

01

Information Visualization

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Introduction



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<http://alfredoferreira.eu>



01

WHAT IS INFOVIS?

Visualization



Visualize

form a mental image of something

to make perceptible to the mind

Information Visualization

**“The use of computer-supported,
interactive visual representations
of data to amplify cognition.”**

- Card, Mackinlay Shneiderman 98

Information Visualization

“Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.”

- Munzner, 2014

Information Visualization

“The use of computer-supported, interactive visual representations of data to amplify cognition.

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Information Visualization

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“Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.”

Sight Rules!

sight

touch

hearing
smell

12.5 MB/s



hard-disk

1250 MB/s



same bandwidth as a computer network

125 MB/s



USB key

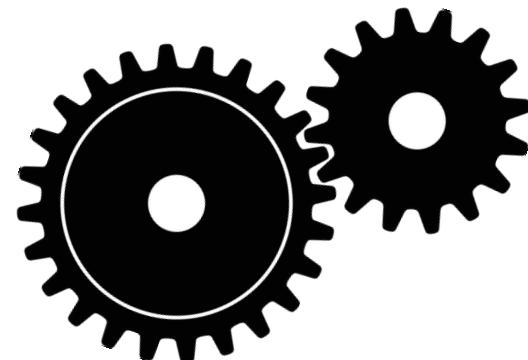
A Human in the Loop

The vis in itself tells little, it needs to be interpreted



A Human in the Loop

Vis not necessary when trusted fully automatic solution exists



Vis good for ill-specified problems



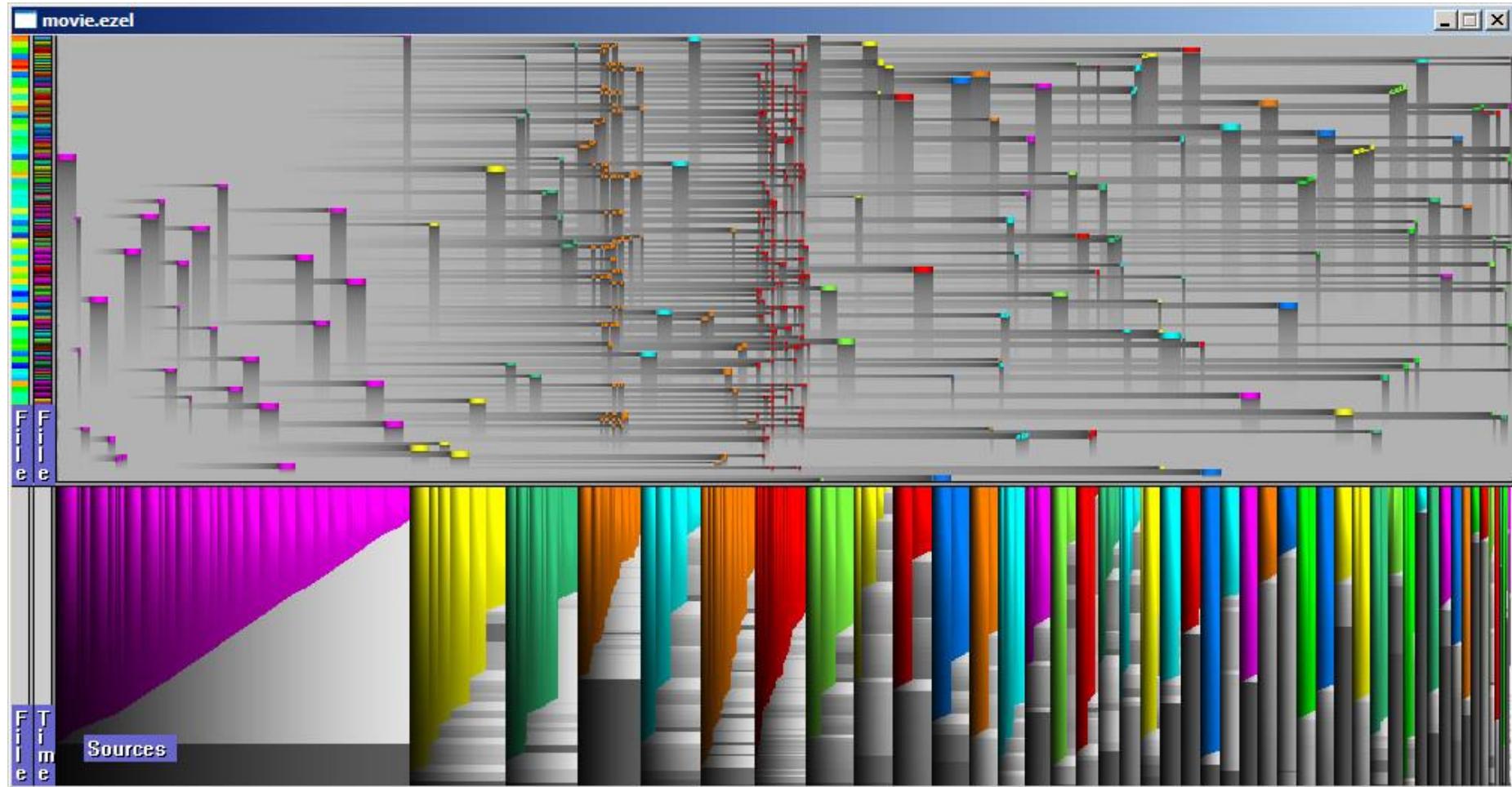
Information Visualization

“The use of computer-supported, interactive visual representations of data to amplify cognition.

“Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.”

A Computer in the loop

Efficiency, patience, interactivity



Information Visualization

“The use of computer-supported, interactive **visual representations** of data to amplify cognition.

“Computer-based visualization systems provide **visual representations** of datasets designed to help people carry out tasks more effectively.”

Vision is a high-bandwidth sense



What about the other senses?

**Not good for parallel apprehension of data.
Low bandwidth**



Technical limitations



Information Visualization

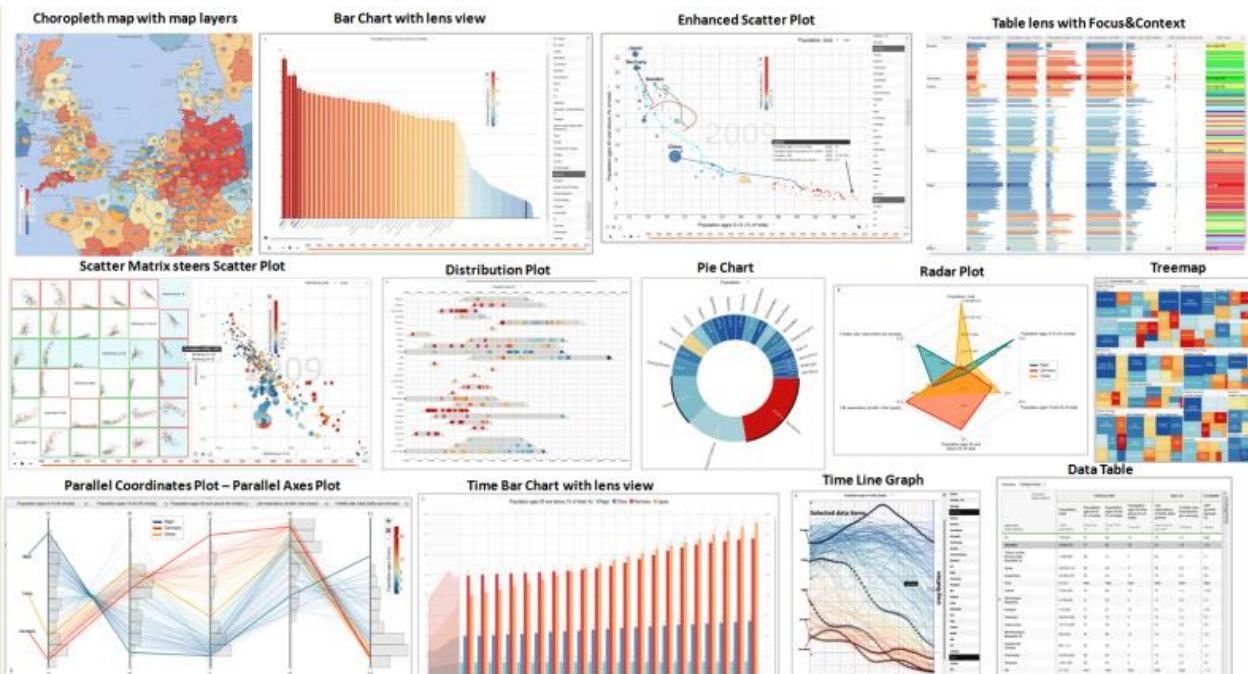
**“The use of computer-supported,
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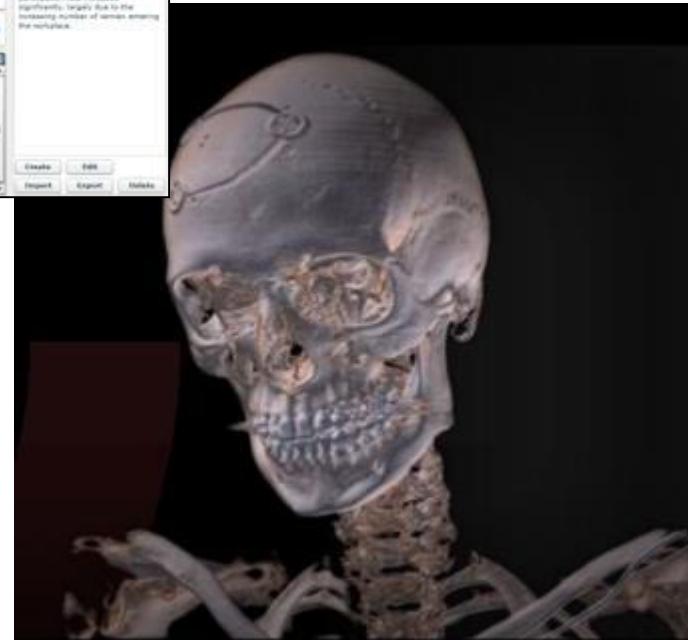
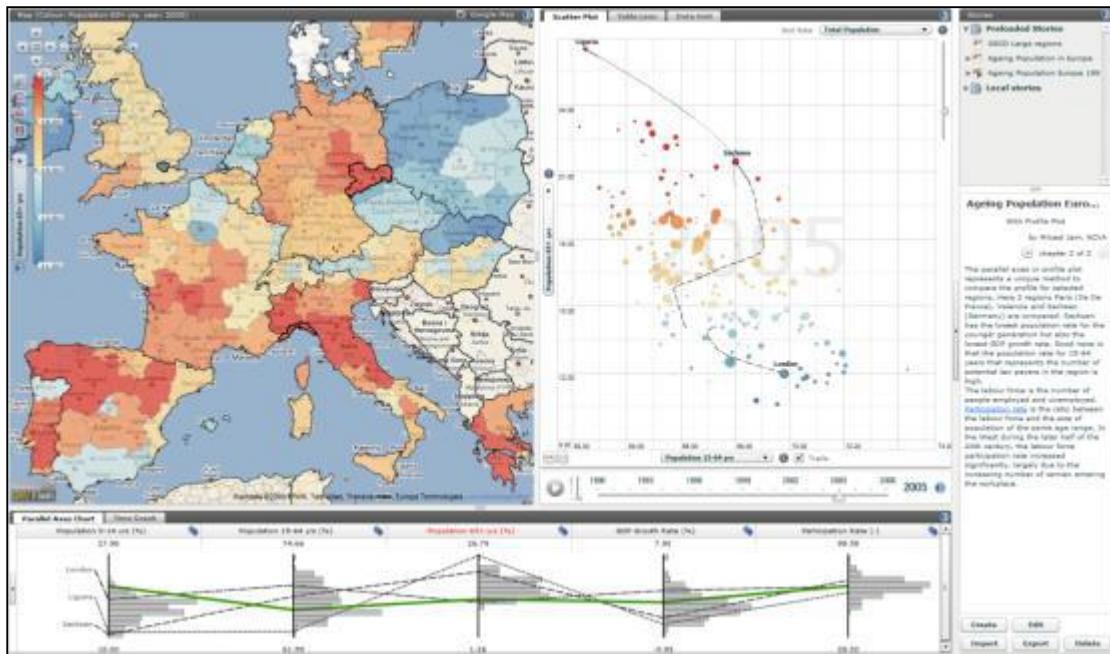
The importance of Tasks

Tasks constrain design

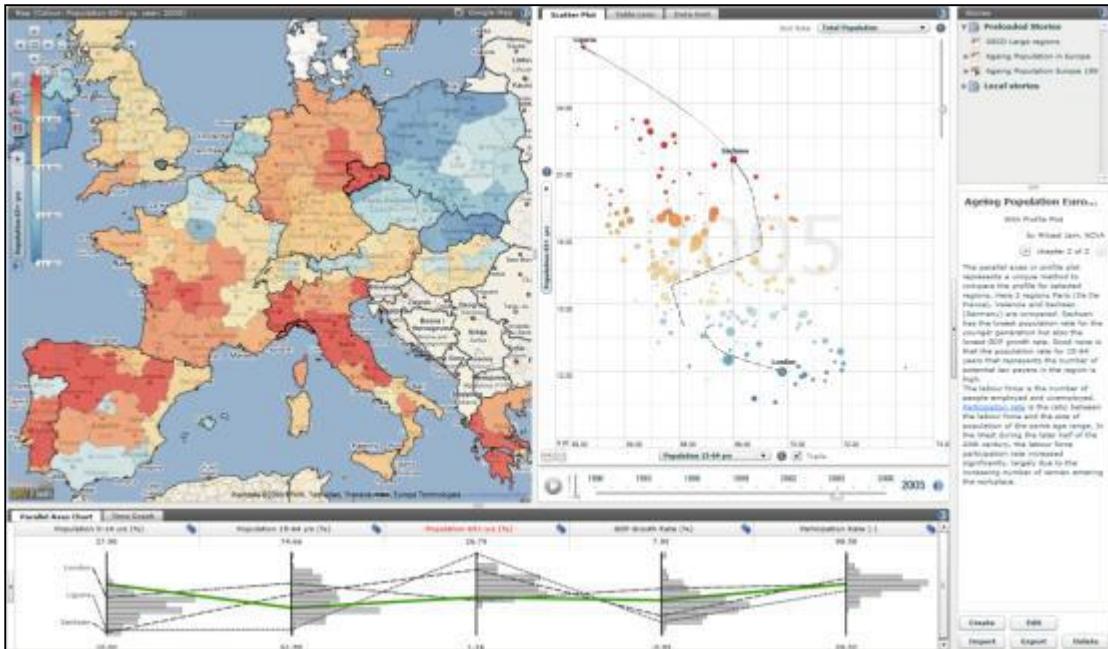
Not all visualization techniques work for all tasks
challenge: recast tasks from domain-specific
vocabulary to abstract forms



InfoVis vs Scientific Visualization



InfoVis vs. “Visualization” (aka Computer Graphics)



02

SYLLABUS

What We'll Study

The Visualization Crafting Process

What, Why, How?

Data

- Variable Types
- Derived measures

Perceptual Issues

- Marks
- Visual encoding
- Color

Overall Organization

Lying and Obfuscating

What We'll Study

Idioms

Simple graphs

Hierarchies

Tabular data

Temporal-based

Geo-based

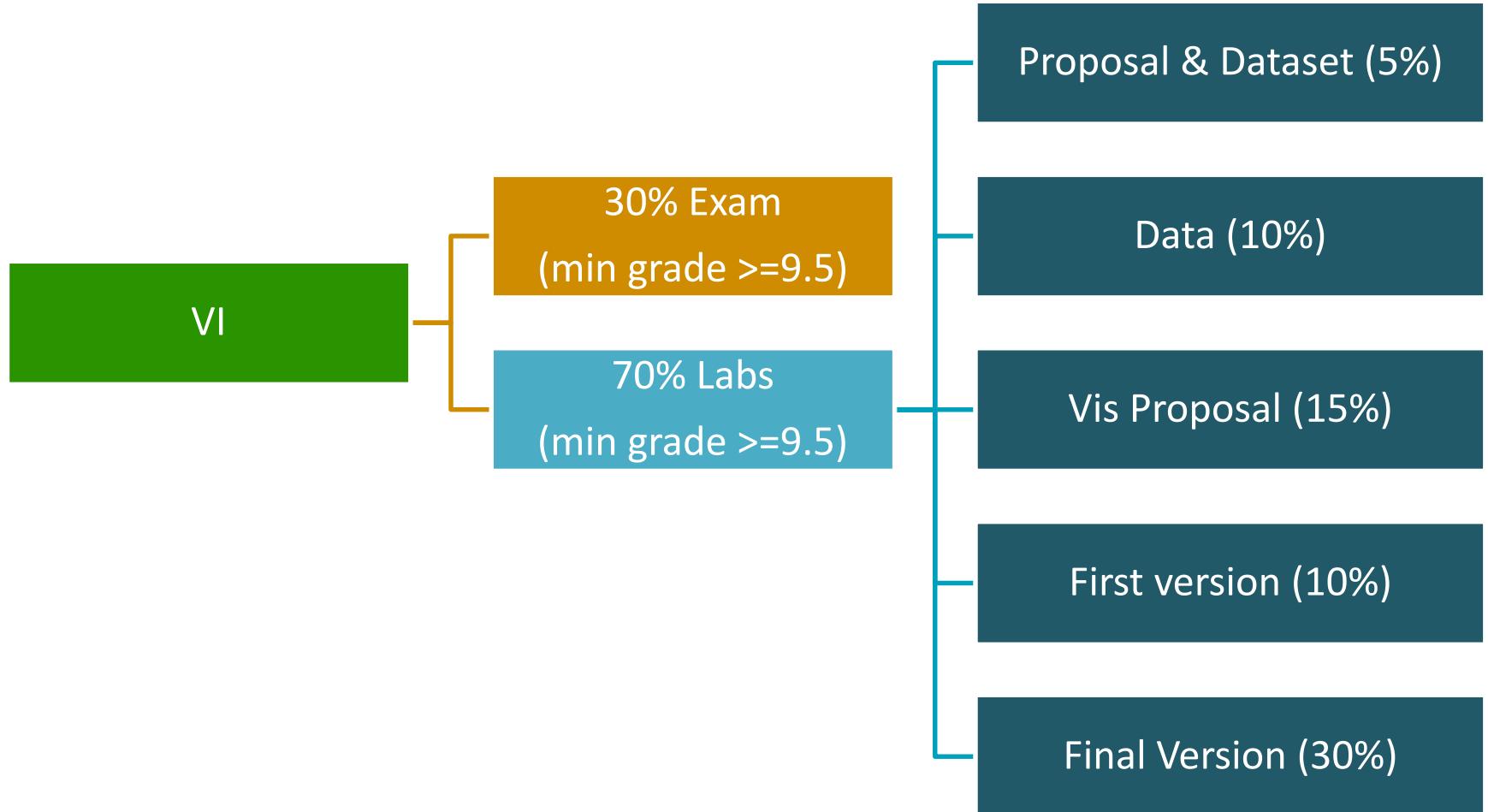
Multivariate

Dealing with complexity

Interactivity

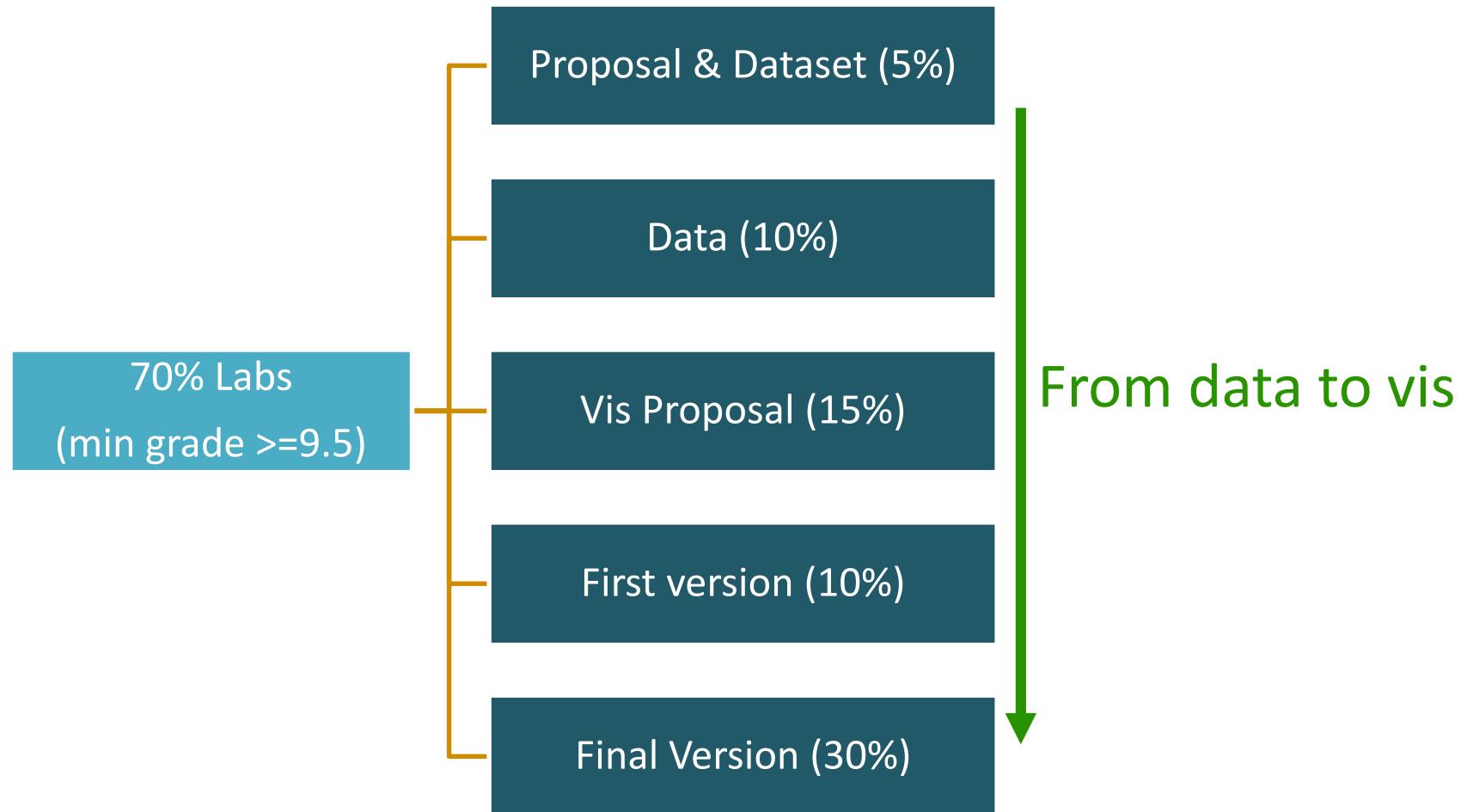
Evaluation

How we will evaluate?



Labs

You will be crafting a visualization



Do you want some...

**EXTRA
GRADE!**

Extra Grade?

Two different ways to get it!

Small tasks, interesting take on InfoVis

(up to) 2.0 extra grade points overall:

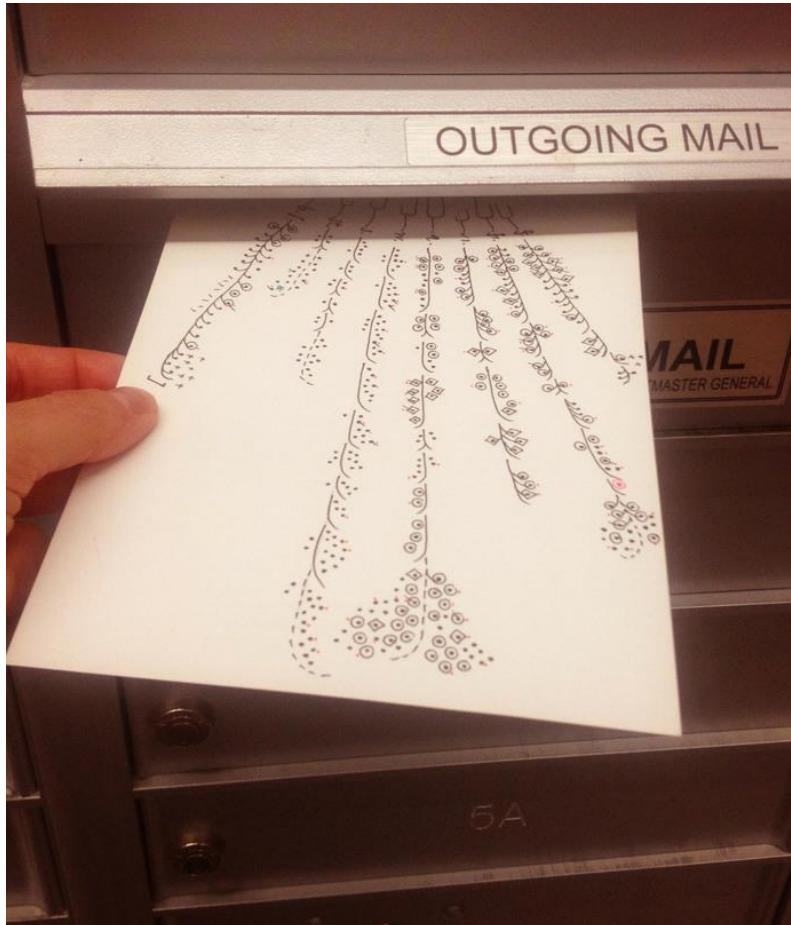
“Dear Data” (1.0)

“Physical Vis” (1.0)

“Dear Data”

<http://www.dear-data.com>

Year-long, analog data drawing project by
Giorgia Lupi and Stefanie Posavec



“Dear Data”

For one week, collect and measure a particular type of data about your life

Represent it visually on a postcard drawing on a postcard!

Rated based on complexity, creativity, originality and appeal

“Dear Data” Examples

.....	o:	o:....	o...	'	o.....x.....	o...o.....
-x.....	...oo..	..o..	..o..o....o	...o..oo..	△o..	o...o...
....o..	o.....o	..o..o	..o....	o...o..o	...o...o..o
o... ..	o...oo	..o..	..△..o	..△....	oo'....	o.....
...o..△	o...ooo	ooooo..	o..o..	...o...o...
.. Γ.....	o@X...△..	..o..X..o..	o.. Γ '...o..o.....	...o..
....	Γ Γ....	...o..o...o..o..
....o..	o....	o o..o..	..o..o..o..	o..o..o..	...o..o..o..	...o..
o..	o..X....	o..o..o..	o..o..o..o...o..
..o..	..o..o..	o..o..o..o..	..	o...o..o..
..oo'oo'...	ooo'oo'...	...o	o..o..o..	..o..o..o..	Xo.....
.. X..o..	...o..	..o...o	o.....	o...o..o..
....	...o..o..o..o..	11111..	o..	o...o.....
...o..	...o..	o...o..	o..	X..X
....oX..	o..	o...o.....
.....	..	X..	..	oo..

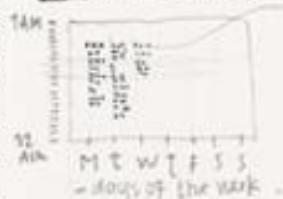
“Dear Data” Examples

.....
* * * * *
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--# A
| T * * * *
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.... O:
O:
-O-
-o o o o-
* * # * *
....
.... O-
....
....

DEAR DATA

WEEK 01: WHAT'S THE TIME?

HOW TO READ IT:



- each symbol represents every moment I glanced at the clock, grouped by hours of the day:
Different symbols and attributes represent WHY and HOW I checked the time.

Symbols

- on purpose: wanted to know what the time was.
 - just glanced: on a phone, mac or else
 - Because I thought of this project.
 - I thought "Don't look!"
But I did.
 - Because I was Bored
 - Because I was Hungry
 - Heard somebody saying the time aloud. 0012

ATTRIBUTES

- f*ck! I'm late!
 - oh, ok. I'm fine.
 - analog support
(i.e. wrist watch)
 - alarm clock rang.
 - glanced at the clock
while testing or
emailing with
Stefanie. ☺

SEND TO:

STEFANIE POSAVEC

~~BRUNSWICK~~ ~~CO.~~

LONDON

[UK]

ENGLAND

“Dear Data” Examples



"Dear Data" Examples

“DEAR DATA
WEEK 24: DOORS' PATTERNS

HOW TO READ IT:

Every little rectangle represents a door I opened and/or passed through, in chronological order, to enter a space. (P.S. closet doors and furniture doors are not included)

MAIN LOCATION:

- my Building
- work (NEW-INC)
- SHOP/STORE
- CAFÉ/PUB RESTAURANT
- CLIENT PLACE

TRANSPORTATION

TIME OF DOOR:

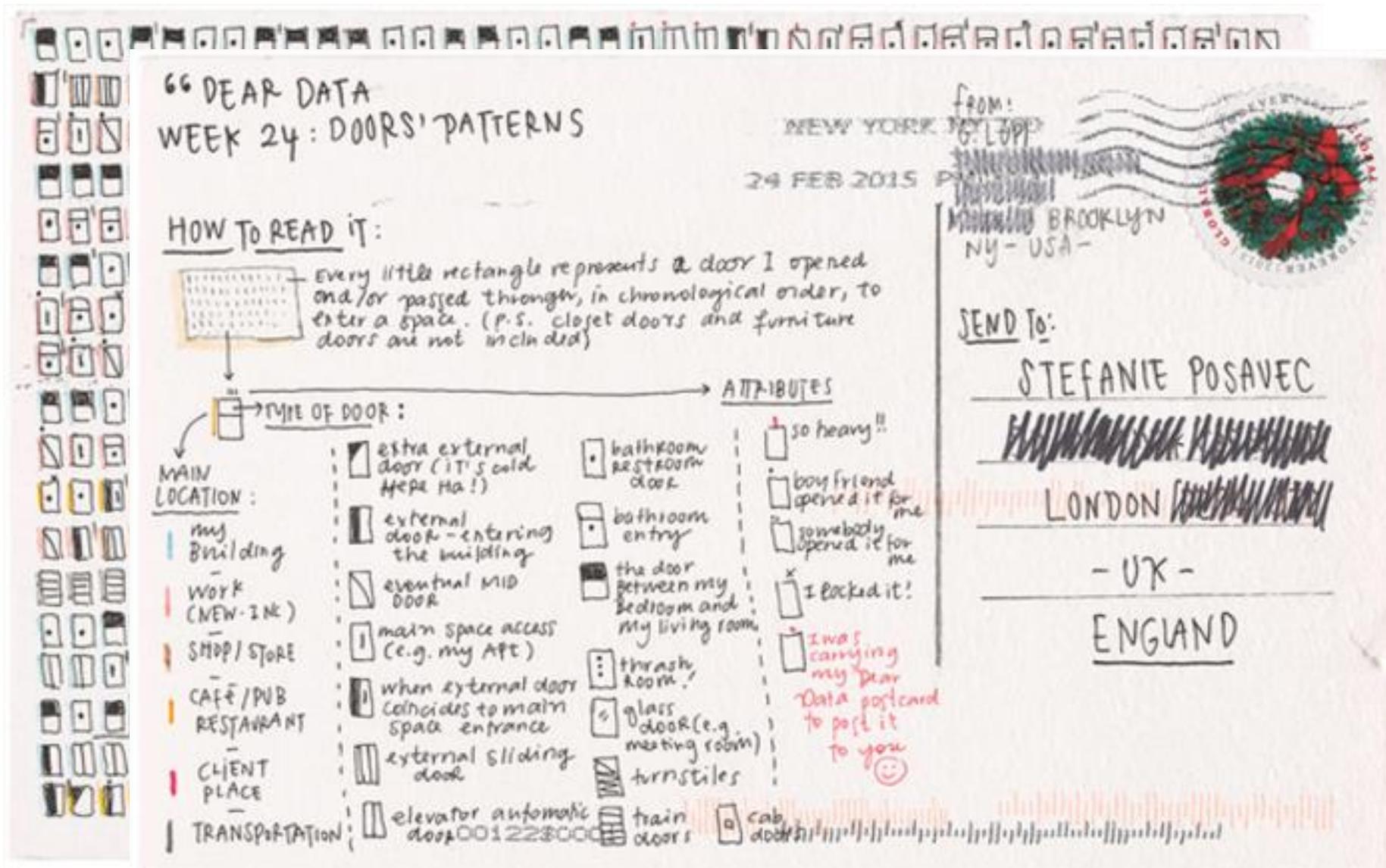
- extra external door (IT's cold here ha!)
- external door - entering the building
- eventual MID DOOR
- main space access (e.g. my Apt)
- when external door coincides to main space entrance
- external sliding door
- elevator automatic door 001228000

ATTRIBUTES

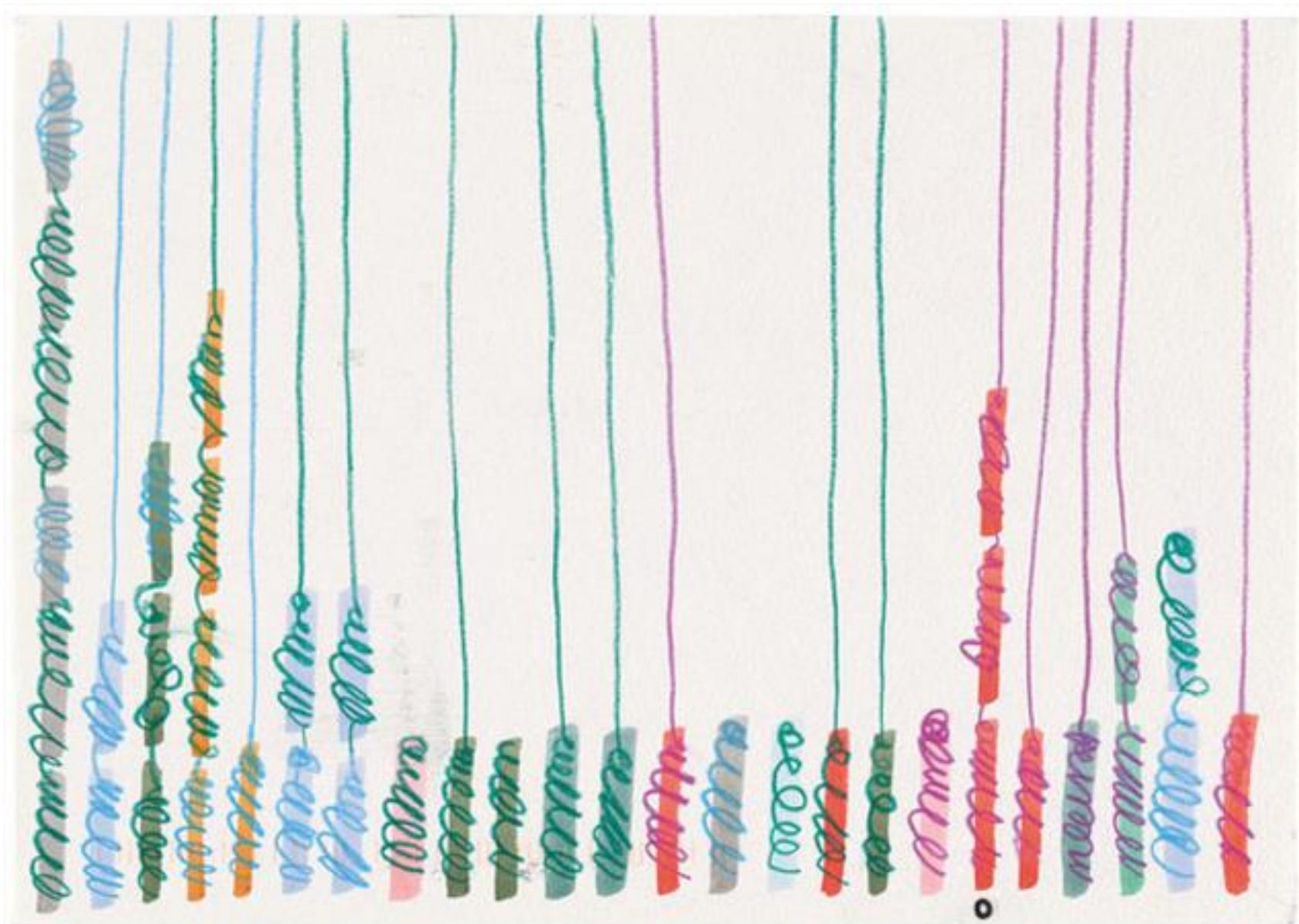
- bathroom RESTROOM door
- bathroom entry
- the door between my bedroom and my living room
- trash room!
- glass door (e.g. meeting room)
- turnstiles
- so heavy!!
- boyfriend opened it for me
- somebody opened it for me
- I locked it!
- I was carrying my dear Data postcard to post it to you 😊

FROM: G. LOPP
TO: STEFANIE POSAVEC
24 FEB 2015
NEW YORK CITY
USA
MINI BROOKLYN
NY - USA

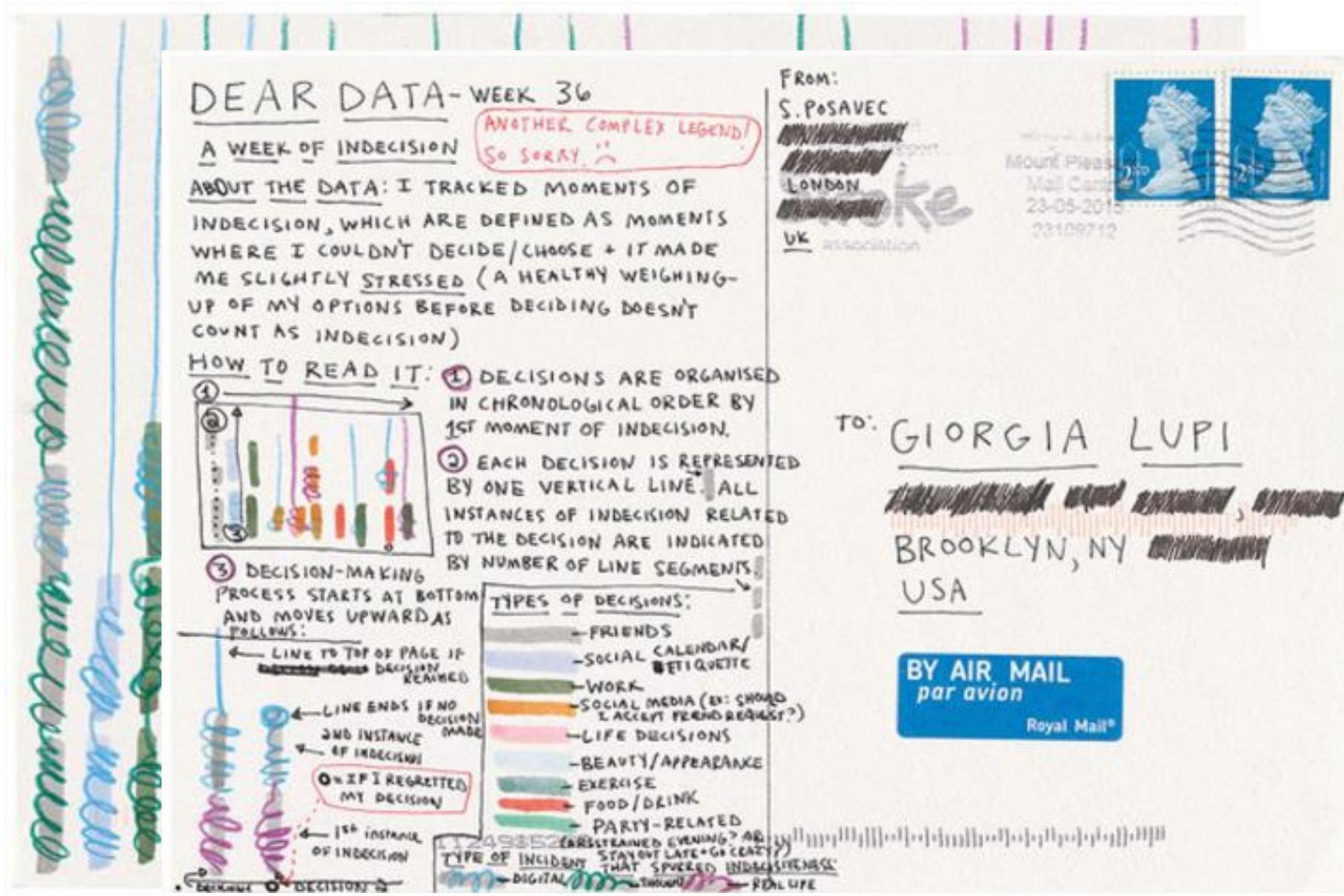
SEND TO:
STEFANIE POSAVEC
LONDON
- UK -
ENGLAND



“Dear Data” Examples



“Dear Data” Examples



“Dear Data” Logistics

Deadline: 15 October

Deliver: Postcard (in class)

ZIP file with two scans of the two sides of the postcard (through Fénix)

Showcase: I'll select a few to be presented in class, week of Oct 22

“Dear Data” Grading

Four criteria

Idea (originality)

Effort

Creativity

Works?

Those will get you up to 0.9

Presenters in class will get the additional 0.1

“Physical Vis”

InfoVis in a non-digital way. Tangible!

Record the data, then craft a physical artifact representing it!

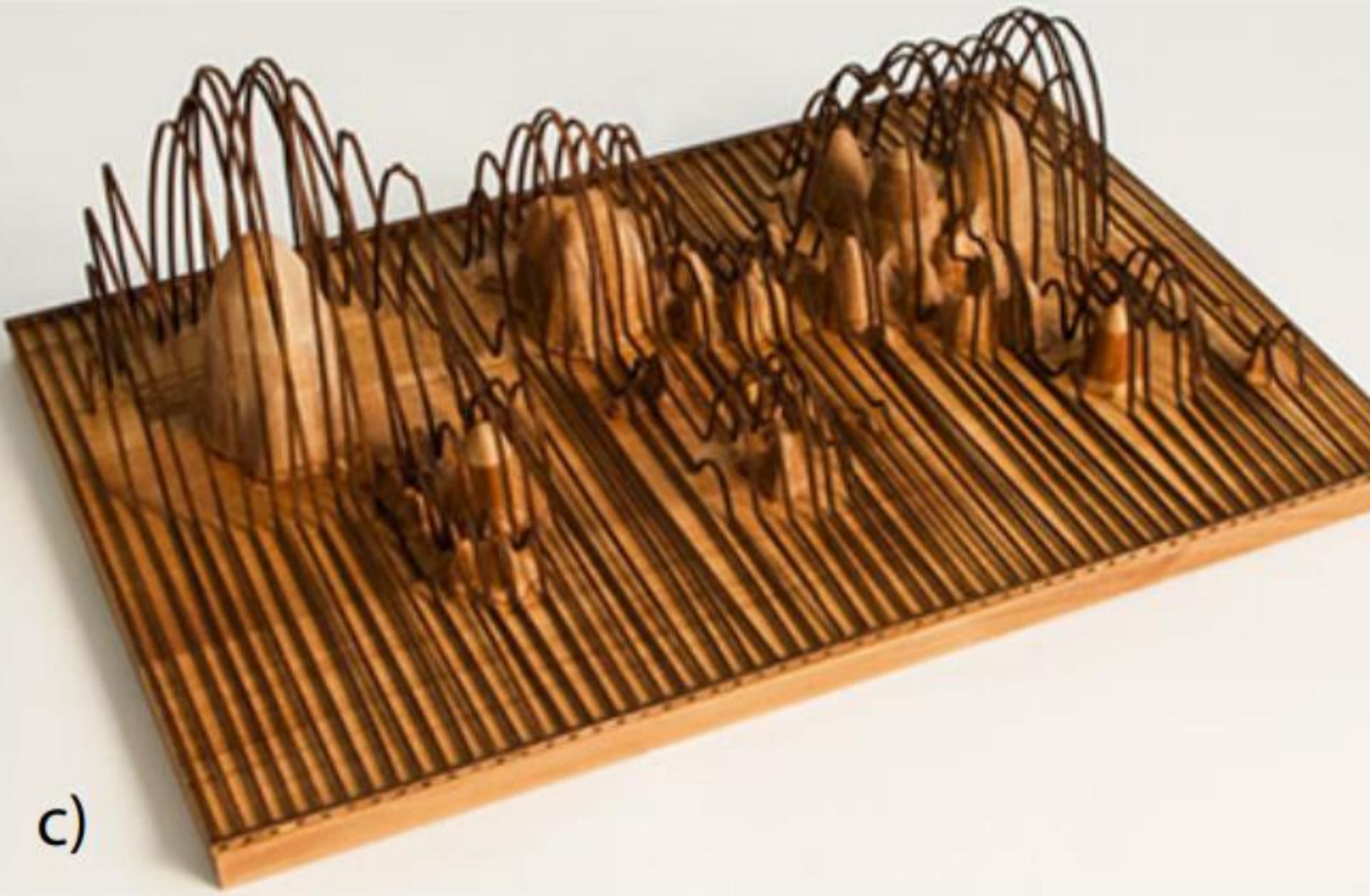
(something you can carry around, fits in my backpack!)

Rated based on complexity, creativity, originality and appeal

Physical Vis Examples

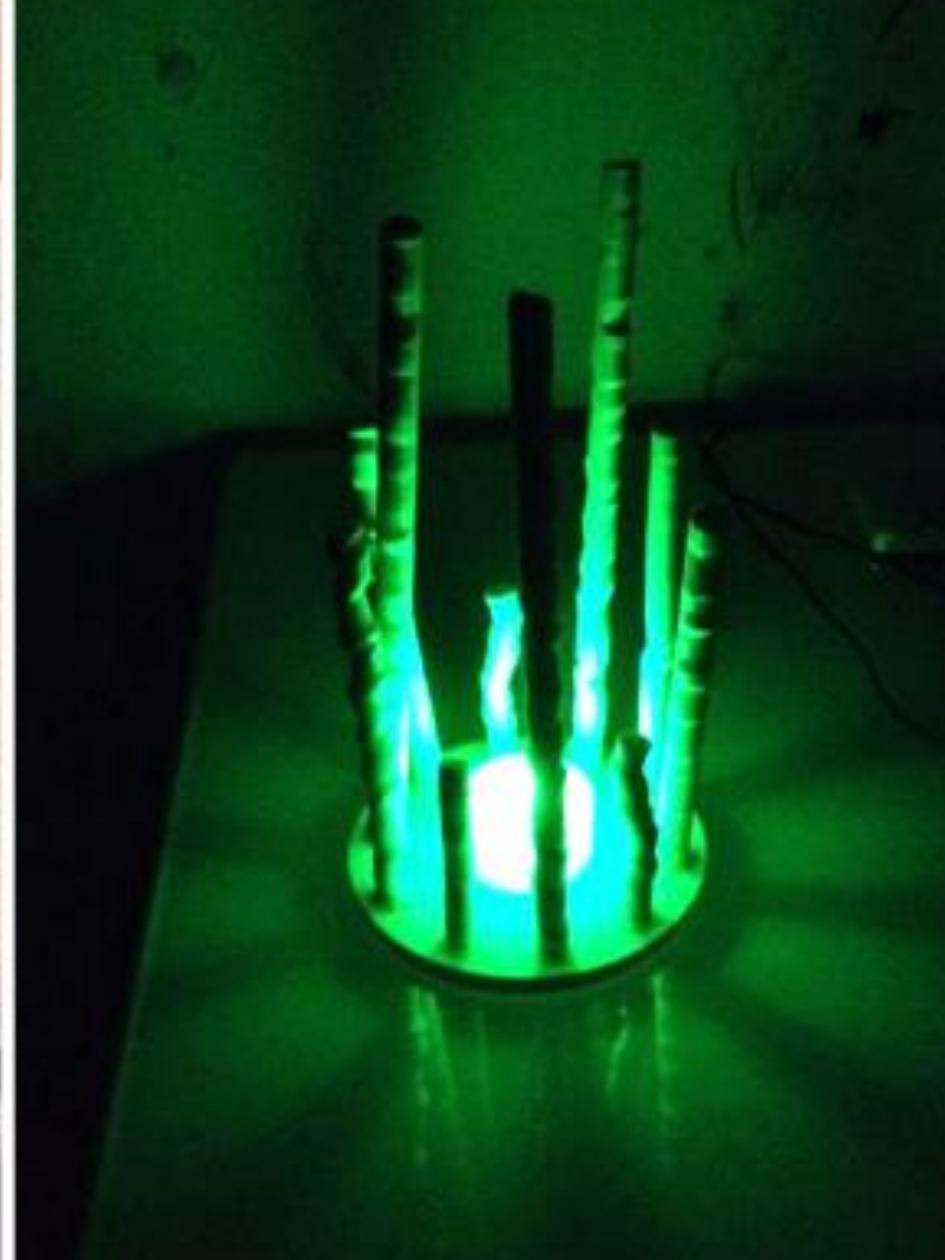


Physical Vis Examples



c)

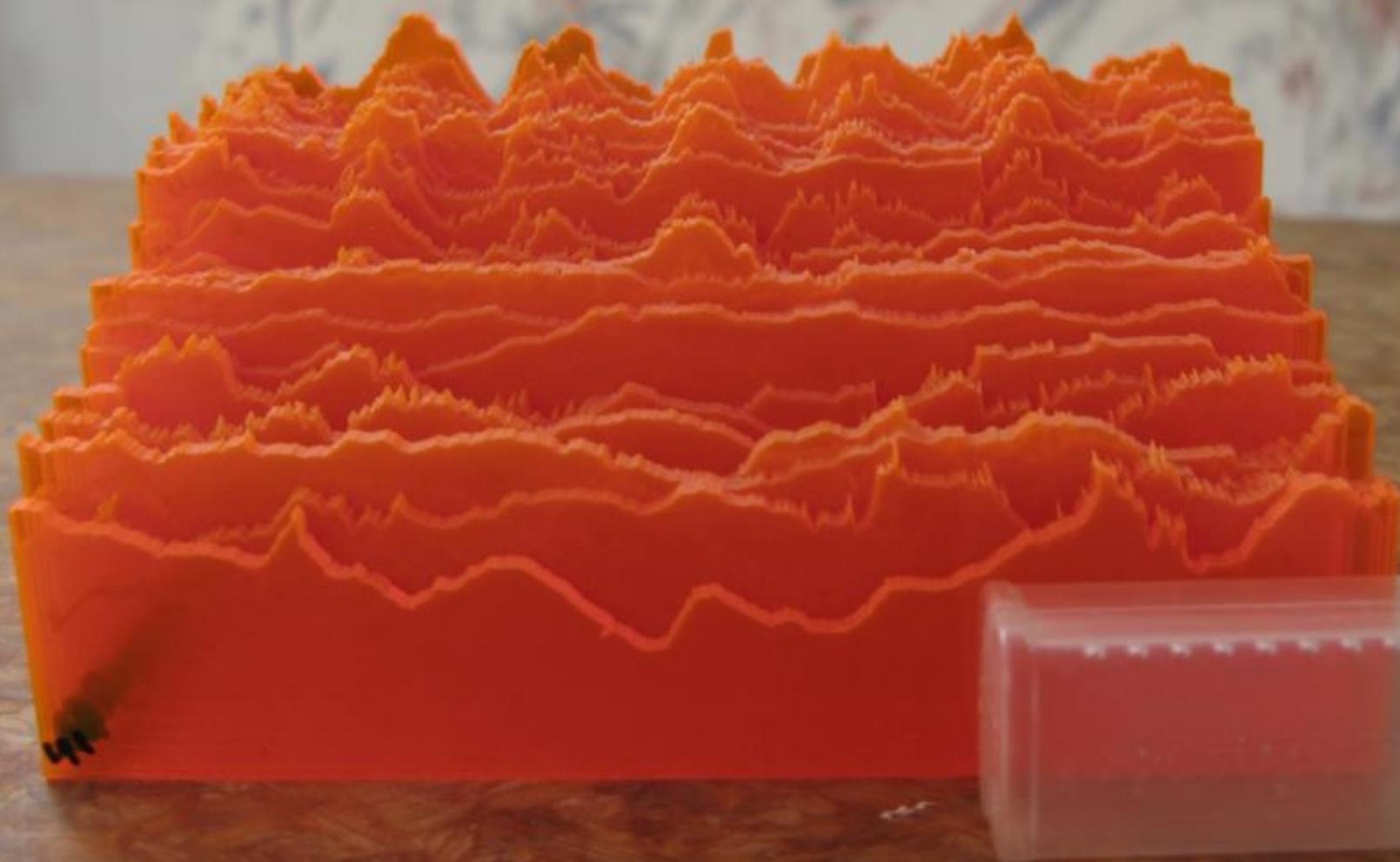
Physical Vis Examples



Physical Vis Examples



Physical Vis Examples



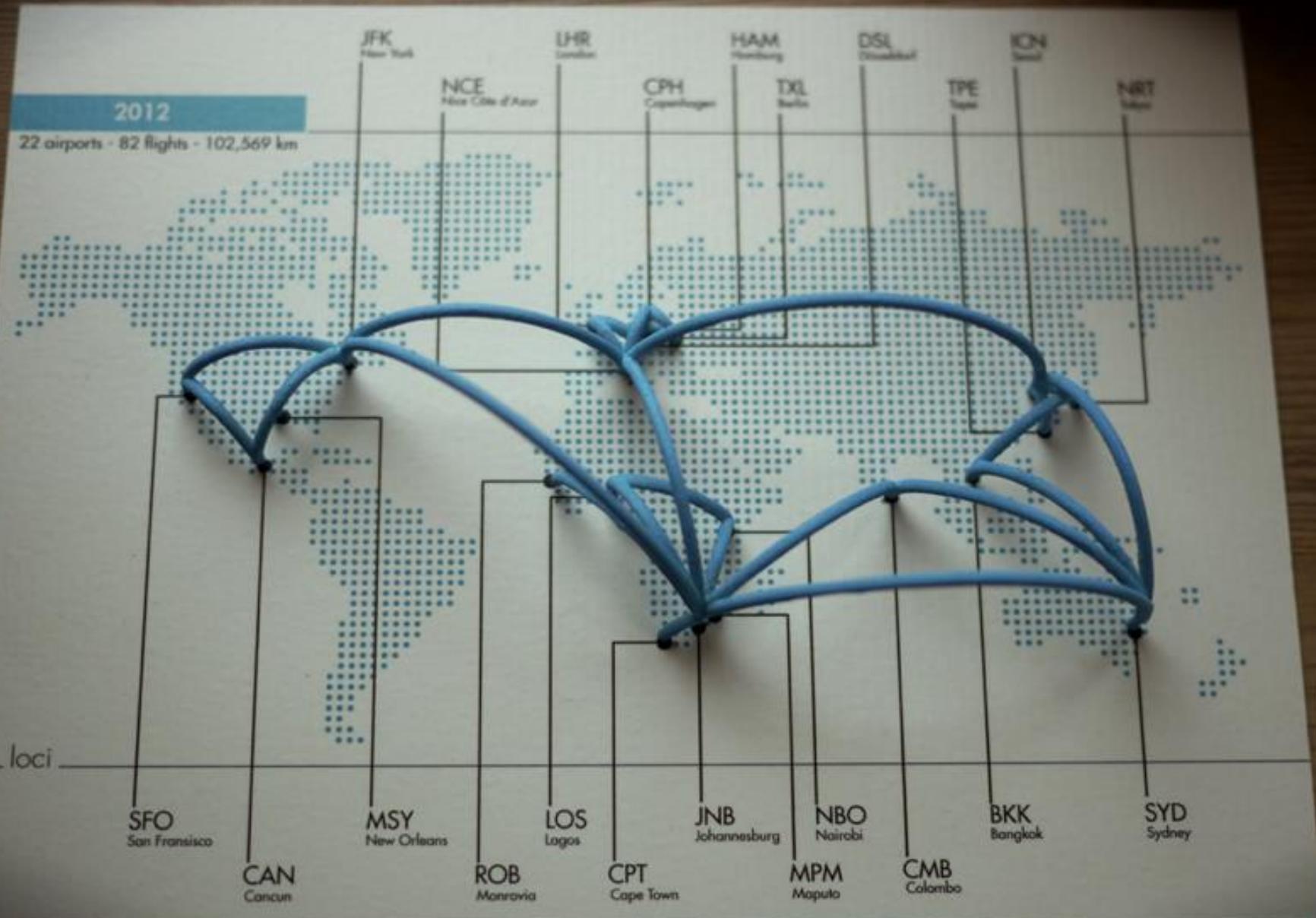
Physical Vis Examples



Physical Vis Examples



Physical Vis Examples



Physical Vis Examples



“Physical Vis” Logistics

Deadline: 26 November

Deliver: **Physical Artifact (I'll be keeping them!)**

ZIP file with photos of the artifact and explanation of how to “read” it

Showcase: I'll select a few to be presented in class, week of Nov 3.

“Physical Vis” Grading

Four criteria

Idea (originality)

Effort

Creativity

Works?

Those will get you up to 0.9

Presenters in class will get the additional 0.1

Lab Classes

Start next week

Groups of 3

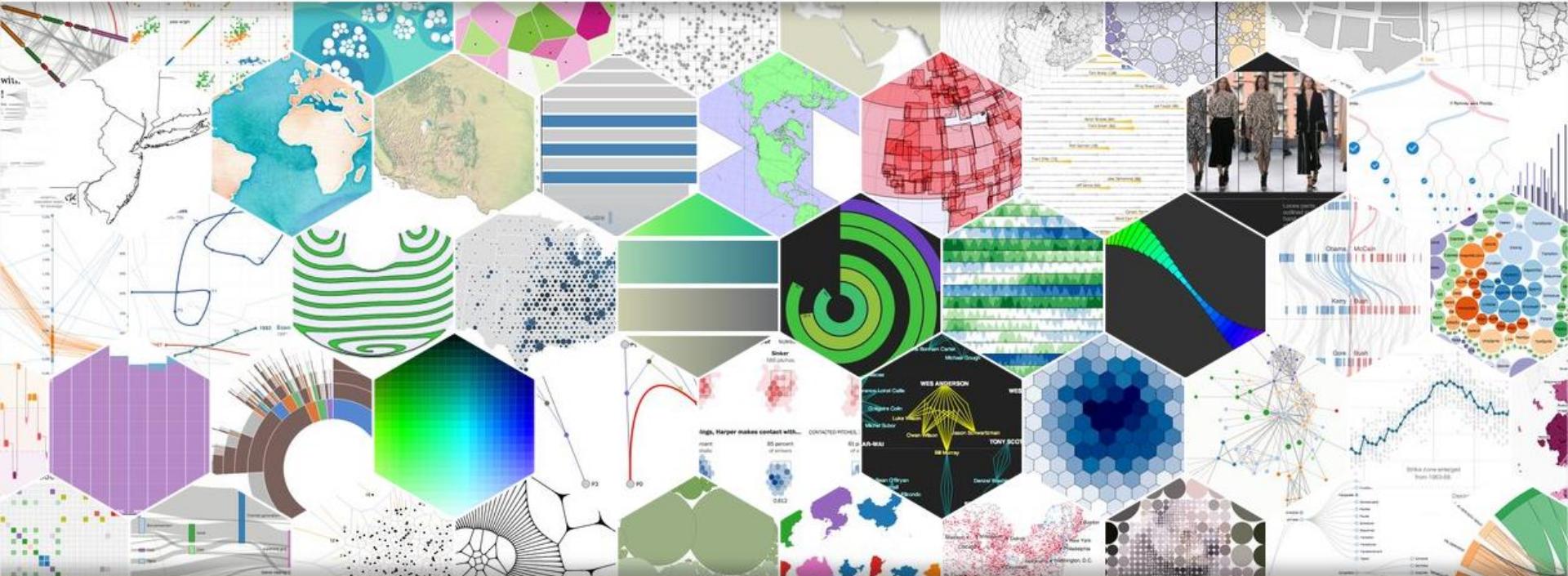
Need a complete group to enroll

Enrollments start *TODAY*, 16h00

GO enroll. FAST!

first come, first served

D3 Data-Driven Documents



Like visualization and creative coding? Try interactive JavaScript notebooks in [Observable](#)!

D3.js is a JavaScript library for manipulating documents based on data. D3 helps you bring data to life using HTML, SVG, and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation.

[See more examples.](#)

We'll use this!

Download the latest version (5.7.0) [here](#).

03

WHY INFOVIS?

Amount of Data Out There

1 000 000 000 000 000 000 bytes

Amount of Data Out There

10^{21} bytes = 1 Zettabyte

Amount of Data Out There

10^{21} bytes = 1 Zettabyte

**EACH YEAR
(and growing)**

How To Cope?



Transform Data into Information

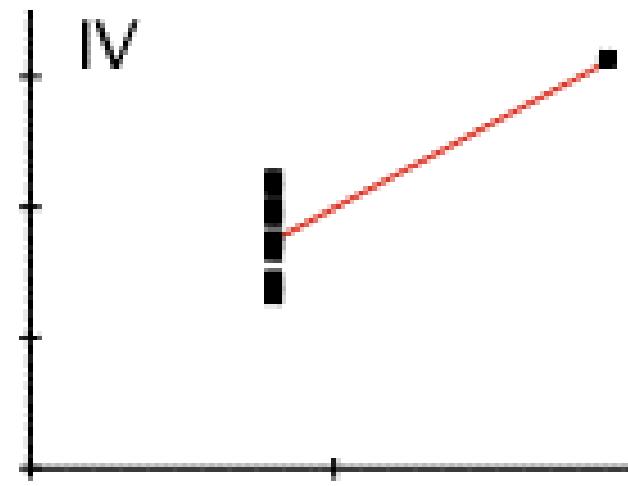
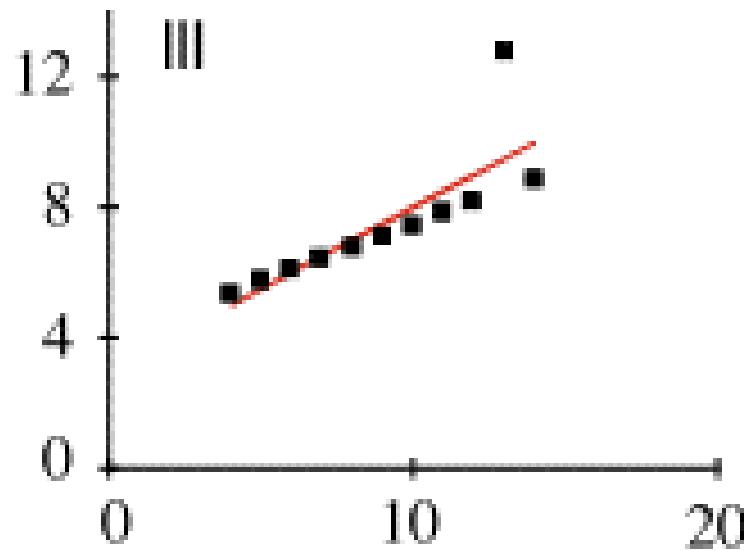
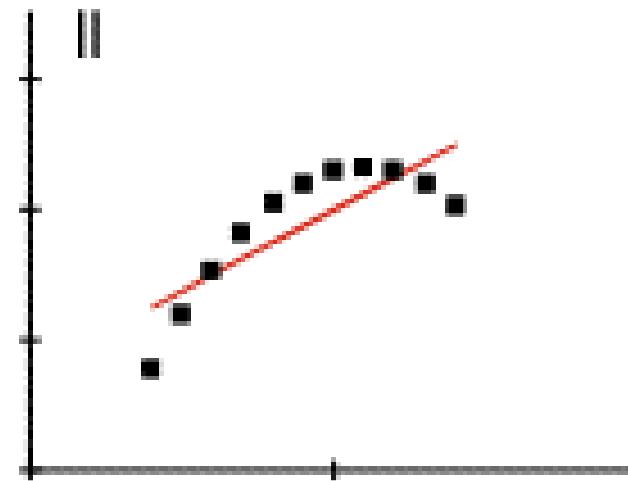
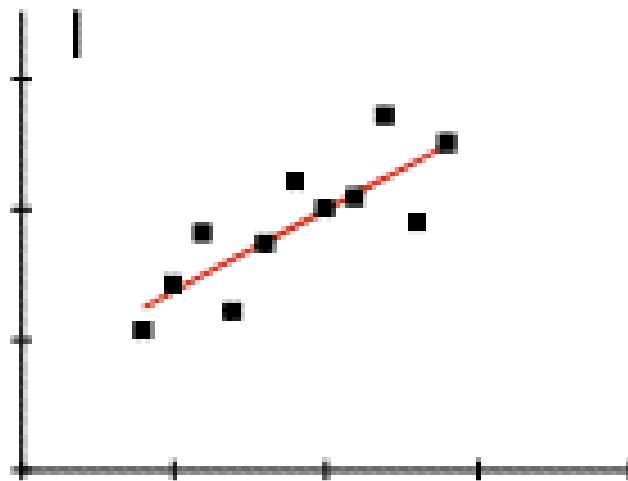


Visualize gives us insights

Anscombe Quartet

I		II		III		IV	
x	y	x	y	x	y	x	y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.10	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.10	4	5.39	19	12.50
12	10.84	12	9.13	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.8

Visualize gives us insights



Visualize shows us the details!

mean of the x values = 9.0

mean of the y values = 7.5

equation of the least-squared regression line is: $y = 3 + 0.5x$

sums of squared errors (about the mean) = 110.0

regression sums of squared errors (variance accounted for by x) = 27.5

residual sums of squared errors (about the regression line) = 13.75

correlation coefficient = 0.82

coefficient of determination = 0.67

Answer me this...

Regions with more higher education have larger GDPs?

OECD Regional Statistics

<http://stats.oecd.org/OECDregionalstatistics/>

Data Table...

ID	Name	Region Group	Total Population	Population 0-14	Population 15-6	Population 75+
TRB2	Van	Turkey	1,959,535	41.76	54.97	6.21
TRC2	Sanliurfa	Turkey	2,983,813	40.22	55.92	6.21
TRC3	Mardin	Turkey	1,925,794	42.04	53.71	6.21
TRA2	Agri	Turkey	1,137,671	36.40	58.52	6.21
TRC1	Gaziantep	Turkey	2,261,242	34.58	60.32	6.21
TR63	Hatay	Turkey	2,843,518	30.70	63.45	6.21
TR10	Istanbul	Turkey	12,573,836	24.22	69.89	6.21
TR62	Adana	Turkey	3,602,588	27.05	66.98	6.21
TR51	Ankara	Turkey	4,466,756	22.60	70.85	6.21
TR42	Kocaeli	Turkey	3,048,651	24.44	68.41	6.21
TR52	Konya	Turkey	2,185,131	27.56	65.25	6.21
TRA1	Erzurum	Turkey	1,075,088	30.12	62.50	6.21
TR61	Antalya	Turkey	2,460,321	23.40	69.18	6.21
TRB1	Malatya	Turkey	1,598,897	27.46	64.98	6.21
TR72	Kayseri	Turkey	2,295,679	27.26	65.17	6.21
TR71	Kirikkale	Turkey	1,481,248	26.83	65.37	6.21
TR41	Bursa	Turkey	3,368,502	22.30	69.83	6.21
TR31	Izmir	Turkey	3,739,353	20.52	71.31	6.21
TR21	Tekirdag	Turkey	1,458,114	20.00	71.01	6.21
TR81	Zonguldak	Turkey	1,016,484	21.25	69.61	6.21
TR33	Manisa	Turkey	2,939,517	22.74	68.12	6.21
TR32	Aydin	Turkey	2,620,452	22.17	68.69	6.21
TR83	Samsun	Turkey	2,728,183	24.86	65.89	6.21

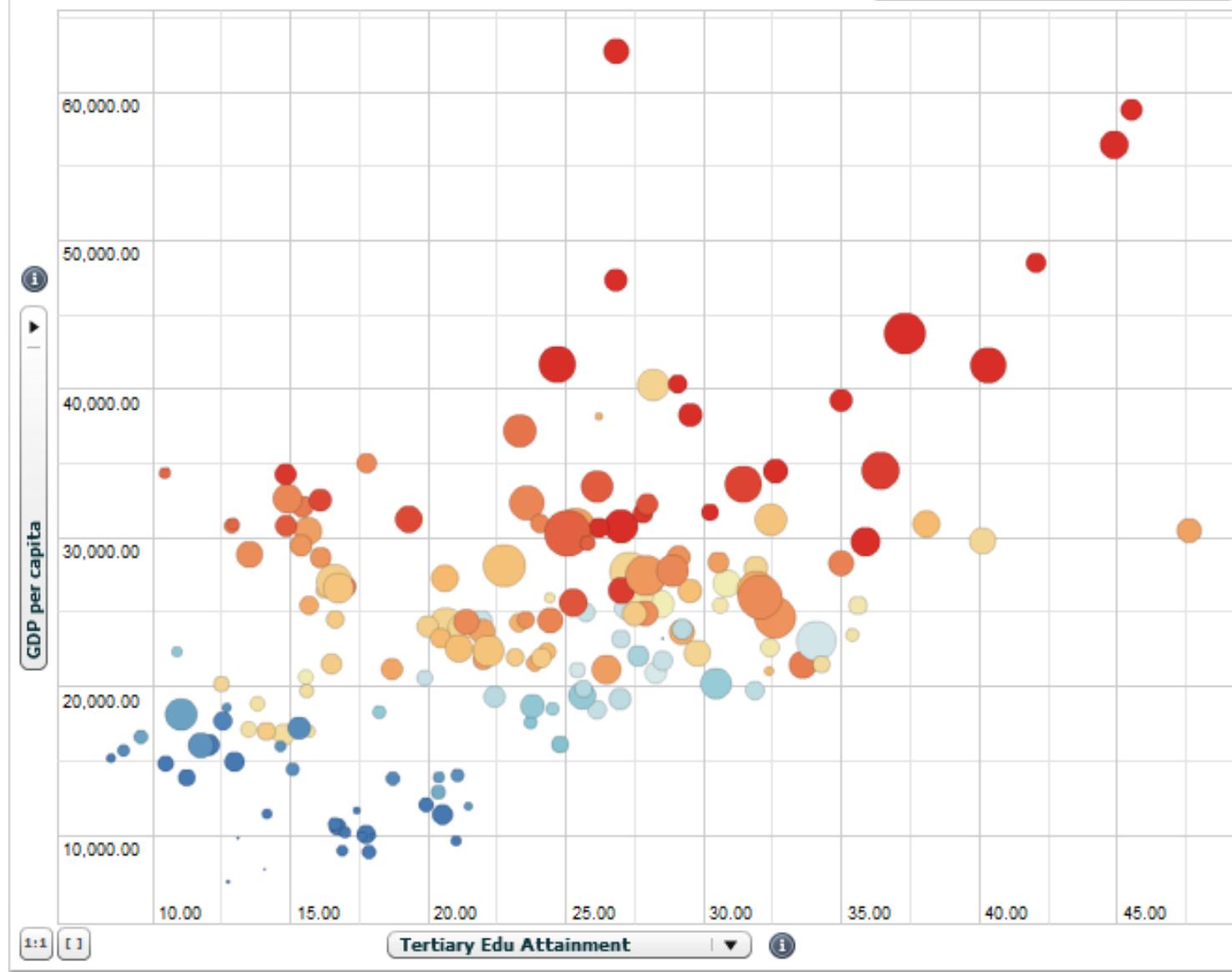
College degrees == High GDP?

<http://stats.oecd.org/oecdfactbook/>

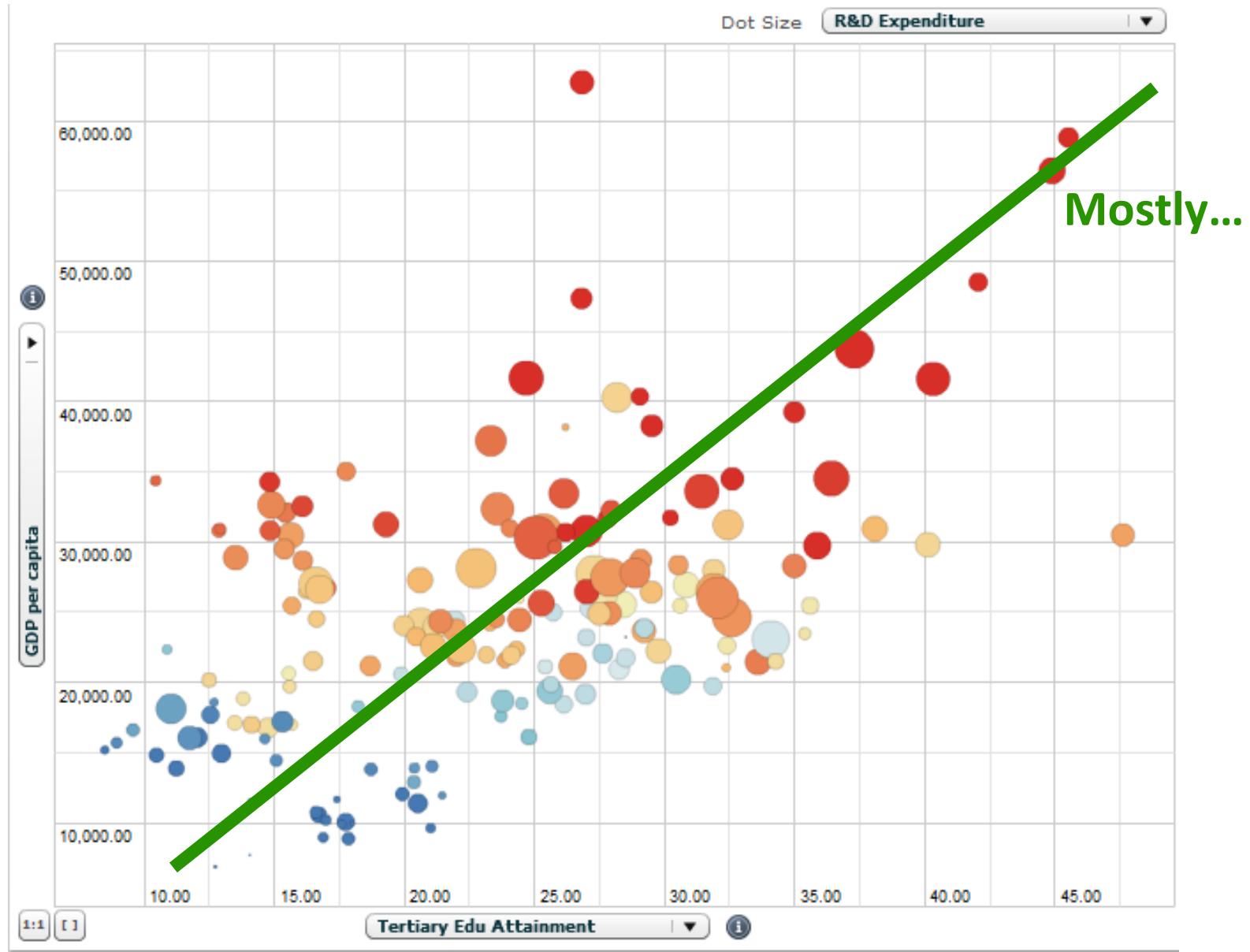


Dot Size

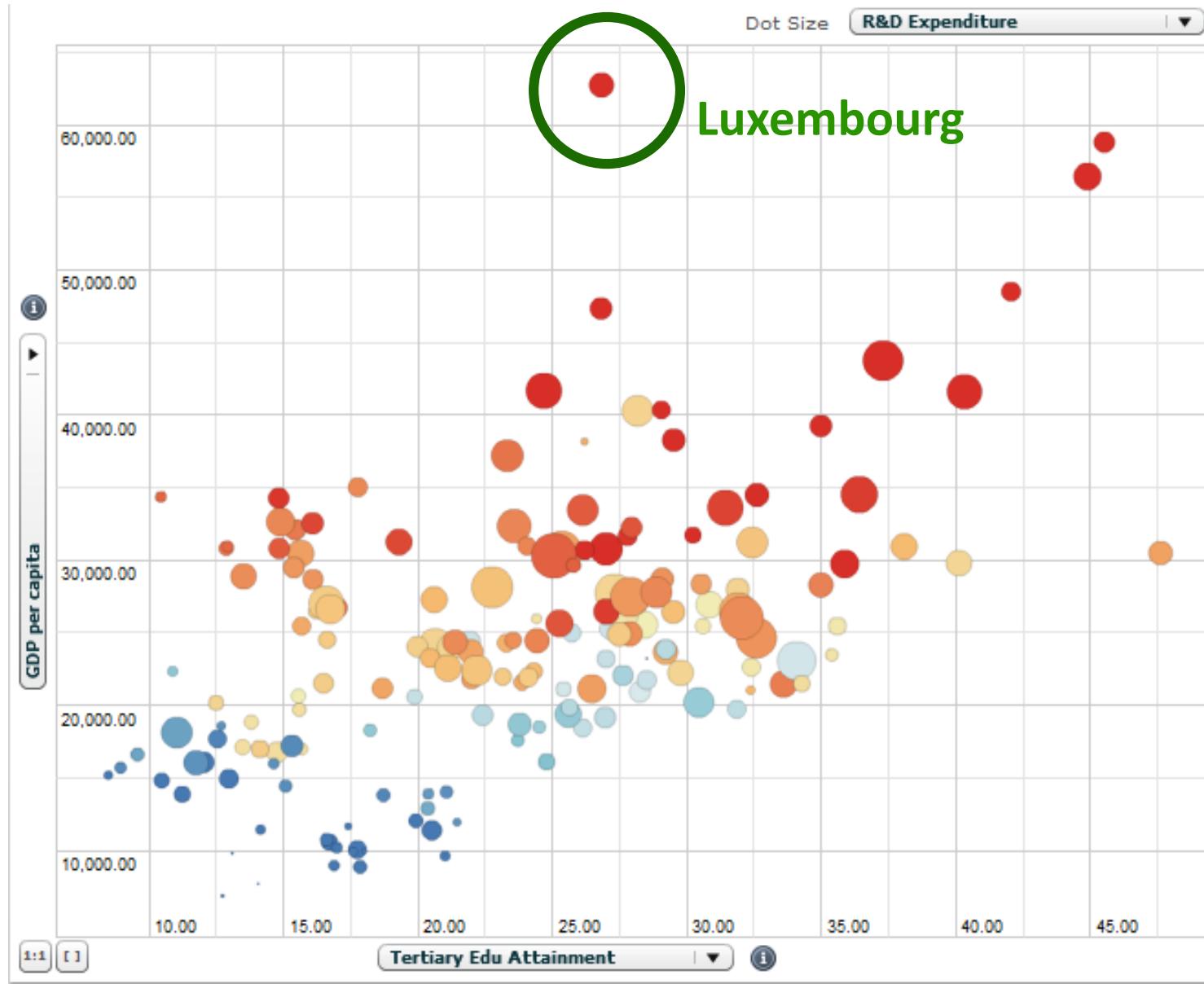
R&D Expenditure



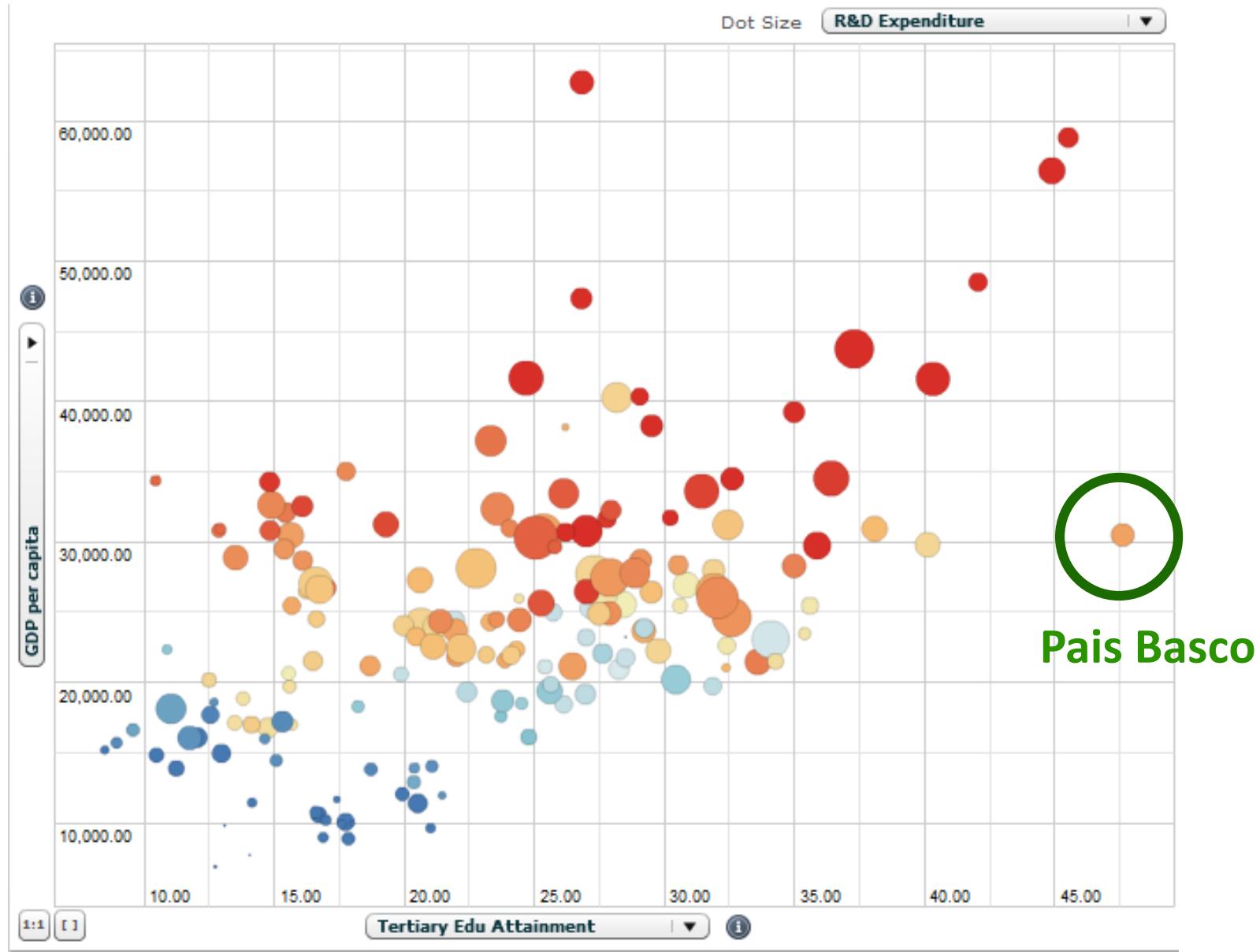
College degrees == High GDP?



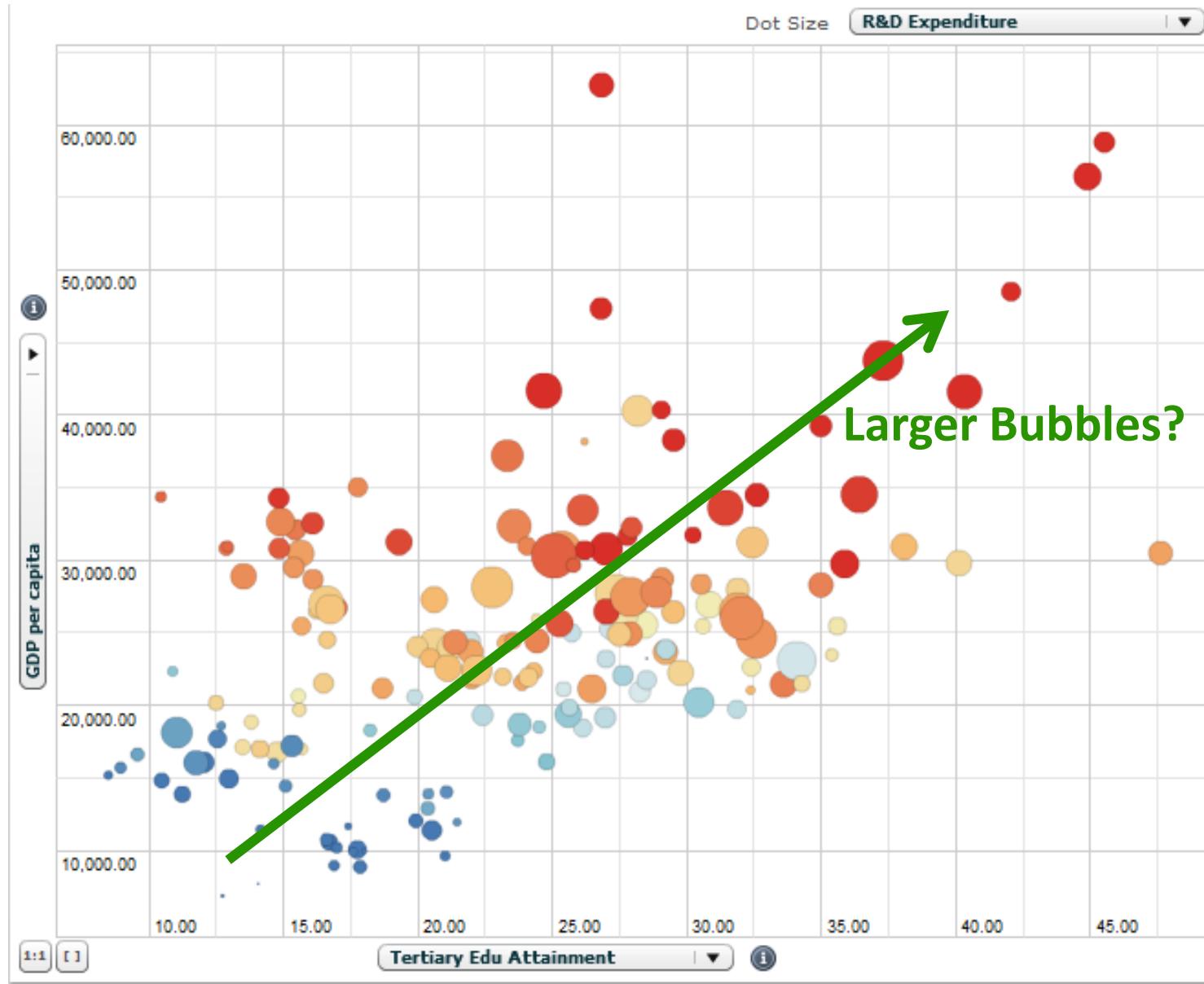
College degrees == High GDP?



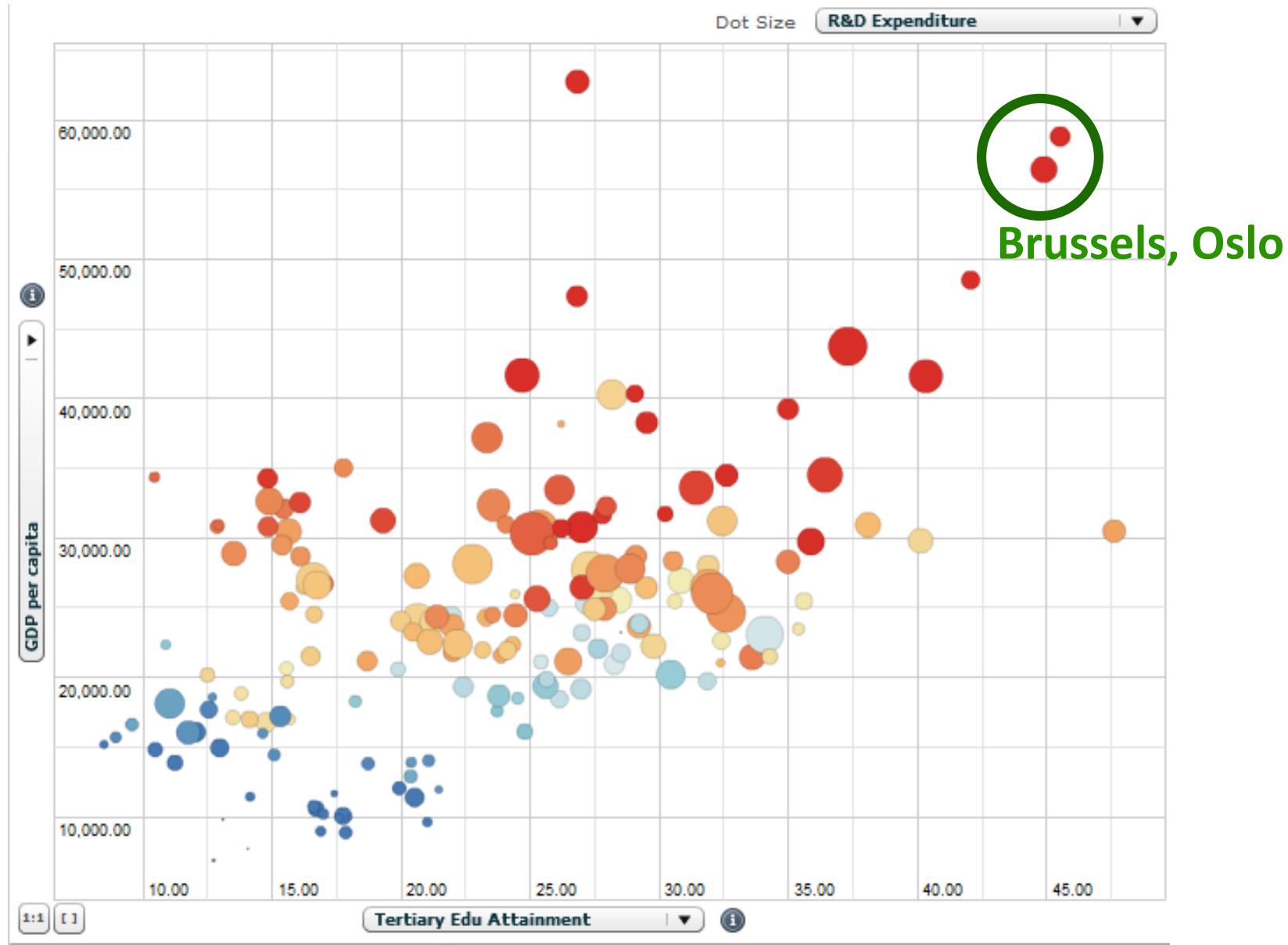
College degrees == High GDP?



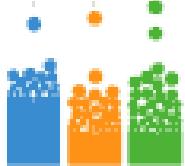
College degrees == High R&D?



Produce more, better educated



Animations, Interactivity



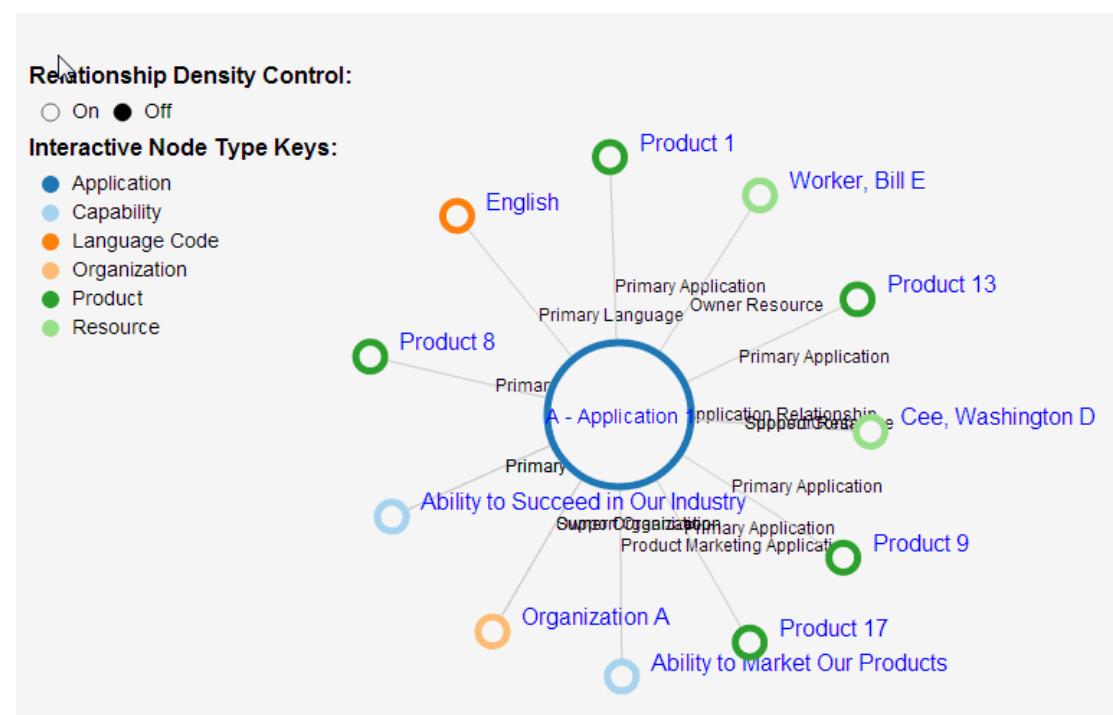
Bar Chart



Pie Chart



Bubble Chart



Interactivity

Different Views on the Data



04

EXAMPLES

Cholera Deaths (John Snow, 1854)



Not this one...



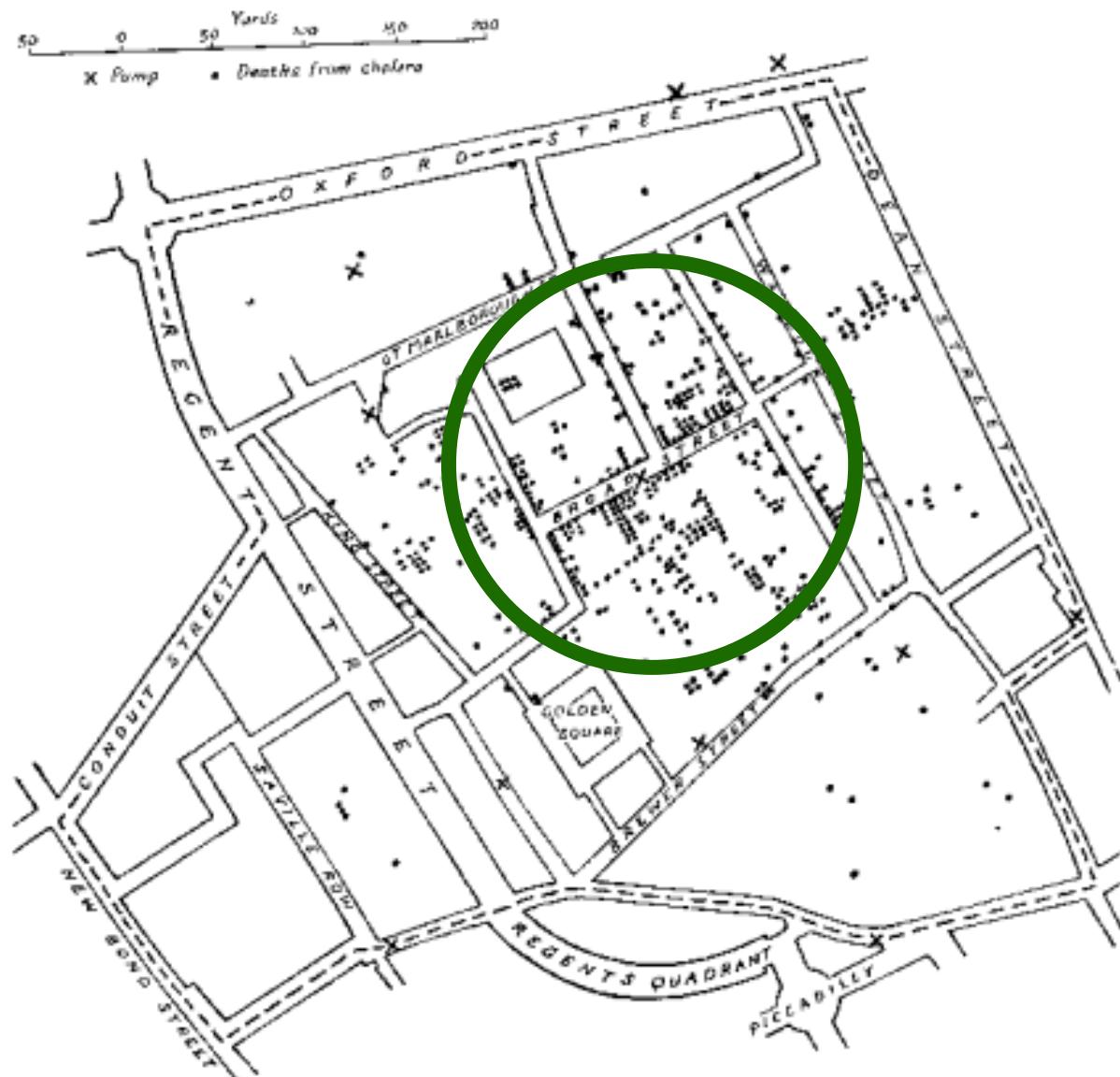
Not this one...



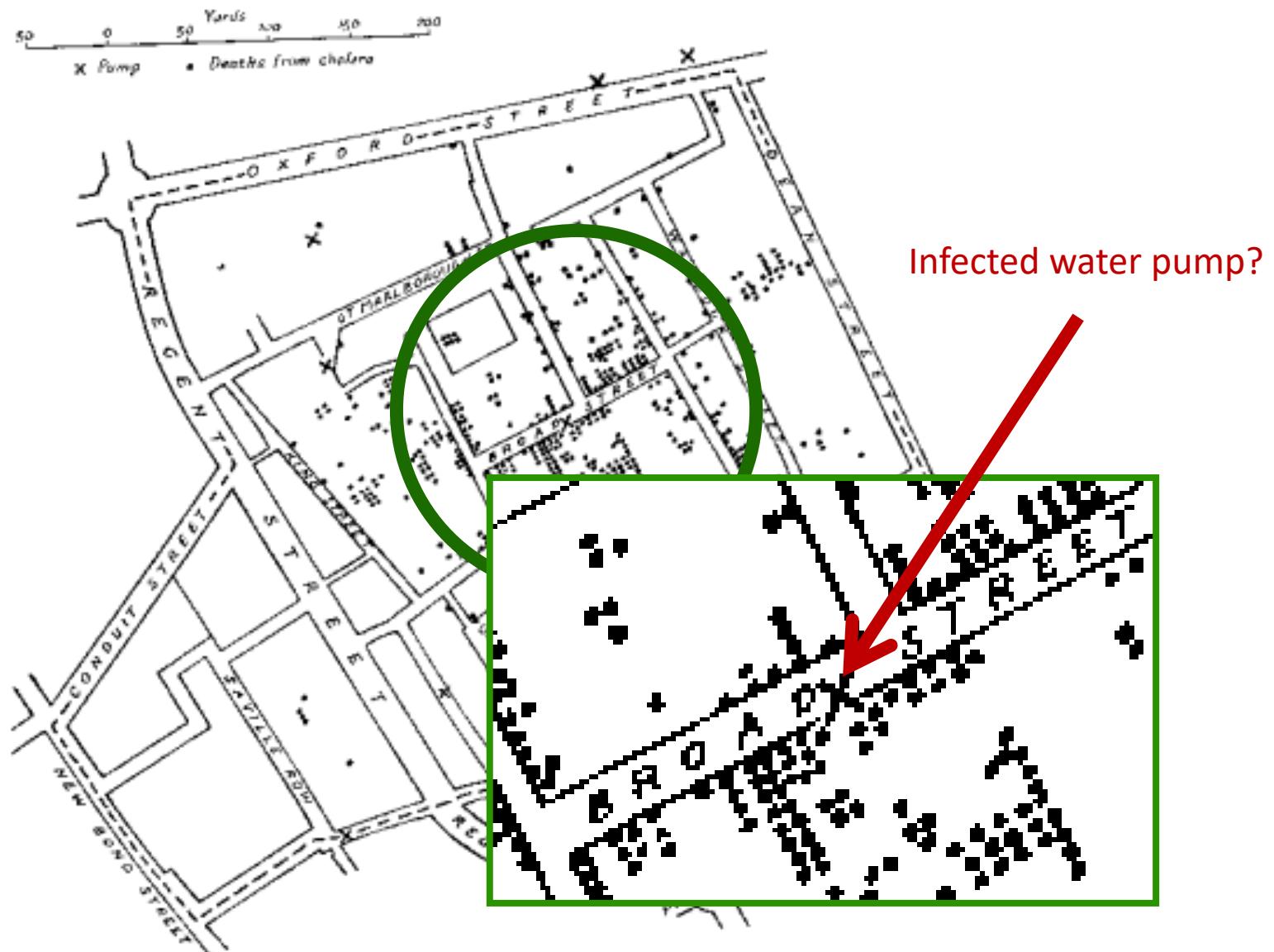
This one!



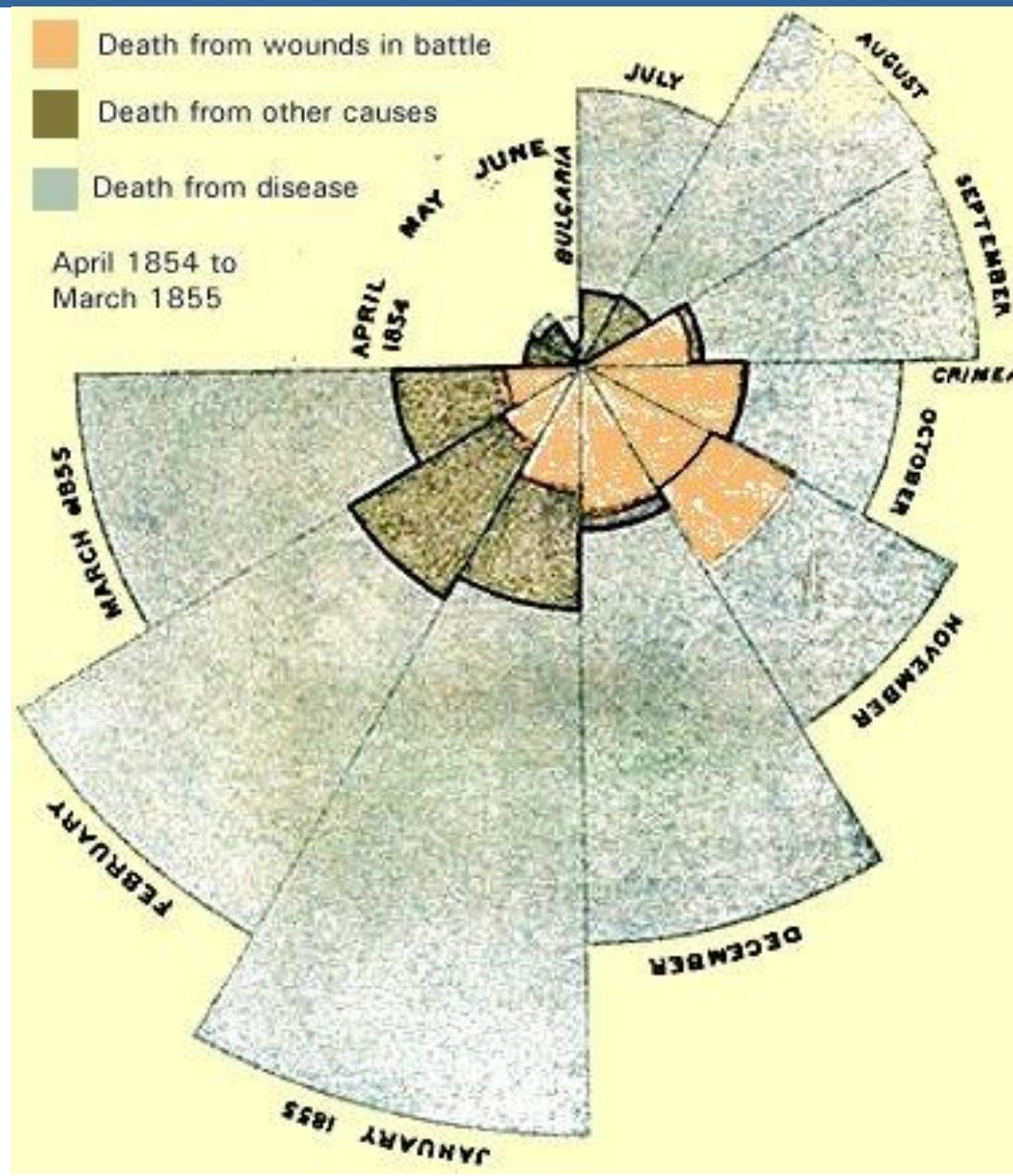
Cholera Deaths (John Snow, 1854)



Cholera Deaths (John Snow, 1854)



Florence Nightingale's Hospital Deaths (1858)



Napoleon's March (Minard, 1861)

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

Créée par M. Minard, Inspecteur Général des Ponts et Chaussées et extraitte

Paris, le 20 Novembre 1869

Les nombres d'hommes peuvent être représentés par les largeurs 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 entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte me ont puise dans les ouvrages de M. M. Chiers, de l'Égur, de Tézondac, de Chambray, du 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 superposé que les corps de l'Empereur et du Maréchal Davout, qui avaient été détachés une Moscou au Nihilov et qui rejoignirent l'Armée à Wilek, avaient toujours marché avec l'armée.

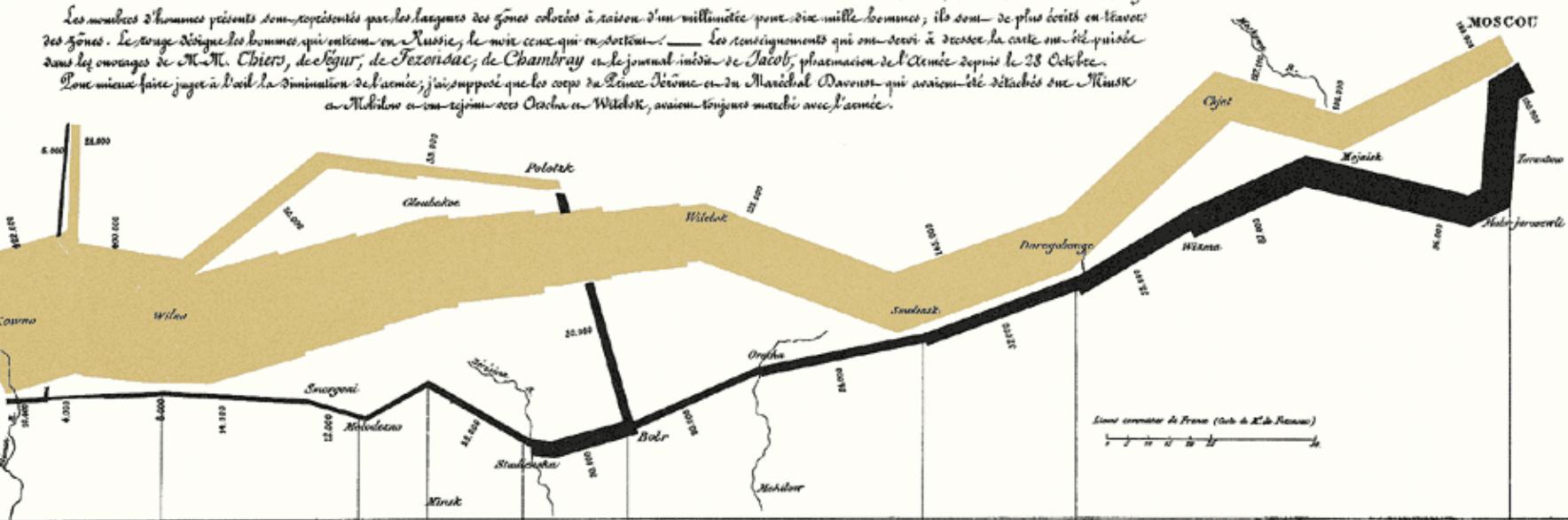
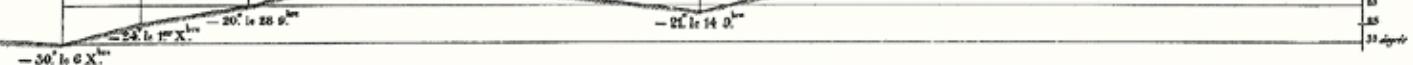


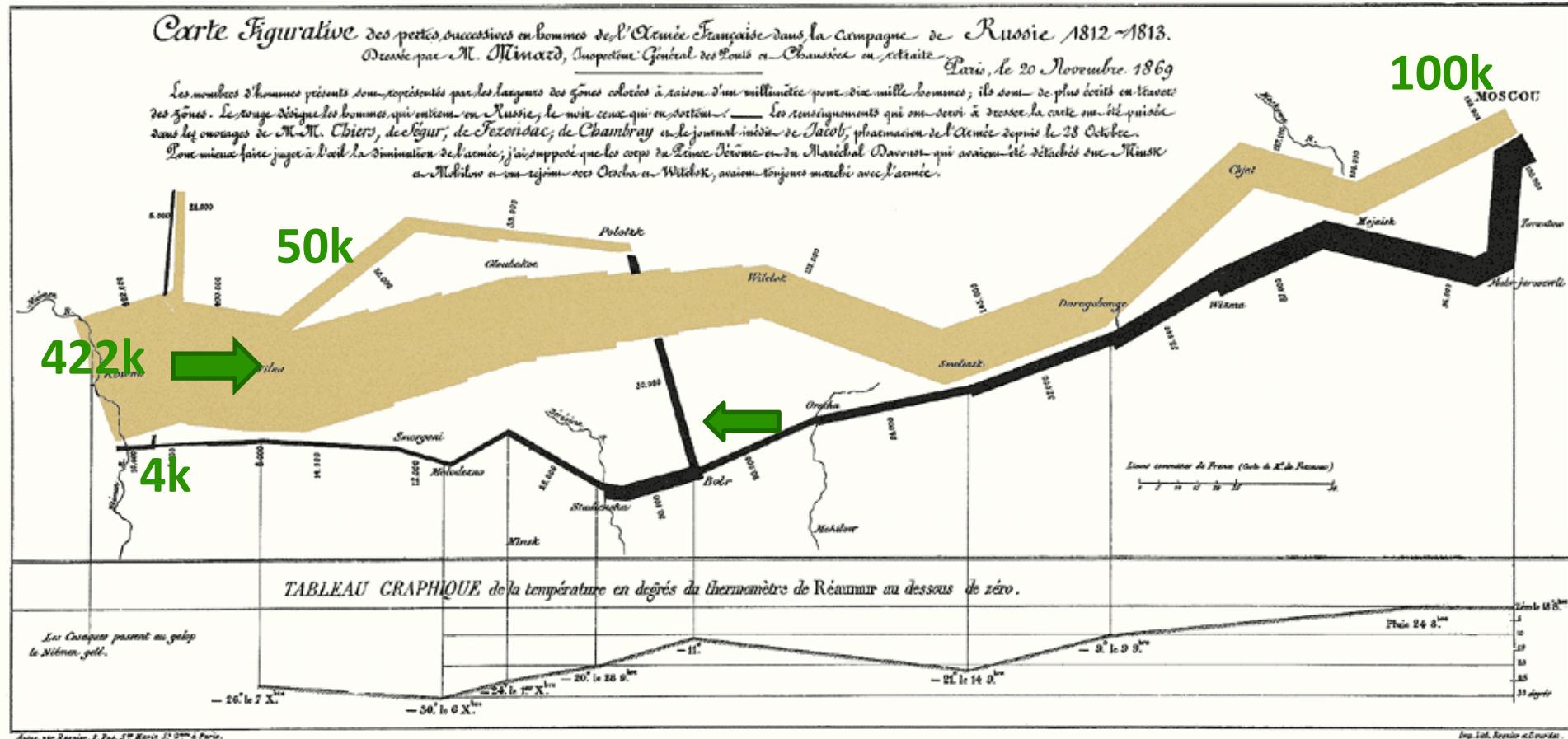
TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les Cosaques passent au gelé
la Némen gèle.
— 16° le 7 X.
— 20° le 11 X.
— 24° le 15 X.
— 30° le 6 X.



Imp. L. Regnier à Paris.

Napoleon's March (Minard, 1861)



Charle Booth's Poverty Map (1889)



Clarify (London Underground)



Clarify (London Underground)

1908



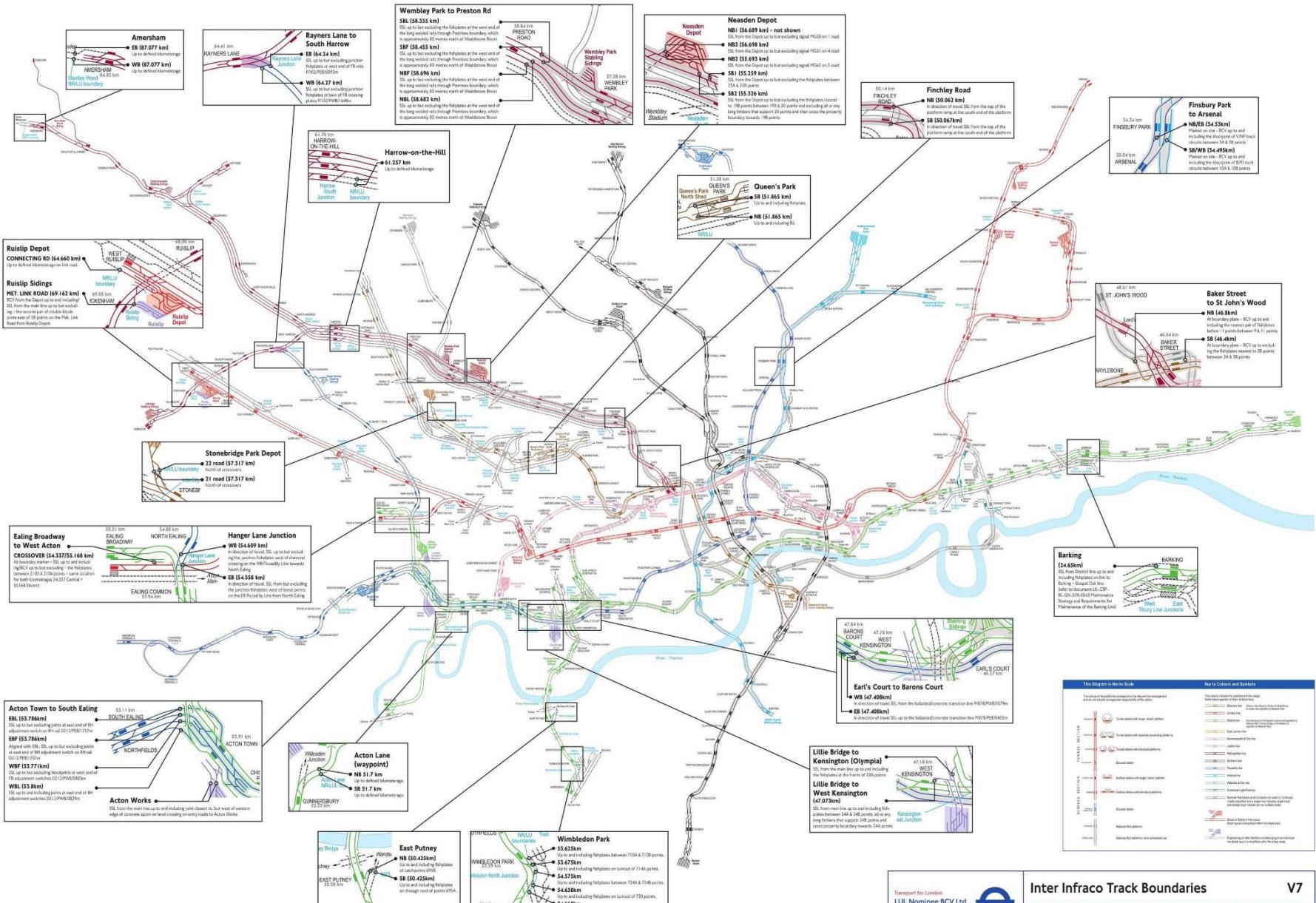
London Underground



Harry Beckin, 1931

Find your way using this...

<http://boingboing.net/2016/09/16/geographically-representative.html#more-483083>



Name Voyager

<http://www.babynamewizard.com/voyager>

Baby Name > sam

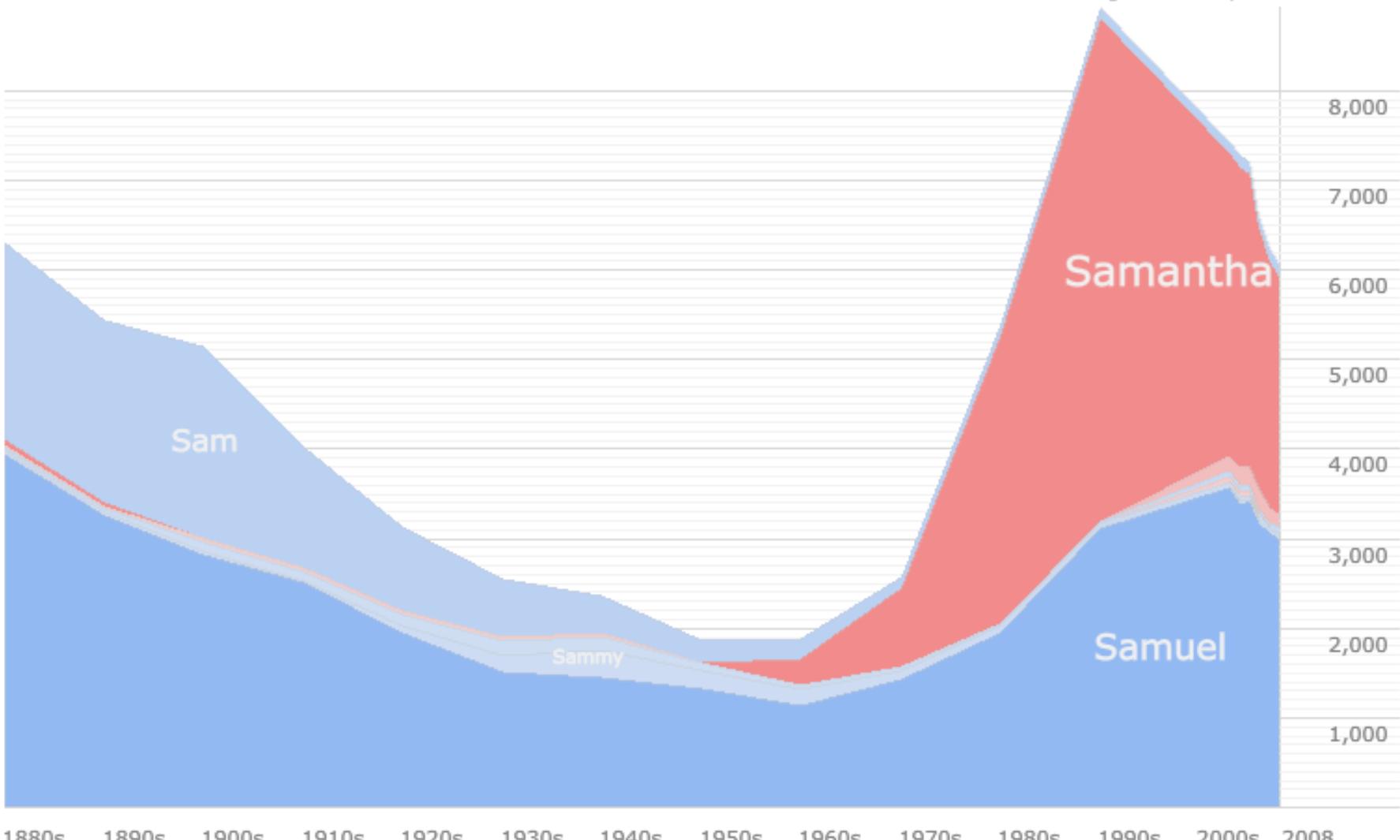


Press 'enter' to see exact matches.

Both Boys Girls

2008 rank: boys 1000 500 100 25 1
girls 1000 500 100 25 1

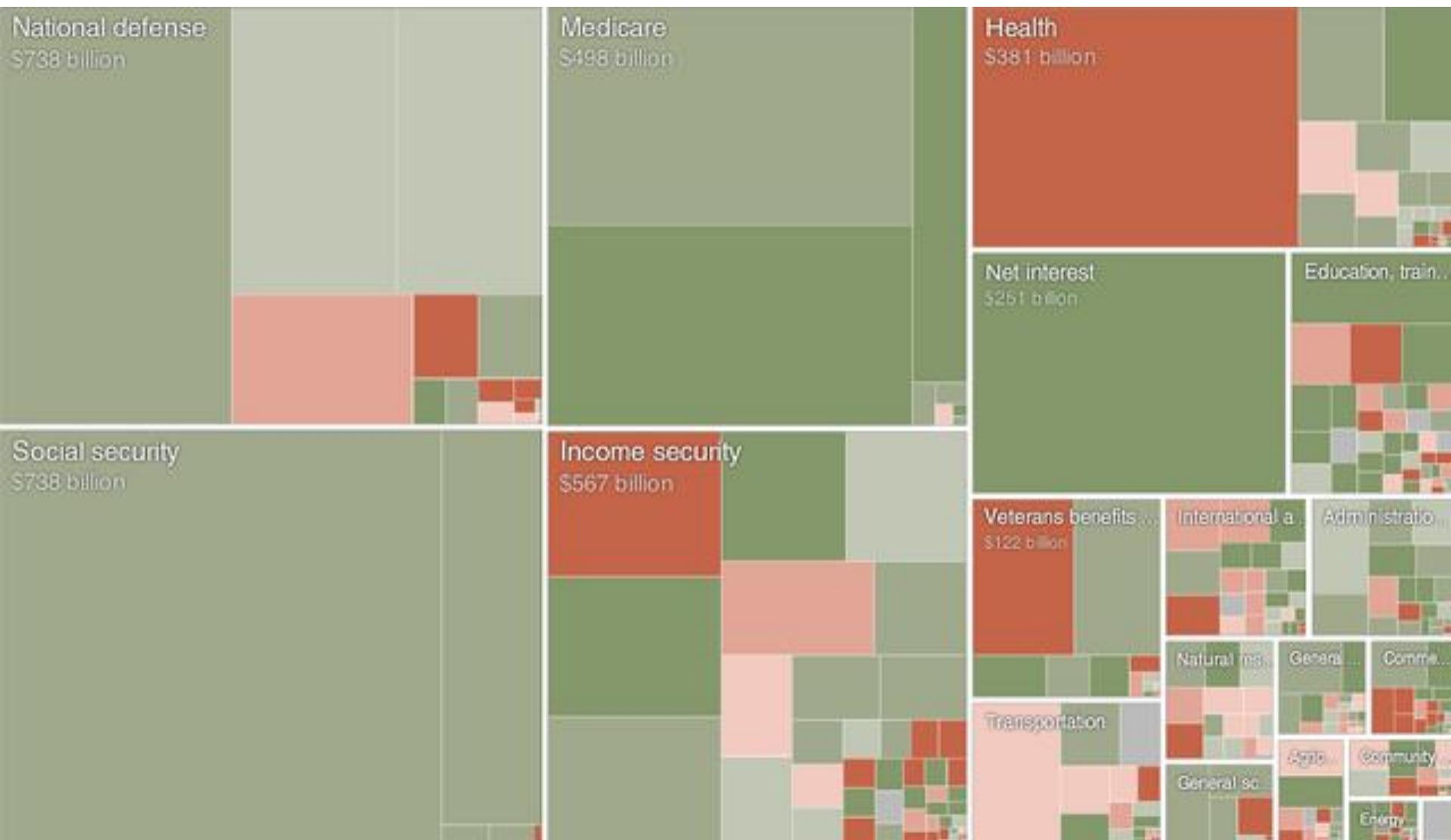
Names starting with 'SAM' per million babies



1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s 2008

Click a name graph to view that name. Double click to read more about it.

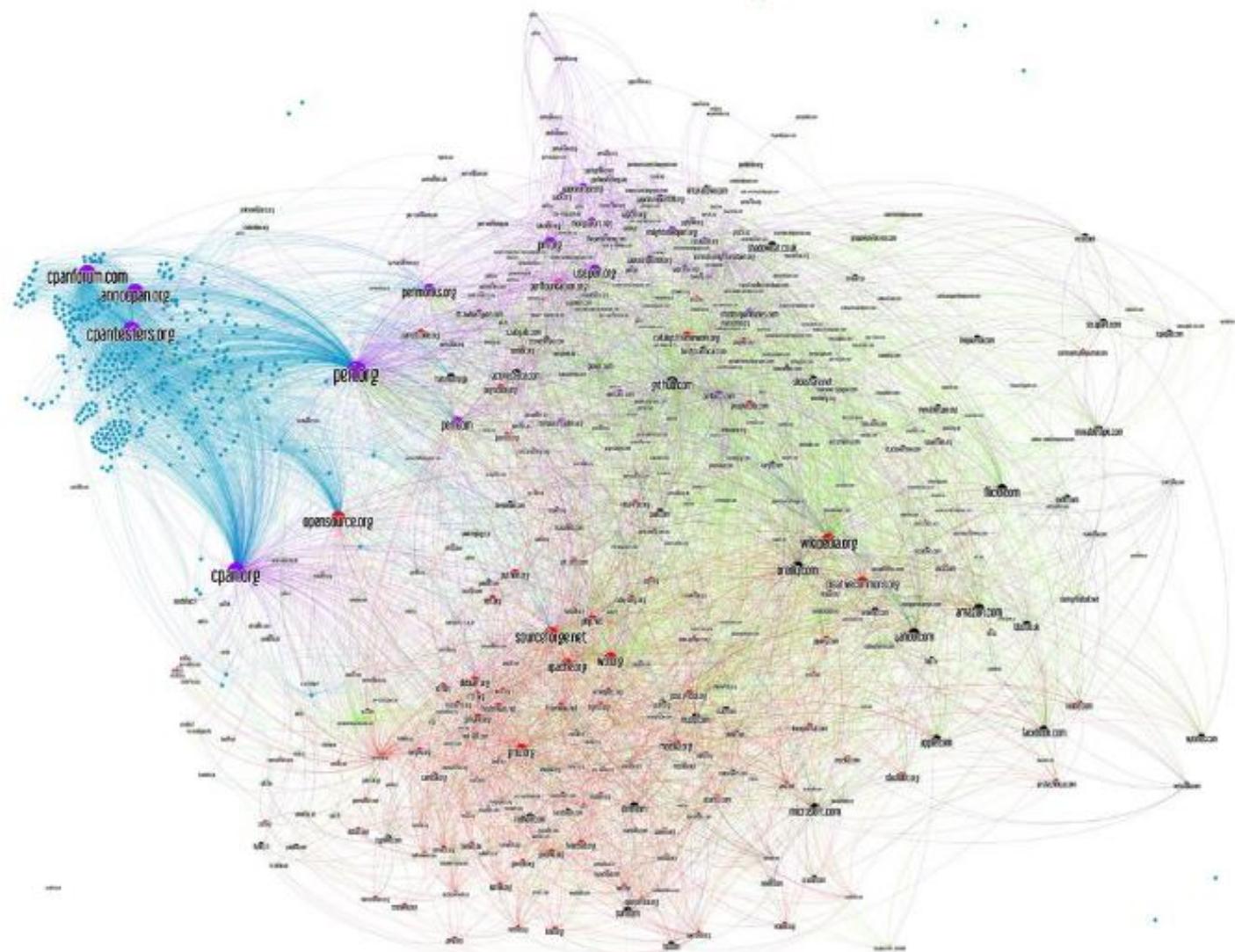
Obama's 2011 Budget Proposal



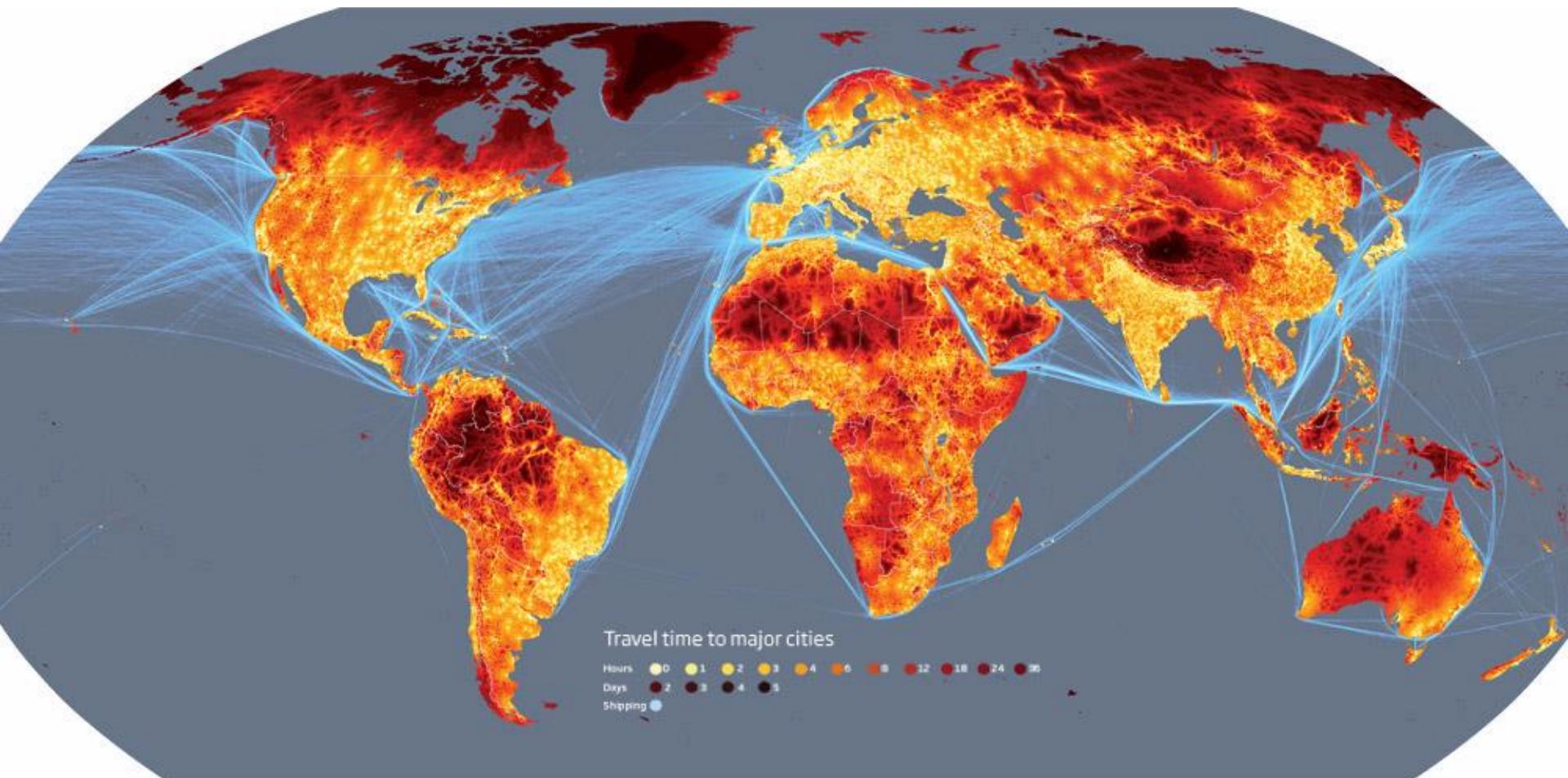
Size = Relative amount of \$\$\$ Color: variation since 2010

<http://www.nytimes.com/interactive/2010/02/01/us/budget.html>

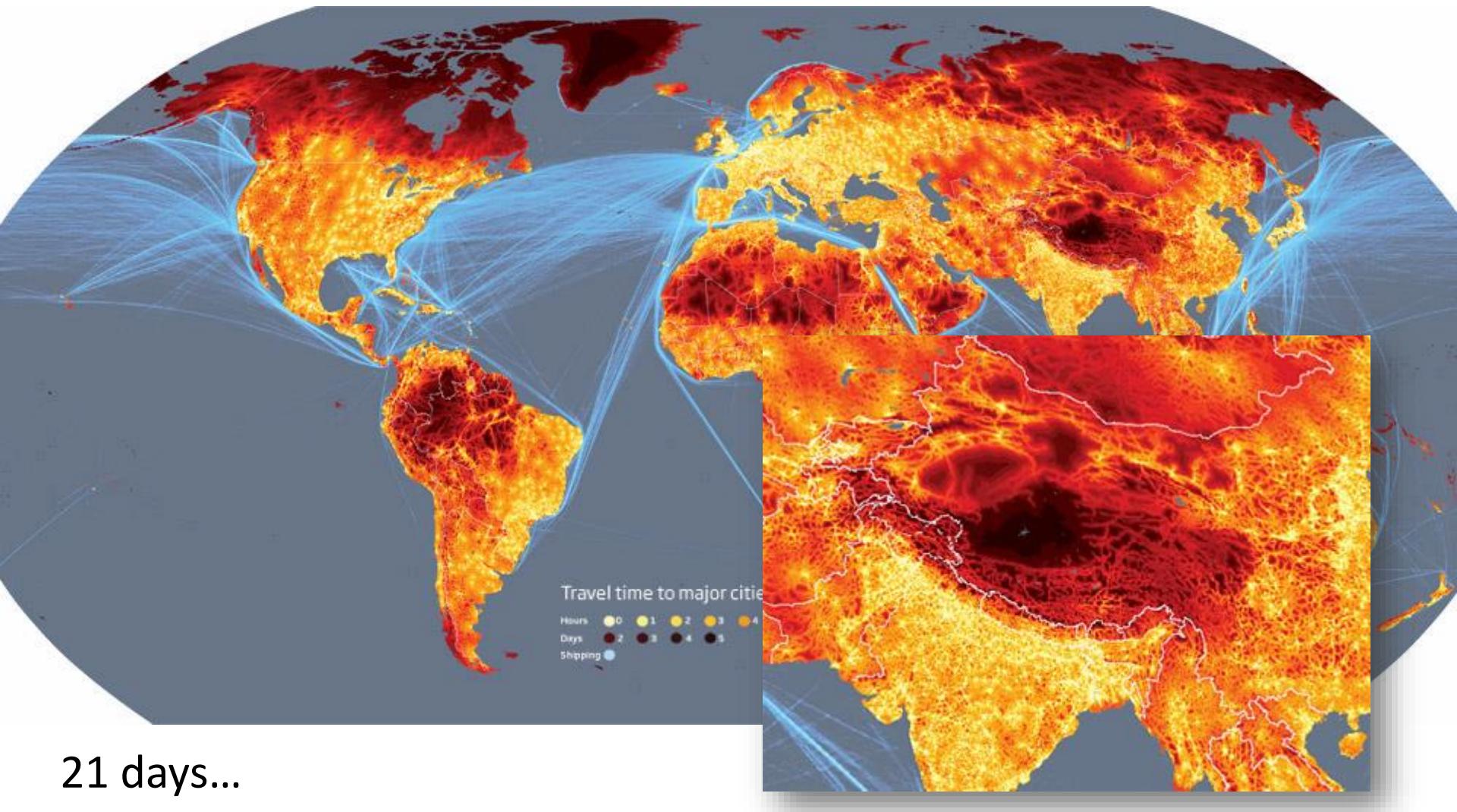
CPAN Explorer



Remotest Place on Earth

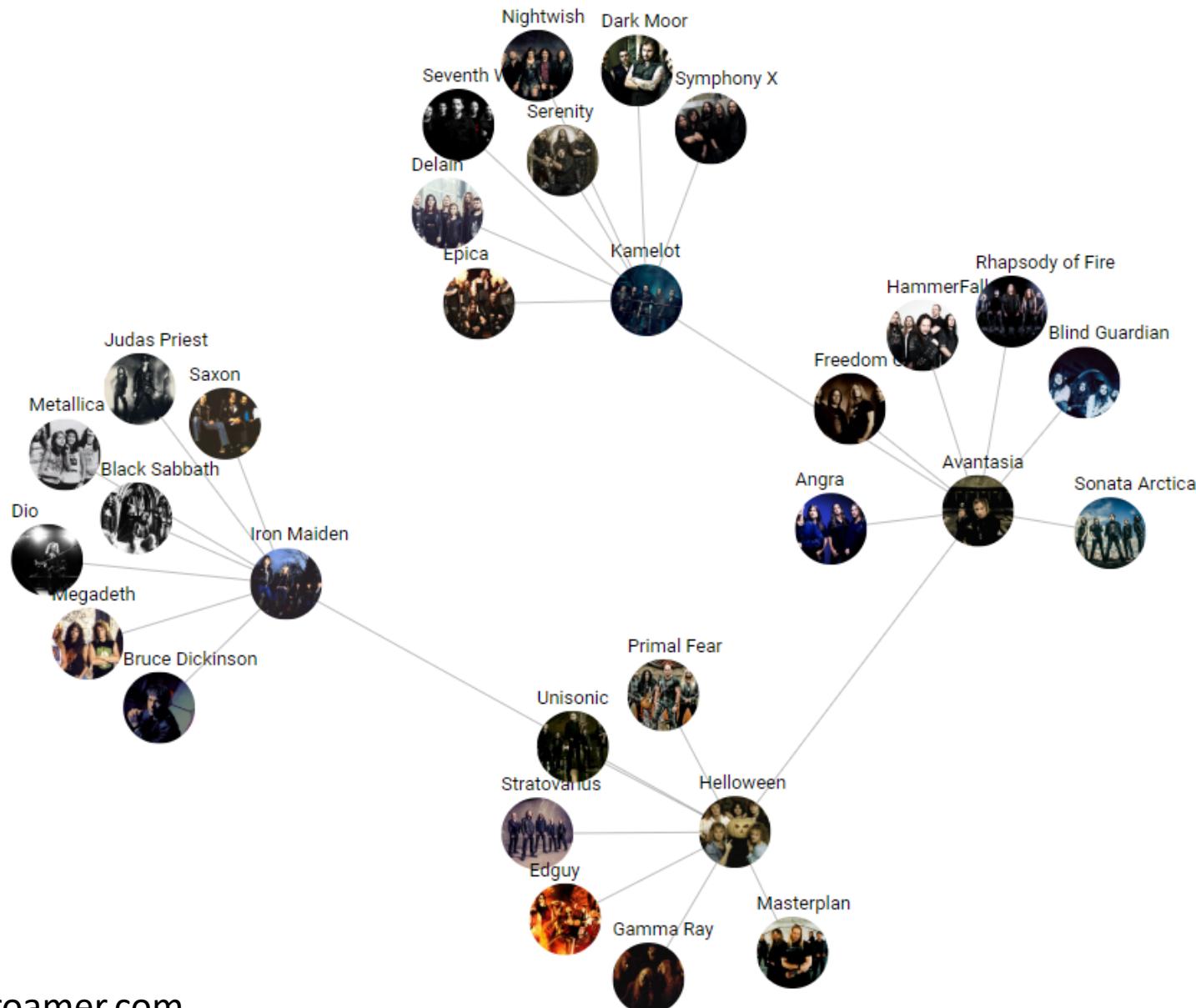


Remotest Place on Earth



21 days...

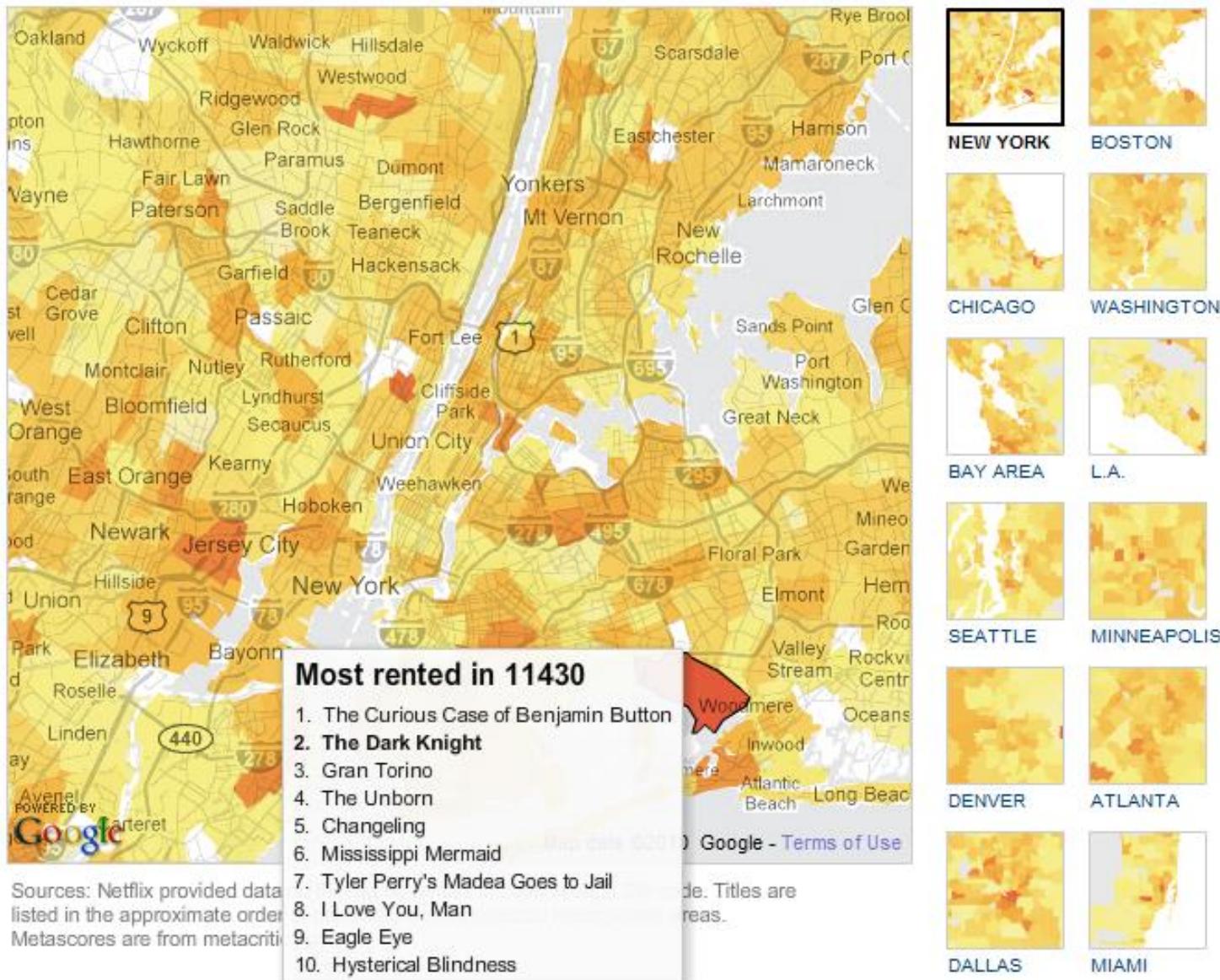
MusicRoamer



Tag Cloud

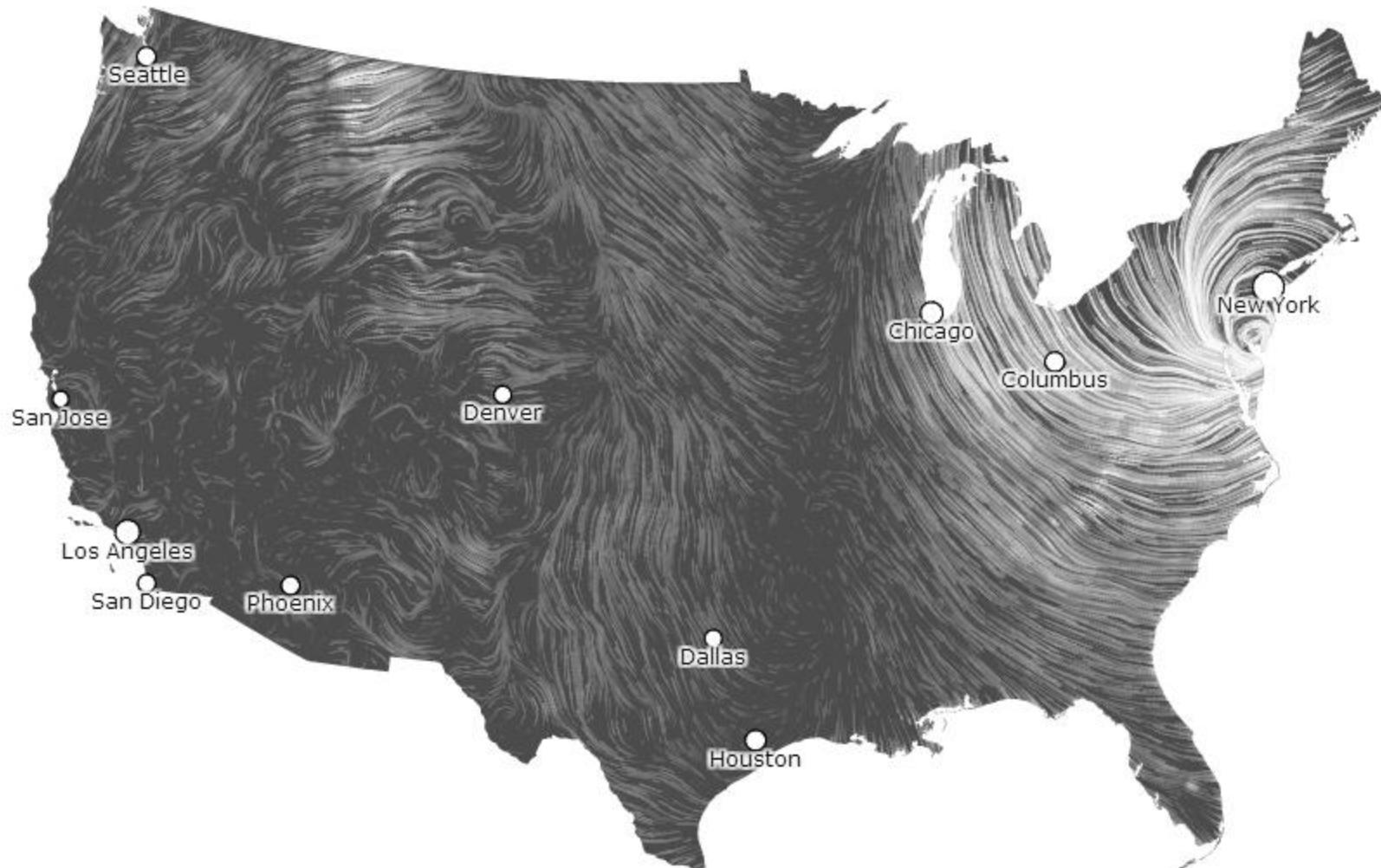
The word cloud is centered around the word 'design' in a large, bold purple font. Other prominent words include 'information' (blue), 'user' (green), 'interface' (orange), 'team' (yellow), 'application' (green), 'usability' (red), and 'development' (teal). The words are arranged in a roughly circular pattern around the center word, with smaller words forming the outer ring and larger words closer to the center.

NYT Netflix Rentals



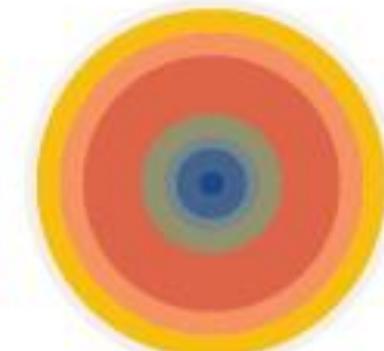
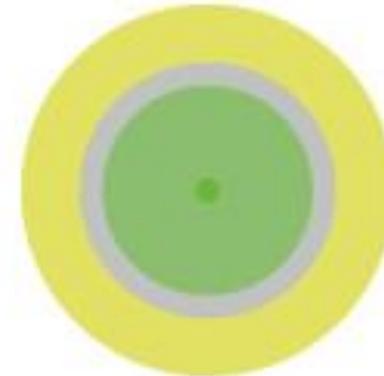
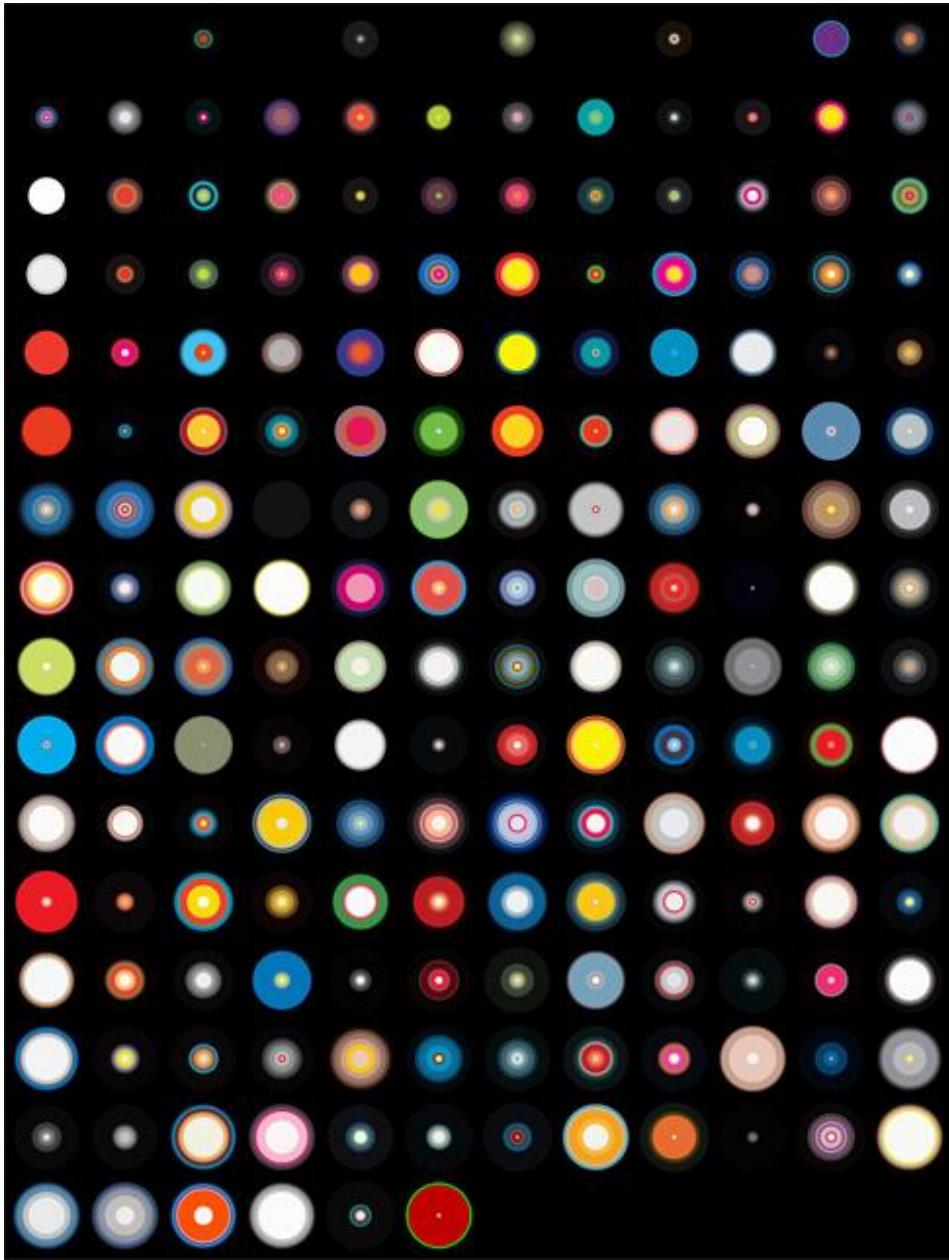
Wind Map

<http://hint.fm/wind/>



10 Years of Wired Magazine

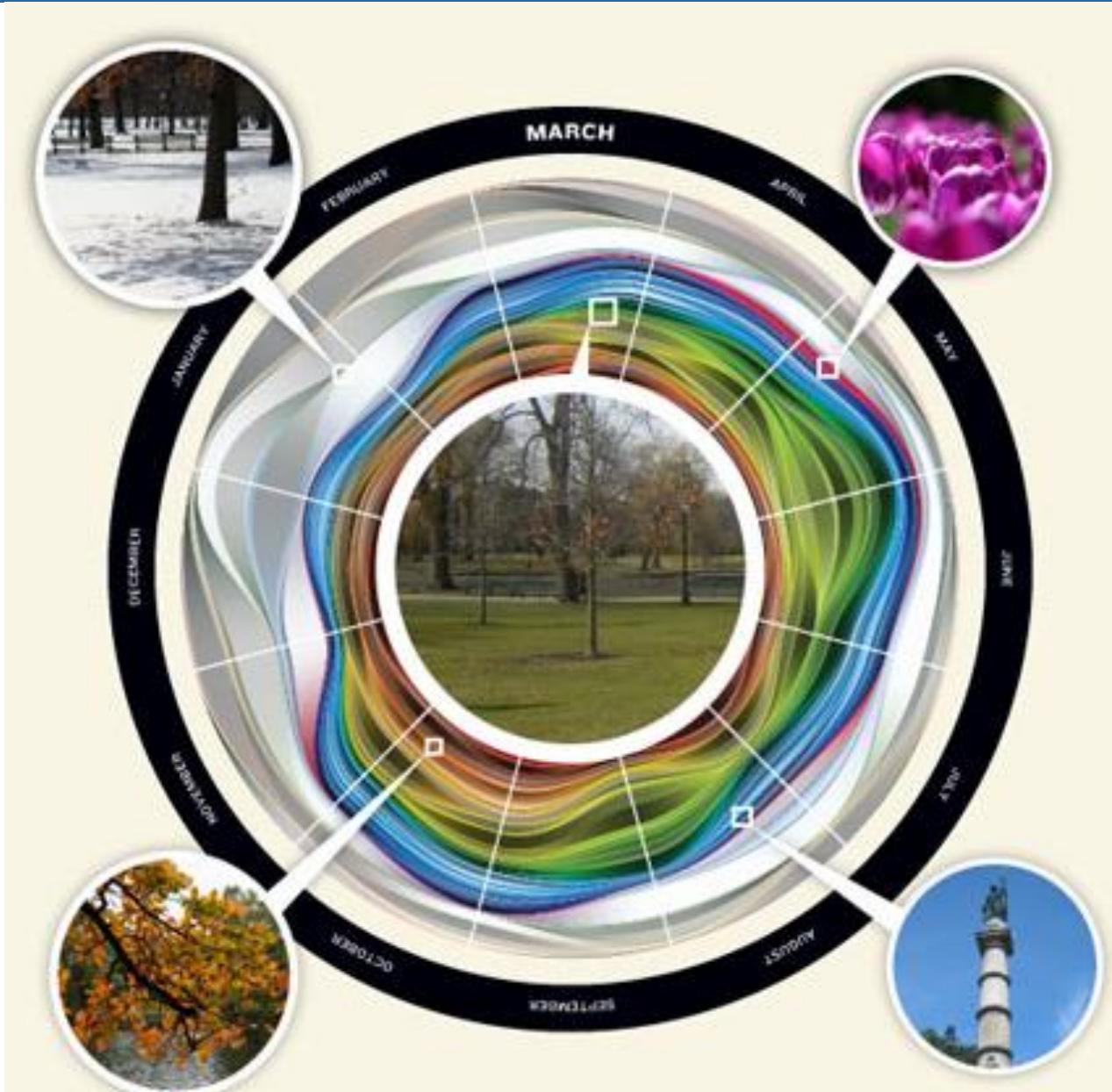
http://fernandaviegas.com/wired_anniversary.html



Flickr Flow

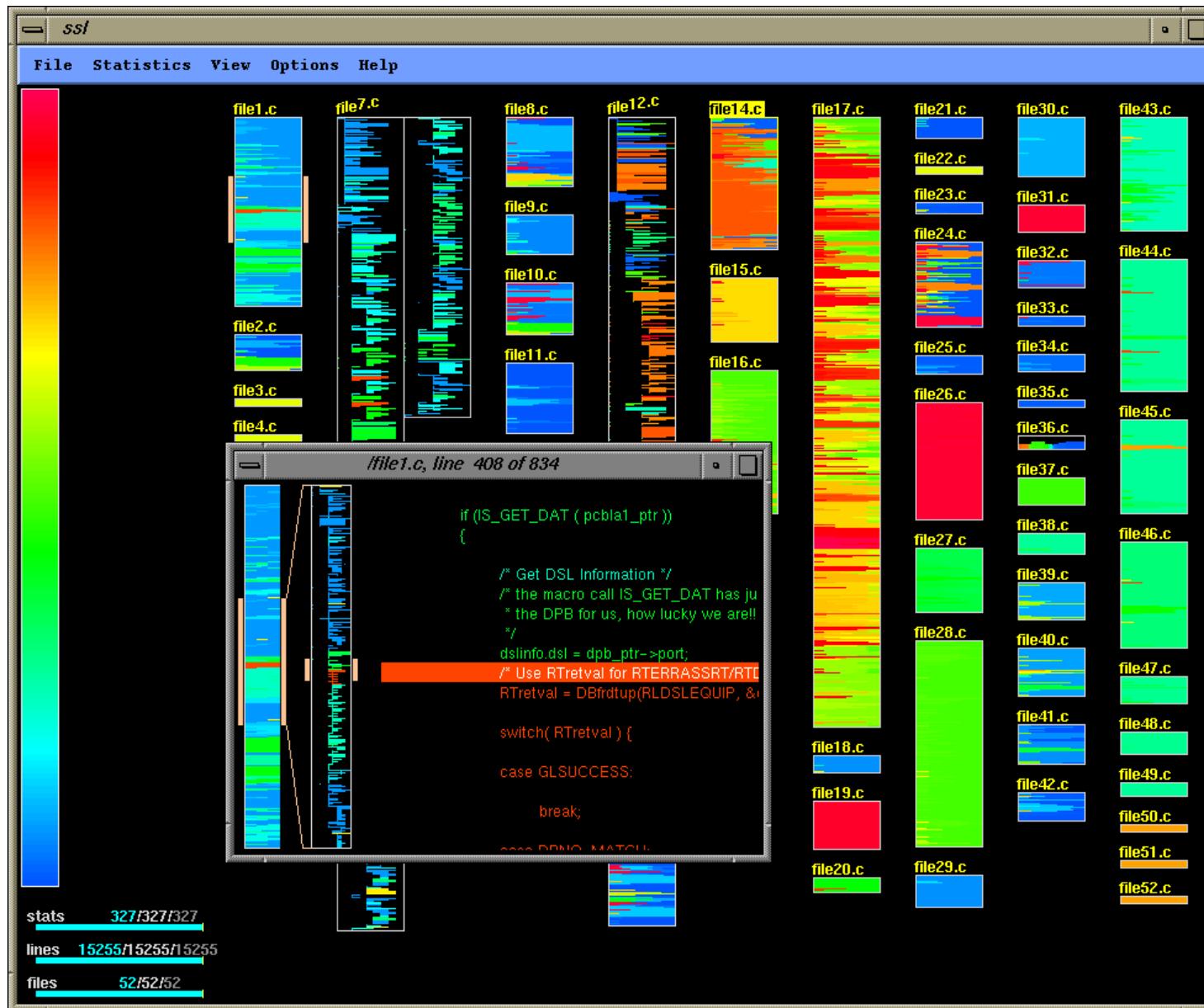


Flickr Flow



SeeSoft

Stephen G. Eick. Graphically displaying text. *Journal of Computational and Graphical Statistics*, 3(2):127-142, June 1994



Facebook Friendships



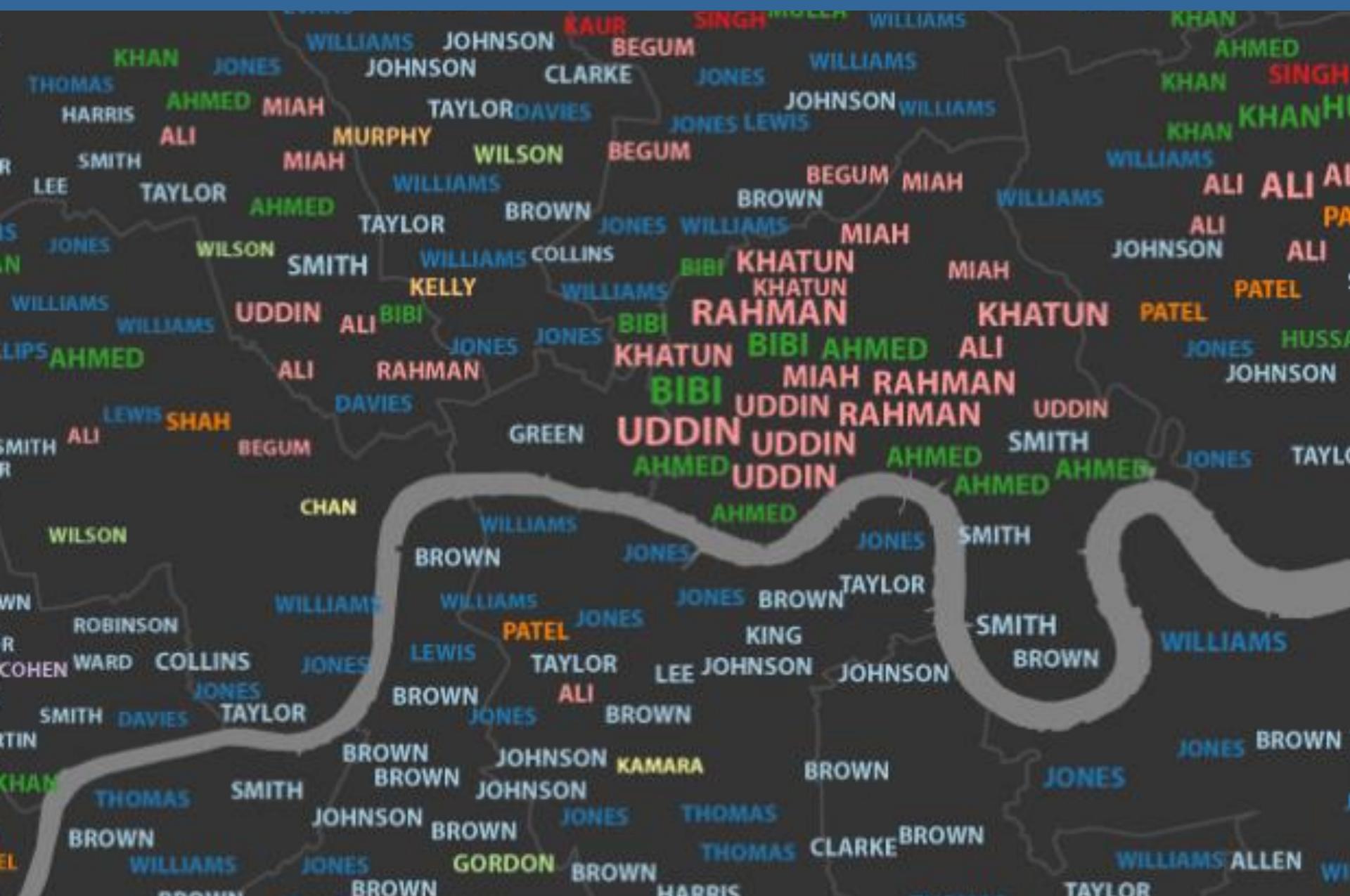
facebook

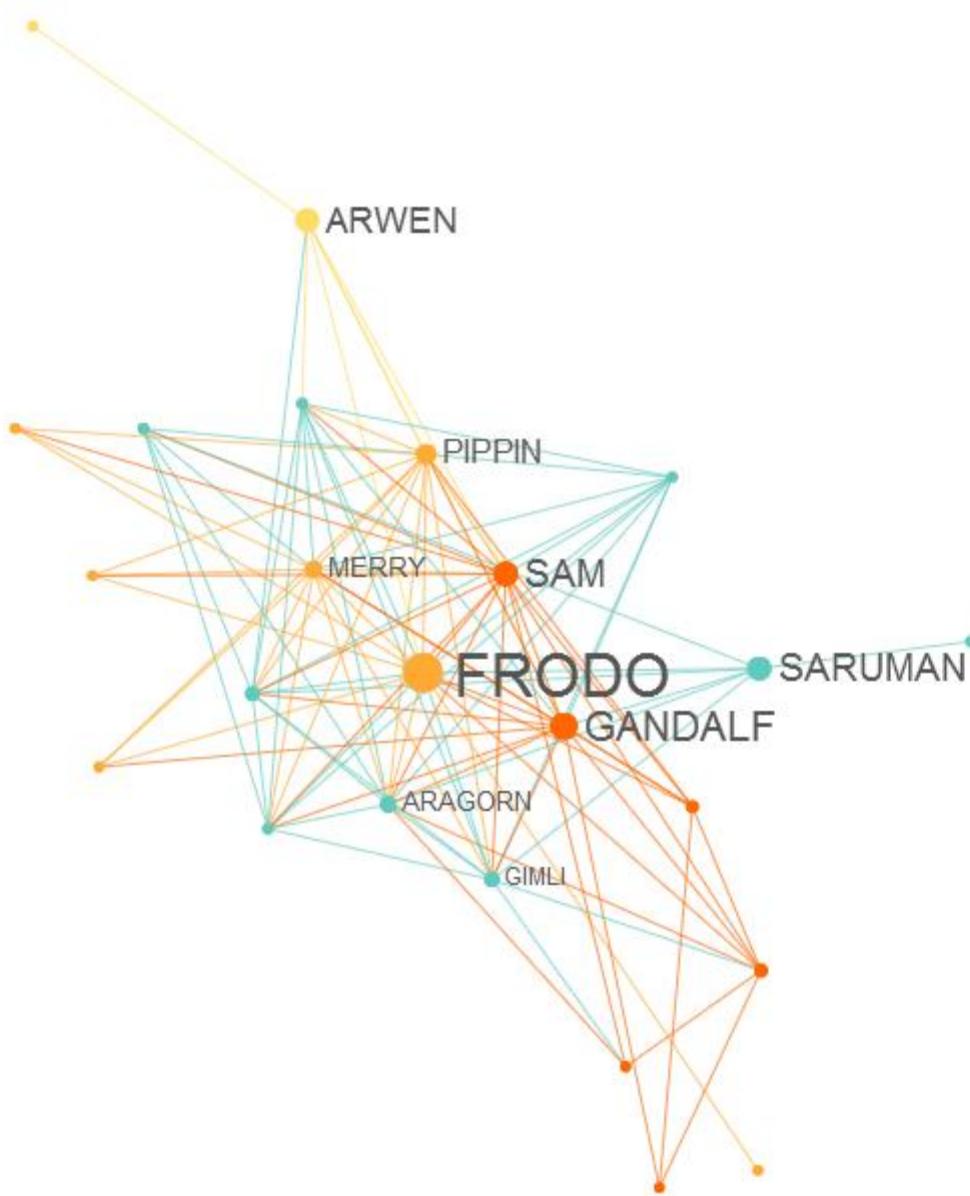
December 2010

<http://www.facebook.com/notes/facebook-engineering/visualizing-friendships/469716398919>

London Names

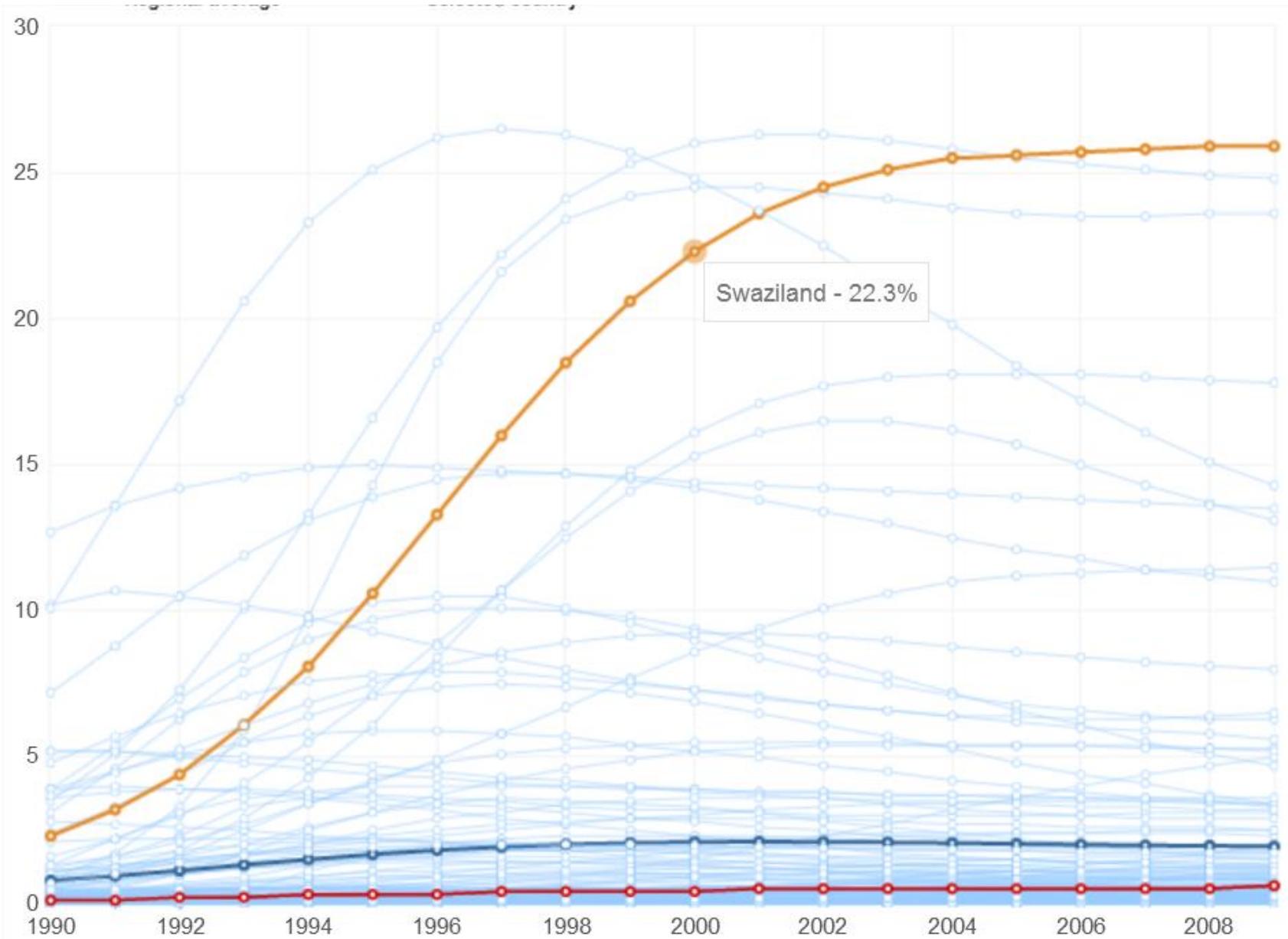
<http://names.mappinglondon.co.uk/>





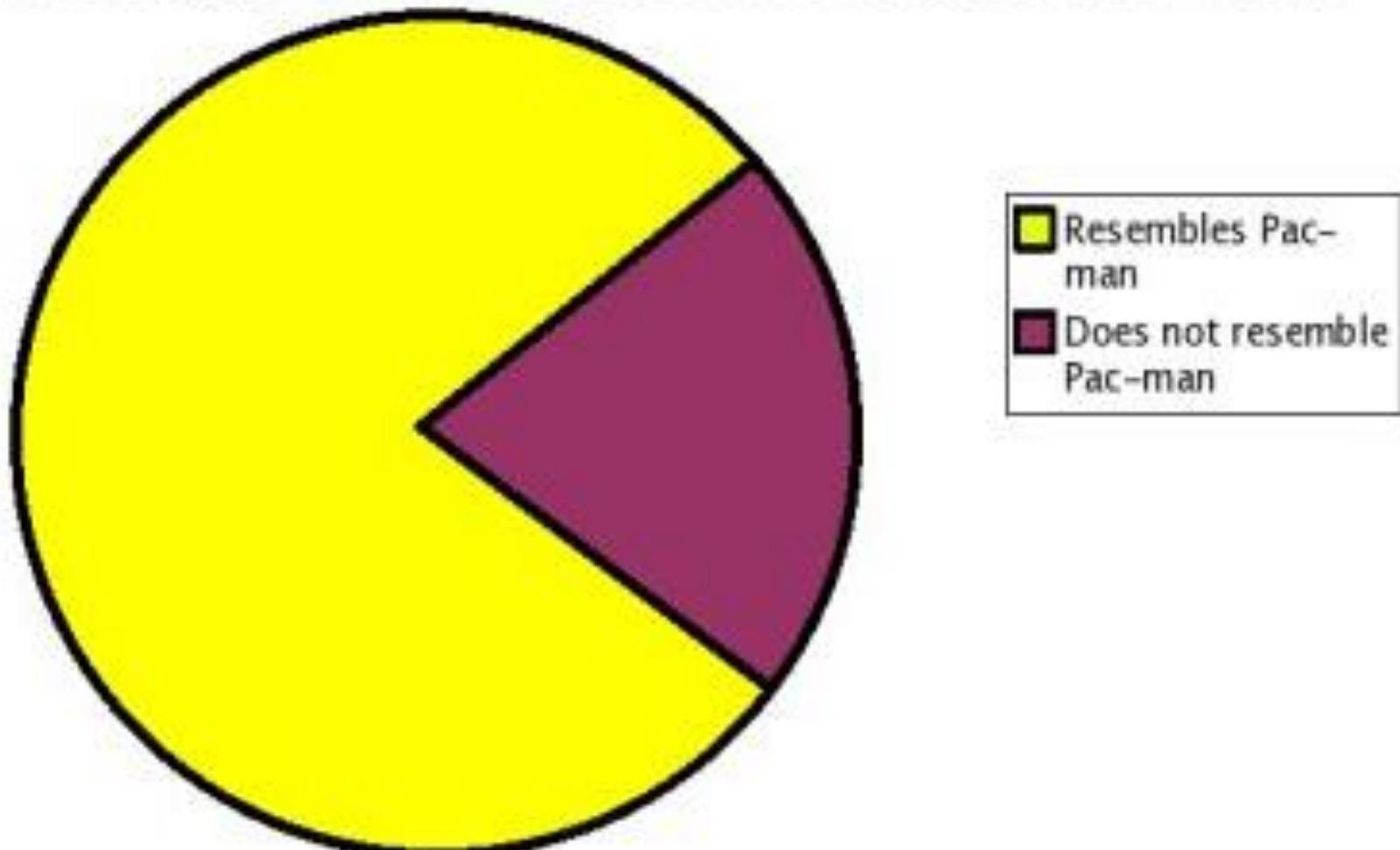
Spread of AIDS

<http://www.npr.org/blogs/health/2012/07/25/156991065/track-the-spread-of-aids-across-the-globe>



For Fun

Percentage of Chart Which Resembles Pac-man



For Fun



- Pie I have eaten
- Pie I have not yet eaten

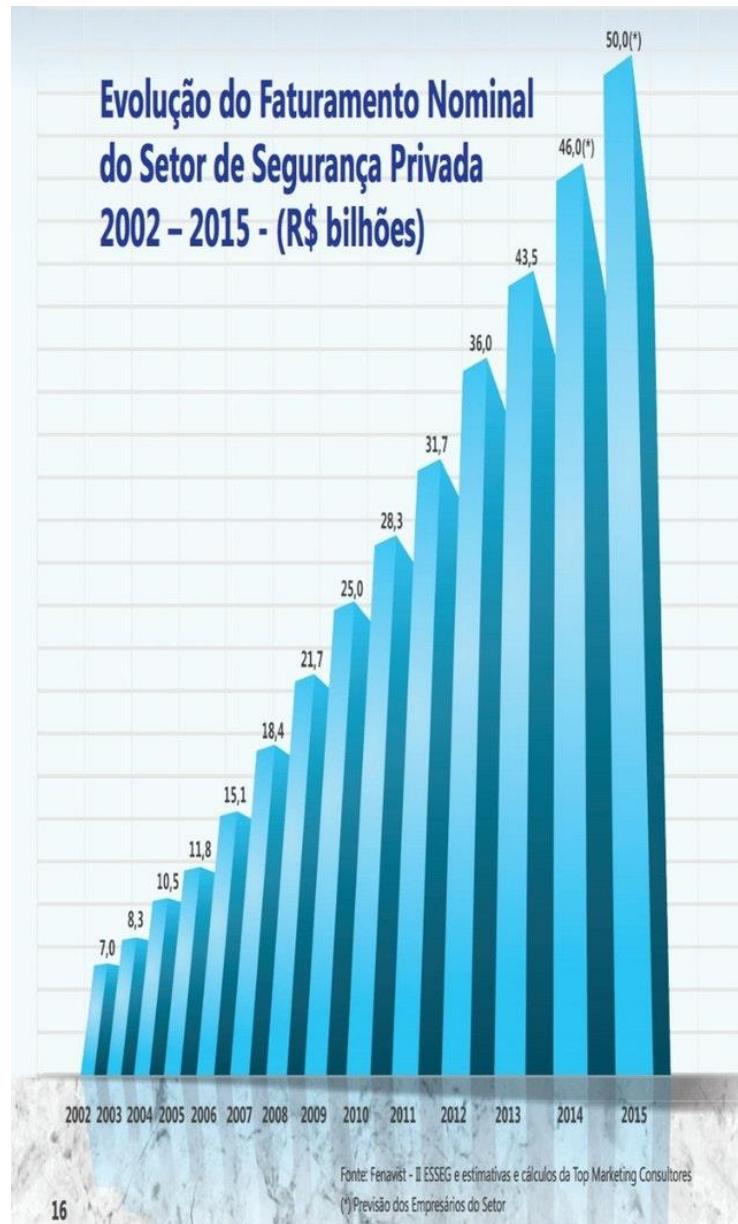
05

CRITIQUE THESE!

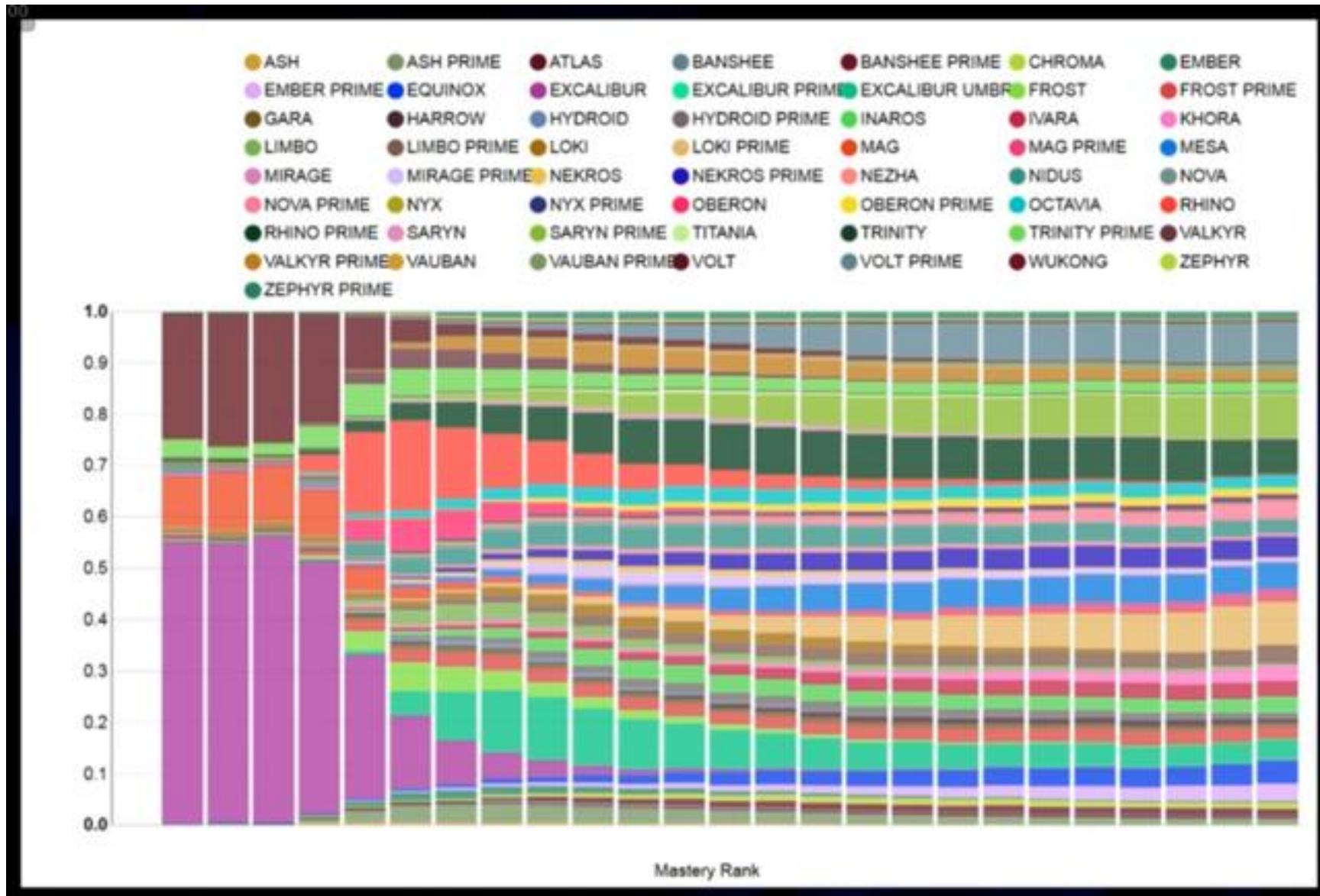
What's going on here??



What's going on here??



What's going on here??



06

JUST... NO,
PLEASE, NO

Unemployment...

<https://twitter.com/ppalcorcon/status/624613615287472128>

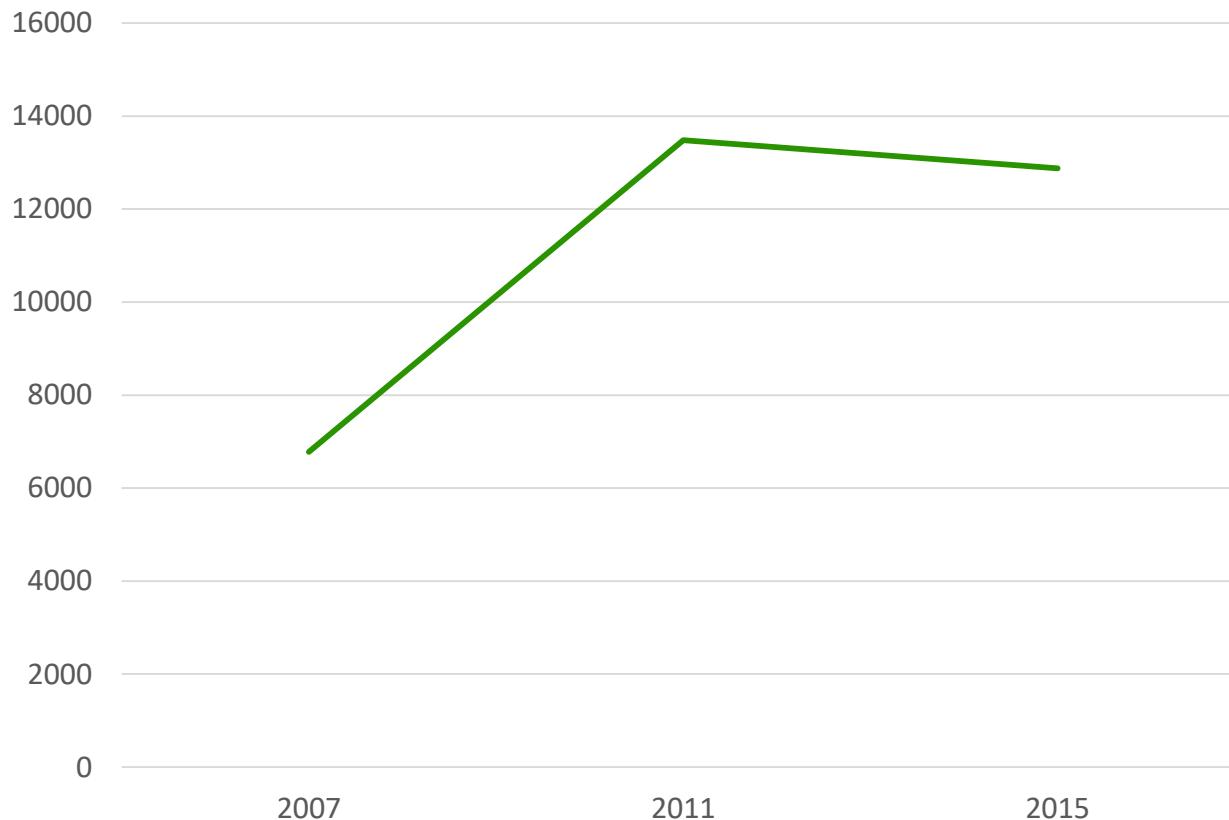
En Alcorcón ahora se crea empleo



POPULARES
de Alcorcón

Unemployment...

<https://twitter.com/ppalcorcon/status/624613615287472128>



Zika Virus

NBC2 VIEWER VOTE

NBC-2.COM

HOW CONCERNED ARE YOU ABOUT THE ZIKA VIRUS?

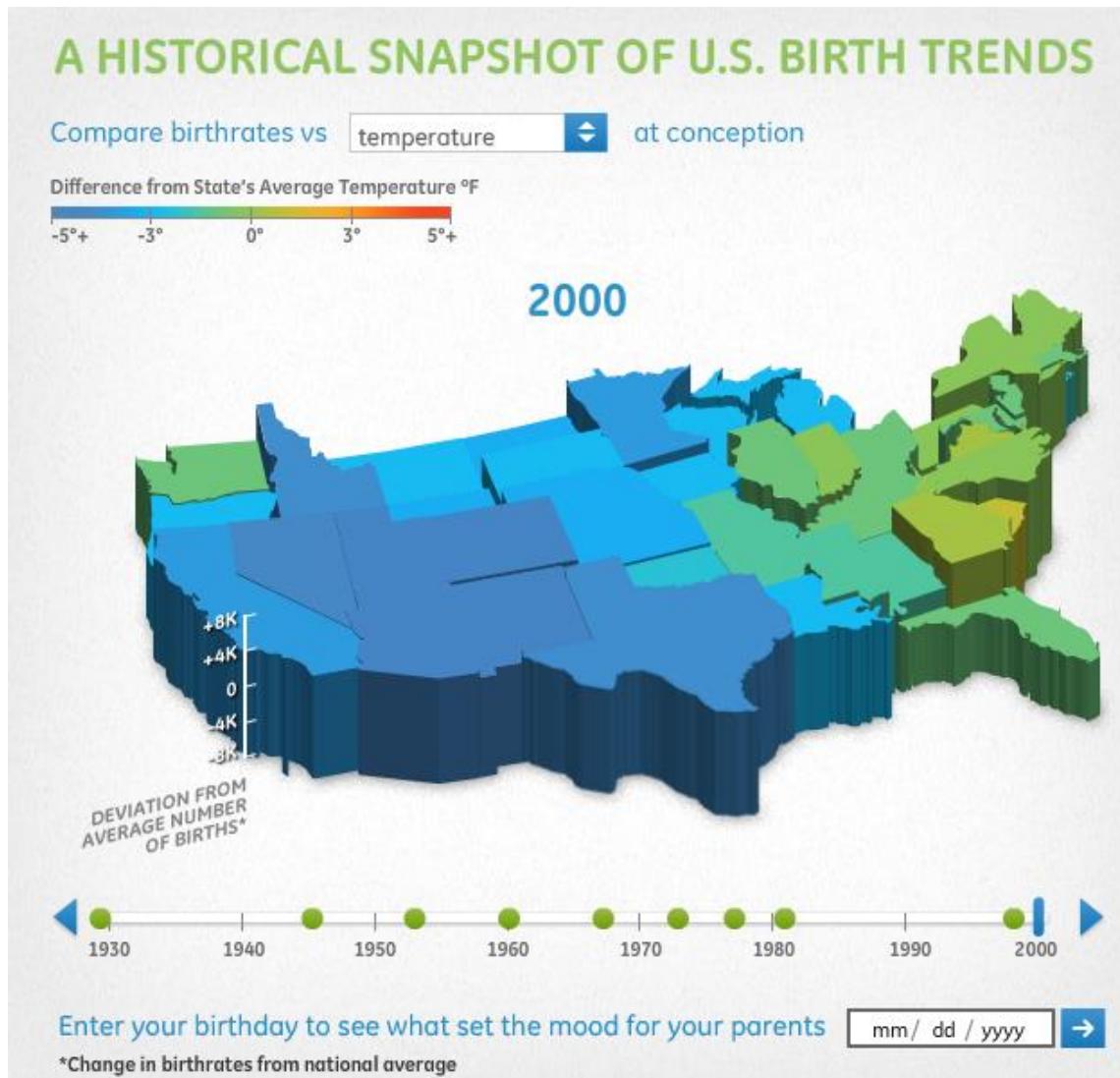


Plantations?

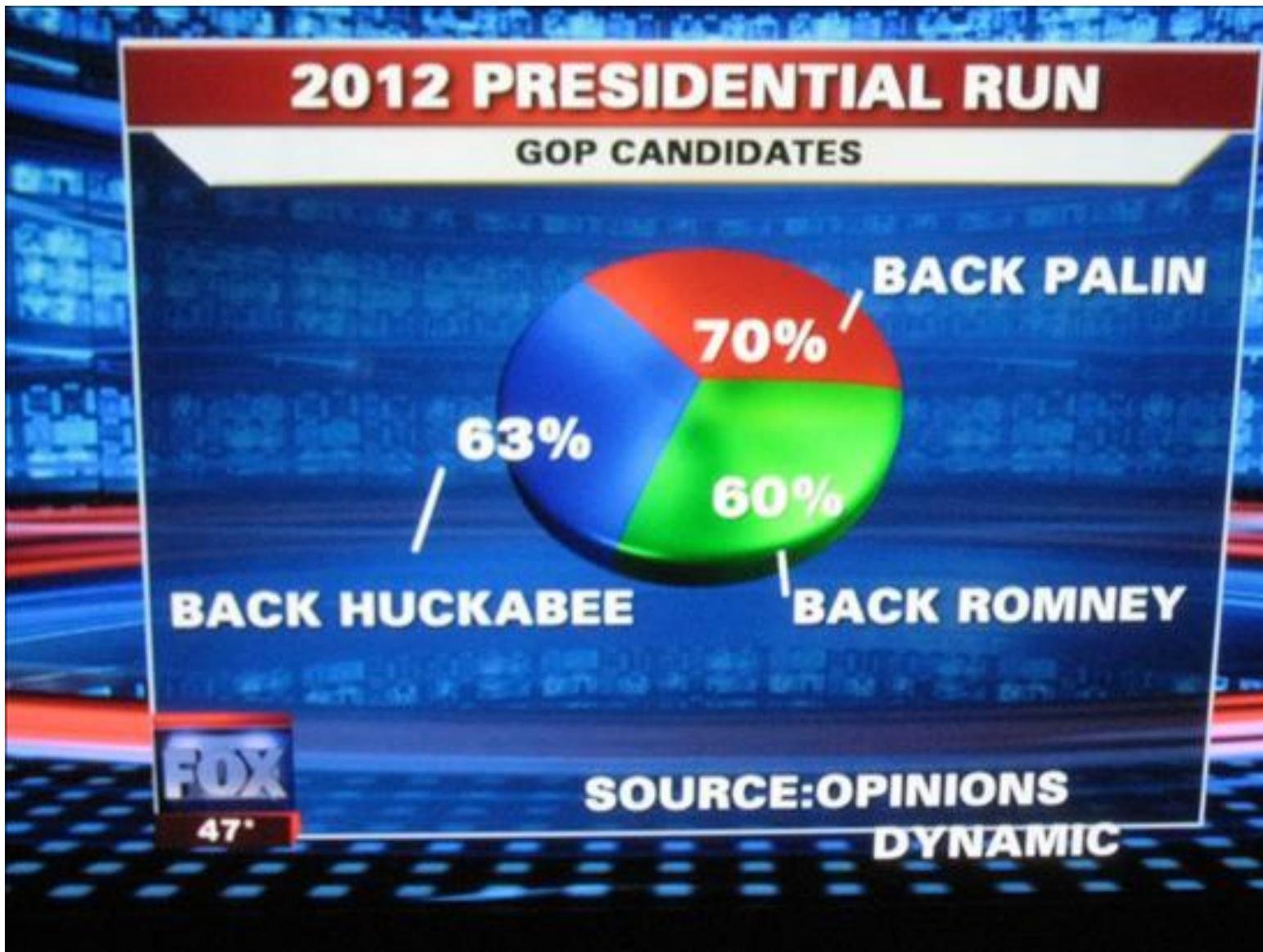
THE SEEDS OF SAAS CHURN
ARE PLANTED EARLY



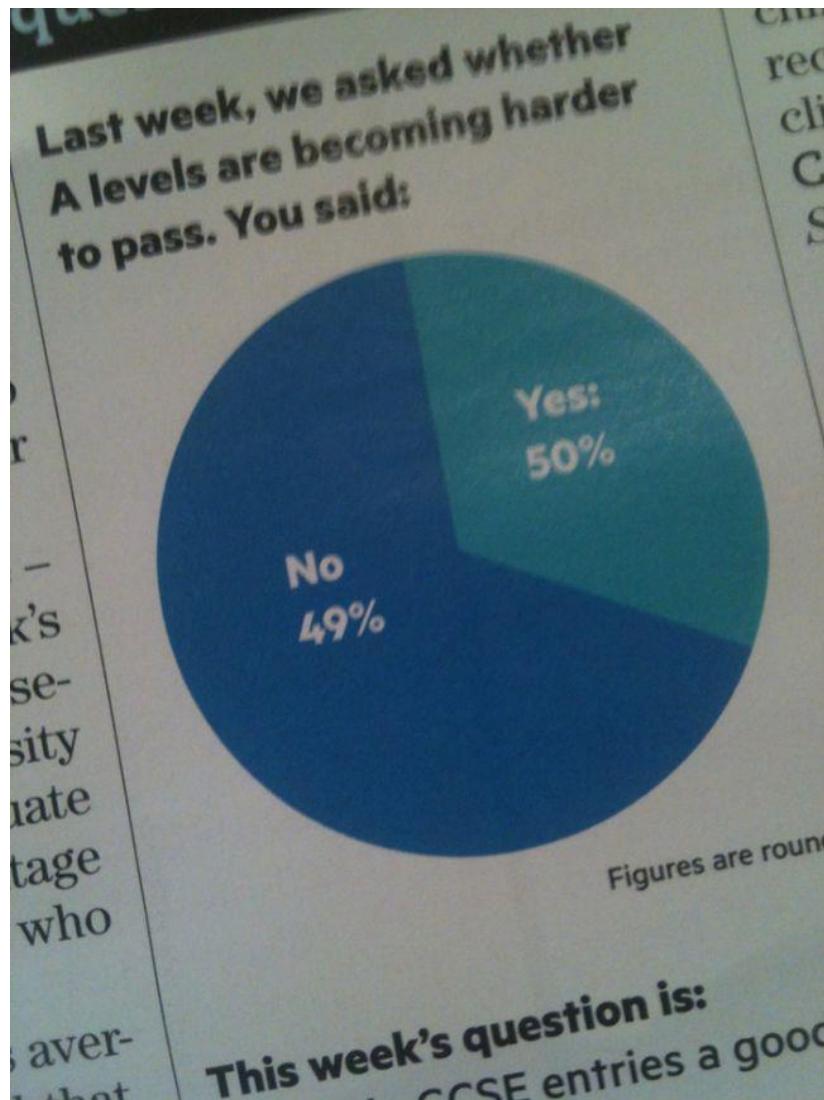
U.S. Births



Yet some more Fox...



Yes or No?



Inspiration: check these out...

<http://www.visualcomplexity.com/vc/>

<http://www.bestiario.org>

<http://www.informationisbeautiful.net/>

<http://www.coolinfographics.com/>

<http://datavisualization.ch/>

<http://flowingdata.com/>

<http://www.visualcomplexity.com/vc/blog/>

<https://pudding.cool/>

QUESTIONS?