Creating Custom Visualisations
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Goals

1. To introduce you to some powerful visualisation tools

2. To demonstrate some prototyping strategies using examples from my research
Disclaimer: A Subjective Selection

- There are many other powerful visualisation tools available!
- For instance, see [Top 15 Data Visualization Tools For 2022](#)

Expressiveness vs Usability

“Visualisation tools sacrifice generality for greater efficiency performing particular tasks. Code has unparalleled expressiveness; it is the most general tool we have. A medium for discovery must be general. Creativity requires composition.”

– Mike Bostock, D3 Creator, 2017
What is D3?

- D3 (or D3.js) is a JavaScript library that stands for **data-driven documents**
- Allows you to dynamically manipulate the **Document Object Model (DOM)**
  - Key concepts include selections, data-binding & the enter-update-exit pattern
  - Also supports data preparation, layout calculation, scales, shapes, animation, interaction and more
- Interactive, flexible, expressive and fast!
- See [http://shirleywu.studio/d3intro/](http://shirleywu.studio/d3intro/)
### Observable Notebooks

**https://observablehq.com/explore**

- “Observable helps you use data to think”
  - Explore and visualise data
  - Get ideas/inspiration from existing notebooks
  - Share your insights with the vis community
- Reactive (live) programming
  - Interactive JavaScript notebooks (similar to Jupyter Notebook for Python)
  - Experiment with (big) data in real-time
  - Quickly build and iterate prototypes, re-use code, etc.
  - Supports creation of highly interactive visualisations

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D3 Example: Choropleth Map of NZ

• Shows the distribution of Māori language tweeters across different regions of NZ
  • Self-reported location
  • Some users missing
• TopoJSON defines geospatial positioning
  • [https://github.com/deldersveld/topojson](https://github.com/deldersveld/topojson)
• Based on the following tutorial
  • [https://www.dataviscourse.net/tutorials/lectures/lecture-maps/](https://www.dataviscourse.net/tutorials/lectures/lecture-maps/)
• Could be enhanced with simple interaction
• Need to include a legend!

Demonstration: Tinkering with D3
Plot via Observable

What is Plot?

• A higher-level JavaScript library for exploratory data visualisation
• Built on top of D3 (but more concise and convenient)
• Centred around the idea of “using vision to think”

With its concise and (hopefully) memorable API, Observable Plot lets you try out ideas quickly. You can make a meaningful chart with as little as one line of code. Yet Plot is still powerful and expressive when you need it. Plot is highly configurable and supports interaction with minimal fuss through Observable dataflow. And Plot is designed to be extended — we can’t wait to see where the community takes it.
Plot vs D3

• Plot not intended as a “replacement” for D3

Plot is informed by ten years of maintaining D3 but does not replace it. We continue to support and develop D3, and recommend its low-level approach for bespoke explanatory visualizations and as a foundation for higher-level exploratory visualization tools. In fact, Plot is built on D3! Observable Plot is more akin to Vega-Lite, another great tool for exploration. We designed Plot to pair beautifully with Observable: to leverage Observable dataflow for fluid exploration and interaction. However, Plot does not depend on Observable; use it wherever you like.

• See https://observablehq.com/@observablehq/introducing-observable-plot

Demonstration: Prototyping with Plot
Expressiveness vs Usability Revisited

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RAW Graphs
• “The missing link between spreadsheets and data”
  • Instantly maps data variables to visual channels
  • Quick and convenient!
  • Uses D3 under the hood

• No programming knowledge required
  • Friendly user interface
  • However, limited layouts available
    • Doesn’t support detailed (low-level) customisation
    • BUT can build custom models with basic understanding of D3

Demonstration: Prototyping with RAW Graphs
Prototyping with
Python (Pandas), Sheets & PowerPoint

Creating Custom ‘Staircase Plots’

Friendly (1999)
Data Wrangling with Python

• I tend to use Python for cleaning & pre-processing data
  • Popular alternatives include R and JavaScript
• Pandas **DataFrames** are especially useful for handling datasets with many variables (multi-dimensional data)
  • Rows = data items
  • Columns = variables

```python
import pandas as pd

def remove_duplicates(input_file):
    tweets = pd.read_csv(input_file, sep="\t")
    print("Original size: ", len(tweets))
    unique_tweets = tweets.drop_duplicates(subset='id', keep='first')
    print("New size: ", len(unique_tweets))
    unique_tweets.to_csv("rmt-corpus-deduplicated.csv", sep="\t", index=False)
```

Process

1. Download Titanic dataset
2. Compute pairwise adjacency matrix using Pandas, keeping categories grouped by variable
3. Open output file as spreadsheet
4. Remove redundant values
5. Create variable ‘boxes’
6. Colour cells using conditional formatting
7. Create legend
8. Remove numeric values
9. Fine-tune display (borders, etc.)
10. Add tooltips in **PowerPoint**
Demonstration: **Staircase Plots Spreadsheet**

**Adding Interaction with PowerPoint**

- Can create Tooltips and Buttons
  - Buttons are just clickable regions that point to different slides
  - Simply create (transparent) shapes, then press ‘Ctrl + K’

- Other controls in ‘Developer’ mode
Creating Custom ‘Staircase Plots’

A more complex dataset...

Covid directives on Twitter
Resources

• Observable
  • Introduction
  • Twitter
  • YouTube Tutorials

• Plot
  • Introduction
  • Eric Lo’s Examples

• D3
  • Shirley Wu’s Introduction to SVG & D3
  • Mike Freeman’s University of Washington Tutorials
  • Mike Bostock’s D3 Gallery
  • Prototyping in D3 by Amelia Wattenberger

More Resources

• D3 (more generally)
  • HTML, CSS and JavaScript
  • D3 Graph Gallery
  • Scott Murray’s Interactive Data Visualization for the Web
  • Data Sketches by Nadieh Bremer & Shirley Wu

• Miscellaneous
  • Data Wrangling with Pandas
  • Interactive Prototypes with PowerPoint
  • Vega-Lite and Altair (akin to Plot)
  • NetworkX
References


Thank you!