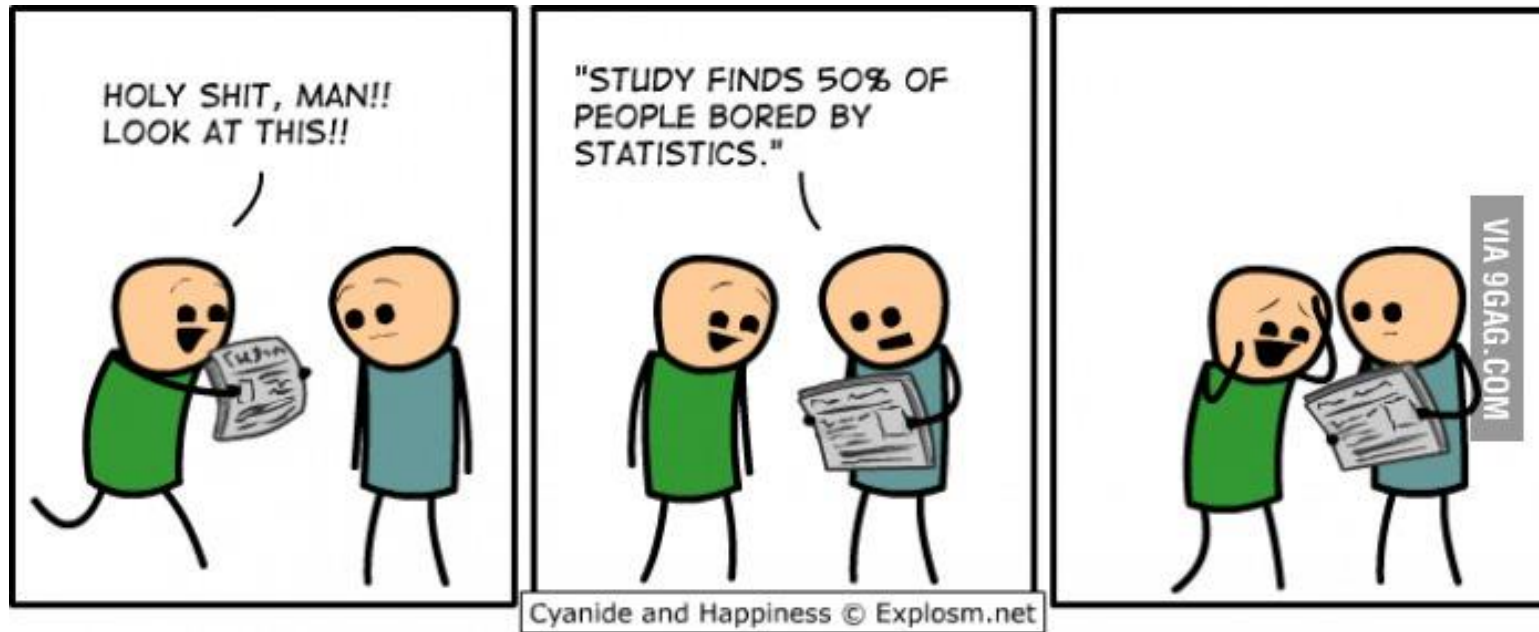


Vizualizace dat

Úvodní a organizační hodina

26. 9. 2019

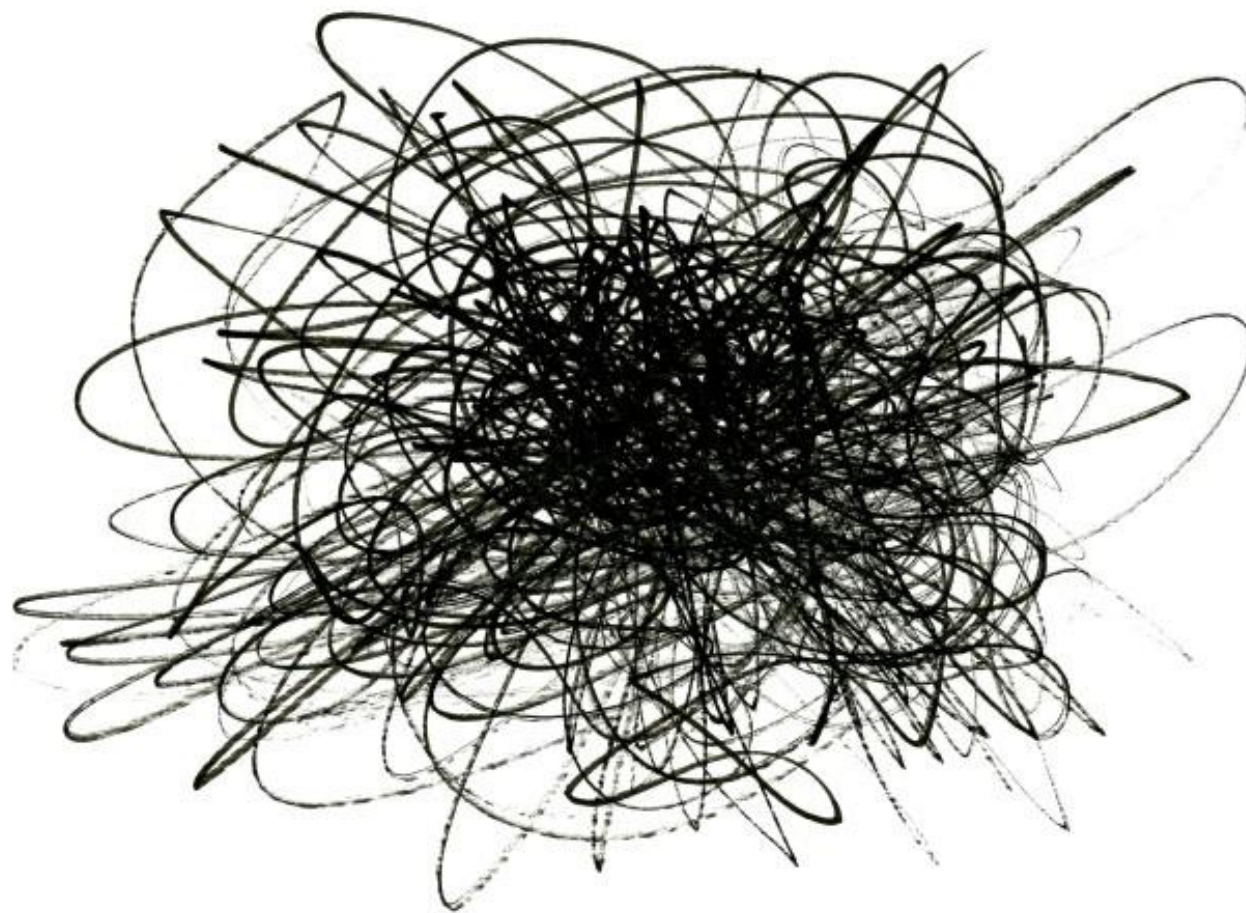


„Data visualization is the fastest way to make a whole bunch of numbers look a lot more interesting.“

Kdo jsem?

- Tomáš Marek
- marek@kisk.cz
- +420 725 594 879

Co čekáte vy?



Co čekám já?

- Komplexní pohled (*informační design...*)
- Vizualizace jako nástroj
- Proč, kdy a jak ji používat v různých kontextech
- Základy, výzkumy, triky a tipy
- Dobrá a špatná praxe
- Historie – protože to dává smysl
- Hraní si s klikačkami
- Specificky zaměřené hodiny: kognice, barva, mapy...

Požadavky na ukončení

- Průběžné úkoly
- Zkouška
- Docházka

Proč vizualizace?

Aktuálně máme hodně dat.

Data jsou všude.

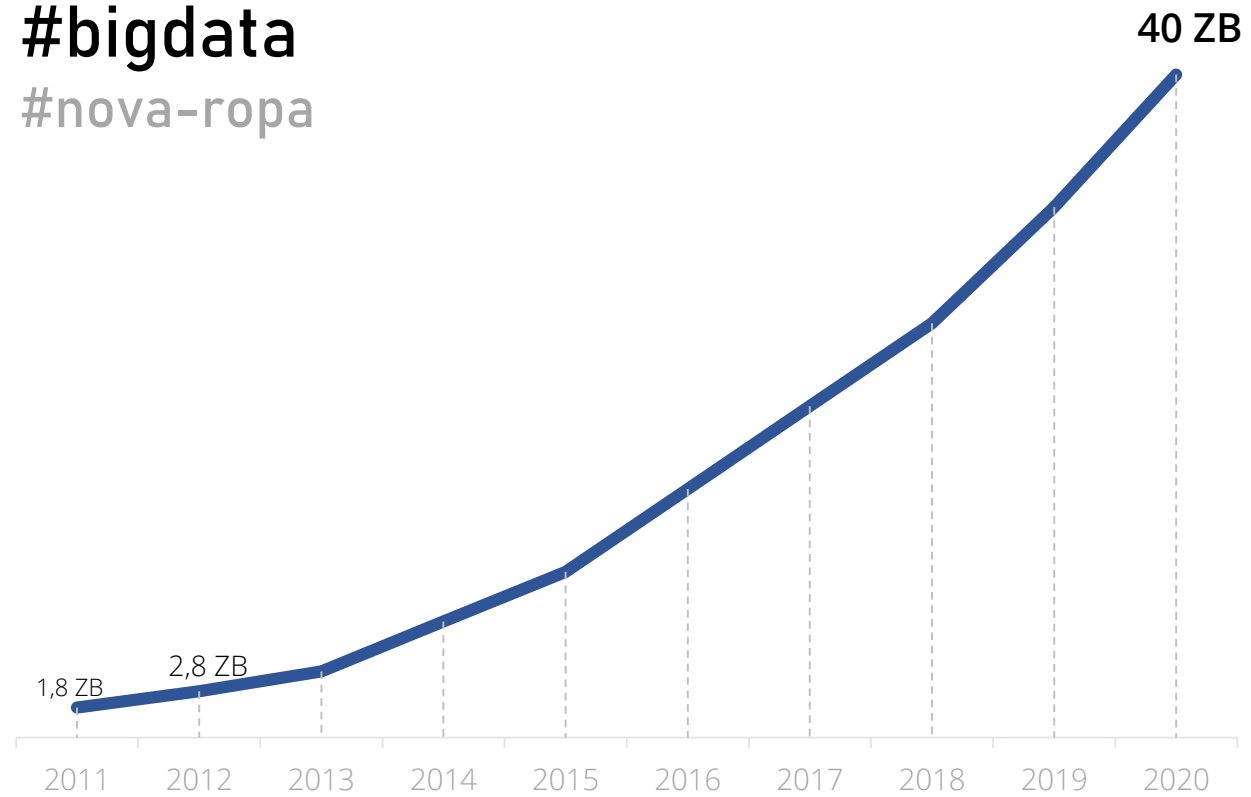
Data jsou o všem.



"According to all the big data we've gathered, our discussions about big data are up 72% this year alone."

#bigdata

#nova-ropa



| X | Y | Z | AA | AB |
|--------------------|----------------------|---|----|----|
| JUNE 2017 | | | | |
| Sales | Tax | | | |
| 4,840,579 | \$ 1,064,302 | | | |
| 5,215,122 | \$ 1,256,920 | | | |
| 2,952,720 | \$ 987,355 | | | |
| 2,224,265 | \$ 774,935 | | | |
| 3,890,290 | \$ 838,947 | | | |
| 3,979,018 | \$ 830,231 | | | |
| 4,617,850 | \$ 833,773 | | | |
| 4,774,399 | \$ 901,683 | | | |
| 5,381,983 | \$ 1,219,918 | | | |
| 2,932,589 | \$ 1,004,275 | | | |
| 2,141,298 | \$ 763,059 | | | |
| 4,088,307 | \$ 784,215 | | | |
| 3,990,602 | \$ 816,751 | | | |
| 4,554,625 | \$ 861,428 | | | |
| 4,922,840 | \$ 951,585 | | | |
| 5,449,133 | \$ 1,246,051 | | | |
| 2,988,242 | \$ 994,368 | | | |
| 2,299,106 | \$ 775,098 | | | |
| 3,879,202 | \$ 810,374 | | | |
| 4,214,111 | \$ 866,423 | | | |
| 4,651,739 | \$ 904,261 | | | |
| 4,727,973 | \$ 939,773 | | | |
| 5,346,354 | \$ 1,192,097 | | | |
| 2,847,706 | \$ 965,755 | | | |
| 2,165,789 | \$ 754,109 | | | |
| 4,027,001 | \$ 825,657 | | | |
| 4,352,374 | \$ 832,652 | | | |
| 4,783,360 | \$ 868,812 | | | |
| 5,402,665 | \$ 959,733 | | | |
| 7,270,700 | \$ 1,423,554 | | | |
| | | | | |
| 124,911,942 | \$ 28,248,093 | | | |

| 2017 Summary | |
|-----------------|----------------|
| Sales | Tax |
| \$1,365,571,860 | \$ 311,232,693 |

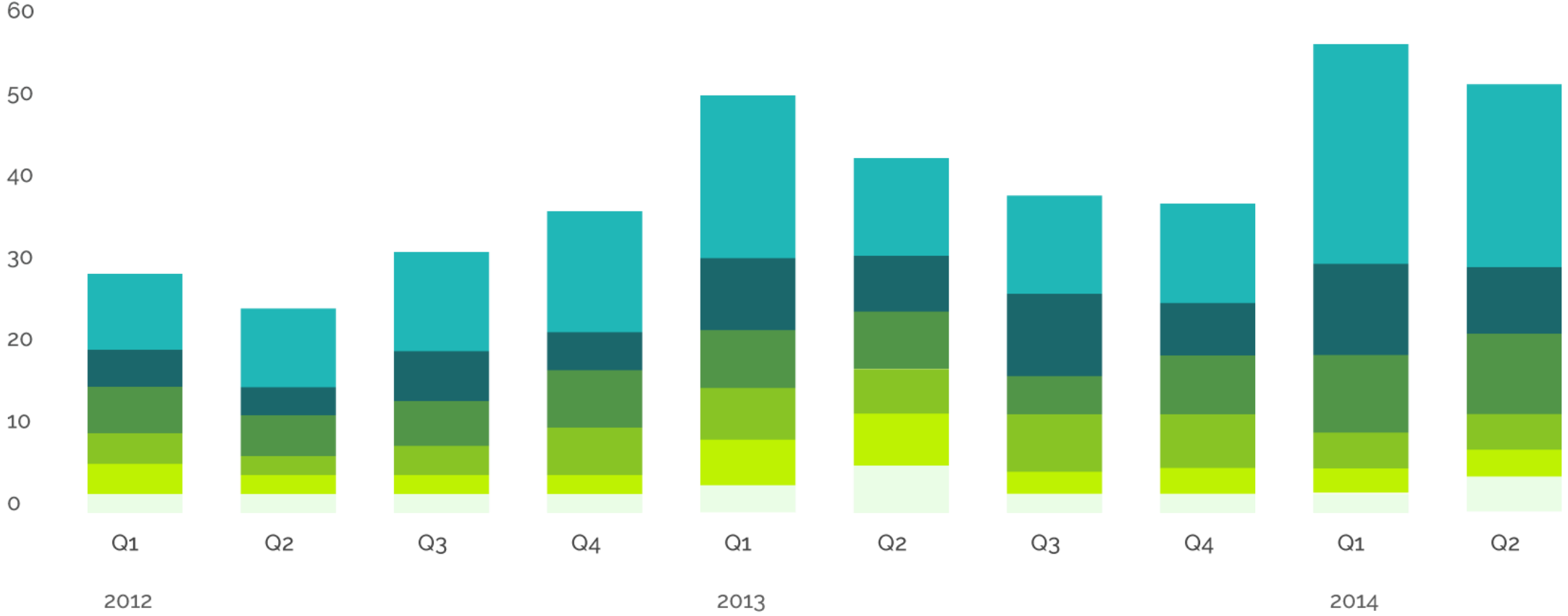
| | A | S | T | U | V | W | X | Y | Z | AA |
|----|--------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|-------------|
| 2 | DATE | APRIL 2016 | | | MAY 2016 | | JUNE 2016 | | 2016 Summary | |
| 3 | | Tax | Sales | Tax | Sales | Tax | Sales | Tax | Sales | Tax |
| 4 | 1 | \$ 563,580 | \$ 3,323,081 | \$ 881,812 | \$ 1,436,863 | \$ 487,540 | \$ 3,087,816 | \$ 686,992 | \$786,387,430 | \$ 1 |
| 5 | 2 | \$ 516,337 | \$ 1,971,737 | \$ 652,143 | \$ 2,266,284 | \$ 534,466 | \$ 3,282,005 | \$ 643,917 | | |
| 6 | 3 | \$ 577,848 | \$ 1,392,094 | \$ 472,041 | \$ 2,449,472 | \$ 591,603 | \$ 3,804,940 | \$ 898,883 | | |
| 7 | 4 | \$ 725,025 | \$ 2,104,560 | \$ 519,457 | \$ 2,833,248 | \$ 541,924 | \$ 2,188,886 | \$ 702,189 | | |
| 8 | 5 | \$ 631,954 | \$ 2,293,434 | \$ 542,937 | \$ 3,220,679 | \$ 616,830 | \$ 1,584,063 | \$ 514,321 | | |
| 9 | 6 | \$ 463,323 | \$ 2,658,728 | \$ 527,966 | \$ 3,450,675 | \$ 788,272 | \$ 2,636,948 | \$ 600,291 | | |
| 10 | 7 | \$ 488,557 | \$ 3,225,386 | \$ 557,070 | \$ 2,037,710 | \$ 631,961 | \$ 2,544,690 | \$ 569,928 | | |
| 11 | 8 | \$ 506,731 | \$ 3,283,071 | \$ 748,172 | \$ 1,477,601 | \$ 514,467 | \$ 2,879,905 | \$ 591,792 | | |
| 12 | 9 | \$ 495,068 | \$ 1,926,156 | | | | | | | |
| 13 | 10 | \$ 553,055 | \$ 1,480,518 | | | | | | | |
| 14 | 11 | \$ 720,916 | \$ 2,327,832 | | | | | | | |
| 15 | 12 | \$ 621,340 | \$ 2,376,567 | | | | | | | |
| 16 | 13 | \$ 435,885 | \$ 2,961,393 | | | | | | | |
| 17 | 14 | \$ 501,008 | \$ 3,129,414 | | | | | | | |
| 18 | 15 | \$ 514,536 | \$ 3,539,473 | | | | | | | |
| 19 | 16 | \$ 517,905 | \$ 2,008,189 | | | | | | | |
| 20 | 17 | \$ 544,855 | \$ 1,502,015 | | | | | | | |
| 21 | 18 | \$ 726,728 | \$ 2,795,613 | | | | | | | |
| 22 | 19 | \$ 646,488 | \$ 3,201,236 | | | | | | | |
| 23 | 20 | \$ 478,636 | \$ 3,753,646 | | | | | | | |
| 24 | 21 | \$ 524,628 | \$ 2,421,589 | | | | | | | |
| 25 | 22 | \$ 496,148 | \$ 2,878,873 | | | | | | | |
| 26 | 23 | \$ 505,226 | \$ 1,879,411 | | | | | | | |
| 27 | 24 | \$ 550,418 | \$ 1,315,719 | | | | | | | |
| 28 | 25 | \$ 729,227 | \$ 2,264,860 | | | | | | | |
| 29 | 26 | \$ 618,574 | \$ 2,247,245 | | | | | | | |
| 30 | 27 | \$ 400,913 | \$ 2,908,787 | | | | | | | |
| 31 | 28 | \$ 510,471 | \$ 3,036,704 | | | | | | | |
| 32 | 29 | \$ 494,012 | \$ 4,062,385 | | | | | | | |
| 33 | 30 | \$ 489,217 | \$ 2,520,970 | | | | | | | |
| 34 | 31 | \$ 736,630 | | | | | | | | |
| 35 | Total | \$ 17,285,238 | \$ 76,790,684 | \$ 18,181,181 | \$ 35,157,619 | \$ 8,789,405 | \$ 41,498,522 | \$ 10,374,631 | \$ 45,916,145 | \$ 1 |

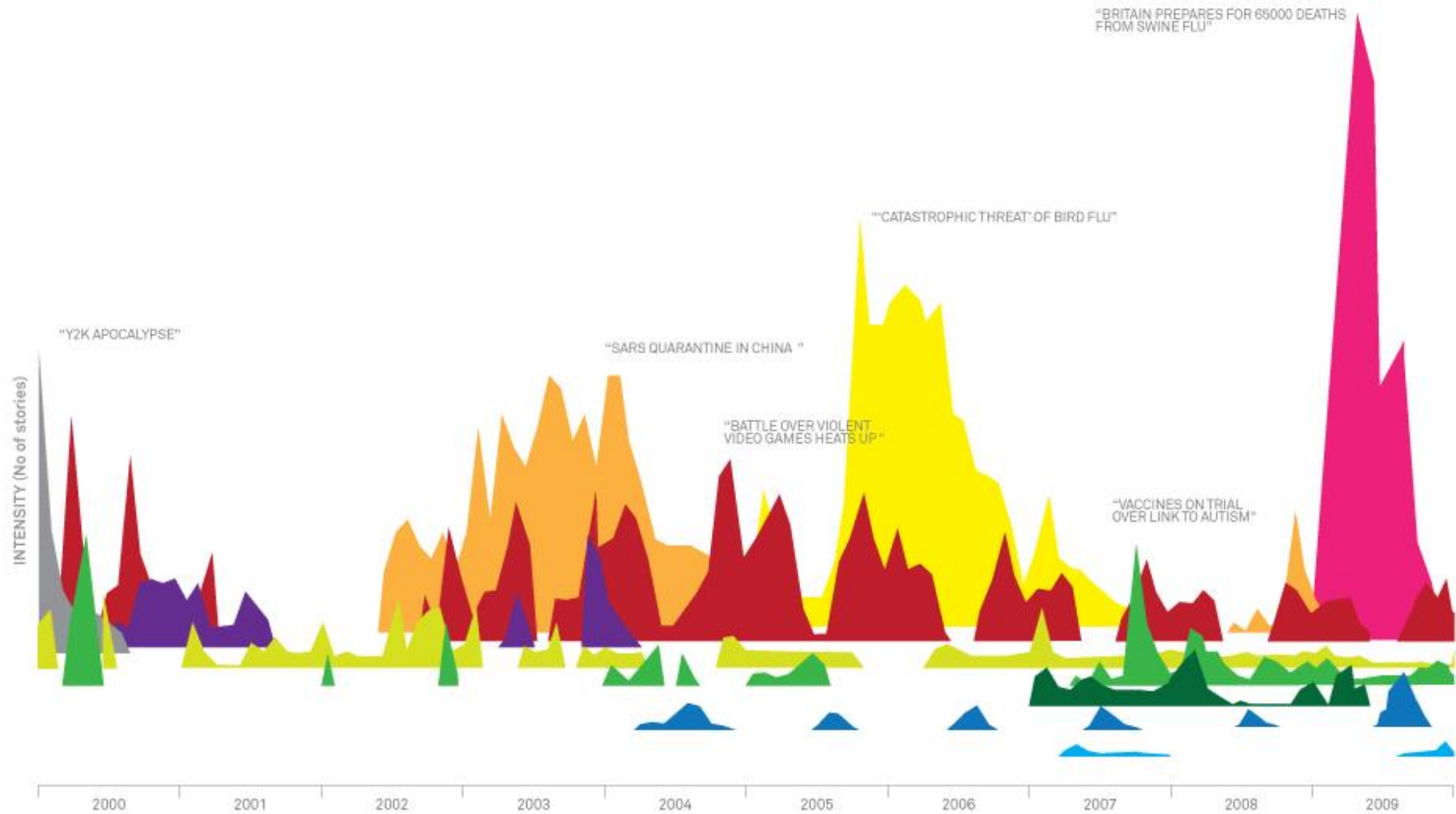
6 2017 2018 +

2015 2016 2017

2015 2016 2017 2018 +

HOW APPLE'S SALES STACK UP

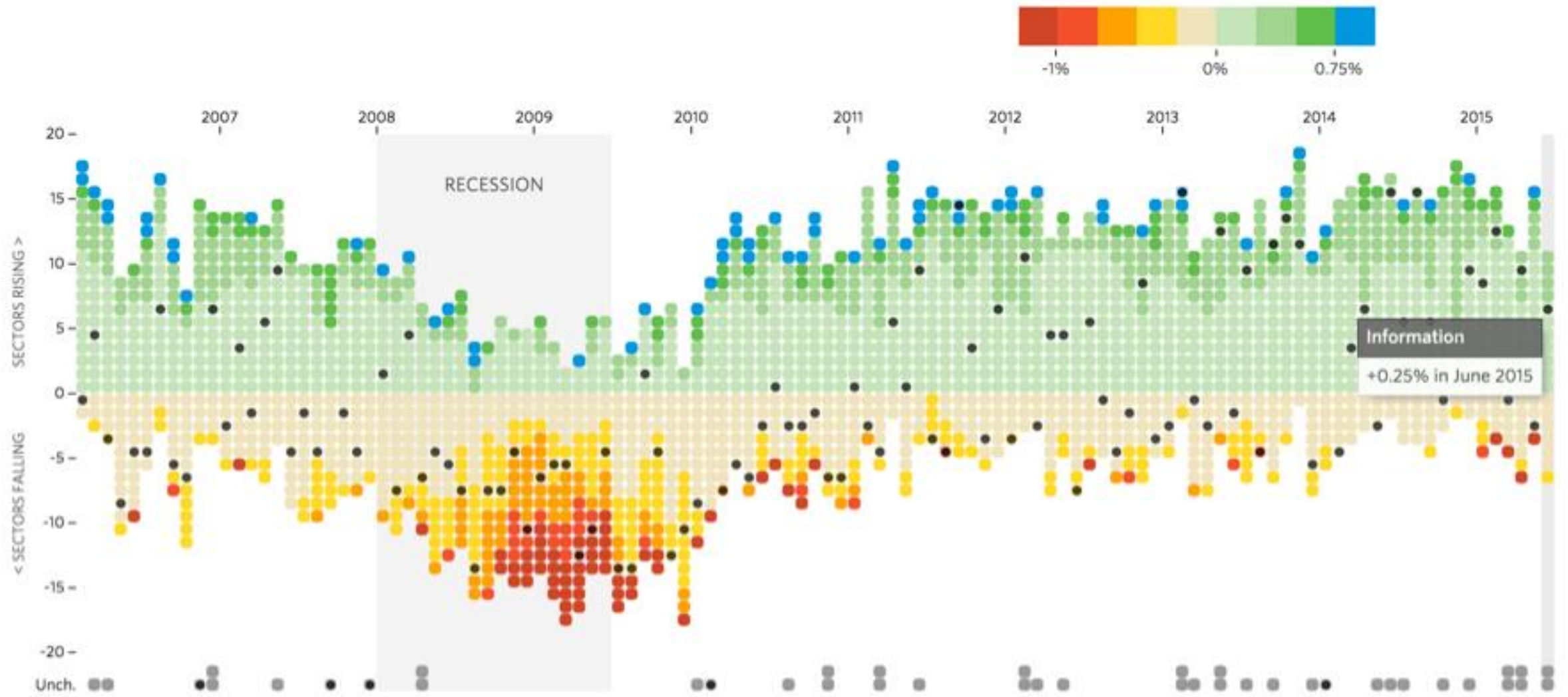


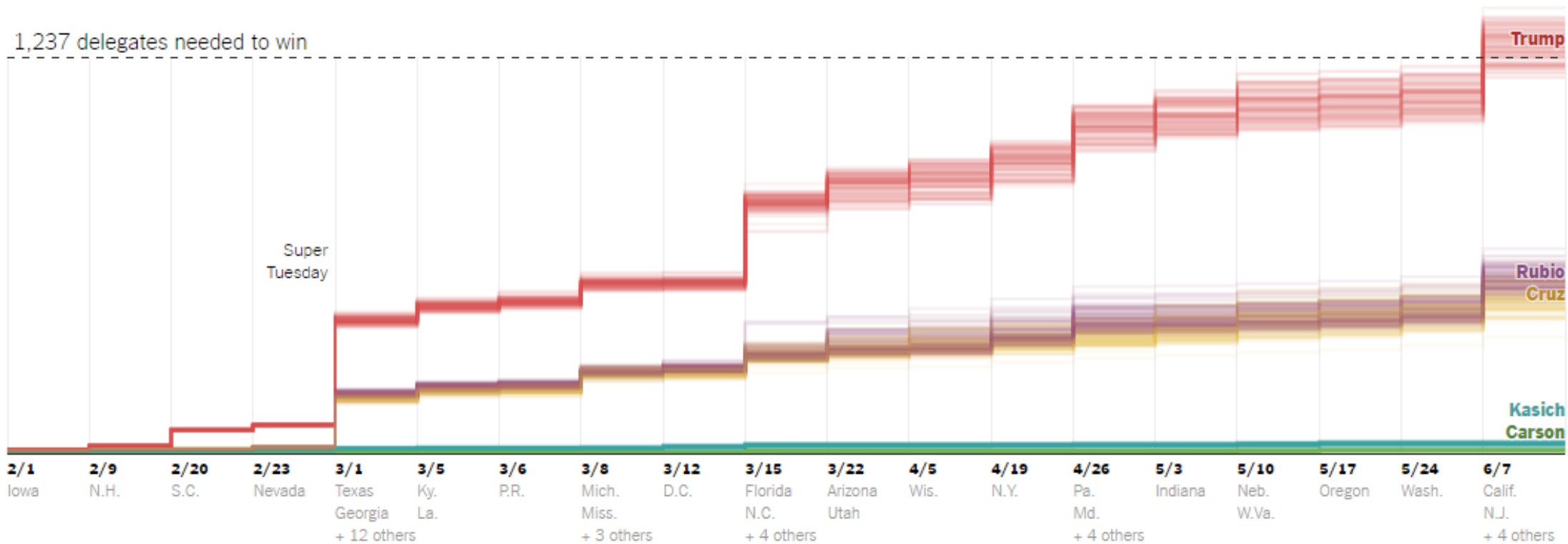


Story (worldwide deaths)

- | | | | |
|-------------------------------|---------------------------|---------------------------------|-------------------|
| ▲ Killer Wasps (1000) | ▲ Autism Vaccinations (0) | ▲ Mad Cow Disease (204) | ▲ Bird Flu (282) |
| ▲ Killer Wifi (0) | ▲ Asteroid Collision (0) | ▲ Violent Video Games (Unknown) | ▲ Swine Flu (702) |
| ▲ Mobile Phones & Tumours (0) | ▲ Millenium Bug (0) | ▲ SARS (774) | |

Mountains Out of Molehills
A timeline of global media scare stories.

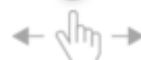
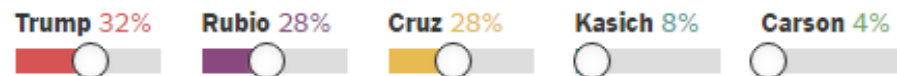




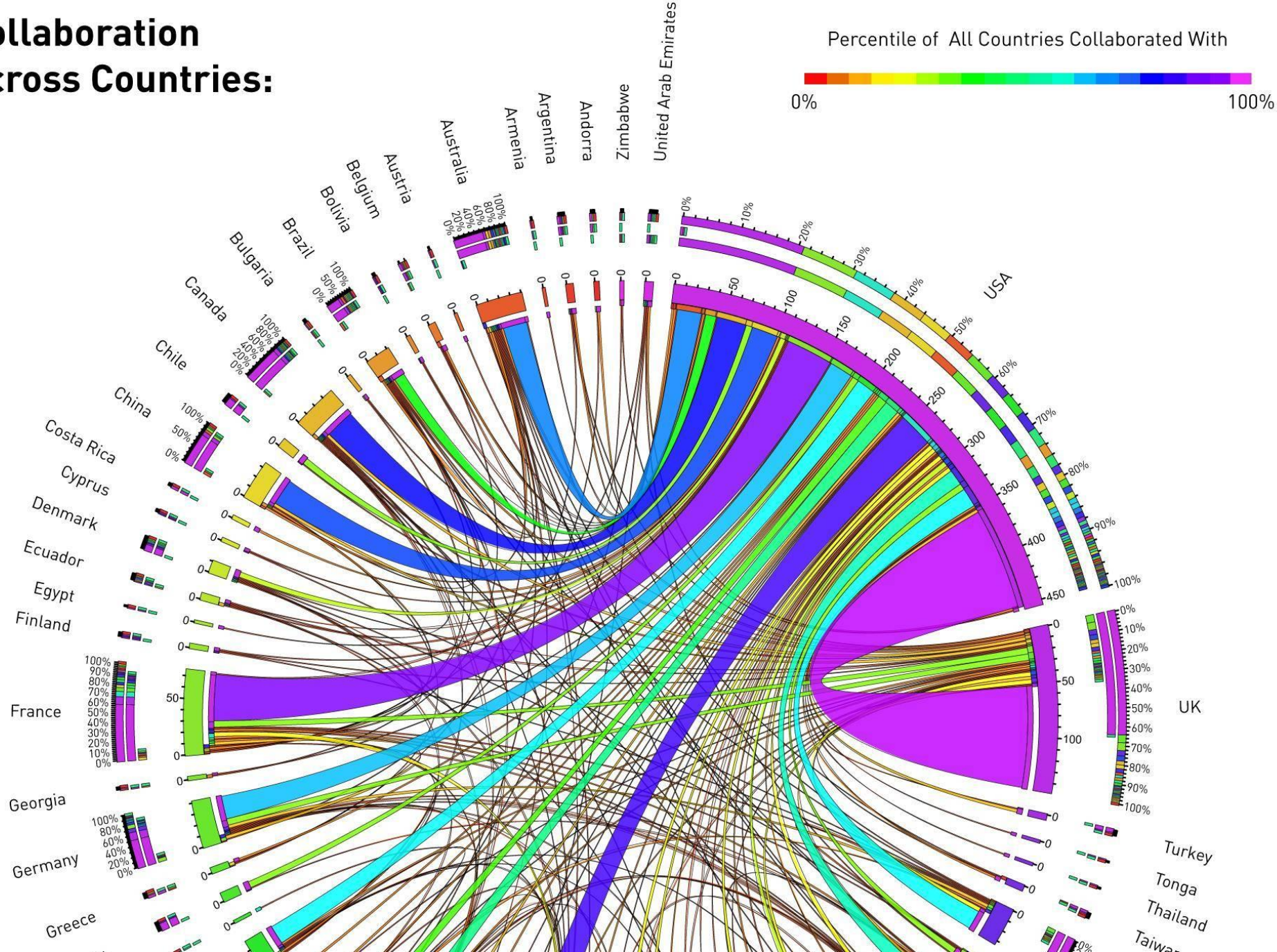
Average results through March 7

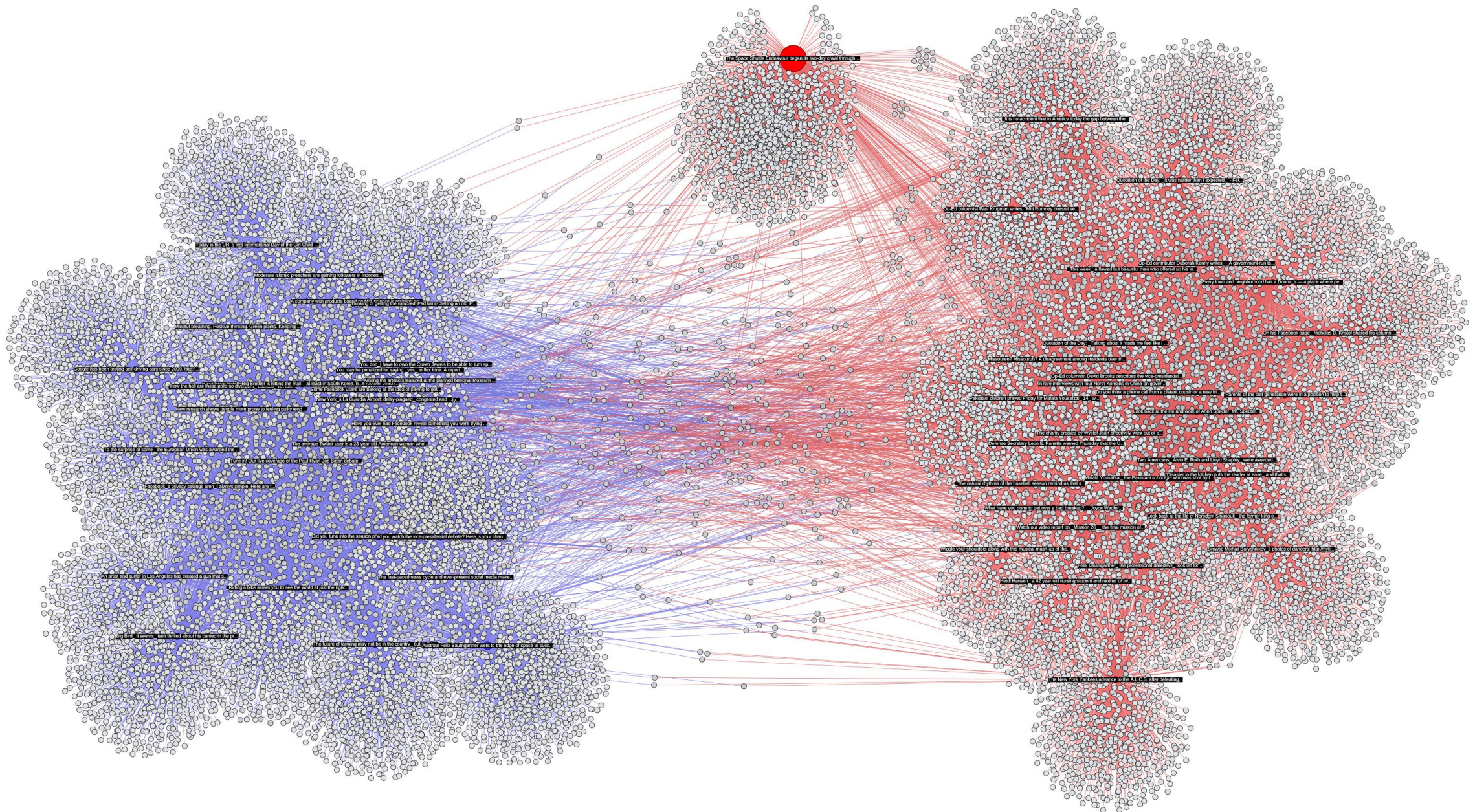


Average results after March 7



Collaboration Across Countries:





The Queen Elizabeth II coronation began its history over 100 years ago.

It is the oldest ever in America since the settlement of the

Location of the Bay - was under the protection of the

It is the oldest ever in America since the settlement of the

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Today is the UN's first International Day of the Girl Child

Victoria Island: Prayers for the victims of the 2004 tsunami

A company with products that are not yet on the shelves

World's largest: Positive thinking: Great things: Keeping

Google has been using the driving cars since 2000. Why?

You can't have a better car than the one you're in

You may be surprised for a while - but for a long time

How do the cars that are used in South Korea? The answer is

some Facebook users are taking the idea of paying to play

New York's La Guardia Airport: they played, compressed and try

New research shows people more prone to being guilty than

Have you ever had Facebook reveal something you were trying

The European Union was awarded the

The average Twitter user is a 28-year-old American woman

Former CIA live coverage of the Paul Ryan-Boehner debate

Facebook & privacy settings with 10 ways to make sure

Did you tune into the season 10 of the voice? Considered the debut? Here's a your crash

An artist and actor in Los Angeles has created a gun that

The fast-paced news cycle and ever-present social media

Being a fan shows you to see the world a little right

Did you know? It's not about the number of likes

The history of America and not the way to success: the American

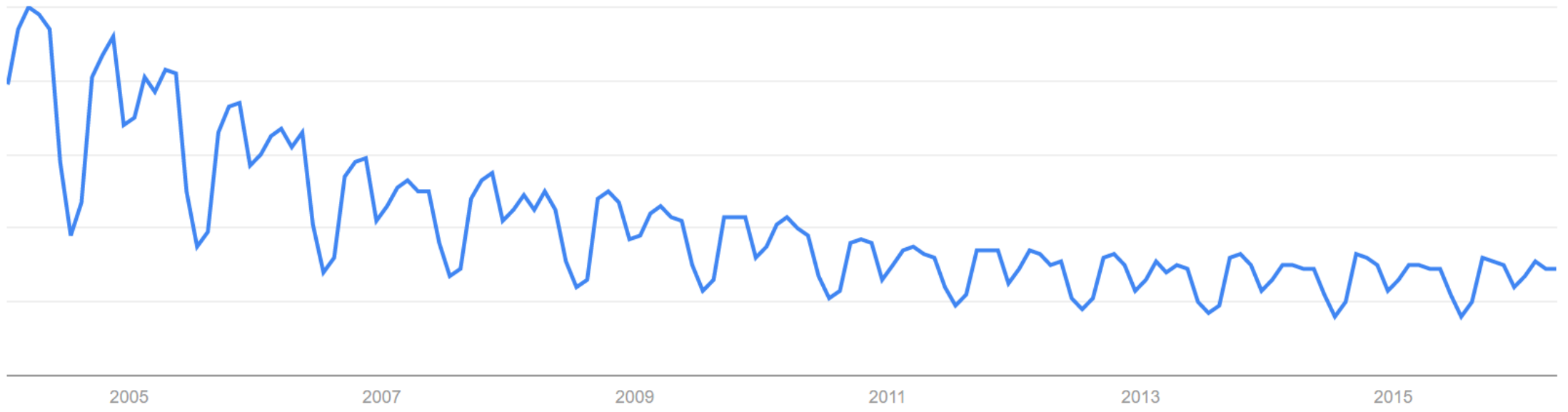
The New York Yankees advance to be A.C.C. this season

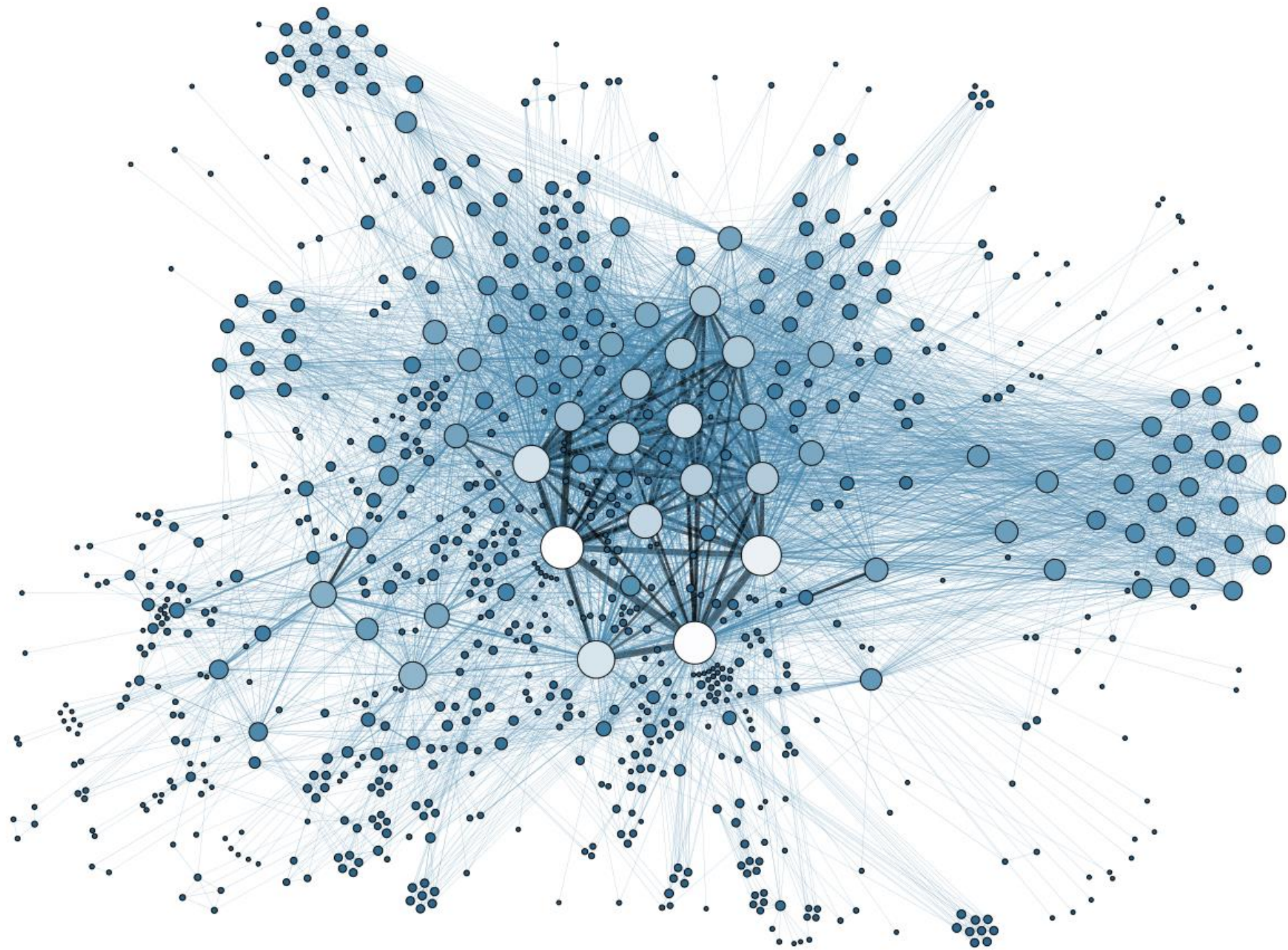


Vizualizujeme data, protože...

...v nich chceme najít vzory, trendy, změny a korelace. Chceme z nich dostat smysluplné informace.

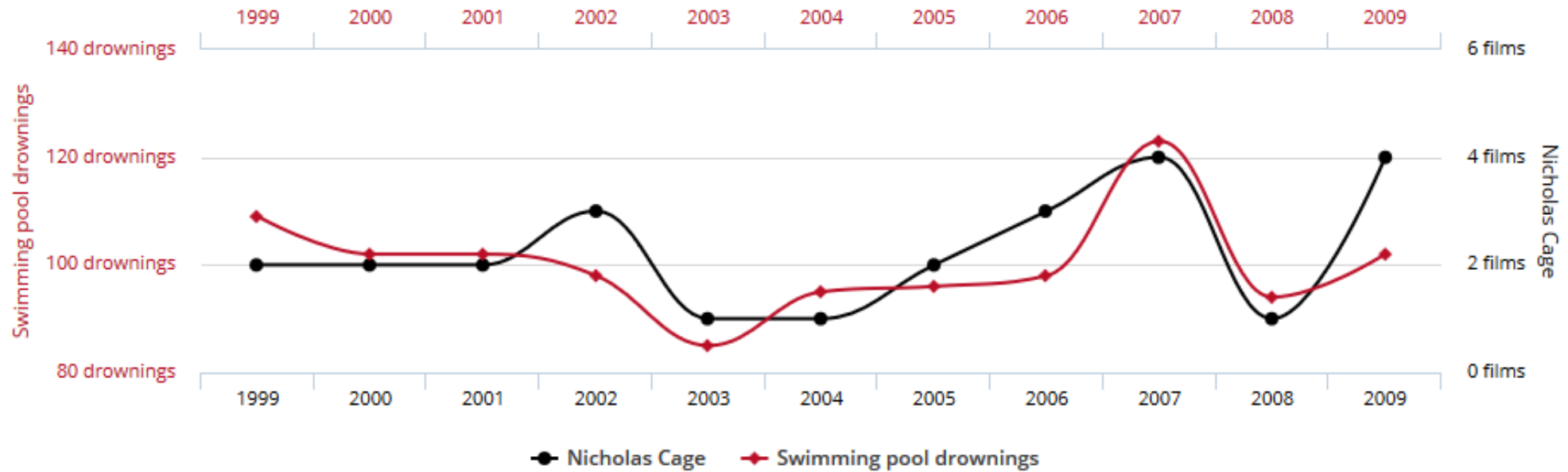






Number of people who drowned by falling into a pool correlates with Films Nicolas Cage appeared in

Correlation: 66.6% ($r=0.666004$, $p>0.05$)



Data sources: Centers for Disease Control & Prevention and Internet Movie Database

tylervigen.com

Anscombův kvartet

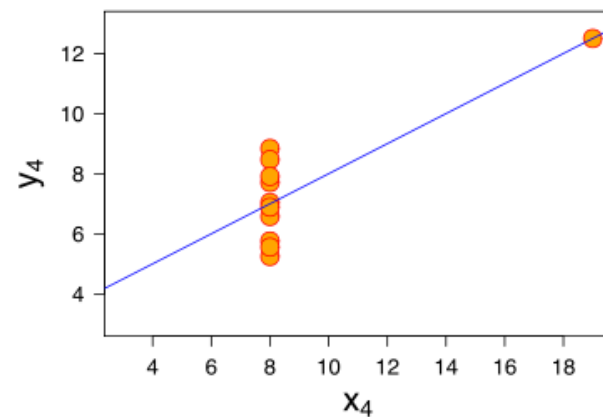
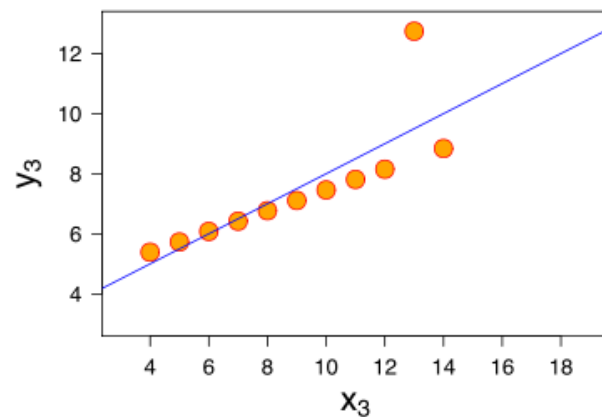
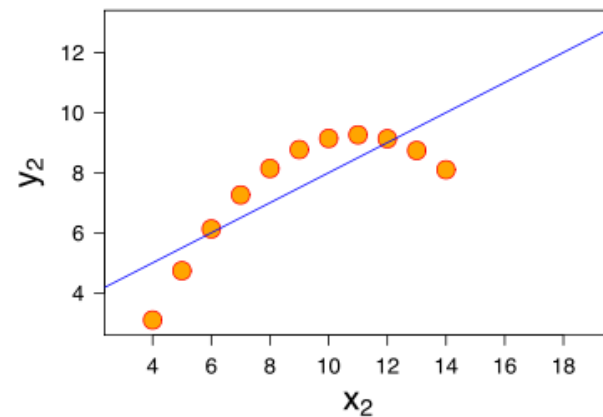
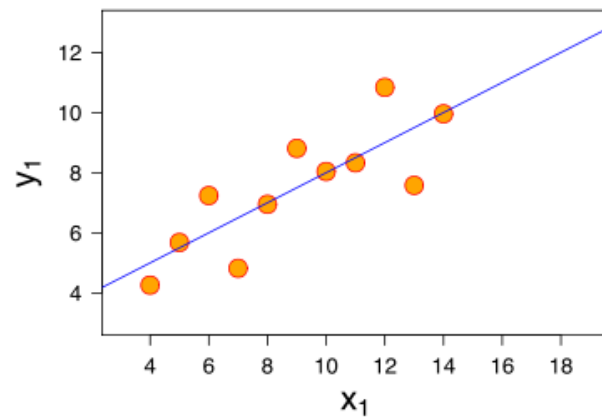
| I | | II | | III | | IV | |
|------|-------|------|------|------|-------|------|-------|
| x | y | x | y | x | y | x | y |
| 10.0 | 8.04 | 10.0 | 9.14 | 10.0 | 7.46 | 8.0 | 6.58 |
| 8.0 | 6.95 | 8.0 | 8.14 | 8.0 | 6.77 | 8.0 | 5.76 |
| 13.0 | 7.58 | 13.0 | 8.74 | 13.0 | 12.74 | 8.0 | 7.71 |
| 9.0 | 8.81 | 9.0 | 8.77 | 9.0 | 7.11 | 8.0 | 8.84 |
| 11.0 | 8.33 | 11.0 | 9.26 | 11.0 | 7.81 | 8.0 | 8.47 |
| 14.0 | 9.96 | 14.0 | 8.10 | 14.0 | 8.84 | 8.0 | 7.04 |
| 6.0 | 7.24 | 6.0 | 6.13 | 6.0 | 6.08 | 8.0 | 5.25 |
| 4.0 | 4.26 | 4.0 | 3.10 | 4.0 | 5.39 | 19.0 | 12.50 |
| 12.0 | 10.84 | 12.0 | 9.13 | 12.0 | 8.15 | 8.0 | 5.56 |
| 7.0 | 4.82 | 7.0 | 7.26 | 7.0 | 6.42 | 8.0 | 7.91 |
| 5.0 | 5.68 | 5.0 | 4.74 | 5.0 | 5.73 | 8.0 | 6.89 |

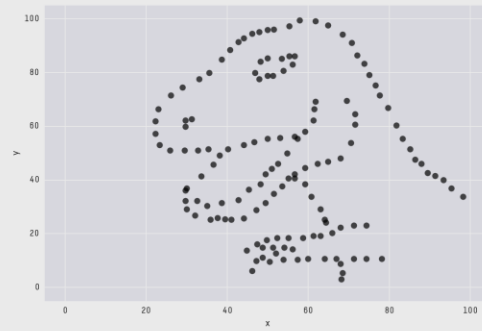
Dataset v popisné statistice

| Property | Value | Accuracy |
|---------------------------------|---------------------|---|
| Mean of x | 9 | exact |
| Sample variance of x | 11 | exact |
| Mean of y | 7.50 | to 2 decimal places |
| Sample variance of y | 4.125 | plus/minus 0.003 |
| Correlation between x and y | 0.816 | to 3 decimal places |
| Linear regression line | $y = 3.00 + 0.500x$ | to 2 and 3 decimal places, respectively |

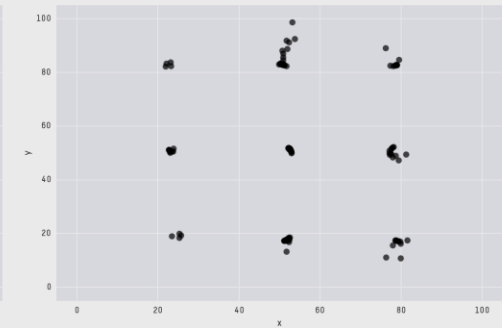
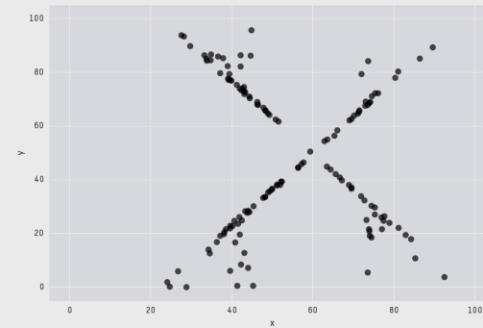
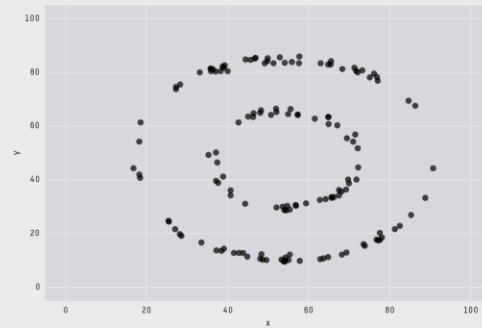
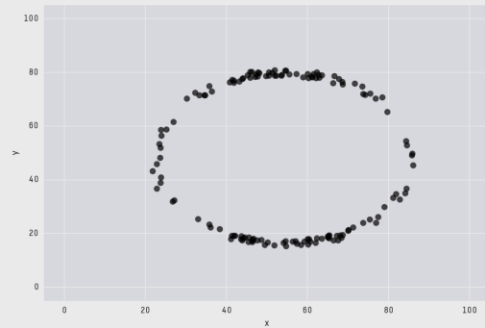
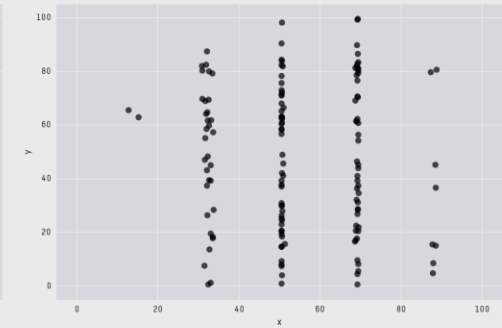
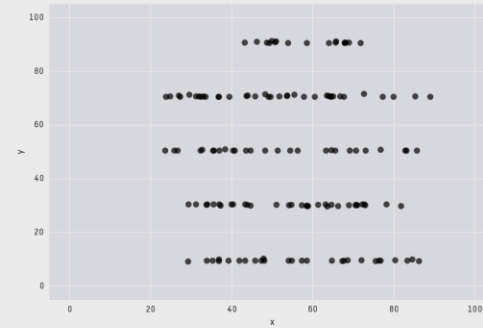
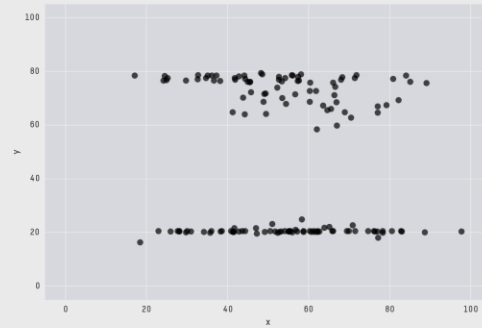
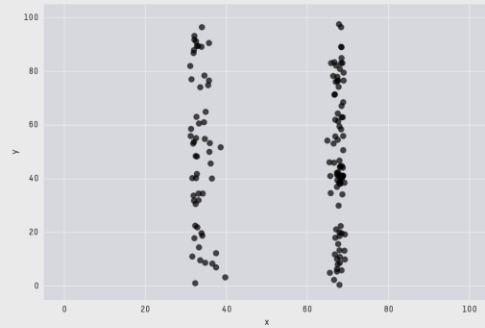
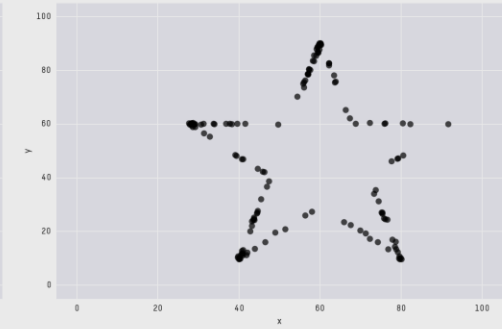
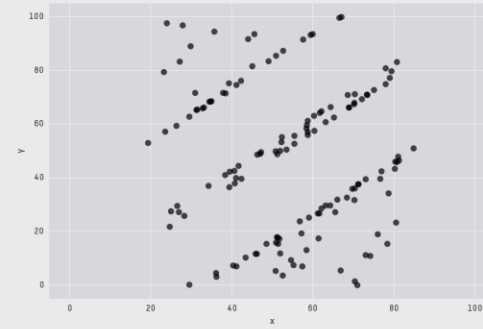
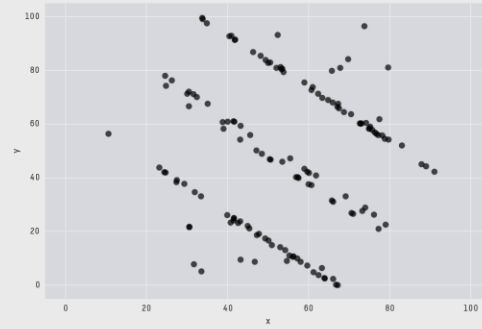
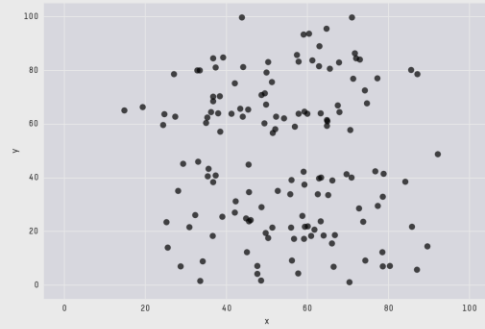
Anscombův kvartet

| I | | II | | III | | IV | |
|------|-------|------|------|------|-------|------|-------|
| x | y | x | y | x | y | x | y |
| 10.0 | 8.04 | 10.0 | 9.14 | 10.0 | 7.46 | 8.0 | 6.58 |
| 8.0 | 6.95 | 8.0 | 8.14 | 8.0 | 6.77 | 8.0 | 5.76 |
| 13.0 | 7.58 | 13.0 | 8.74 | 13.0 | 12.74 | 8.0 | 7.71 |
| 9.0 | 8.81 | 9.0 | 8.77 | 9.0 | 7.11 | 8.0 | 8.84 |
| 11.0 | 8.33 | 11.0 | 9.26 | 11.0 | 7.81 | 8.0 | 8.47 |
| 14.0 | 9.96 | 14.0 | 8.10 | 14.0 | 8.84 | 8.0 | 7.04 |
| 6.0 | 7.24 | 6.0 | 6.13 | 6.0 | 6.08 | 8.0 | 5.25 |
| 4.0 | 4.26 | 4.0 | 3.10 | 4.0 | 5.39 | 19.0 | 12.50 |
| 12.0 | 10.84 | 12.0 | 9.13 | 12.0 | 8.15 | 8.0 | 5.56 |
| 7.0 | 4.82 | 7.0 | 7.26 | 7.0 | 6.42 | 8.0 | 7.91 |
| 5.0 | 5.68 | 5.0 | 4.74 | 5.0 | 5.73 | 8.0 | 6.89 |



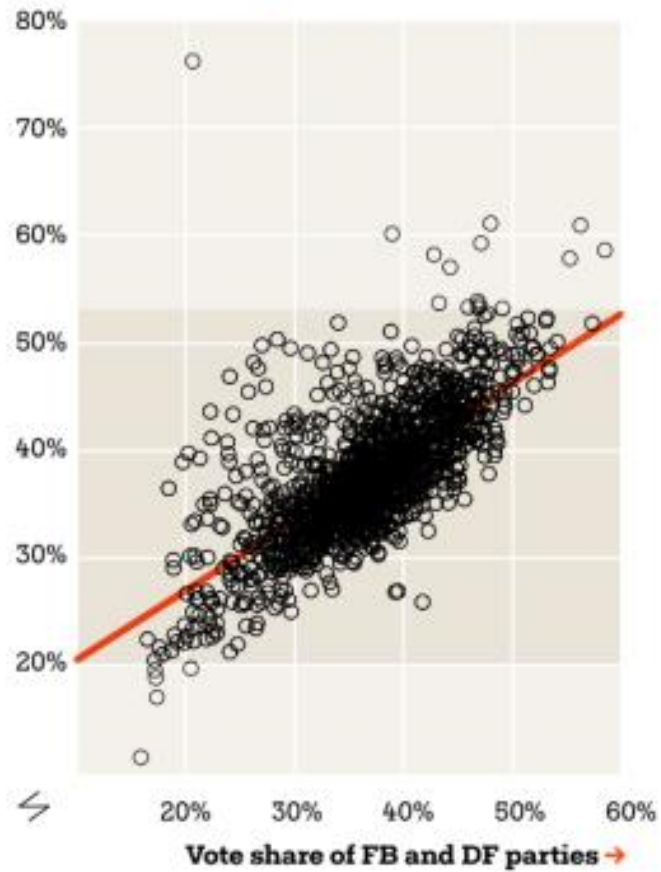


X Mean: 54.26
Y Mean: 47.83
X SD : 16.76
Y SD : 26.93
Corr. : -0.06



Vote shares in European Parliament election 2014 and referendum results by precinct in Denmark

**"No" votes
in the referendum ↑**



Source: Open Knowledge Danmark 2014.
Valgdata workshop

Vizualizujeme data, protože...

...můžeme efektivněji komunikovat
komplexní informace vizuální cestou.



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

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

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui ont été en Russie, le noir ceux qui en sont sortis. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Léger, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davoust qui avaient été détachés sur Minsk et Mohilow et ont rejoint vers Orscha et Witebsk, avaient toujours marché avec l'armée.

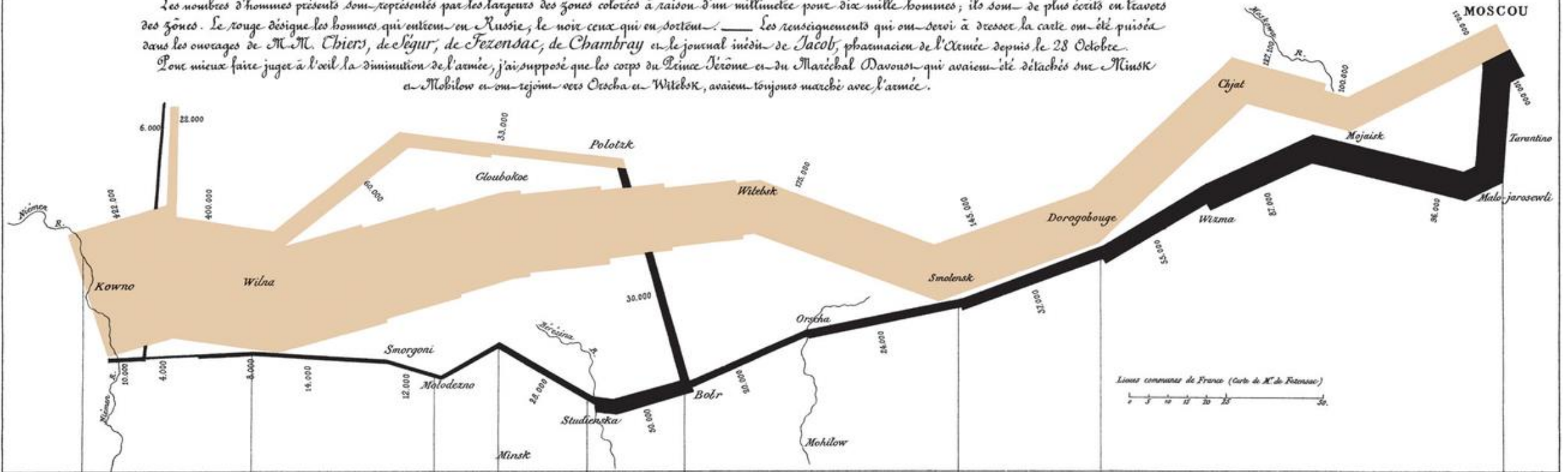
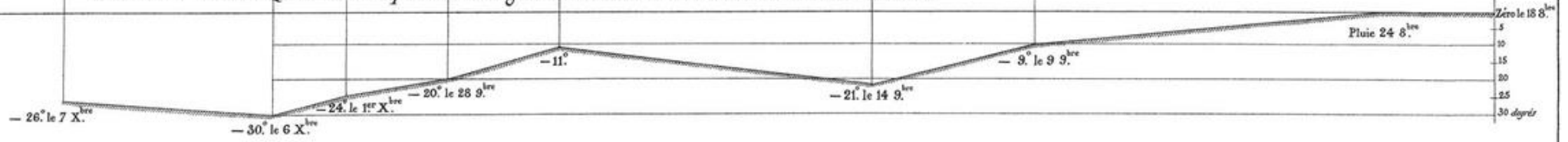


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

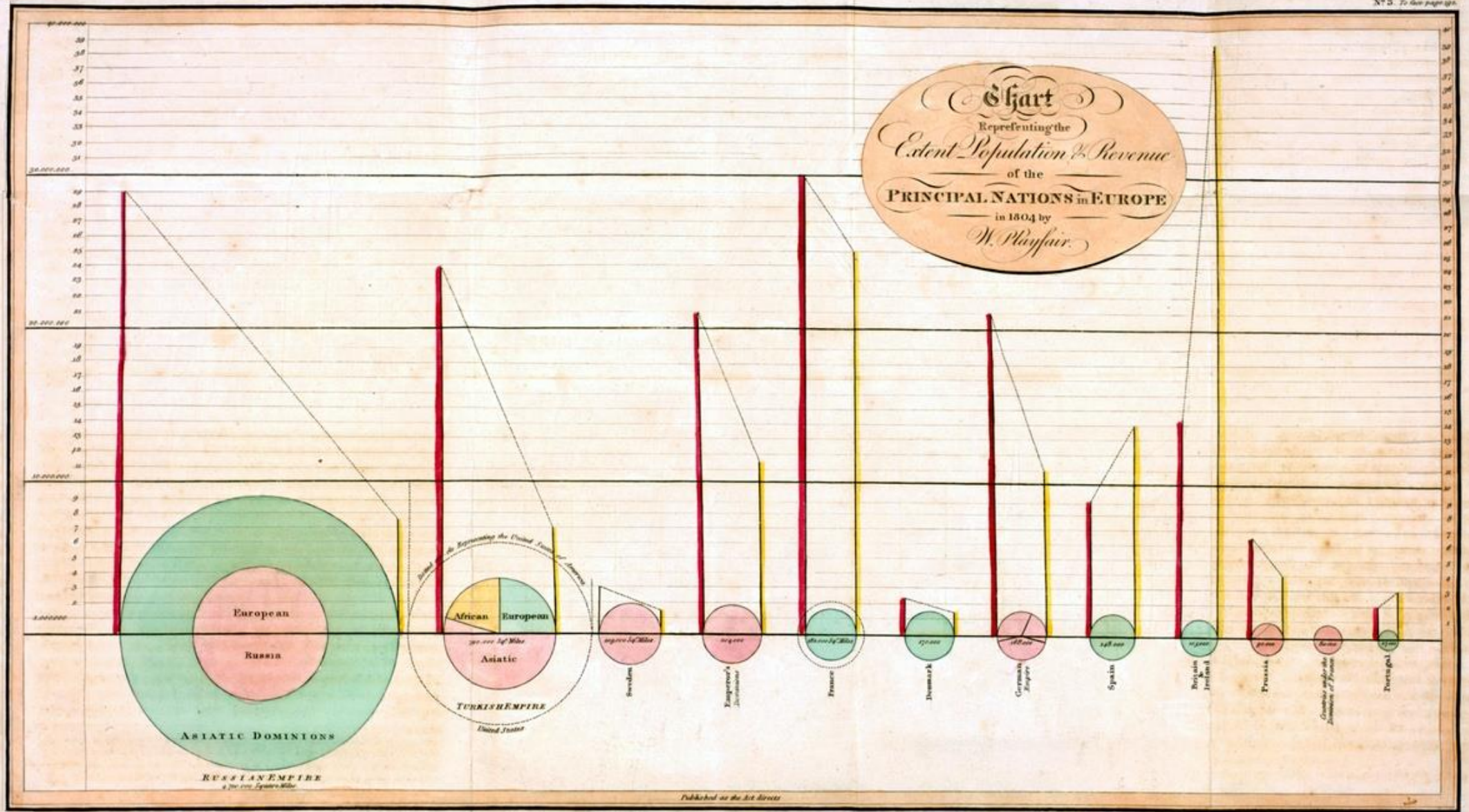
Les Cosaques passent au galop le Niémen, gelé.

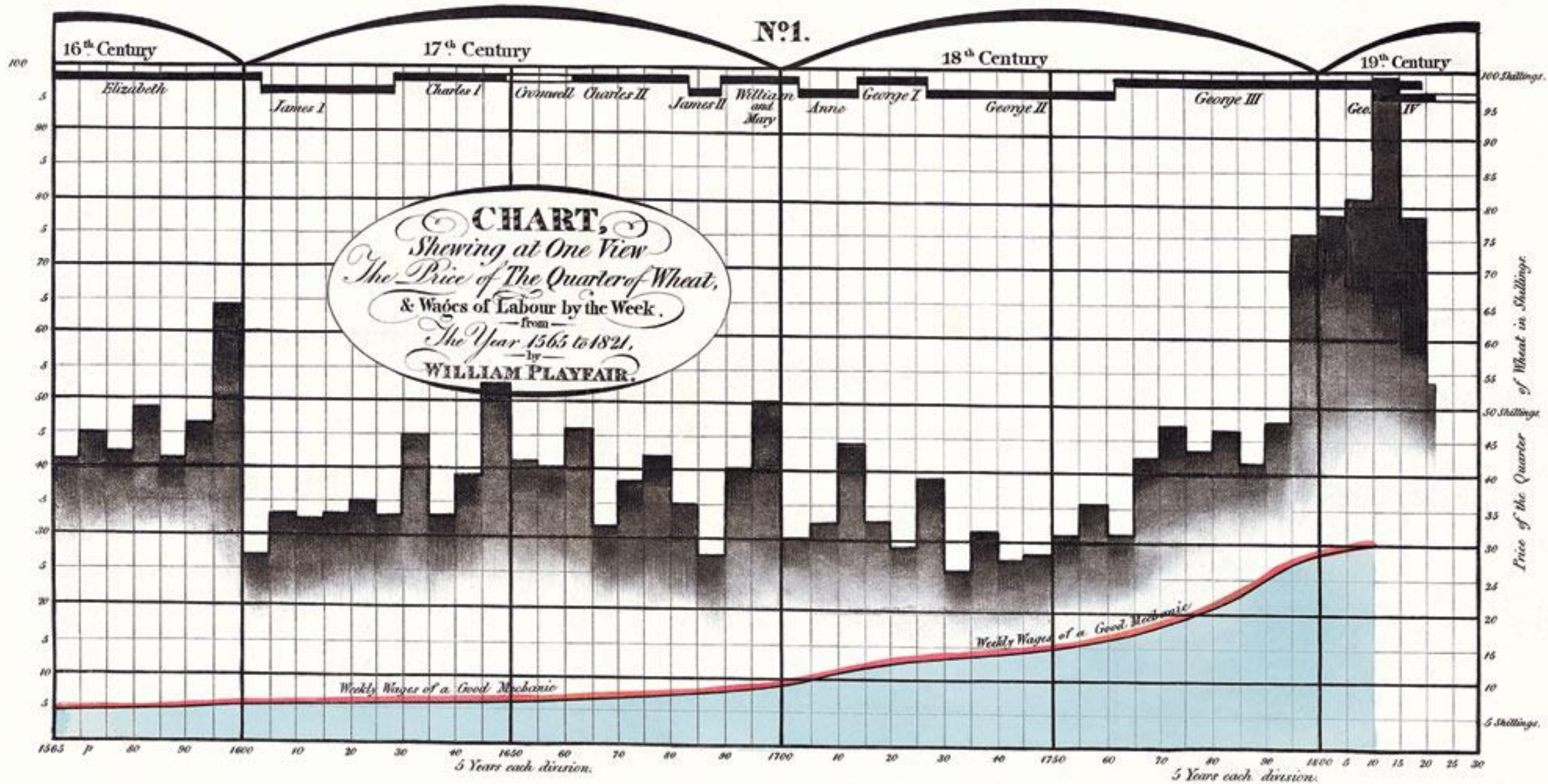


Autog. par Rognier, 1. Par. 5^{me} Marie St 6^{me} à Paris.

Imp. Lit. Rognier et Desvres.

„Probably the best statistical graphic ever drawn.“ *Edward Tufte*





Vizualizujeme data, protože...

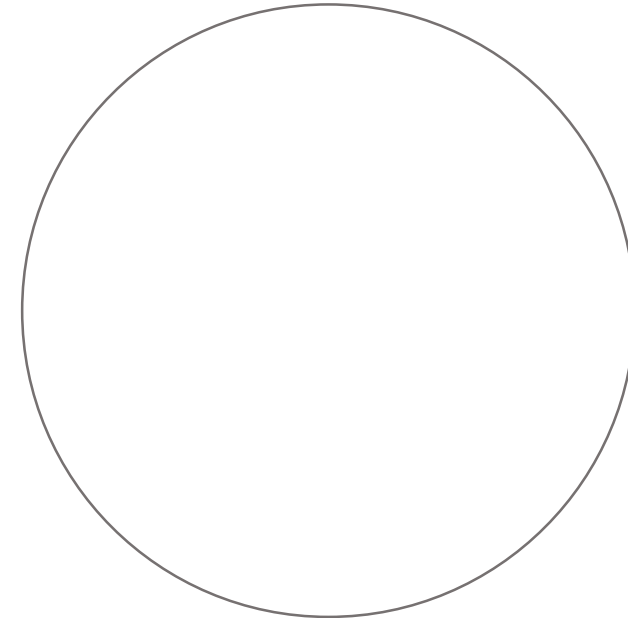
...máme oči a náš mozek
pracuje s vizuální informací efektivně.



Množina všech bodů
v rovině, které leží ve stejné
vzdálenosti, označované jako
poloměr, od pevně daného
bodu, zvaného střed.

00.000x

Množina všech bodů
v rovině, které leží ve stejné
vzdálenosti, označované jako
poloměr, od pevně daného
bodu, zvaného střed.



60.000x

Vizualizujeme data, protože...

...můžeme vizuálně (tj. lépe)
podpořit svůj argument.



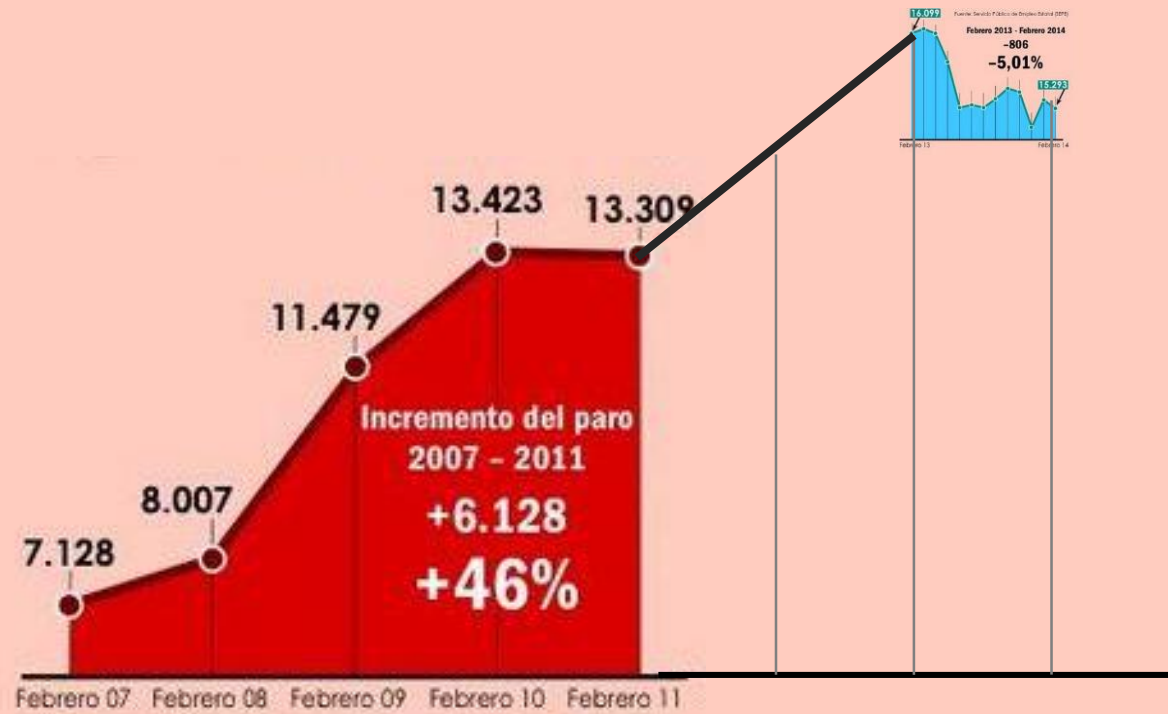
43 %

Vizualizujeme data, protože...

...vizualizace nám umožňují
lépe ~~argumentovat~~ manipulovat.







Vizualizujeme data, protože...

...skrže vizualizovaná data dokážeme lépe působit na emoce.





Vizualizujeme data, protože...

...k tomu máme boží technologie,
které nám umožňují vytvářet
boží vizualizace.



2001

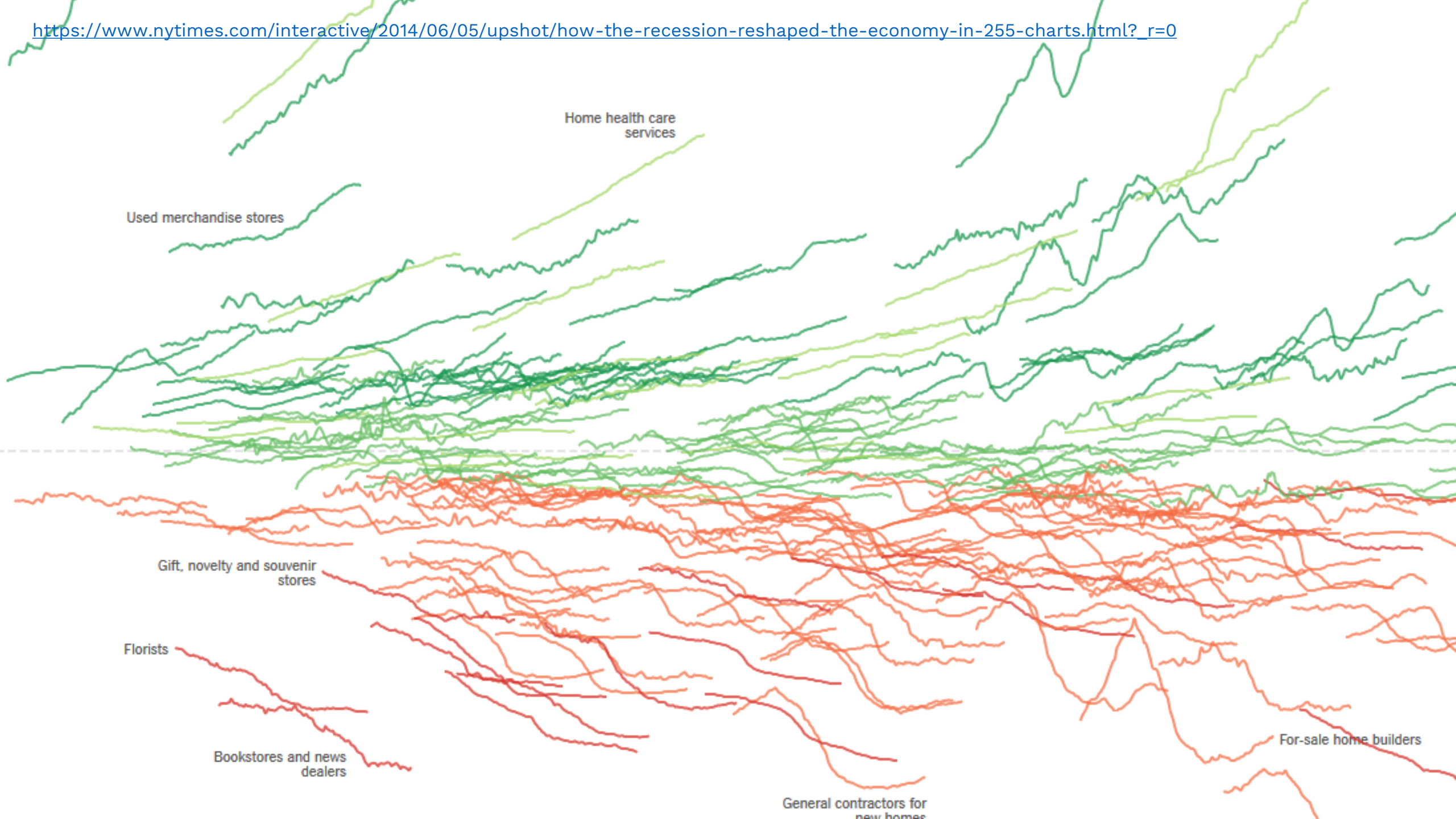
EXTREME POVERTY

\$1

\$10

\$100







Vizualizace je **nástroj**
s širokým spektrem použití.



Přesvědčování

Argumentace

Motivace

Ilustrace

Vhled

Emoce

Vizualizace dnes!

Vizualizace dnes

- otevírání pole širokému spektru lidí (ve smyslu tvorby)
- stabilní oblast studia v akademické sféře
- vznikají samostatné studijní obory
- otevřené vzdělávání v oblasti - MOOC
- zmatení pojmů a představ (umění)

Objem a dostupnost dat

- 2011 - 1.8 ZB dat
- data smog - přehlčení daty
- big data - krása, ale co s tím
- nefunguje bez “*information taming*” technologií

- široká dostupnost všem, open data hnutí

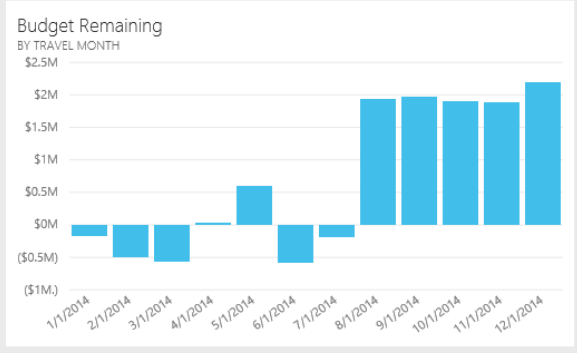
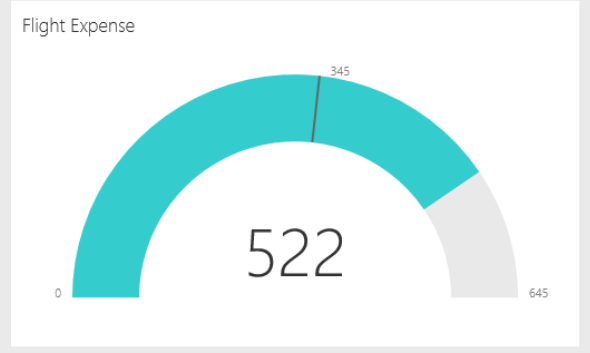
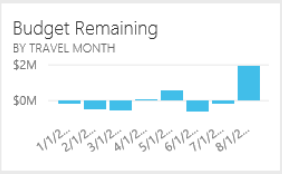
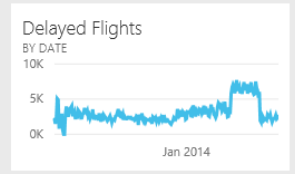
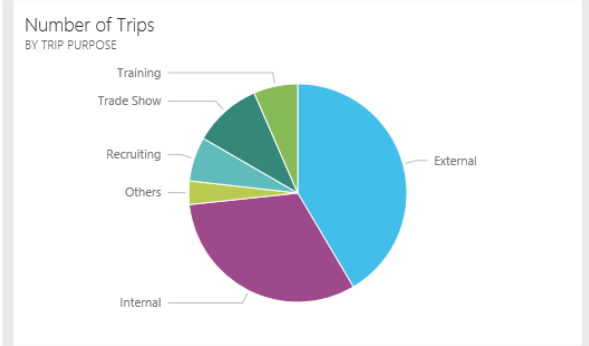
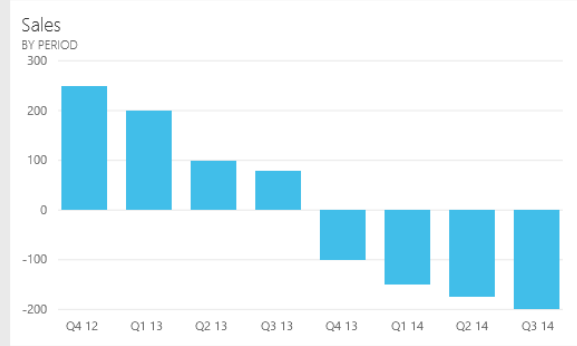
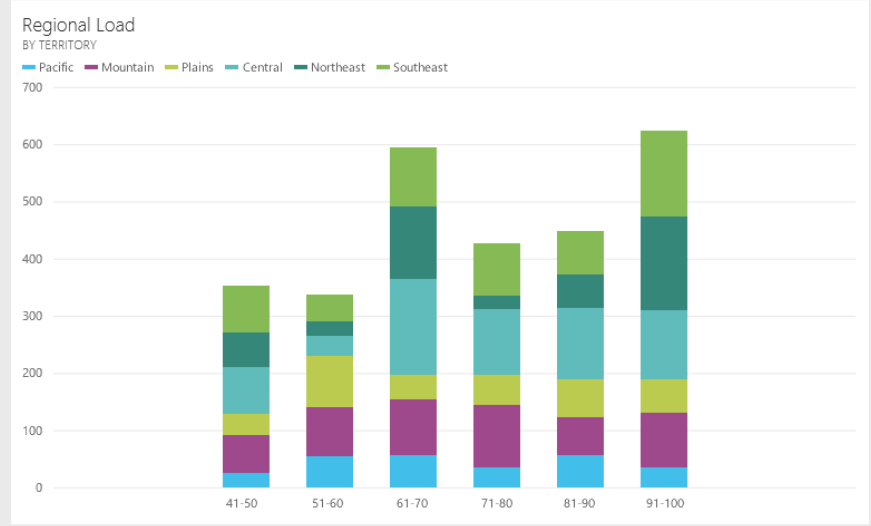
Dostupnost nástrojů

- Demokratizace, laicizace
- Naklikávačky
- Tableau; D3.js,...
- Gephi, NodeXL - sítě
- ImagePlot, Voyant Tools - digital humanities
- Quadrigram, R, Processing

<http://idl.cs.washington.edu/projects/lyra/>

Travel Analysis

Ask a question about your data



Variance to Budget

(\$1.39M)

Average Cost Per Trip

\$723.16

Web 2.0 a spolupráce

- Sdílení
- Inspirace
- Spolupráce
- <http://helpmeviz.com/>

Otevřené vzdělávání

- Knihy zacílené na “nevědce”.
- Nathan Yau - Data Points
- Nathan Yau - Visualize This!
- MOOC a kurzy



Terminologické okénko

Přesahy vizualizace

- Grafický design
- Žurnalistika
- Kartografie
- Počítačová věda
- Management
- Statistika
- ...

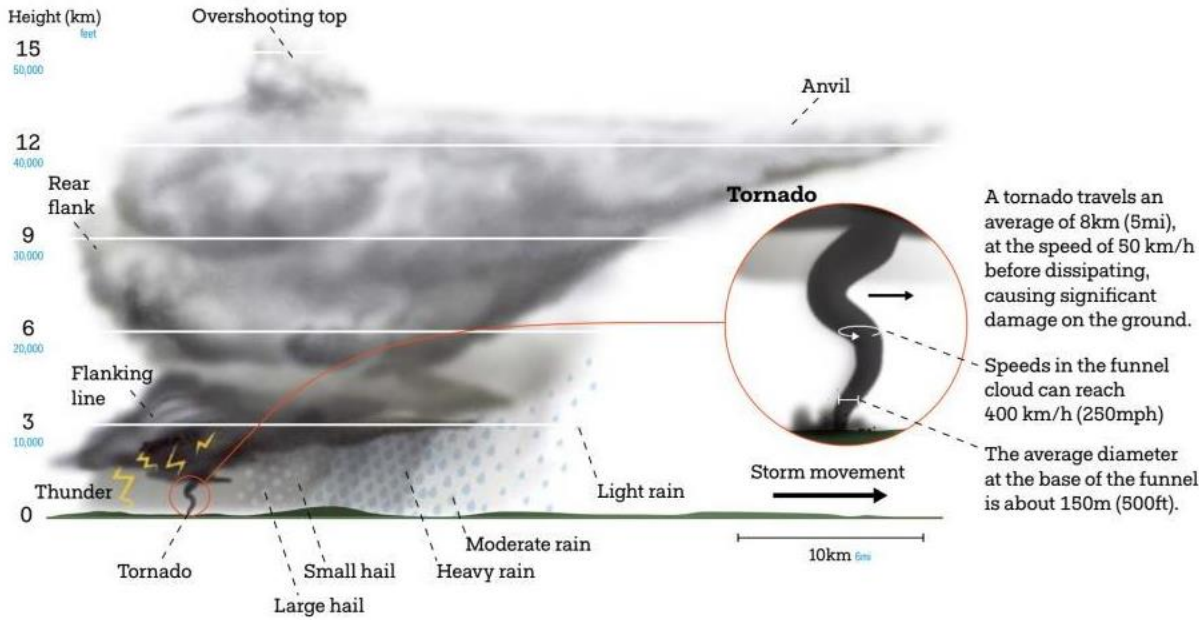
**Odlišné slovníky
v jednom poli.**

Informační design

“The art and science of preparing information so that it can be used by human beings with efficiency and effectiveness.” – [Robert Horn](#)

- informační design X grafický design
- [Information Design Journal](#) (1979)
- finský výzkum obalů léčiv – léky vypadají podobně

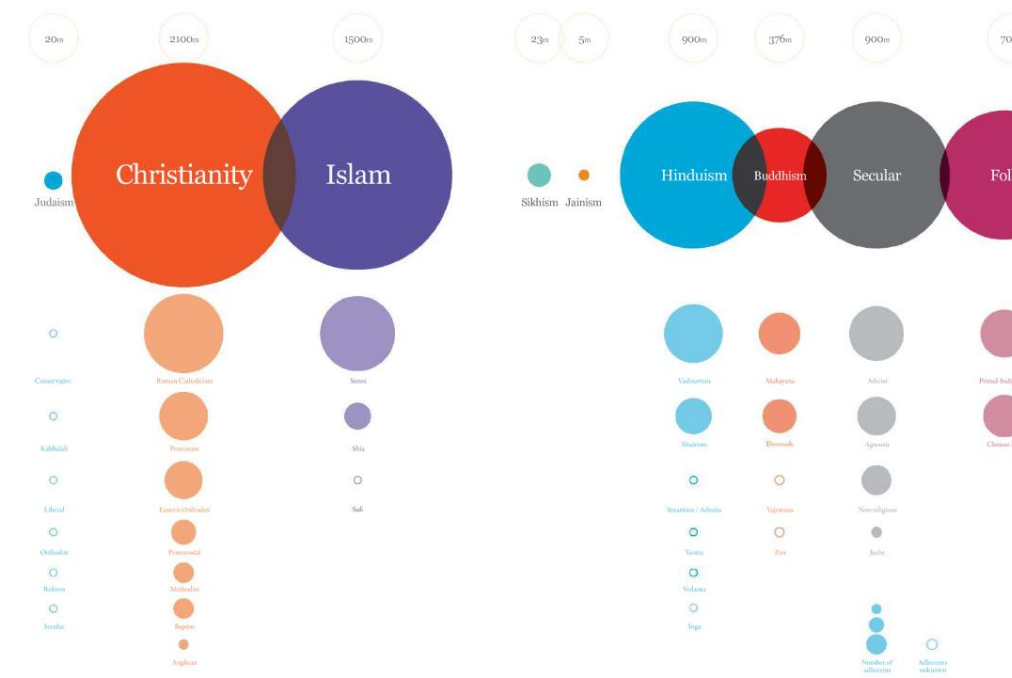
The structure of a supercell cloud



A tornado travels an average of 8km (5mi), at the speed of 50 km/h before dissipating, causing significant damage on the ground.

Speeds in the funnel cloud can reach 400 km/h (250mph)

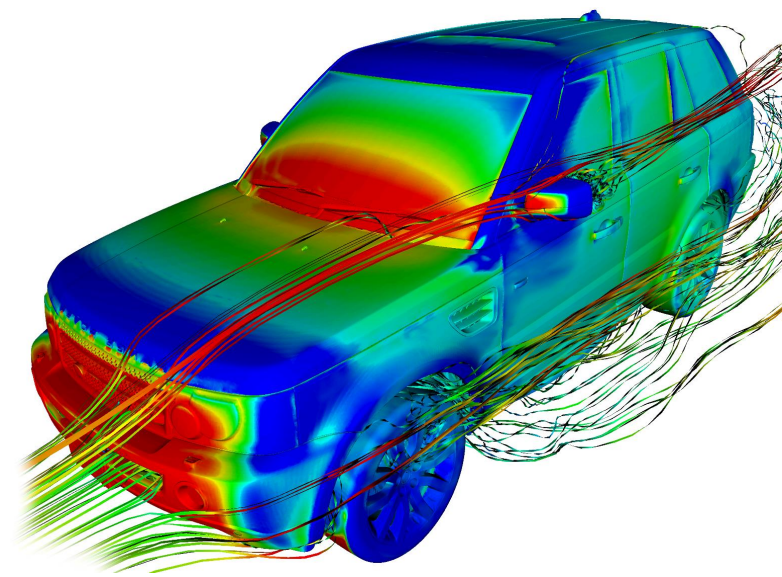
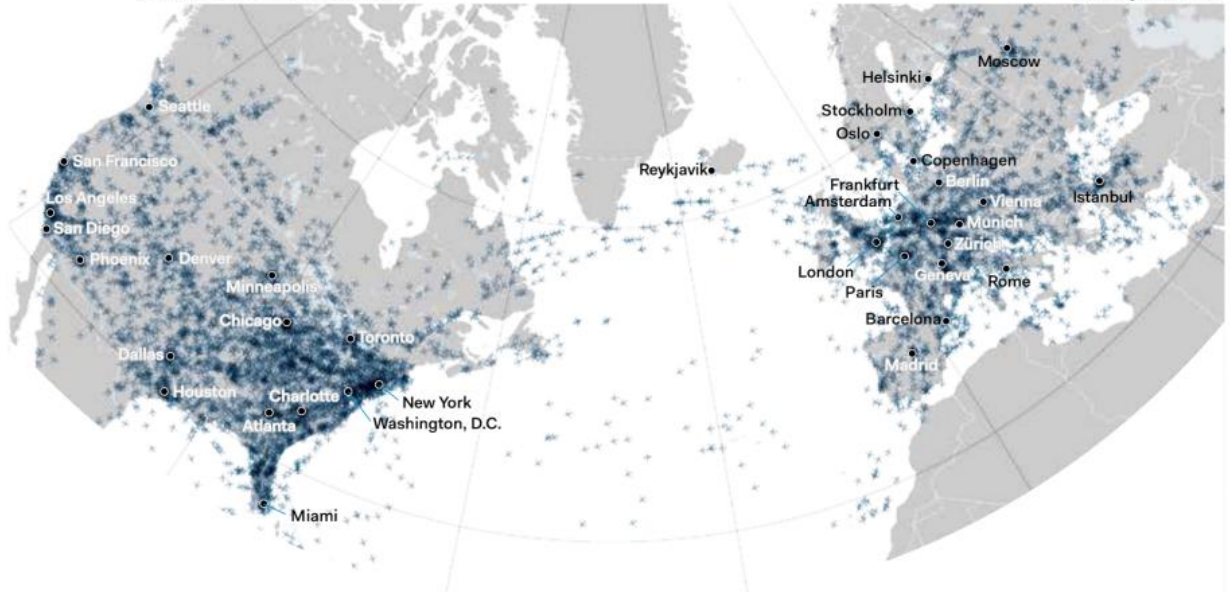
The average diameter at the base of the funnel is about 150m (500ft).



Aircraft in European and North American airspaces

Tuesday, 18 June 2013 at 14:00 UTC

Each + is a single aircraft. Source: Flightradar24.com

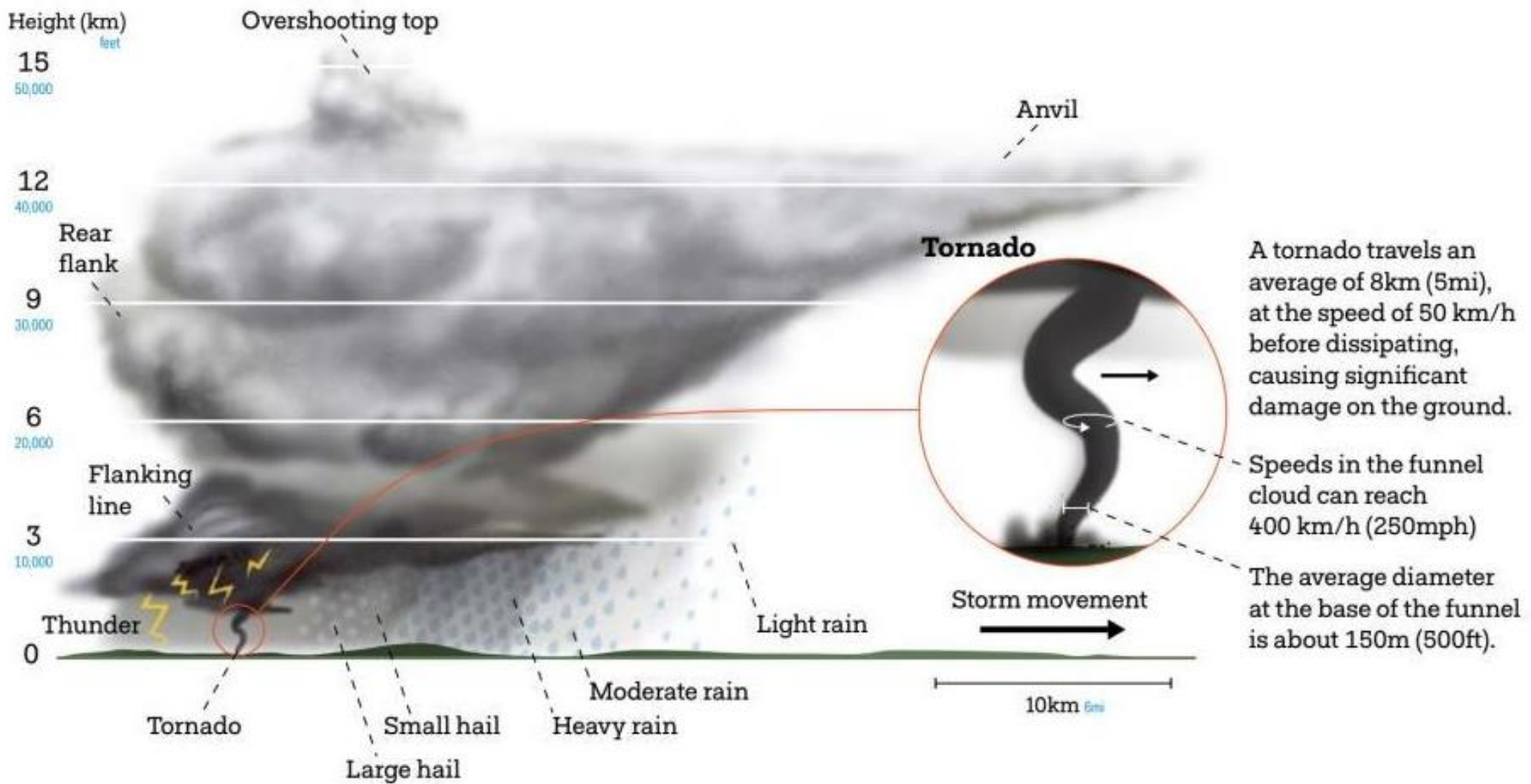


Typologie datové grafiky

- Scott Berinato – [Good Charts](#)
- Je informace konceptuální nebo založená na datech?
- Je cílem vysvětlovat (*explain*) nebo explorovat (*explore*)?

- Dvě škály:
- **conceptual – measurable**
- **explanatory – exploratory**
- vypráví příběh **X** poskytuje nástroj k hledání příběhů

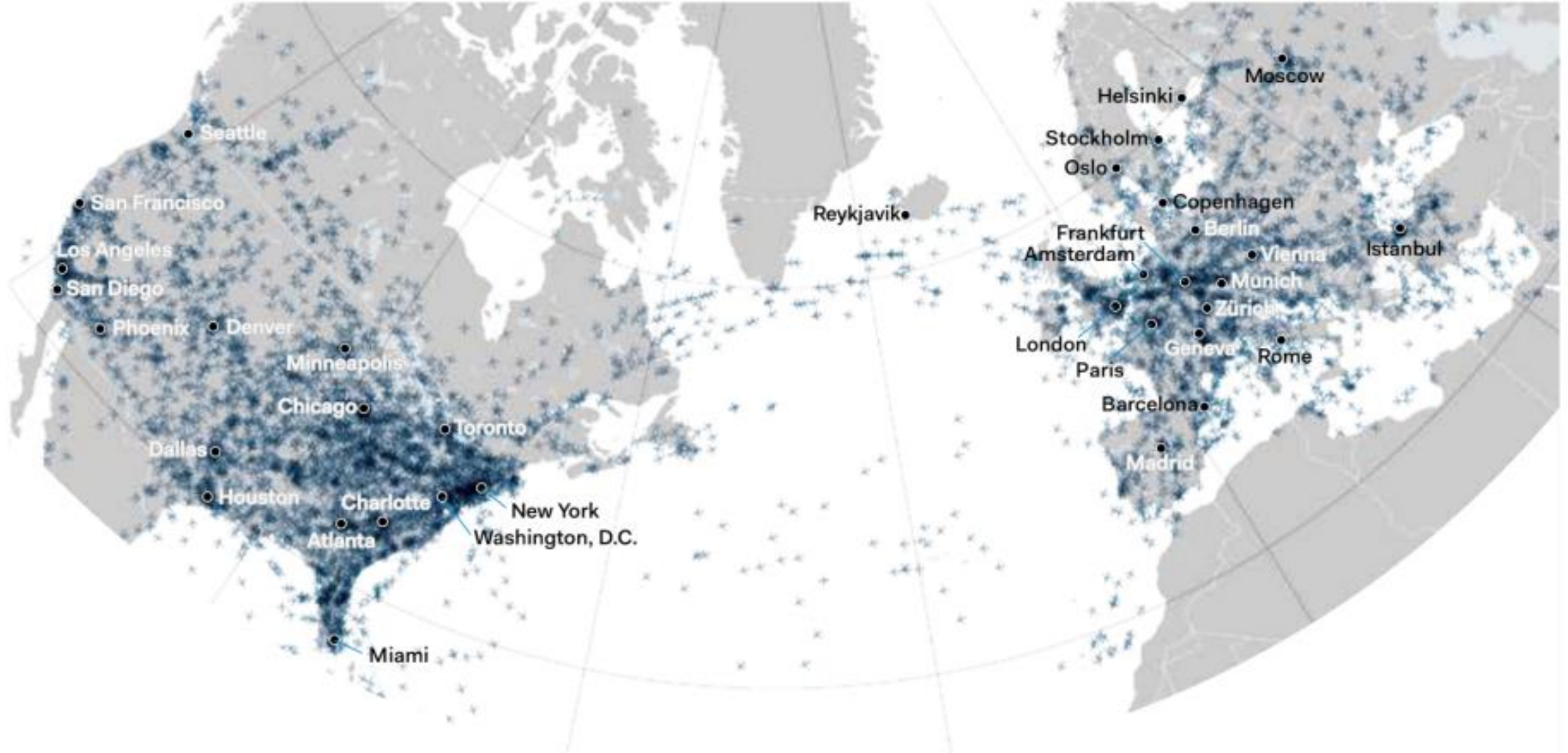
The structure of a supercell cloud



Aircraft in European and North American airspaces

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Each + is a single aircraft.
Source: Flightradar24.com



Ještě několik termínů

- *zásadní problematický termín*
- infografika = explanatory / conceptual - measurable
- vizualizace = exploratory / measurable

- informační grafika X infografika

- chart X diagram X plot



Explanatorní
Cíl grafiky



Konceptuální
Typ informace

Měřitelná

Exploratorní



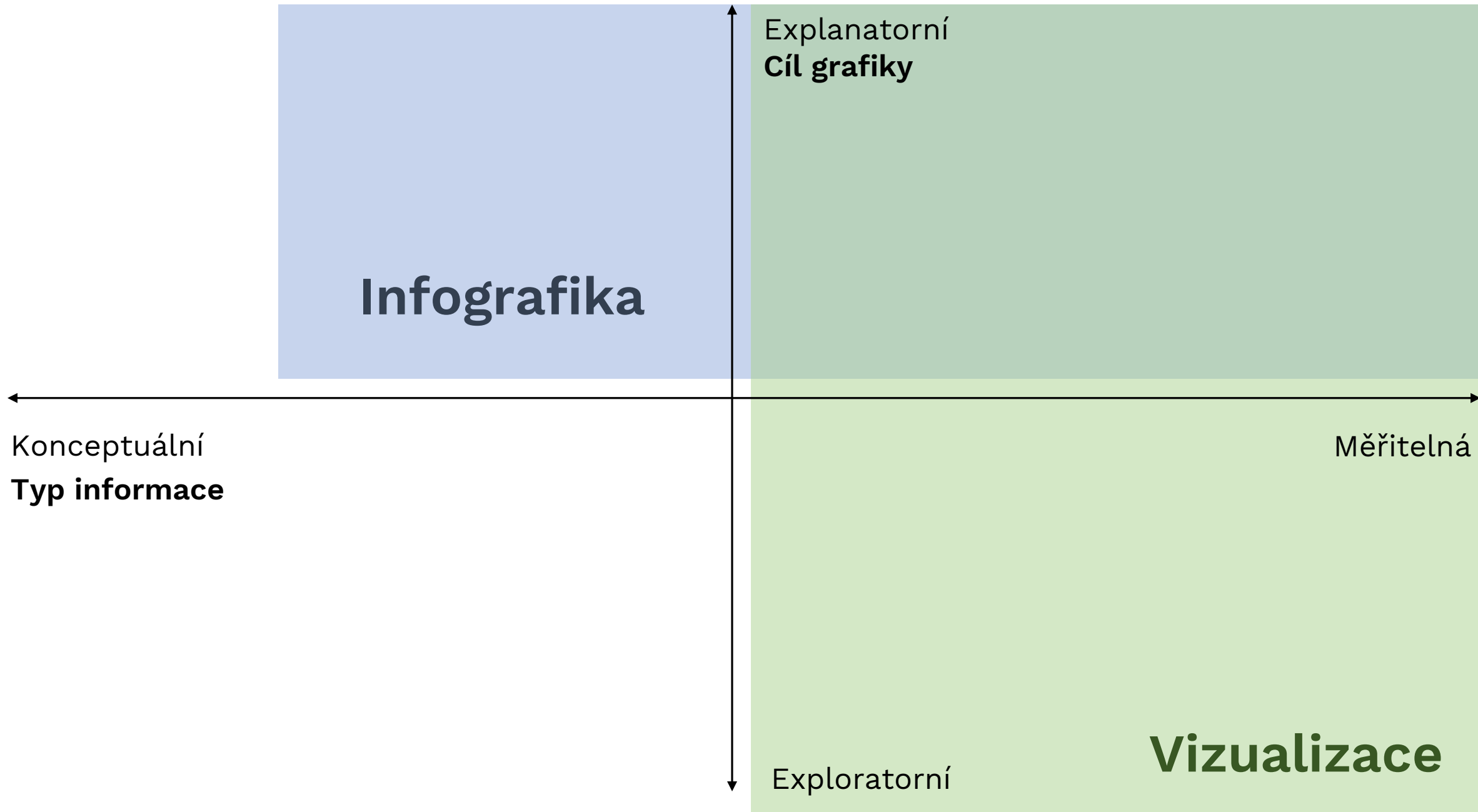
Explanatorní
Cíl grafiky

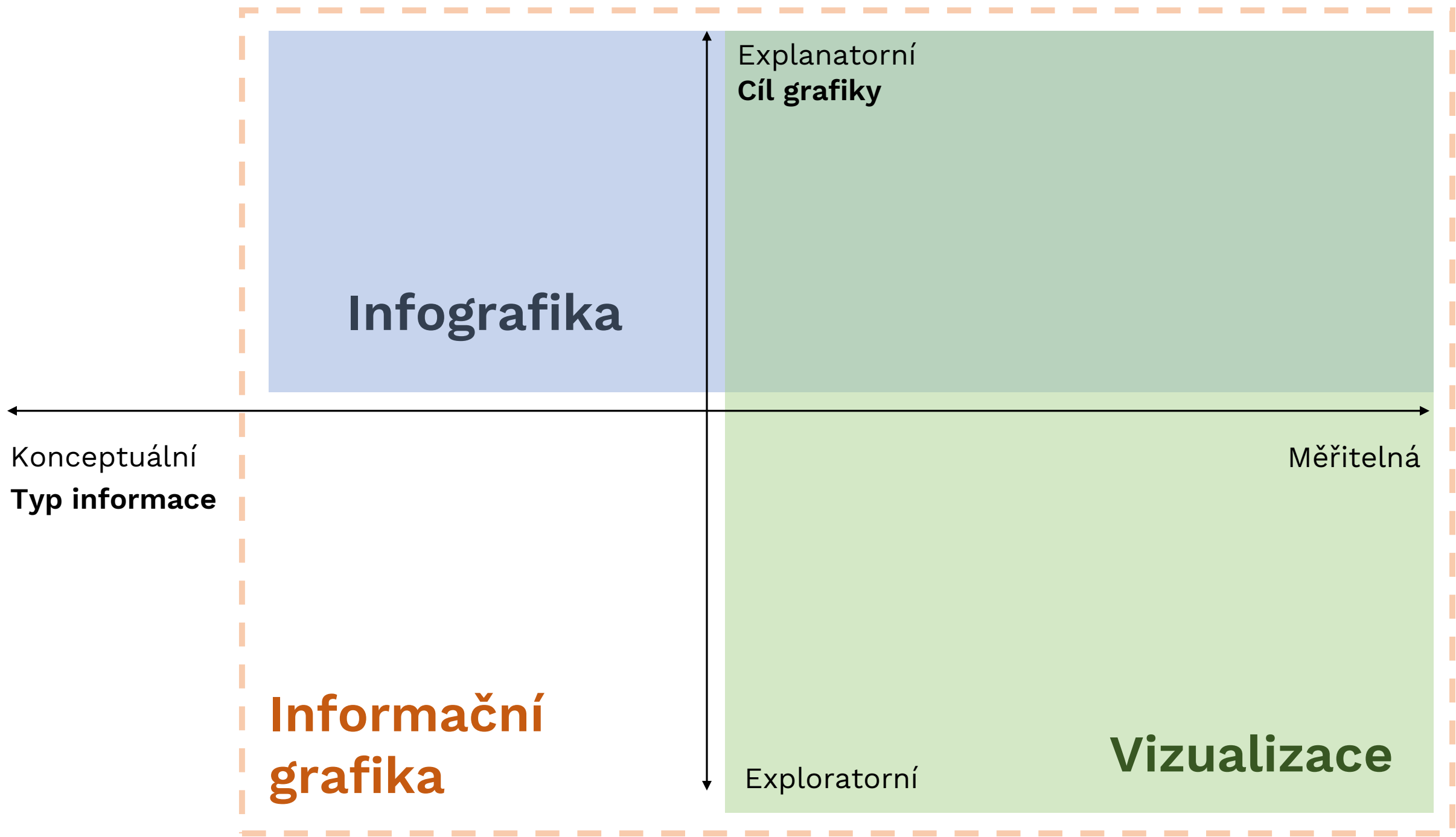
Konceptuální
Typ informace

Měřitelná

Exploratorní

Vizualizace





Ilustrace

Infografika

Explanatorní
Cíl grafiky

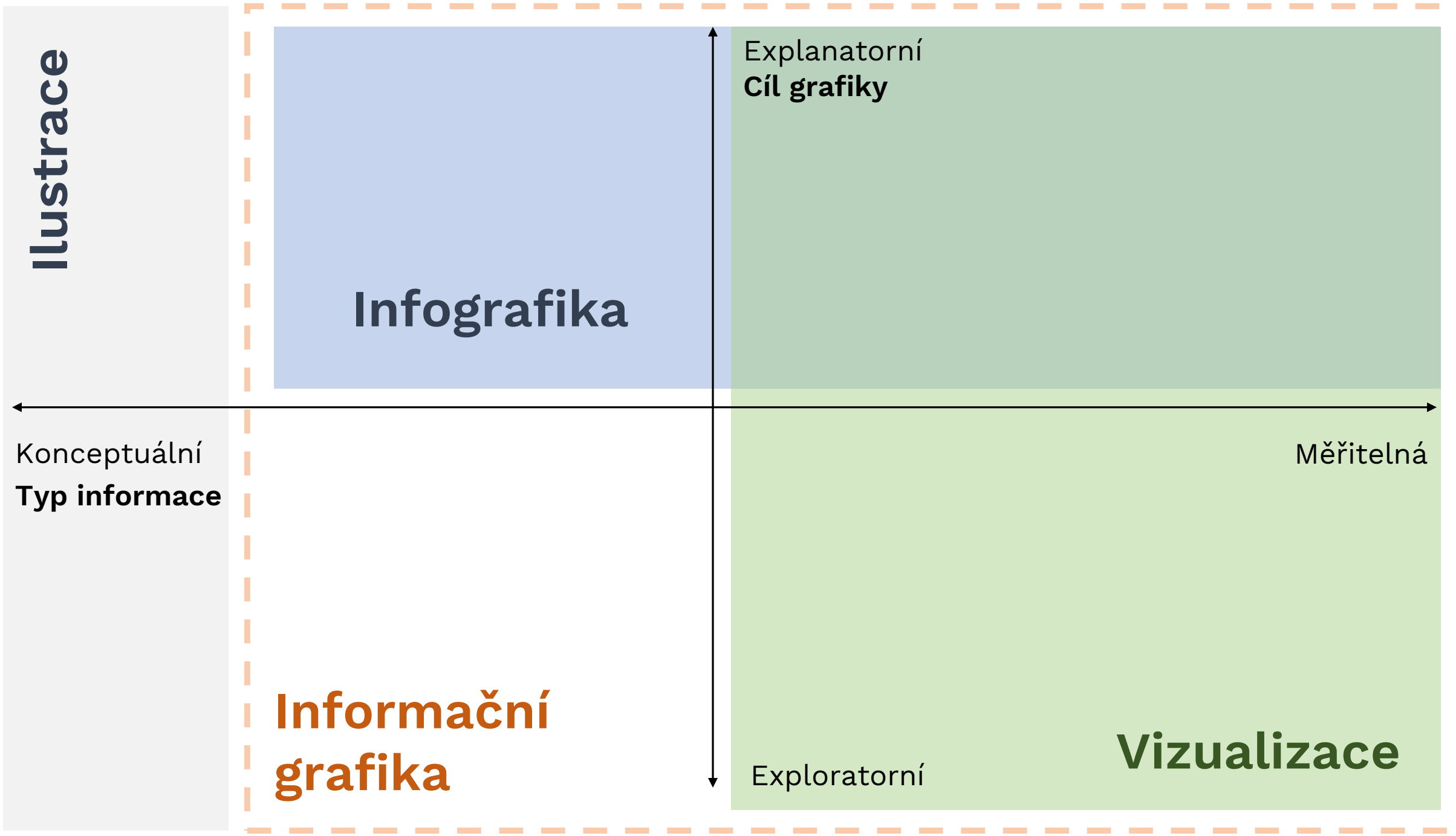
Konceptuální
Typ informace

Měřitelná

**Informační
grafika**

Exploratorní

Vizualizace



Definice Roberta Kosary

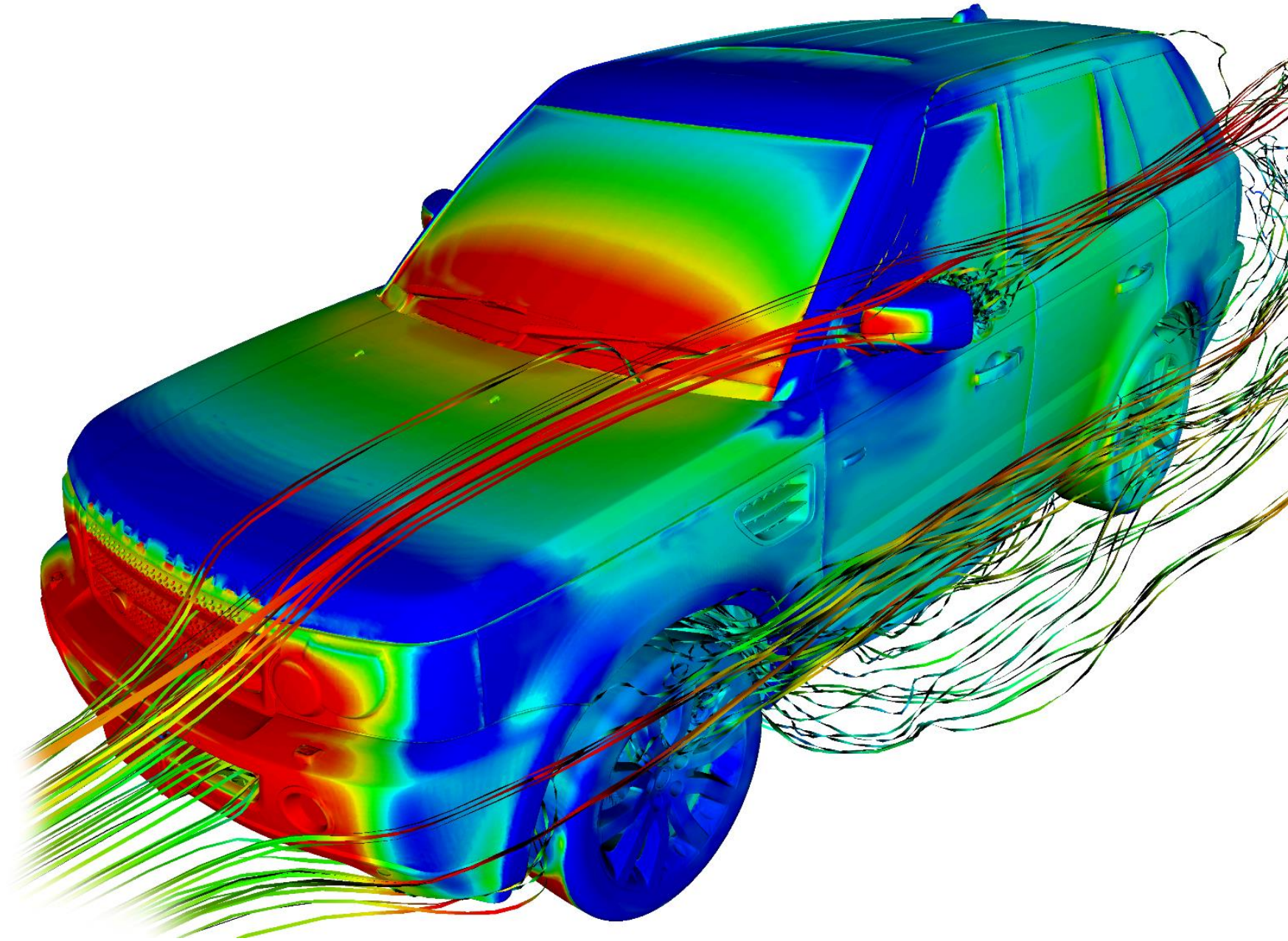
- *it is based on (non-visual) data – krajinka to není*
- *it produces an image*
- *the result is readable and recognizable*

KOSARA, Robert. [Visualization criticism](#) (2007)

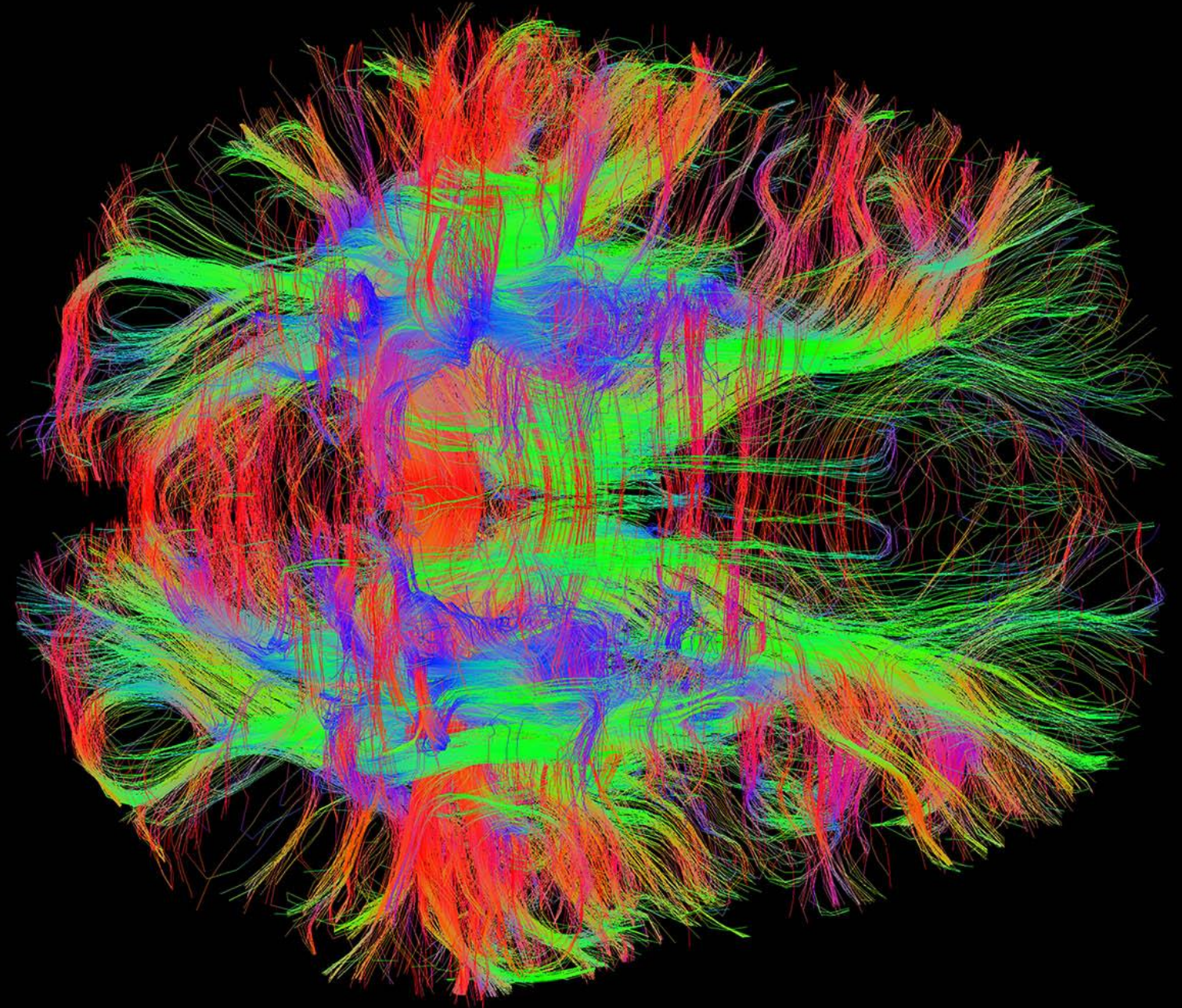
Dělení podle typu dat

- scientific visualization
- information visualization
- geographic visualization

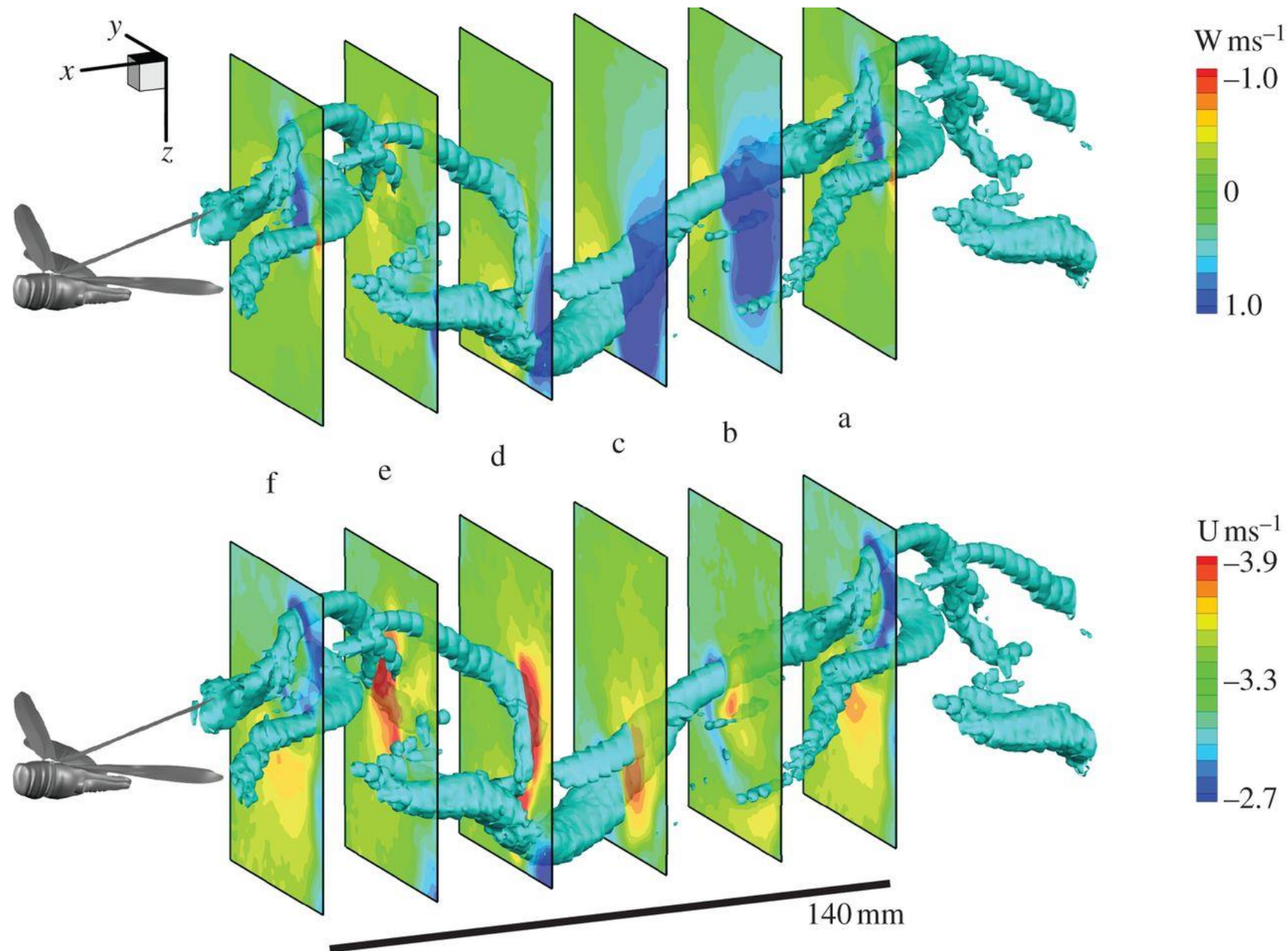
#sciviz



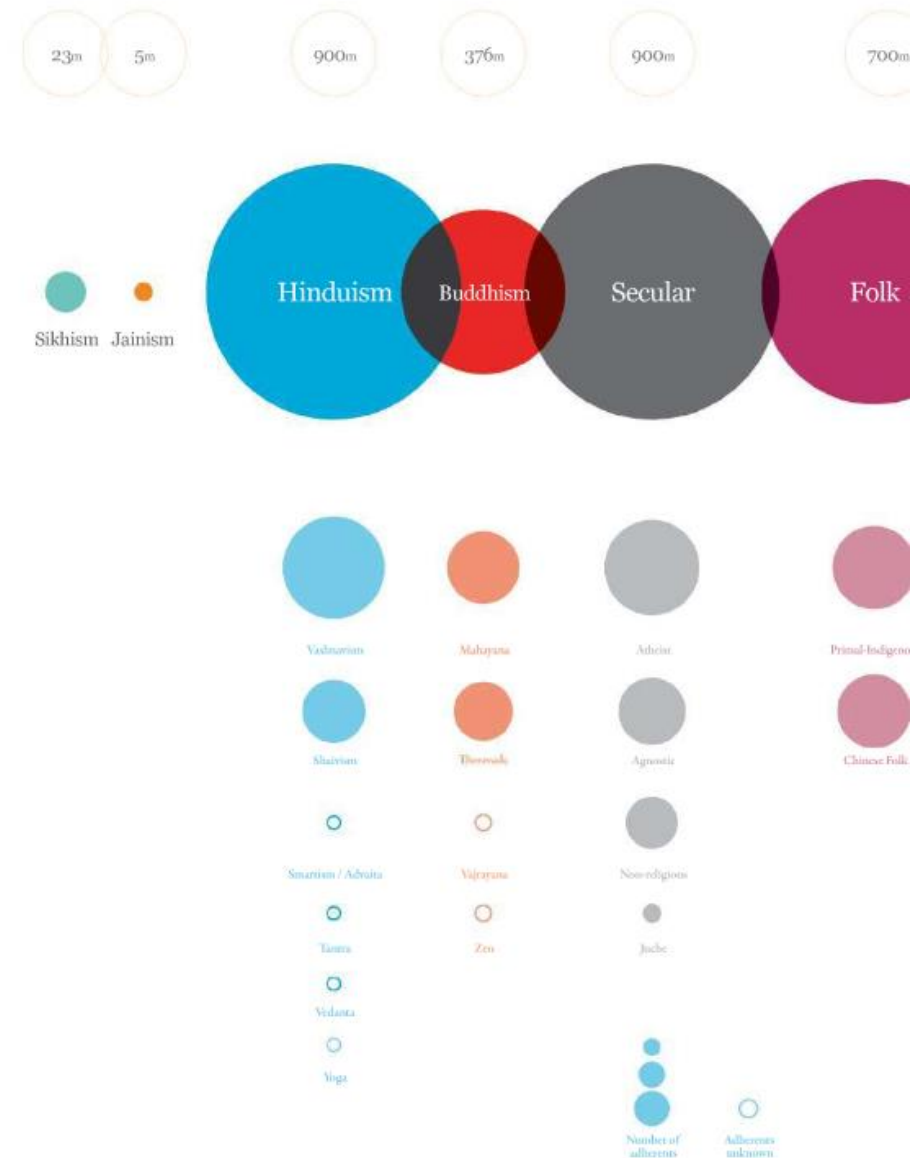
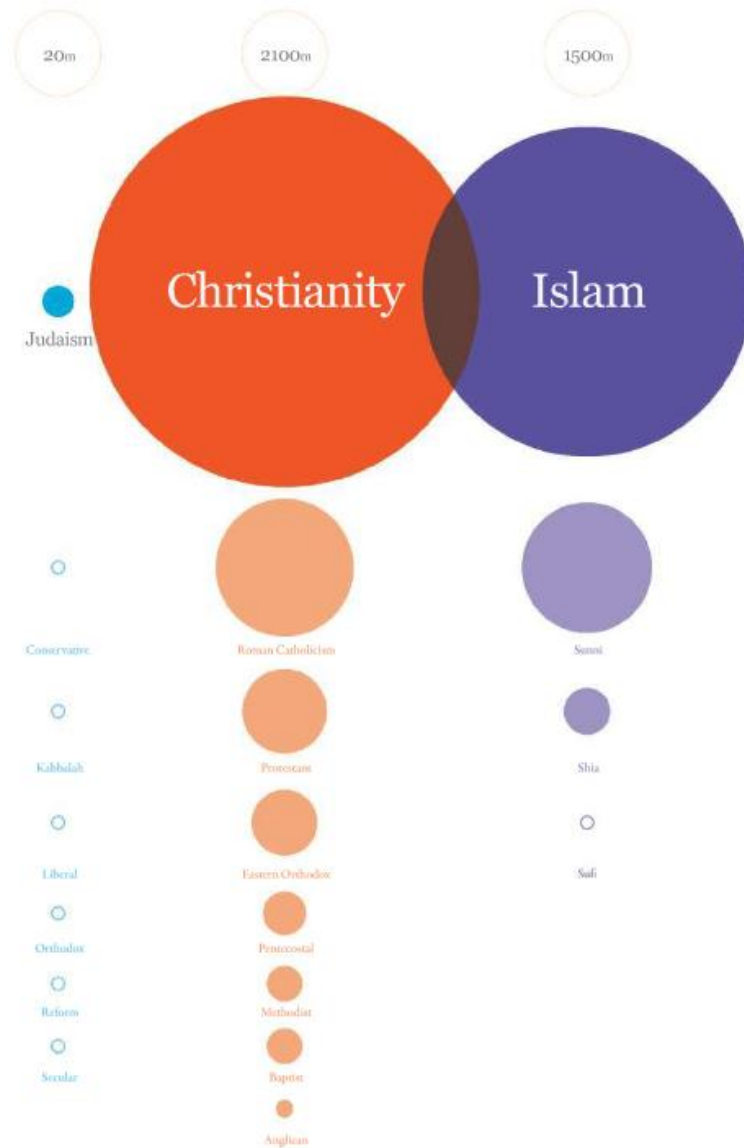
#sciviz



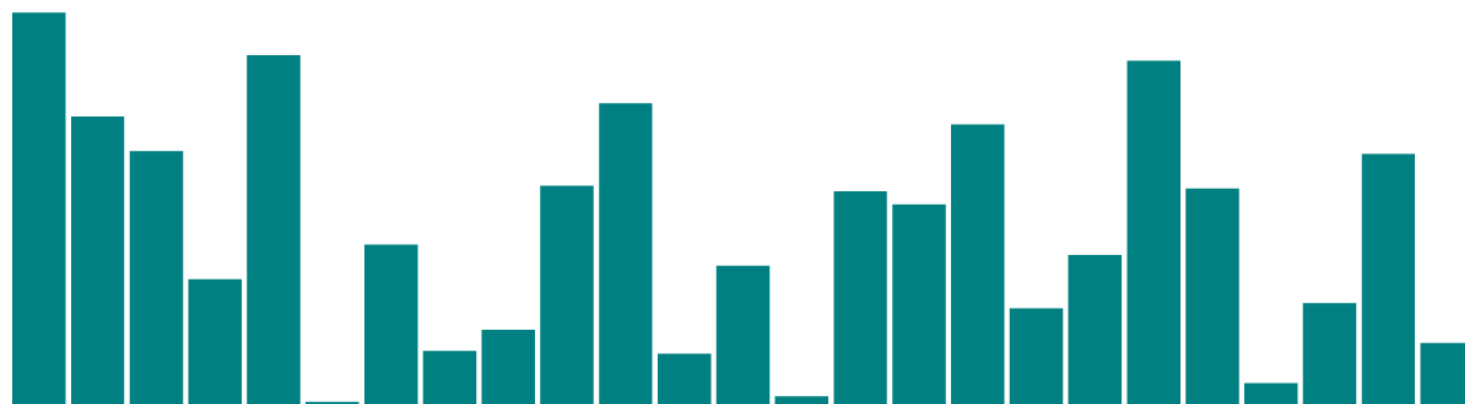
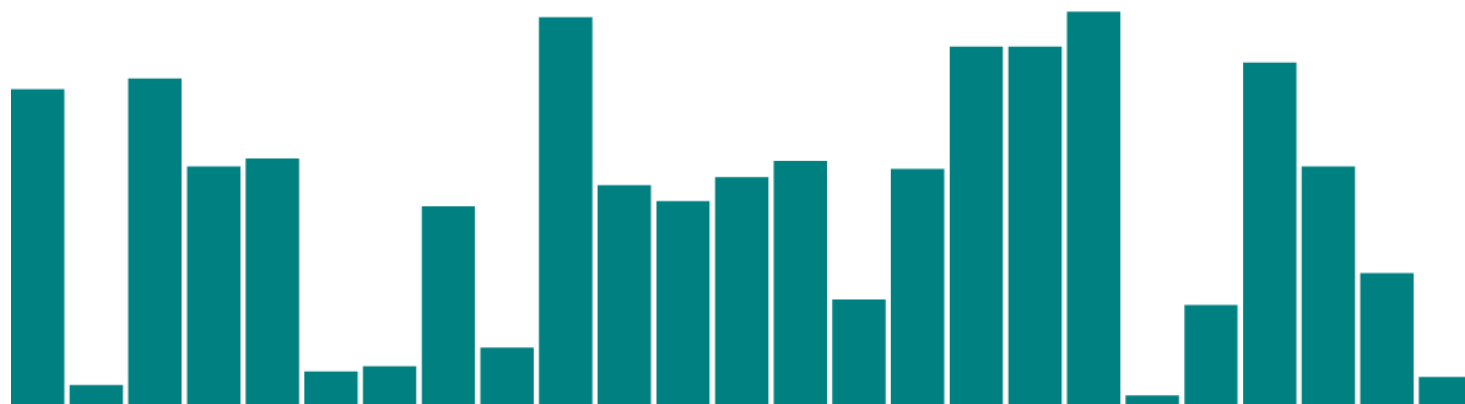
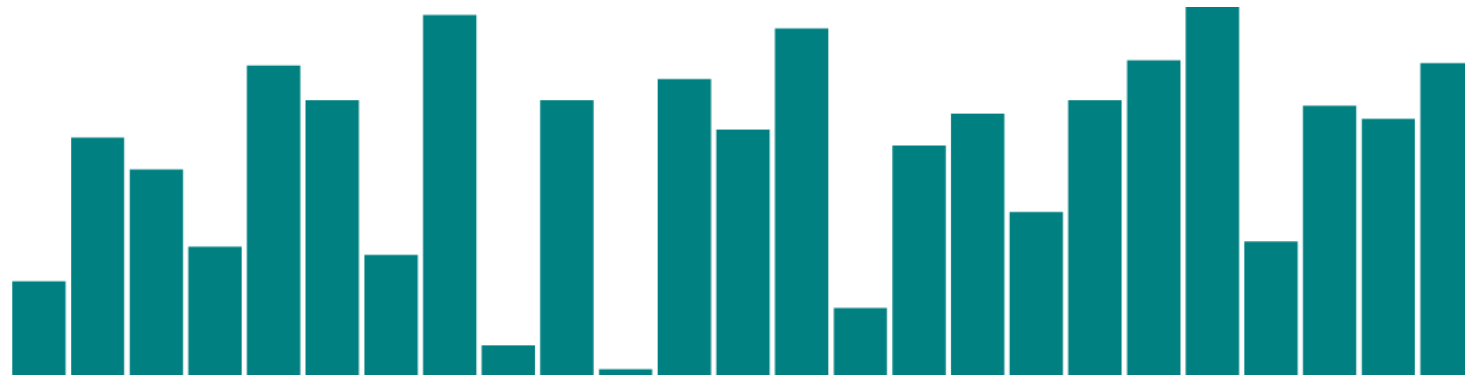
#sciviz



#infoviz



#infoviz




#infoviz

Vložit graf

Doporučené grafy Všechny grafy

- Poslední
- Šablony
- Sloupcový
- Spojnicový
- Výšečový**
- Pruhový
- Plošný
- XY bodový
- Burzovní
- Povrchový
- Paprskový
- Stromová mapa
- Vícevrstvý prstencový
- Histogram
- Krabicový graf
- Vodopádový
- Trychtýřový
- Kombinovaný

Výšečový




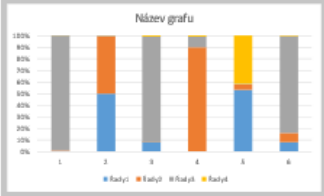
Název grafu

Vložit graf


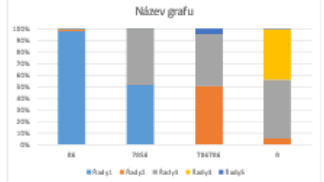
Doporučené grafy Všechny grafy

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- Vodopádový
- Trychtýřový
- Kombinovaný

100% skládaný sloupcový



Název grafu



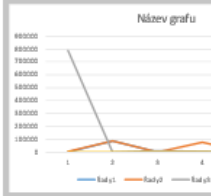
Název grafu

Vložit graf

Doporučené grafy Všechny grafy

- Poslední
- Šablony
- Sloupcový
- Spojnicový**
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- Paprskový
- Stromová mapa
- Vícevrstvý prstencový
- Histogram
- Krabicový graf
- Vodopádový
- Trychtýřový
- Kombinovaný

Spojnicový

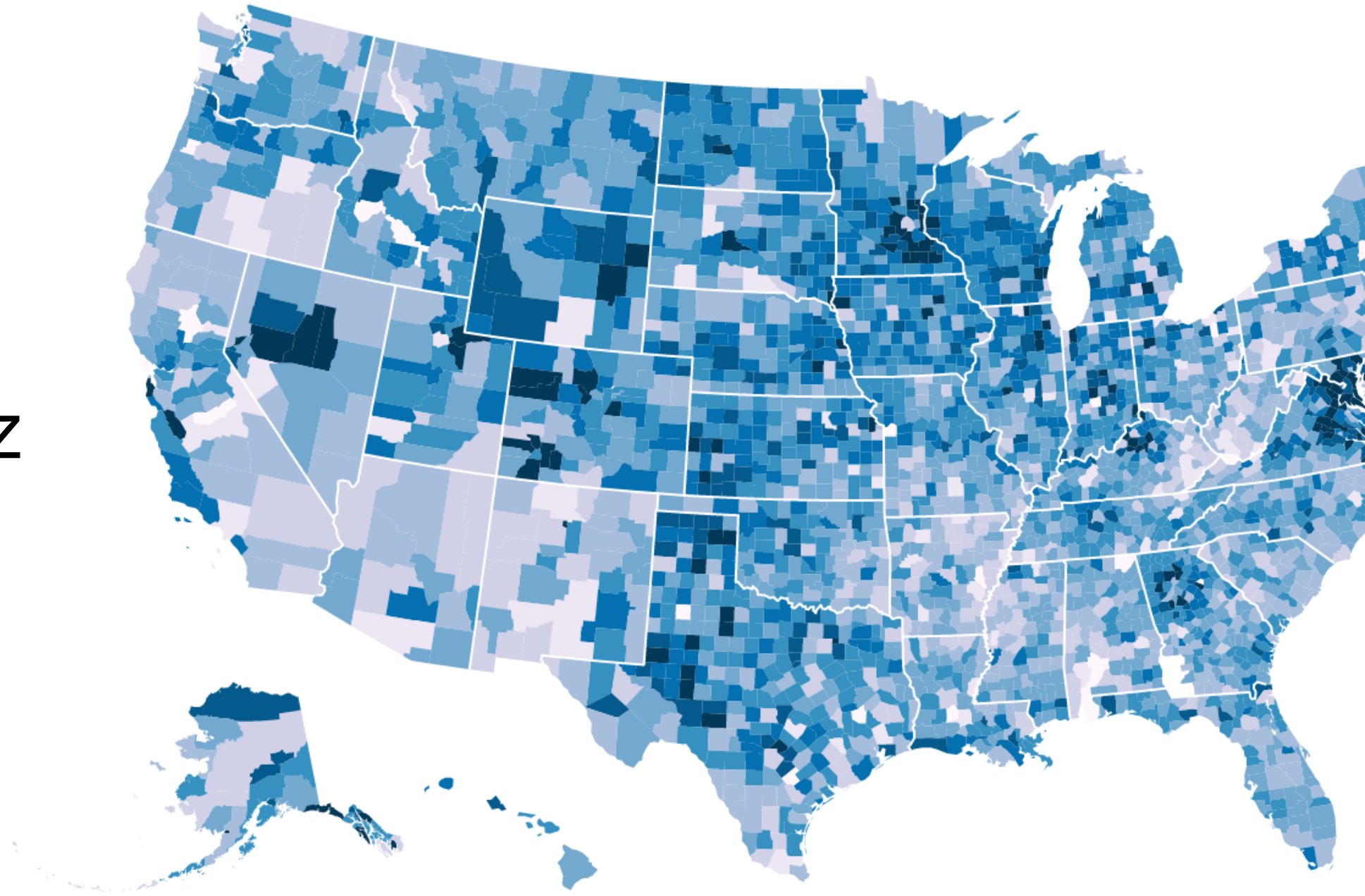


Název grafu

OK

Zrušit

#geoviz



V příštím díle uvidíte...

- A je toho víc... data art?
- Historie vizualizace.
- Jak to všechno začalo?
- Co se s ní děje dneska?
- Jaké si vzít poučení z předchozího vývoje?