Communicating with Data – Introduction to Interactive Visualization

Dr. Ab Mosca (they/them)

Slides based off slides courtesy of Jordan Crouser (https://jcrouser.github.io/)

Plan for Today

- Interaction
  - Definition
  - Data and problem spaces
  - Relationship between interaction and understanding
- Interaction with visual interfaces
  - Basic interaction types
- Demo: coordinated multiple views

Rewind

Humans and machines have **complimentary strengths**

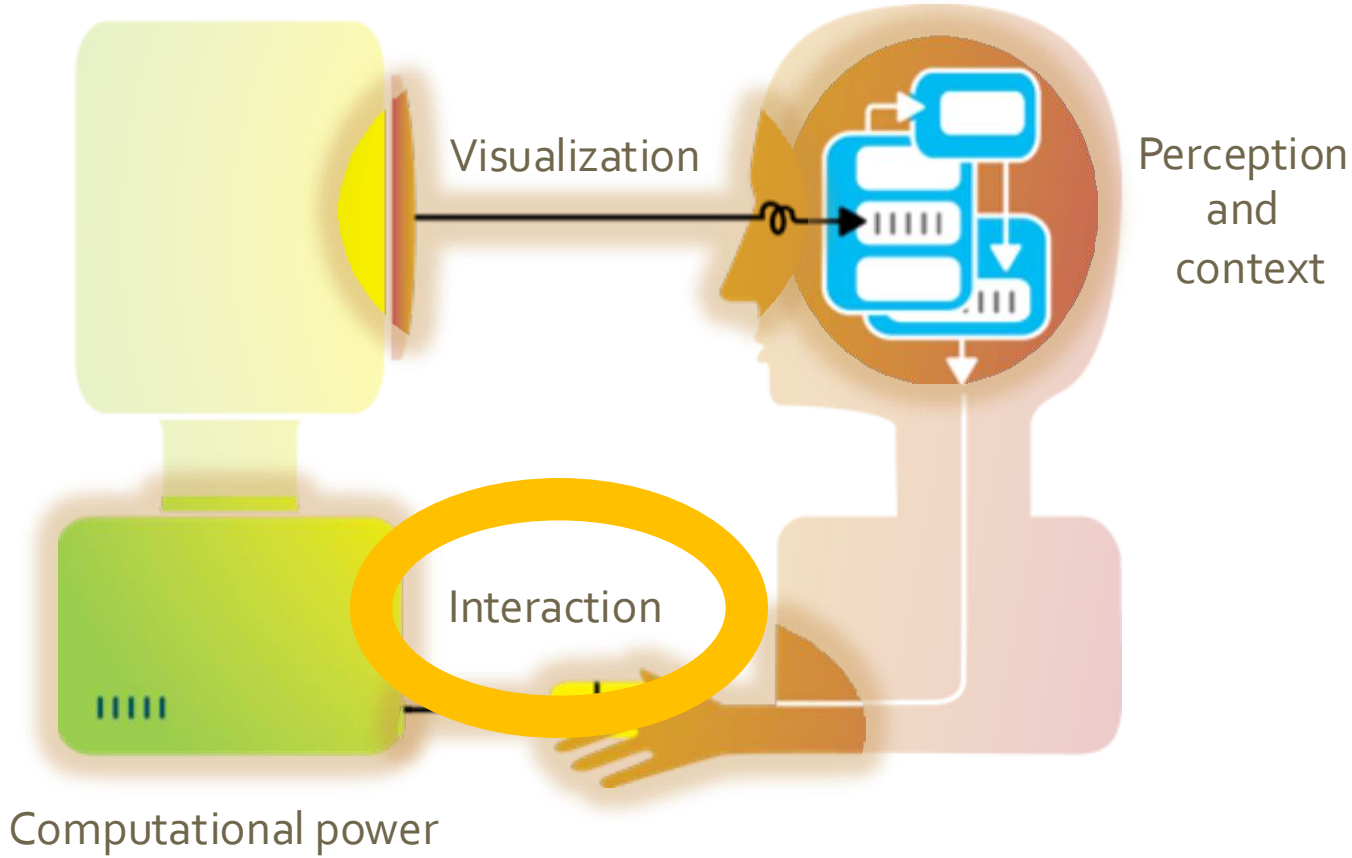


Image credit: Ali Ansari

Interaction (def.)

"Interaction for visualization is the interplay between a person and a data interface involving a data-related intent, at least one action from the person and an interface reaction that is perceived as such."

Mandatory Components

- Interplay
- Person
- Data Interface
- Action
- Action-Reaction
- Reaction Perceived as Such
- Data-Related Intent

What is Interaction for Data Visualization? Evanthia Dimara, Charles Perin. 2020

Interaction

High level: **between human and problem space**

- a cognitive act *enabled* by the tool
- does not need to take place exclusively within them
- might be distributed across multiple tools

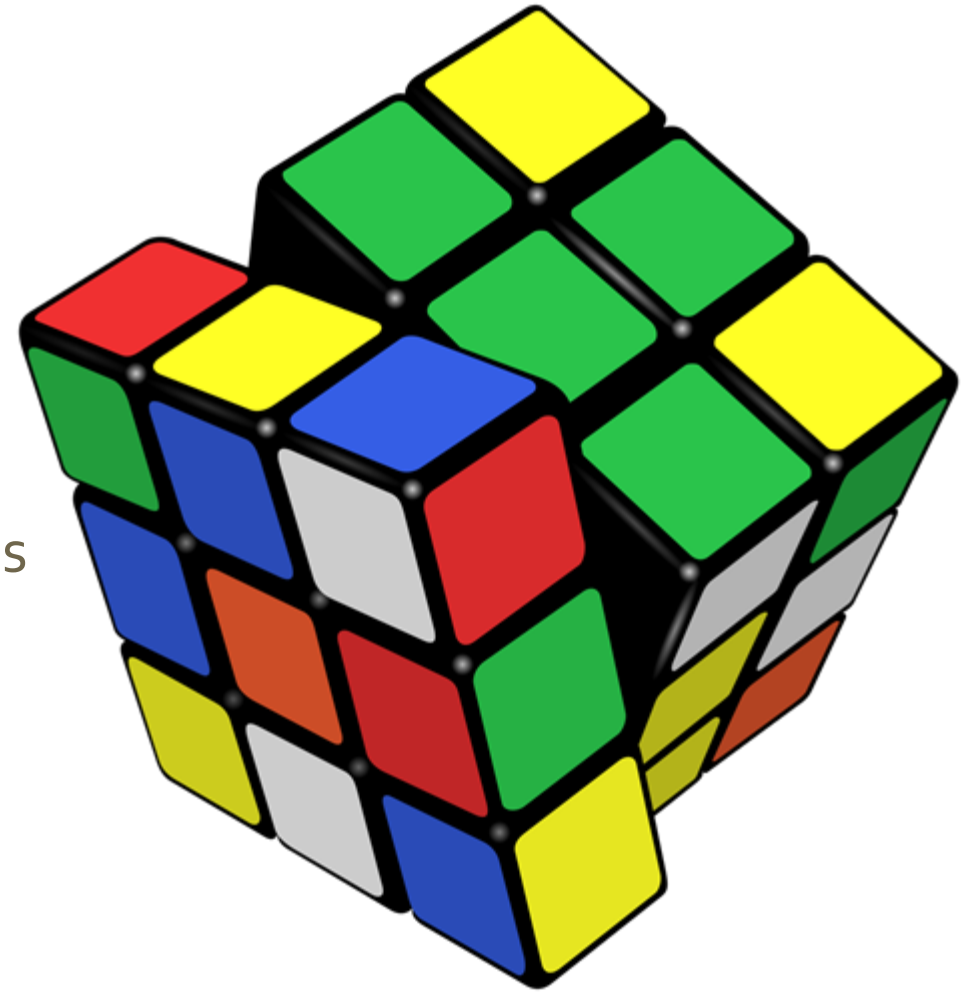
Low level: **between human and interface**

- the set of operations available
- the relationship between the human and the visualization

Example: Rubik's Cube

What **high-level** interactions are there?

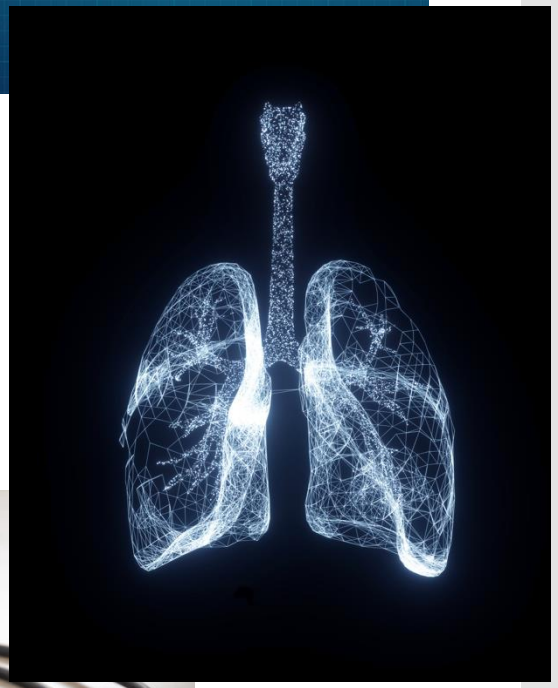
What **low-level** interactions could there be?



Example: Vitals

What **high-level** interactions are there?

What **low-level** interactions could there be?



Example: Lumos

What were your **high-level** interactions?

What were your **low-level** interactions?

https://lumos-webapp-4aeadb3bf30d.herokuapp.com/

Part I: High Level

Interaction with
Data / Problem Space

Brehmer and Munzner (2013)

- *High-level* interactions with a visualization correspond to *analysis tasks*
- We can think about *why* users perform interactions at different levels of specificity

M. Brehmer and T. Munzner, "A Multi-Level Typology of Abstract Visualization Tasks," in *IEEE Transactions on Visualization and Computer Graphics*, vol. 19, no. 12, pp. 2376-2385, Dec. 2013, doi: 10.1109/TVCG.2013.124.

High-level Interaction: *broadly, why*

- Learn
  - Read a data story; be guided through a series of cognitive operations
- Discover
  - Generation and verification of hypotheses, associated with models of scientific inquiry
- Enjoy
  - Casual encounters with visualization
  - User is not driven by a need to verify or generate a hypothesis; novelty stimulates curiosity and exploration
- Generate
  - Create new artifacts such as transformed or derived data, annotation, recorded interactions, screenshots

High-level Interaction: *specifically, why*

- A user may interact with a visualization to:
  - Identify
    - Find a characteristic(s) about a target
    - Ex. User of a choropleth map *identifies* the margin of victory for the winning election candidate in CA
  - Compare
    - Refers to multiple subsets of targets
    - Ex. User of a choropleth map identifies election results for CA and *compares* them to results for MA
  - Summarize
    - Refers to a whole set of targets
    - Ex. User of a choropleth map *summarizes* election results across all states

Part II: Low Level

Interaction with
a Visual Interface

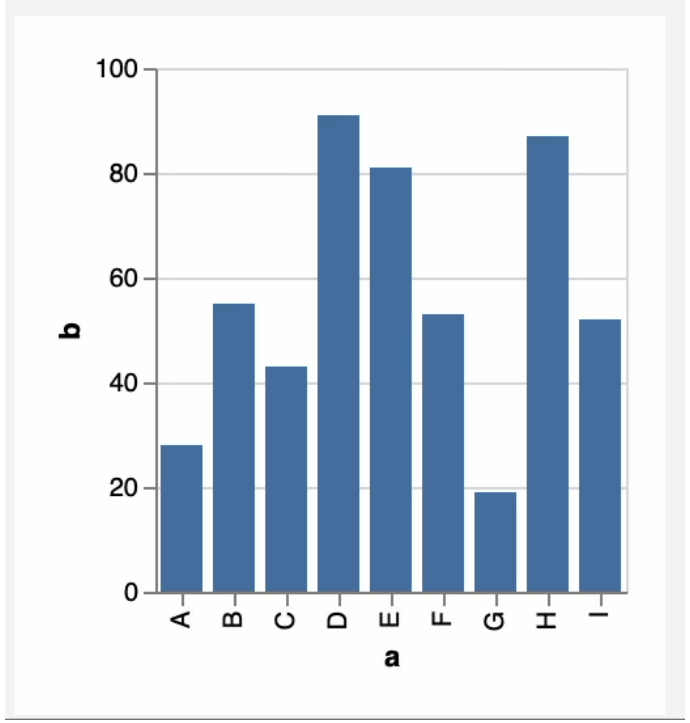
Yi, Kang, Stasko and Jacko (2007)

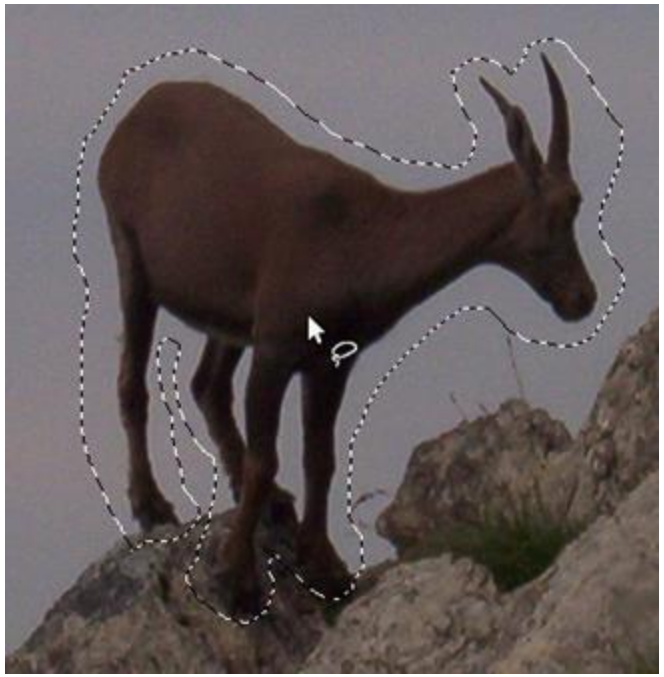
1. Select
2. Explore
3. Reconfigure
4. Encode
5. Abstract/Elaborate
6. Filter
7. Connect

Yi, J. S., ah Kang, Y., Stasko, J. T., & Jacko, J. A. (2007). Toward a deeper understanding of the role of interaction in information visualization. Visualization and Computer Graphics, IEEE Transactions on, 13(6), 1224-1231.

1. Select

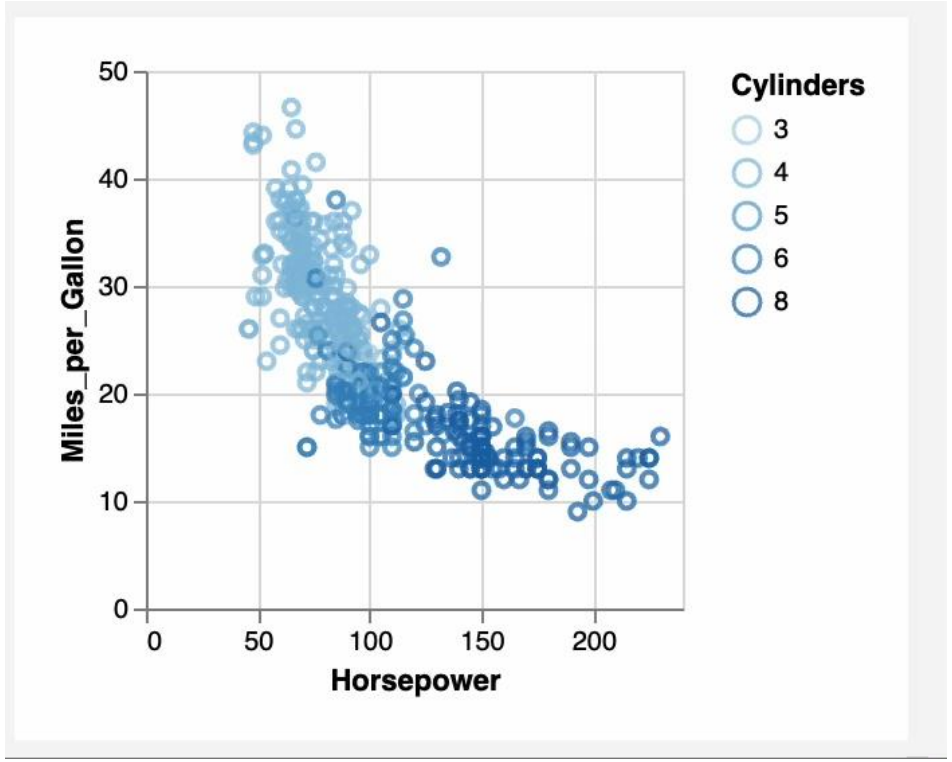
Mark something as interesting: direct





1. Select

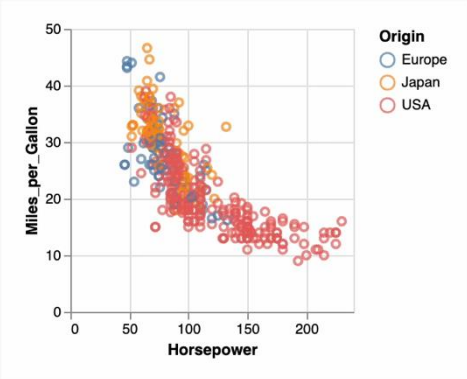
Mark something as interesting: indirect



2. Explore

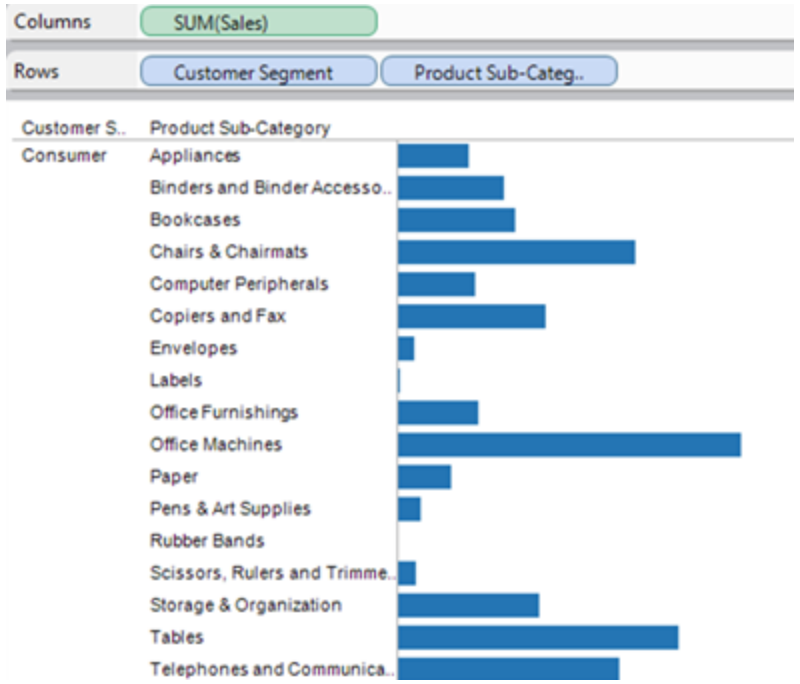
Show me something else

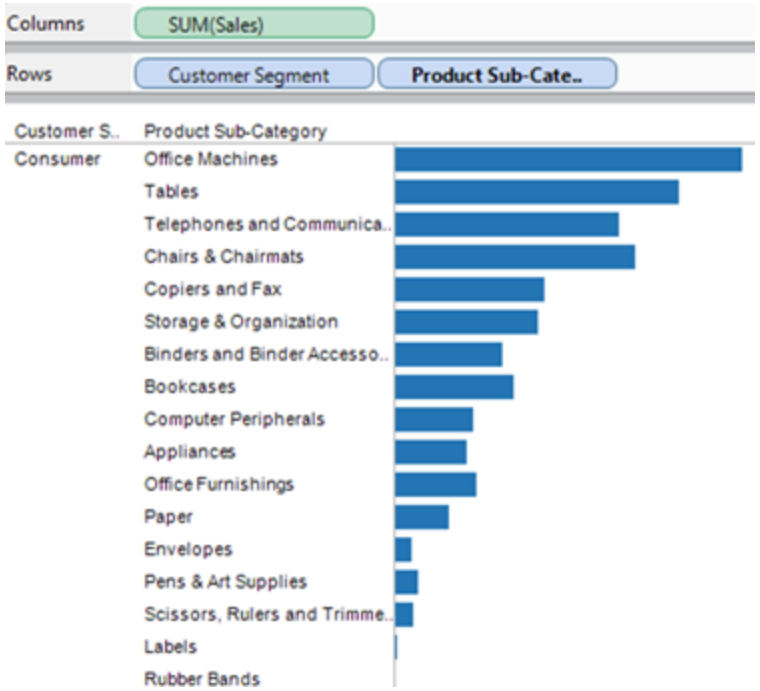
- Scroll bars
- Panning
- Direct-Walk (e.g. hyperlink traversal)



3. Reconfigure

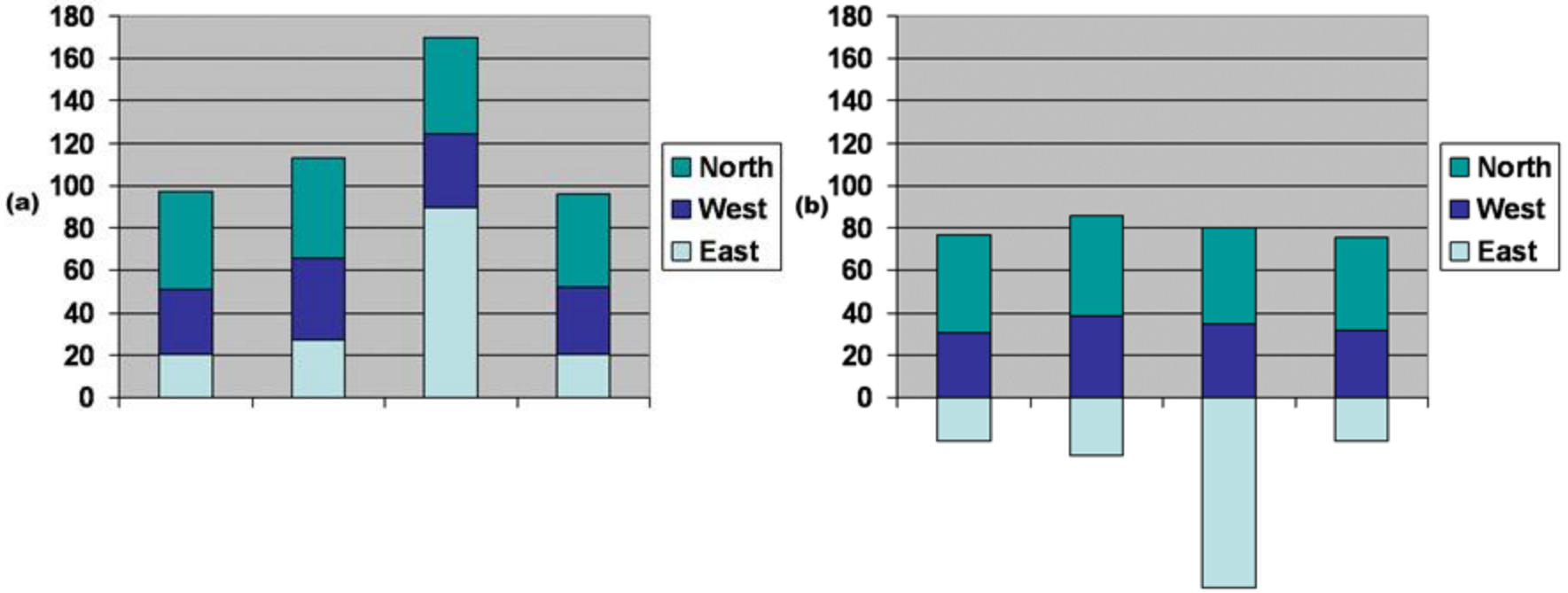
Show me a different arrangement: sorting





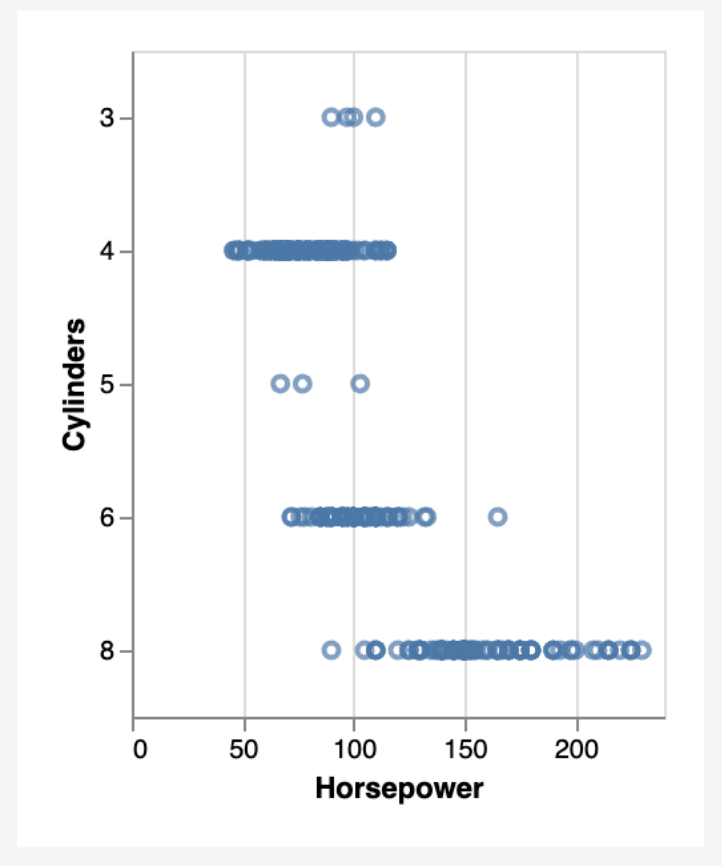
3. Reconfigure

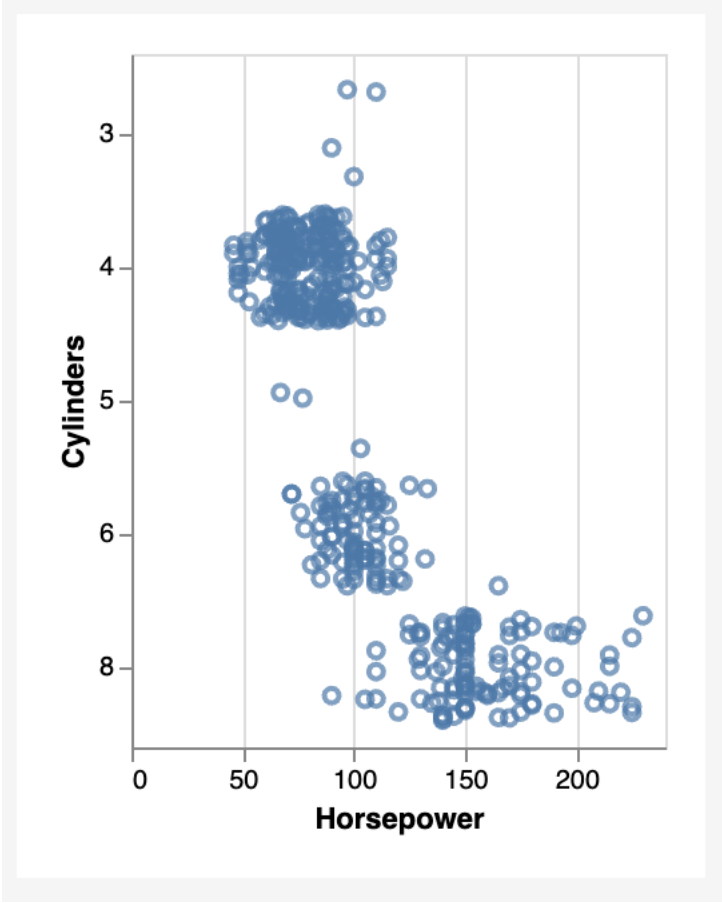
Show me a different arrangement: baseline adjustment



3. Reconfigure

Show me a different arrangement: reduce occlusion (jitter)



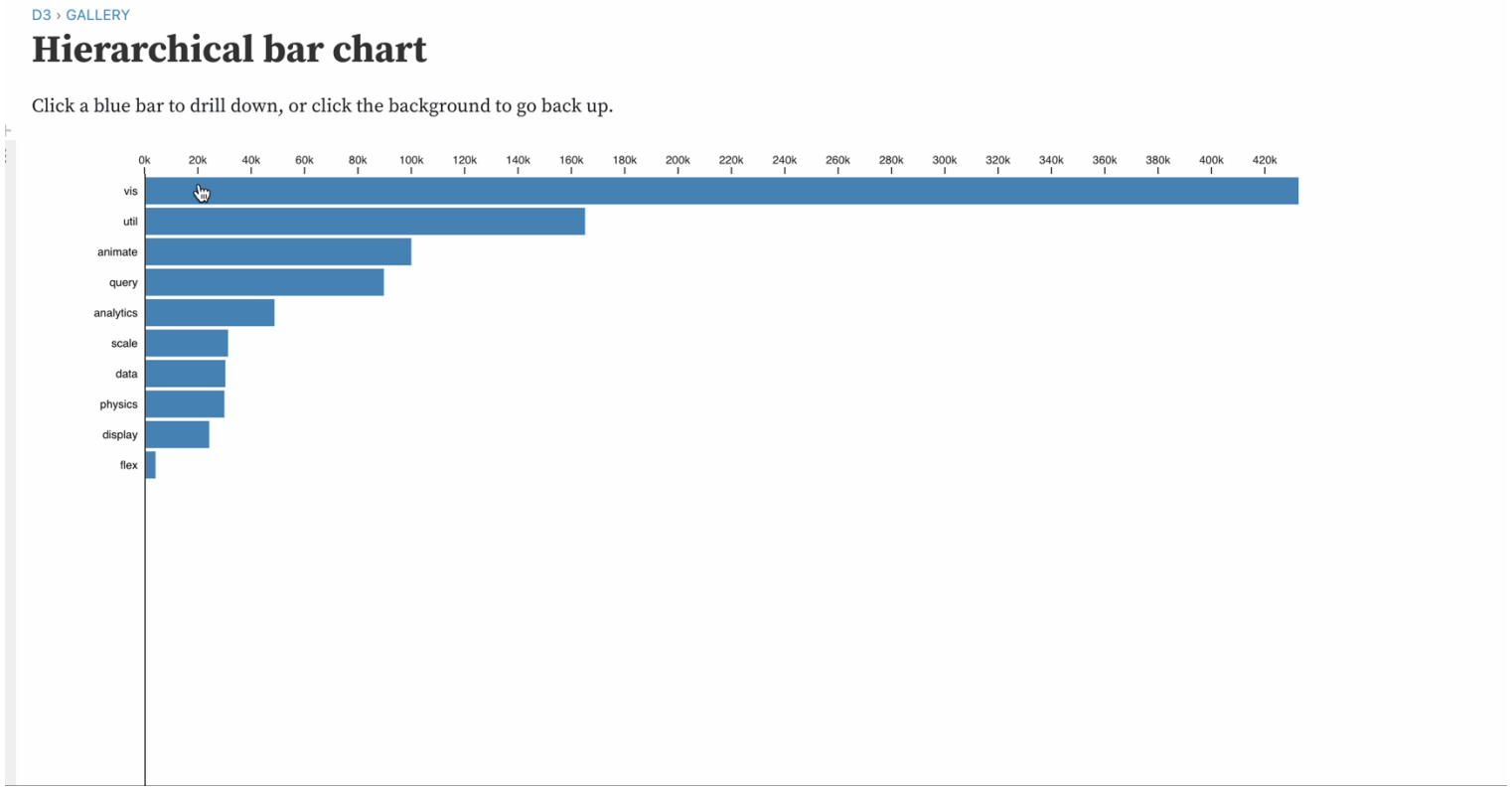


4. Encode

Show me a different representation: visualization type, color, size, orientation, etc.

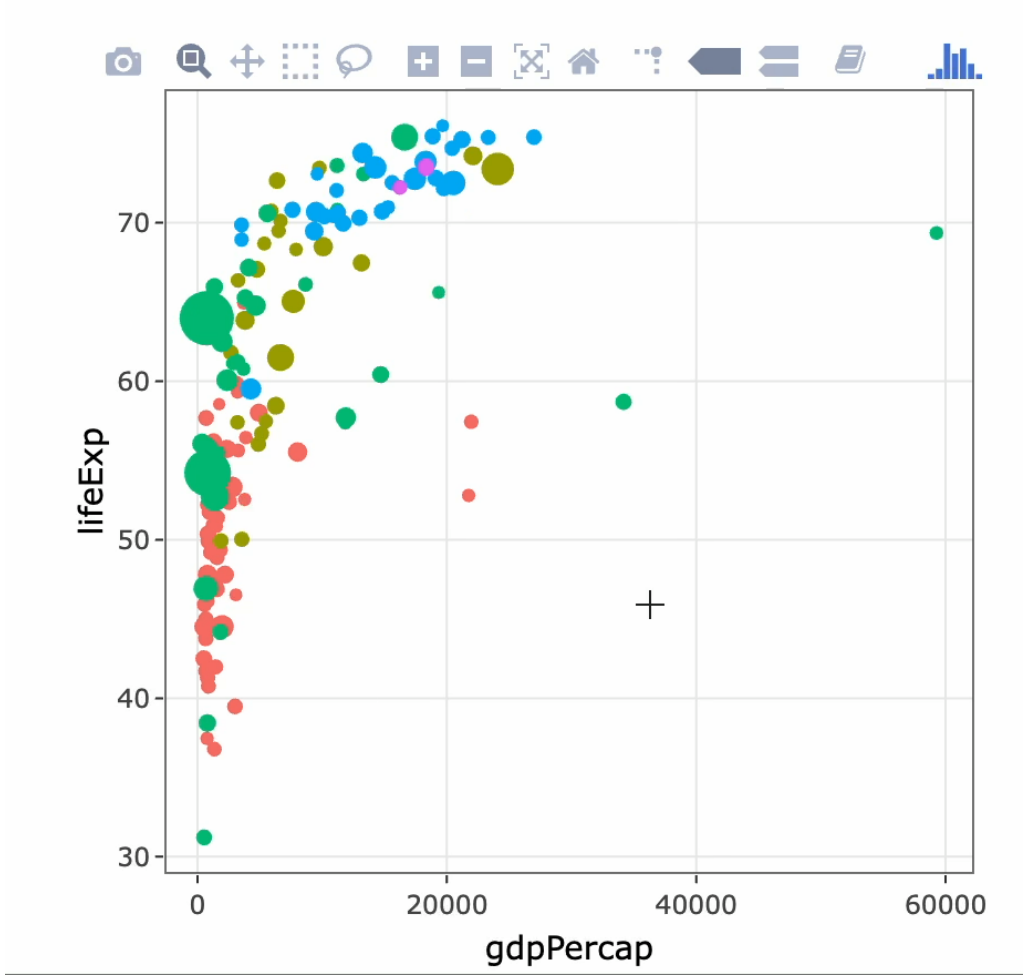
5. Abstract / Elaborate

Show me more or less detail: drill up/down



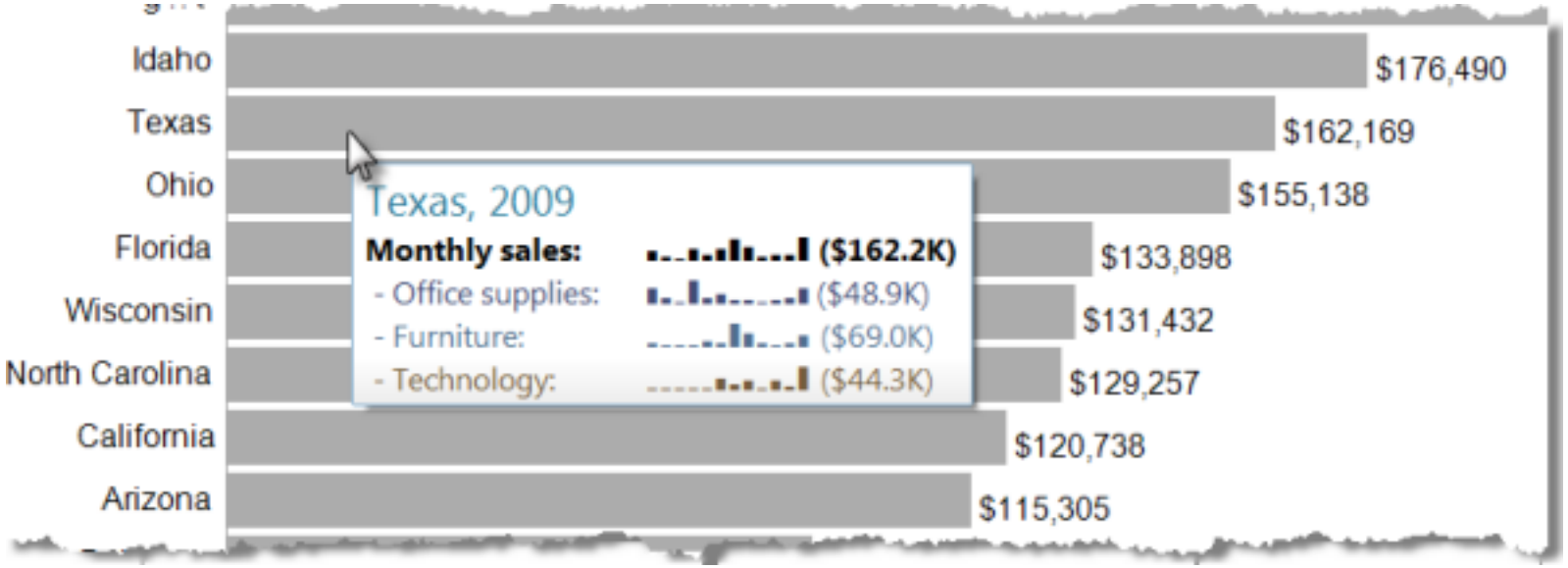
5. Abstract / Elaborate

Show me more or less detail: zooming



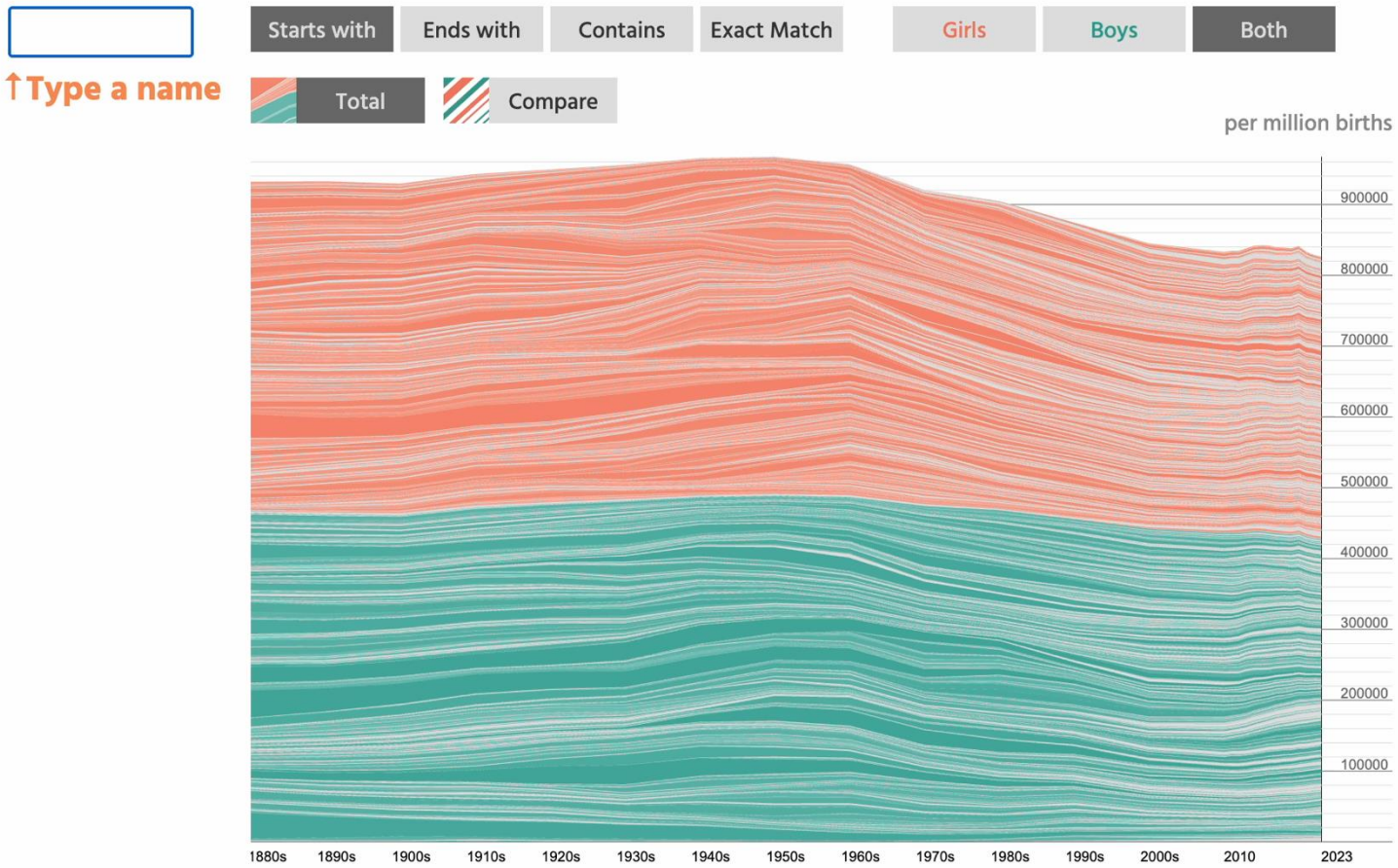
5. Abstract / Elaborate

Show me more or less detail: tooltips



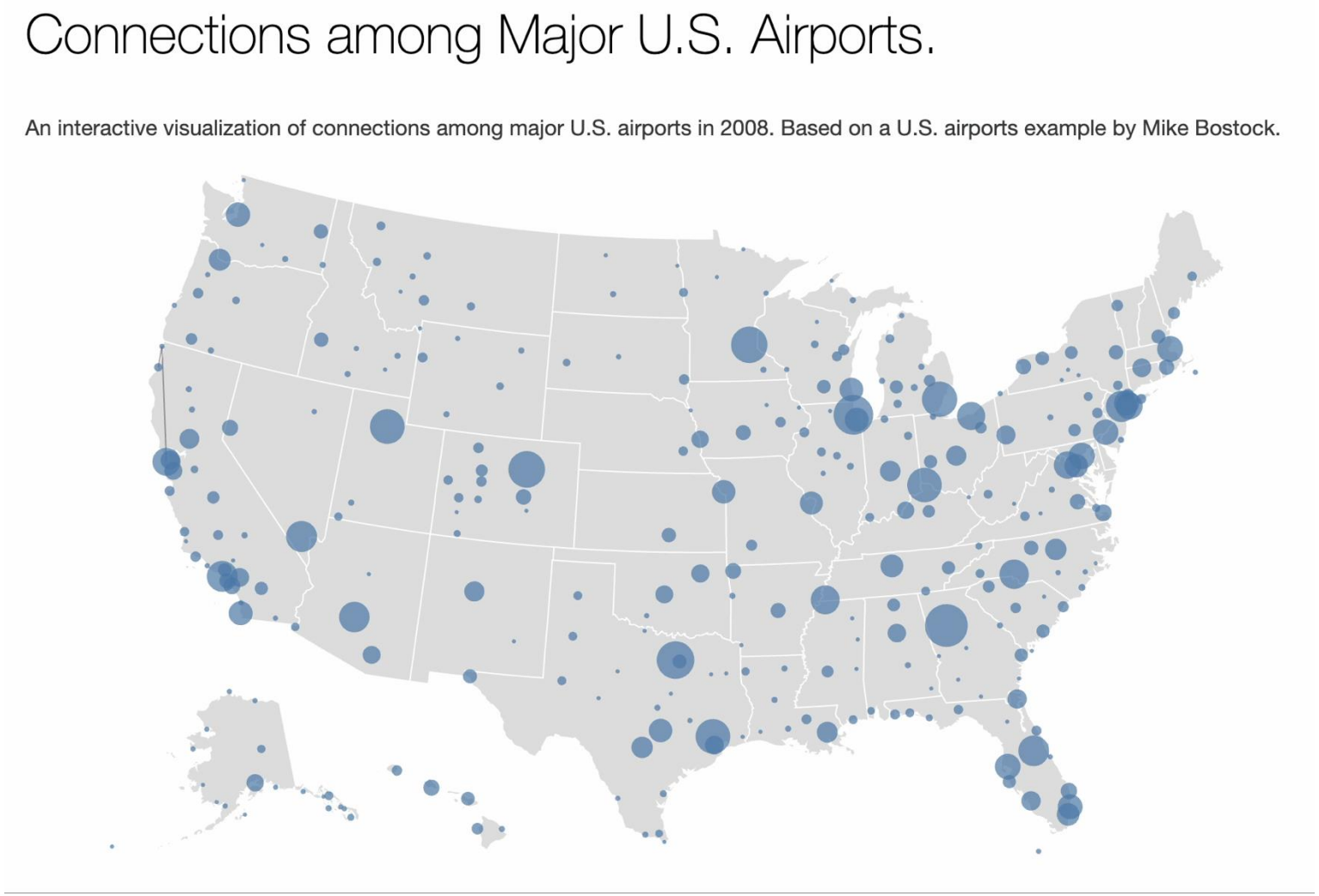
6. Filter

Show me something conditionally



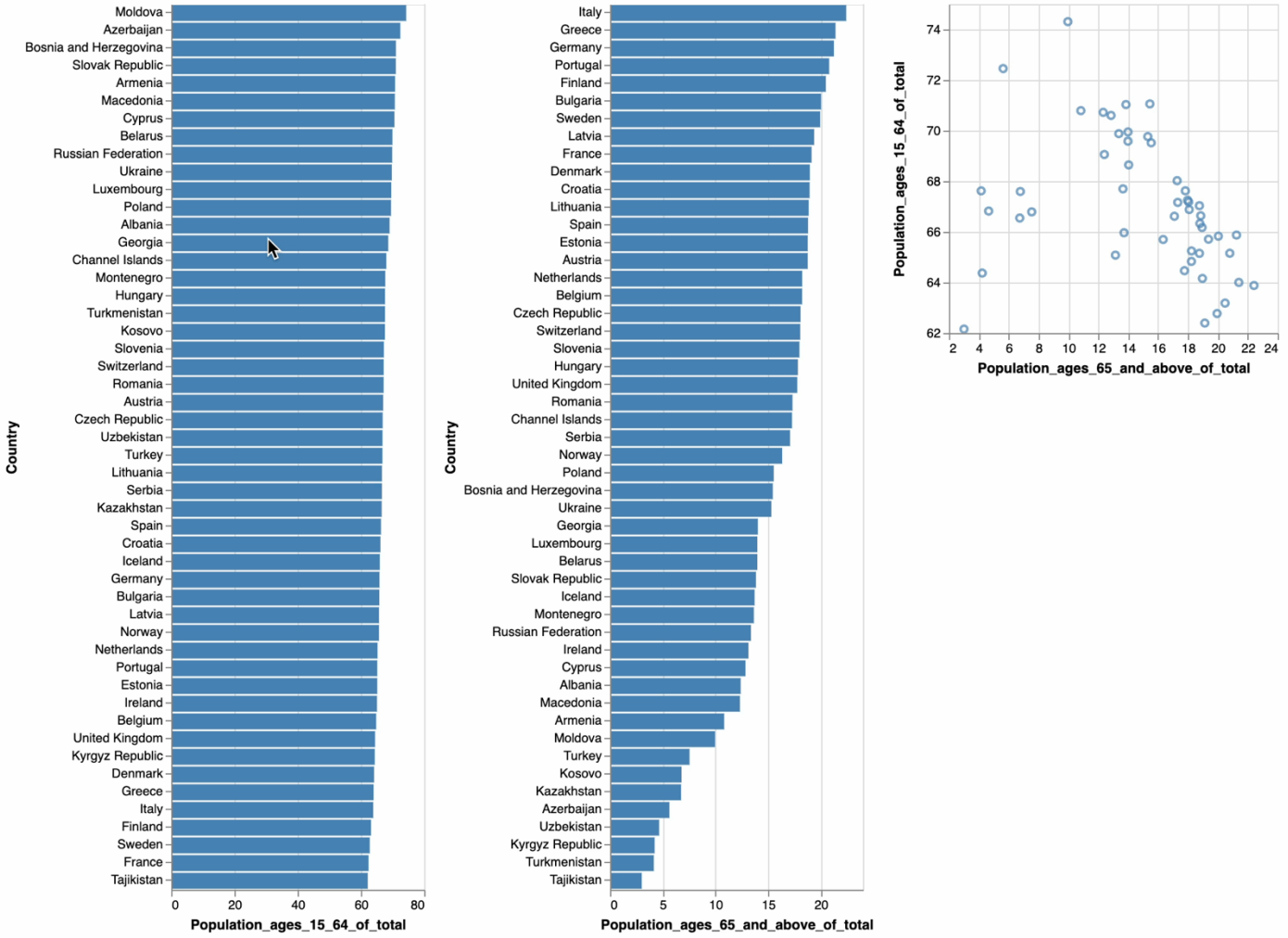
7. Connect

Show me related items: build-out

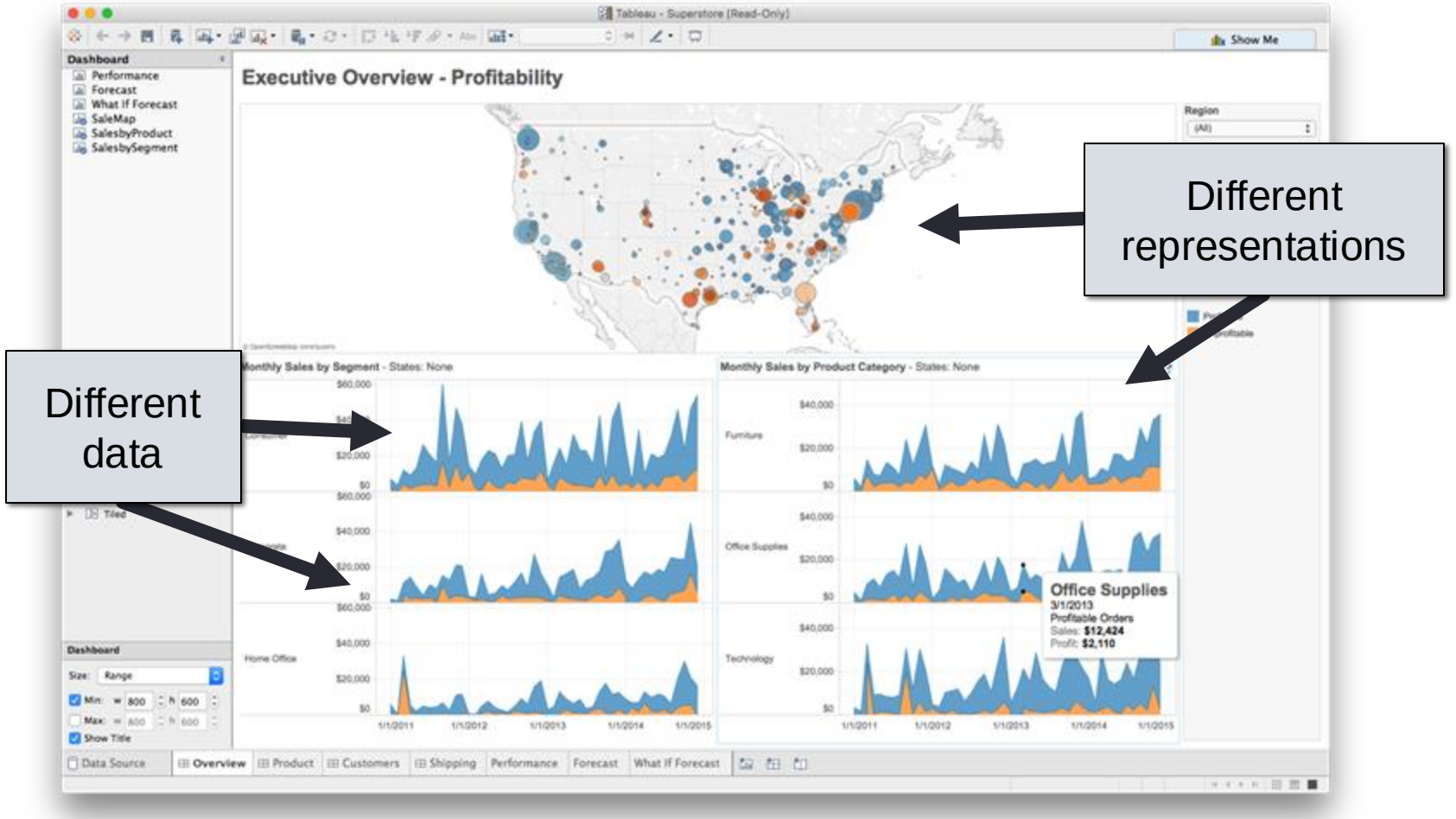


7. Connect

Show me related items: coordinated multiple views (CMV)



Multiple views



Systems that use **two or more distinct views**
to support the exploration of a single concept or domain

Suggested questions to ask when designing

1. What is the goal of the analysis?
   - Decision-making
   - Better understand a domain or a problem
   - Identify the trends of a phenomenon
   - Forecast the future

   …etc.
2. What kinds of operations do we need to enable?
3. How can the visualization support those operations?

Demo: coordinated multiple views

Tableau CMV walkthrough