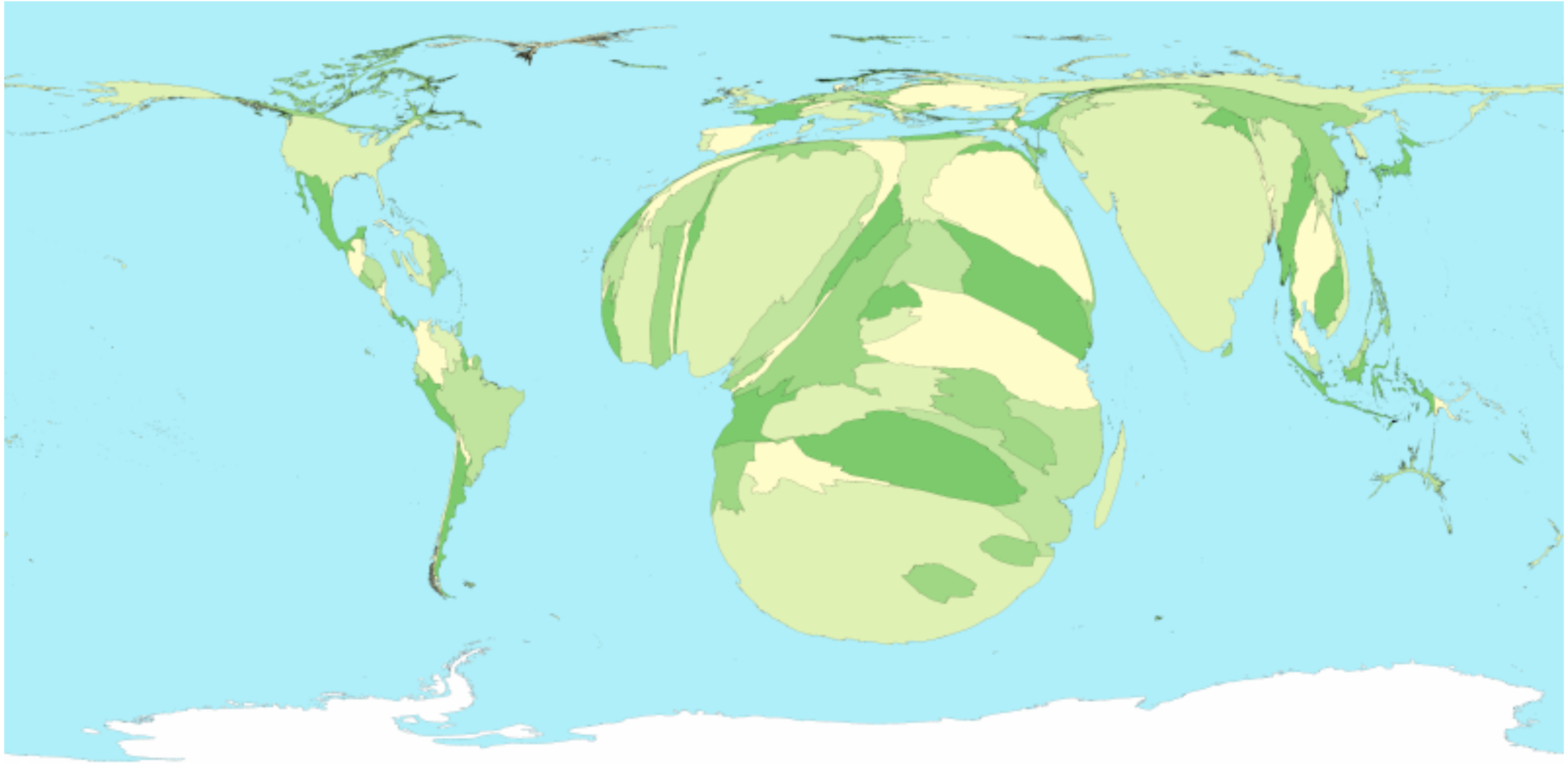
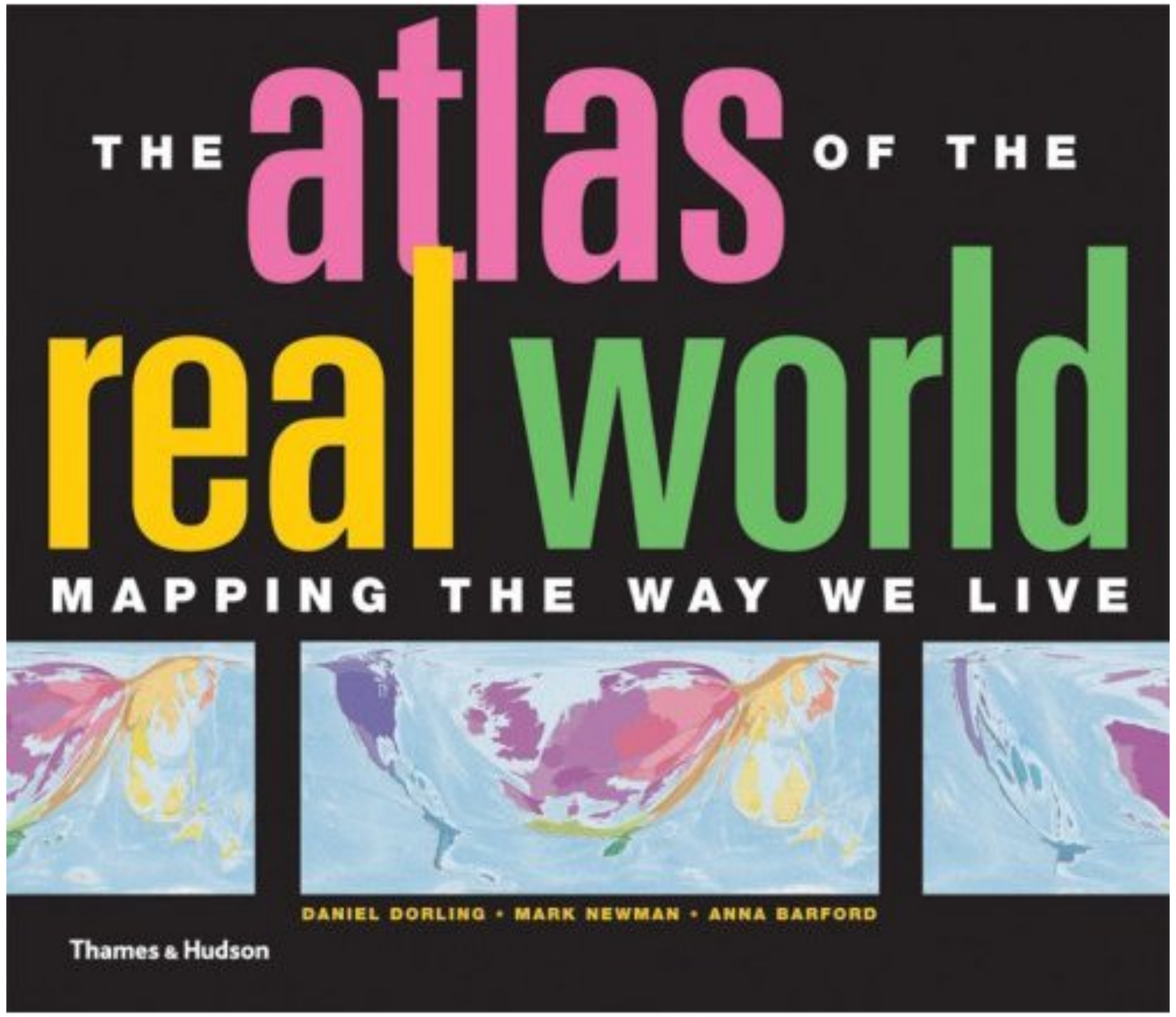
DR CONGO
ATLANTIC OCEAN
INDONESIA
SOUTH AFRICA
INDIAN OCEAN
AUSTRALIA
NEW ZEALAND
ANTARCTICA

Population



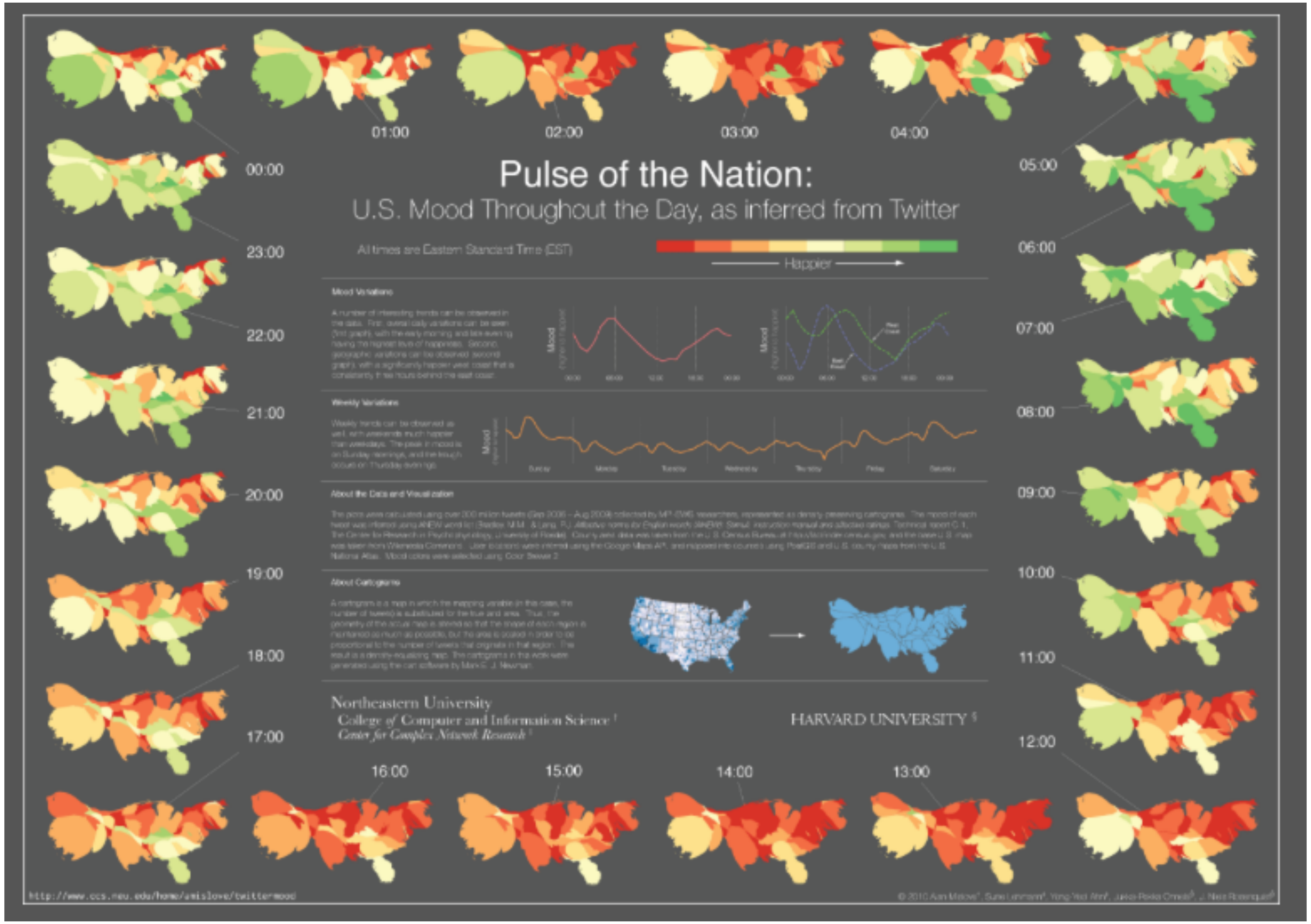


HIV



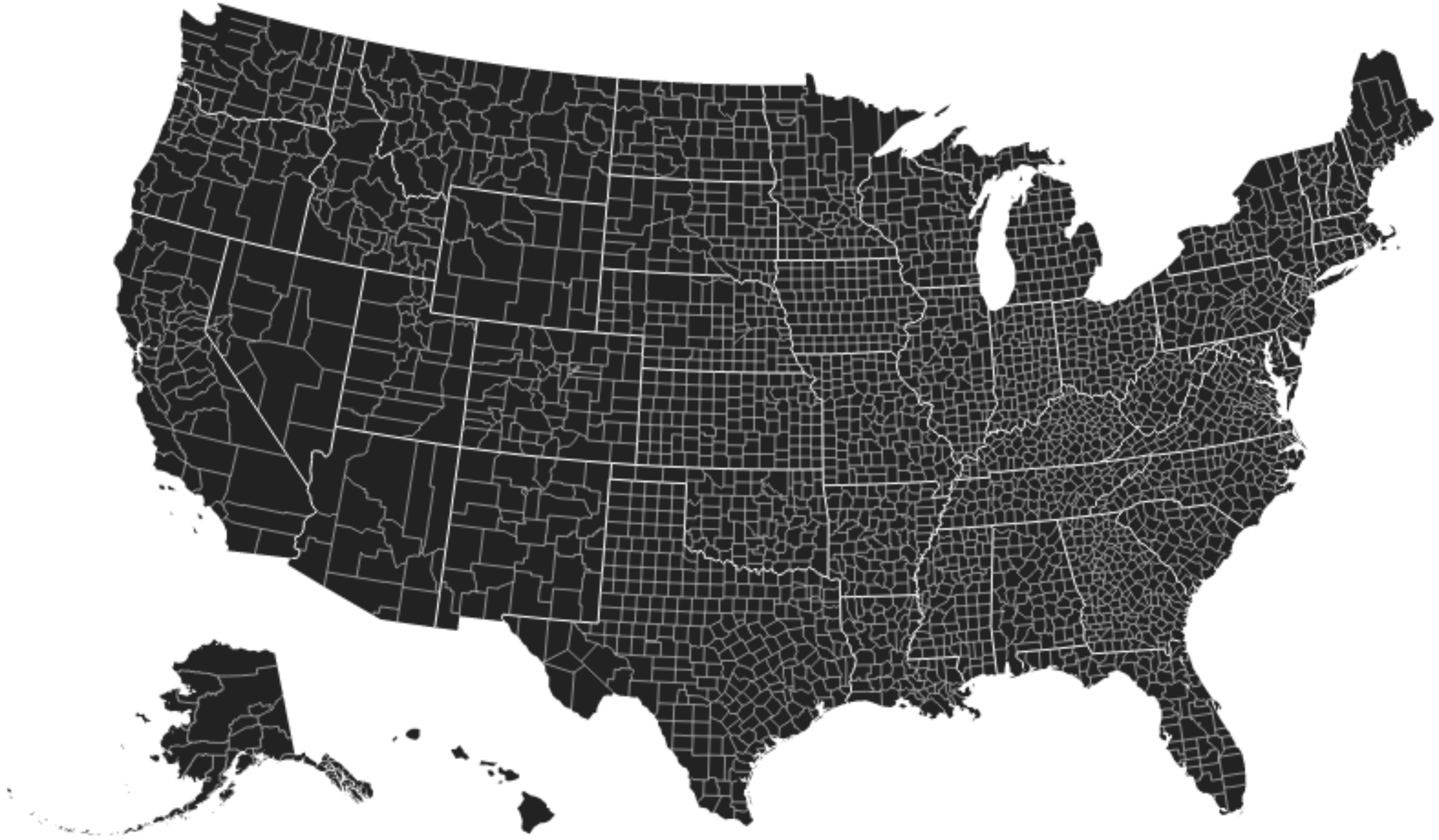
http://www-personal.umich.edu/~mejn/cartograms/

https://www.google.com/search?q=The+Atlas+of+the+Real+World



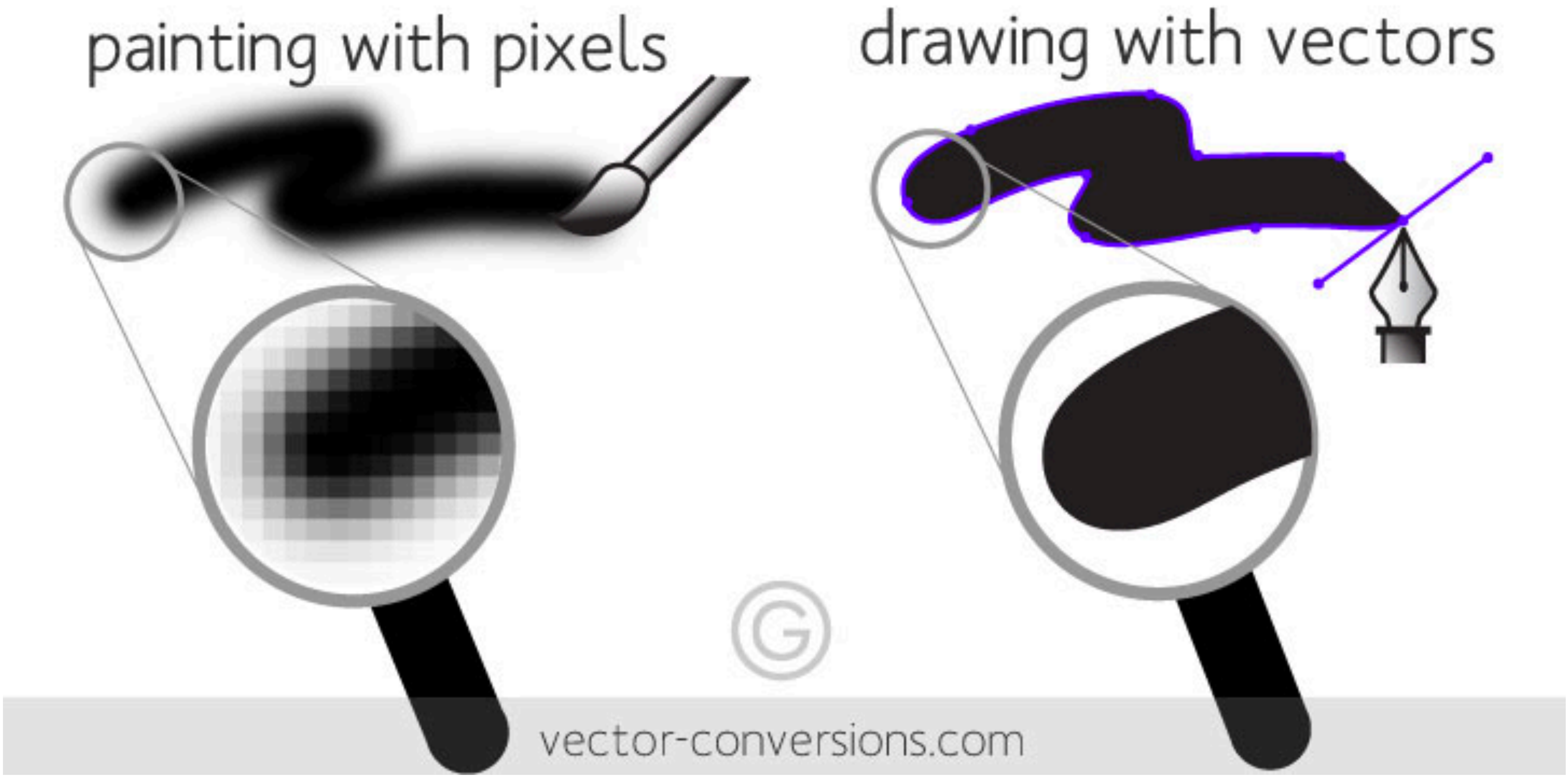
http://www.youtube.com/watch?v=ujcrJZRSGkg

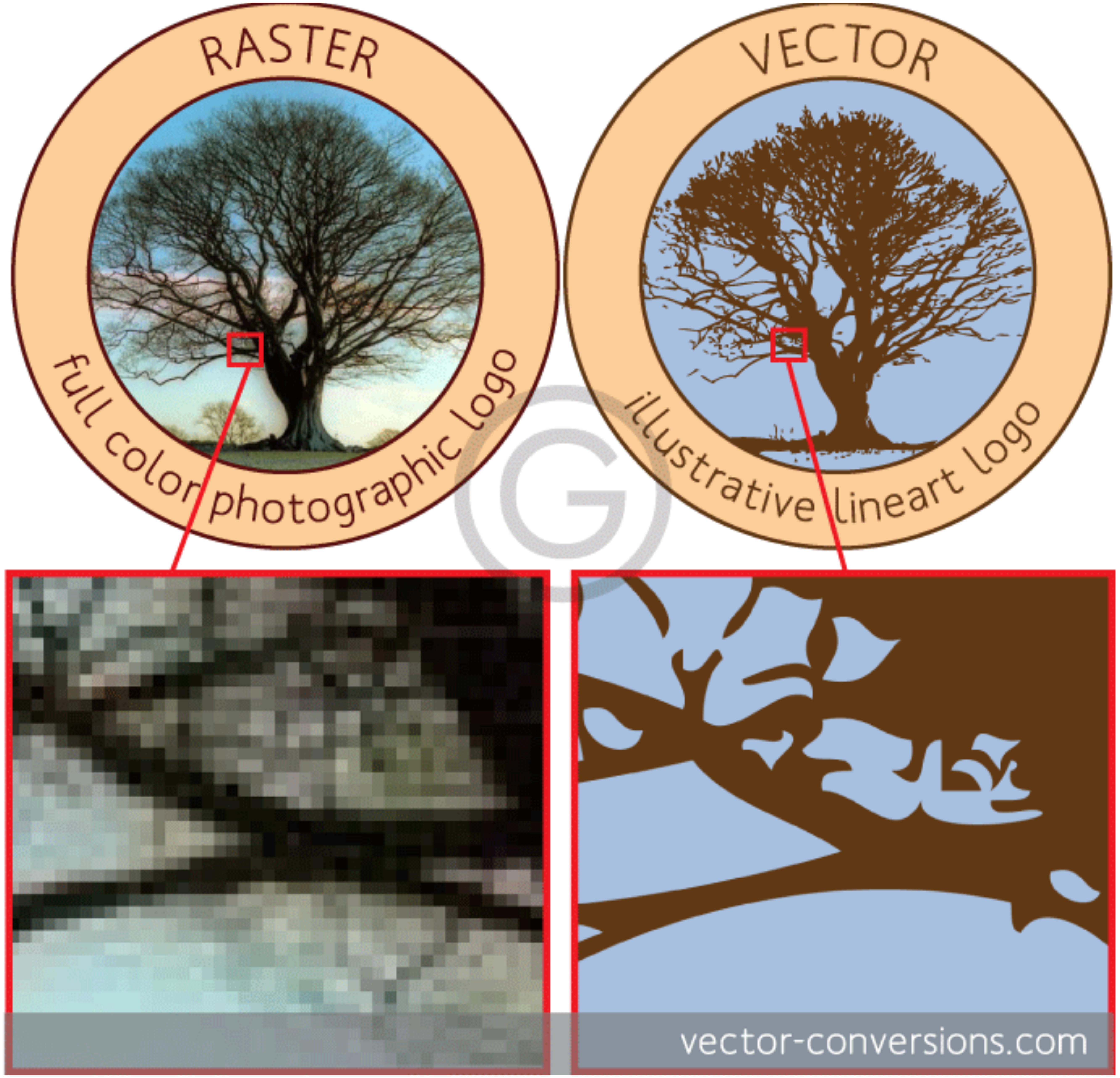
How do you practically store & draw a map like this?



Raster vs. Vector

Image vs. Drawing Instruction


painting with pixels
drawing with vectors
vector-conversions.com


RASTER
full color photographic logo
VECTOR
illustrative lineart logo
vector-conversions.com

TopoJSON

https://github.com/mbostock/topojson/wiki

```json
{
  "type": "Topology",
  "transform": {
    "scale": [0.036003600360036005, 0.017361589674592462],
    "translate": [-180, -89.99892578124998]
  },
  "objects": {
    "aruba": {
      "type": "Polygon",
      "arcs": [[0]],
      "id": 533
    }
  },
  "arcs": [
    [[3058, 5901], [0, -2], [-2, 1], [-1, 3], [-2, 3], [0, 3], [1, 1], [1, -3], [2, -5], [1, -1]]
  ]
}
```

Origine_Point
    "coordinates": [0,0]

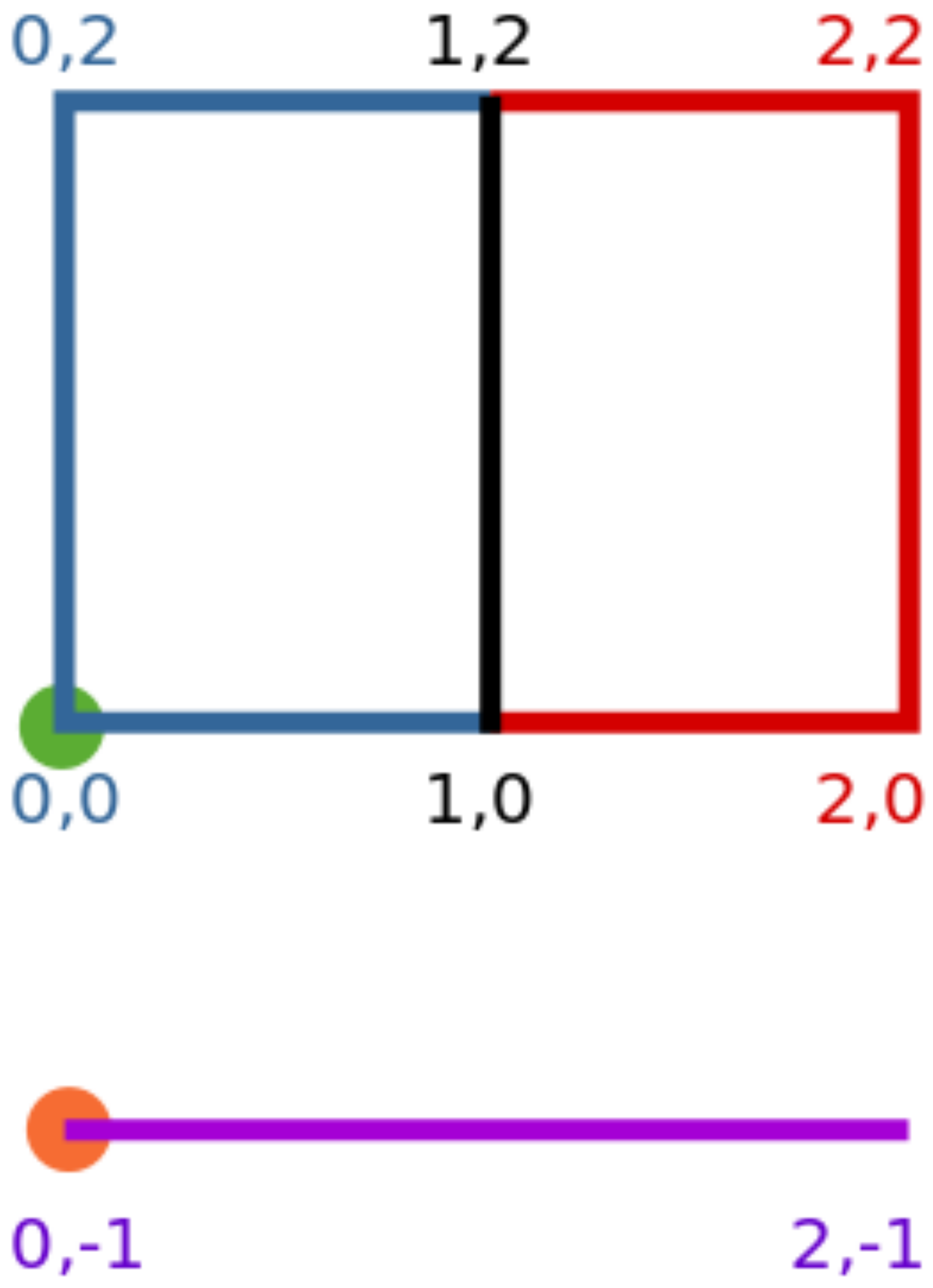
Under_Point
    "coordinates": [0,-1]

Under_LineString
    "arcs": [3]

Left_Polygon
    "arcs": [[0,1]]

Right_Polygon
    "arcs": [[2,-1]]

"arcs":[
    [[1,2],[0,-2]],
    [[1,0],[-1,0],[0,2][1,0]],
    [[1,2],[1,0],[0,-2],[-1,0]],
    [[0,-1],[2,0]]
    ]



http://en.wikipedia.org/wiki/Topojson