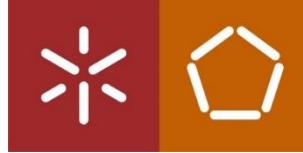


Universidade do Minho
Departamento de Informática

SENSORIZAÇÃO E AMBIENTE

MESTRADO EM ENGENHARIA INFORMÁTICA, 1º ANO - Perfil SI



Universidade do Minho
Departamento de Informática



Data Visualization



Data Visualization

Data Visualization (Data Viz) deals with the graphical representation of information and data:

- Using **visual elements** like charts, graphs, and maps
- Provides an accessible way to **see** and **understand** trends and patterns in **data**
- Essential to analyze massive amounts of information and make **data-driven decisions**

It is a big field of study. How to be effective?

“It is storytelling with a purpose.”



Data Visualization

Takes advantage of **pre-attentive processing**:

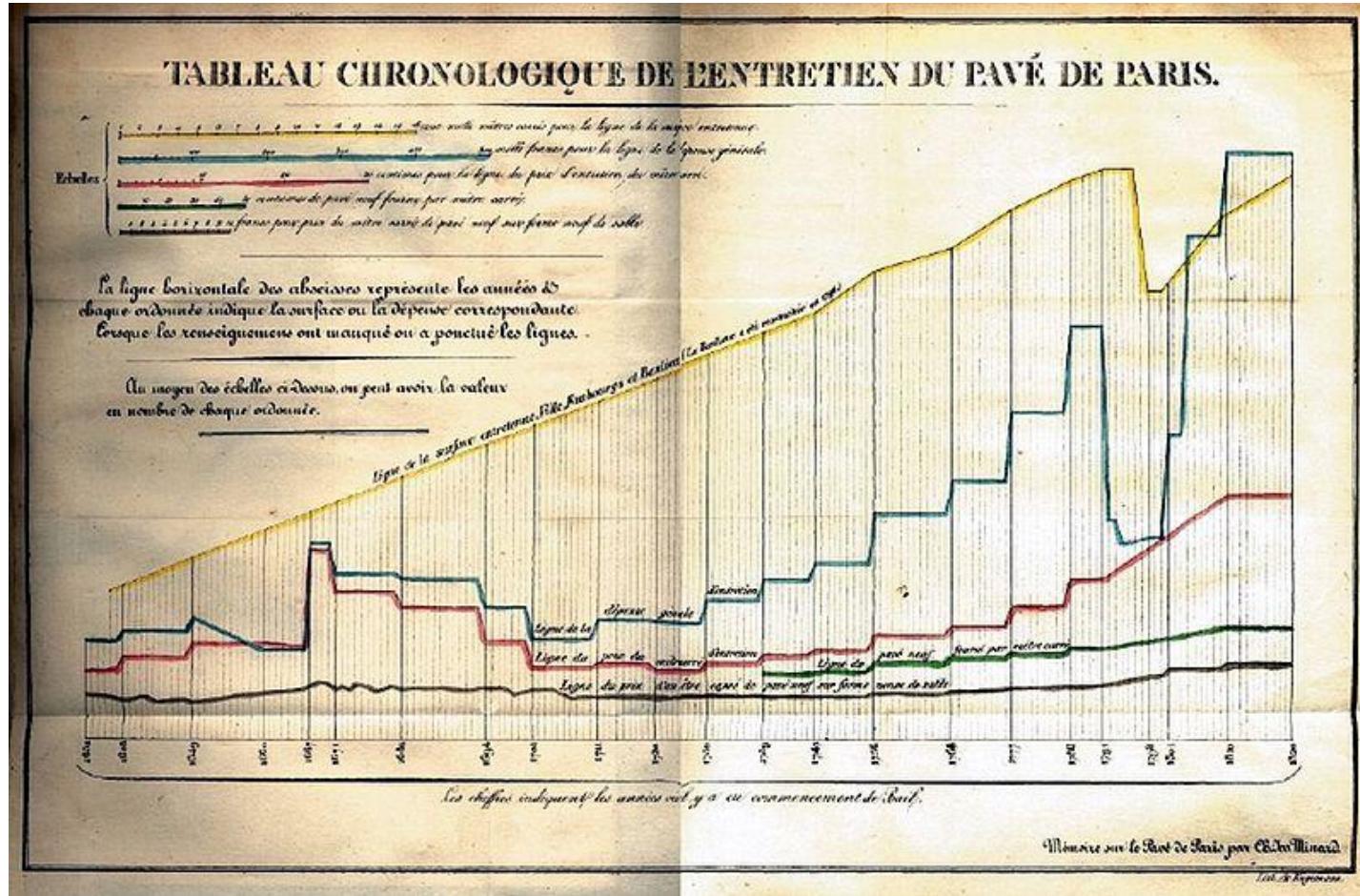
- The human being can distinguish differences in line length, shape, orientation, and color without significant processing effort
- Data viz are **created** for **human consumption**

Interactivity is important:

- Filter
- Scaling
- Linking
- Labeling
- Navigation

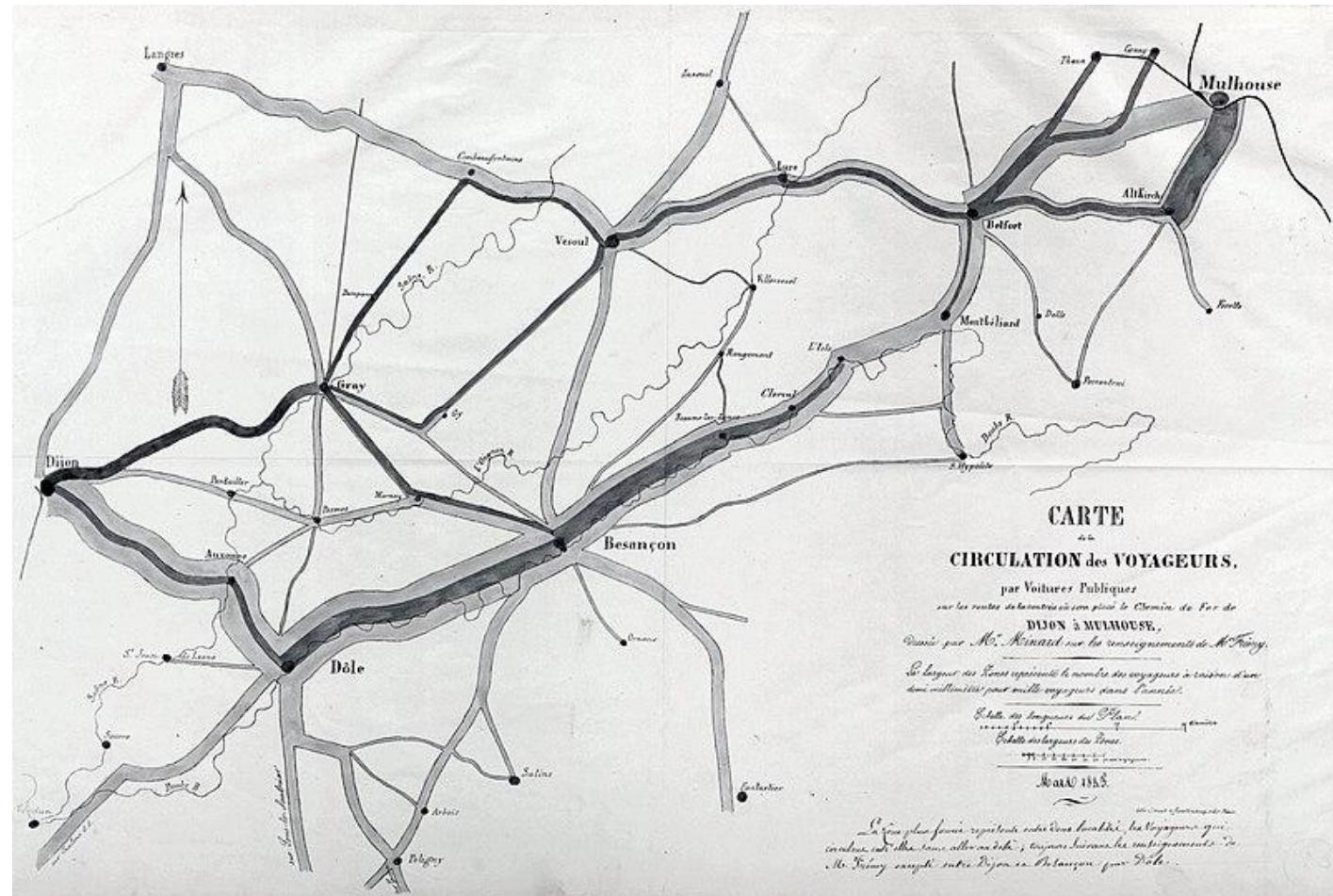


Data Visualization



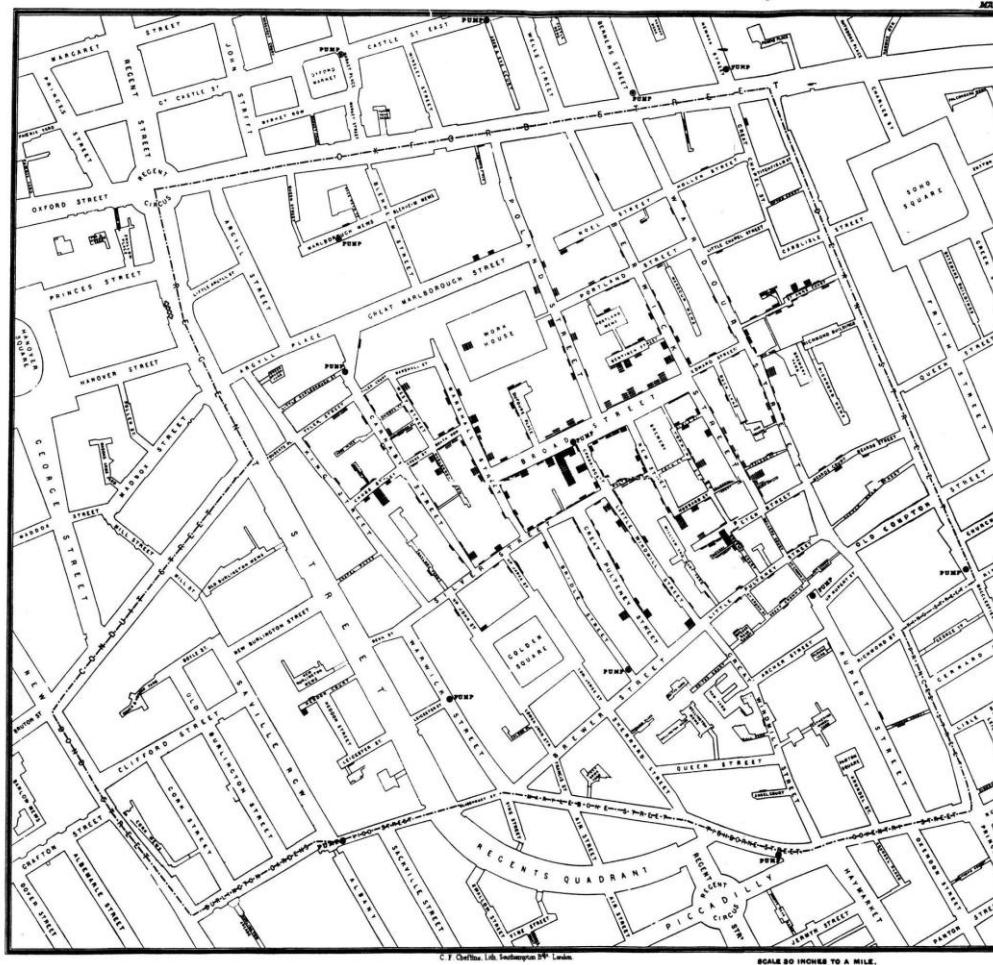


Data Visualization



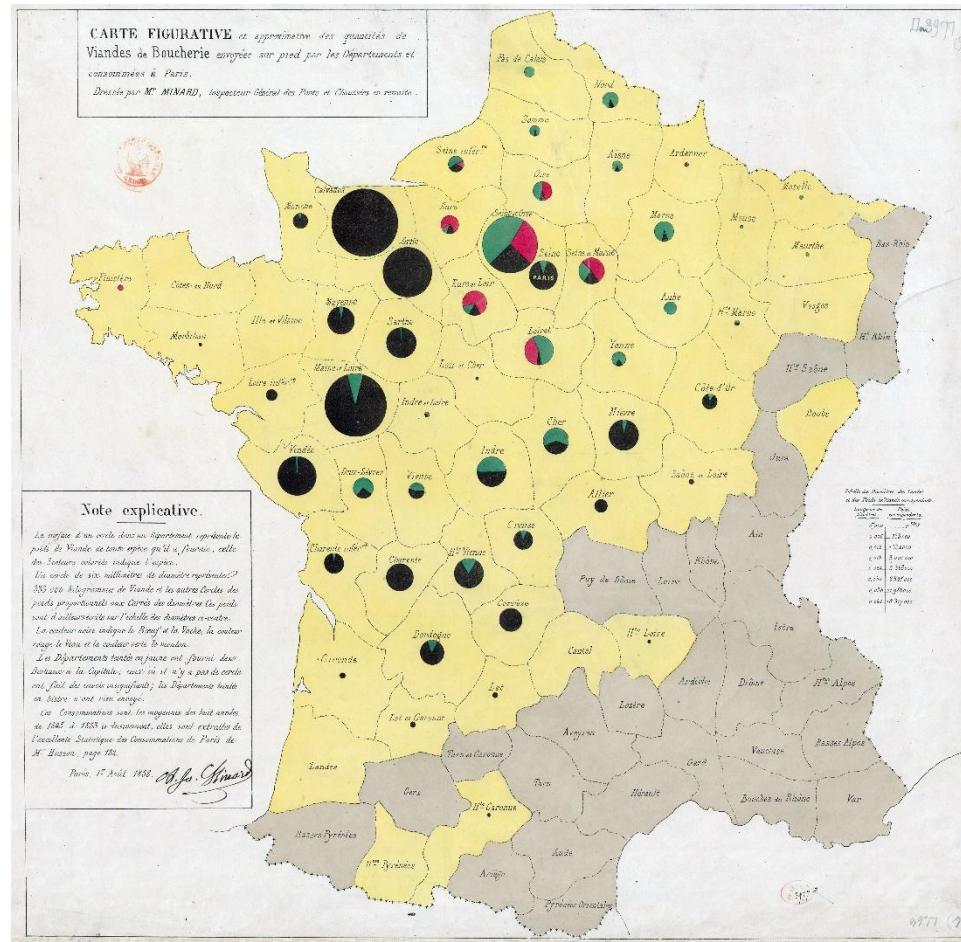


Data Visualization



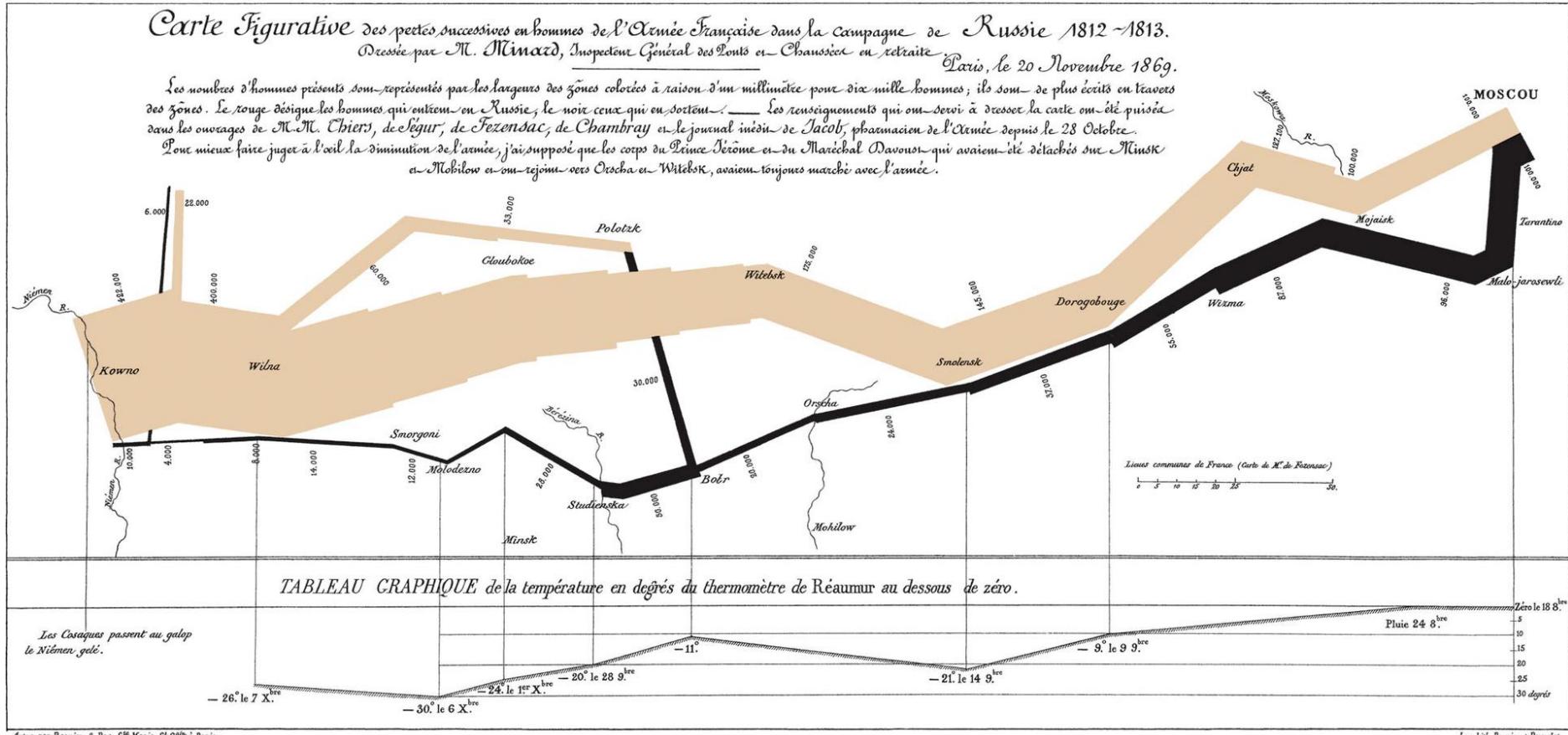


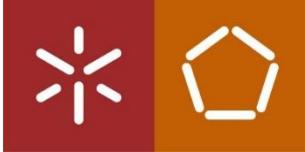
Data Visualization





Data Visualization





Data Visualization

Possibilities





Data Visualization

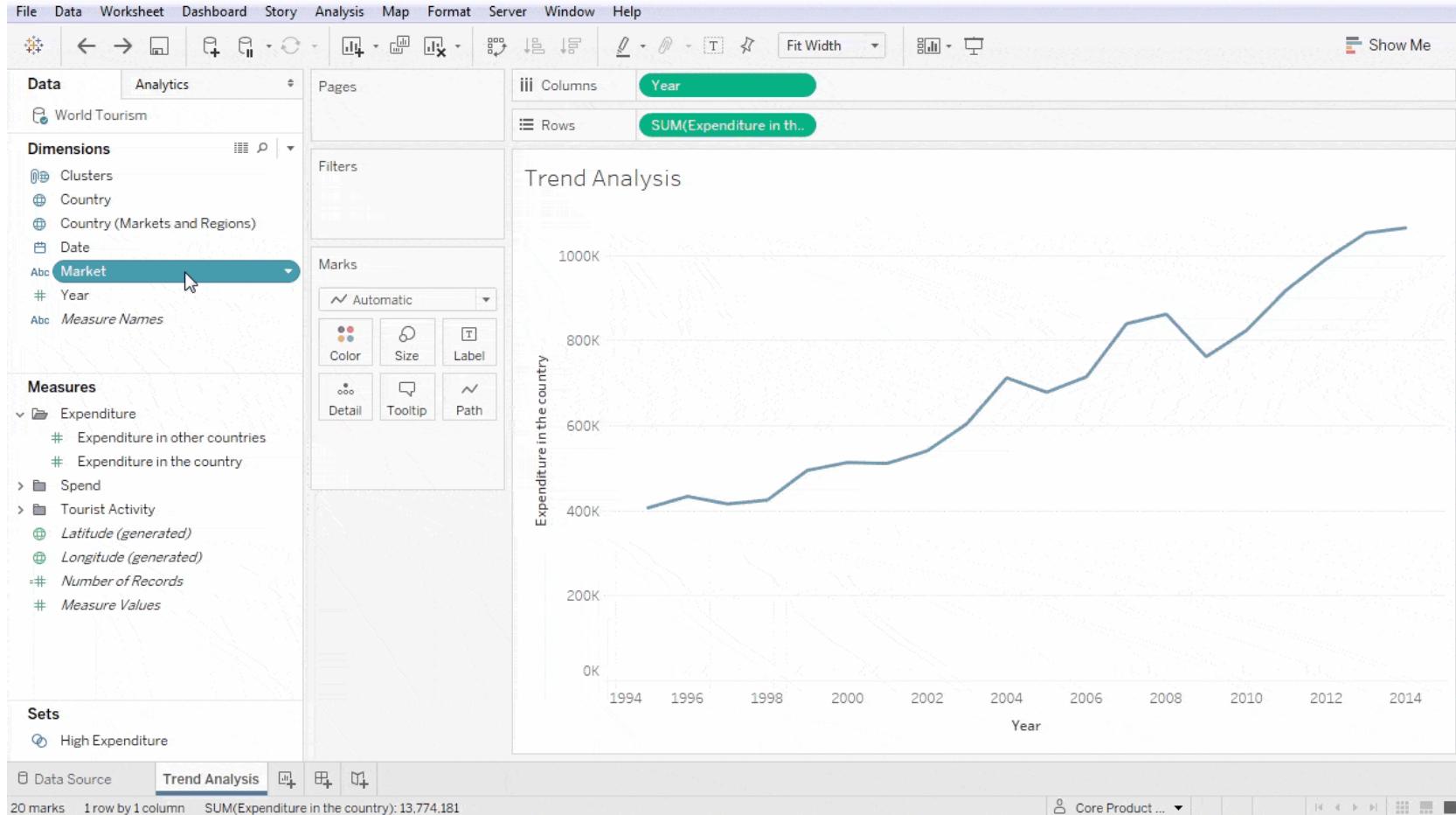
Examples





Data Visualization

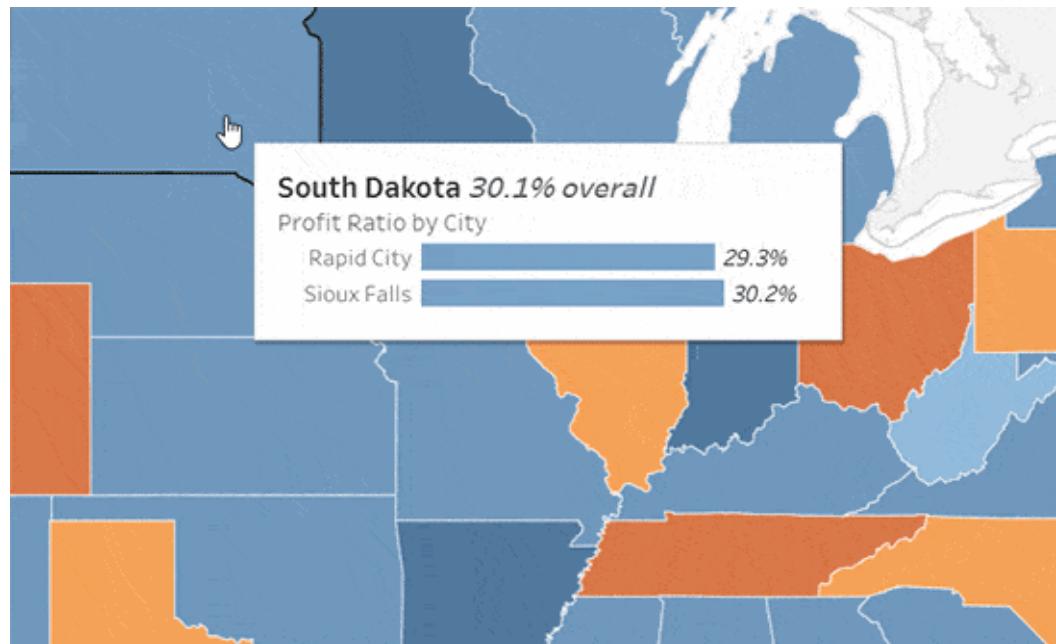
Examples





Data Visualization

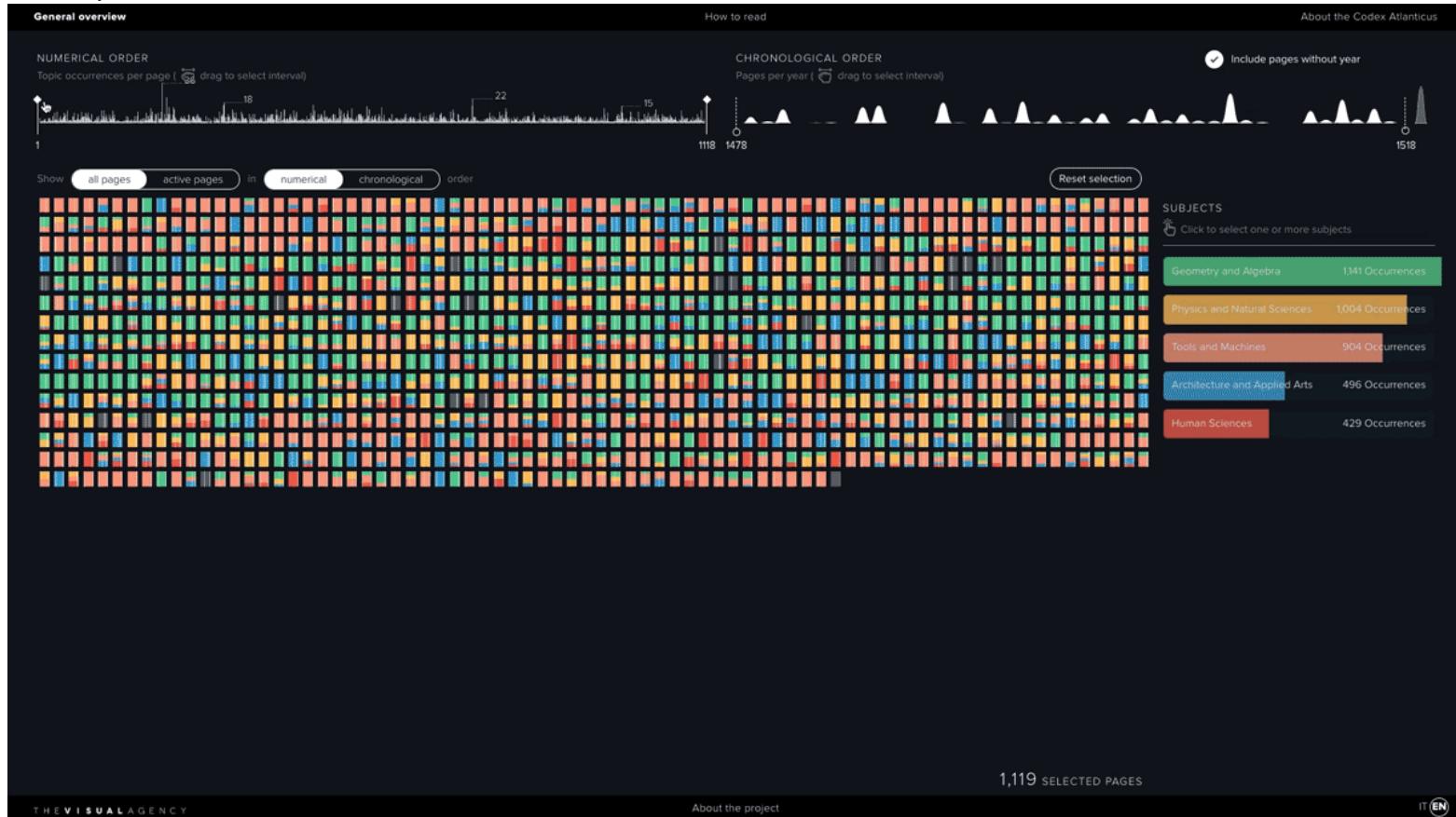
Examples





Data Visualization

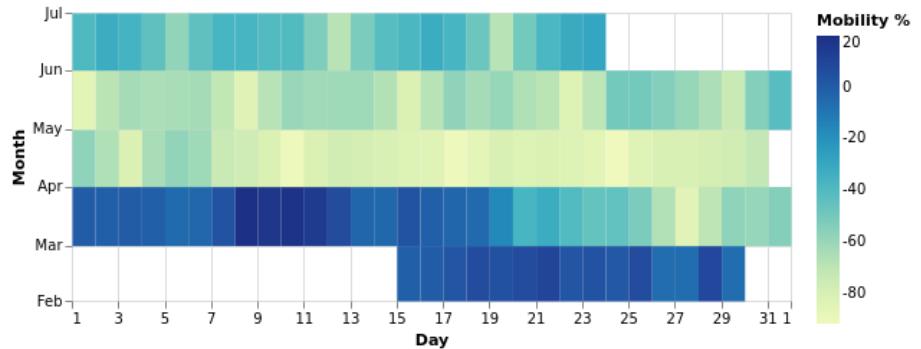
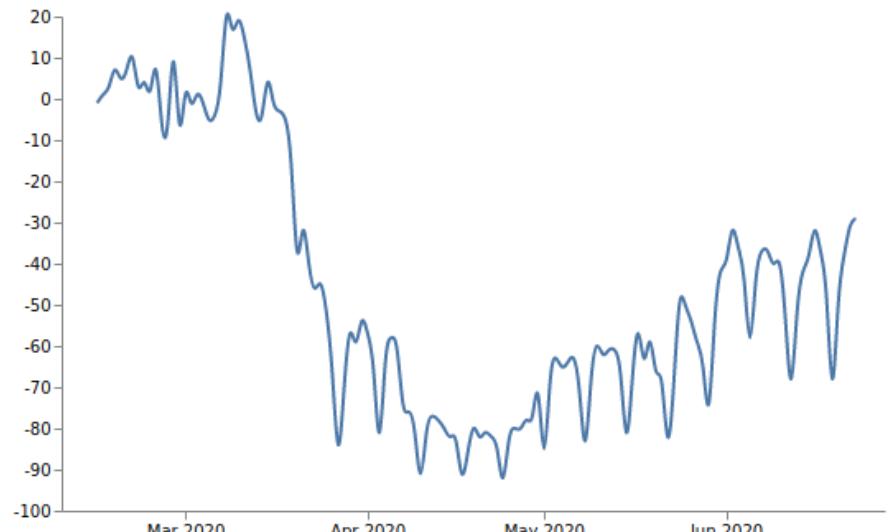
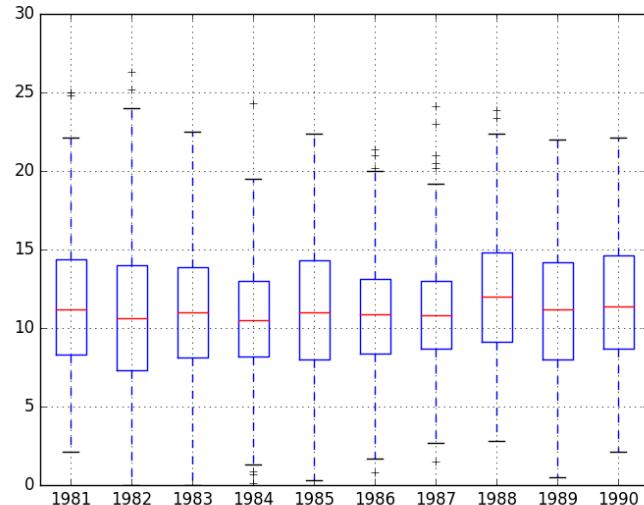
Time Series Examples





Data Visualization

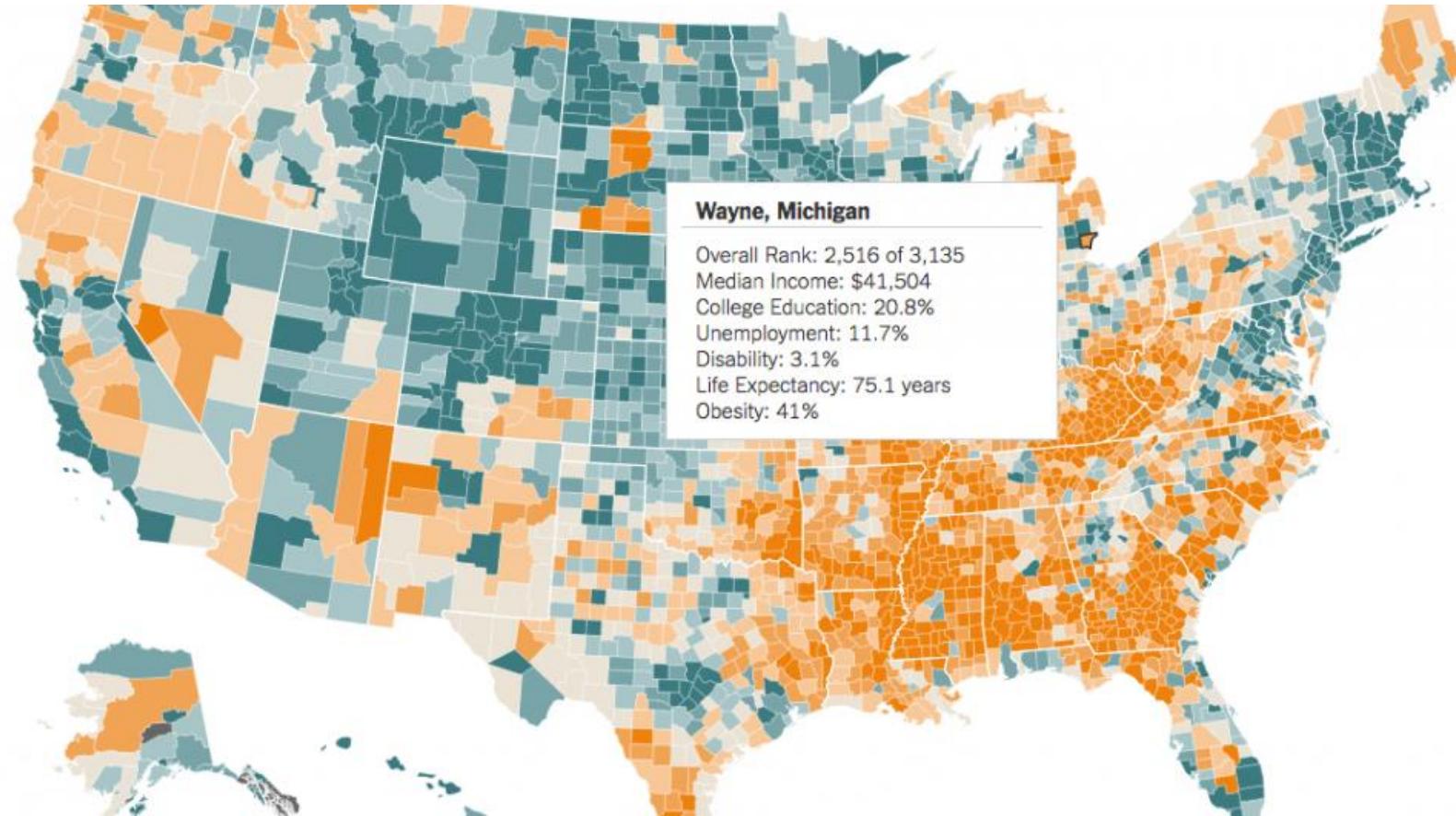
Time Series Examples





Data Visualization

Geospatial Data Examples





Data Visualization

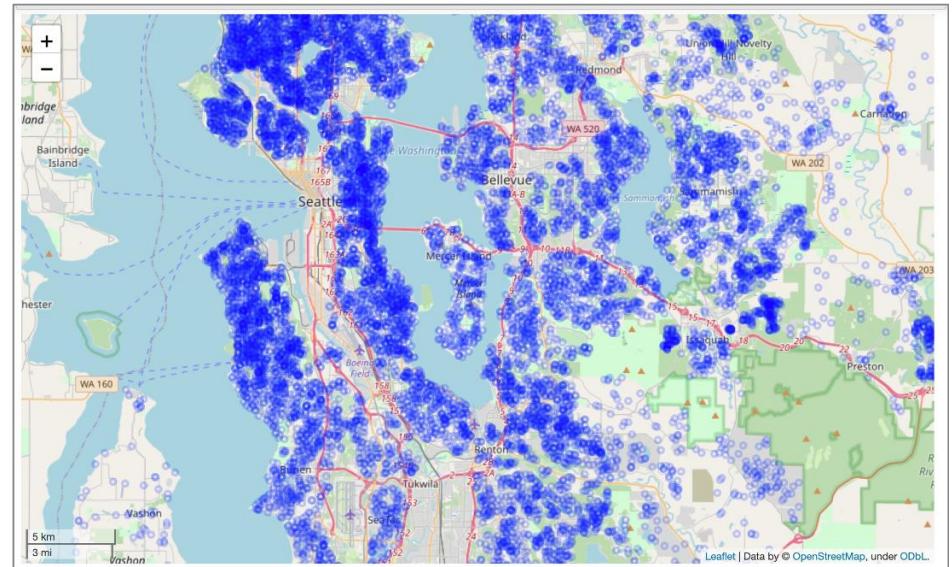
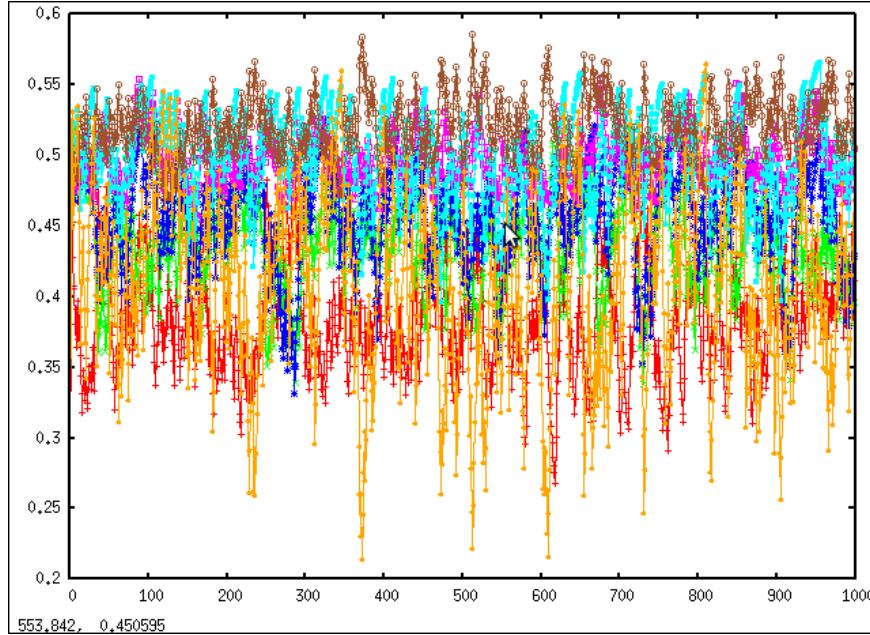
Geospatial Data Examples





Data Visualization

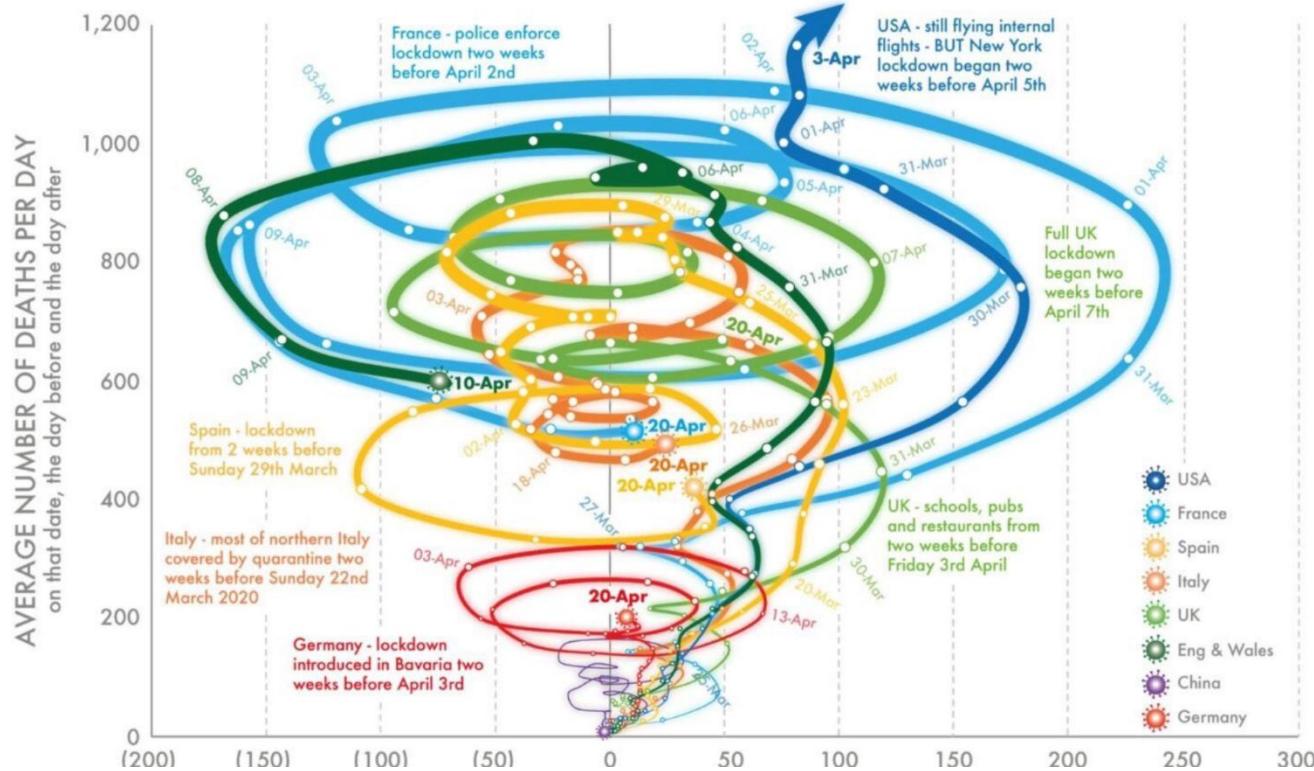
Bad Examples





Data Visualization

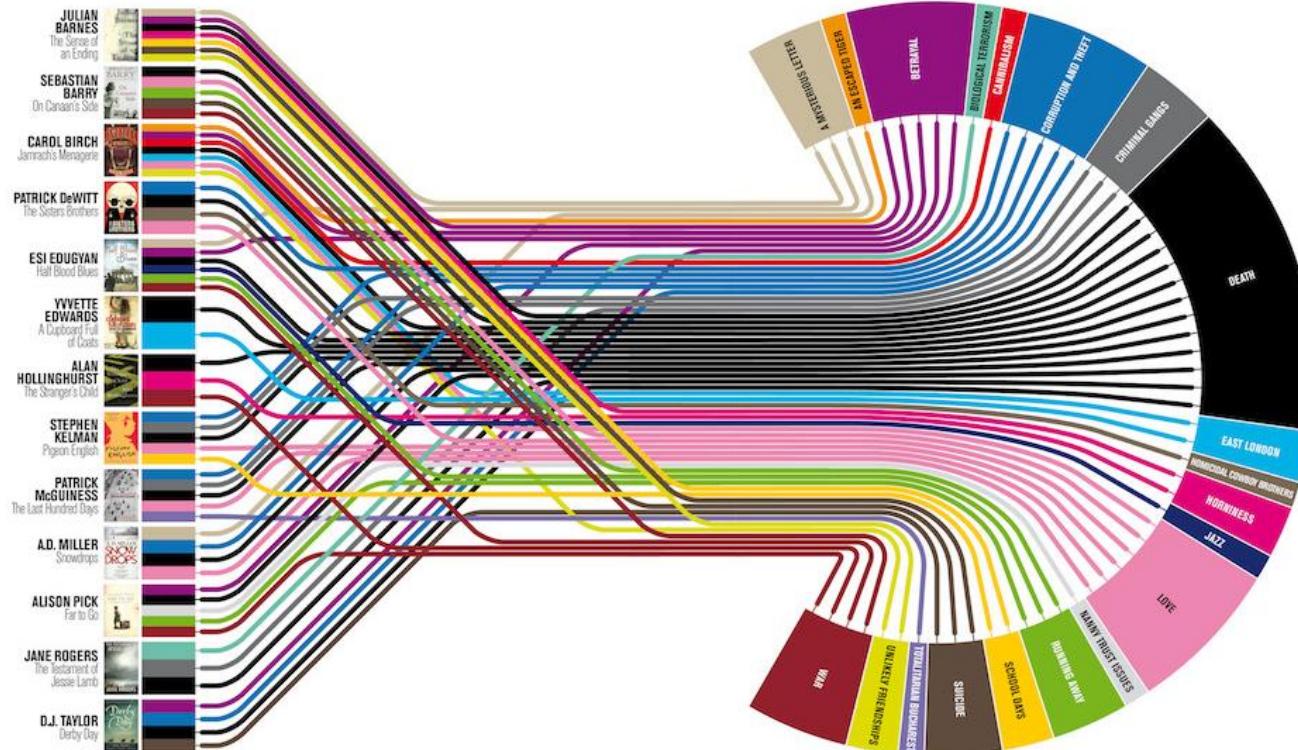
Bad Examples





Data Visualization

Bad Examples



Plot lines

What makes a prize-winning novel? As Julian Barnes wins the Booker Prize, Delayed Gratification's Johanna Kamradt charts the themes of this year's longlisters.

Illustration: Christian Tate



Data Visualization

Libraries and Platforms



D3.js



Chart.js



Google
Developers
Charts



Streamlit



seaborn



plotly



Power BI



tableau



Looker Studio



Data Visualization



The screenshot shows a Power BI dashboard titled "Default Data" with the date range "26 Mar 2021 - 22 Apr 2021". The dashboard features three main sections:

- Conversion Rate & Cost**: A summary card showing Conversions (2.1K), Conv. rate (24.4%), and Cost / conv. (\$5.47). Below it is a line chart comparing Conversions and Conv. rate over time.
- Cost Per Click**: A summary card showing Cost (\$11.55K), Avg. CPC (\$1.33), and Avg. CPM (\$199.33). Below it is a line chart comparing Cost and Avg. CPC over time.
- Device Breakdown**: A summary card showing Avg. CPC (26%), Cost / conv. (66%), and a list of device breakdowns (e.g., 1009693 | Google Analytics Demo | DR | joe...).

The dashboard also includes three donut charts at the bottom labeled "Clicks", "Cost", and "Conversions". On the left, there is a navigation pane with various chart types like Table, Scorecard, Time series, etc. On the right, there is a "Chart" ribbon tab and a "DATA" pane with a "Available Fields" list.

Device	Value	Percentage
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	32.67%
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	31.58%
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	30.56%
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	30.06%
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	27.78%
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	27.48%
1009693 Google Analytics Demo DR joe...	1009693 Google Analytics Demo DR joe...	27.21%



Data Visualization



Looker Studio

Google Ads

Default Data
Click to select your data

26 Mar 2021 - 22 Apr 2021

Overview

Click Through Rate & Impressions

by Clicks, CTR, and Impressions

Clicks 8.7K -2.8%	CTR 14.9% +2.4%	Impressions 58.0K -5.1%
--------------------------------	------------------------------	--------------------------------------

Line chart showing Clicks (green line) and CTR (blue line) over time from March 26 to April 20. The x-axis shows dates from 26 Mar to 20 Apr. The y-axis shows Clicks from 0 to 400 and CTR from 0% to 20%. Both metrics show a general upward trend over the period.

Conversion Rate & Cost

by Conversions Rate and Cost / Conv.

Conversions 2.1K +91.2%	Conv. rate 24.4% +96.7%	Cost / conv. \$5.47 -41.9%
--------------------------------------	--------------------------------------	---

Line chart showing Conversions (green line) and Conversion rate (blue line) over time from March 26 to April 20. The x-axis shows dates from 26 Mar to 20 Apr. The y-axis shows Conversions from 0 to 150 and Conversion rate from 0% to 40%. Both metrics show a general upward trend over the period.

Cost Per Click

by Cost, CPC, and CPM

Cost \$11.55K +11.1%	Avg. CPC \$1.33 +14.3%	Avg. CPM \$199.33 +17.0%
-----------------------------------	-------------------------------------	---------------------------------------

Line chart showing Cost (green line) and Avg. CPC (blue line) over time from March 26 to April 20. The x-axis shows dates from 26 Mar to 20 Apr. The y-axis shows Cost from 0 to 600 and Avg. CPC from 0 to 2. Both metrics show a general upward trend over the period.

Top Campaigns

by CTR, Avg. CPC, and Cost / Conv.

Campaign	CTR	Avg. CPC	Cost / conv.
1. 1009693 Google Analytics Demo DR joe...	44.26%	\$0.49	\$0
2. 1009693 Google Analytics Demo DR joe...	37.66%	\$2.28	\$470.42
3. 1009693 Google Analytics Demo DR joe...	32.67%	\$1.64	\$474.88
4. 1009693 Google Analytics Demo DR joe...	31.58%	\$9.04	\$0
5. 1009693 Google Analytics Demo DR joe...	30.56%	\$1.02	\$0
6. 1009693 Google Analytics Demo DR joe...	30.06%	\$4.52	\$235.05
7. 1009693 Google Analytics Demo DR joe...	27.78%	\$1.97	\$0
8. 1009693 Google Analytics Demo DR joe...	27.48%	\$3.71	\$0
9. 1009693 Google Analytics Demo DR joe...	27.21%	\$2.38	\$0

1 - 88 / 88 < >

Device Breakdown

by Clicks, Cost, and Conversions

Three donut charts showing the breakdown of Clicks, Cost, and Conversions by device. The charts are divided into three segments: Clicks (top), Cost (middle), and Conversions (bottom). The segments represent different devices or platforms.

- Clicks:** 20.2%, 75.2%, 4.6%
- Cost:** 26.2%, 68%, 6.8%
- Conversions:** 96.1%, 3.8%

23

https://lookerstudio.google.com/u/0/reporting/0B_U5RNpwhcE6ctldmZEJ0ZDXUJnM/preview



Data Visualization



Looker Studio

Vices: Drug Usage & Overdoses

By [Daniel Waisberg](#)

Data sources



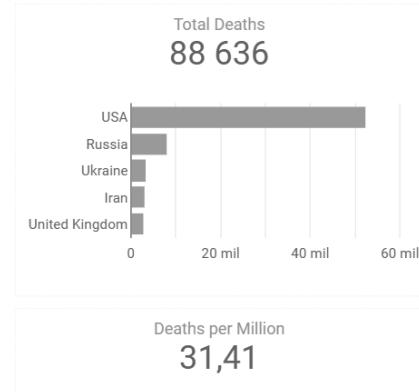
Drug usage by age (USA)

This table shows the percentage of people in an age group who used a drug in the past 12 months. Not surprisingly, the 20-34 age group is the "winner" for all drugs. However, it is interesting to see the relatively high usage of all drugs (except for heroin and crack) among teenagers. Read more about [the data](#) (by FiveThirtyEight).

age ▾	Alcohol	Cannabis	Painkillers	Hallucinogen	Cocaine	Heroin	Crack
12-19	33,1%	17,7%	5,8%	3,4%	1,3%	0,2%	0,1%
20-34	80,7%	26,0%	8,8%	4,7%	3,9%	0,8%	0,5%
35-49	75,0%	10,4%	4,2%	0,6%	1,5%	0,1%	0,5%
50-64	67,2%	7,3%	2,5%	0,3%	0,9%	0,1%	0,4%
65+	49,3%	1,2%	0,6%	0,1%	0,0%	0,0%	0,0%

Overdose deaths (global)

The charts below show yearly overdose deaths by country, both per million people and total deaths. USA leads the pack in both metrics by far, with almost all deaths attributed to opioids (see next section). Iceland is an outlier as it has a very small population, so "only" 45 deaths places it very high on deaths per million people. Read more about [the data](#) (by UNODC).





Data Visualization



Looker Studio





Data Visualization

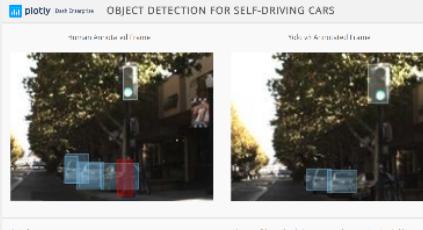
Dash Enterprise App Gallery

This public instance of the [Dash Enterprise app manager](#) runs >60 Dash apps for 100s of concurrent users on Azure Kubernetes Service. Click on a Dash app's title for more information. For the open-source demos, the [Python & R source code](#) can be found on GitHub. For apps using [Design Kit](#) or [Snapshot Engine](#), reach out to [get a demo](#).

[Aerospace](#) | [Automotive](#) | [Energy](#) | [Finance](#) | [Manufacturing](#) | [Medical Imaging](#) |
[Pharma](#) | [Retail](#) | [Sports Analytics](#)

All Apps (102)

Search applications...



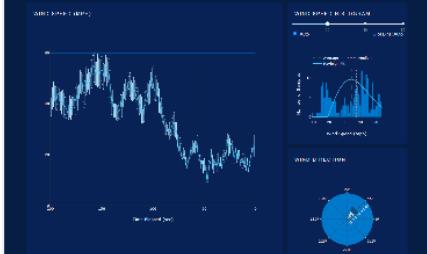
Real-Time Object Detection

Image Processing | AI | ML | Computer Vision | (+1)



Manufacturing SPC Dashboard

Streaming | DAQ | Manufacturing

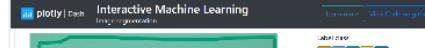


Wind Speed Dashboard for ...

Streaming | SQL | Energy



World Cell Towers



Interactive Machine Learning



Big Data on AWS Lambda



Data Visualization

Solar Aircraft Design with AeroSandbox and Dash

Peter Sharpe

Key Parameters

Number of booms:

Wing Span [m]:

Angle of Attack [deg]:

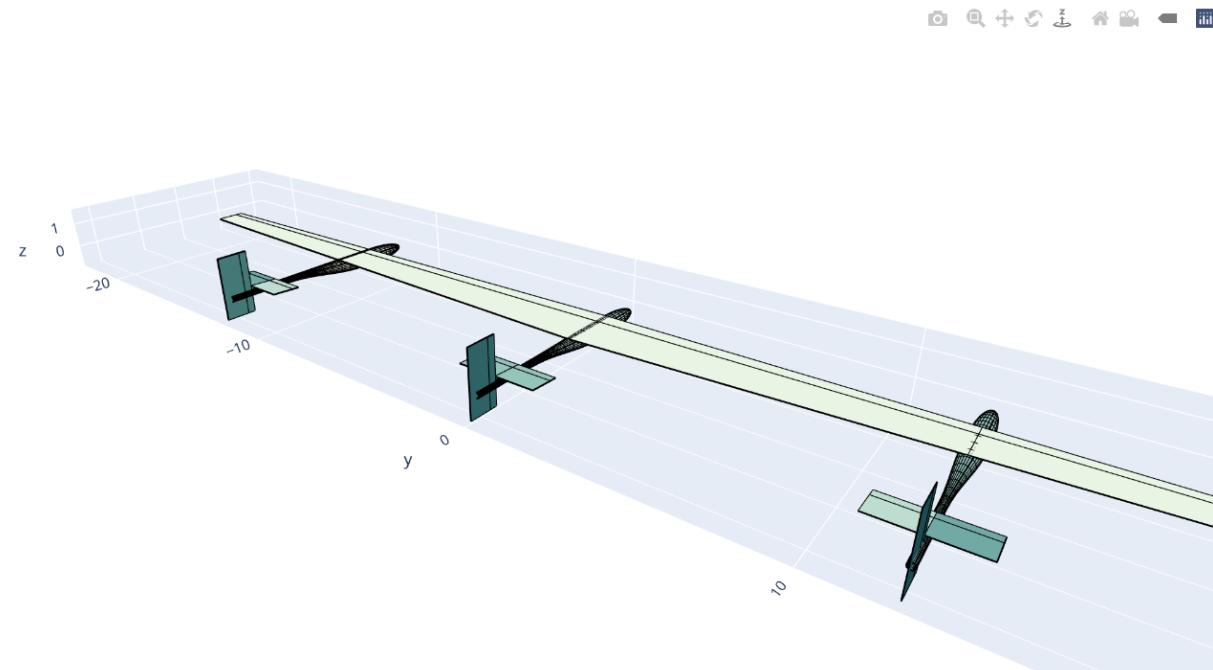
Commands

Display (1s) LL Analysis (3s)

VLM Analysis (15s)

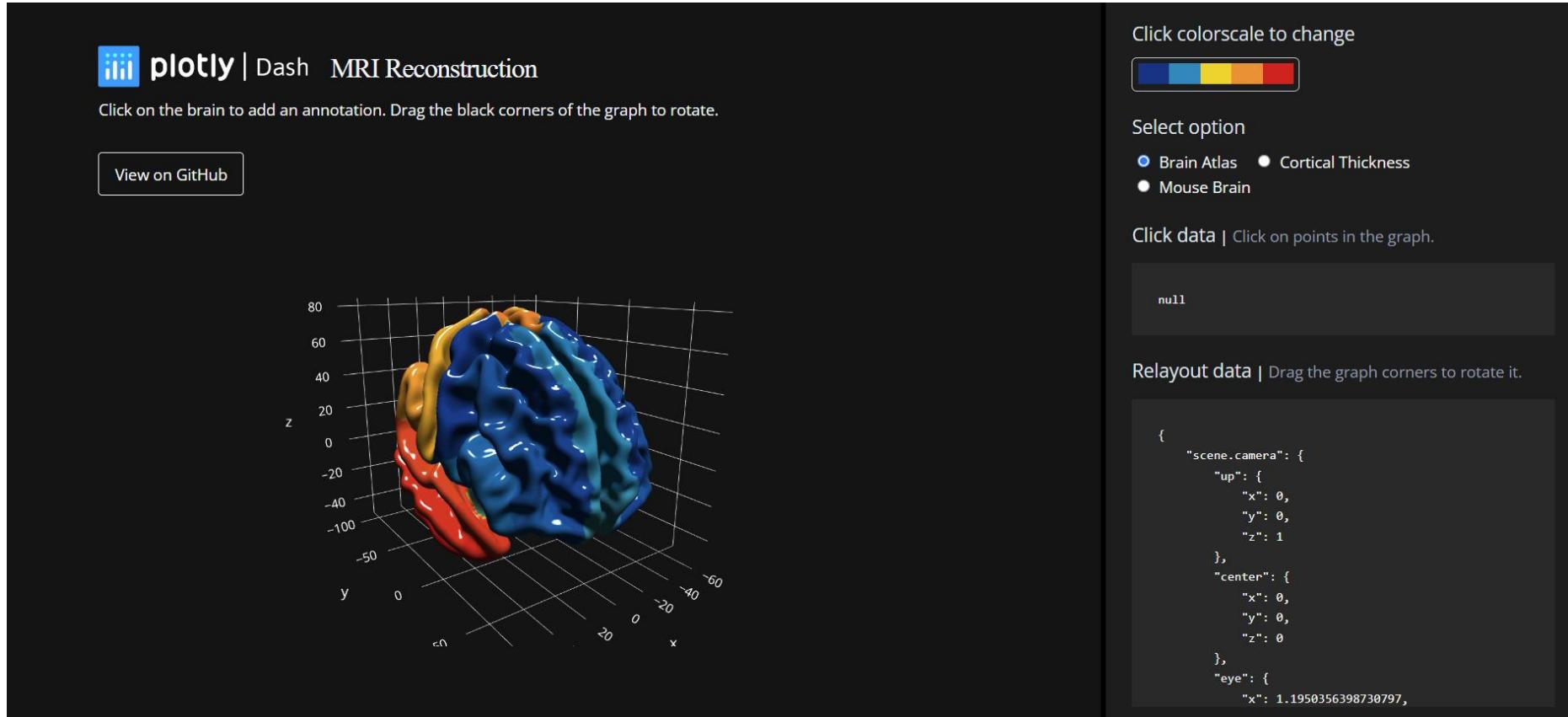
Aerodynamic Performance

Please run an analysis to display the data.





Data Visualization





Data Visualization

Clinical Analytics

Welcome to the Clinical Analytics Dashboard

Explore clinic patient volume by time of day, waiting time, and care score. Click on the heatmap to visualize patient experience at different time points.

Select Clinic

Select Check-In Time

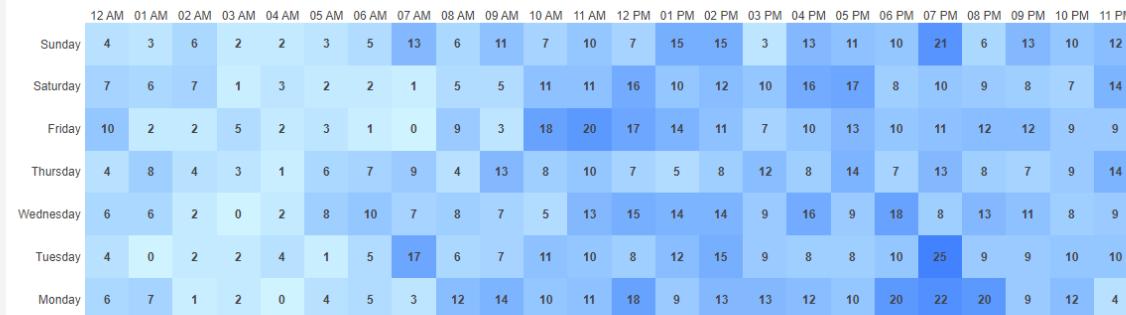
 →

Select Admit Source

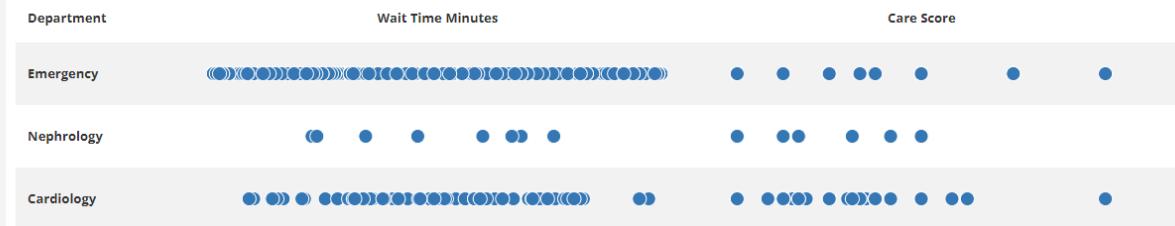
- Emergency Room Clinic Referral Physician Referral
- Not Identified Outside Health Care Facility
- Admitted as transfer from another unit Court/Law Enforcement
- Outside Hospital Transfer from Critical Access Hospital
- Outside Home Health Agency Information Unavailable
- Psych, Substance Abuse, or Rehab Hospital

RESET

Patient Volume



Patient Wait Time and Satisfactory Scores





Data Visualization





Data Visualization

Installations

```
pip install dash  
pip install pandas
```

Data

```
country,continent,year,lifeExp,pop,gdpPerCap  
Afghanistan,Asia,1952,28.801,8425333,779.4453145  
Afghanistan,Asia,1957,30.332,9240934,820.8530296  
Afghanistan,Asia,1962,31.997,10267083,853.10071  
Afghanistan,Asia,1967,34.02,11537966,836.1971382  
Afghanistan,Asia,1972,36.088,13079460,739.9811058  
Afghanistan,Asia,1977,38.438,14880372,786.11336  
Afghanistan,Asia,1982,39.854,12881816,978.0114388  
Afghanistan,Asia,1987,40.822,13867957,852.3959448  
Afghanistan,Asia,1992,41.674,16317921,649.3413952  
Afghanistan,Asia,1997,41.763,22227415,635.341351  
Afghanistan,Asia,2002,42.129,25268405,726.7340548  
Afghanistan,Asia,2007,43.828,31889923,974.5803384  
Albania,Europe,1952,55.23,1282697,1601.056136  
Albania,Europe,1957,59.28,1476505,1942.284244  
Albania,Europe,1962,64.82,1728137,2312.888958  
Albania,Europe,1967,66.22,1984060,2760.196931  
Albania,Europe,1972,67.69,2263554,3313.422188  
Albania,Europe,1977,68.93,2509048,3533.00391  
Albania,Europe,1982,70.42,2780097,3630.880722  
Albania,Europe,1987,72,3075321,3738.932735  
Albania,Europe,1992,71.581,3326498,2497.437901  
Albania,Europe,1997,72.95,3428038,3193.054604  
Albania,Europe,2002,75.651,3508512,4604.211737  
Albania,Europe,2007,76.423,3600523,5937.029526  
Algeria,Africa,1952,43.077,9279525,2449.008185  
Algeria,Africa,1957,45.685,10270856,3013.976023  
Algeria,Africa,1962,48.303,11000948,2550.81688  
Algeria,Africa,1967,51.407,12760499,3246.991771  
Algeria,Africa,1972,54.518,14760787,4182.663766  
Algeria,Africa,1977,58.014,17152804,4910.416756  
Algeria,Africa,1982,61.368,20033753,5745.160213  
Algeria,Africa,1987,65.799,23254956,5681.358539  
Algeria,Africa,1992,67.744,26298373,5023.216647  
Algeria,Africa,1997,69.152,29072015,4797.295051  
Algeria,Africa,2002,70.994,31287142,5288.040382  
Algeria,Africa,2007,72.301,33333216,6223.367465  
-----  
-----
```



Data Visualization

Code sample

```
from dash import Dash, html, dcc, callback, Output, Input
import plotly.express as px
import pandas as pd

df = pd.read_csv('https://raw.githubusercontent.com/plotly/datasets/master/gapminder_unfiltered.csv')

app = Dash(__name__)

app.layout = html.Div([
    html.H1(children='Title of Dash App', style={'textAlign':'center'}),
    dcc.Dropdown(df.country.unique(), 'Canada', id='dropdown-selection'),
    dcc.Graph(id='graph-content')
])

(...)
```



Data Visualization

Code sample

```
(...)

@callback(
    Output('graph-content', 'figure'),
    Input('dropdown-selection', 'value')
)
def update_graph(value):
    df = df[df.country==value]
    return px.line(df, x='year', y='pop')

if __name__ == '__main__':
    app.run(debug=True)
```

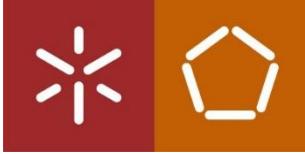




Hands On

Discover and implement:

- Build a data app in **Python** using **Dash**
- For inspiration, go to <https://dash.gallery/Portal/>

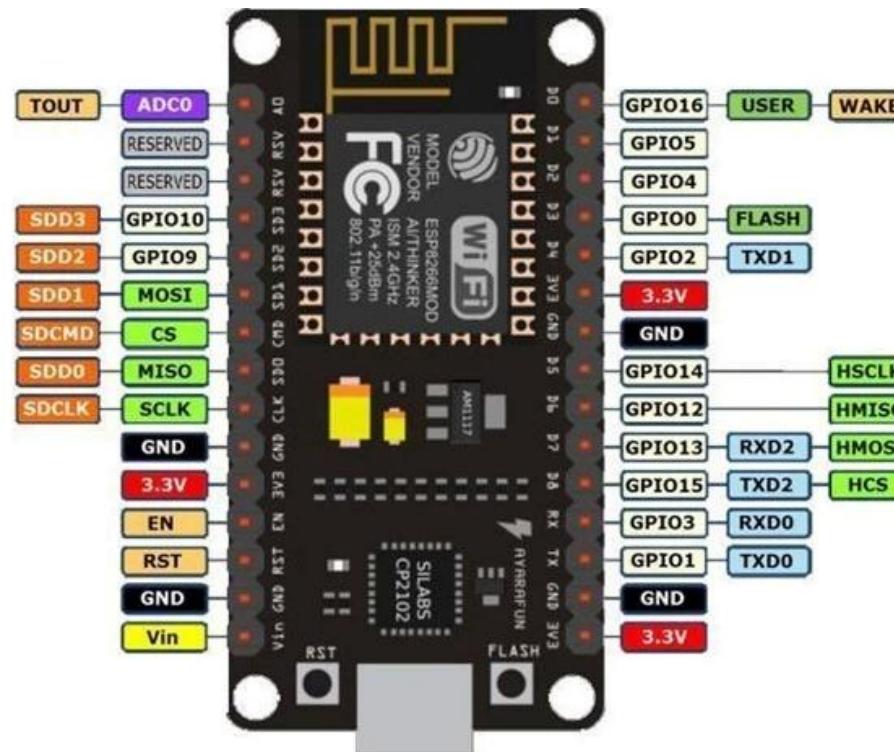


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ESP8266

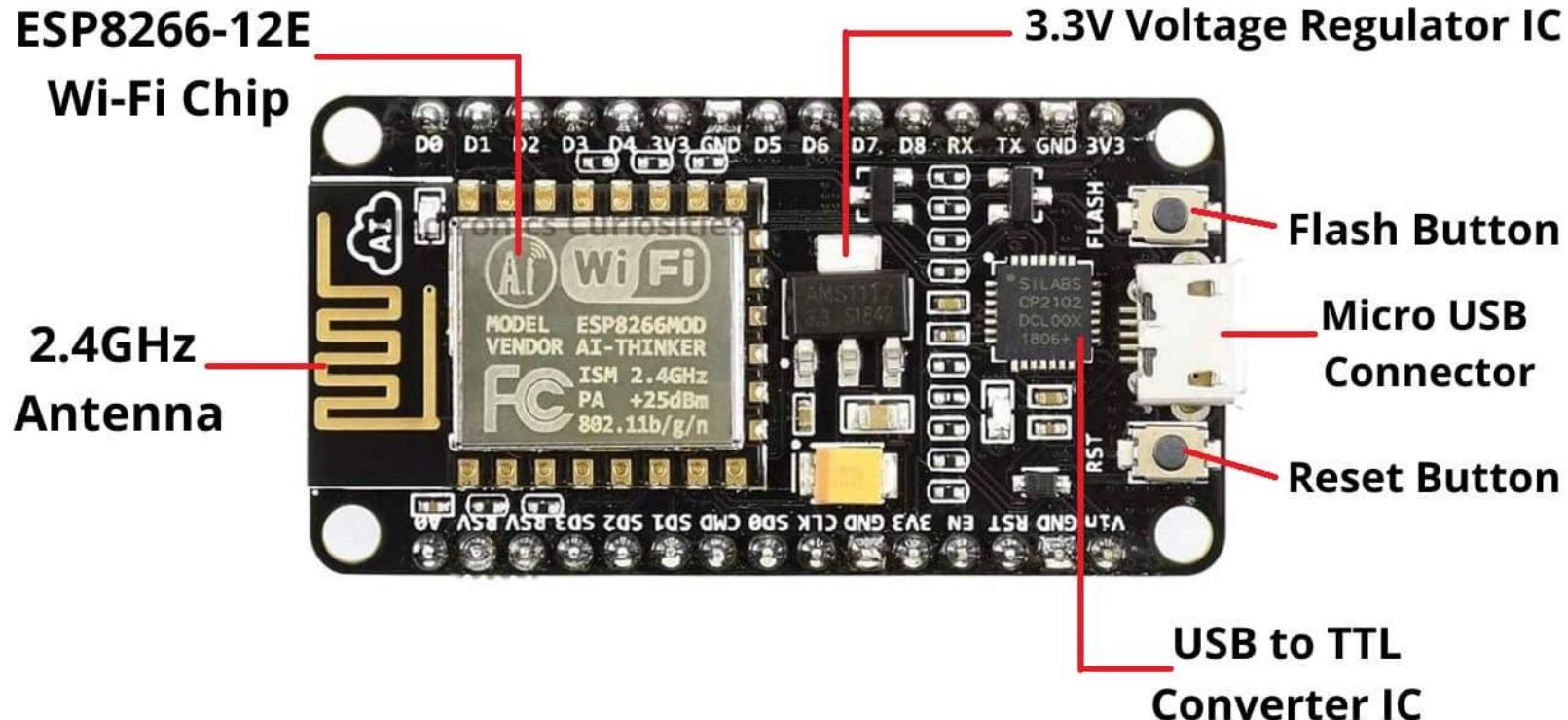


ESP8266 Node MCU





ESP8266 Node MCU





ESP8266 Node MCU

Useful links:

- <https://www.esp8266.com/>
- https://mauser.pt/catalog/product_info.php?products_id=096-7936
- <https://www.make-it.ca/nodemcu-details-specifications/>
- <https://www.electronicscuriosities.com/2021/08/esp8266-node-mcu-board-specifications.html>
- <https://www.arduinoportugal.pt/programar-arduino-nodemcu-esp8266-no-arduino-ide/>