

Data Visualization Tools

Matteo Fortini



This collage illustrates a variety of data visualization tools, each with a small screenshot and a brief description:

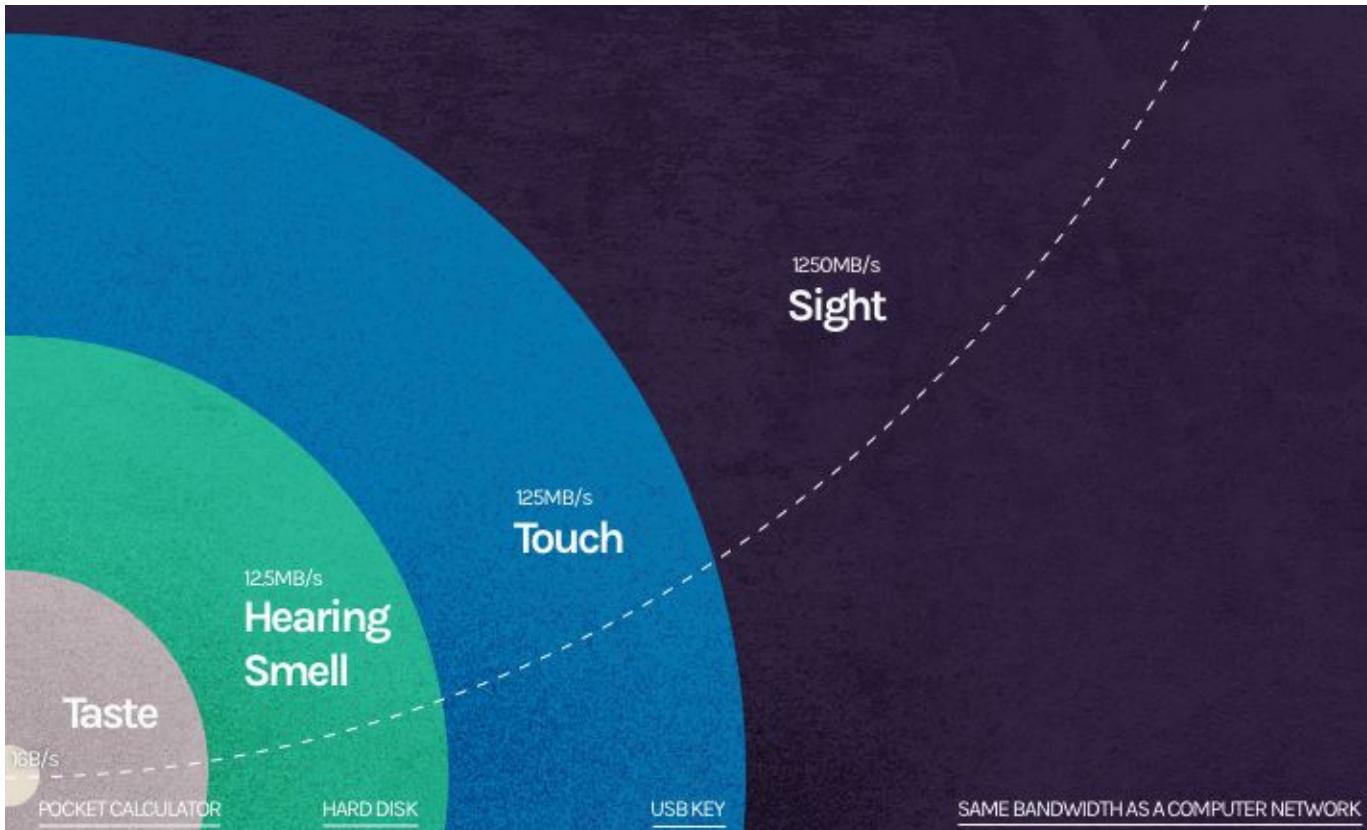
- Leaflet**: A light-weight JavaScript library for making the easiest interactive maps for desktop and mobile browsers.
- Many Eyes**: A web application to turn a list and images into a bar chart or bubble chart.
- MapBox**: A web platform for building custom interactive maps and a fast-paced online tool to practice them.
- Miso**: A toolkit to quickly create or interact with rich and dynamic data visualizations.
- Modest**: A data visualization framework for Python, JavaScript and Java.
- NVD3.js**: A collection of re-usable charts and chart components for D3.js.
- NodeBox**: A desktop application that lets you create graphics with code, as in code or in traditional media.
- OpenRefine**: A tool for working with data, cleaning it, fixing it, and integrating it by extracting its best features.
- paper.js**: A vector graphics scripting framework for 2D design and coding with a drawing interface.

Below the collage, there are two rows of cards, each containing three items:

Polymaps	Prefuse	Processing
A library for making dynamic, interactive maps with Image- and vector-based tiles.	A vector software tool for creating highly reactive data via visualization in Java.	An open source programming language and environment for creating images, animiations, and interactions.

At the bottom center is a Creative Commons Attribution (CC BY) license logo.

Perché la visualizzazione



(Tor Nørrestrand)

Usiamo la visualizzazione

- Per sintetizzare grandi quantità di dati
- Alternativa: statistiche (media, varianza, coefficienti correlazione)
- Per **esplorare** i dati (EDA)
- Per **raccontare** una storia basata sui dati

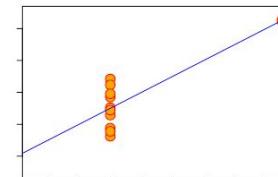
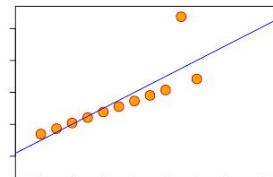
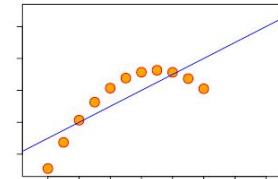
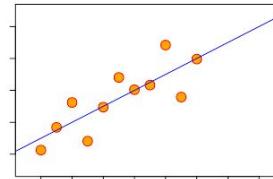
Exploratory Data Analysis

- Grafi "grezzi": non curiamo etichette, titoli, didascalie
- Cerchiamo **relazioni o pattern**
- Cerchiamo **distribuzioni e outliers**
- Usiamo la **forma, il colore, la distribuzione spaziale**

EDA: Relazioni fra grandezze

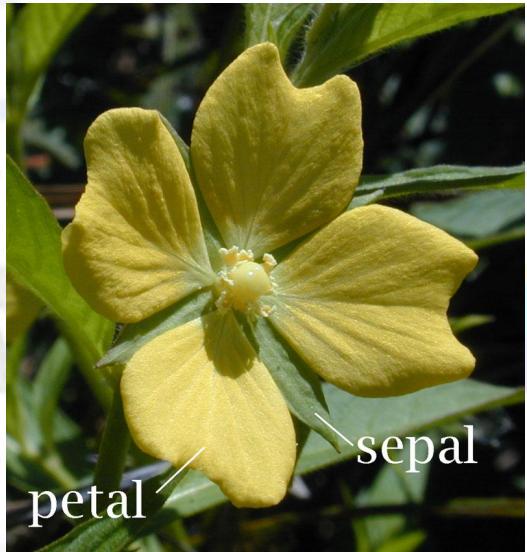
Anscombe's quartet (1973):

- stessa media
- stessa varianza
- stessa regressione
- **molto diverse**

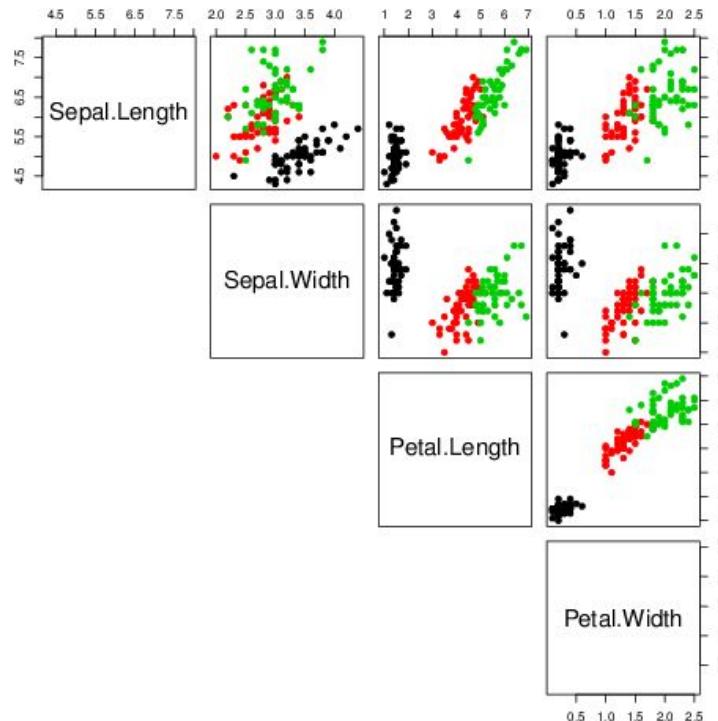


"Anscombe's quartet 3" by Anscombe.svg: Schutzderivative work (label using subscripts): Avenue (talk) - Anscombe.svg. Licensed under CC BY-SA 3.0 via Commons

EDA: Relazioni fra grandezze

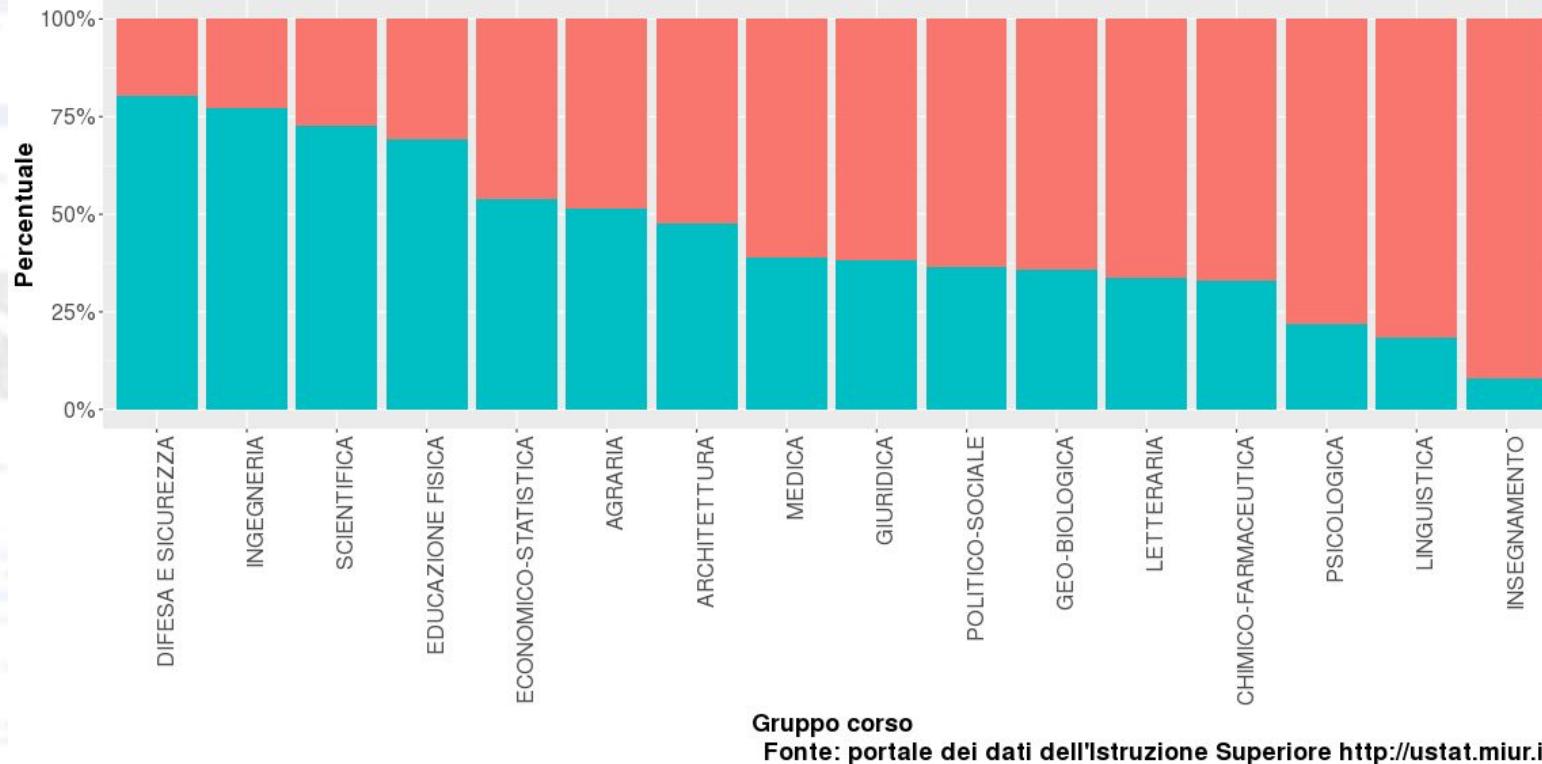


"Petal-sepal". Licensed under CC BY-SA 3.0 via Commons

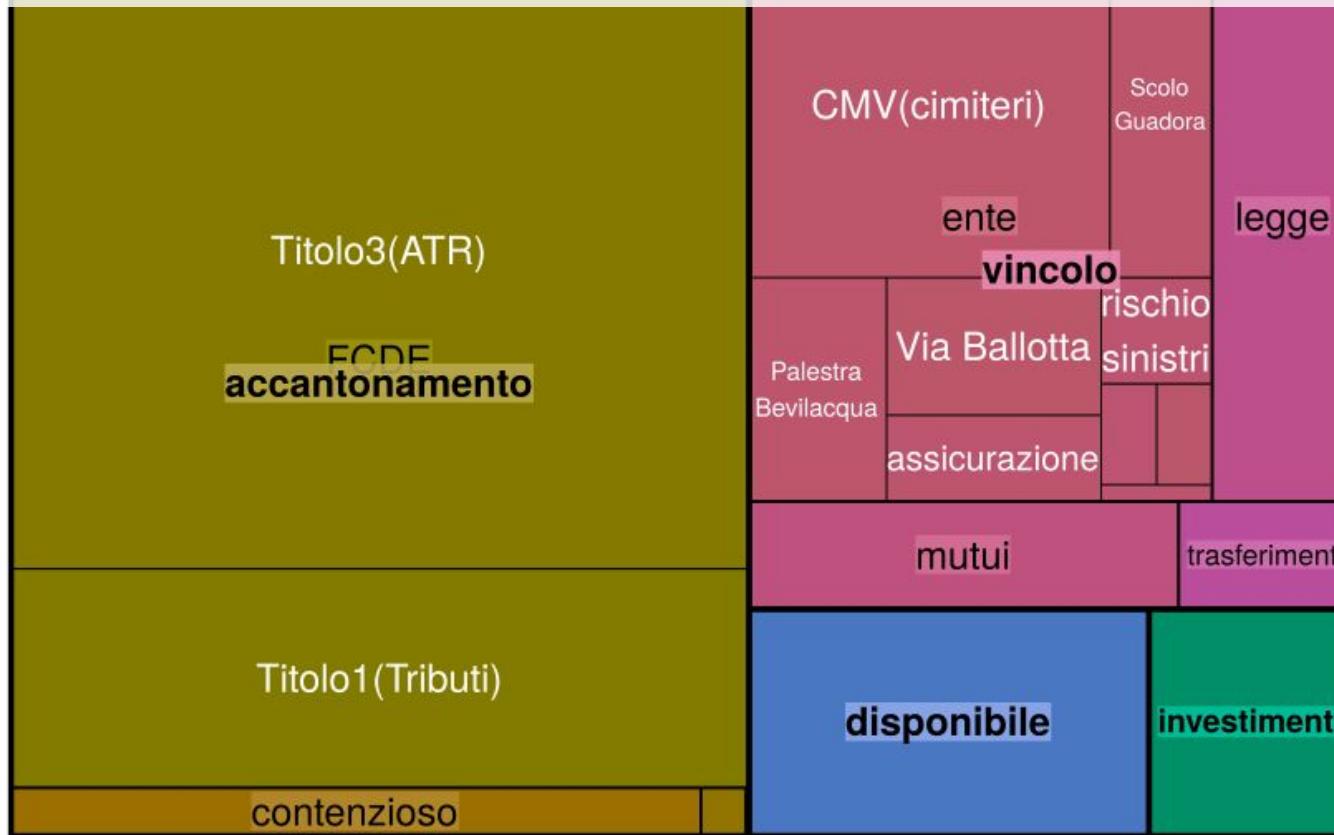


EDA: Quantità

Numero di studenti per tipo di corso di laurea (AA2015/2016)

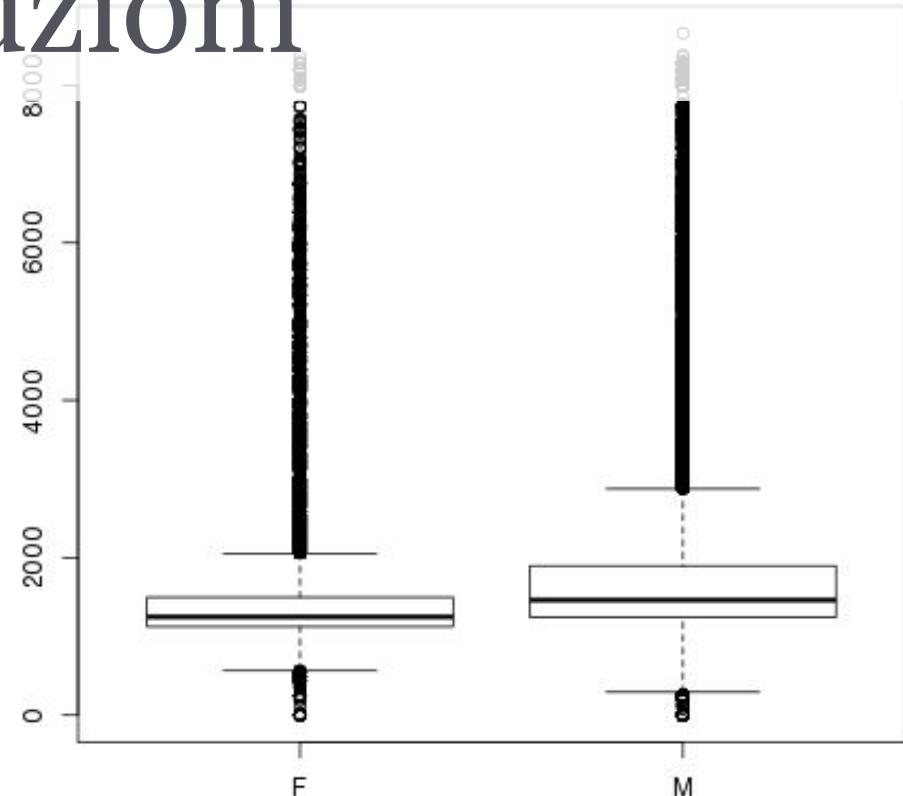
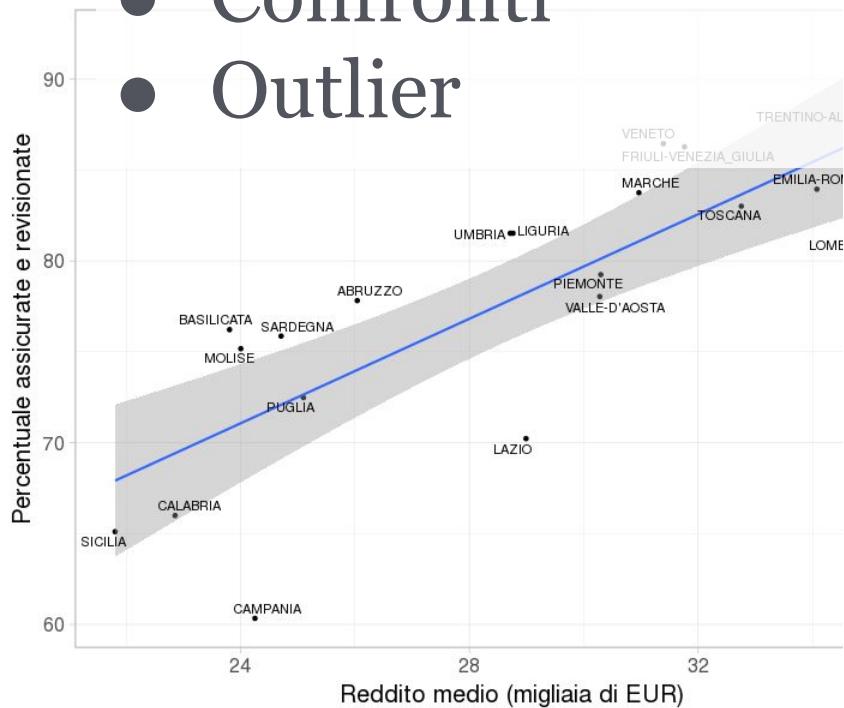


EDA: Quantità gerarchiche



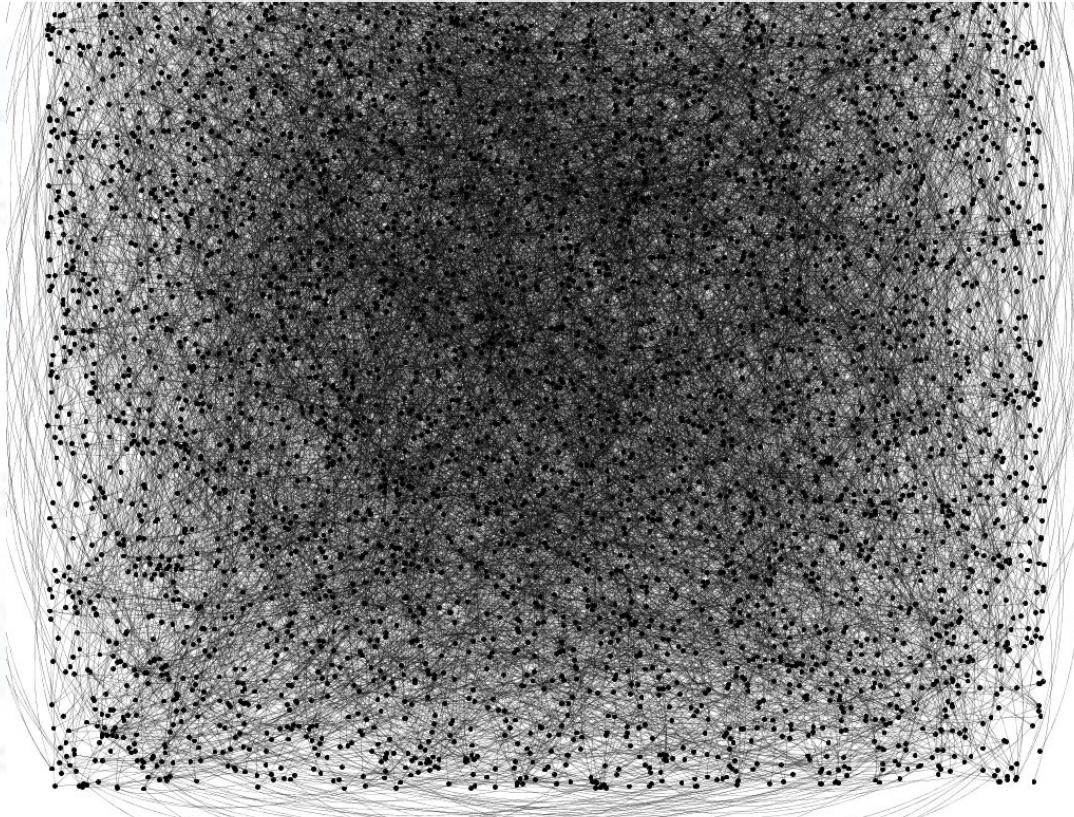
EDA: Distribuzioni

- Confronti
- Outlier

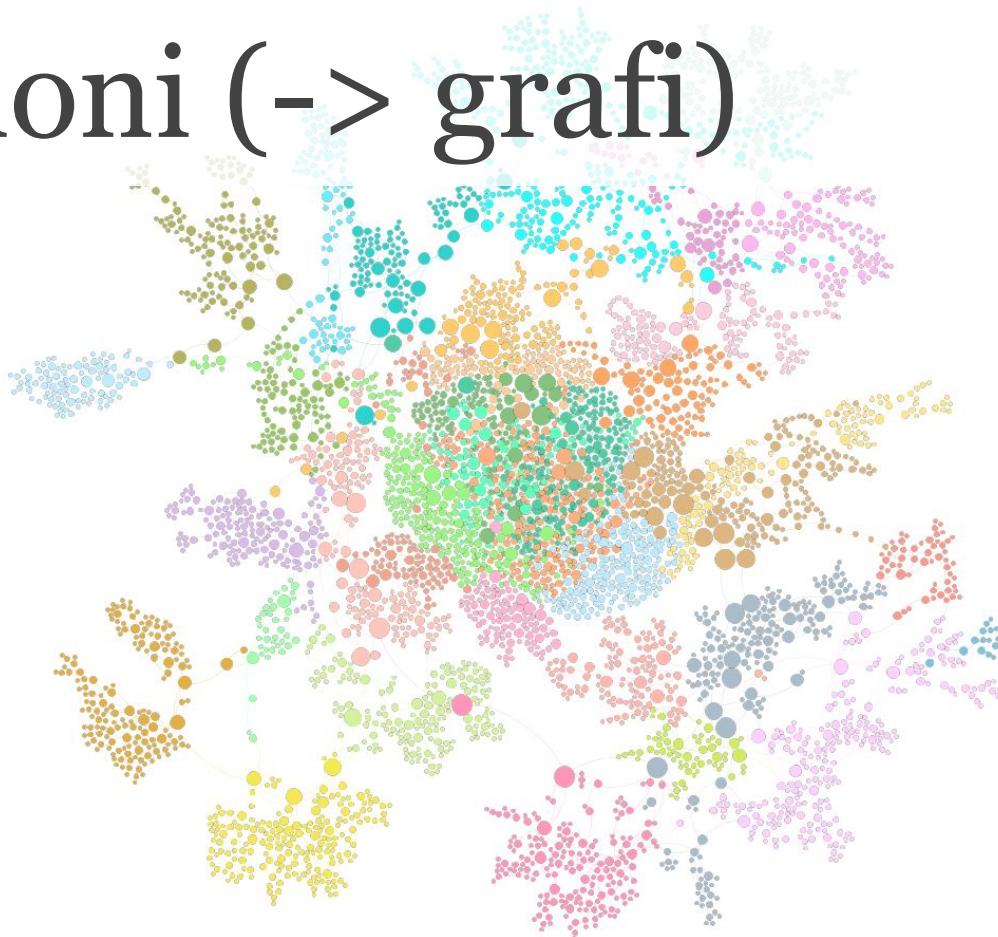


Cilindrata per genere (parco circolante auto 2017)

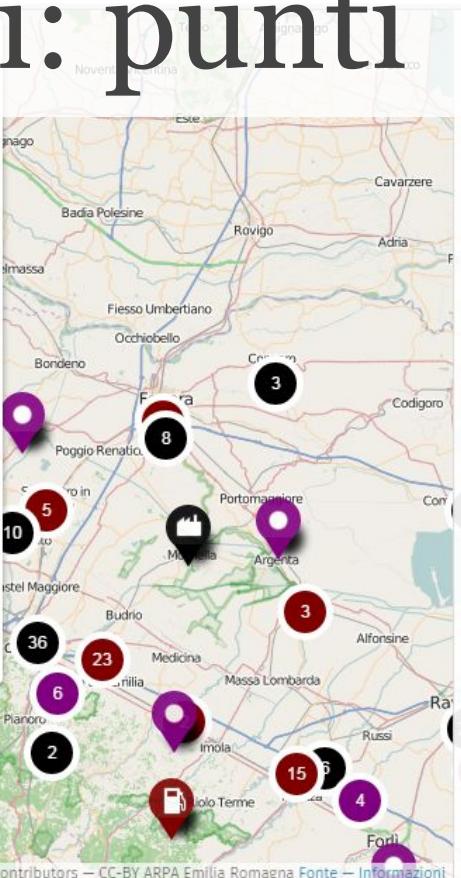
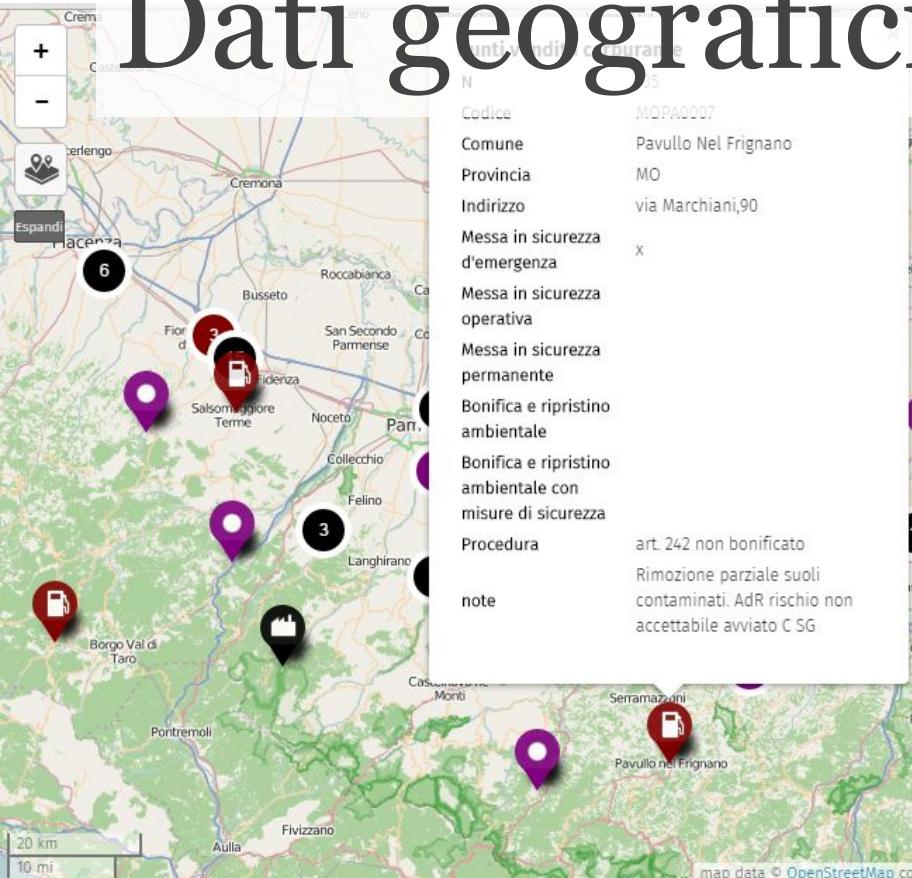
Relazioni (-> grafi)



Relazioni (-> grafi)



Dati geografici: punti



Siti contaminati della Regione Emilia-Romagna (rapporto ARPA 2015)

di mfortini

Mappa dei siti contaminati della Regione Emilia-Romagna secondo il rapporto ARPA 2015.

Licenza: CC-BY

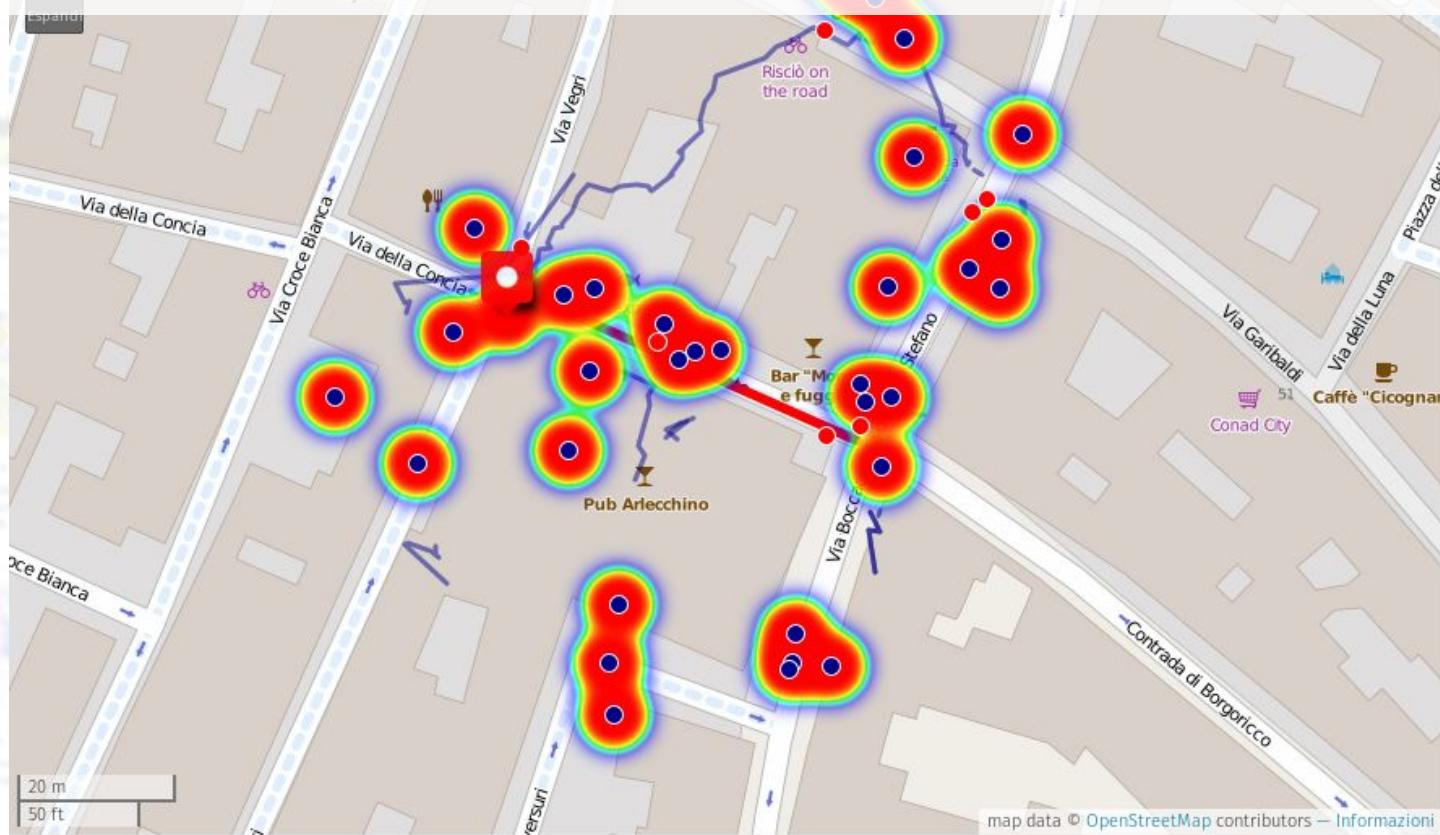
Altro

Industriali

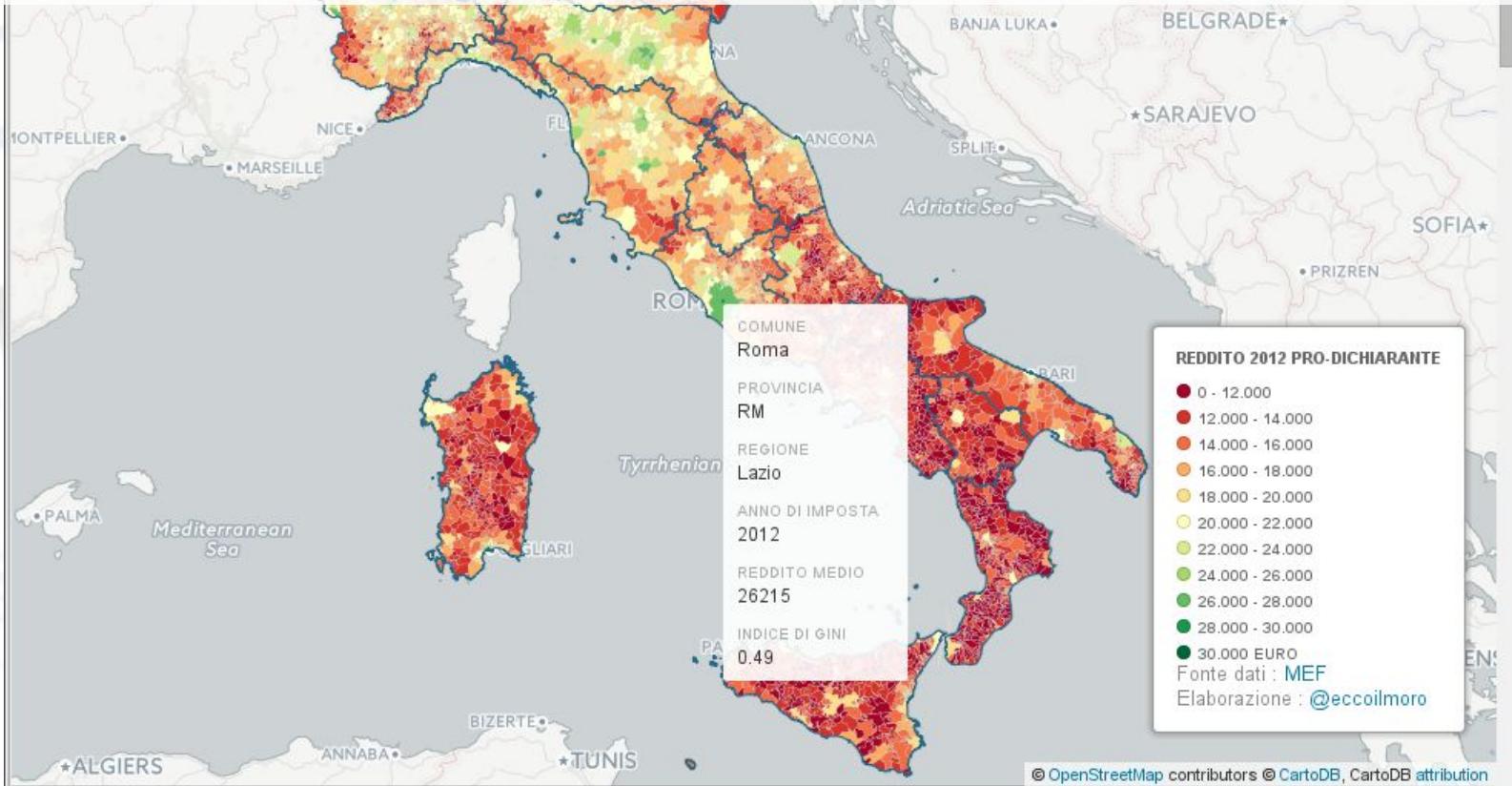
Punti vendita carburante

Ringraziamenti

Dati geografici: heatmap



Dati geografici: choropleth



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

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

Les nombres d'hommes perdus sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres de chiffres romains au-dessous de la carte. L'usage n'est pas toujours le même; dans une zone, il est écrit 125 000, dans une autre 125.000. On peut juger à l'œil que lorsque l'armée passe de l'ouest vers l'est, elle perd de plus en plus d'hommes. Cela se voit aussi sur la carte de Jaccard, page 128. On peut voir que l'armée française, qui débute à Malibow et gagne vers Osscha et Witebsk, avance toujours marche avec l'armée.

L'armée française suit la route de l'Oural, et c'est à l'ouest de l'armée russe. La carte de Jaccard, page 128, montre que l'armée russe passe par les villes de Tchernigov, Polotsk, Smolensk, Dorogobouge, Vitebsk, Osscha, et Witebsk. L'armée française passe par les villes de Kowno, Vilna, Smorgoni, Molodzno, Studenitska, Minsk, Mohilow, Orscha, Dorogobouge, Vitebsk, Osscha, et Witebsk. Les deux armées se rejoignent à Witebsk.

On peut voir que l'armée française passe par les villes de Kowno, Vilna, Smorgoni, Molodzno, Studenitska, Minsk, Mohilow, Orscha, Dorogobouge, Vitebsk, Osscha, et Witebsk. Les deux armées se rejoignent à Witebsk.

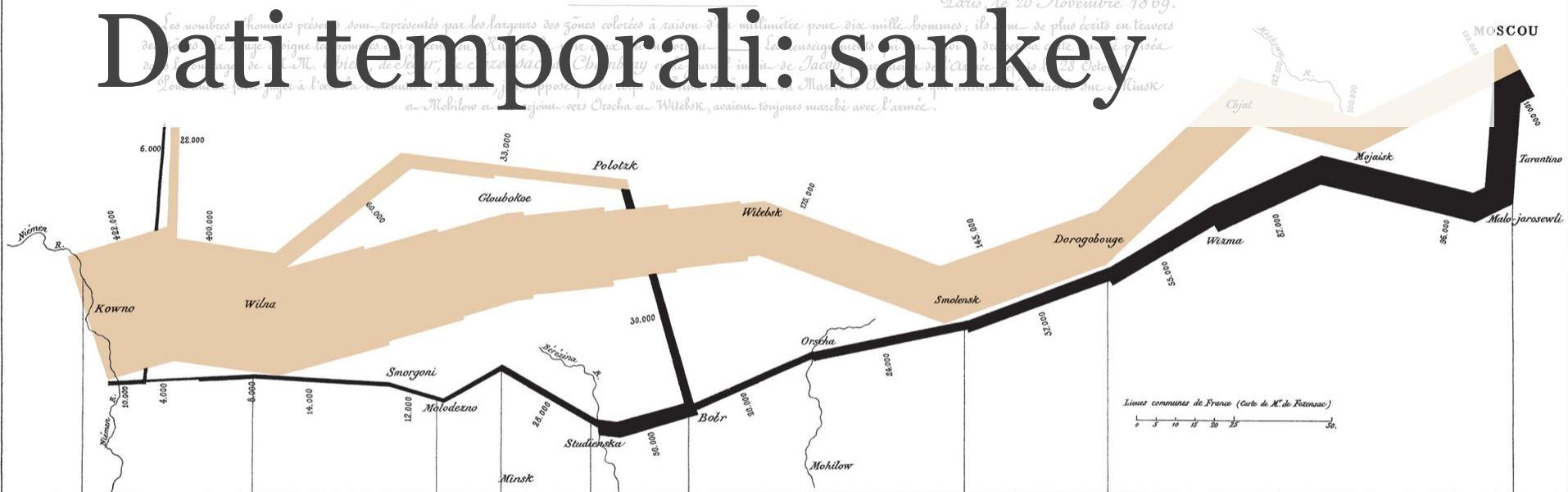
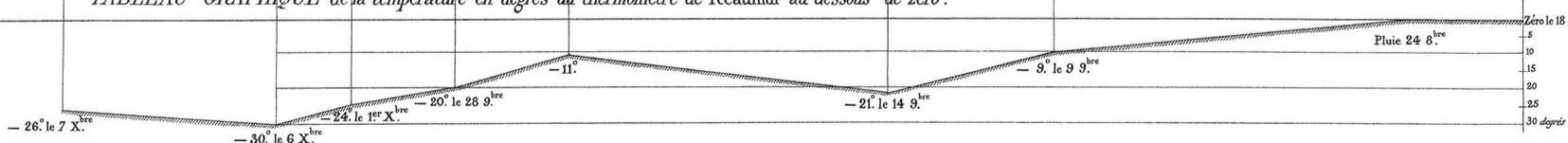


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Autog. par Regnier, 8. Pas. S^ete Marie S^t G^{de} à Paris.

Imp. Lith. Regnier et Dourdet.

"Minard" by Charles Minard (1781-1870) - see upload log. Licensed under Public Domain via Wikimedia Commons

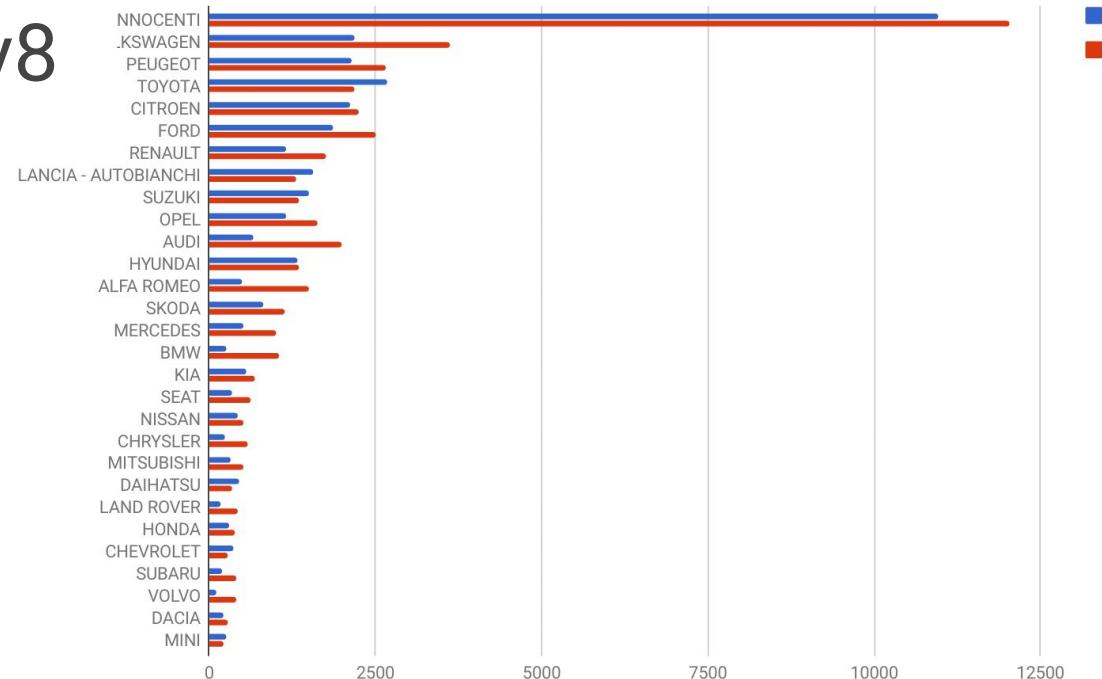
EDA Tool: Foglio Elettronico

Excel,Calc,Fogli,Numeri,...e tabelle pivot

<https://goo.gl/hLnv8>

3

setosa	4,9
setosa	5,4
setosa	4,8
setosa	4,8
setosa	4,3
setosa	5,8
setosa	5,7
setosa	5,4
setosa	5,1
setosa	5,7
setosa	5,1
setosa	5,4
setosa	5,1
setosa	4,6





File Data Worksheet Dashboard Analysis Map Format Window Help

Data

Dimensions

Abc Tipologia

Abc Measure Importo

http://www.tableau.com/

Marks

Automatic

Color

Size

Abc 123

Detail

Tooltip

Tipologia

Tipologia

Cultura e beni culturali

Disinfestazione, disinfezio..

Illuminazione

Manutenzione ordinaria str..

Polizia locale

Settore sportivo e ricreativo

0K

200K

400K

600K

800K

Importo

Measures

Importo

=# Number of Records

Measure Values

Tipologia

Cultura e beni culturali

Disinfestazione, disinfezi..

Illuminazione

Manutenzione ordinaria s..

Polizia locale

Settore sportivo e ricreativo

Sheet 1

6 marks 6 rows by 1 column SUM(Importo): 4.316.487



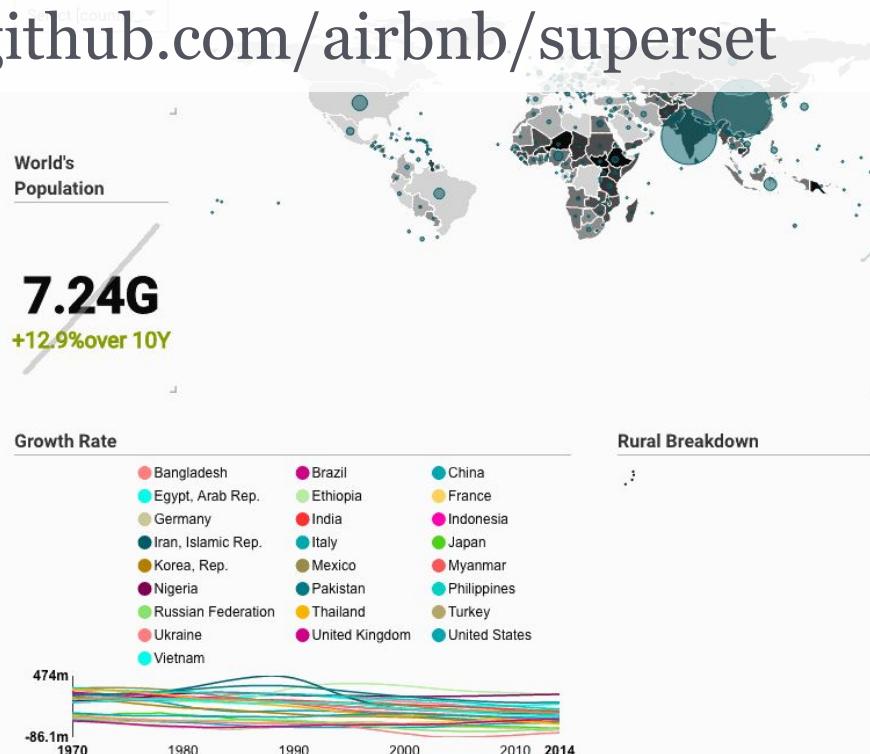
For **horizontal bars** try

0 or more dimensions

1 or more measures

EDA Tool: Superset

<https://github.com/airbnb/superset>



Indonesia	254M
Brazil	206M
Pakistan	185M
Nigeria	177M
Bangladesh	159M
Russian Federation	144M
Japan	127M
Mexico	125M
Philippines	99.1M
Ethiopia	97.0M
Vietnam	90.7M
Egypt, Arab Rep.	89.6M
Germany	80.9M
Iran, Islamic Rep.	78.1M
Turkey	75.9M
Congo, Dem. Rep.	74.9M
Thailand	67.7M
France	66.2M
United Kingdom	64.5M
Italy	61.3M
South Africa	54.0M
Myanmar	53.4M
Tanzania	51.8M
Korea, Rep.	50.4M
Colombia	47.8M
Spain	46.4M
Ukraine	45.4M
Kenya	44.9M
Argentina	43.0M
Sudan	39.4M
Algeria	38.9M



1 EDA Tool: Datawrapper

<https://datawrapper.de/>

It all starts with your data...

Select your data (including header row/column) in Excel, OpenOffice or select the text field on the right. You can also upload a CSV file from your computer. Learn more about how to upload your data.

• **Completo**
• **Versatile**

If you don't want to use Datawrapper, here's a list of some example datasets you can use:

Select a sample dataset ▾

Nome;Importo A Piano 2013-2014

Palazzo Comunale;1850000

Sant. Rocca e campanile e parte mon.;312500

Cimitero XII Morelli;248000

Ch.S.Rocco e Sebastiano;207500

Ch.P. di S.Lorenzo e pert. canonica Casumaro;162500

P. del Governatore;1241750

Ch. p. S.M. del Salice e pert. con campanile Alberone;1225000

Collegiata S.Biagio e pert. chiesa;895000

Struttura Ospedaliera SS.Annunziata;1847000

...or upload a CSV file

Upload and continue ➔

Tool: Datawrapper

Make sure the data looks right

<https://datawrapper.de/>

Please make sure that Datawrapper interprets
the data correctly. Texts, dates and numbers
should be shown in blue, dates in green and text
in black.

First row as label

[Back](#) [Revert](#) [Proceed ➔](#)

Customize column format

	A	B
1	Nome	Importo
2	Palazzo Comunale	
3	Sant. Rocca e campanile e parte mon.	
4	Cimitero XII Morelli	
5	Ch.S.Rocco e Sebastiano	
6	Ch.P. di S.Lorenzo e pert. canonica Casumaro	
7	P. del Governatore	
8	Ch. p. S.M. del Salice e pert. con campanile Alberone	
9	Collegiata S.Biagio e pert. chiesa	
10	Struttura Ospedaliera SS.Annunziata	
11	Ch.P. S.Sebastiano Renazzo	
12	Santuario Rocca, campanile, parte monastero	
13	Cimitero Renazzo	
14	Ch. S.Pietro Ap. e campanile	
15	Ch.P. S.Maria e S.Isidoro Penzale	
16	Ch.P. di S.Giorgio e campanile Corporeno	
17	Cimitero Casumaro	

Upload Data ✓

2 Check & Describe ✓

3 Visualize

Publish & Embed ✓

Tool: Datawrapper

<https://datawrapper.de/>



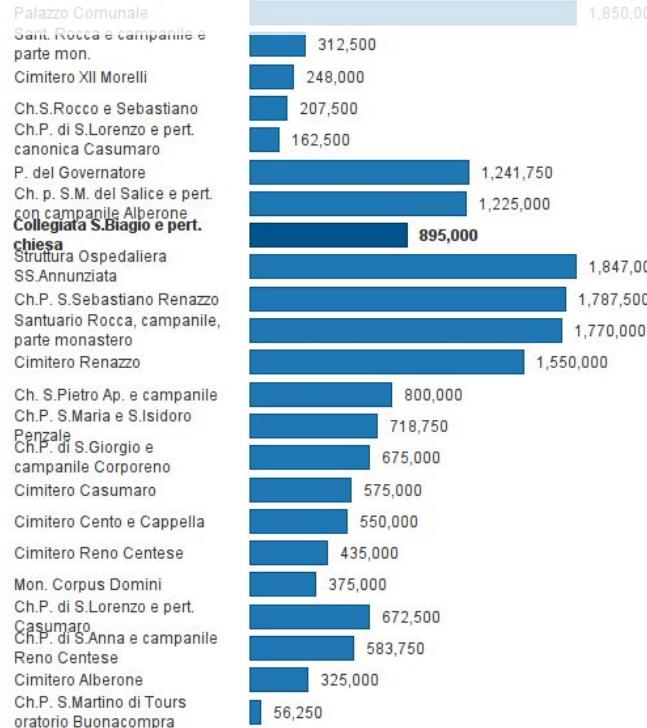
Hint: In case the visualization doesn't look like you expected, you should try to transpose the data.

◀ Back

Proceed ➔

Cento (FE) - importo RER 2013-14 per ricostruzione Beni Culturali

Importo per la ricostruzione dei beni culturali del Comune di Cento (FE) stanziato dalla RER per il 2013-2014



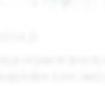
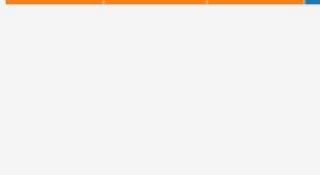
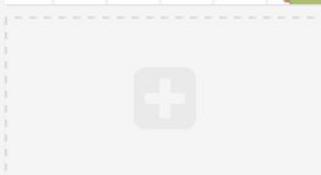
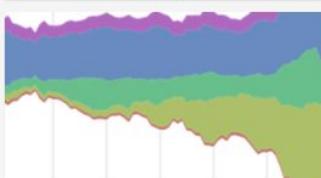
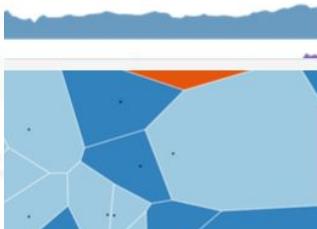
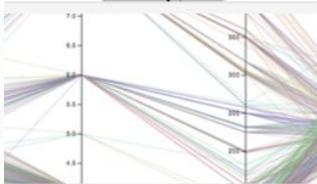
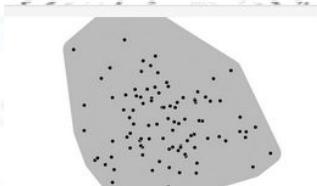
Source: [Regione Emilia-Romagna](#) [Get the data](#)

Created with [Datawrapper](#)

Tool: RAW

<http://rawgraphs.io/>

RAW The missing link between
spreadsheets and vector graphics.



Tool: uMap

<https://umap.openstreetmap.fr>

The screenshot shows the uMap interface. On the left is a map of the Emilia-Romagna region in Italy, displaying various locations marked with purple and red pins. A sidebar on the left contains icons for search, zoom, and other map functions. At the bottom left, there is a scale bar from 20 km to 10 mi, and at the bottom right, copyright information for OpenStreetMap contributors and ARPA Emilia Romagna.

Importa dati

Scegli file Nessun file selezionato

Aggiungi un URL qui

Incollare i propri dati qui

Seleziona il formato dei dati da importare [?](#)

Scegli il formato dati

Seleziona il livello dove importare

Altro

Importare

Siti contaminati della Regione Emilia-Romagna (rapporto ARPA 2015) di mfortini — Informazioni | Visualizza dati

Progetto Modifica Visualizza Layer Impostazioni Plugins Vettore Raster Database Web MMQGIS Processing Guida



Tool: QGIS

<https://qgis.org>

- Dati geografici
- JOIN
- Plugin
- Web

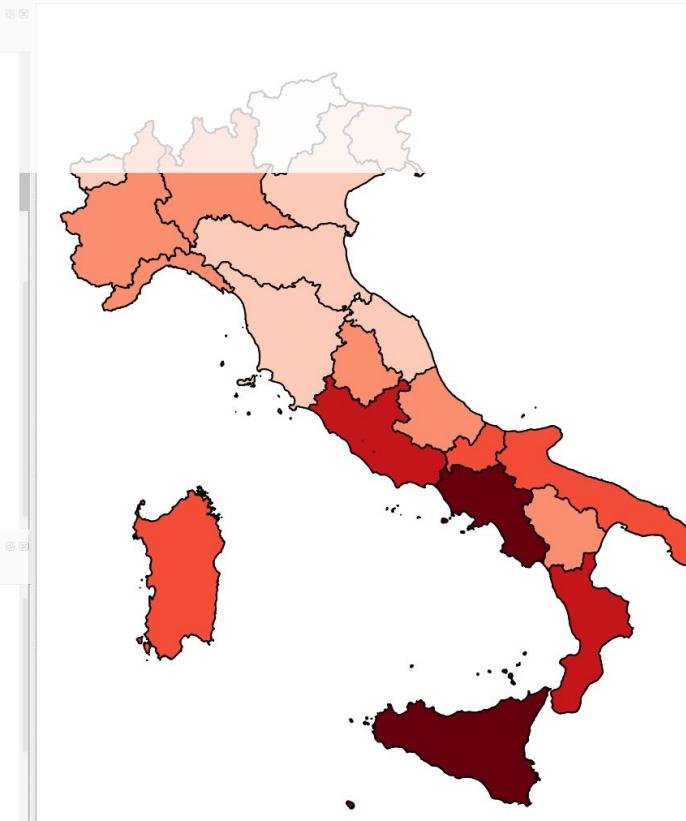
DBTR_MonoFull
DBTR2013_Ctr5
Emilia Romagna CTR
dbtr_ctrmultiscala
Emilia Romagna DBTR
Emilia Romagna DBTR_Ctr5
Lidar Emilia Romagna
ELL.LIDAR.EMILIA_ROMAGNA.1x1
ELL.LIDAR.EMILIA_ROMAGNA.2x2
Ortofoto ER AGEA 2011
Ortofoto ER AGEA 2014

possibile scaricare le capabilities
WPS OSM WMS

regione_revisione_assicurazione
popregioni_2016
regione_auto_pop18
Elenco-codici-statistici-e-denominazioni-al-24_03_2017

revisione
65.0 - 70.0
70.0 - 75.0
75.0 - 80.0
80.0 - 85.0
85.0 - 90.0
90.0 - 93.0

assicurazione



Coordinata 1083396,5007351

Scala 1:9.597.583

Magnifier 100% Rotazione 0,0

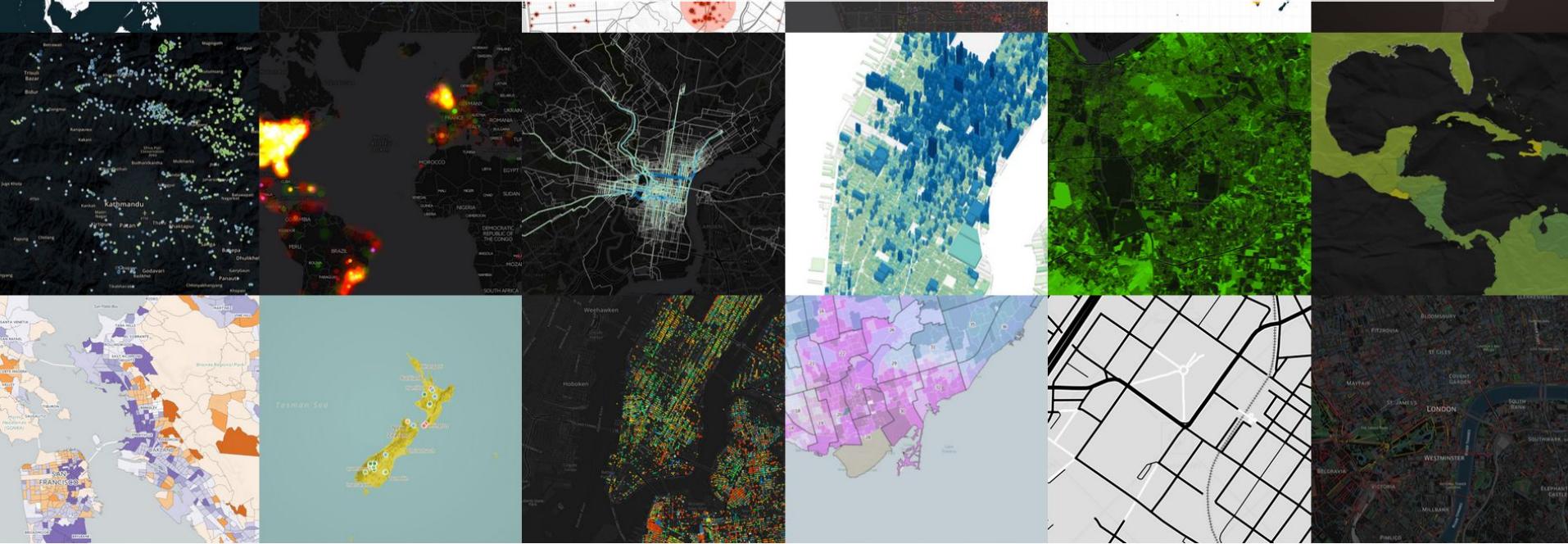
Visualizza EPSG:32632 (OTF)

Tool: Gephi

<https://gephi.org/>

- Grafi
- Layout
- Algoritmi SNA
- “Like Photoshop for graphs”





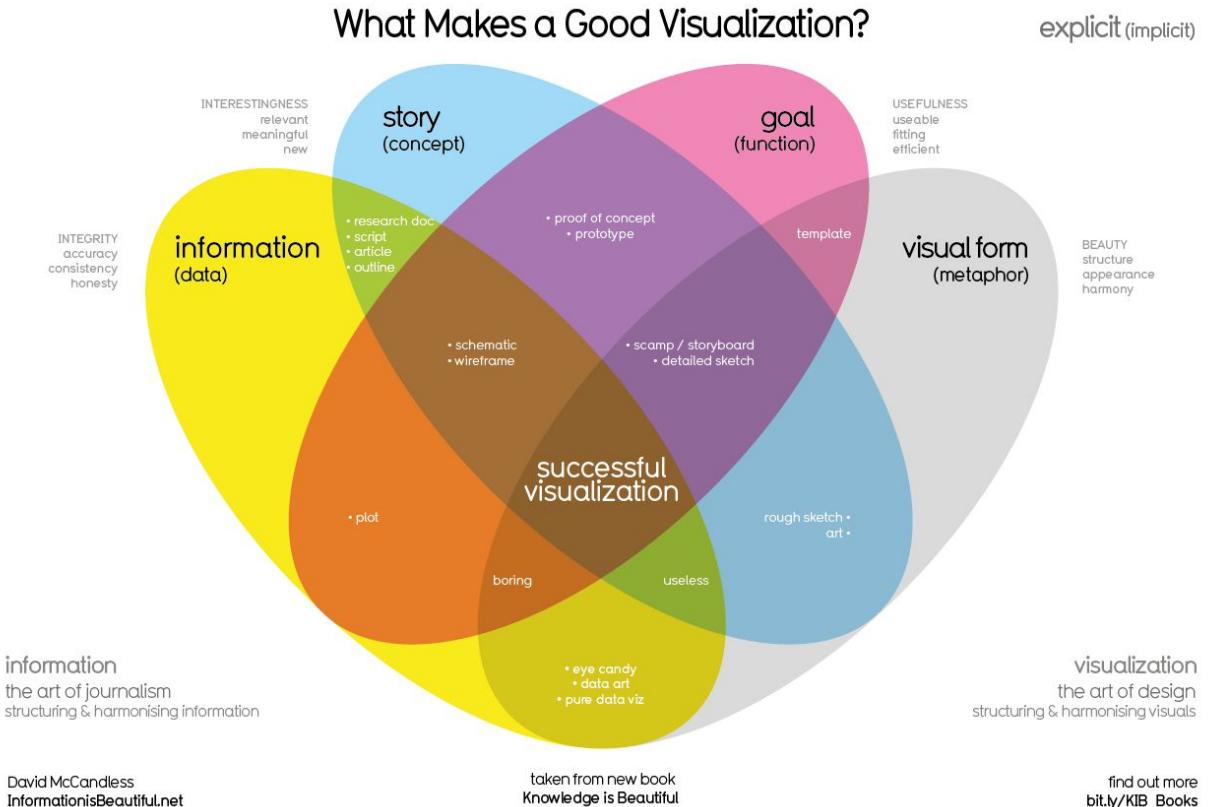
Tool: Carto

<https://carto.com/>

Visualizzazione

- Permette di descrivere le informazioni in modo chiaro e diretto
- Può essere dedicata alla stampa
- Oppure al web
- Nel secondo caso, possibilmente è **interattiva** (zoom, ricerca, ...)

Una buona visualizzazione



Una buona visualizzazione

- Non mente (oppure sì...)
- È chiara
- Racconta una (sola) storia
- Contiene tutti gli elementi per l'interpretazione
- Specifica una licenza
- Fornisce accesso ai dati raw

Una buona visualizzazione

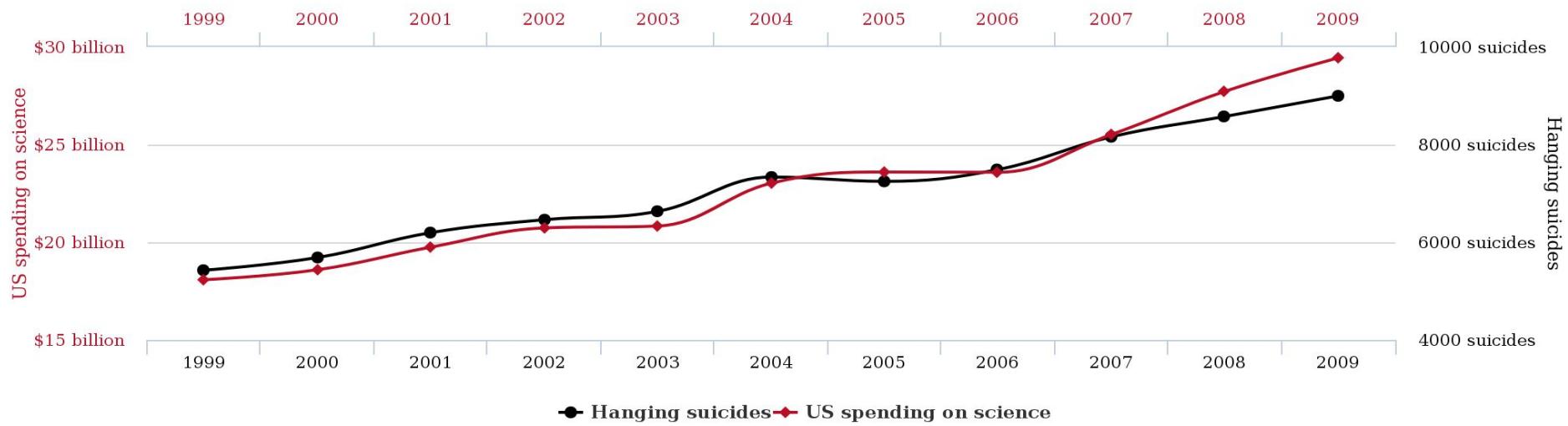
Non mente (oppure sì...)



Una buona visualizzazione

Non mente (oppure sì...)

US spending on science, space, and technology
correlates with
Suicides by hanging, strangulation and suffocation



Una buona visualizzazione

È chiara

Cleveland e McGill (1984) "Graphical perception: theory, experimentation and application to the development of graphical methods" **NB non è una legge.**

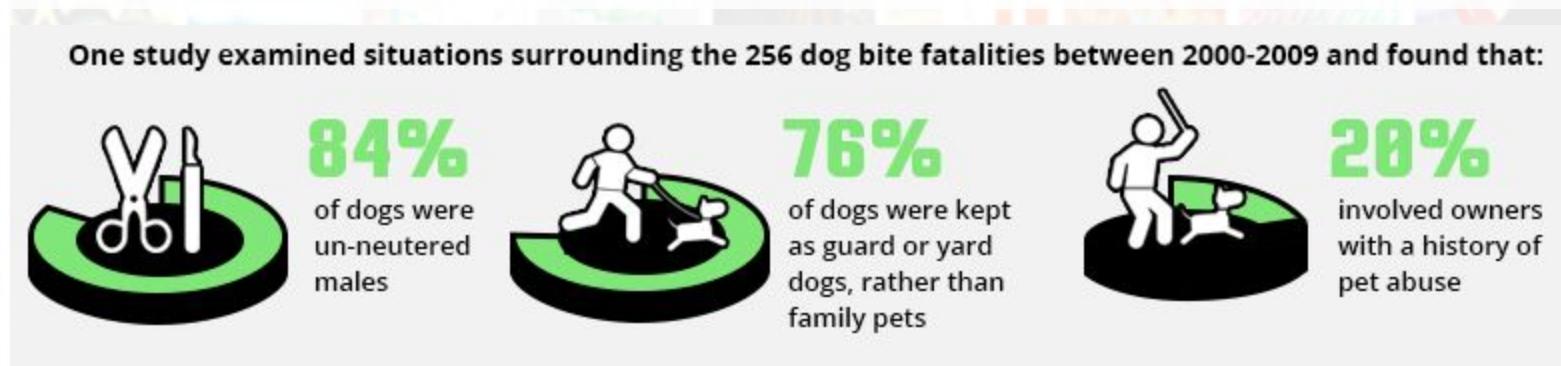


Sempre minore accuratezza percettiva



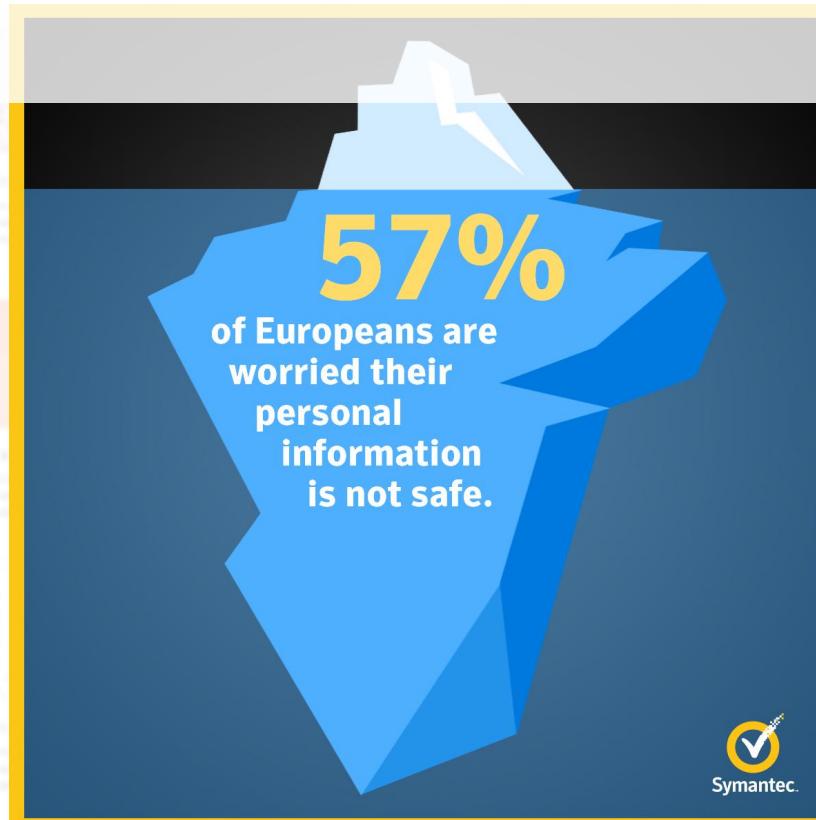
Una ~~buona~~ visualizzazione

È chiara?



Una ~~buona~~ visualizzazione

È chiara?



Una buona visualizzazione

Racconta una sola storia

Awarded the patent of the world's first two-wheeled vehicle adopting aerospace attitude control theory, fuzzy software algorithm and gyroscope system to maintain balance by leaning forward and backward.
Riders can control the scooter to go forward, accelerate, decelerate, brake, etc. by leaning forward or backward.
Similar to the techniques of riding a bicycle, riders achieve balance via slightly tilting sideways.



10

Weight/kg



Charge Time/min



18

Maximum Speed/km/h

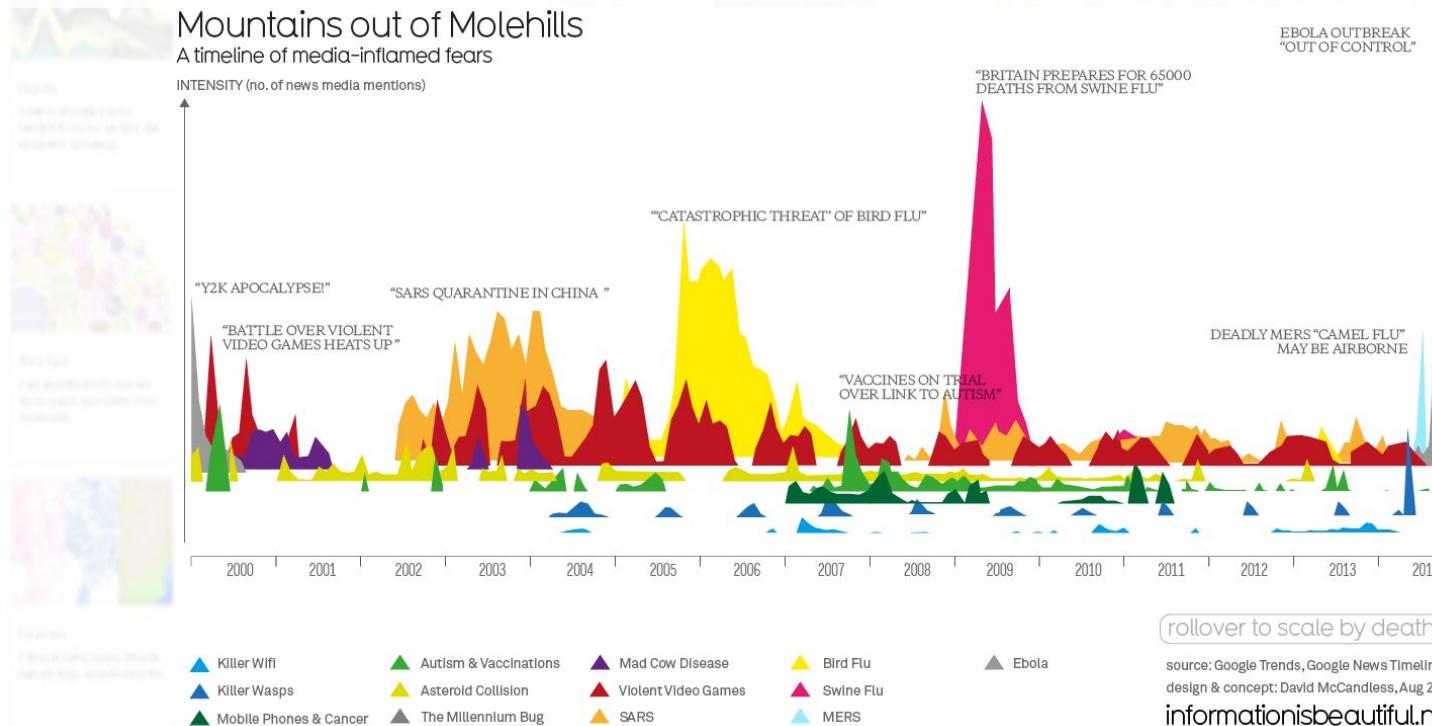


23

Range/km

Una buona visualizzazione

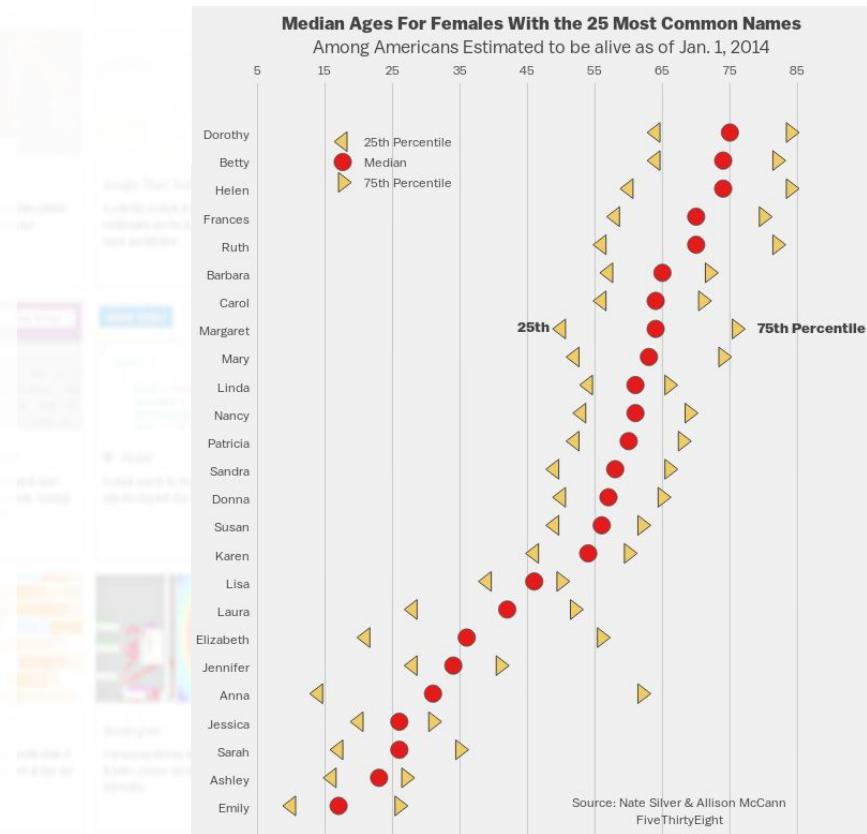
È chiara



Una buona visualizzazione

Contiene tutti gli elementi per l'interpretazione

- Assi
- Unità di misura
- Titolo
- Didascalia
- Legenda
- Fonti



Tool: R(RStudio)+Web

<https://www.rstudio.com/>

- Originariamente software statistico
- Completissimo
- Rigoroso
- Difficile
- Grafica molto potente
- Estendibile al web: rCharts, shiny, ...



Tool: Bubble Charts

Python(Pandas)+Matplotlib

In [37]:

```
df2007.iplot(kind='bubble', x='gdpPercap', y='lifeExp', size='pop', text='country',
              color='country', title='Life Expectancy',
              filename='cufflinks/simple-bubble-chart')
```

Copy to clipboard

- Out[37]:
- “R per Python”
 - Completissimo
 - Notebooks
 - Estendibile al web: cufflinks, ...



Support our open-source mission: Go Pro

(WEB)Tool: Leaflet

<http://leafletjs.com/>

- Orientato alle mappe
- Javascript
- Alla base di molti tool come umap
- Grafica molto potente
- Plugin



(WEB) Tool: SigmaJS

<http://sigmajs.org/>

- Orientato alla visualizzazione di **grafi**
- Javascript
- Versione web di Gephi
- Dinamico

(WEB) Tool: Timeline.js

<https://timeline.knightlab.com/>

- Orientato alla visualizzazione di timeline
- Javascript
- Interattivo

(WEB) Tool: infogr.am

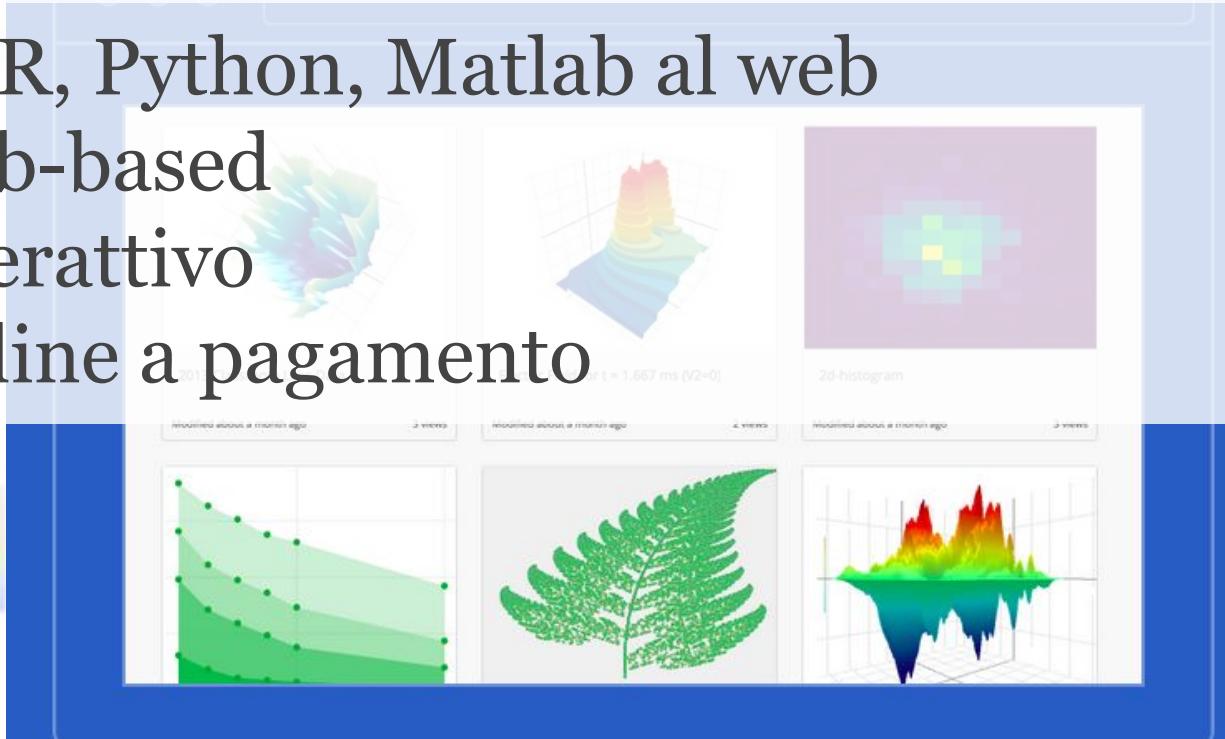
<https://infogr.am/>

- Orientato alla visualizzazione di **infografiche**
- Web-based
- Interattivo

(WEB) Tool: Plot.ly

<https://plot.ly/>

- Da R, Python, Matlab al web
- Web-based
- Interattivo
- Offline a pagamento



mbostock's blocks

(WEB) Tool: D3.js

<http://d3js.org/>

- Generico, potente
- Javascript
- Alla base di quasi tutti i tool web-based



mbostock's blocks

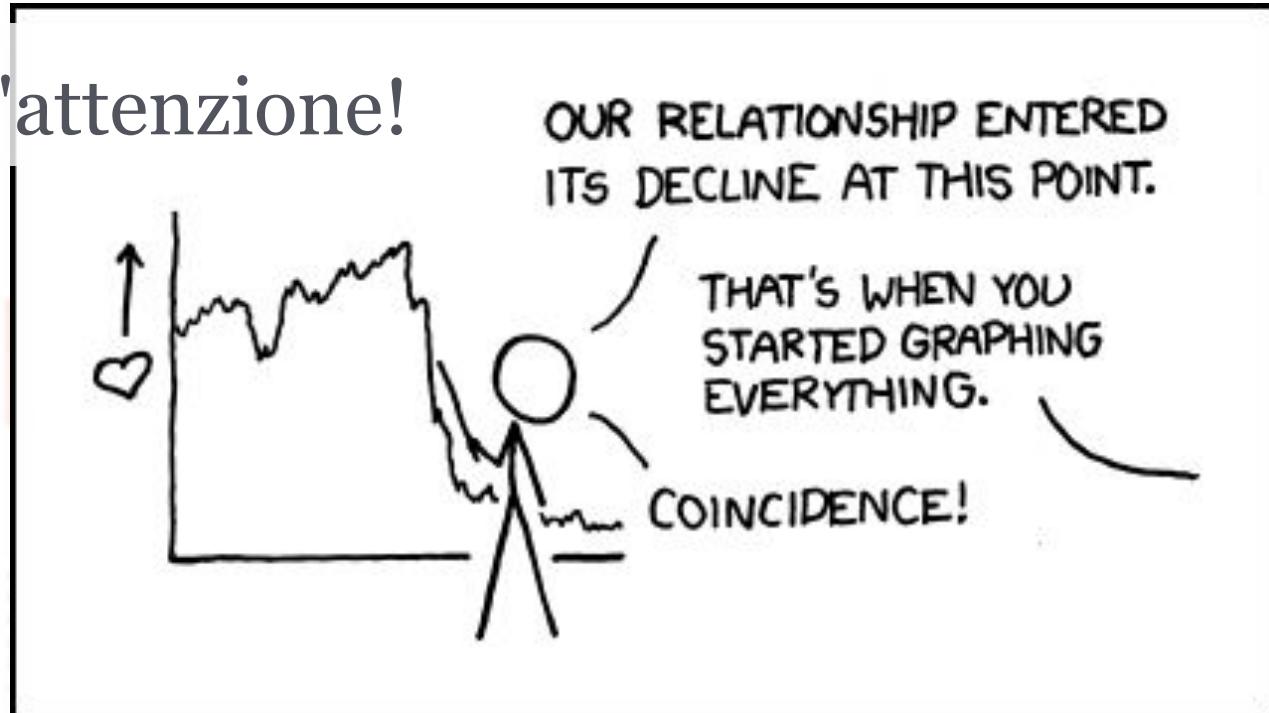
Stimoli

- <http://selection.dataviz.ch/>
- <https://github.com/d3/d3/wiki/Gallery>
- <http://www.scienzainrete.it/articolo/che-razza-di-infografica/marco-capovilla/2017-05-14>

4

Domande?

Grazie per l'attenzione!



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