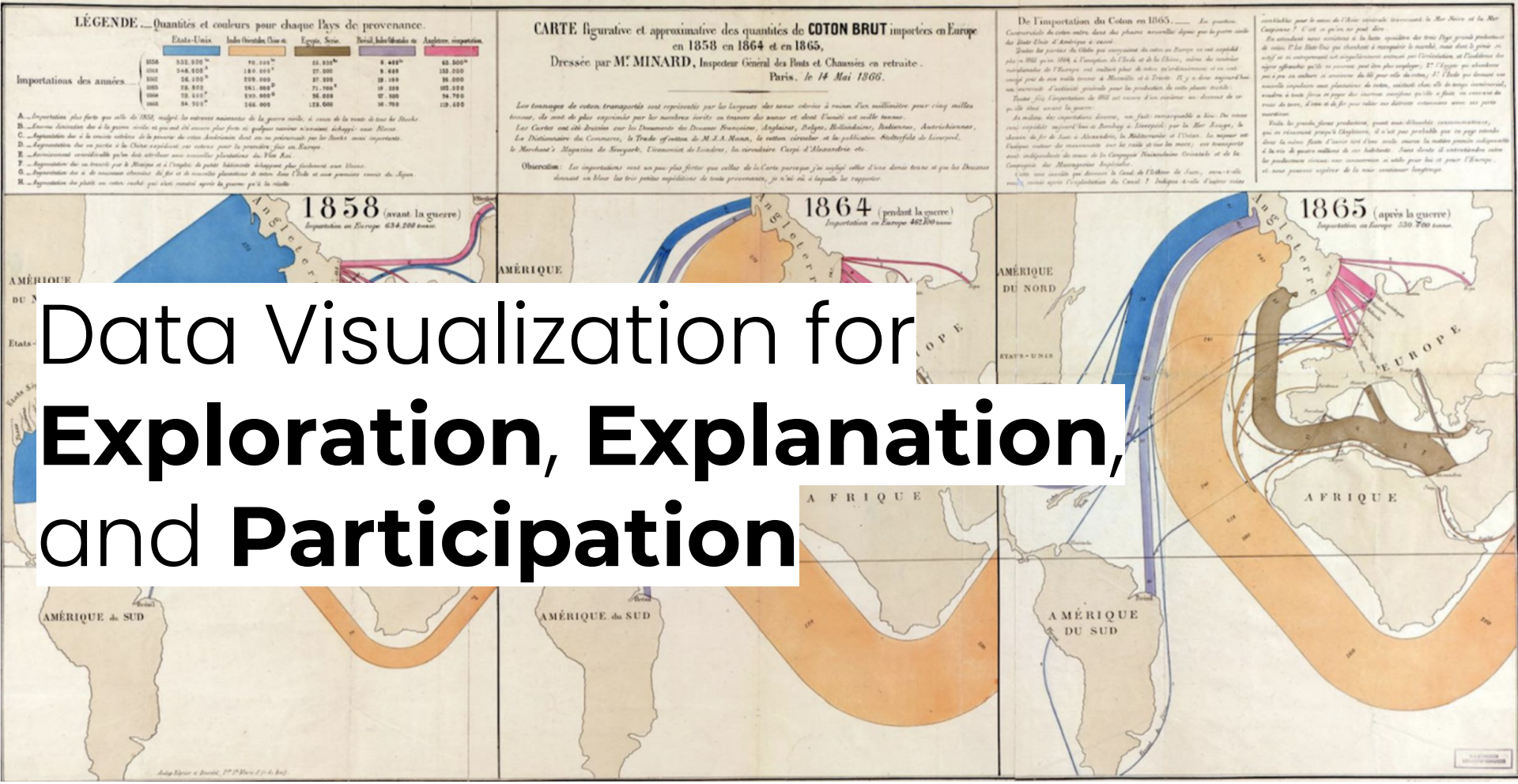


Data Visualization for **Exploration**, **Explanation**, and **Participation**

Benjamin Bach
Lecturer in Design Informatics and Visualisation
University of Edinburgh
@benjbach

VIS HUB University of Edinburgh — Visual+ Interactive Data

design informatics

DCS DATA CULTURE SOCIETY

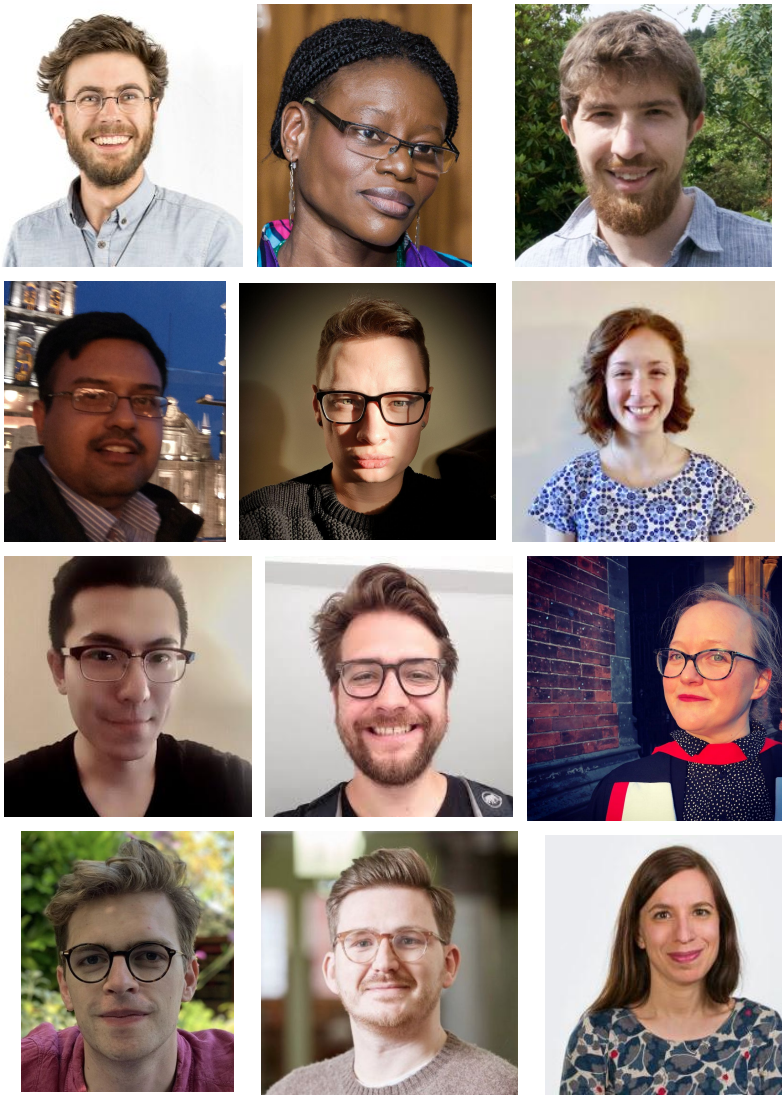
THE UNIVERSITY OF EDINBURGH

VIS HUB
University of Edinburgh

Visual+ Interactive Data

Home | People | Projects | Publications
For students | Vis Resources
Open Positions | Invited Talks
Edinburgh DataVis Meetup

design informatics
THE UNIVERSITY of EDINBURGH informatics
THE UNIVERSITY of EDINBURGH



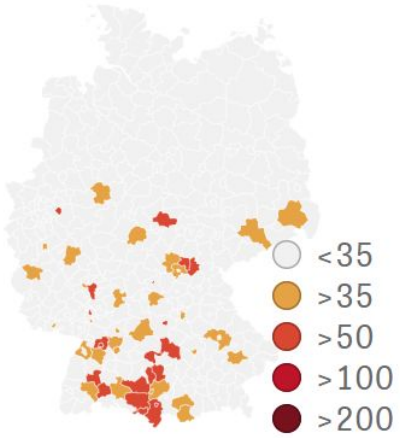
http://visualinteractivedata.github.io

Wählen Sie ein Land, Kontinent, Bundesland oder Kreis

Deutschland

Zum Beispiel:

Leipzig | Bayern | USA



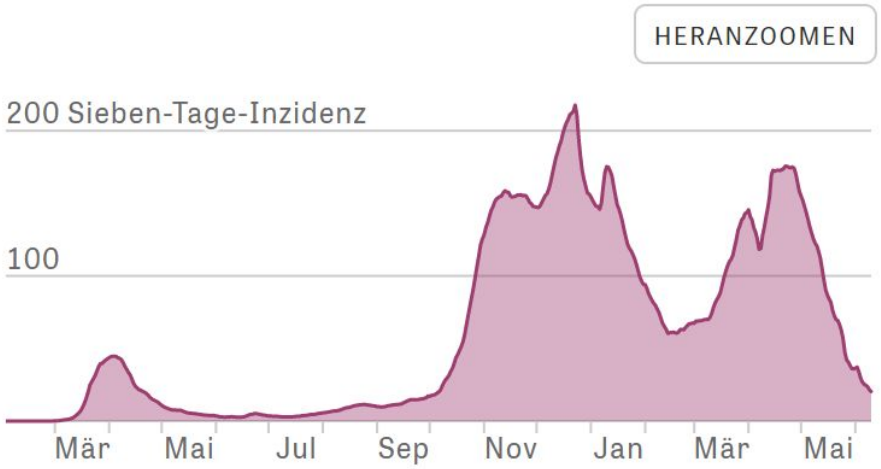
Sieben-Tage-Inzidenz

20,4 ↘

2.719 Fälle heute

Wochentrend: –40 %

Stand: 10. Juni



2.719 ↘

Fälle heute

3.717.842 gesamt

93 ↘

Todesfälle heute

90.280 gesamt

1.510 ↘

Intensivpatienten

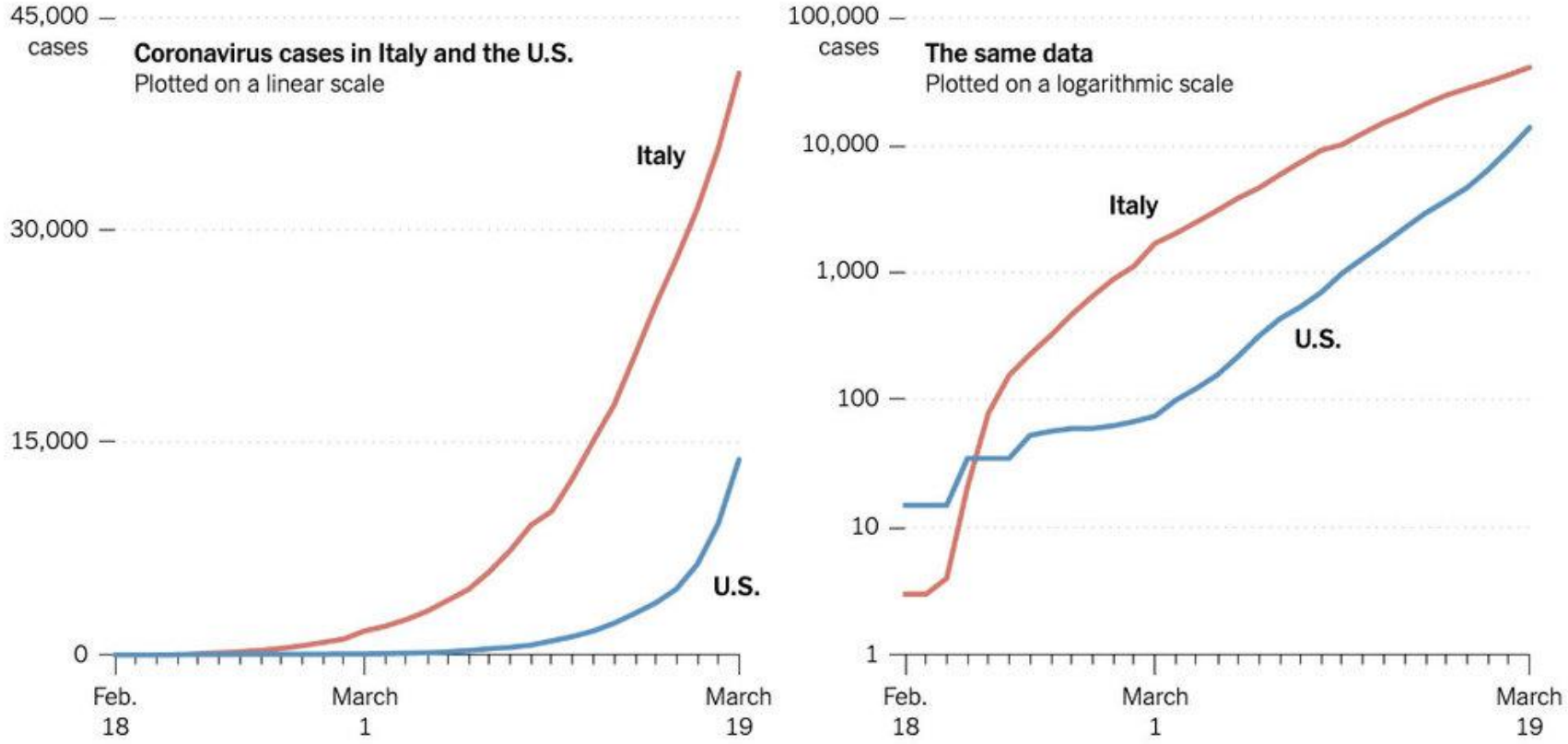
6 % aller Betten

47,0 %

Geimpfte

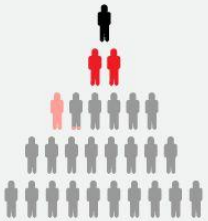
23,9 % vollständig

Quellen: Kreis- und Landesbehörden, Robert Koch-Institut, Divi Intensivregister, Johns-Hopkins-Universität, Our World in Data ⊕ Methodik


45,000
cases
Coronavirus cases in Italy and the U.S.
Plotted on a linear scale
Italy
30,000
15,000
U.S.
0
Feb. 18
March 1
March 19
100,000
cases
The same data
Plotted on a logarithmic scale
10,000
Italy
1,000
U.S.
100
10
1
Feb. 18
March 1
March 19

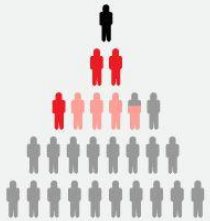
How contagious is a disease?

Scientists use "R naught," or R0, to estimate how many other people one sick person is likely to infect



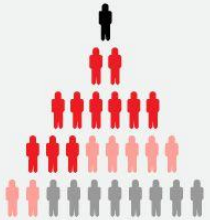
2019-nCoV
2-3.11

*This estimate is preliminary and likely to change

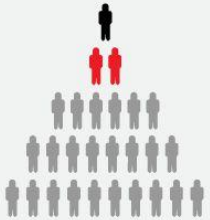


Zika
3-6.6

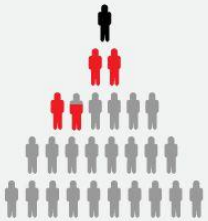
*An early estimate based on the Colombia outbreak in 2015



Measles
11-18

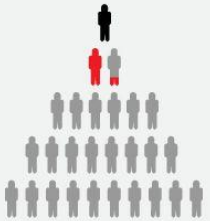


Ebola
2

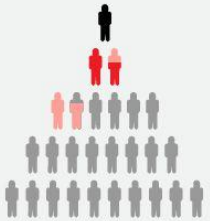


HIV
3.6-3.7

*An estimate based on Réunion Island in 2006



Seasonal flu
1.3



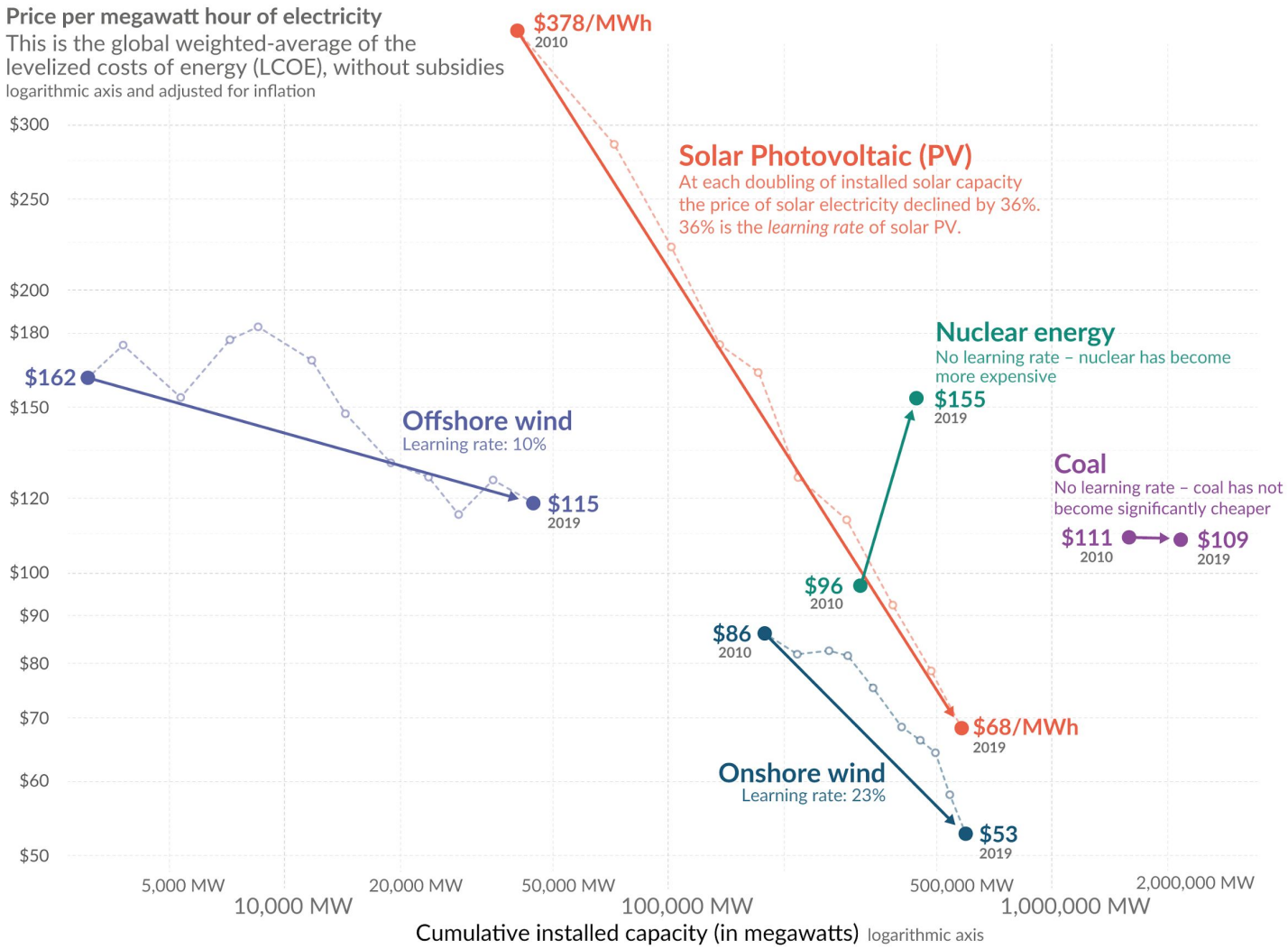
Norovirus
1.6-3.7

SOURCES: Travel Medicine, PLOS One, JAMA Pediatrics, MDPI, NCBI, New England Journal of Medicine, "The Spread and Control of Norovirus Outbreaks Among Hospitals in a Region"

Vox

Electricity from renewables became cheaper as we increased capacity – electricity from nuclear and coal did not

Our World in Data



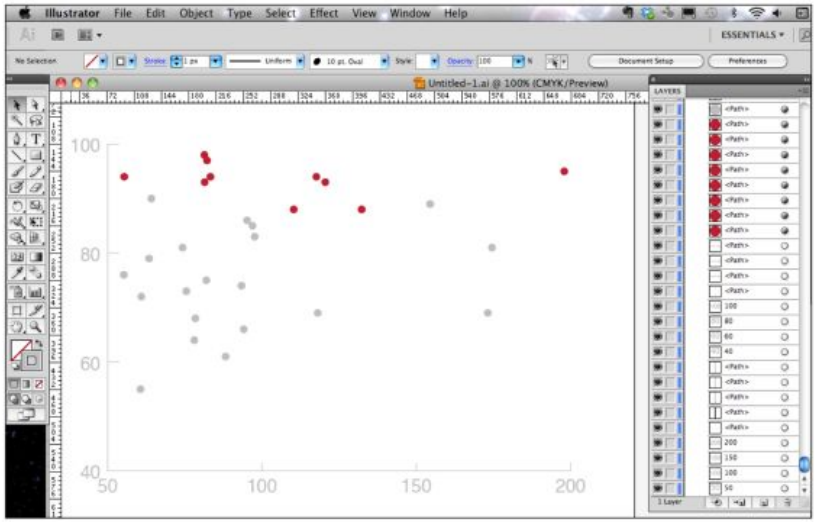
Source: IRENA 2020 for all data on renewable sources; Lazard for the price of electricity from nuclear and coal – IAEA for nuclear capacity and Global Energy Monitor for coal capacity. Gas is not shown because the price between gas peaker and combined cycles differs signficantly, and global data on the capacity of each of these sources is not available. The price of electricity from gas has fallen over this decade, but over the longer run it is not following a learning curve.

OurWorldinData.org – Research and data to make progress against the world's largest problems.

Licensed under CC-BY
by the author Max Roser

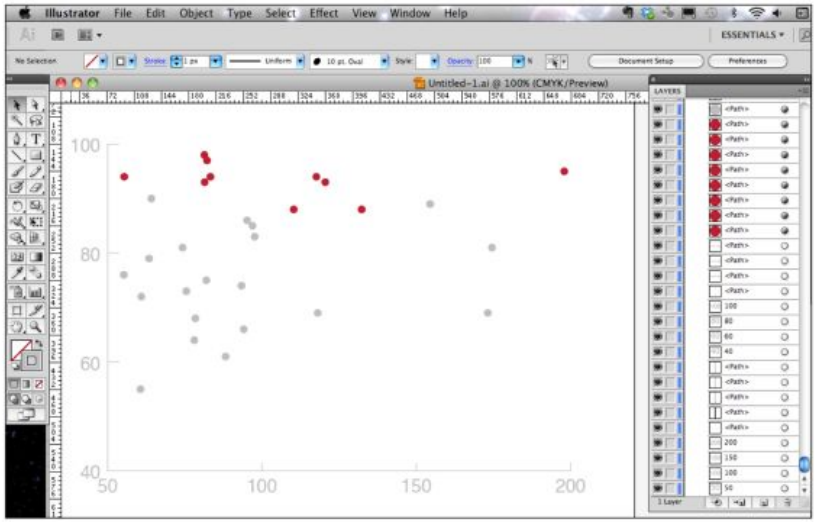
https://ourworldindata.org/cheap-renewables-growth

HOW TO MAKE A SCATTER PLOT IN ADOBE ILLUSTRATOR

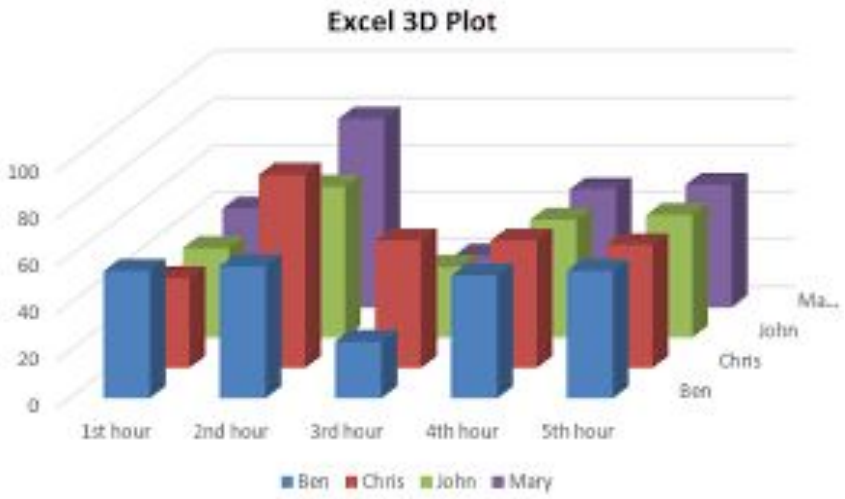


by Jeff Bennett | **Digital Splash Media**

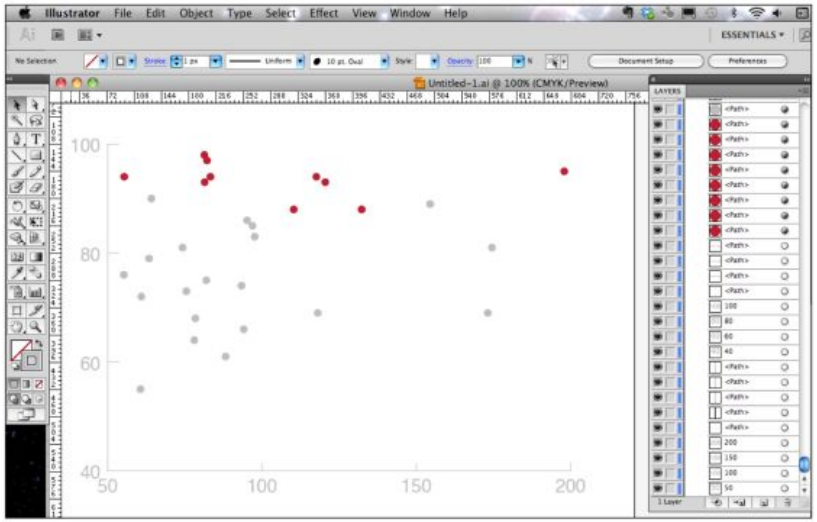
HOW TO MAKE A SCATTER PLOT IN ADOBE ILLUSTRATOR



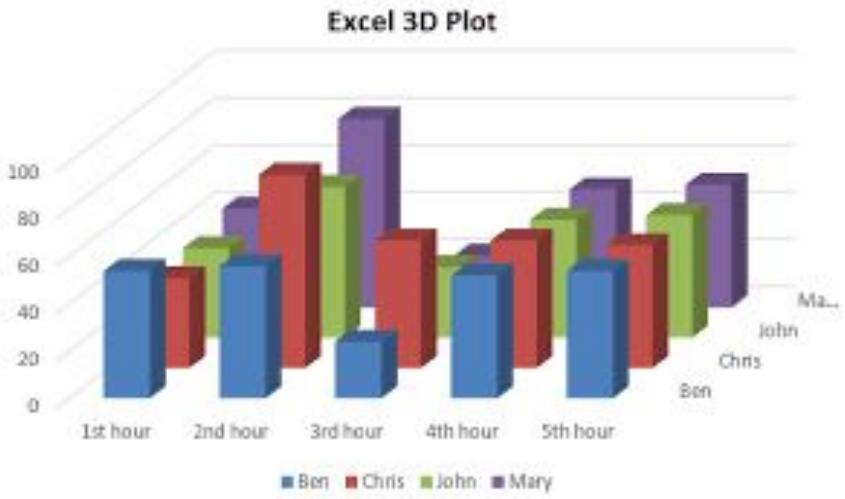
by Jeff Bennett | Digital Splash Media



HOW TO MAKE A SCATTER PLOT IN ADOBE ILLUSTRATOR



by Jeff Bennett | Digital Splash Media

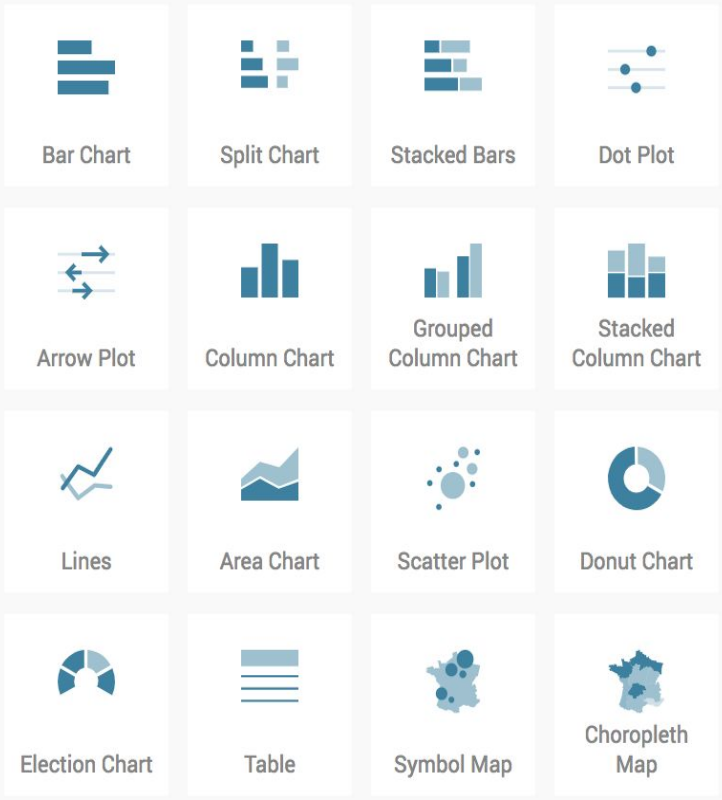


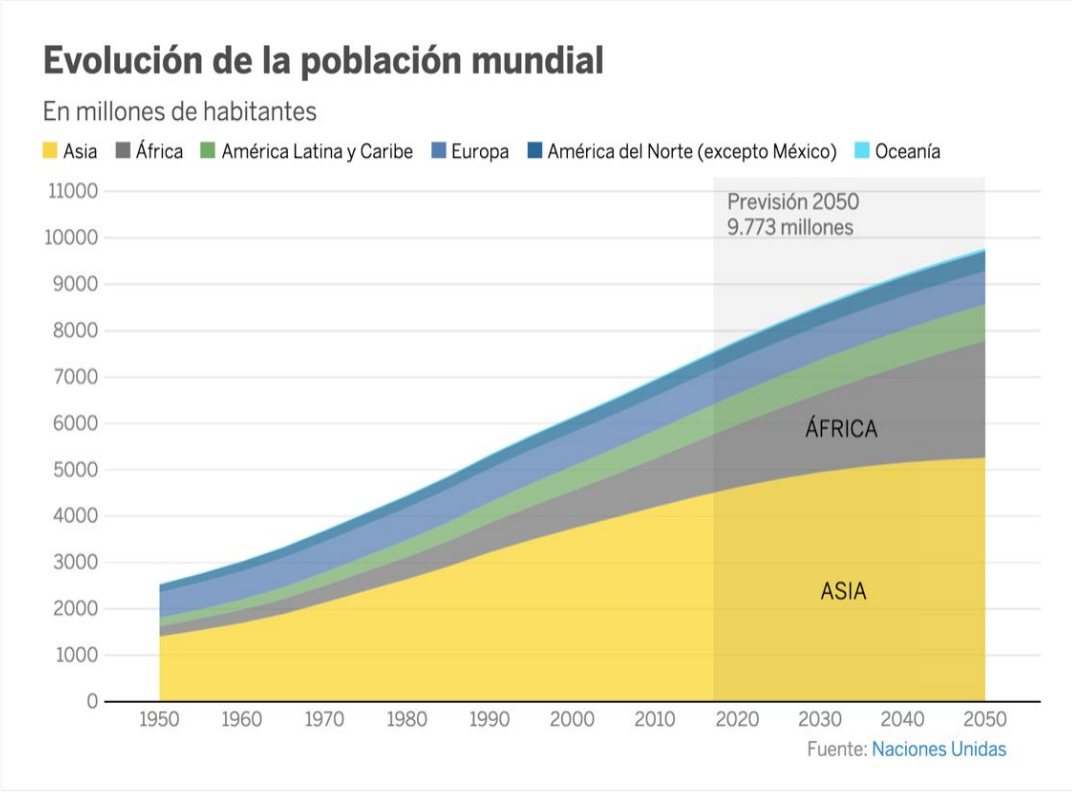

```
// return array of locations
toArray(): Location[] {
    var a: Location[] = [];
    for (var i = 0; i < this._elements.length; i++) {
        a.push(this.g._locations[this._elements[i]]);
    }
    return a;
}
createAttribute(attrName: string, f: Function): Locatio
    // create and init new attribute array if necessary
    if ((this.g.locationArrays as any)[attrName] == und
        (this.g.locationArrays as any)[attrName] = []
        for (var i = 0; i < this.g._locations.length; i
            (this.g.locationArrays as any)[attrName].pu
        }
    }
    for (var i = 0; i < this._elements.length; i++) {
        (this.g.locationArrays as any)[attrName][this._
    }
    return this;
}

intersection(q: LocationQuery): LocationQuery {
    return new LocationQuery(this.generic_intersection(
}
removeDuplicates(): LocationQuery {
    return new LocationQuery(this.generic_removeDuplica
}
forEach(f: Function): LocationQuery {
    for (var i = 0; i < this._elements.length; i++) {
        f(this.g.location(this._elements[i]), i);
    }
    return this;
}
```

DataWrapper

https://www.datawrapper.de/

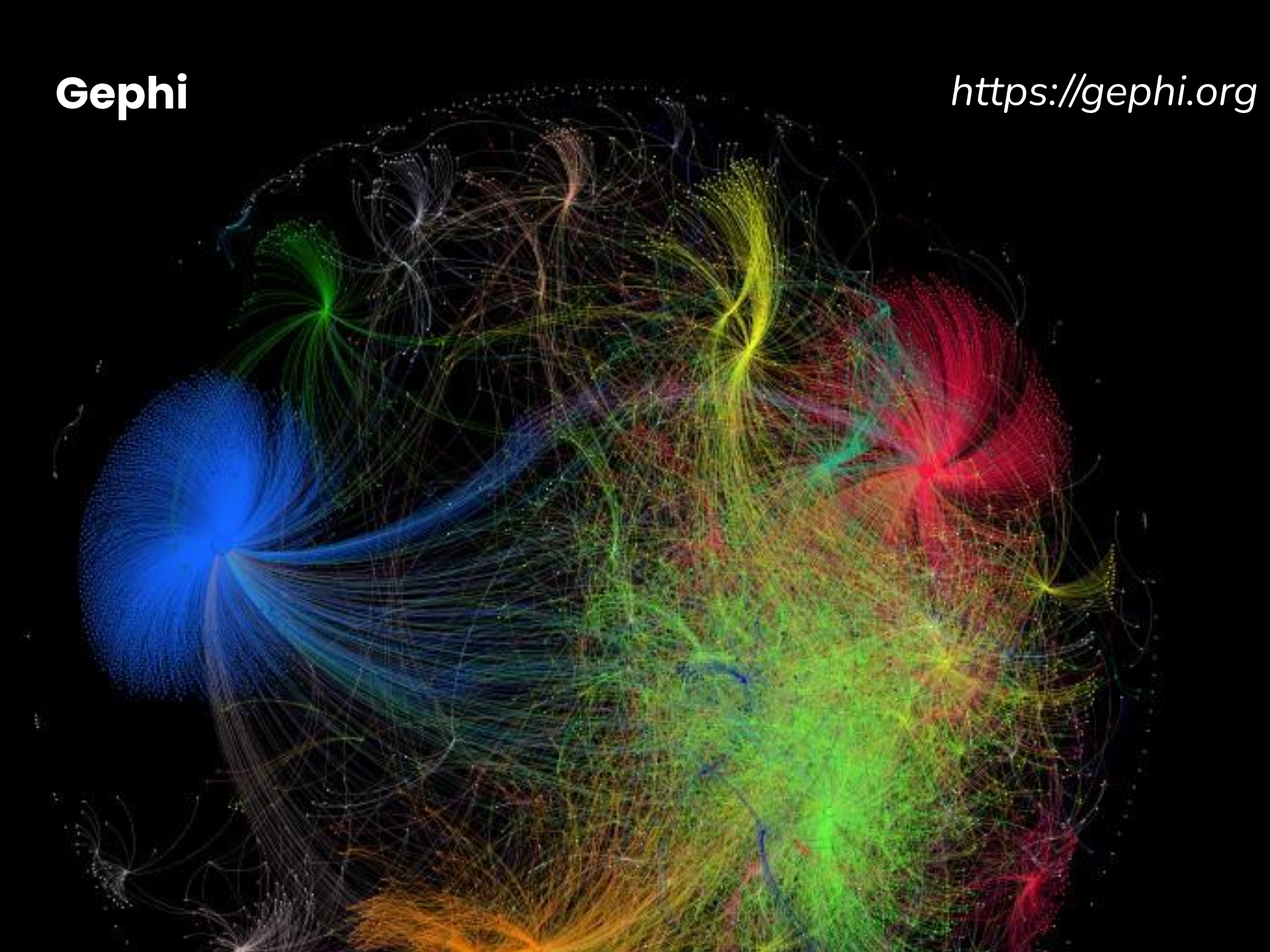




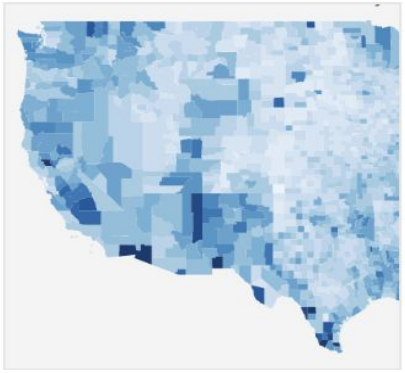
By David Alameda for elpais.com

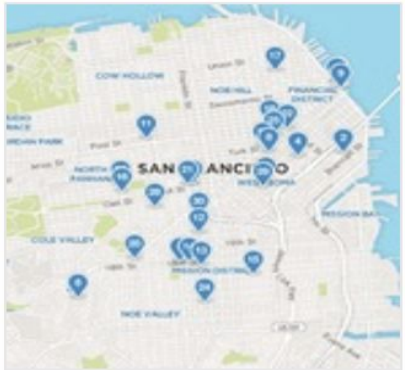
Gephi

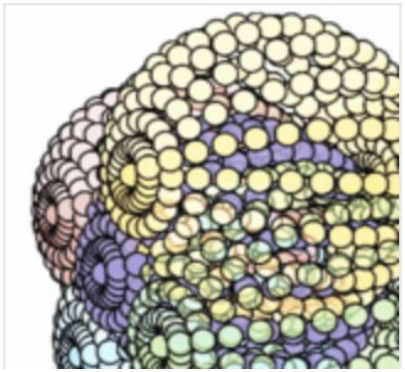
https://gephi.org

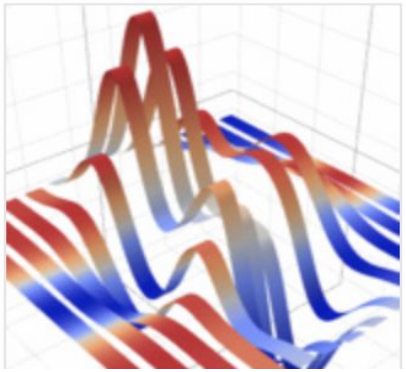


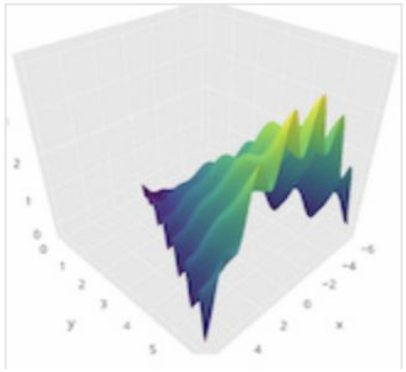
Plotly

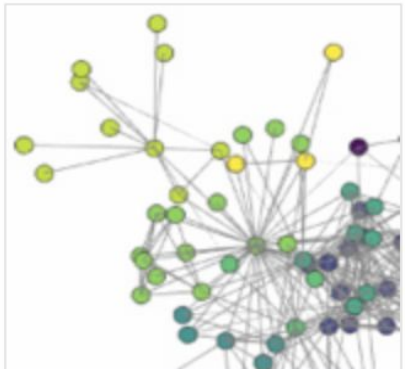


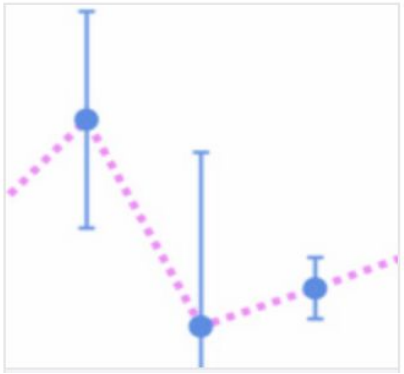


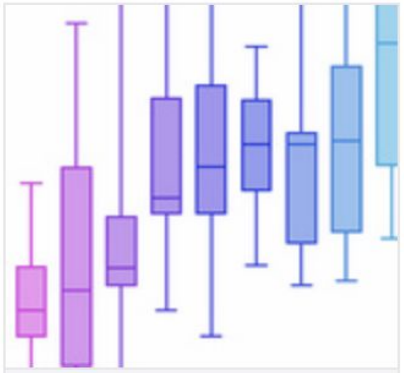








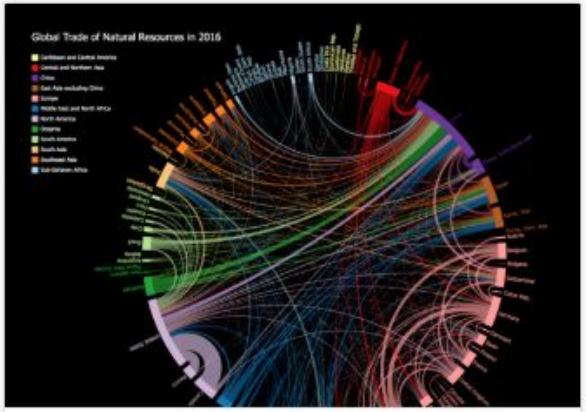




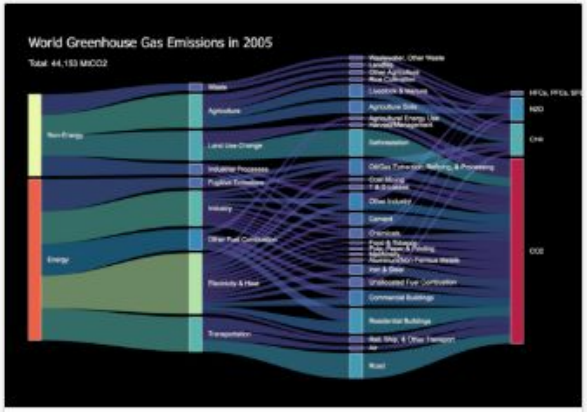
Charticulator

https://charticulator.com

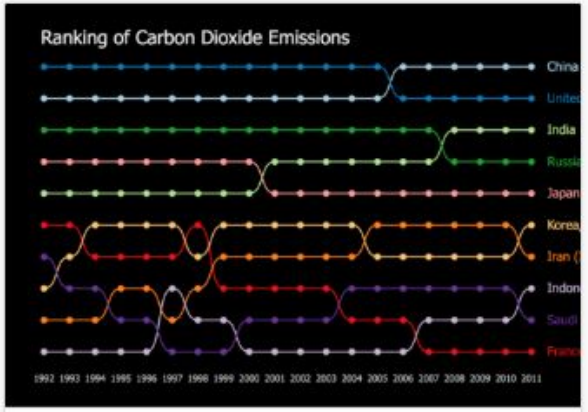
Chart & Video



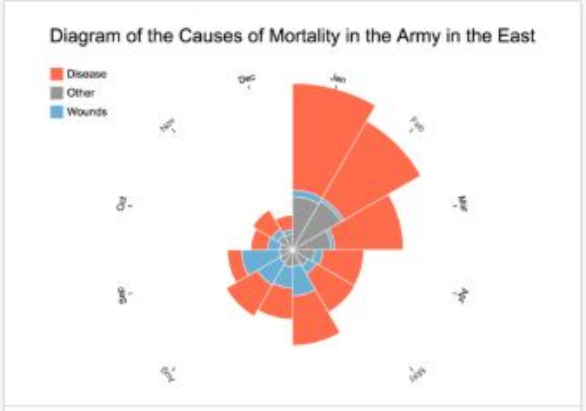
Global trade of natural resources in 2016



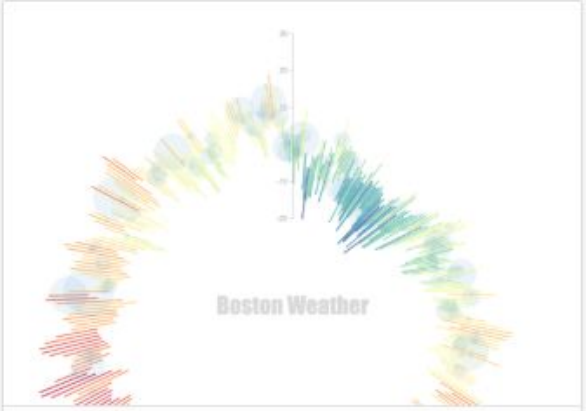
World greenhouse gas emissions



Ranking of carbon dioxide emissions of selected countries



Causes of Mortality over time (Reproduction of the Nightingale chart)

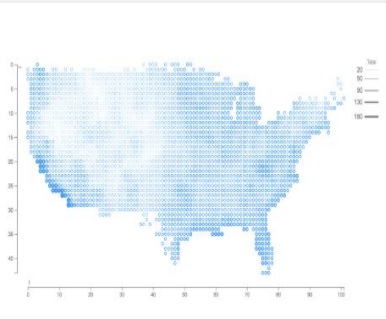


Boston weather in a year

Spiral Bar Chart

Data Illustrator

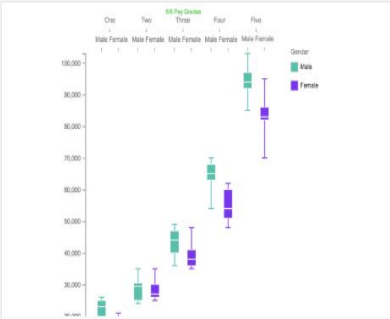
http://data-illustrator.com



The Pleasant Places to Live

Binned map showing pleasant weather days in the US.

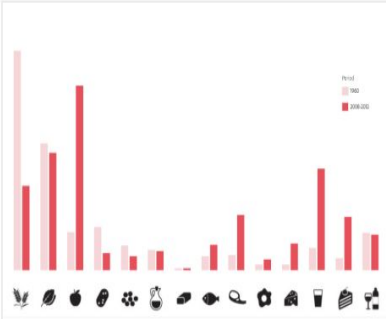
Open Example | Watch Demo



Gender Pay Gap - Box Plot

A box and whisker plot demonstrating the gender pay gap across salary grades.

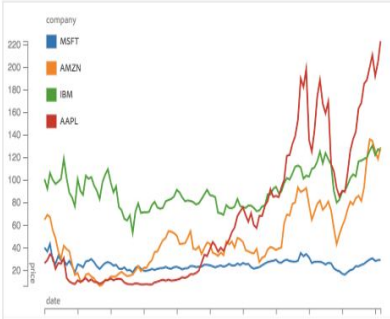
Open Example | Watch Demo



How Consumption Has Changed

How consumption of different types of food has changed since 1960

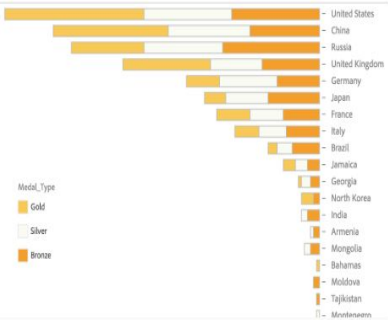
Open Example | Watch Demo



Stock Market

Monthly stock prices for four companies from 2000 to 2010

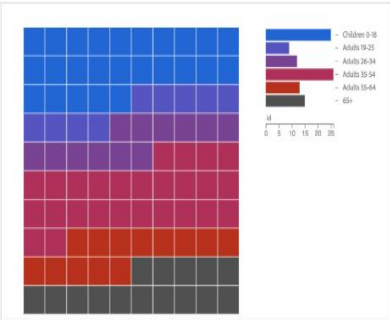
Open Example | Watch Demo



2012 Summer Olympic Medals

Stacked bar chart on the number of gold, silver and bronze medals by country

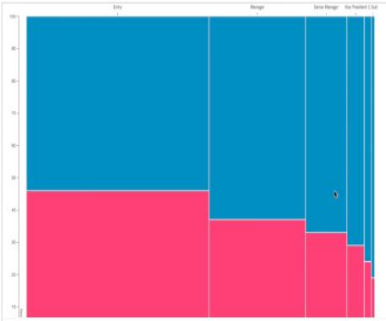
Open Example | Watch Demo



Population Distribution by Age

The distribution of population by age groups in the United States in 2016

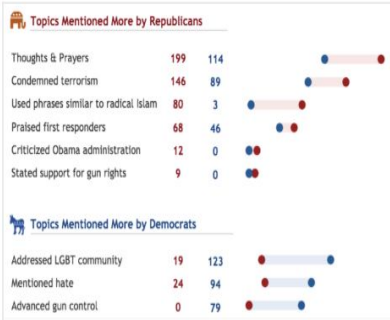
Open Example | Watch Demo



Share of Women across Job Levels

The proportion of women declines in higher job titles.

Open Example | Watch Demo



Partisan Reactions on Mass Shooting

Topics mentioned by the two parties after the Orlando nightclub shooting

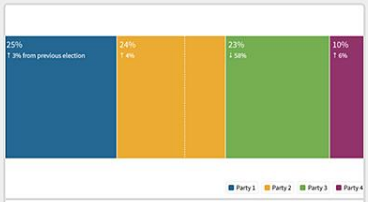
Open Example | Watch Demo

Flourish

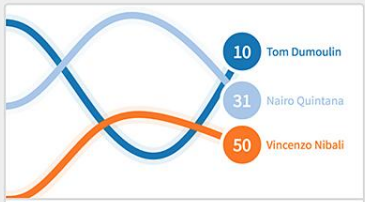
Choose a template

Showing Featured Favourites Mine Company All by Flourish

Connections globe
Made by Flourish team

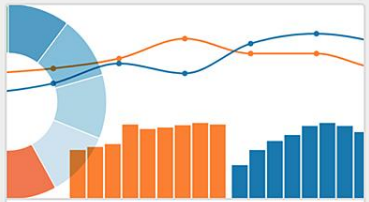


Election results chart
Made by Flourish team



Horserace chart
Made by Flourish & Google News Lab teams

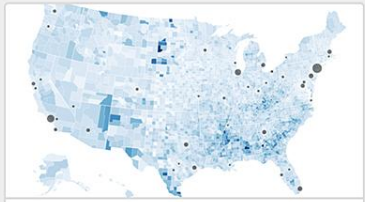
Icon map
Made by Flourish team



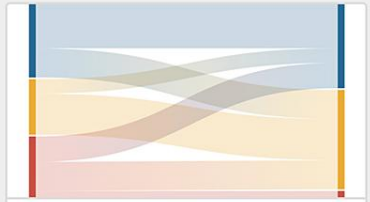
Line, bar and pie charts
Made by Flourish team

Map: the world
Made by Flourish team

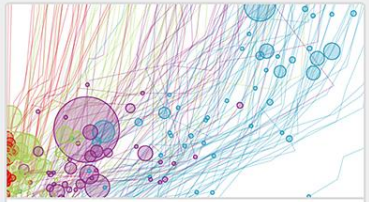
Map: UK constituencies
Made by Flourish team



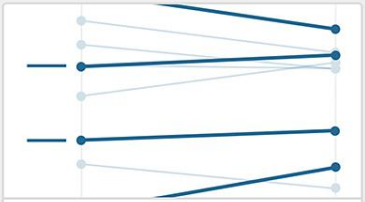
Map: US counties
Made by Flourish team



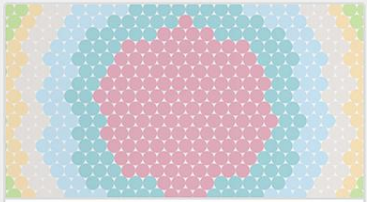
Sankey diagram
Made by Flourish team



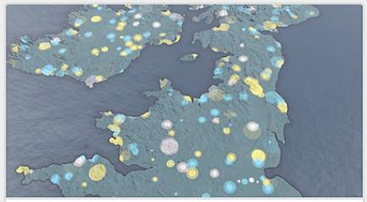
Scatter
Made by Flourish team



Slope chart
Made by Flourish team



Survey
Made by Flourish team

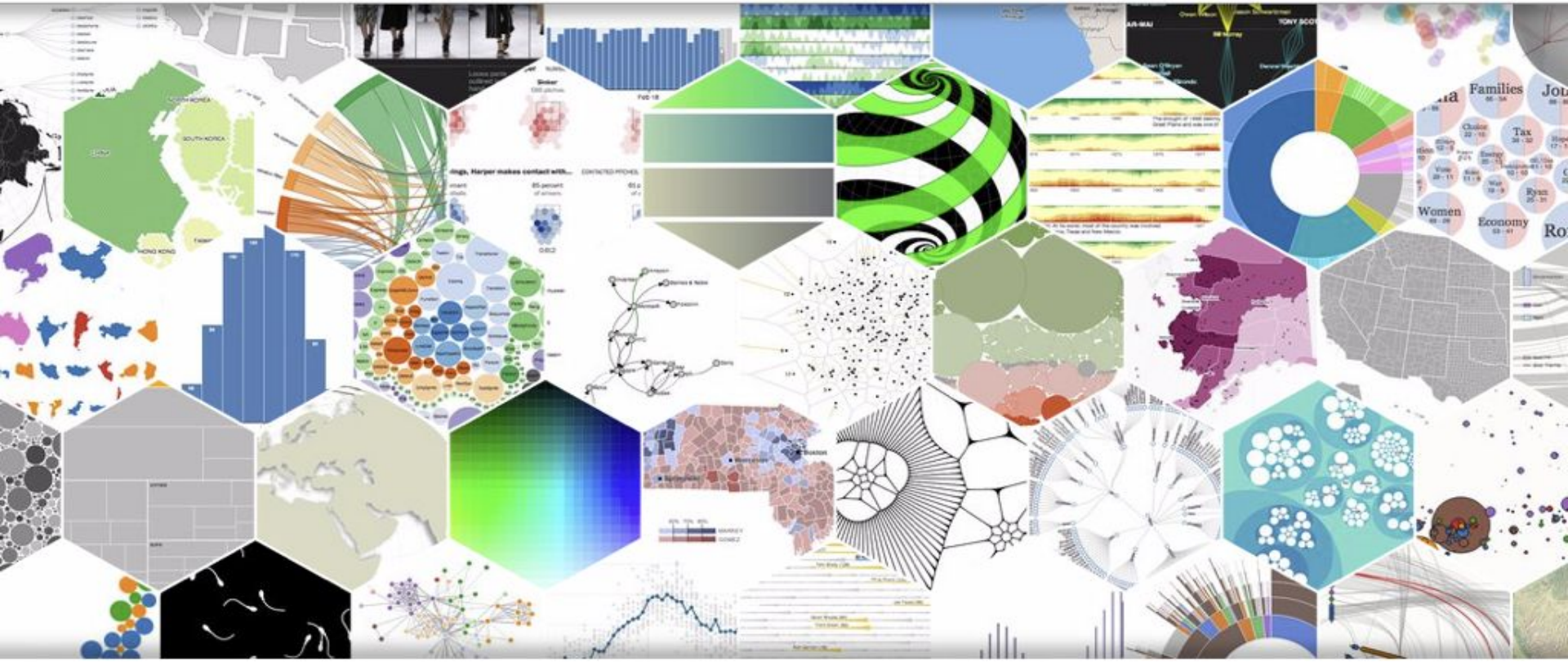


Time map (UK)
Made by Flourish team

Time map (world)
Made by Flourish team

JavaScript: **D3**

http://d3.js



Power BI

Gephi

polestar

Data Illustrator

Graphy

THE VISTORIAN
(BETA)

RAWGraphs

mapbox

Data-Driven Documents

Leaflet

Processing

i want hue

Charticulator

+ableau

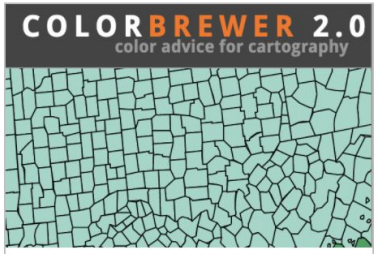
Bokeh

COLORBREWER 2.0
color advice for cartography

plotly

VISBROWSER ADD A TOOL ABOUT http://vistools.net Search

AVAILABILITY	PROGRAMMING SKILLS	PLATFORM	FEATURES	TYPE OF DATA	VISUALIZATION
34 Free	23 None	17 Apple	23 Web-publishing	33 Numeric	11 Networks
28 Open source	11 Javascript	20 Windows	26 File exports	25 Geographic	25 Maps
18 Paid	6 Python 2 Java	12 Linux 22 Web	10 Other	29 Temporal	32 Basic charts
	10 Other	8 Library	11 Wizard	12 Text 18 Other	17 Advanced charts

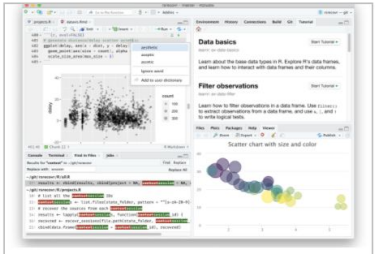


COLORBREWER

https://colorbrewer2.org/
Intended for use as a diagnostic tool for evaluating the robustness of individual colour schemes.

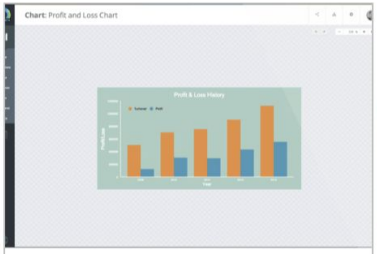
IWANTHUE

https://medialab.github.io/iwanthue/
Colors for data scientists. Generate and refine palettes of optimally...



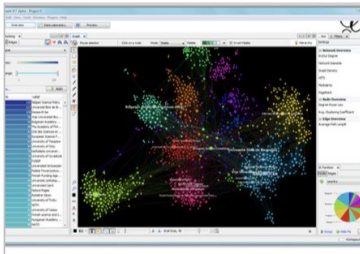
RSTUDIO

https://rstudio.com/
RStudio is an integrated development environment for R, a programming language for...



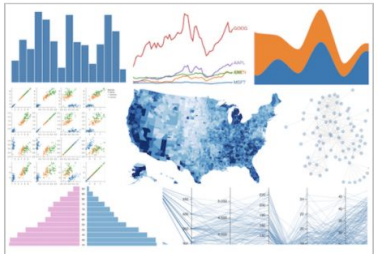
CHARTBLOCKS

https://www.chartblocks.com/en/
Build a chart in minutes in the easy to use chart designer, choosing from dozens of chart types and...



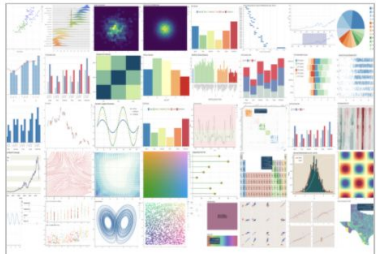
GEPHI

https://gephi.org/
Gephi is an open-source network analysis and visualization software package written in Java on the...



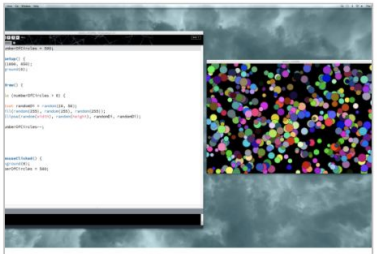
VEGA-LITE

https://vega.github.io/vega-lite/
Vega-Lite is a high-level grammar of interactive graphics. It provides a concise JSON syntax for rapidly...



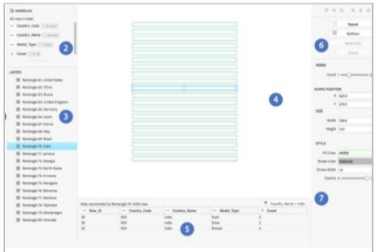
BOKEH

https://docs.bokeh.org/
Bokeh is an interactive visualization library for modern web browsers.



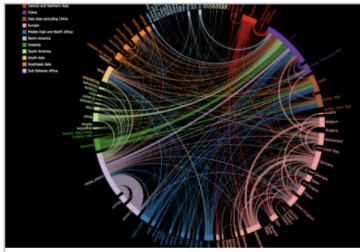
PROCESSING

https://processing.org/
Processing is a flexible software sketchbook and a language for learning how to code within the...



DATA ILLUSTRATOR

http://data-illustrator.com/
Create infographics and data visualizations without programming.



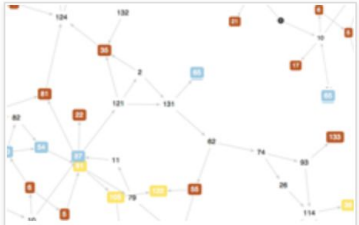
CHARTICULATOR

https://charticulator.com/index.html
Allows you to create bespoke chart designs without the need for any programming.

Datavisualization.ch

DATAVISUALIZATION.CH SELECTED TOOLS Sear

All Maps Charts Data Color

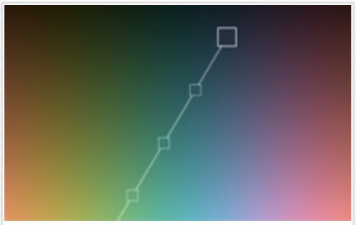


Arbor.js

A library of force-directed layout algorithms plus abstractions for graph organization and refresh handling.

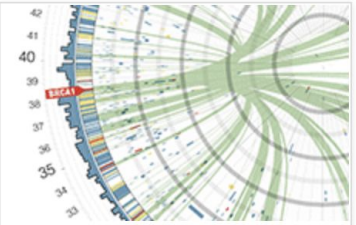
CartoDB

A web service for mapping, analyzing and building applications with data.



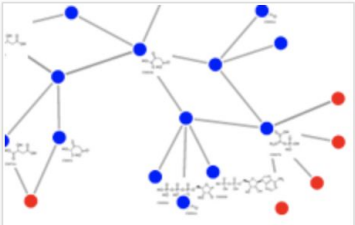
Chroma.js

Interactive color space explorer that allows to preview a set of linear interpolated equidistant colors.



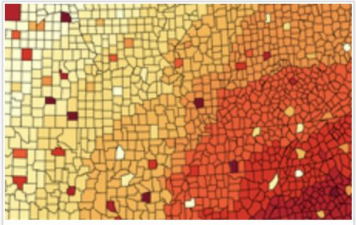
Circos

A software package for visualizing data in a circular layout.



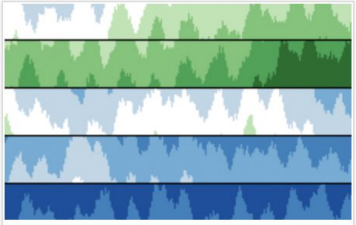
Cola.js

A library for arranging networks using constraint-based optimization techniques.



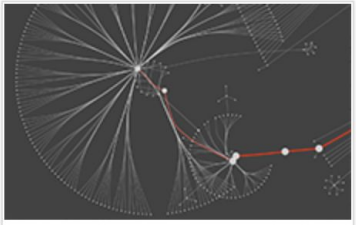
ColorBrewer

A web tool for selecting colors for maps.



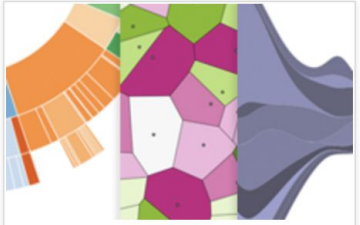
Cubism.js

A library for creating interactive time series and horizon graphs based on D3.js



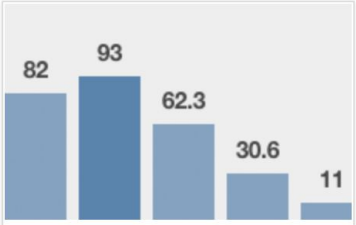
Cytoscape

An application for visualizing complex networks and integrating these with any type of attribute data.



D3.js

An small, flexible and efficient library to create and manipulate interactive documents based on data.

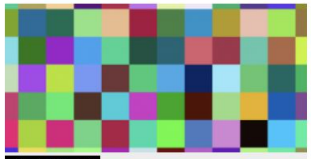


Dance.js

A simple data-driven visualization framework based on Data.js and Underscore.js

Andy Kirk

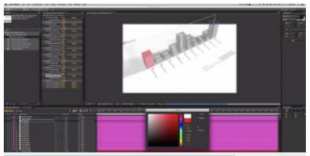
DATA HANDLING | APPLICATIONS | PROGRAMMING | WEB-BASED | QUALITATIVE | MAPPING | SPECIALIST | COLOUR


0 TO 255

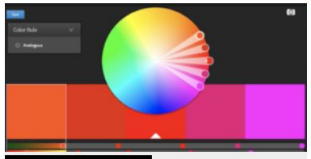
ABBYY

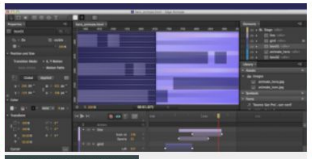
ABLE2EXTRACT

ADIOMA

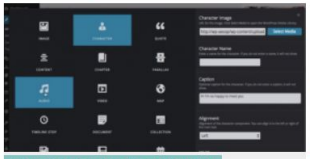

ADOBE AFTER EFFECTS

ADOBE ANIMATE


ADOBE COLOR


ADOBE EDGE

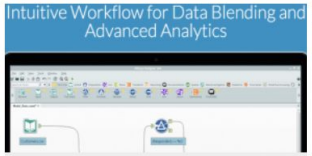
ADOBE ILLUSTRATOR


AESOP STORY ENGINE

AFFINITY DESIGNER

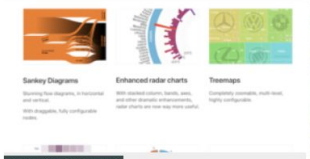
AFFINITY DESIGNER

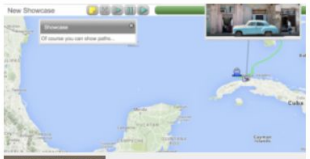
AI2HTML

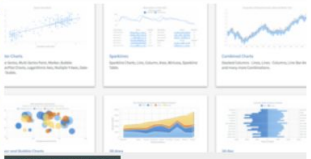


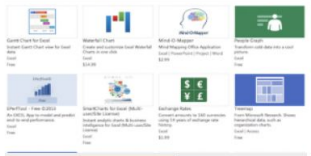
ALTERYX

AMAZON QUICKSIGHT

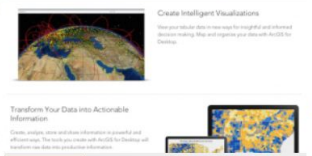

AMCHARTS


ANIMAPS


ANYCHART


APPS FOR EXCEL

ARBOR.JS

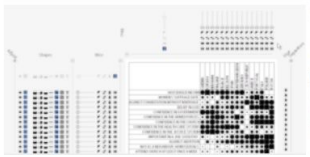


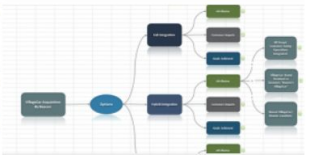
ARCGIS

AUTODRAW

AXURE

BALSAMIQ

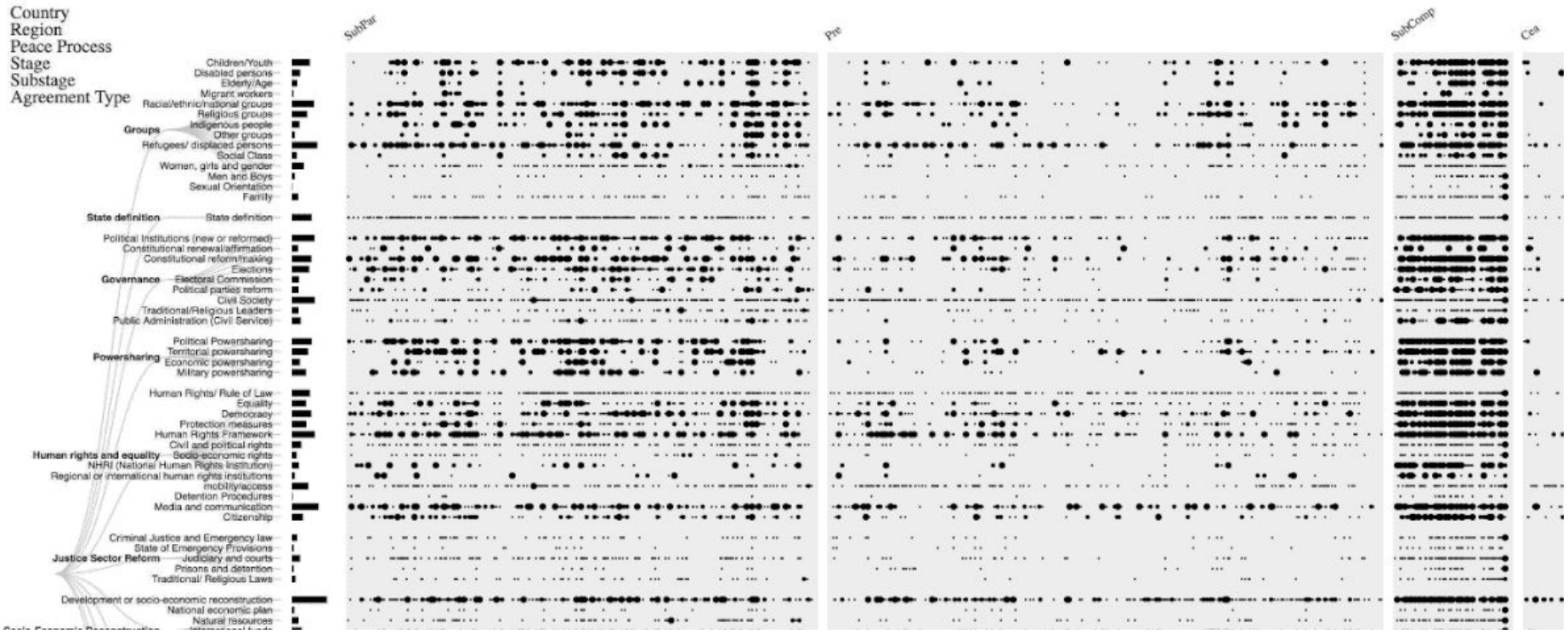




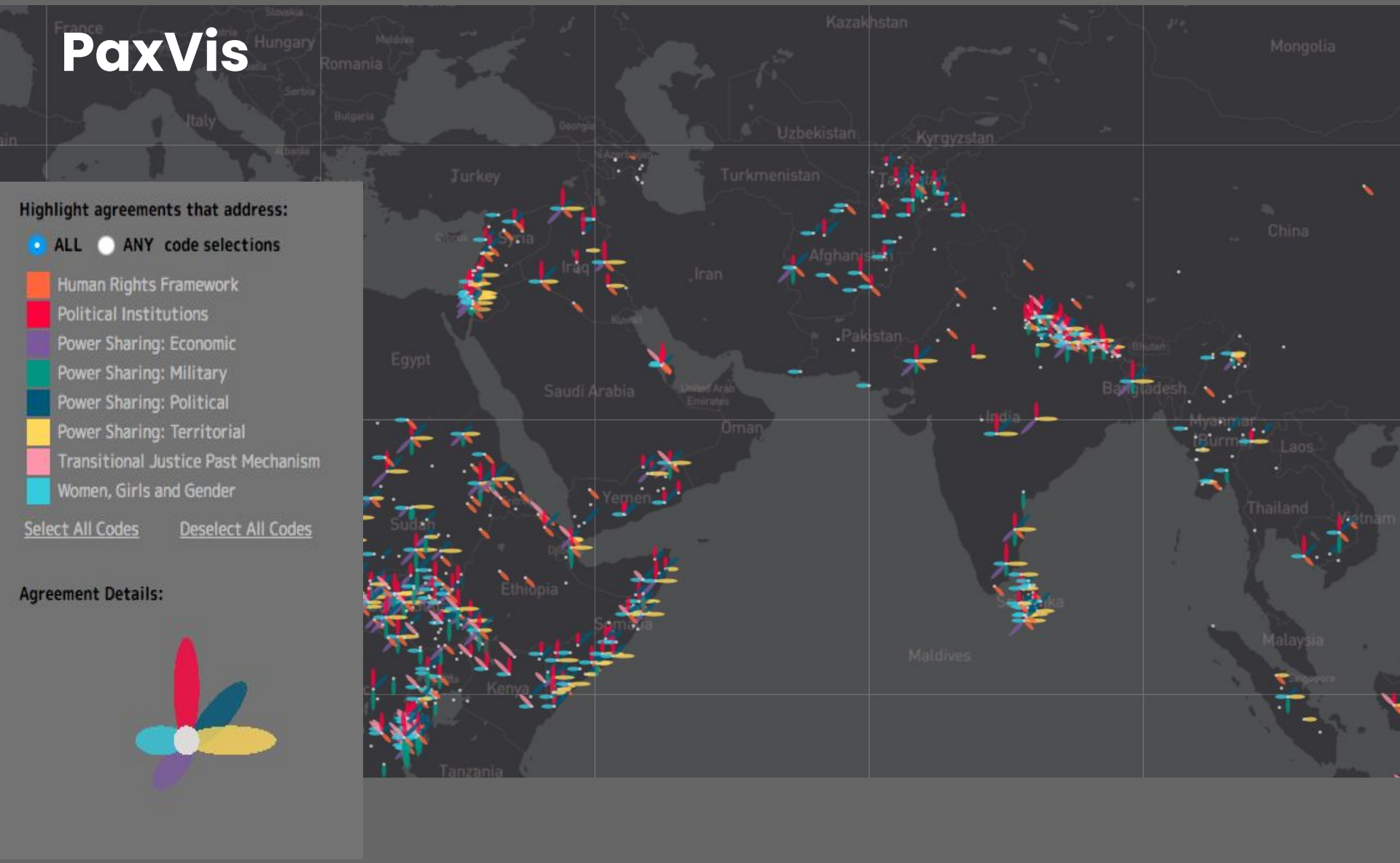
Visualization Scenarios

Exploration

Database exploration



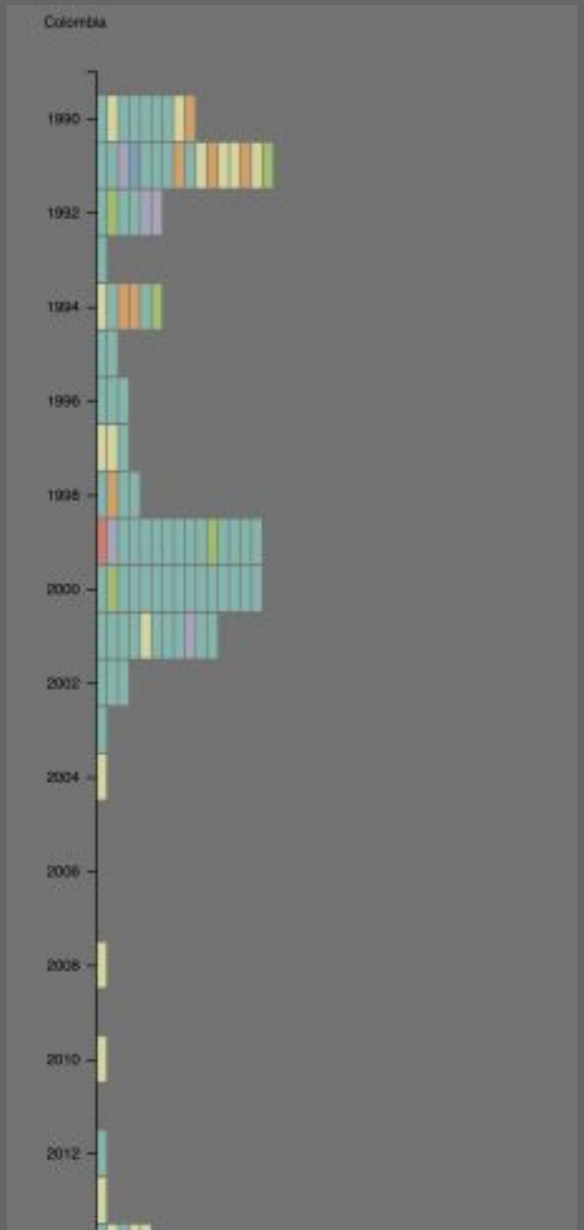
PaxVis



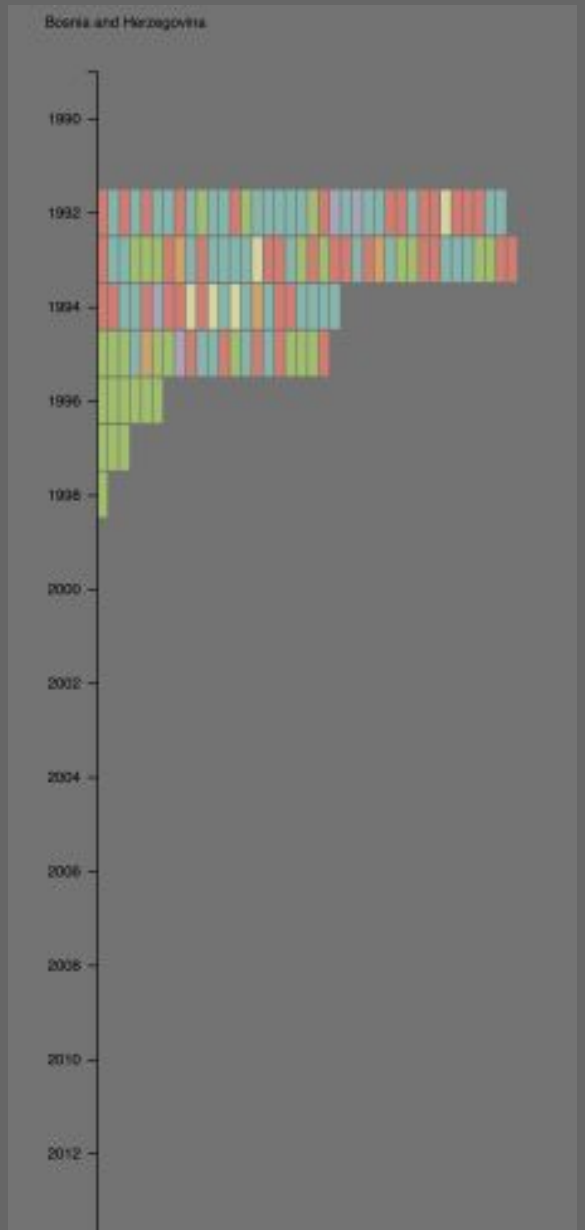
https://sarah37.github.io/pax/timeandspace/#

Havens, Lucy, et al. "Paxvis: Visualizing peace agreements." *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. 2019.

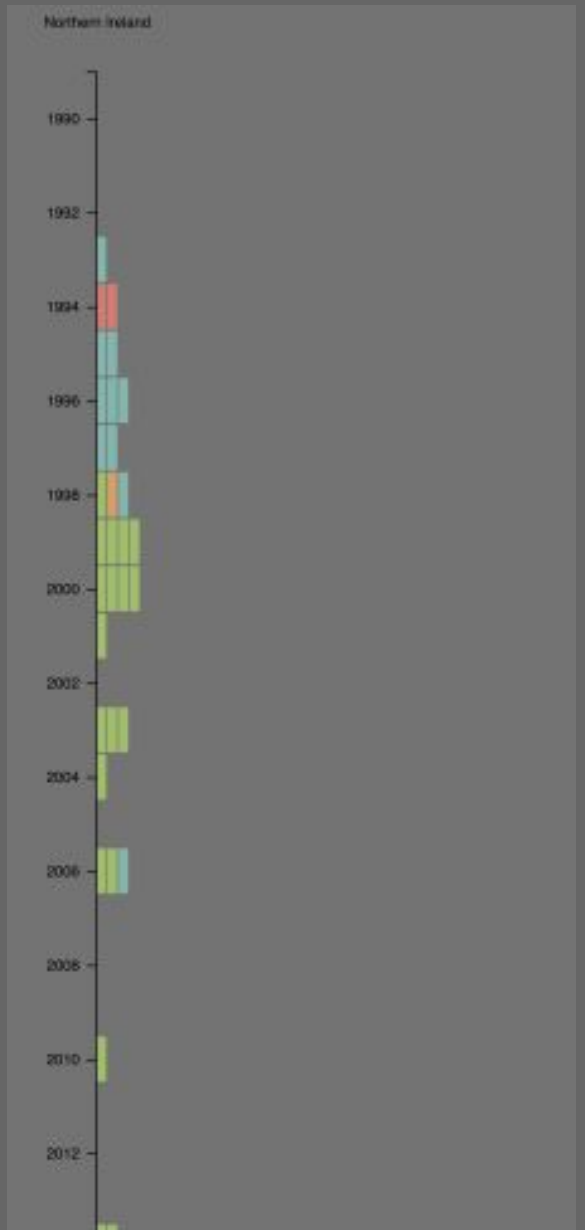
Columbia



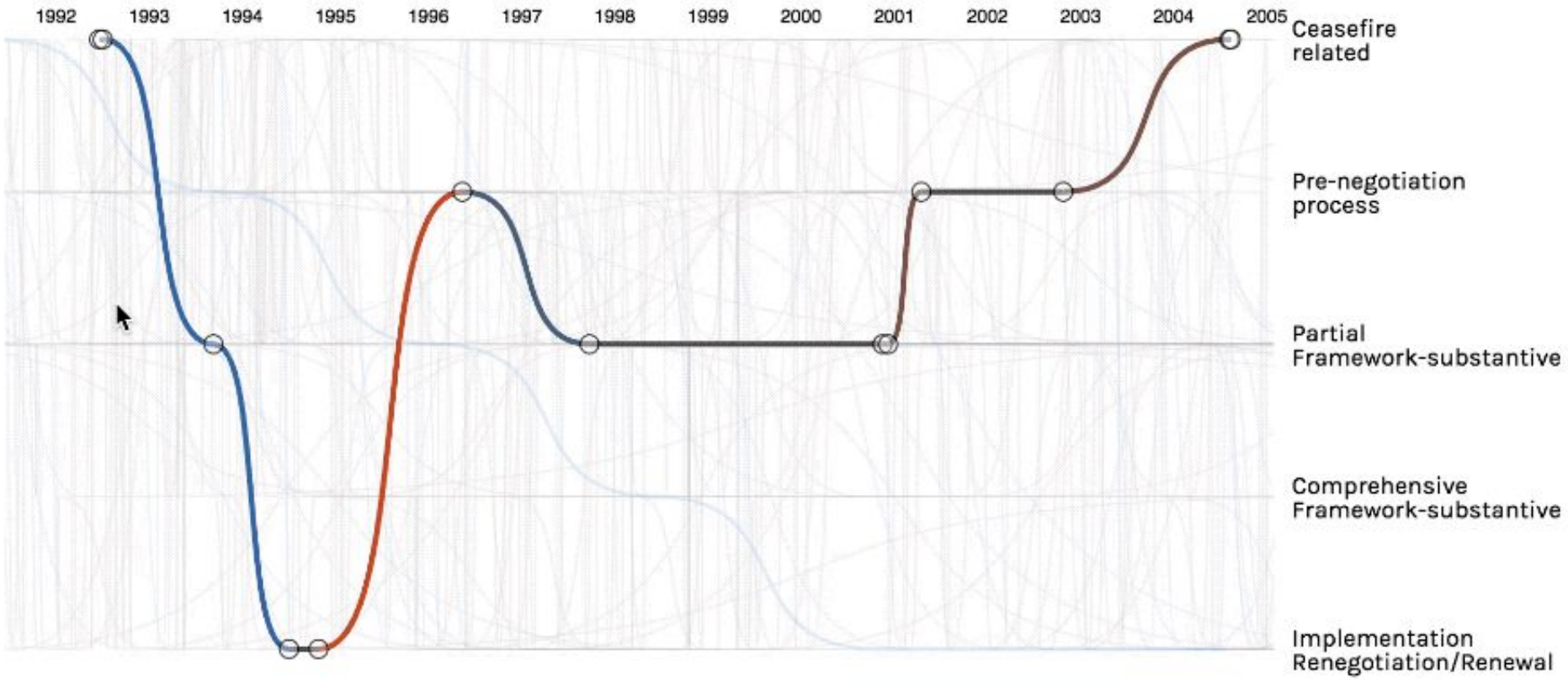
Bosnia and Herzegovina



Northern Ireland



Comparing Peace Processes



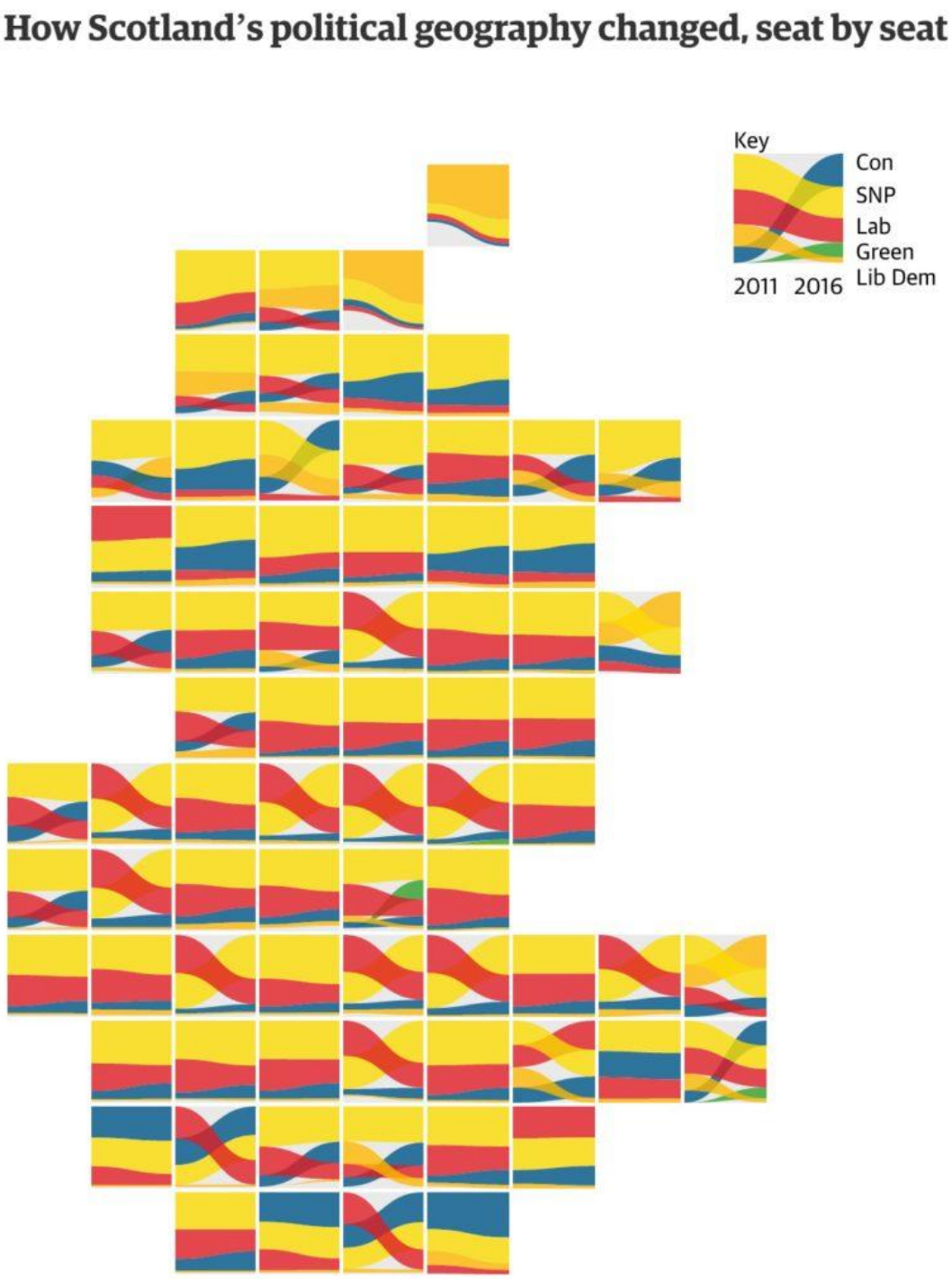
Peace Process

South Ossetia peace process

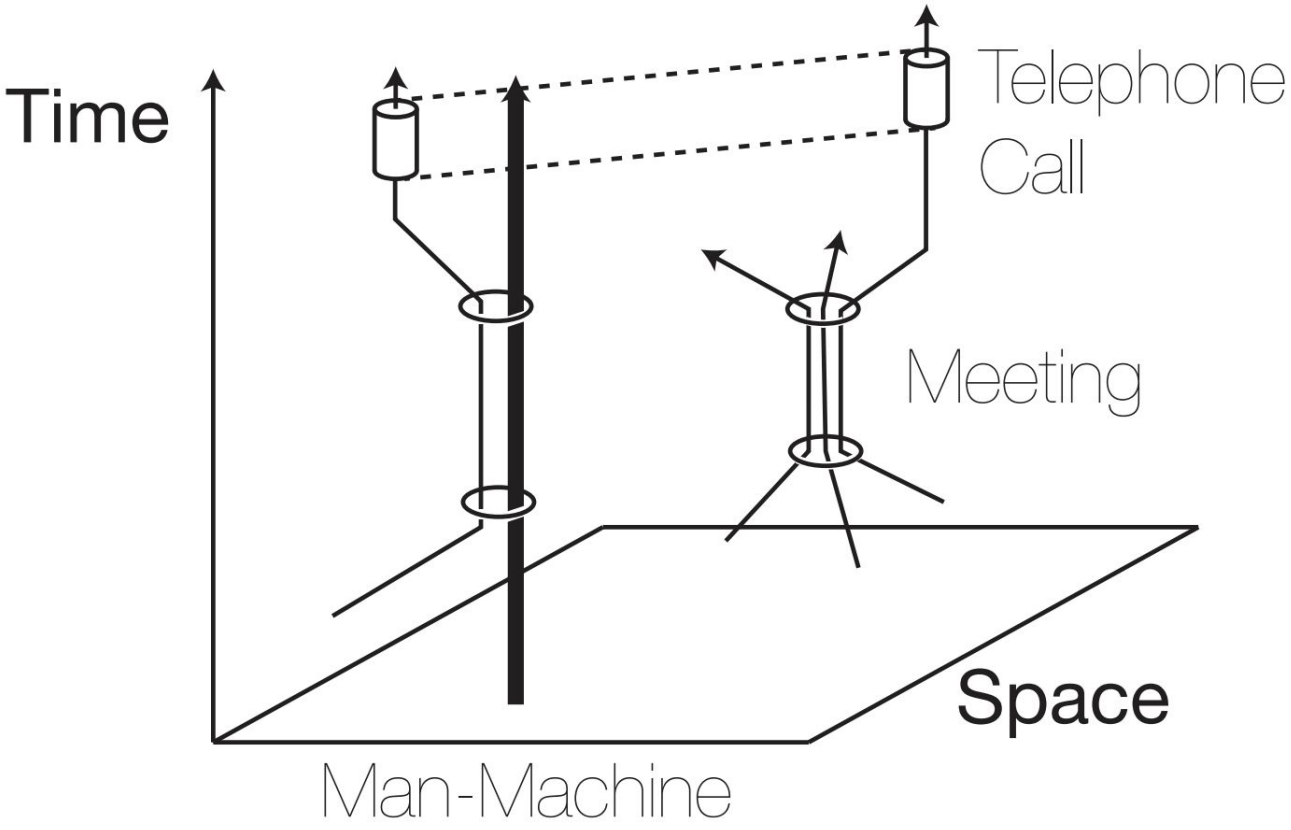
Agreement

Hover circle to select agreement

Overview


How Scotland's political geography changed, seat by seat
Key
Con
SNP
Lab
Green
Lib Dem
2011 2016

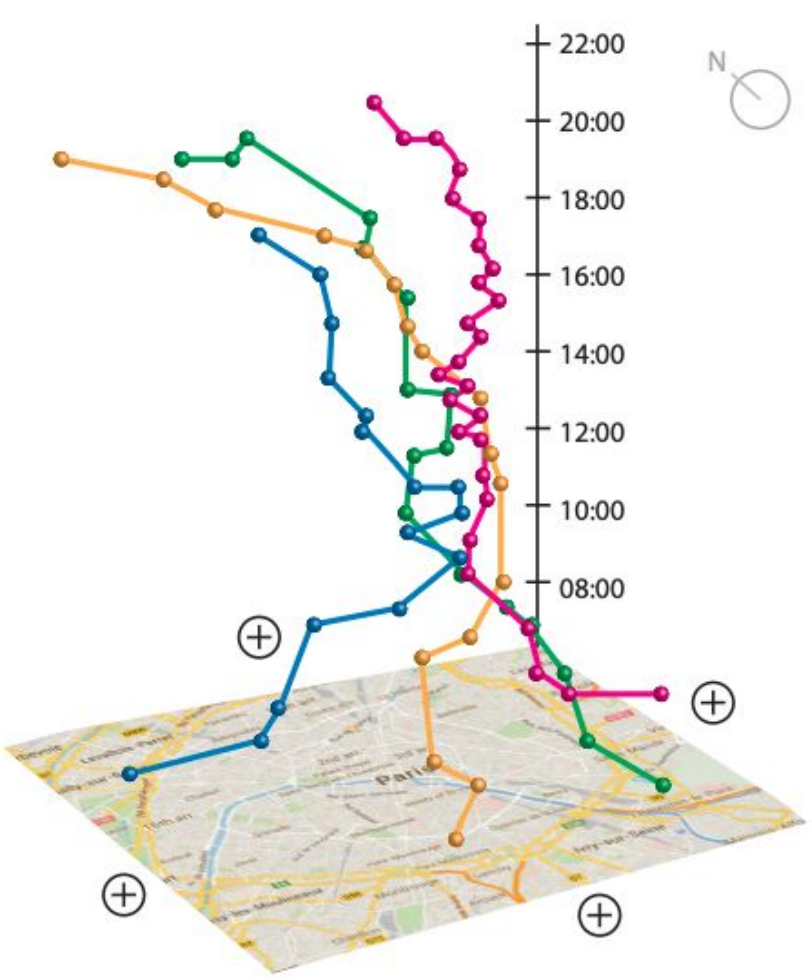
Space-Time Cubes



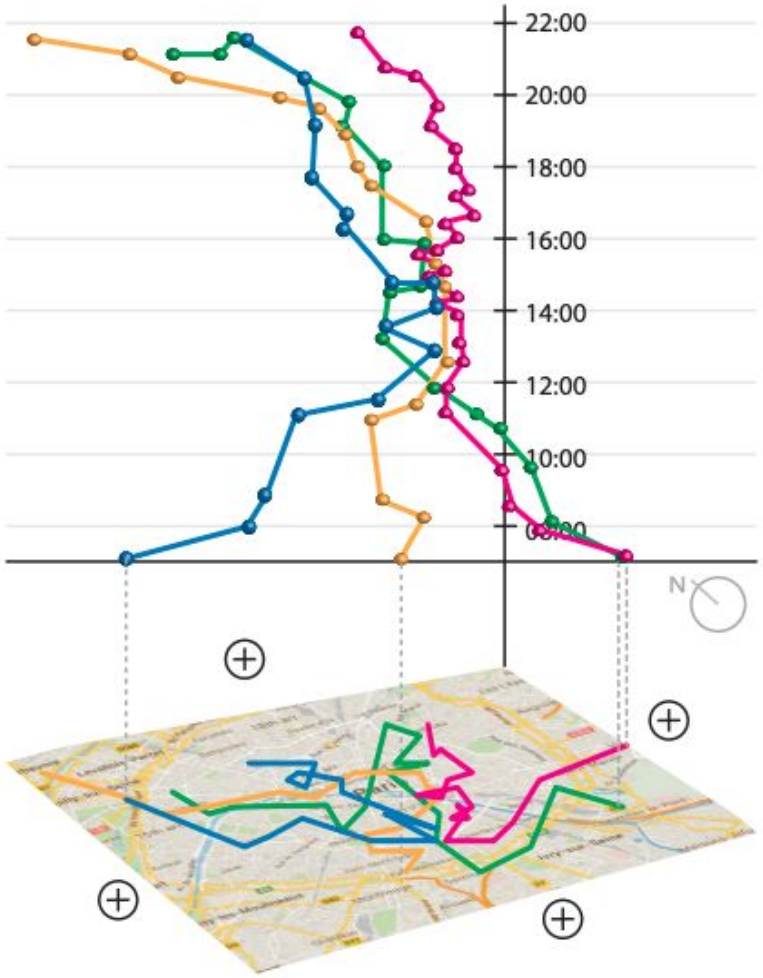
Ilägcrstrand, Torsten. "What about people in regional science?." *Papers of the Regional Science Association*. Vol. 24. 1970.

Kraak, Menno-Jan. "The space-time cube revisited from a geovisualization perspective." *Proc. 21st International Cartographic Conference*. Citeseer, 2003.

Space-Time Cubes

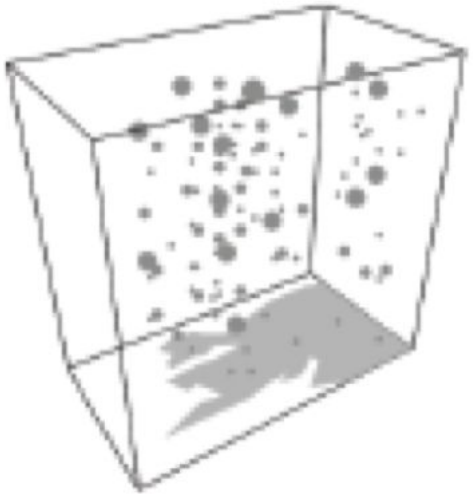


(a) 3D rendering

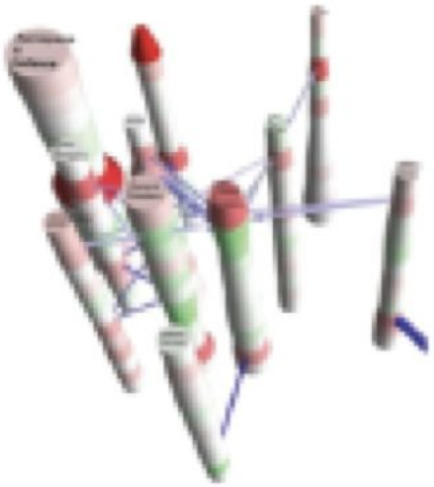


(b) Space flattening (on top)

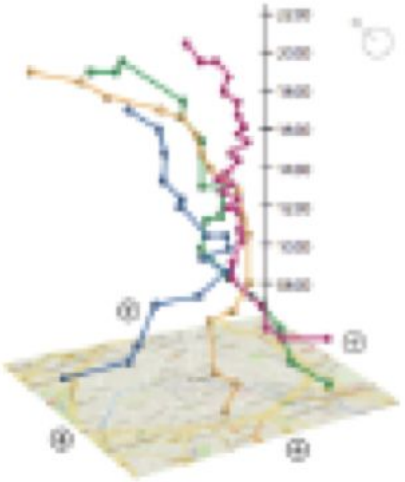
Space time cubes



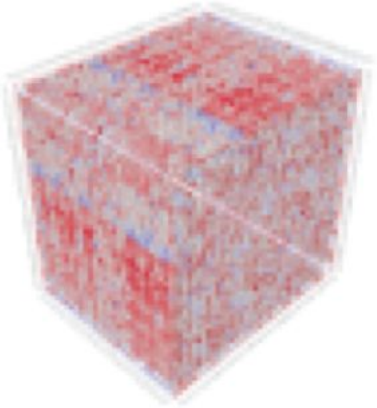
Earthquakes



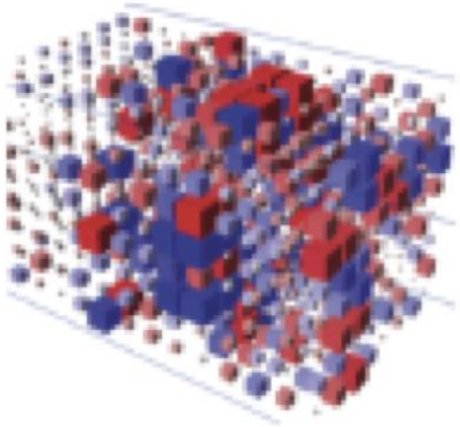
Finance network



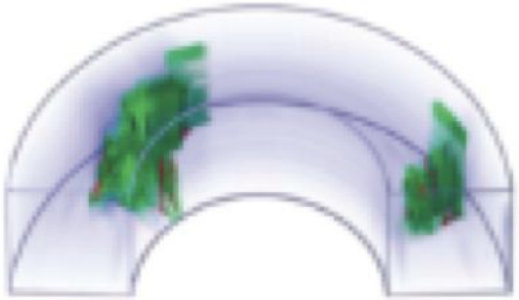
Person movement



Antenna communication



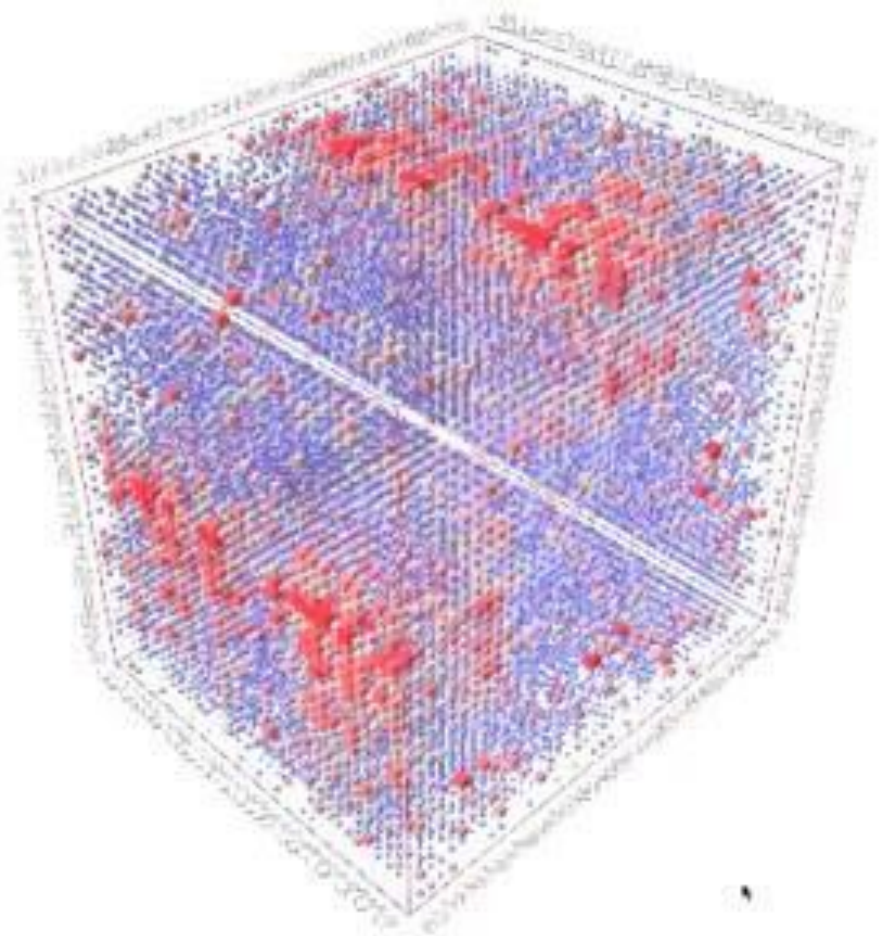
Brain connectivity



Surveillance video

Small Time Multiples

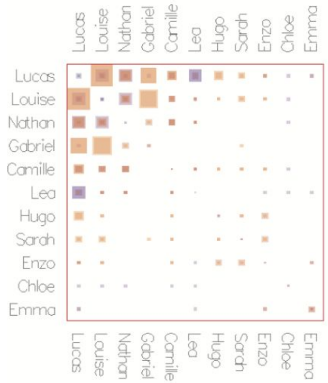
Dynamic graphs



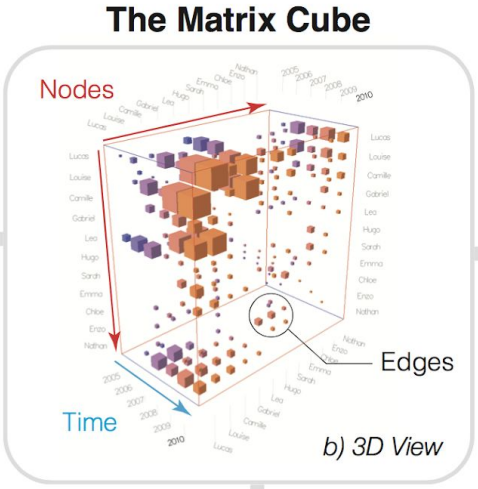
... in a consistent manner.

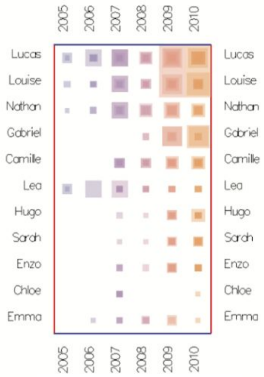
Bach, Benjamin, Emmanuel Pietriga, and Jean-Daniel Fekete. "Visualizing dynamic networks with matrix cubes." *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. ACM, 2014.

Matrix Cubes

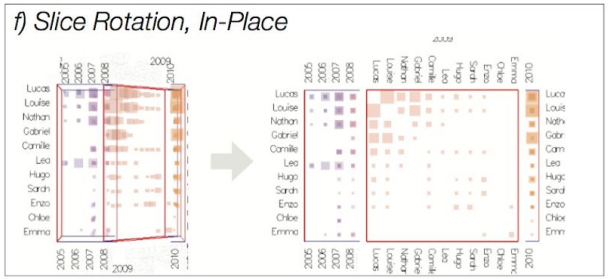


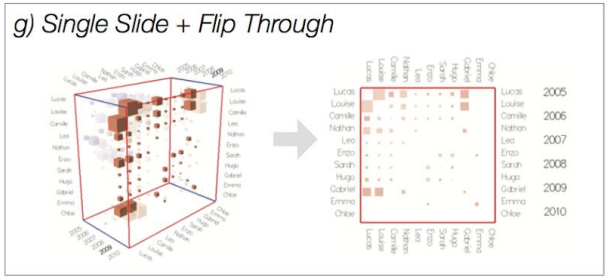
a) Rotation and Time Projection



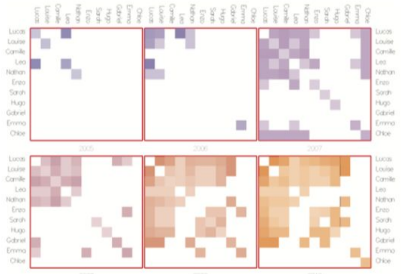


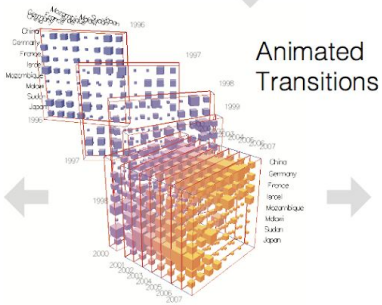
c) Rotation and Node Projection



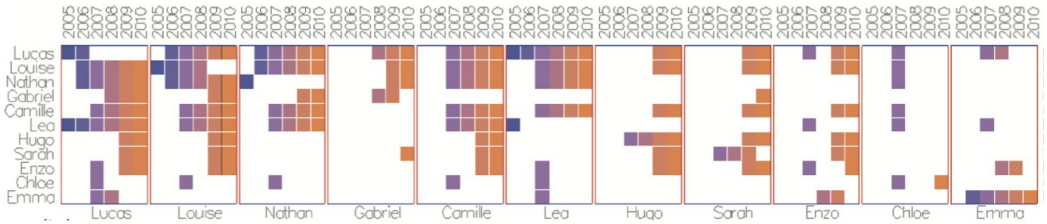


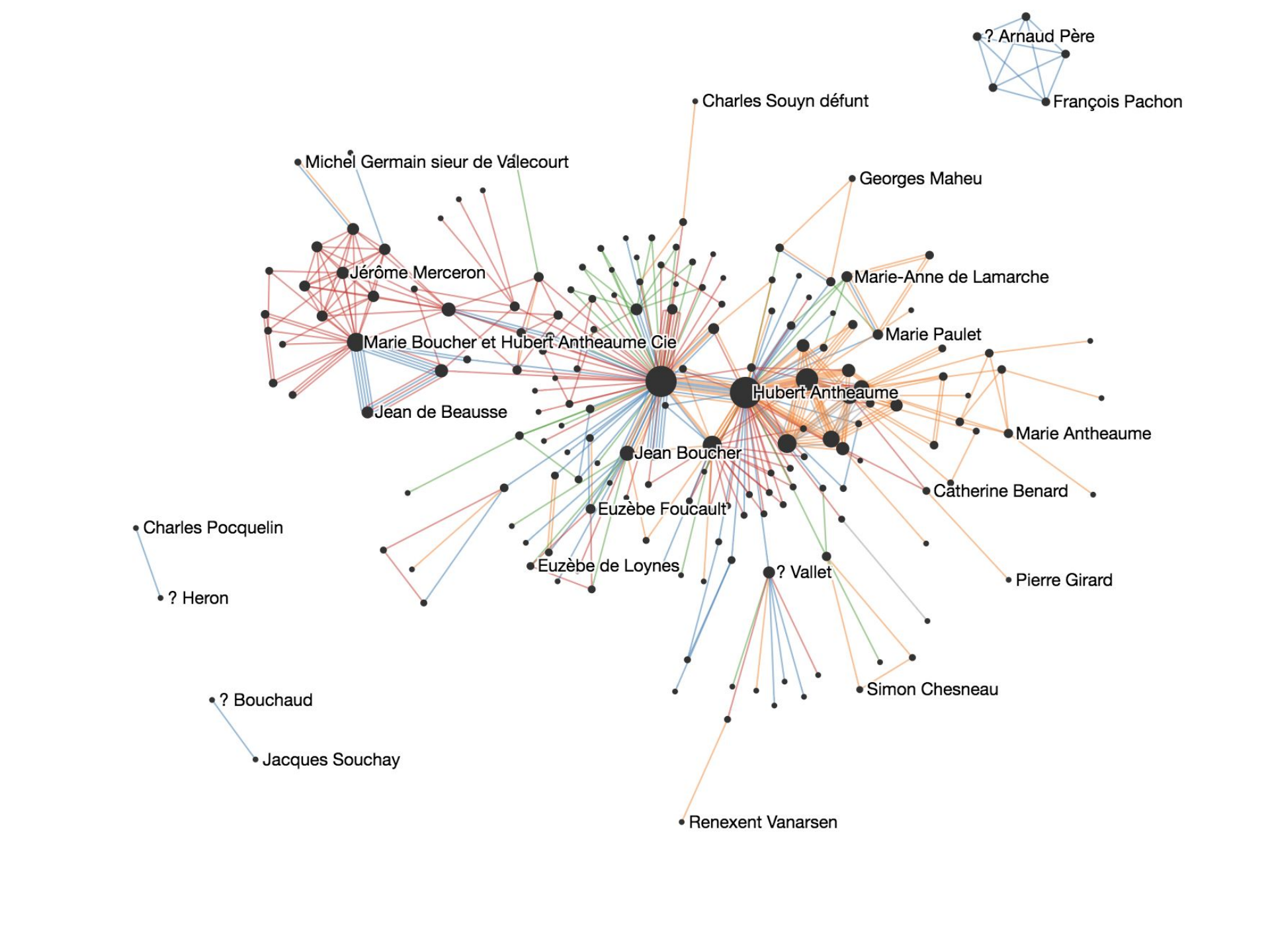
d) Time Small Multiples



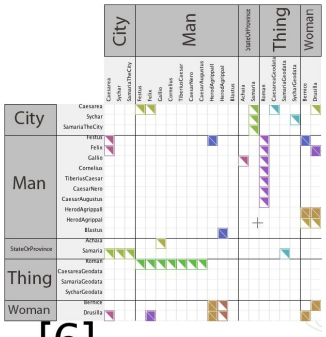


e) Node Small Multiples

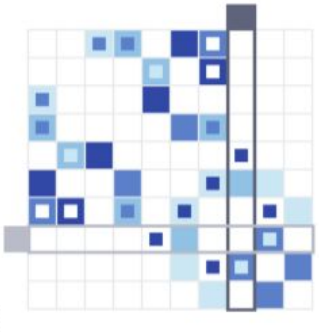


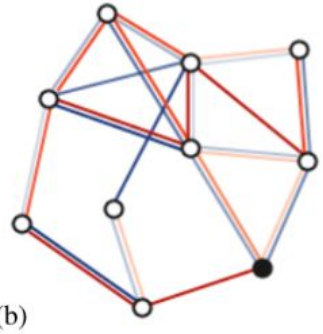

? Arnaud Père
François Pachon
Charles Souyn défunt
Michel Germain sieur de Valecourt
Georges Maheu
Jérôme Merceron
Marie-Anne de Lamarche
Marie Boucher et Hubert Antheaume Cie
Marie Paulet
Hubert Antheaume
Jean de Beausse
Marie Antheaume
Jean Boucher
Catherine Benard
Euzèbe Foucault
Charles Pocquelin
Euzèbe de Loynes
? Vallet
Pierre Girard
? Heron
Simon Chesneau
? Bouchaud
Jacques Souchay
Renexent Vanarsen

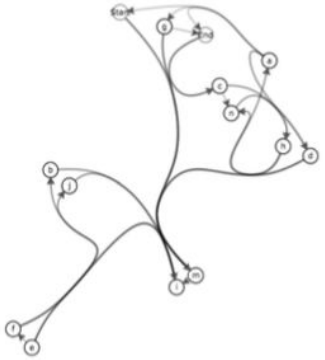
Ceci n'est pas un réseaux

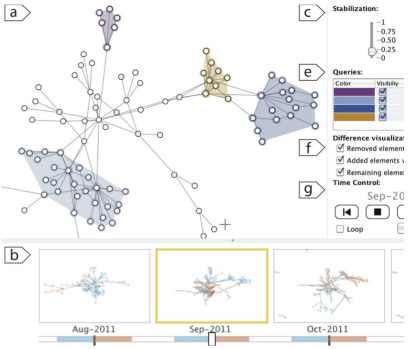

City
Man
Thing
Woman
Caesarea
Sychar
SamariaTheCity
Felix
Ida
Gallo
Cornelius
TiberiusCaesar
CaesarNero
CaesarAugustus
HerodAgrippaII
HerodAgrippa
Blastus
Achaia
StateOrProvince
Samaria
Roma
CaesareaGeodata
SamariaGeodata
SycharGeodata
Berea
Drusilla

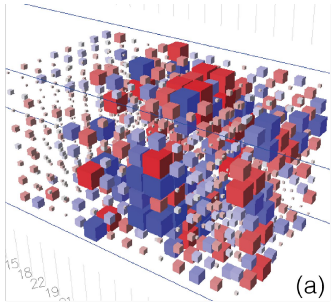
[6]

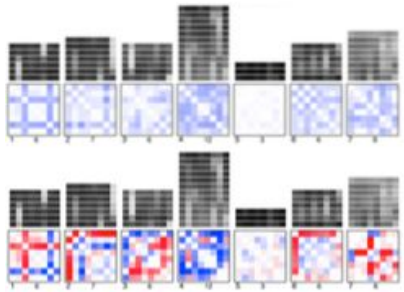

(a)

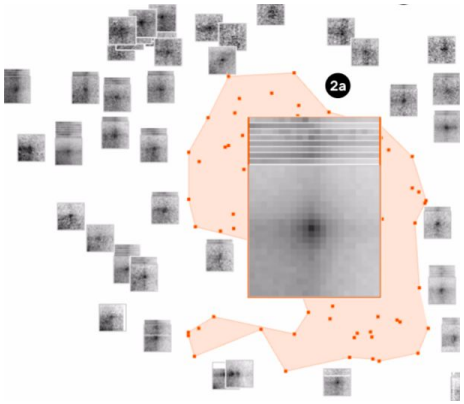

(b)

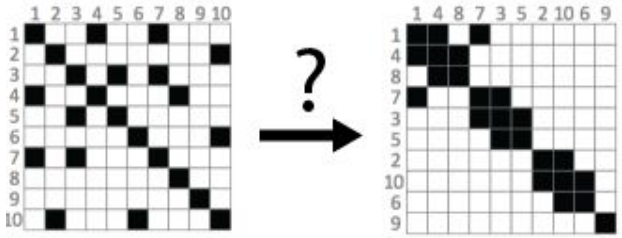


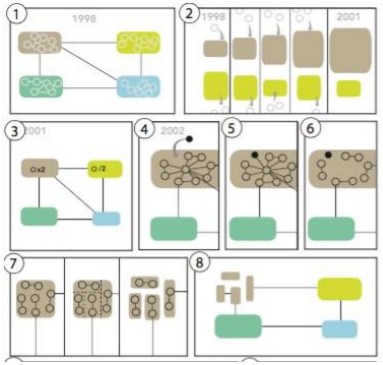

a
b
c
Stabilization:
e
Queries:
Color
Visibility
f
Difference visualiza
Removed element
Added elements
Remaining eleme
g
Time Control:
Loop
Aug-2011
Sep-2011
Oct-2011


(a)




2a

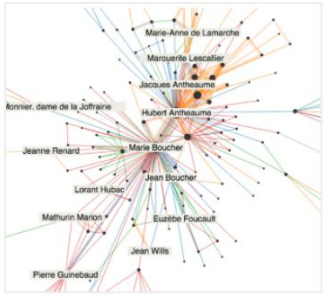

1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10
?
1 4 8 7 3 5 2 10 6 9
1 4 8 7 3 5 2 10 6 9

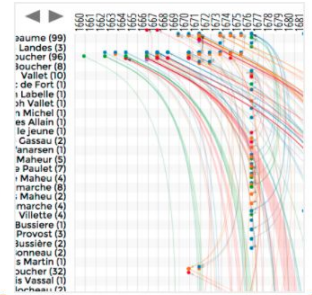

1
1998
2
1998
2001
3
2001
O×2
O/2
4
2002
5
6
7
8

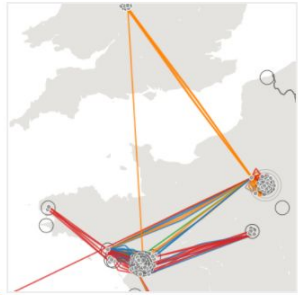
https://vistorian.net

The Vistorian (beta)

Interactive Visualizations for Dynamic and Multivariate Networks.
Free, online, and open source.



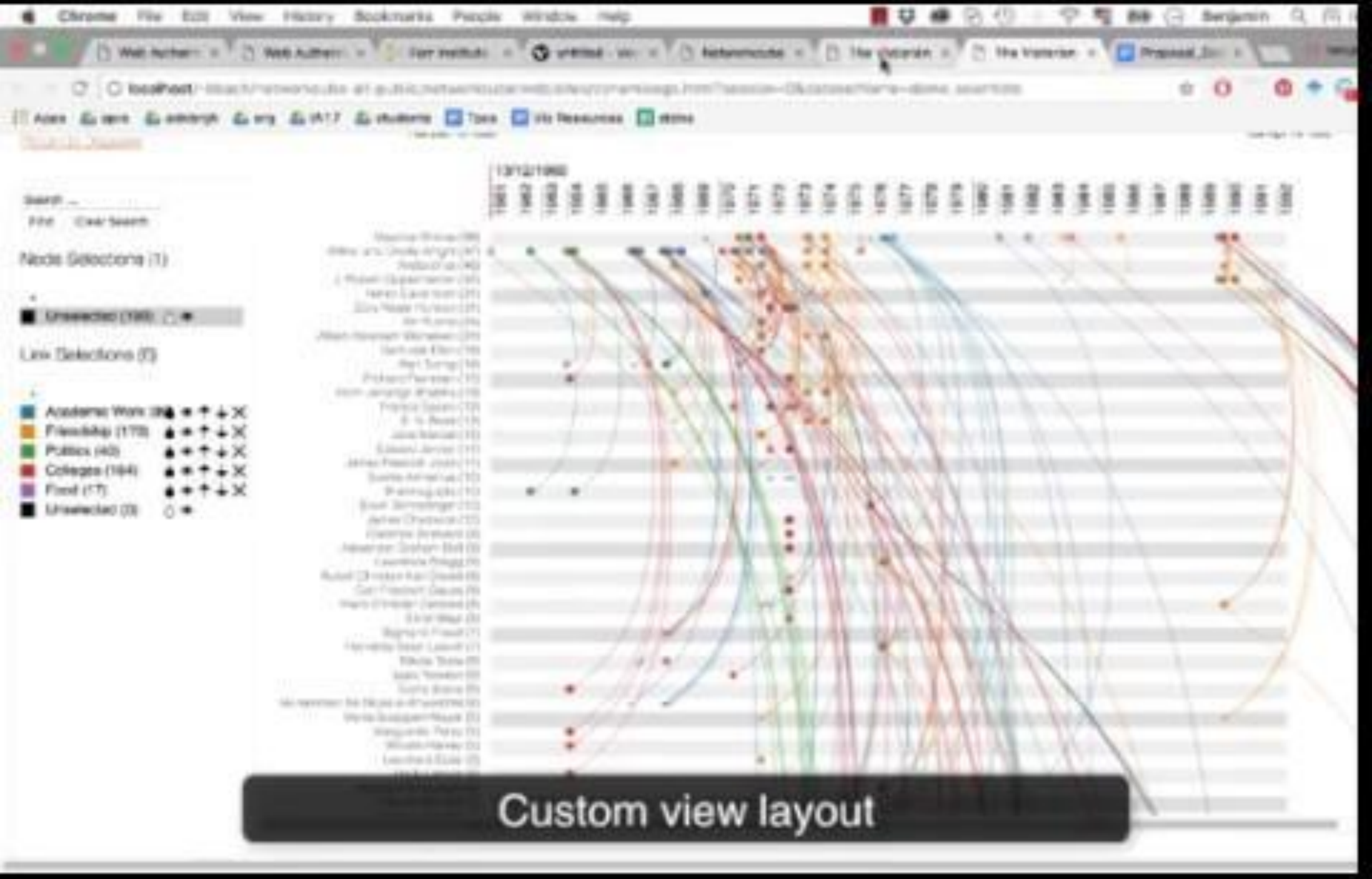




Visualizations Example Session Your Session

Manual Github Contact

The University of Edinburgh Microsoft Research - Inria Joint Centre Aviz Inria Microsoft Research


Node Selections (1)
Link Selections (5)
Academic Work (3)
Friendship (170)
Politics (40)
Colleges (164)
Food (17)
Unselected (3)
Custom view layout

GEOGRAPHIC NETWORK VISUALISATION

About • Poster • Read the abstract

Select filters:
61 techniques (show all)

Geography Representation

Map	Distorted Map	Abstract

Network Representation

Abstract Nodes & Explicit Edges	Abstract Nodes & Abstract Edges
Explicit Nodes & Explicit Edges	Explicit Nodes & Abstract Edges

Integration

Geography as Basis	Balanced	Network as Basis

Interaction

No Interaction	Optional Interaction
Required Interaction	Interaction Technique

Origin-Destination Flow Maps in Immersive Environments

Yang, Y.; Dwyer, T.; Jenny, B.; Marriott, K.; Cordeil, M.; Chen, H. (2019) [DOI Link]

map explicit-explicit base-geo required-interaction

Revealing Patterns and Trends of Mass Mobility Through Spatial and Temporal Abstraction of Origin-Destination Movement Data

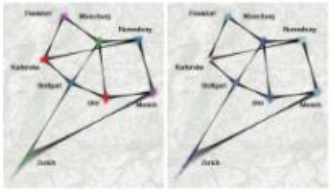
Andrienko, G.; Andrienko, N.; Fuchs, G.; Wood, J. (2017) [DOI Link]

map abstract-abstract base-geo optional-interaction

Visual Abstraction of Large Scale Geospatial Origin-Destination Movement Data

Zhou, Z.; Meng, L.; Tang, C.; Zhao, Y.; Guo, Z.; Hu, M.; Chen, W. (2019) [DOI Link]

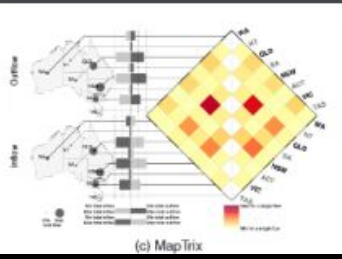
map abstract-abstract balanced required-interaction



Probabilistic Graph Layout for Uncertain Network Visualization

Schulz, C.; Nocaj, A.; Goertler, J.; Deussen, O.; Brandes, U.; Weiskopf, D. (2017) [DOI Link]

map explicit-explicit base-geo no-interaction



Animated Edge Textures in Node-Link Diagrams: A Design Space and Initial Evaluation

Romat, Hugo; Appert, Caroline; Bach, Benjamin; Henry-Riche, Nathalie; Pietriga, Emmanuel (2018) [DOI Link]

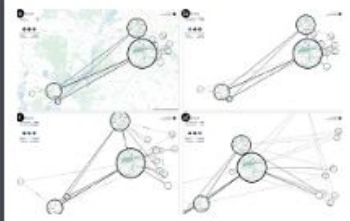
map explicit-explicit base-geo no-interaction

Module-based visualization of large-scale graph network data

Li, Chenhui; Baciu, George; Wang, Yunzhe (2017) [DOI Link]

map abstract-explicit balanced required-interaction

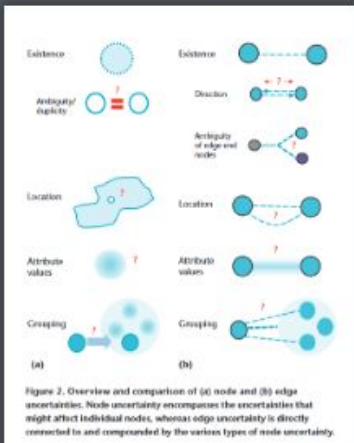
FFTEB: Edge bundling of huge graphs by the Fast Fourier Transform



Shifted Maps: Revealing spatio-temporal topologies in movement data

Otten, Heike; Hildebrand, Lennart; Nagel, Till; Dörk, Marian; Müller, Boris (2018) [DOI Link]

map abstract-explicit balanced required-interaction



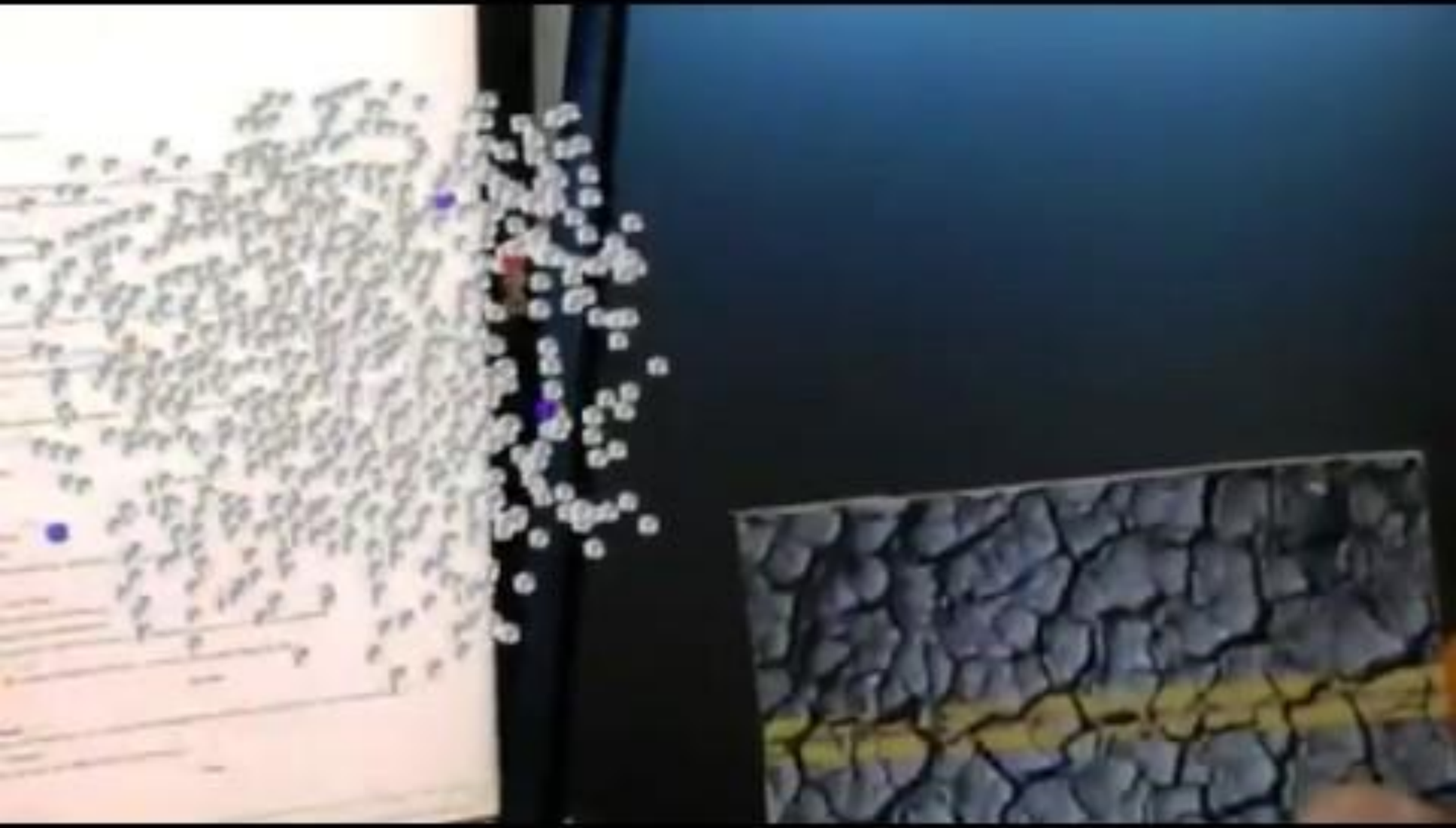
Typology of Uncertainty in Static Geolocated Graphs for Visualization

Landesberger, T. von; Bremm, S.; Wunderlich, M. (2017) [DOI Link]

map explicit-explicit base-geo no-interaction

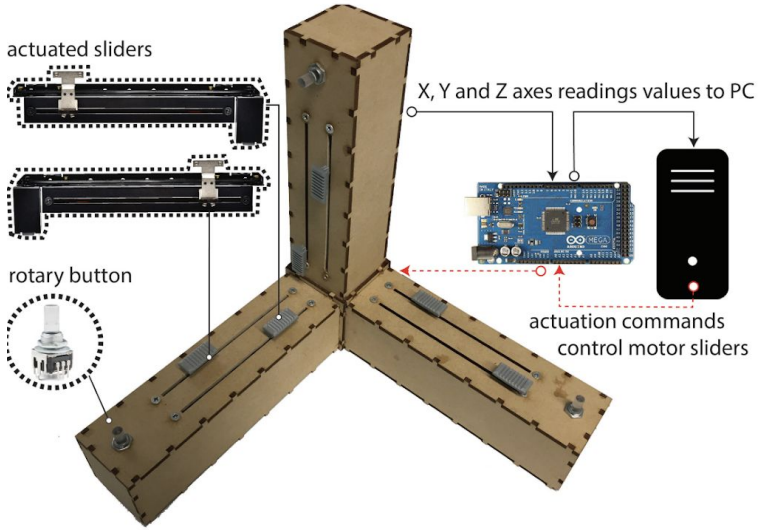
http://geographic-networks.github.io/

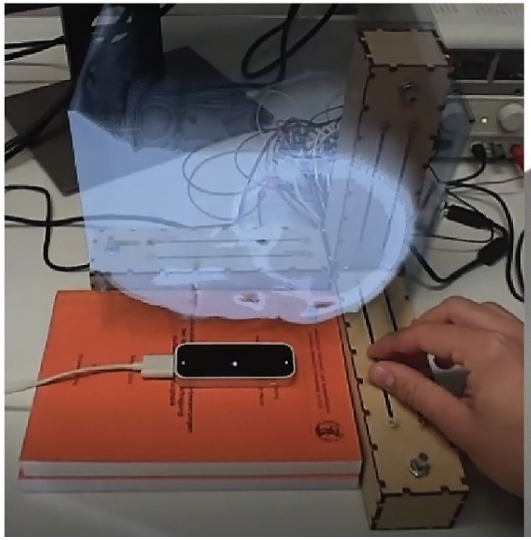
Bach, Benjamin, et al. "The hologram in my hand: How effective is interactive exploration of 3D visualizations in immersive tangible augmented reality?." *IEEE transactions on visualization and computer graphics* 24.1 (2017): 457-467.

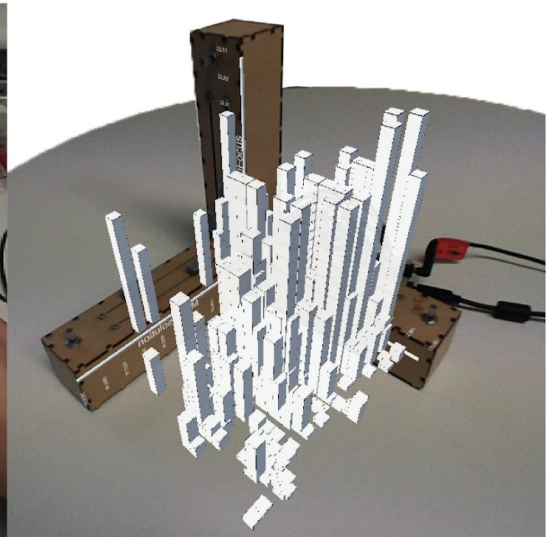


Satriadi, K.A., Ens, B., Cordeil, M., Czauderna, T. and Jenny, B., 2020. Maps around me: 3D multiview layouts in immersive spaces. *Proceedings of the ACM on Human-Computer Interaction*, *4*(ISS), pp.1-20.

Tangible Exploration in AR







Cordeil et al.: "Embodied Axes: Tangible, Actuated Interaction for 3D Augmented Reality Data Spaces" ACM Conference on Human Factors in Computing Systems (CHI)

Cordeil, Maxime, et al. "Design space for spatio-data coordination: Tangible interaction devices for immersive information visualisation." *2017 IEEE Pacific Visualization Symposium (PacificVis)*. IEEE, 2017.

https://www.youtube.com/watch?v=An42HSbi7IE&feature=youtu.be

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

Immersion

Exploration

Overview

Hypothesis generation

Asking Questions

Iteration

Multiple views

New forms

Interaction

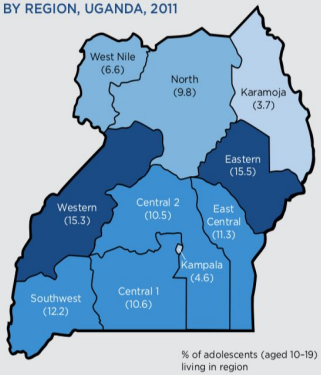
Immersion

Explanation

physical, social, political, and economic structures of a region can place residents at varying risks for vulnerability. Areas susceptible to violence or natural disaster pose clear threats to individuals. An individual's environment also affects his or her development and behavioral choices. Resources available in the physical and social environments create the contexts within which decisions are made about health, education, and employment. Political and social environments also dictate whether resources are accessible to all adolescents. An examination of the residential distribution of adolescents provides a baseline for comparing geographical patterns of vulnerability. Within Uganda, by type of residence, the majority of adolescents (87 percent) live in rural versus urban areas. Figure 6 shows the distribution of adolescents aged 10 to 19 living in Uganda. Regional distributions show Karamoja contains only four percent of the adolescent population. Kampala with a much denser population contains 4.6 percent of the population. The Eastern and Western regions contain the largest proportions of the adolescent population.

FIGURE 6

PROPORTION OF ADOLESCENTS AGED 10-19 BY REGION, UGANDA, 2011



Source: DHS 2011.

Household factors influencing vulnerability

Household-level factors have direct impacts on the well-being of adolescents. Households are the primary setting where adolescents live and engage in activities. For this reason, the household environment and the people who live there have significant impacts on the lives of adolescents. Physical conditions of the home influence the health of residents. Family structures and demographic characteristics of household members affect the knowledge, decisions, behaviors and interactions in the environment of the adolescent.

Access to improved water sources and sanitation

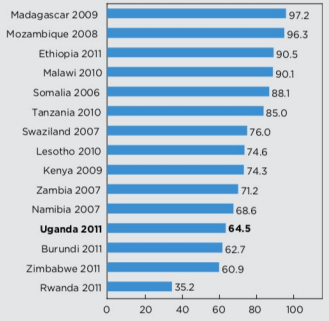
Unsafe water, inadequate sanitation, and poor hygiene are among the five leading risk factors responsible for one quarter of all deaths in the world (WHO 2009). Unsafe water supplies and inadequate sanitation in homes increase exposure to water-borne diseases and can cause diarrhea. Ensuring access to clean water sources and sanitation is key to maintaining hygiene and health. Improved water sources are those that either naturally protect water from contamination or are constructed to do so. These include piped water, public taps, standpipes, boreholes, tube wells, protected wells and springs, and rainwater collection. Improved sanitation includes constructs and systems that prevent fecal contamination. These include flush or pour toilets, ventilated pit latrines, pit latrines with slabs, and composting toilets (UNICEF 2013b).

Housing conditions across East and Southern Africa are largely in need of improvement, and lack of improved sanitation varies by country. In nearly all of East and Southern Africa, over half of adolescents either do not have improved sanitation or share facilities with other households. Conditions are worst in Madagascar and Mozambique where fewer than four percent of adolescents live in households with improved sanitation that is not shared (Figure 7). Rwanda has the lowest proportion of adolescents affected—35 percent—which is still unacceptably high. Lack of access to improved water sources affects lower proportions but is still a problem in the region. In five countries, fewer than half of adolescents have access to improved water sources (Figure 8). Water conditions are best in Namibia, where only 15 percent of adolescents have no access to improved water.

In Uganda, overall access to improved water and sanitation increased by a small but significant percentage between 2006 and 2011 (Figure 9). In 2006, 33 percent of adolescents had no access to improved water; in 2011, it is 30 percent. The proportion of adolescents without access to improved

FIGURE 7

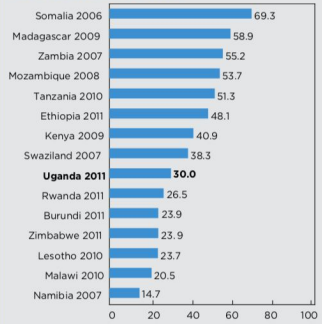
PERCENT OF ADOLESCENTS AGED 10-19 LIVING IN HOUSEHOLDS WITH NO IMPROVED OR WITH SHARED SANITATION, EAST AND SOUTHERN AFRICA



Source: DHS 2007-2011; MICS 2006-2008.

FIGURE 8

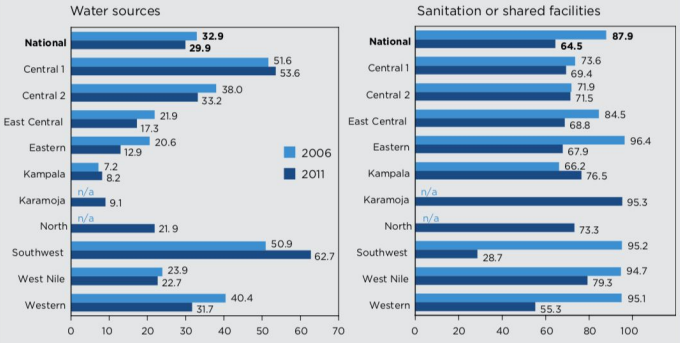
PERCENT OF ADOLESCENTS AGED 10-19 LIVING IN HOUSEHOLDS WITH NO IMPROVED WATER SOURCE, EAST AND SOUTHERN AFRICA



Source: DHS 2007-2011; MICS 2006-2008.

FIGURE 9

PERCENT OF ADOLESCENTS AGED 10-19 LIVING IN HOUSEHOLDS WITHOUT ACCESS TO IMPROVED WATER AND WITHOUT ACCESS TO IMPROVED OR WITH SHARED SANITATION, IN UGANDA, BY REGION, 2006 AND 2011

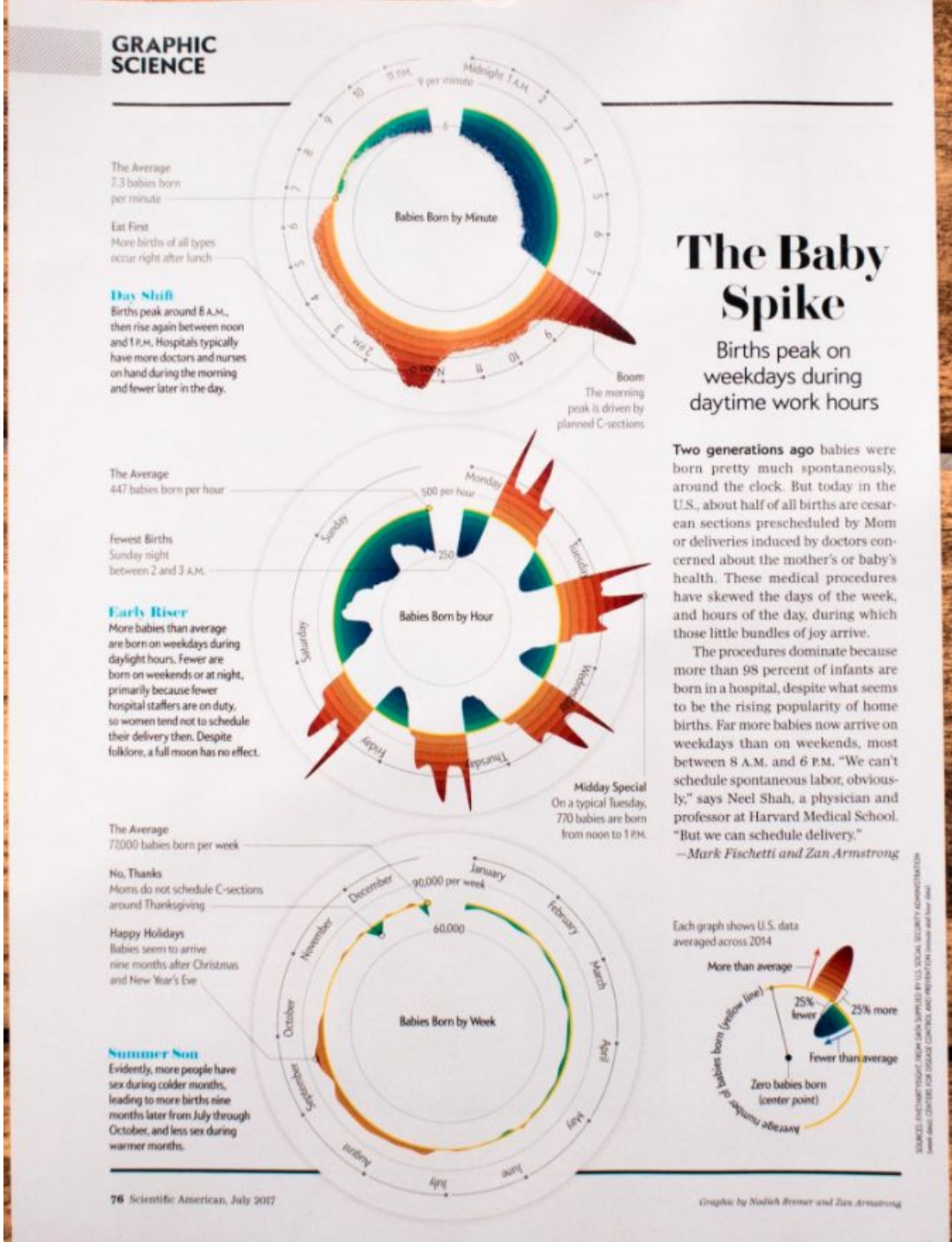


Source: DHS 2006 and 2011.
Note: Changes to the geographic boundaries were made to the North region in the 2011 DHS. The 2006 DHS North region is now divided into the North and Karamoja. For this reason, rates for 2006 are not shown for the North since it is not comparable and Karamoja was not identified in the previous survey.

Wang, Zezhong, et al. "Comparing Effectiveness and Engagement of Data Comics and Infographics." *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, 2019.

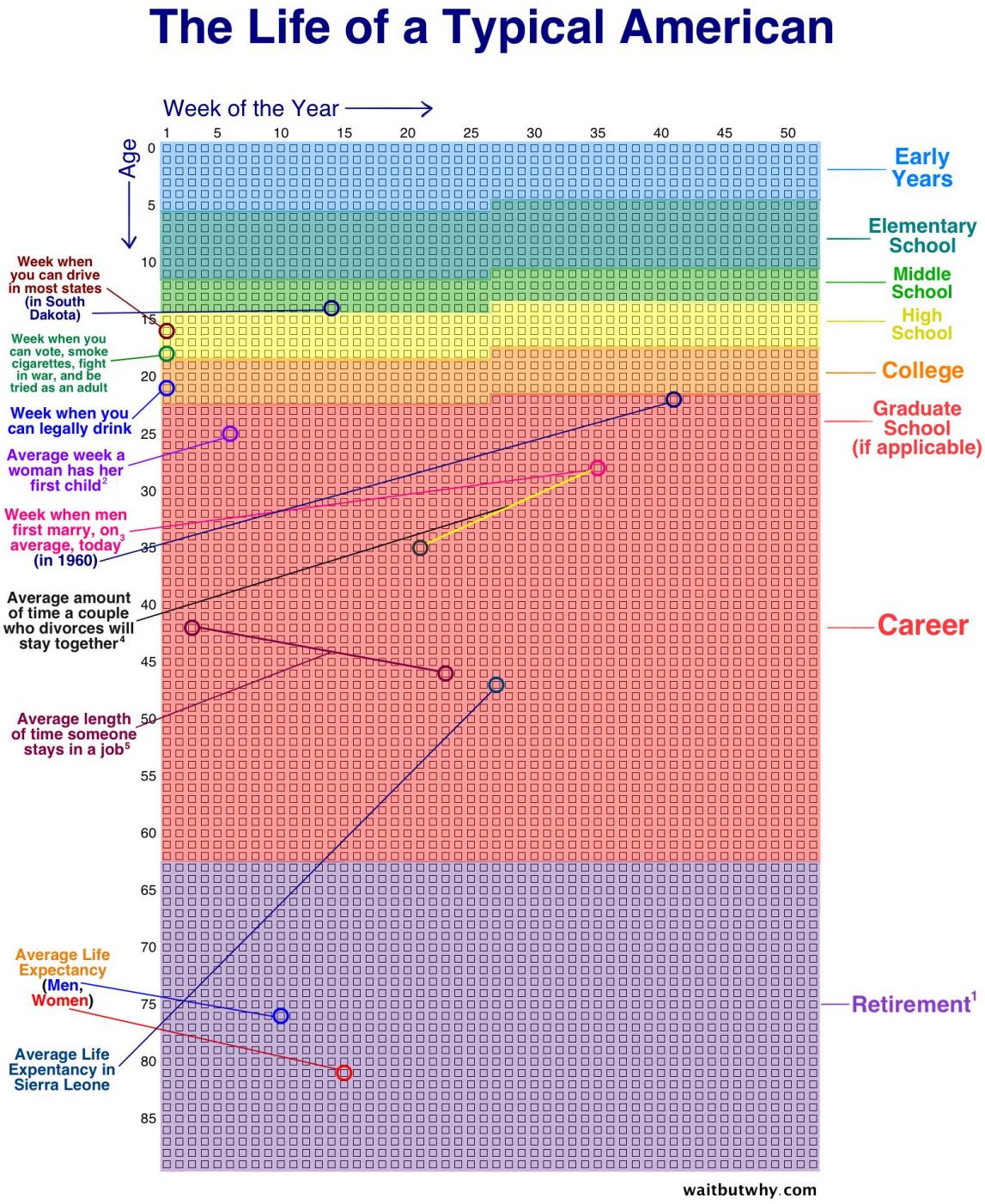
Bach, Benjamin, et al. "The emerging genre of data comics." *IEEE computer graphics and applications* 37.3 (2017): 6-13.

https://www.visualcinnamon.com/portfolio/baby-spike



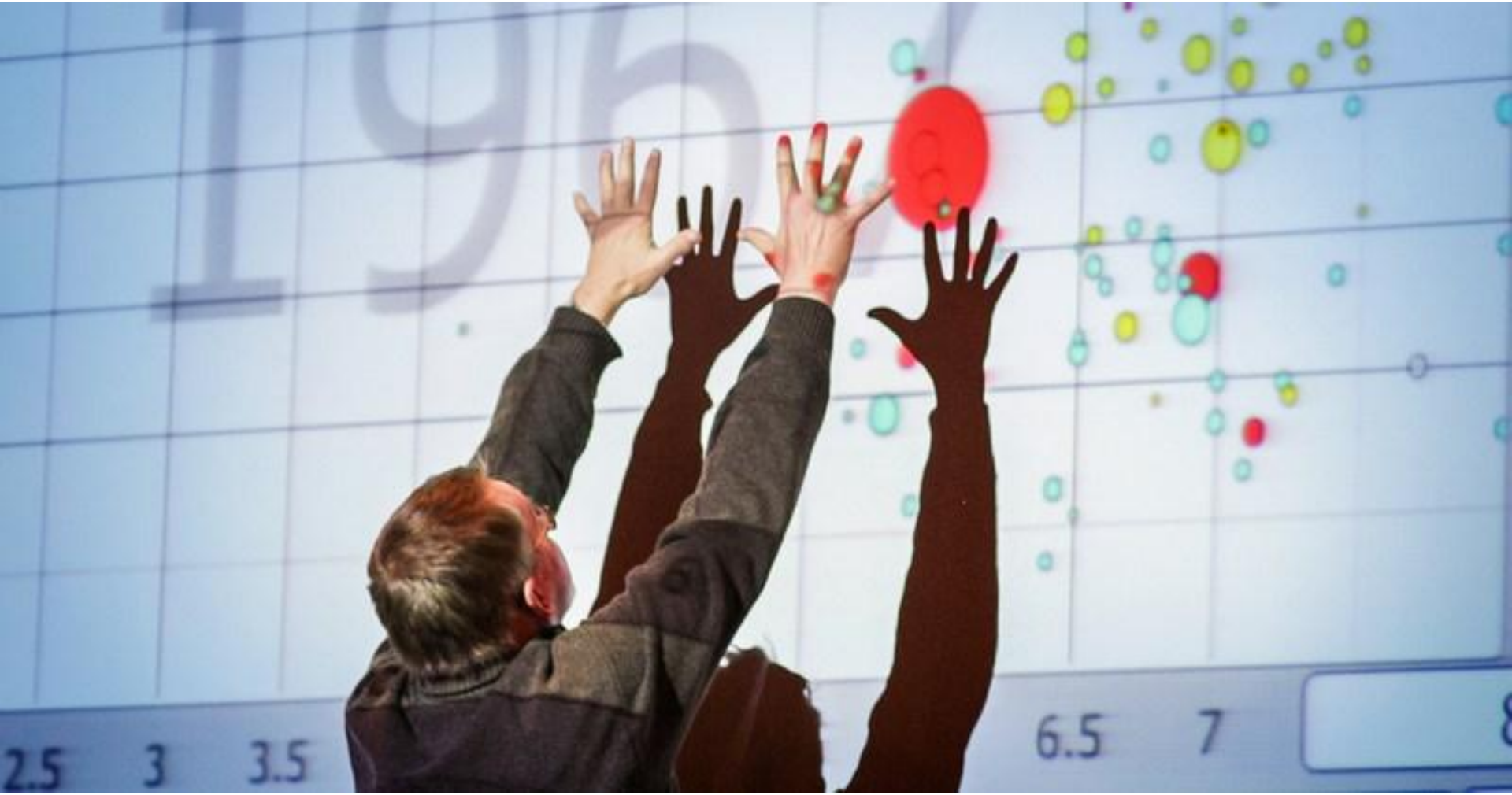
Time is complex

- Directed
- Cyclic
- Quantities
- Scales
- Parellity
- Granules: *weeks*, *months*



https://waitbutwhy.com/2014/05/life-weeks.html

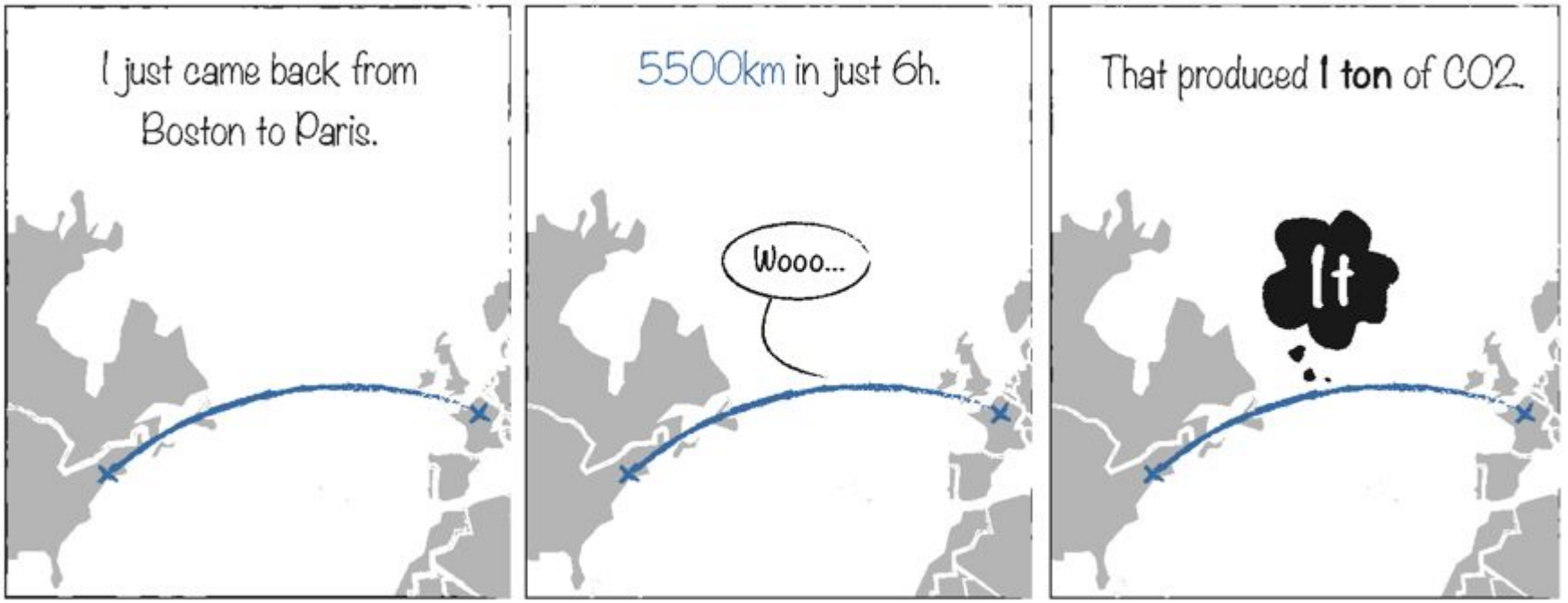
Life Presentations



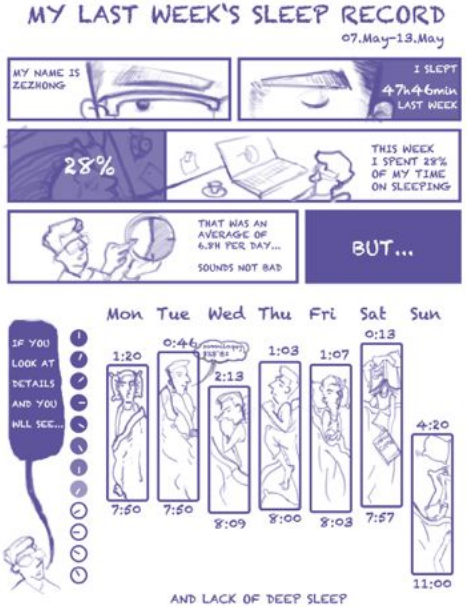
https://www.ted.com/talks/hans_rosling_shows_the_best_stats_you_ve_ever_seen?language=en

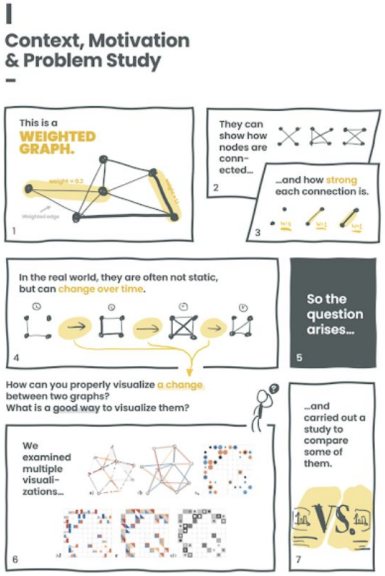
Panel

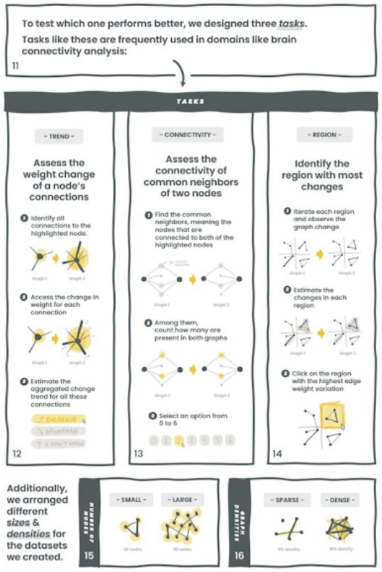
Panel

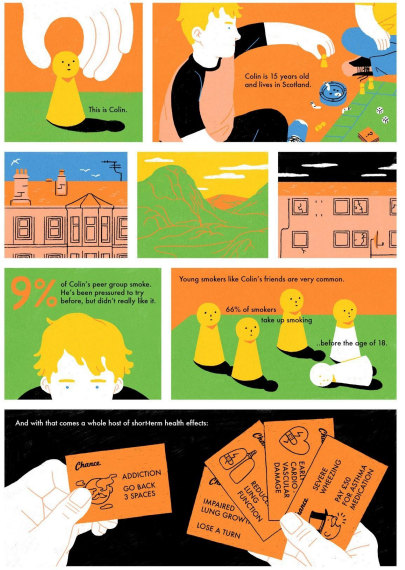


Sequence

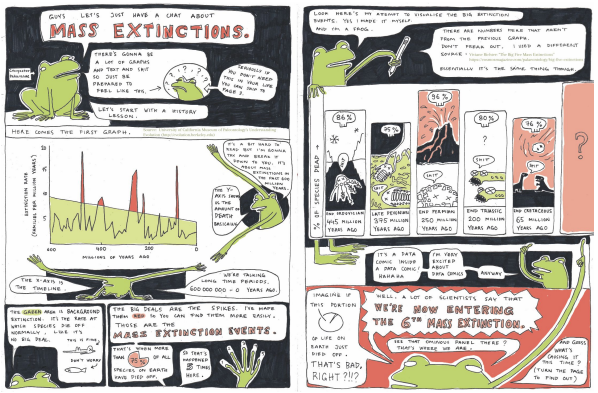

MY LAST WEEK'S SLEEP RECORD
07.May-13.May
MY NAME IS ZEZHONG
I SLEPT 47h46min LAST WEEK
28%
THIS WEEK I SPENT 28% OF MY TIME ON SLEEPING
THAT WAS AN AVERAGE OF 6.8H PER DAY...
SOUNDS NOT BAD
BUT...
Mon Tue Wed Thu Fri Sat Sun
1:20 0:46 2:13 1:03 1:07 0:13 4:20
7:50 7:50 8:09 8:00 8:03 7:57 11:00
IF YOU LOOK AT DETAILS AND YOU WILL SEE...
AND LACK OF DEEP SLEEP
I WENT TO BED AT 1:35 ON AVERAGE
Deep 17% Light 74% Dream 7%
WHAT ABOUT THIS!
BUT I WENT WIMMING IN THE MORNING EVERYDAY!
WAIT!
BECAUSE..
THE SWIMMING POOL OPENS AT 11 ON SUNDAY

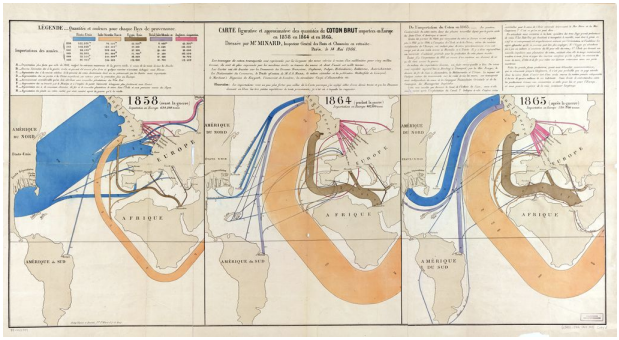

Context, Motivation & Problem Study
This is a WEIGHTED GRAPH.
They can show how nodes are connected...
...and how strong each connection is.
In the real world, they are often not static, but can change over time.
So the question arises...
How can you properly visualize a change between two graphs? What is a good way to visualize them?
We examined multiple visualizations...
...and carried out a study to compare some of them.
VS.

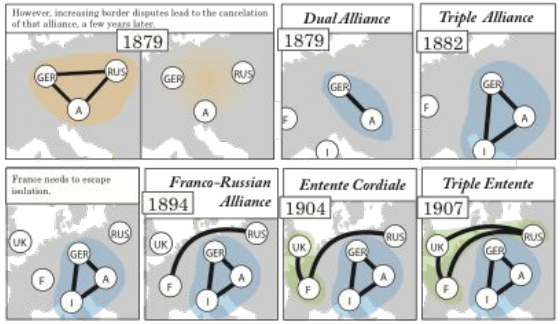

To test which one performs better, we designed three tasks.
Tasks like these are frequently used in domains like brain connectivity analysis:
TASKS
- TREND -
Assess the weight change of a node's connections
- CONNECTIVITY -
Assess the connectivity of common neighbors of two nodes
- REGION -
Identify the region with most changes
Additionally, we arranged different sizes & densities for the datasets we created.
- SMALL - - LARGE -
- SPARSE - - DENSE -

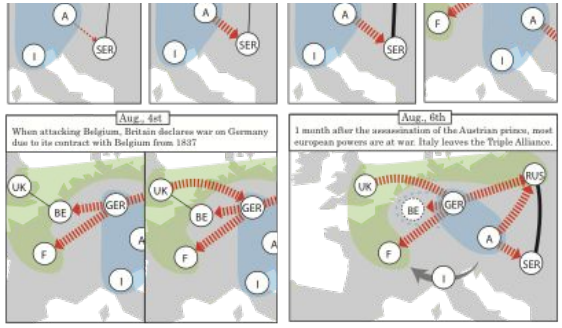

This is Colin.
Colin is 15 years old and lives in Scotland.
9% of Colin's peer group smoke. He's been pressured to try before, but didn't really like it.
Young smokers like Colin's friends are very common.
66% of smokers take up smoking before the age of 18.
And with that comes a whole host of short-term health effects:
Chance.
ADDICTION GO BACK 3 SPACES
IMPAIRED LUNG GROWTH LOSE A TURN
EARLY VASCULAR DAMAGE
SEVERE WHEEZING
Chance.

300 MILLION TONNES
TIGERS STRIKE UP TO 4X CARBON
EXCUSE ME SIR, ARE YOU AWARE OF THE DAMAGE IT CAUSES THE EARTH BY CUTTING DOWN TREES?
HOW MUCH BLAME CONTRIBUTES TO THIS MASS REDUCTION
37%
41%
RESULTS ACCORDING TO W. STOVIN CANADA
HOWEVER, ALL IN ALL, 18 MILLION ACRES OF FOREST ARE LOST PER YEAR
281 OF THE AMAZON RAINFOREST HAS ALREADY BEEN DEFORESTED. WHILST (?) HAS BEEN LOST DUE TO CATTLE FARMING
157
TEN EATING A MORE PLANT BASED DIET
EAT DOWN ON YOUR PAPER & USE AND USE
RECYCLED PAPERS
AND SUPPORT YOUR LOCAL SMALL GROWERS

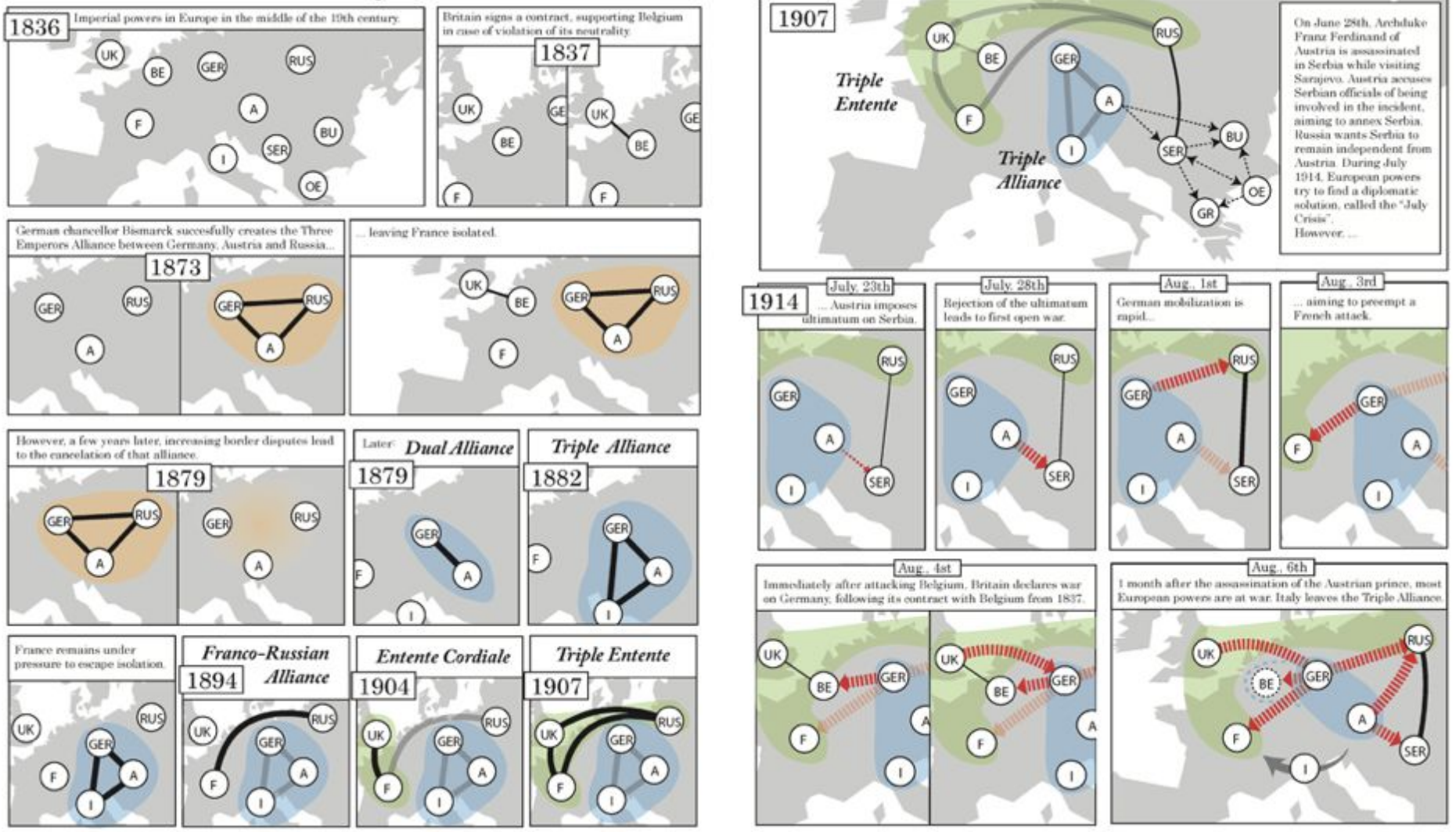

GUYS LET'S JUST HAVE A CHAT ABOUT
MASS EXTINCTIONS.
THERE'S GONNA BE A LOT OF GRAPHS AND TEXT AND I'LL DO JUST BE PREPARED TO FEEL LIKE YES,
LET'S START WITH A HISTORY LESSON.
HERE COMES THE FIRST GRAPH.
EXTINCTION RATE (FAMILIES PER MILLION YEARS)
MILLIONS OF YEARS AGO
IT'S A BIT HARD TO READ BUT THE SPIKES ARE BEGIN A BIT HIGHER THAN THE REST SO THEY MUST BE MASS EXTINCTIONS IN THE PAST
AND THE TINY BIT IN THE MIDDLE DEATH BECOMES
WE'RE TALKING LONG TIME PERIODS.
500 000 000 - 0 YEARS AGO
THE BIG DEALS ARE THE SPIKES. THE MORE THERE ARE TO YOU CAN FIND MORE SPIKES, THOSE ARE THE
MASS EXTINCTION EVENTS.
THERE'S ONLY 5 OF ALL SPECIES ON EARTH HAVE DIED OFF.
SO THAT'S HAPPENED 5 TIMES HERE.
THE GREEN AREA IS BACKGROUND EXTINCTION. IT'S THE RATE AT WHICH SPECIES DIE OFF NORMALLY. LIKE IT'S NO BIG DEAL.
THE RAVEN IS THE TIMELINE
LOOK HERE'S MY ATTEMPT TO VISUALISE THE BIG EXTINCTION.
BAMPTC. YES I MADE IT MYSELF AND I'M A TROG.
THERE ARE NUMBERS MEAN THAT AREN'T FROM THE PREVIOUS GRAPH. DON'T FREAK OUT. I USED A DIFFERENT SOURCE.
ESSENTIALLY IT'S THE SAME THING THOUGH
86%
25%
96%
80%
96%
?
?
?
% OF SPECIES PRESENT
541 PRECAMBRIAN MILLION YEARS AGO
485 ORDOVICIAN MILLION YEARS AGO
359 LATE DEVONIAN MILLION YEARS AGO
252 END PERMIAN MILLION YEARS AGO
201 END TRIASSIC MILLION YEARS AGO
66 END CRETACEOUS MILLION YEARS AGO
IT'S A DATA COMIC! INCLUDE A DATA COMIC! DATA COMICS! DATAAA
I'M VERY EXCITED ABOUT DATA COMICS!
DATAAA
IMAGINE IF THIS RATION OF LIFE ON EARTH JUST DIED OFF.
THAT'S BAD, RIGHT ?!?
WELL. A LOT OF SCIENTISTS SAY THAT
WE'RE NOW ENTERING THE 6TH MASS EXTINCTION.
SEE THAT ORANGE PANEL THERE ? THAT'S WHERE WE ARE.
AND GUESS WHAT'S CAUSING IT THIS TIME ? (YOU'RE THE TROG TO FIND OUT)


1858
1864
1865
EUROPE
AFRIQUE
AMERIQUE du NORD
AMERIQUE du SUD

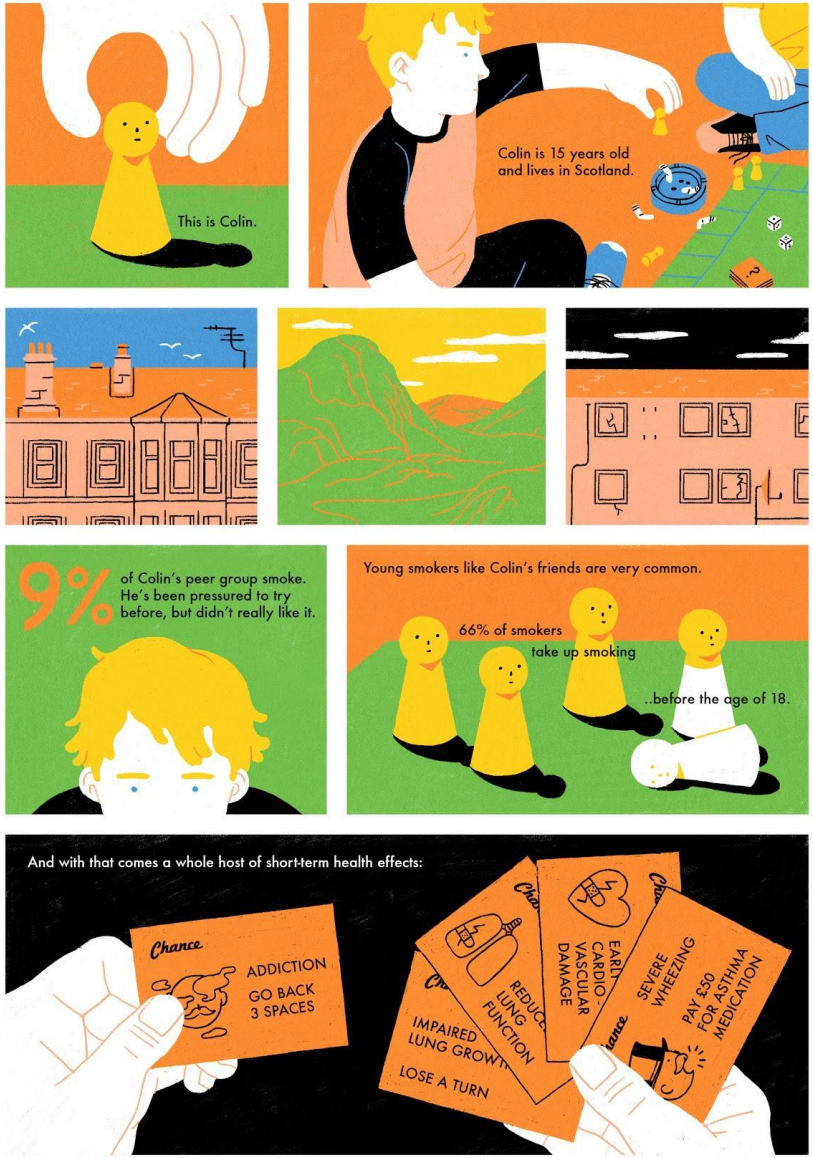

However, increasing border disputes lead to the cancelation of that alliance, a few years later.
1879
Dual Alliance
1879
Triple Alliance
1882
France needs to escape isolation.
Franco-Russian Alliance
1894
Entente Cordiale
1904
Triple Entente
1907
GER
RUS
A
UK
F
I

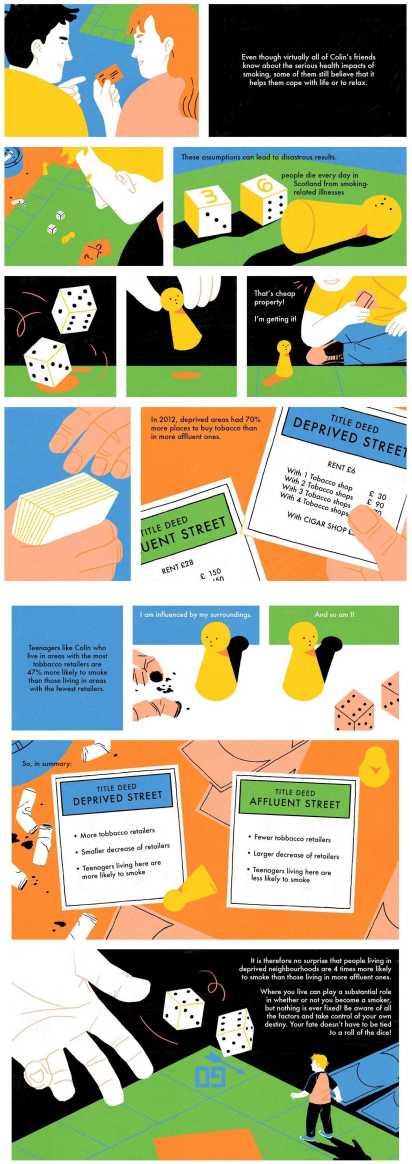

Aug., 4st
When attacking Belgium, Britain declares war on Germany due to its contract with Belgium from 1837
Aug., 6th
1 month after the assassination of the Austrian prince, most european powers are at war. Italy leaves the Triple Alliance.
UK
BE
GER
A
F
I
SER
RUS

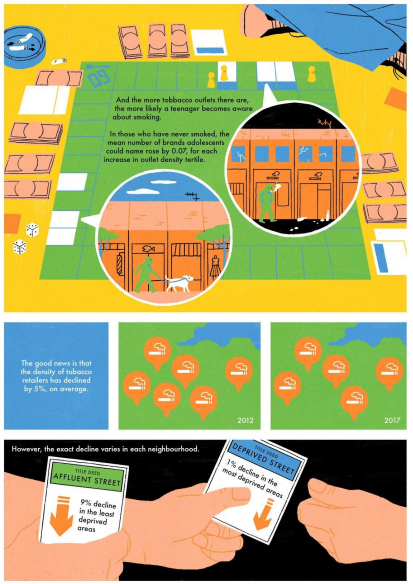
European Alliances before World War I (1836-1914)



Smoking



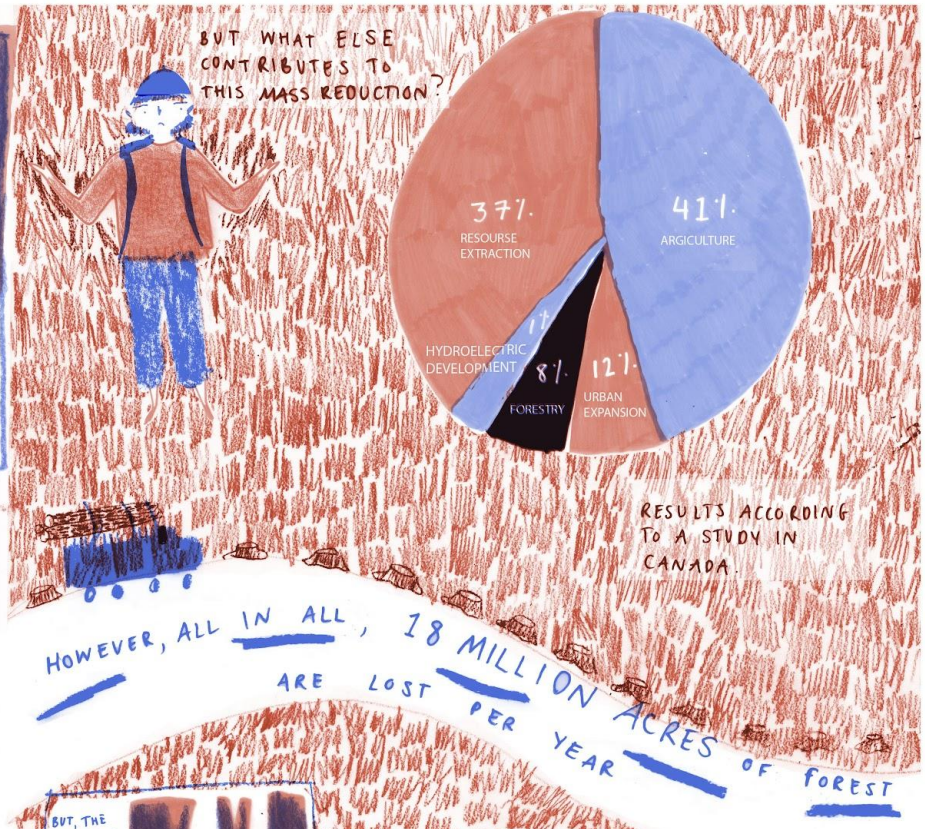




Terri Po

TREES STORE UP TO 300 MILLION TONNES OF CARBON

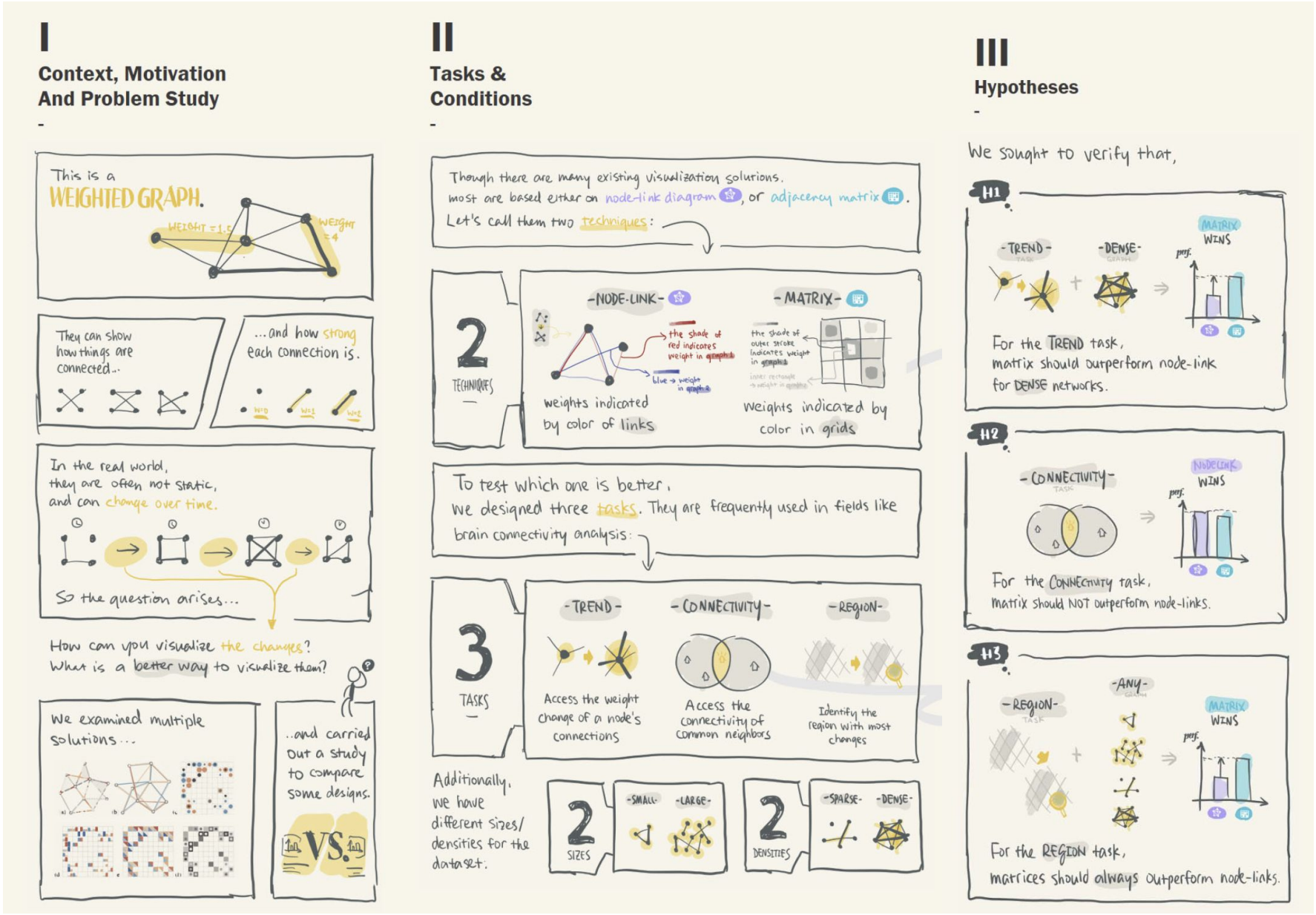
EXCUSE ME SIR, ARE YOU AWARE OF THE DAMAGE IT CAUSES THE EARTH BY CUTTING DOWN TREES?

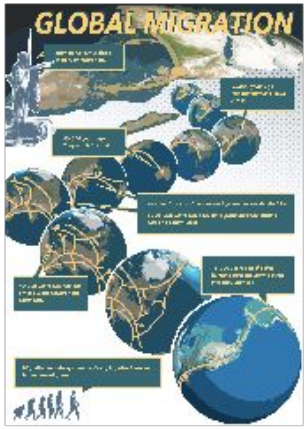


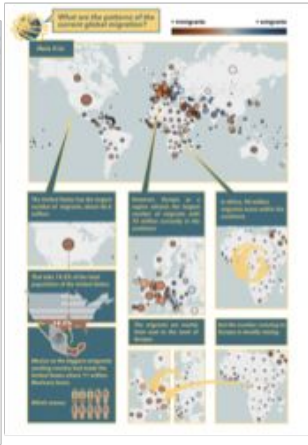
Stats Comics

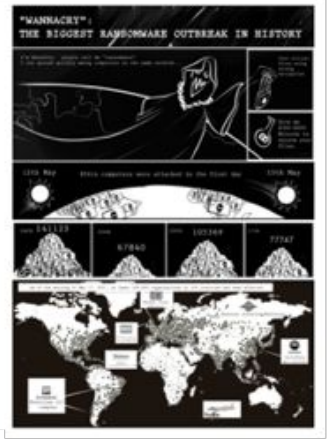
1. Context and Motivation
2. Conditions
3. Hypotheses
4. Tasks
5. Stimuli & Study Materials
6. Power Analysis
7. Study Setup
8. Dependent Variables and Data Collection
9. Data Transformations and Checks
10. Presentation of Results
11. Hypothesis Evaluation

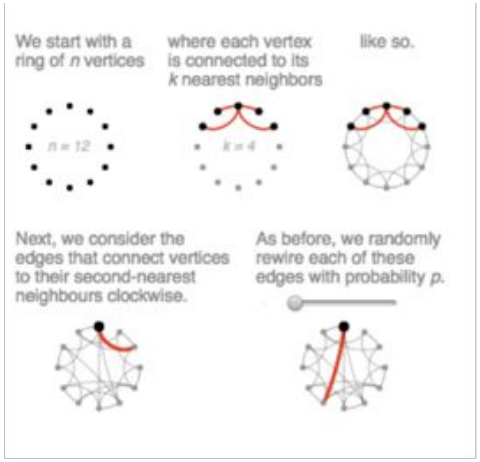
Stats Comics

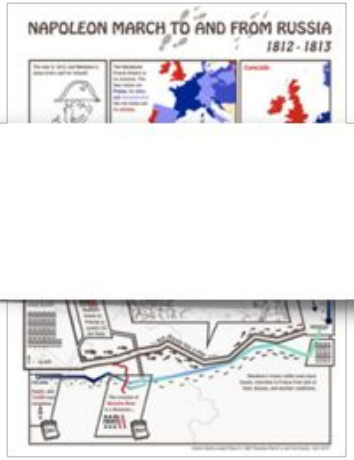


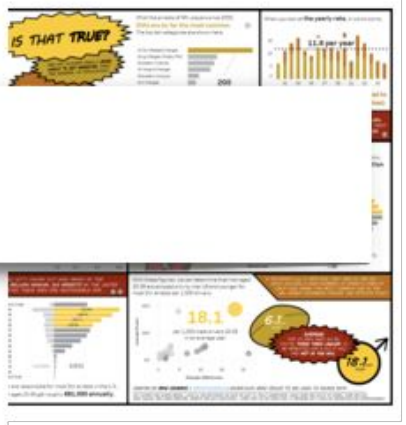


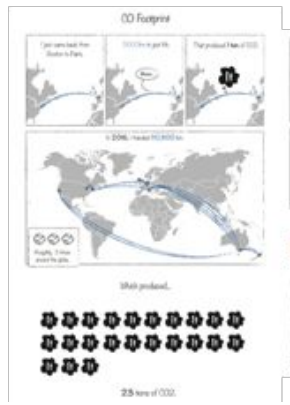


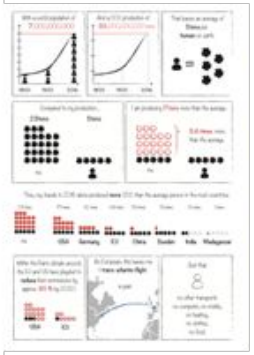


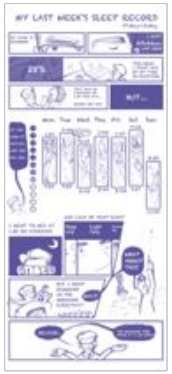


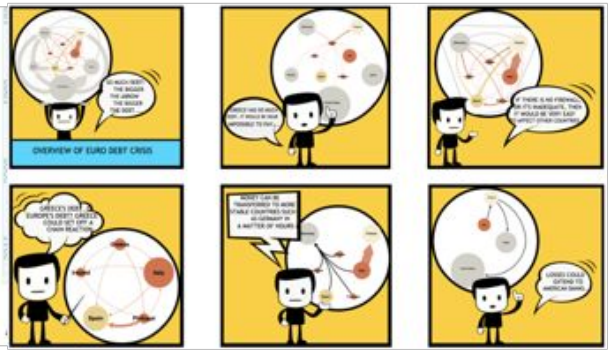












http://datacomics.net

Explanation

Simplicity

Messages

Aesthetics

Metaphors

Scrollytelling

Explanation

Simplicity

Messages

Aesthetics

Metaphors

Scrollytelling

Explanation

Simplicity

Messages

Aesthetics

Metaphors

Scrollytelling

Explanation

Simplicity

Messages

Aesthetics

Metaphors

Scrollytelling

Explanation

Simplicity

Messages

Aesthetics

Metaphors

Scrollytelling

Explanation

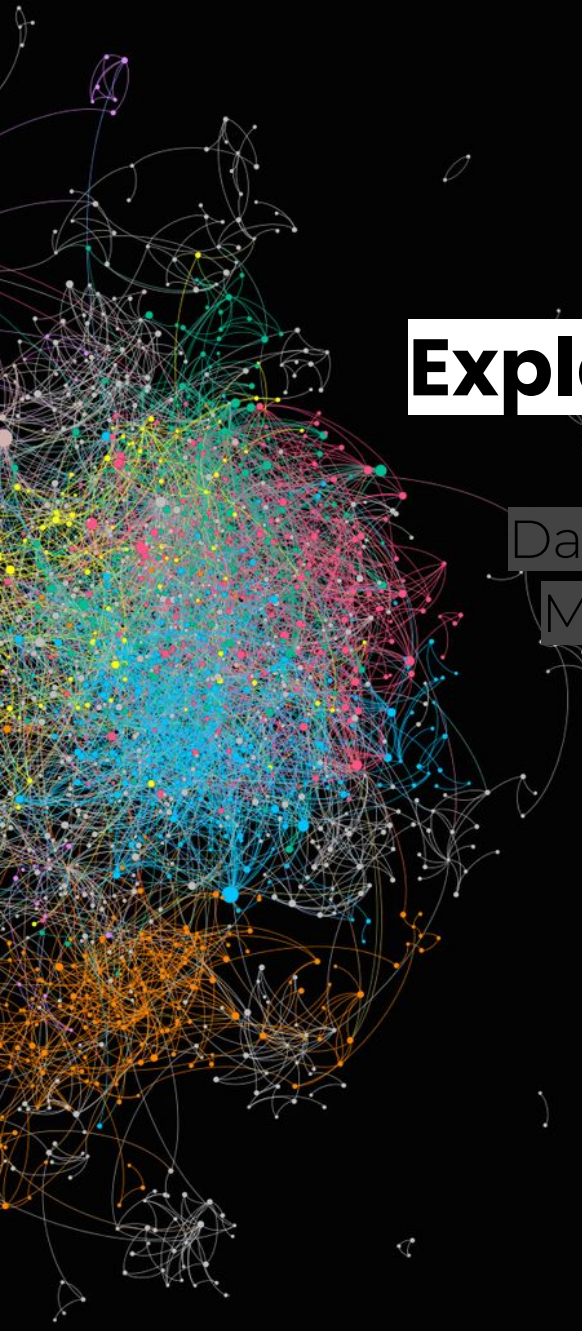
Simplicity

Messages

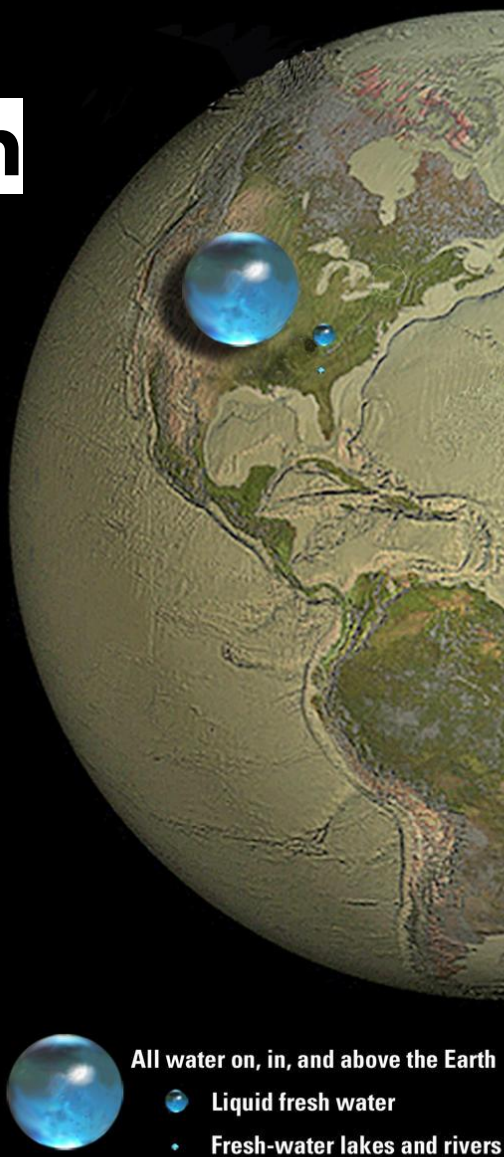
Aesthetics

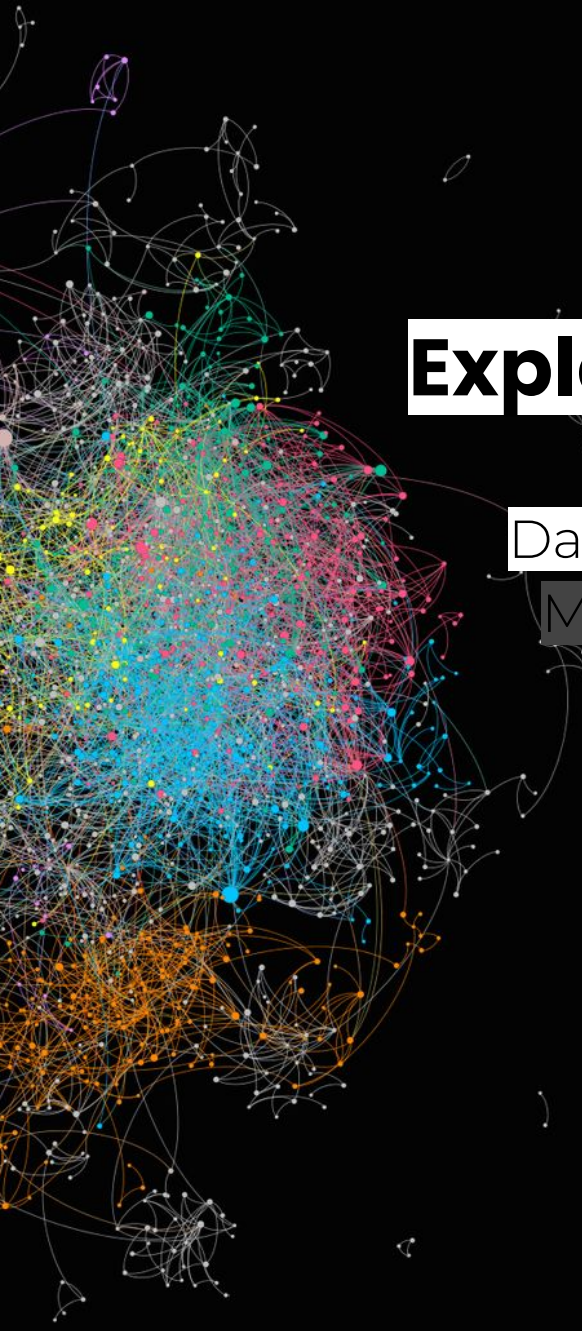
Metaphors

Scrollytelling

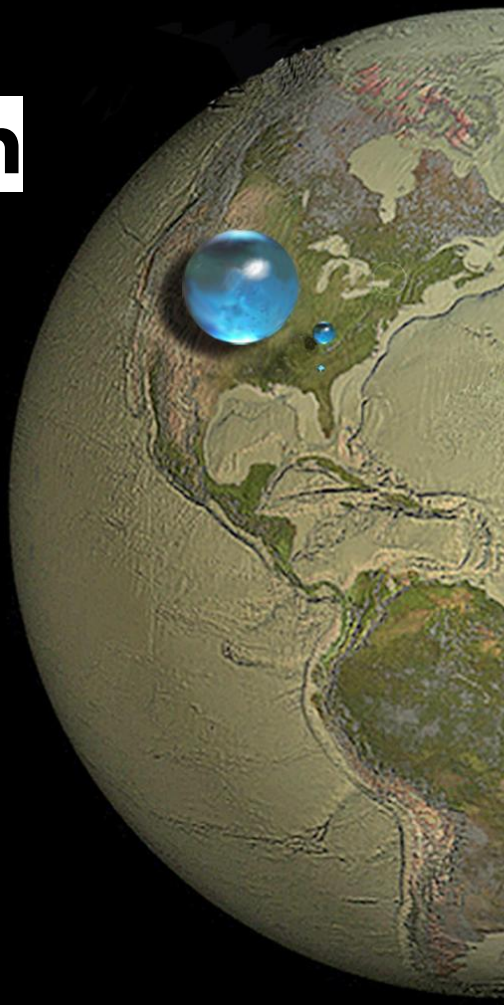


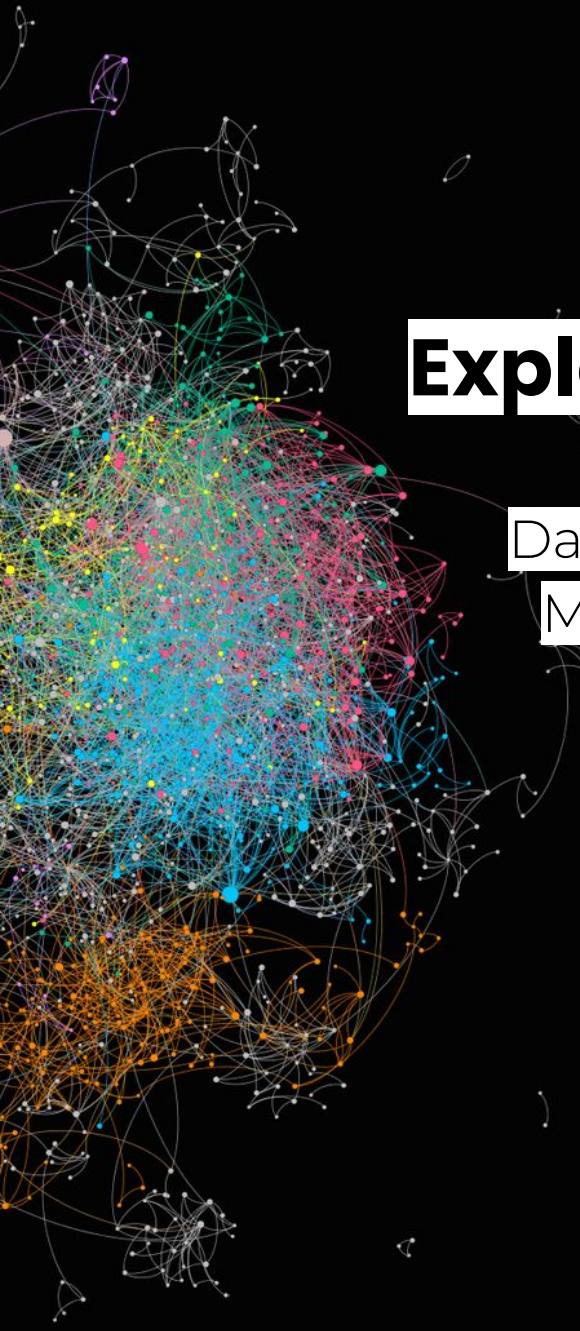
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



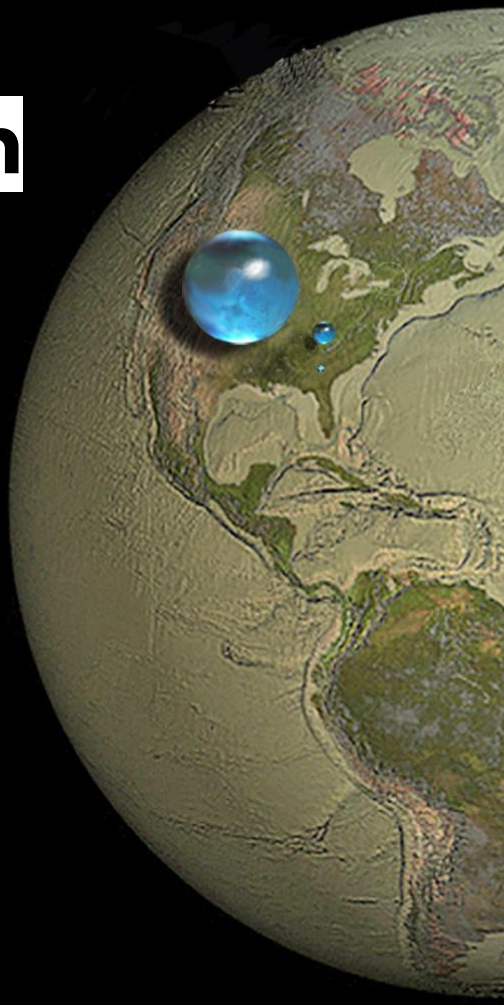


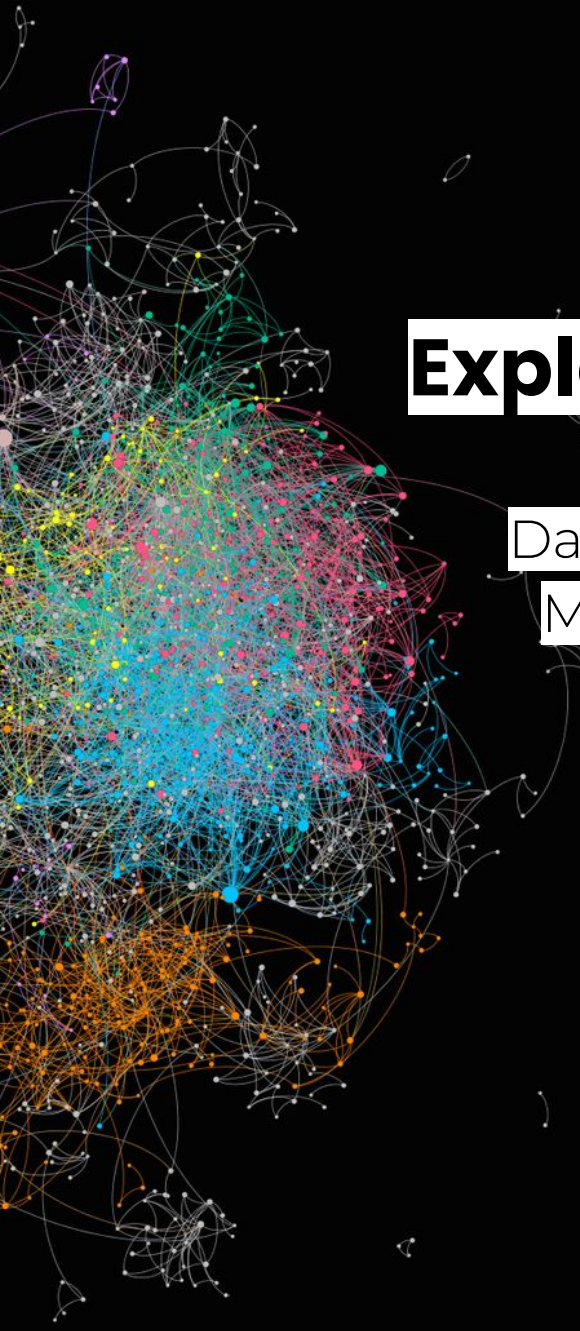
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



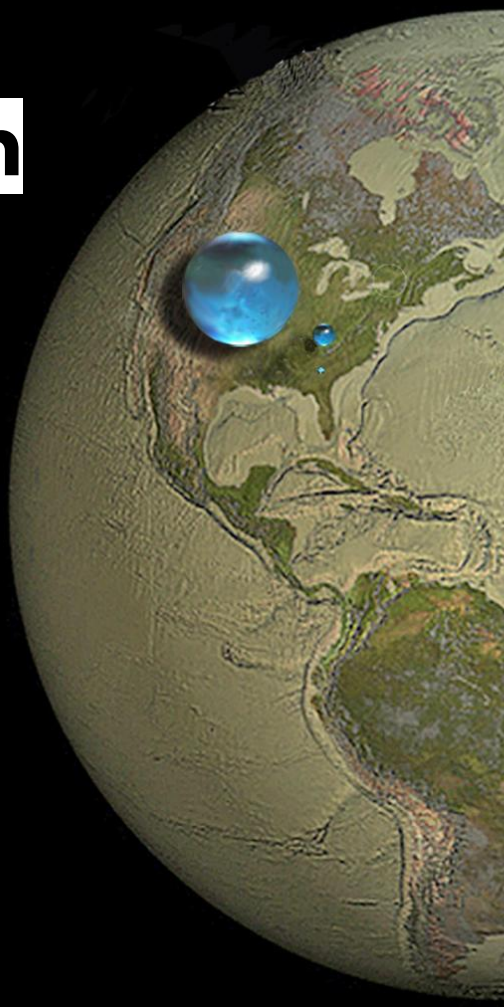


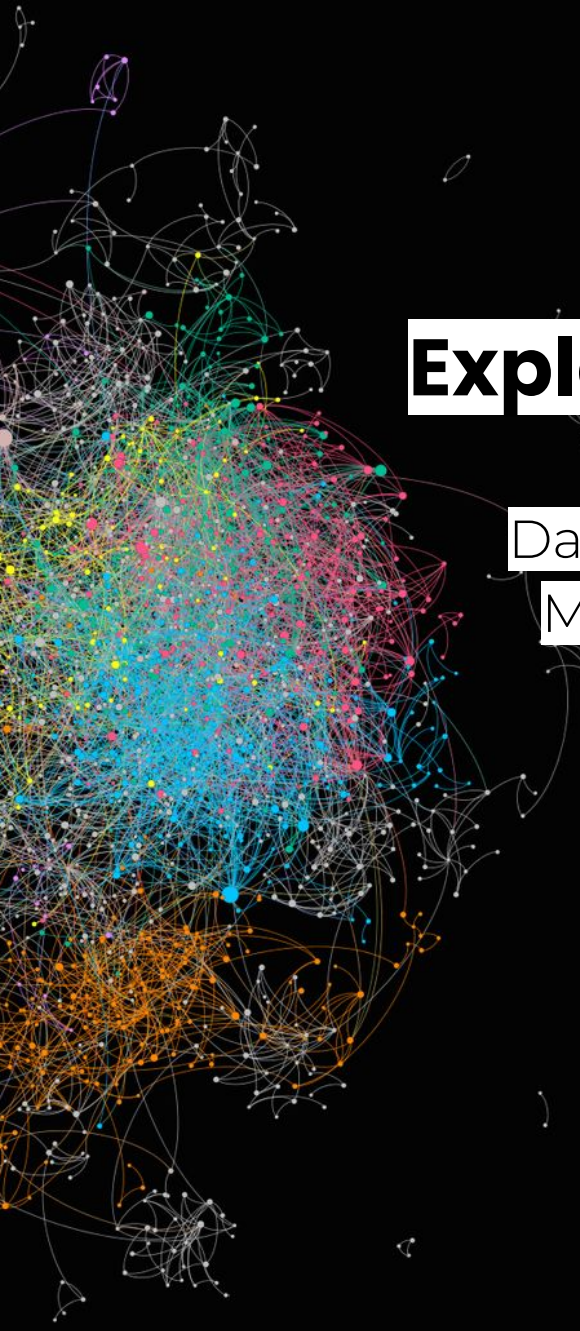
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



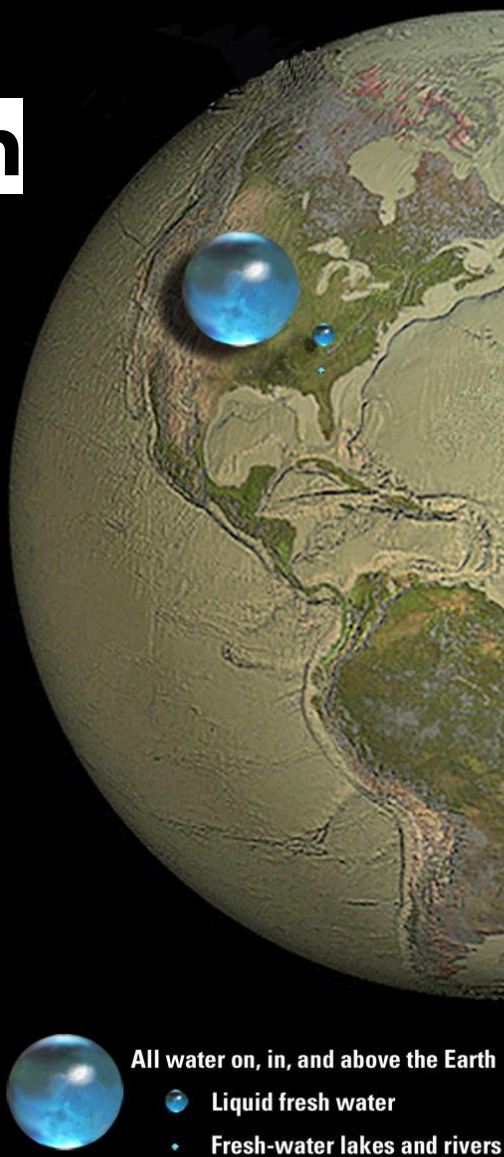


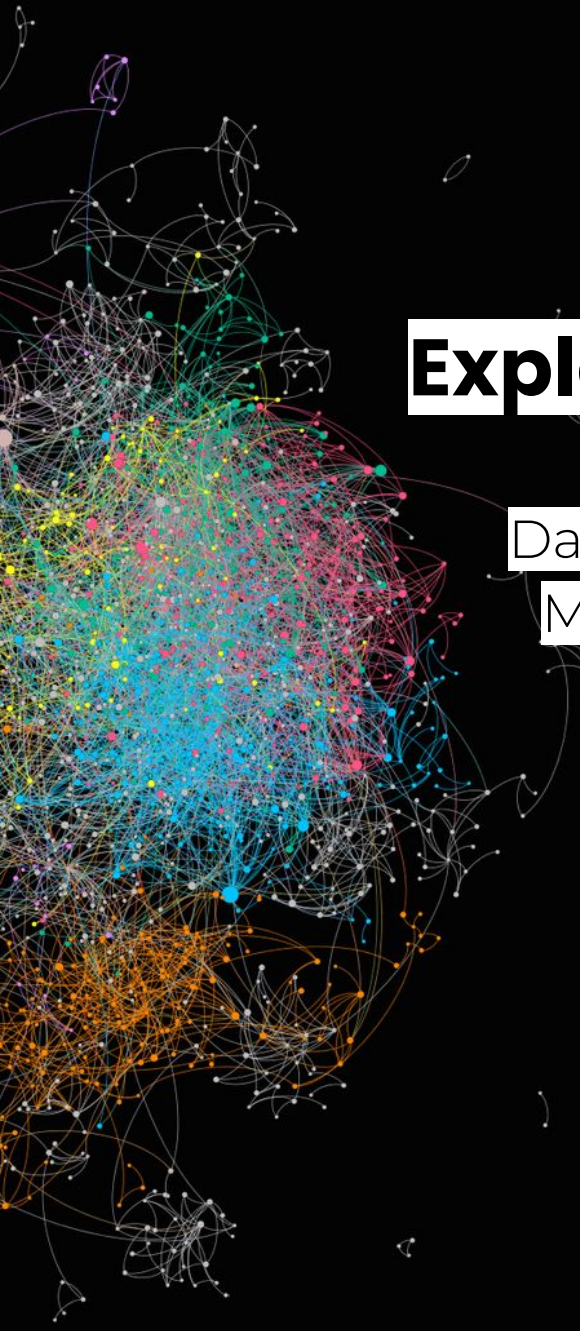
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



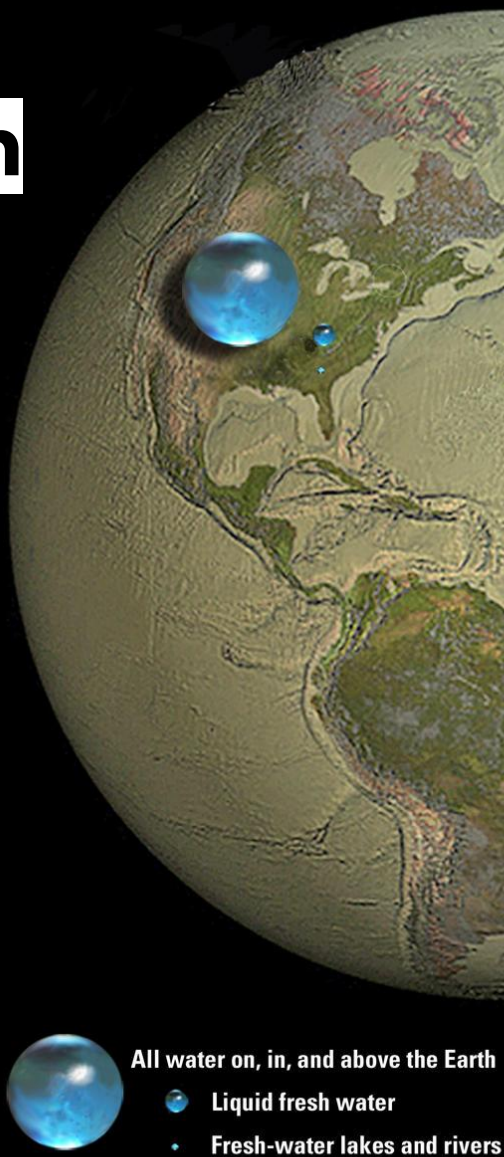


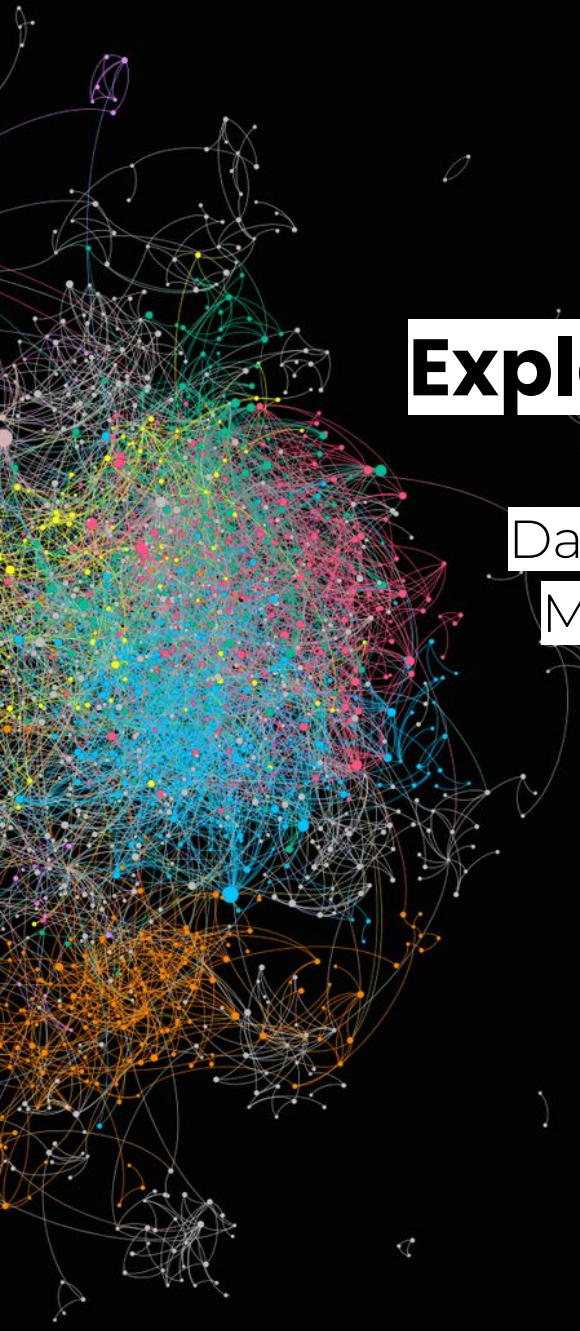
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



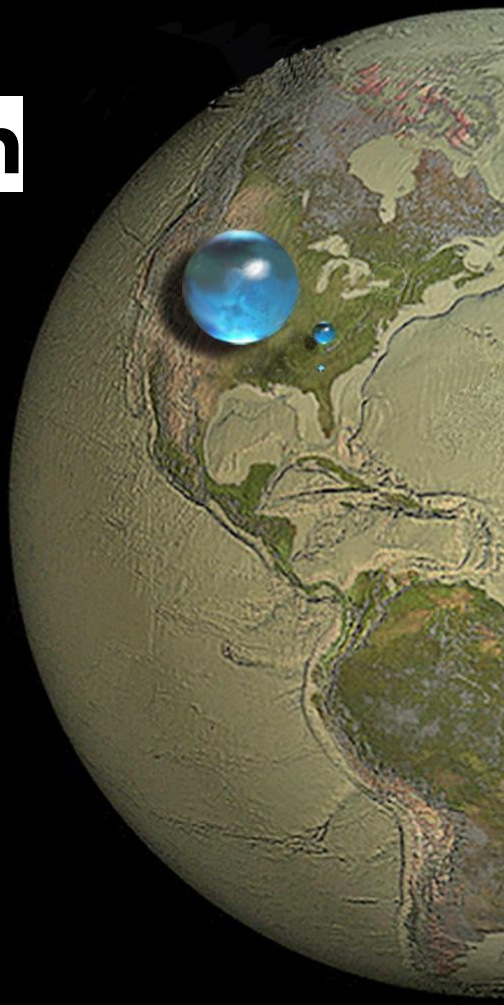


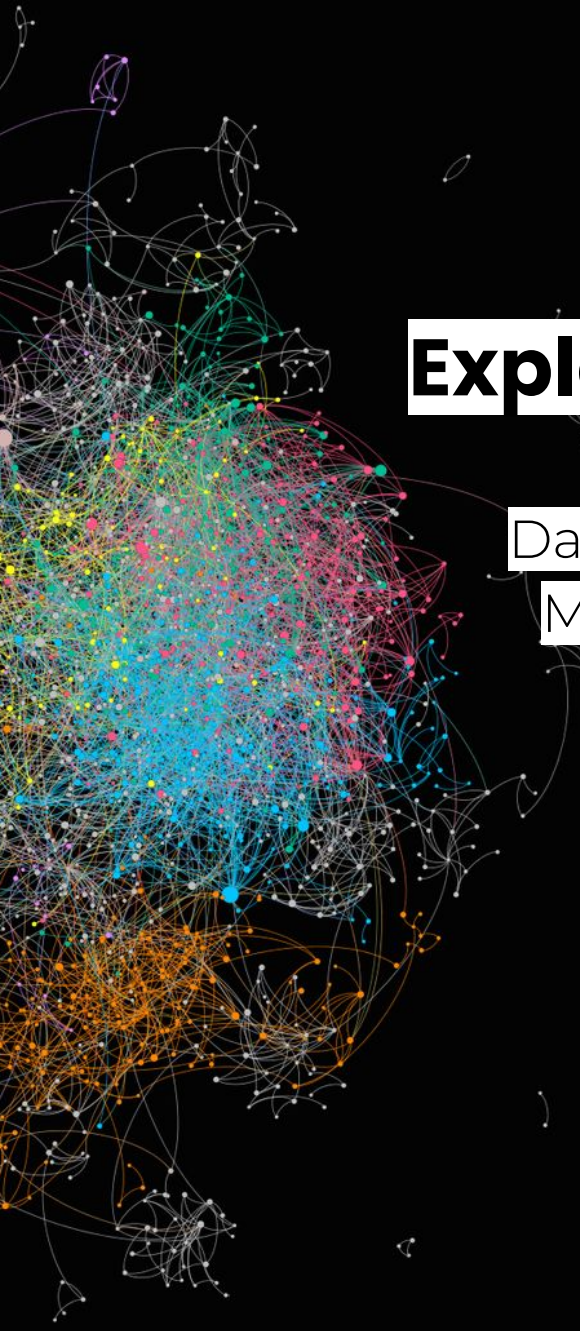
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



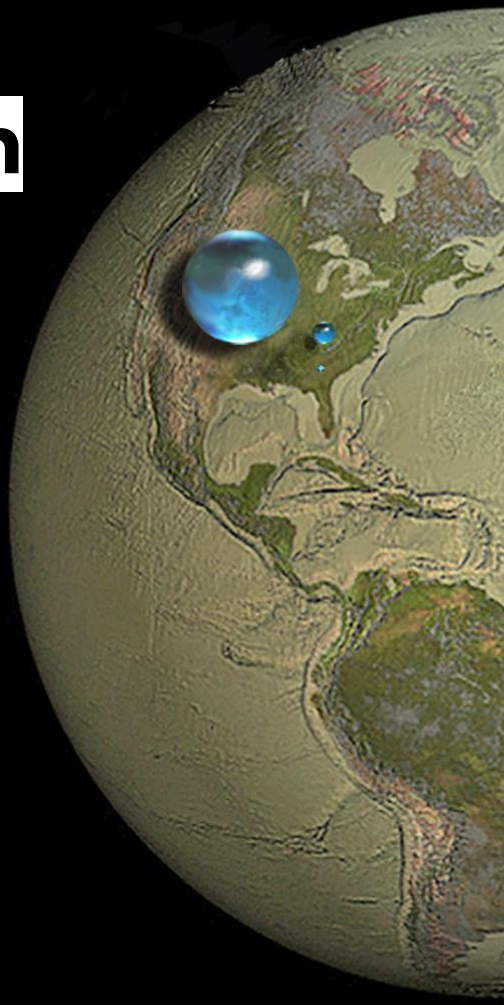


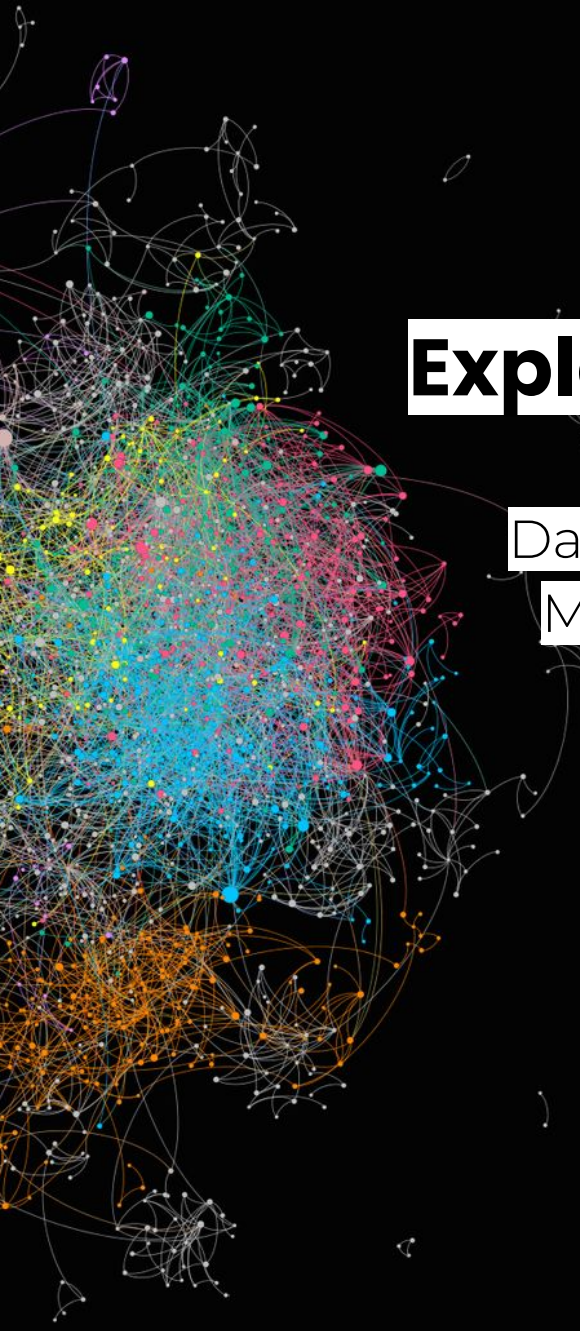
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



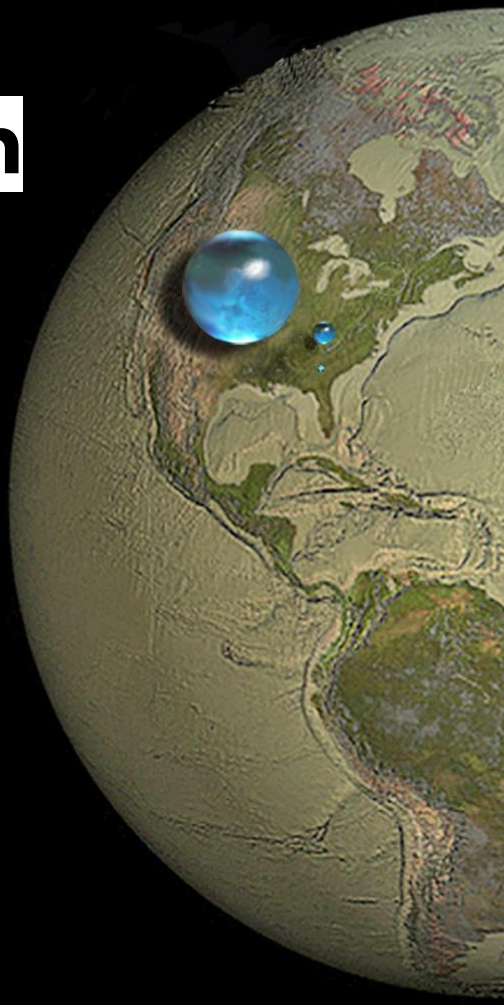


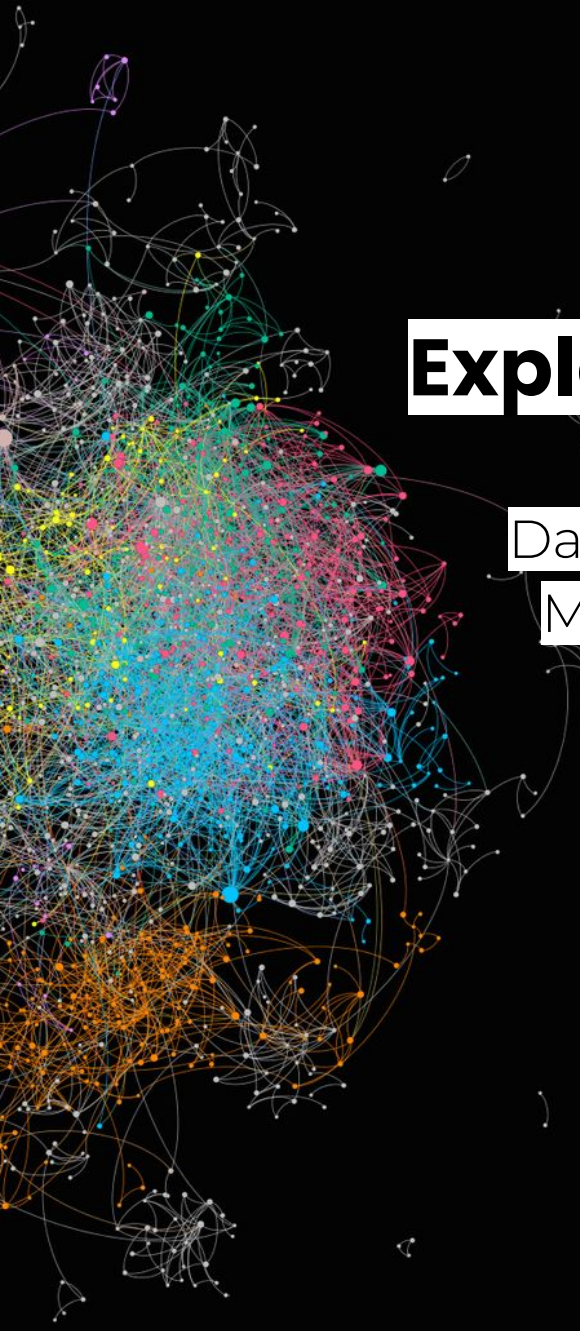
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise





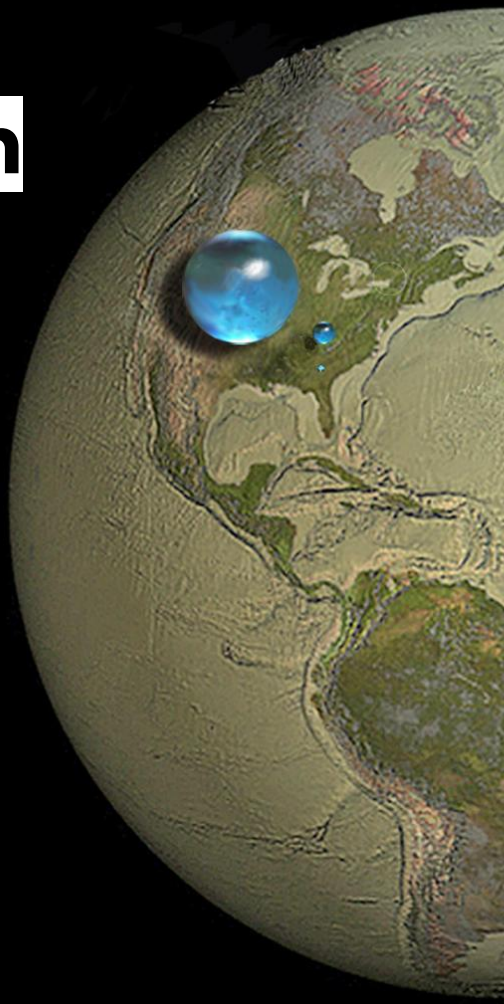
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise

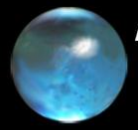




The World's Water

Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise

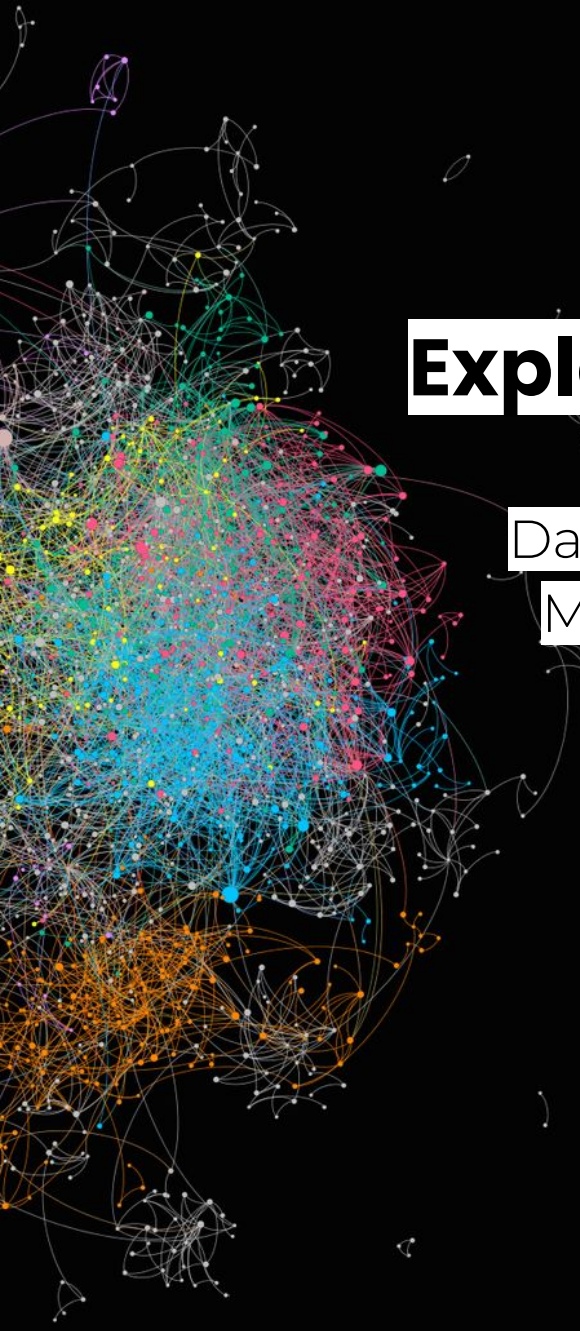




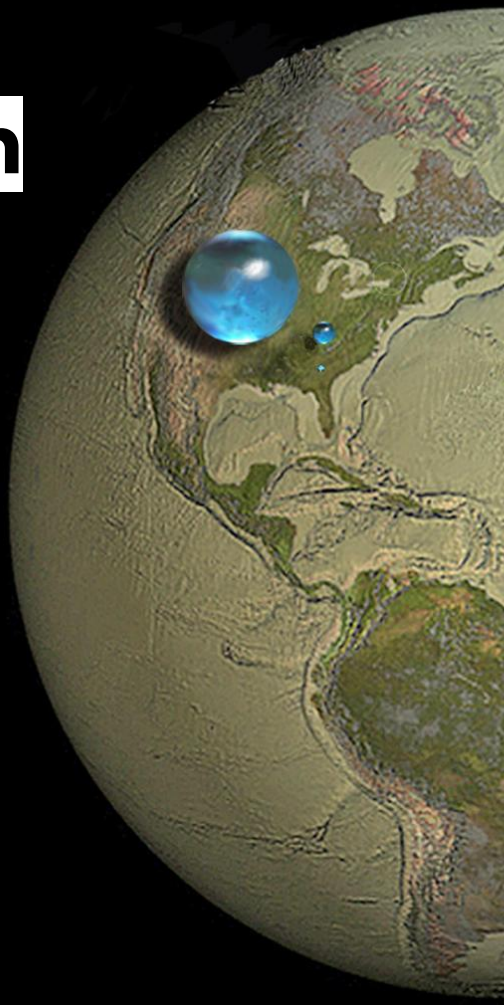
All water on, in, and above the Earth

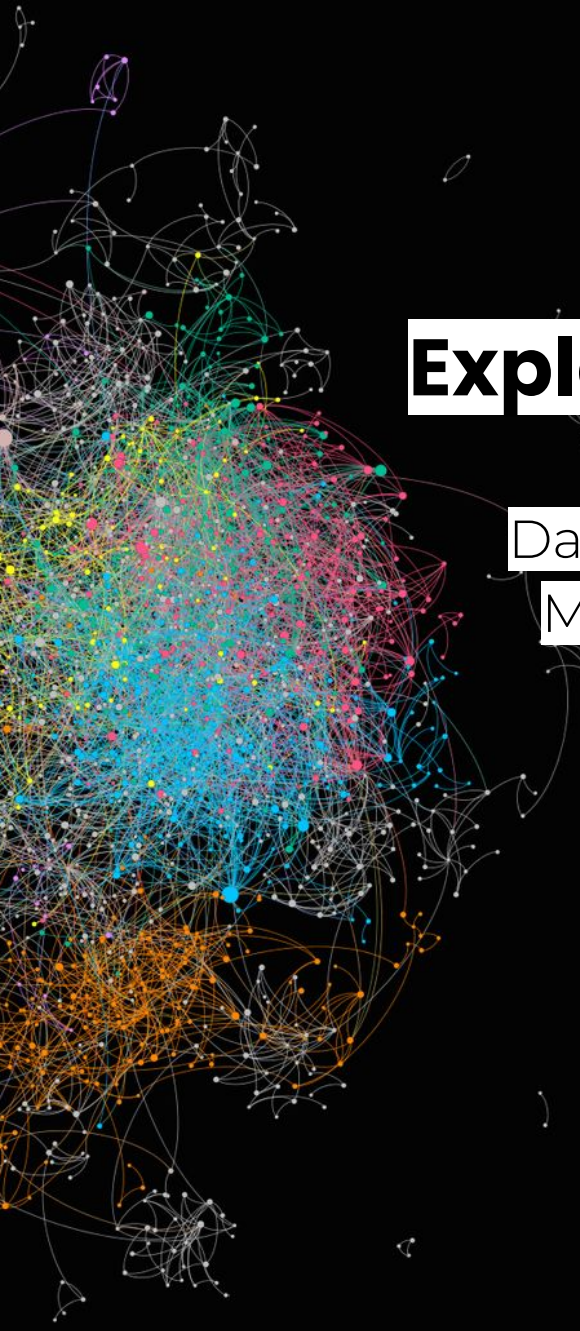
Liquid fresh water

Fresh-water lakes and rivers

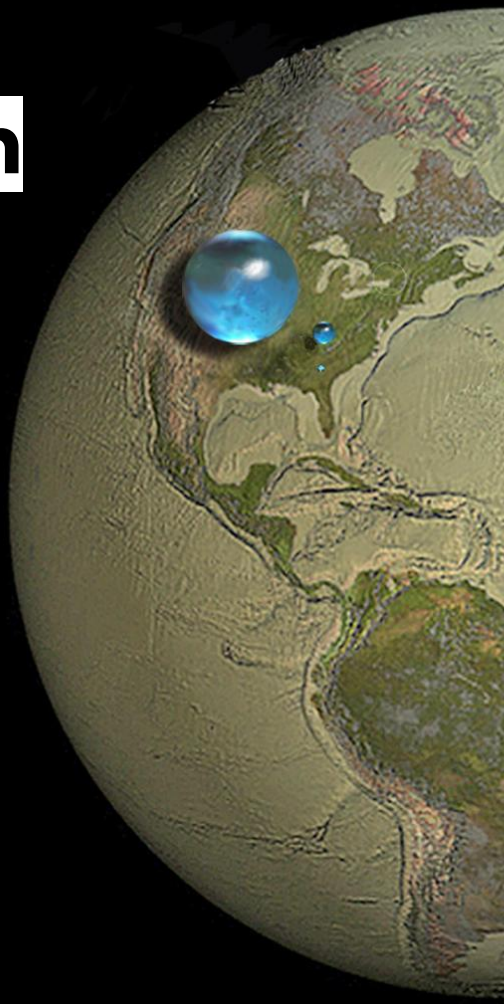


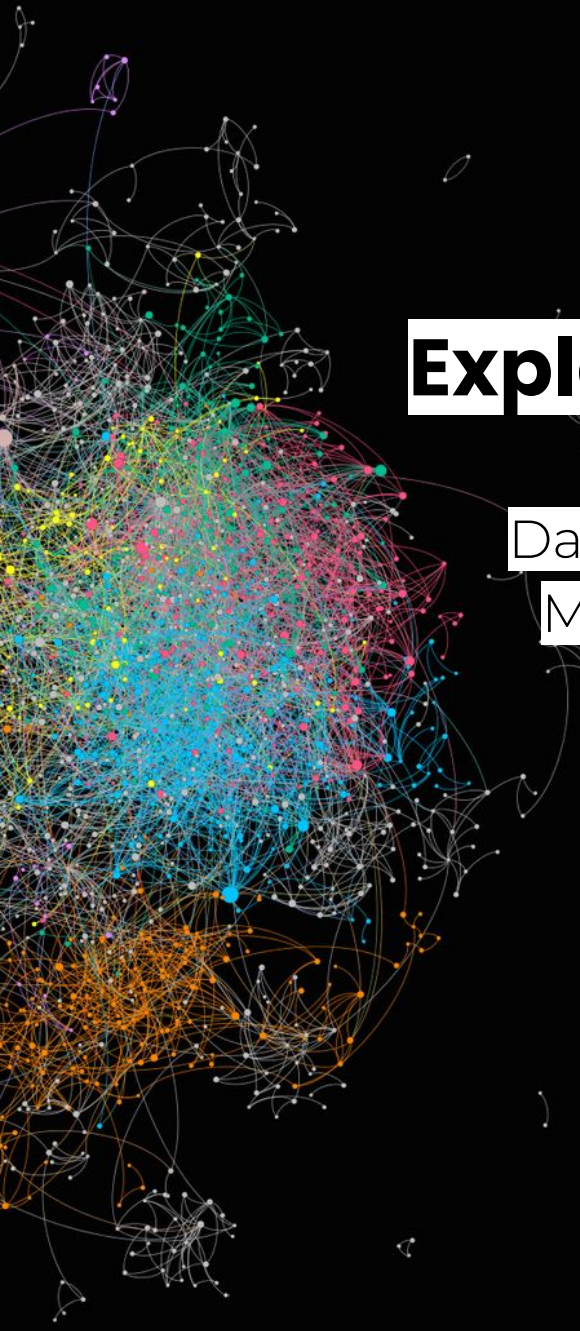
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



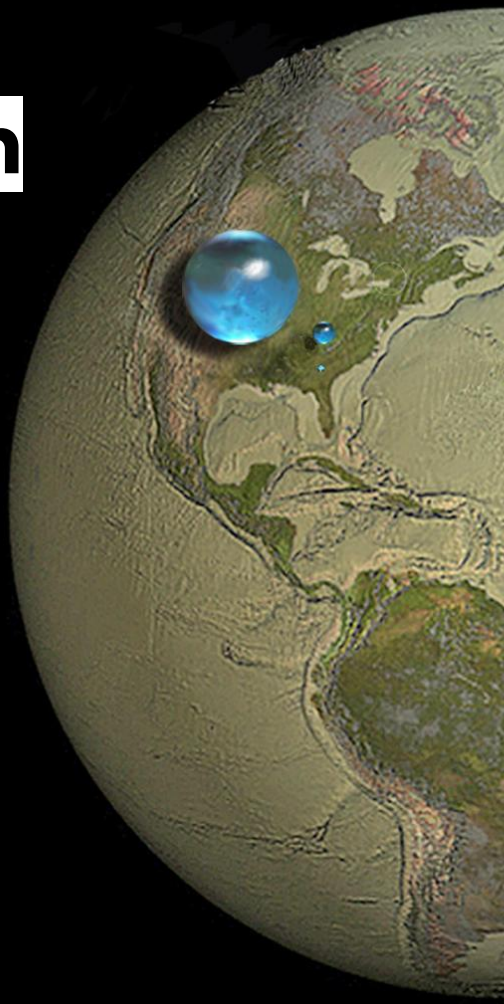


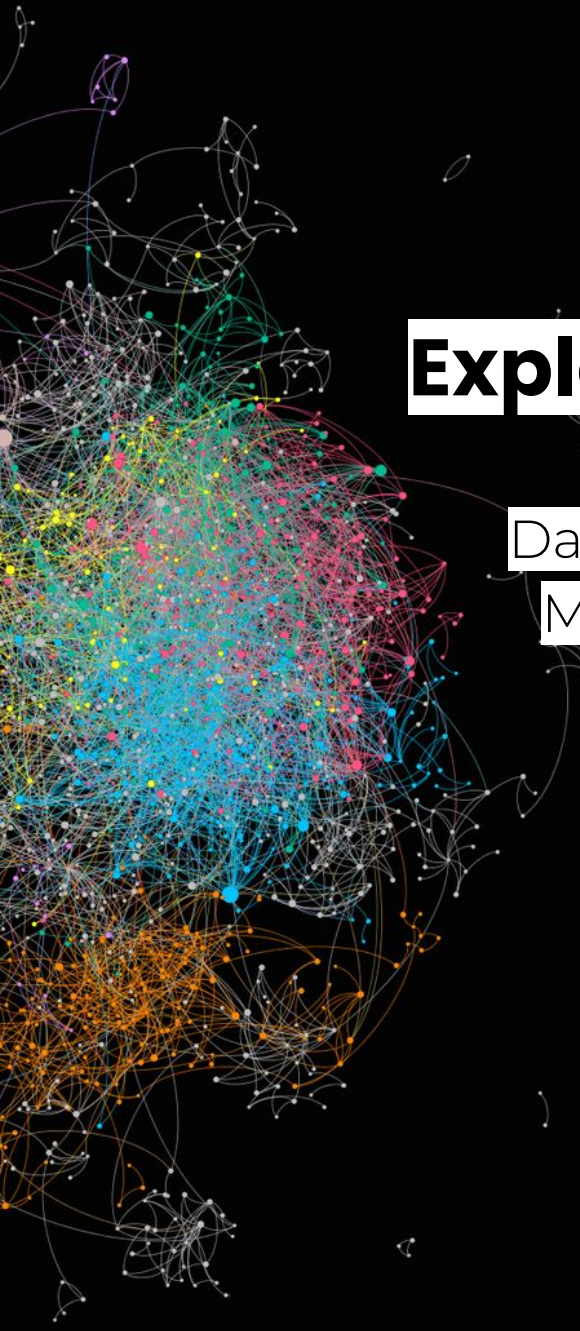
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



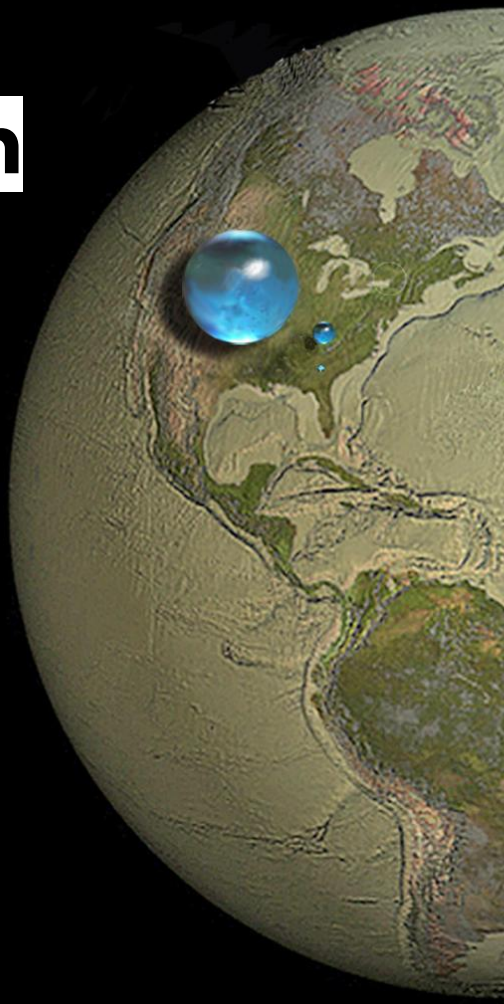


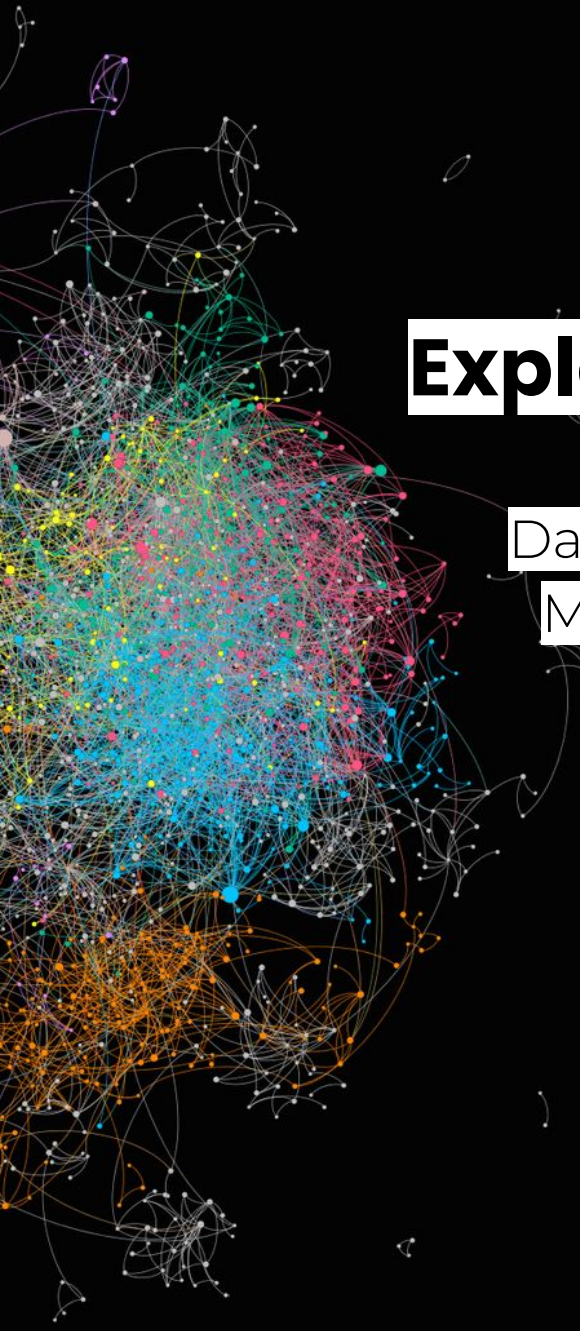
Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



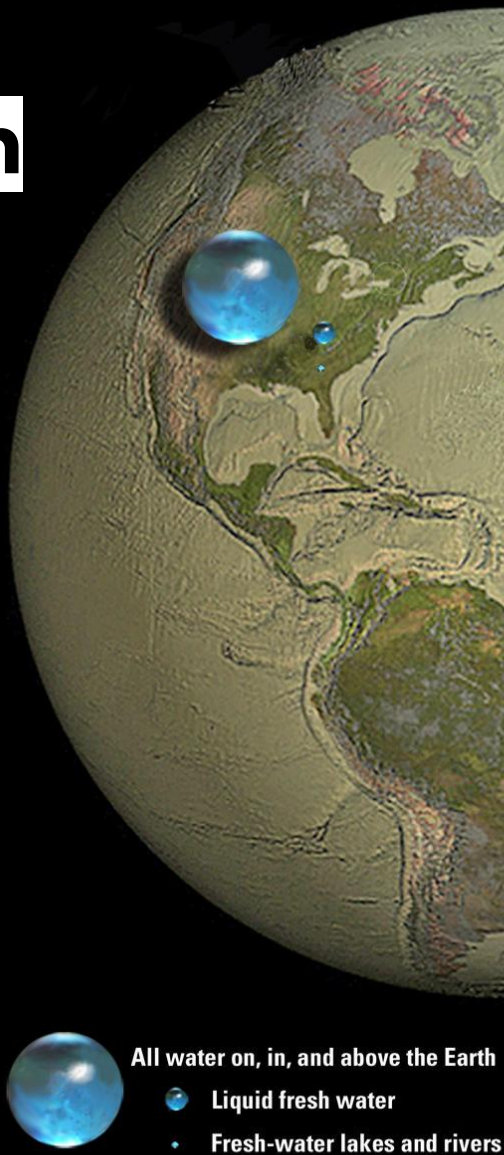


Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise

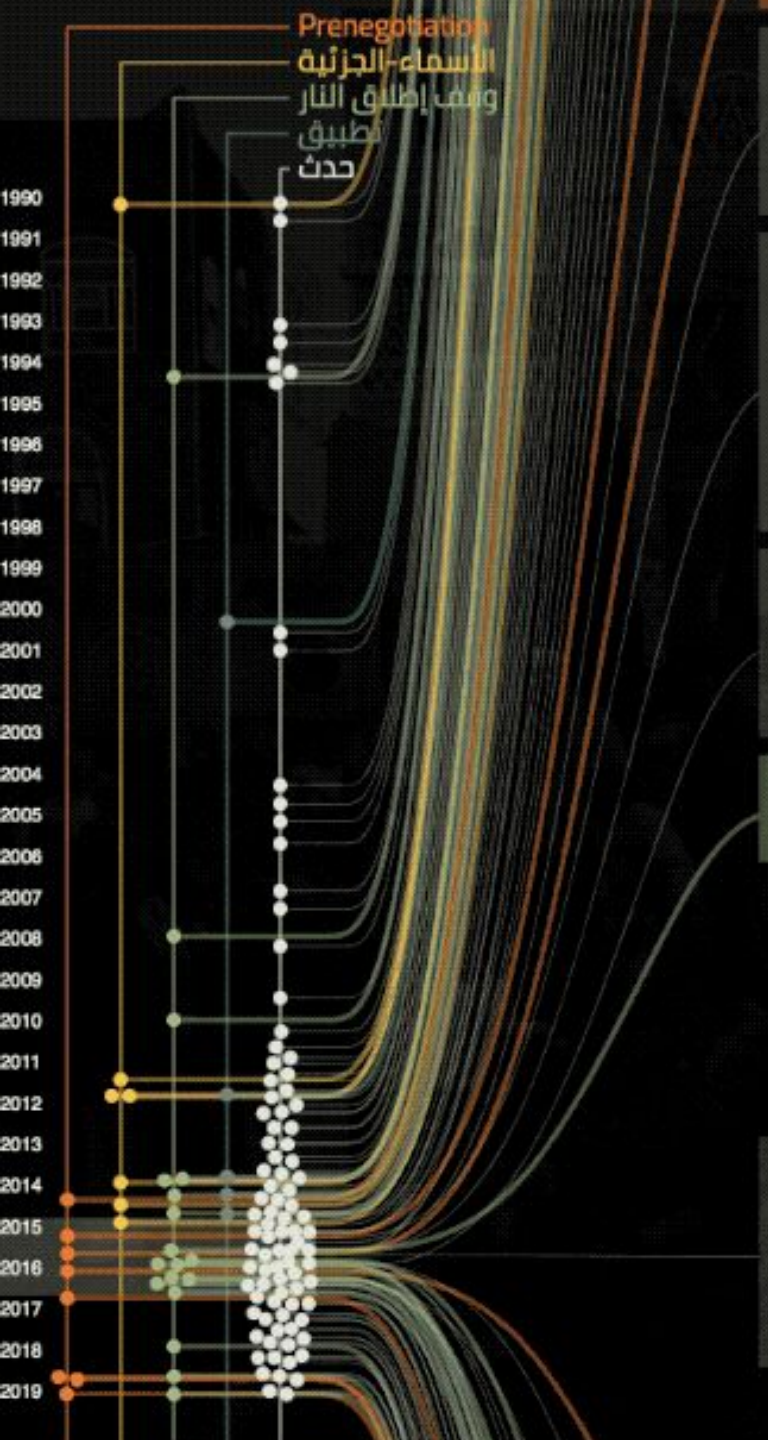




Exploration	Explanation
Data centered	Human centered
More is more	Less is more
Experts	Non-experts
Insights	Messages
Lab Setting	In-the-wild
Lengthy	To-the-point
Fuzzy	Precise



Participation



26/10/2015

تدمير مستشفى في صعدة جراء غارة جوية

أفادت منظمة أطباء بلا حدود عن تدمير مستشفى تابع لها في صعدة من غارة جوية

وفود إلى مسقط للتحضير للمناقشات
ية

ان الوساطة المستترة ويصل وفدان من أنصار الله والمؤتمر الشعبي العام إلى مسقط لإجراء مناقشات

محافظ عدن على يد الدولة الإسلامية

عدن وستة من مرافقيه تفجير سيارة تبناه تنظيم الدولة الإسلامية وتم تعيين عيدروس الزبيدي خلفا له

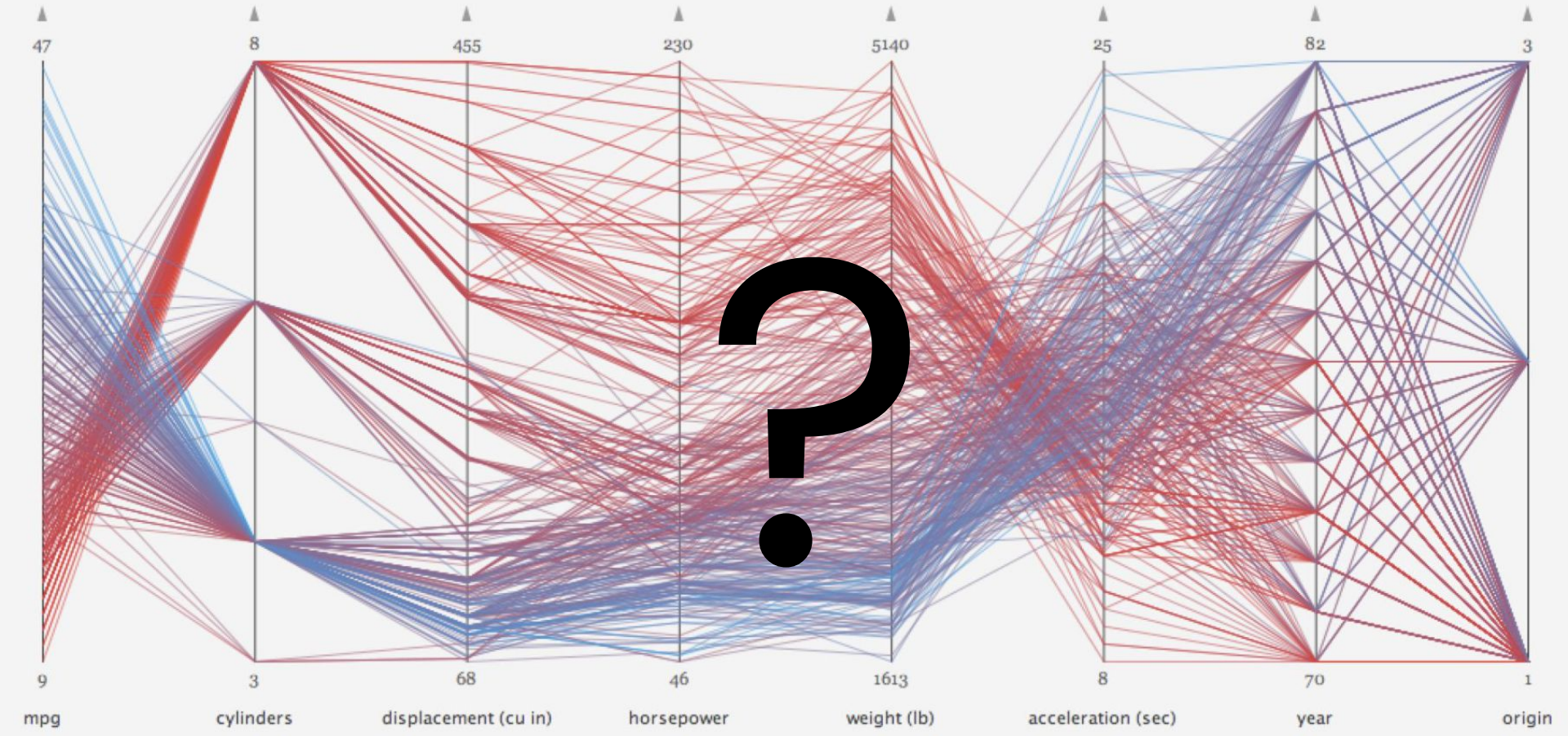
10/24/2014

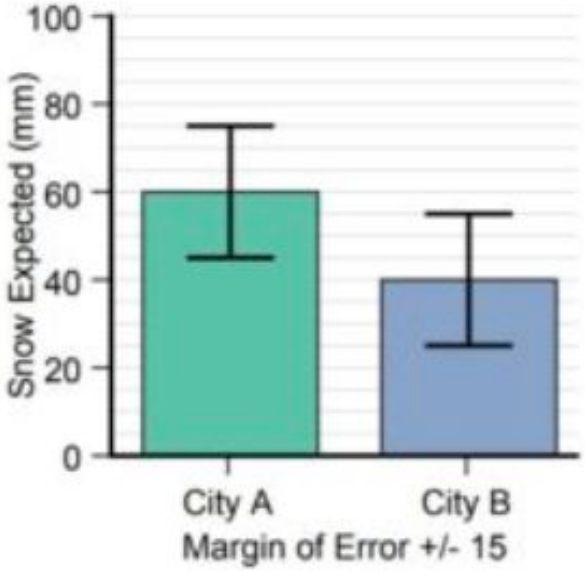
لة الثانية من المفاوضات في جنيف

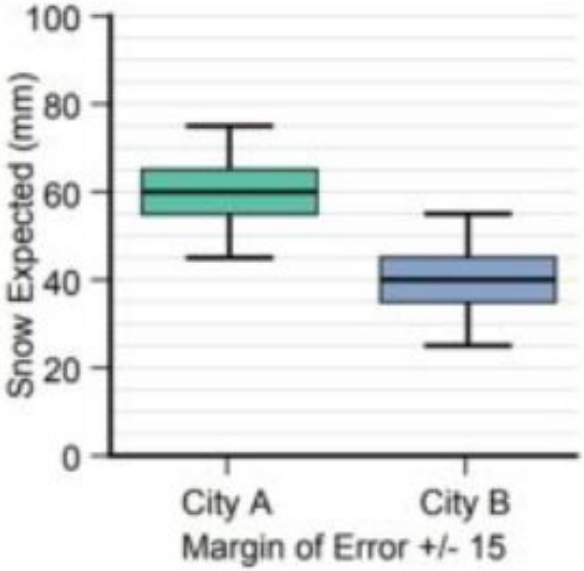
جولة ثانية من المفاوضات في جنيف بين أنصار الله والحكومة اليمنية ولكنها تتأخر وفي النهاية تنهار
ف إطلاق النار من كلا الجانبين

Type	Description	#
OBSERVATION	Stating the obvious; point out specific data points or trends; express insights and interpretations	62
CONCLUSION	Taking a step back to provide an overview over the presented information and draw conclusions or call to action	29
HYPOTHESIS	Providing a speculative explanation to explain the presented information. This can range from tentatively asked questions to bold claims that introduce additional data to argue for an explanation	56
CLARIFICATION	Asking for information to better understand the data, a visualization or its insight	50
PROPOSAL	Propose future work and possible adaptations of the data or visualization	43
CRITIQUE	Feedback to the visualization author, ranging from expressing constructive feedback and pointing out improvements to disagreement with the visualization and contestation of data.	90
ADDITIONAL INFORMATION	Introduce additional information to allow people to better contextualize or relate to the presented data. Includes background information, comparisons with similar data, trivia, and links to external sources with additional data.	58
TESTIMONY	Providing personal information by speaking from first-hand experiences and sharing anecdotes or memories	41
OPINION	Providing a personal perspective by sharing opinions, but also feelings and emotional reactions.	92
OTHER	Unfitting in other categories, off-topic or not understandable reactions	19

Visualization Literacy


47
8
455
230
5140
25
82
3
?
9
3
68
46
1613
8
70
1
mpg
cylinders
displacement (cu in)
horsepower
weight (lb)
acceleration (sec)
year
origin


100
80
60
40
20
0
Snow Expected (mm)
City A
City B
Margin of Error +/- 15


100
80
60
40
20
0
Snow Expected (mm)
City A
City B
Margin of Error +/- 15

Visualization Literacy

Reading:

- Correctly decode (simple & complex) visual representations
- Know pitfalls and deceptions
- Think critically 'beyond' and see 'through' the visualization

Design:

- Create efficient and effective visualizations
- Design efficient and effective visualizations

Explore:

- perform tasks: ask and answer questions
- Interact with with visualizations

Visualization Literacy

Reading:

- Correctly decode (simple & complex) visual representations
- Know pitfalls and deceptions
- Think critically 'beyond' and see 'through' the visualization

Design:

- Create efficient and effective visualizations
- Design efficient and effective visualizations

Explore:

- perform tasks: ask and answer questions
- Interact with with visualizations

Visualization Literacy

Reading:

- Correctly decode (simple & complex) visual representations
- Know pitfalls and deceptions
- Think critically 'beyond' and see 'through' the visualization

Design:

- Create efficient and effective visualizations
- Design efficient and effective visualizations

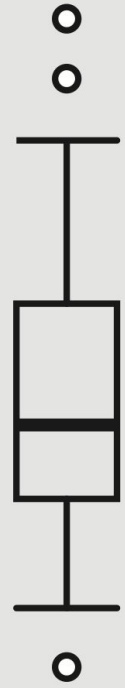
Explore:

- perform tasks: ask and answer questions
- Interact with with visualizations

Boxplot

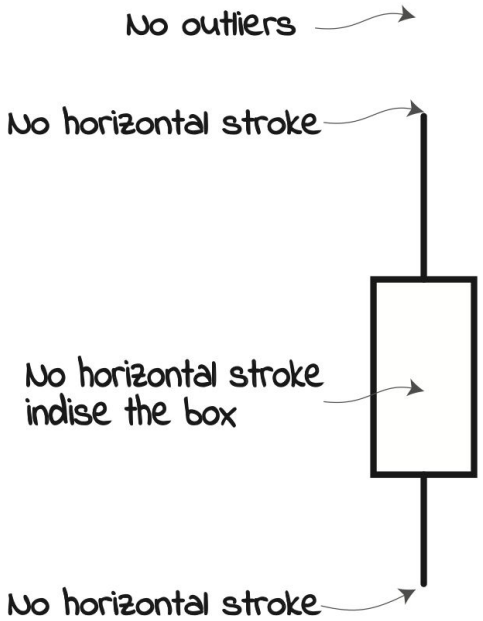
False-Friends

Boxplots



≠

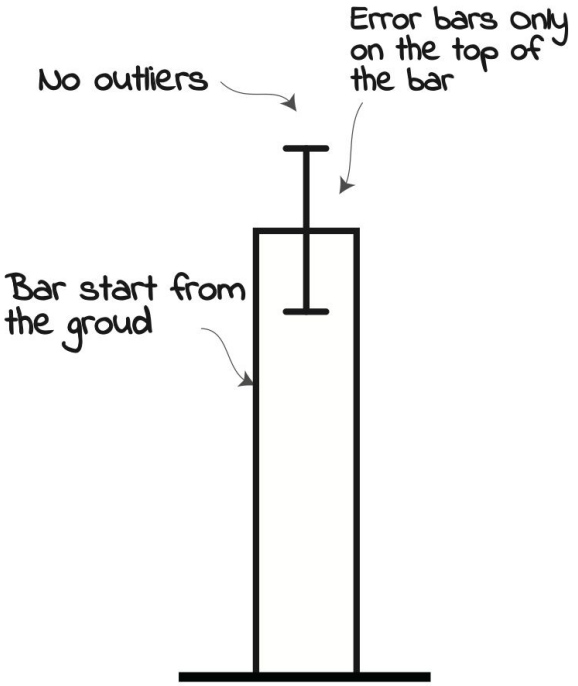
Candlesticks



A candlestick represents the price activity of an asset during a specified timeframe through the use of four main components: the open, close, high and low.

≠

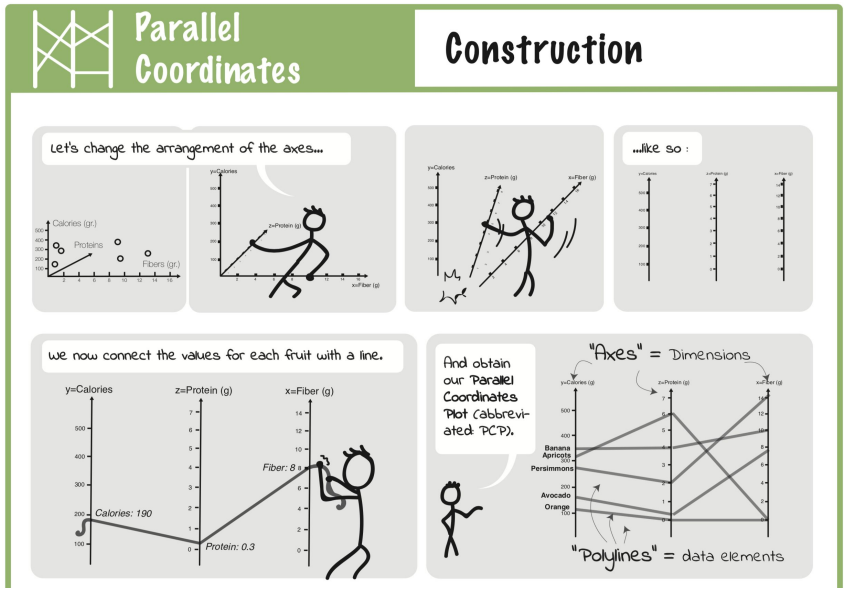
Error bars



Error bars are graphical representations of the variability of data and used on graphs to indicate the error or uncertainty in a reported measurement.

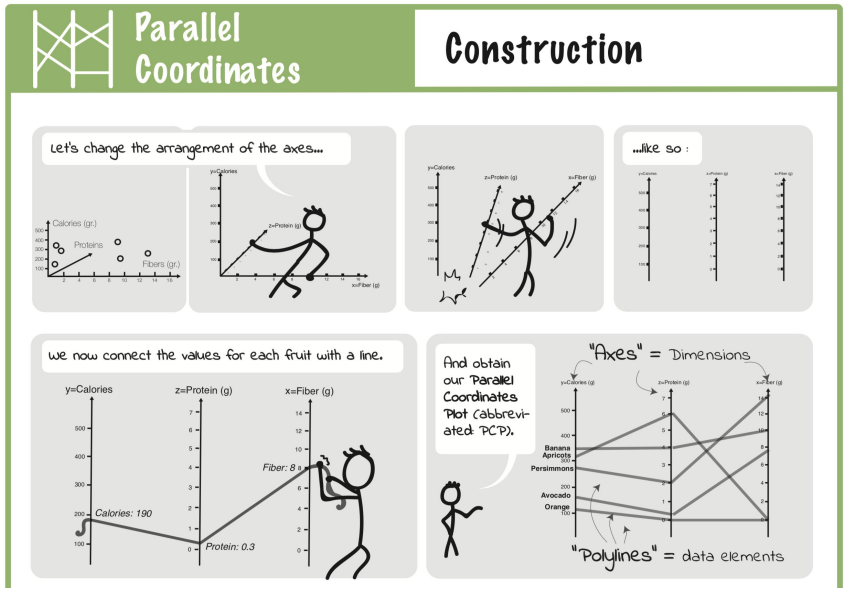
CC BY NC ND

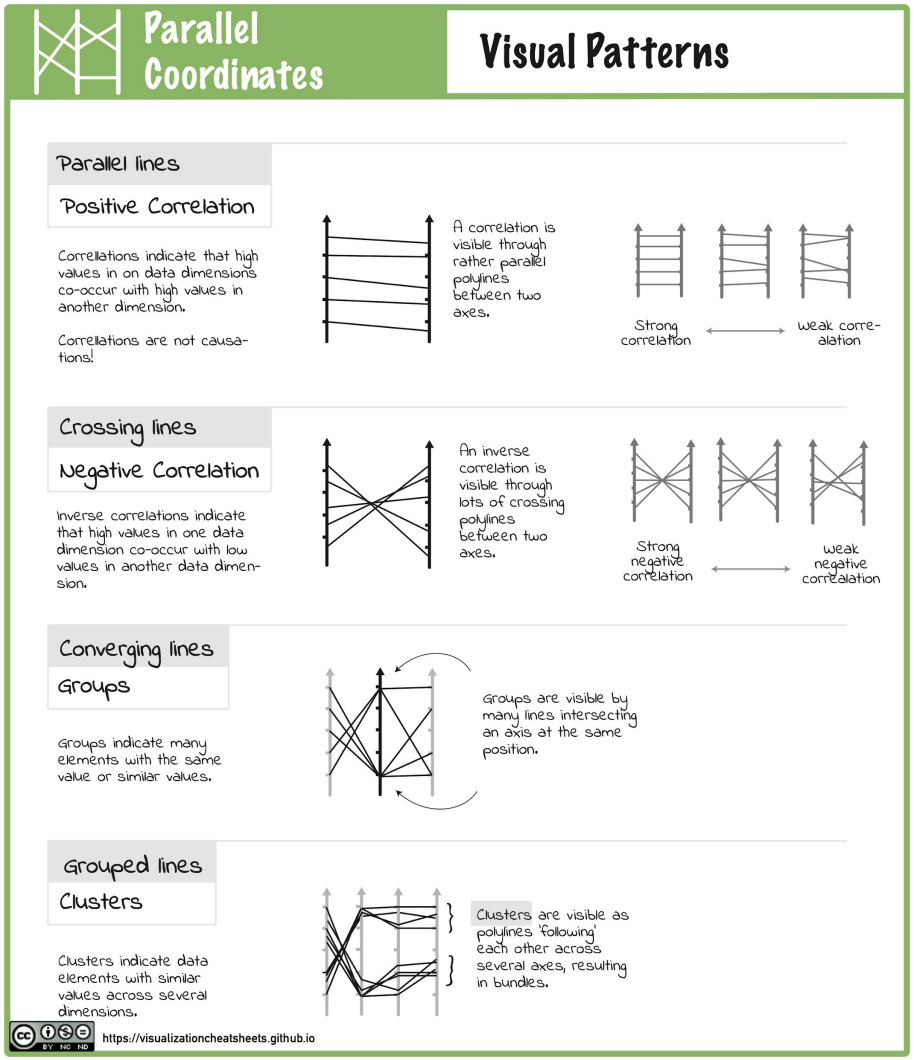
Visualization Cheat Sheets



Wang, Z., Sundin, L., Murray-Rust, D. and Bach, B., 2020, April. Cheat Sheets for Data Visualization Techniques. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-13).

Visualization Cheat Sheets

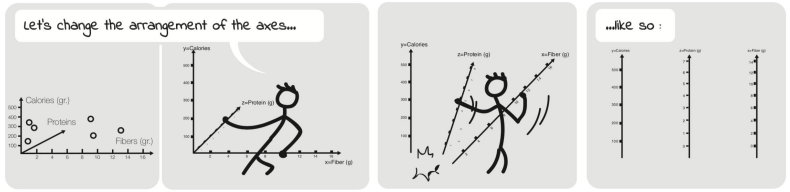




Wang, Z., Sundin, L., Murray-Rust, D. and Bach, B., 2020, April. Cheat Sheets for Data Visualization Techniques. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-13).

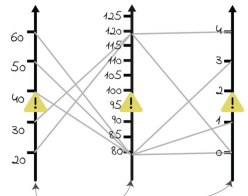
Visualization Cheat Sheets

Parallel Coordinates — Construction



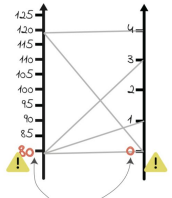
Parallel Coordinates — Pitfalls

Axis scales



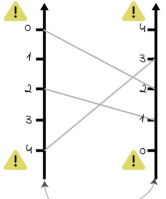
Different dimensions usually have different scales and units.

Truncated axes



Values on axes can start form values other than '0'.

Axes order



Values on axes can be either decending or acending.

https://visualizationcheatsheets.github.io

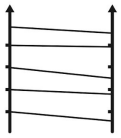
Parallel Coordinates — Visual Patterns

Parallel lines

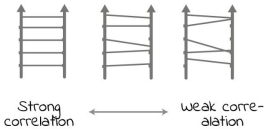
Positive Correlation

Correllations indicate that high values in on data dimensions co-occur with high values in another dimension.

Correllations are not causations!



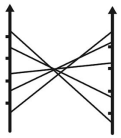
A correlation is visible through rather parallel polylines between two axes.



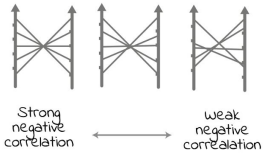
Crossing lines

Negative Correlation

Inverse correlations indicate that high values in one data dimension co-occur with low values in another data dimension.



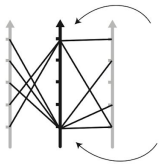
An inverse correlation is visible through lots of crossing polylines between two axes.



Converging lines

Groups

Groups indicate many elements with the same value or similar values.

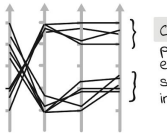


Groups are visible by many lines intersecting an axis at the same position.

Grouped lines

Clusters

Clusters indicate data elements with similar values across several dimensions.



Clusters are visible as polylines 'following' each other across several axes, resulting in bundles.

https://visualizationcheatsheets.github.io

Wang, Z., Sundin, L., Murray-Rust, D. and Bach, B., 2020, April. Cheat Sheets for Data Visualization Techniques. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-13).

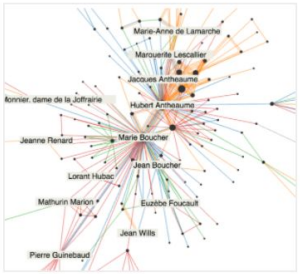
The more you see,

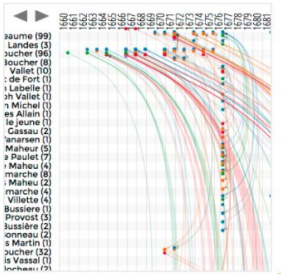
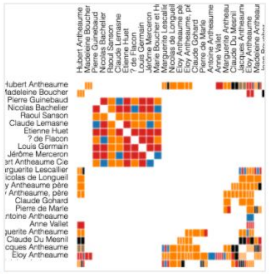
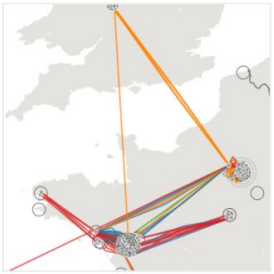
The more you see,
the more you see what you
don't see

http://vistorian.github.io

THE VISTORIAN (BETA)

Interactive Visualizations for Dynamic and Multivariate Networks.
Free, online, and open source.



Visualizations Example Session Your Session

Manual Github Contact

The University of Edinburgh Microsoft Research - Inria Joint Centre Aviz Inria Microsoft Research

datafairs.github.io

DATA FAIR 2021
University of Edinburgh

Overview >> Submit a Challenge >> What we teach >> Previous Data Fairs >> Research >> Contact >>

design informatics

THE UNIVERSITY of EDINBURGH

VIS HUB University of Edinburgh
Visual+ Interactive Data

What is the Data Fair?

Our data fair brings together our Master students in Design Informatics at the University of Edinburgh and external partners (you!) to collaborate on data analysis and visualization. The goal is for the students to chose a real-world dataset and an associated 'challenge' over in our course 'Data Science for Design', running from October to December 2021. Within that course, students will learn the basics of data analysis and visualization. Their assignment requires them to analyze a data set (basic analysis and plotting) and work on a visualization project that can focus on exploratory or explanatory issues for data visualization. Students will work in groups of 3 students. Visit projects from the past years here.

Data Visualization for **Exploration**, **Explanation**, and **Participation**

Benjamin Bach
Lecturer in Design Informatics and Visualisation
University of Edinburgh
@benjbach
https://visualinteractivedata.github.io

VIS HUB University of Edinburgh Visual+ Interactive Data

design informatics

DCS DATA CULTURE SOCIETY

THE UNIVERSITY OF EDINBURGH