

Lecture II: Filtering & Aggregation and Focus+Context

DS 4200
FALL 2022

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NORTHEASTERN UNIVERSITY

Last Class

We:

- Reviewed Interaction
- Reviewed Faceting

Any Questions?

Today

- Filtering and Aggregation
- Focus+Context

Visualizing Big Data



Visualizing Big Data

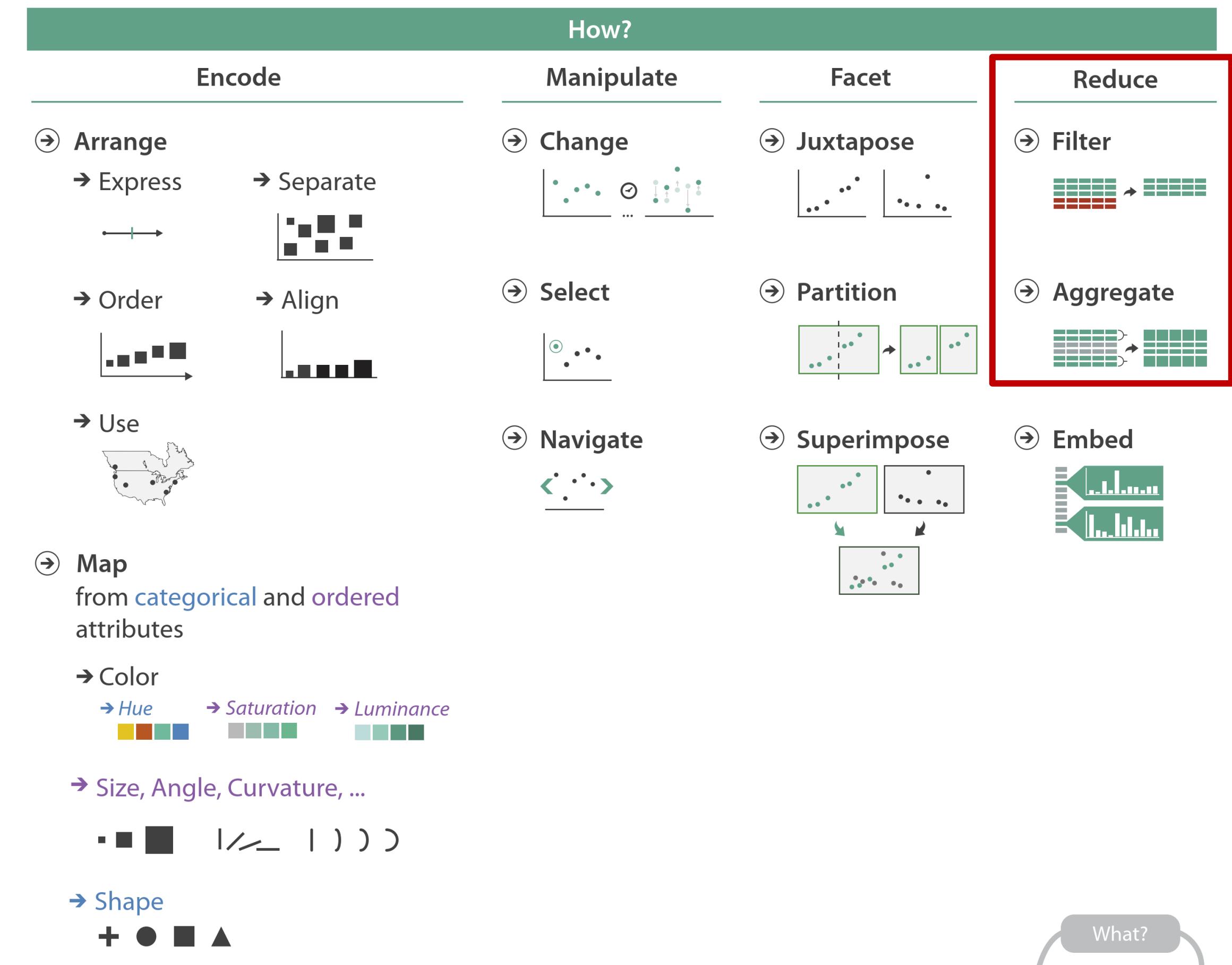
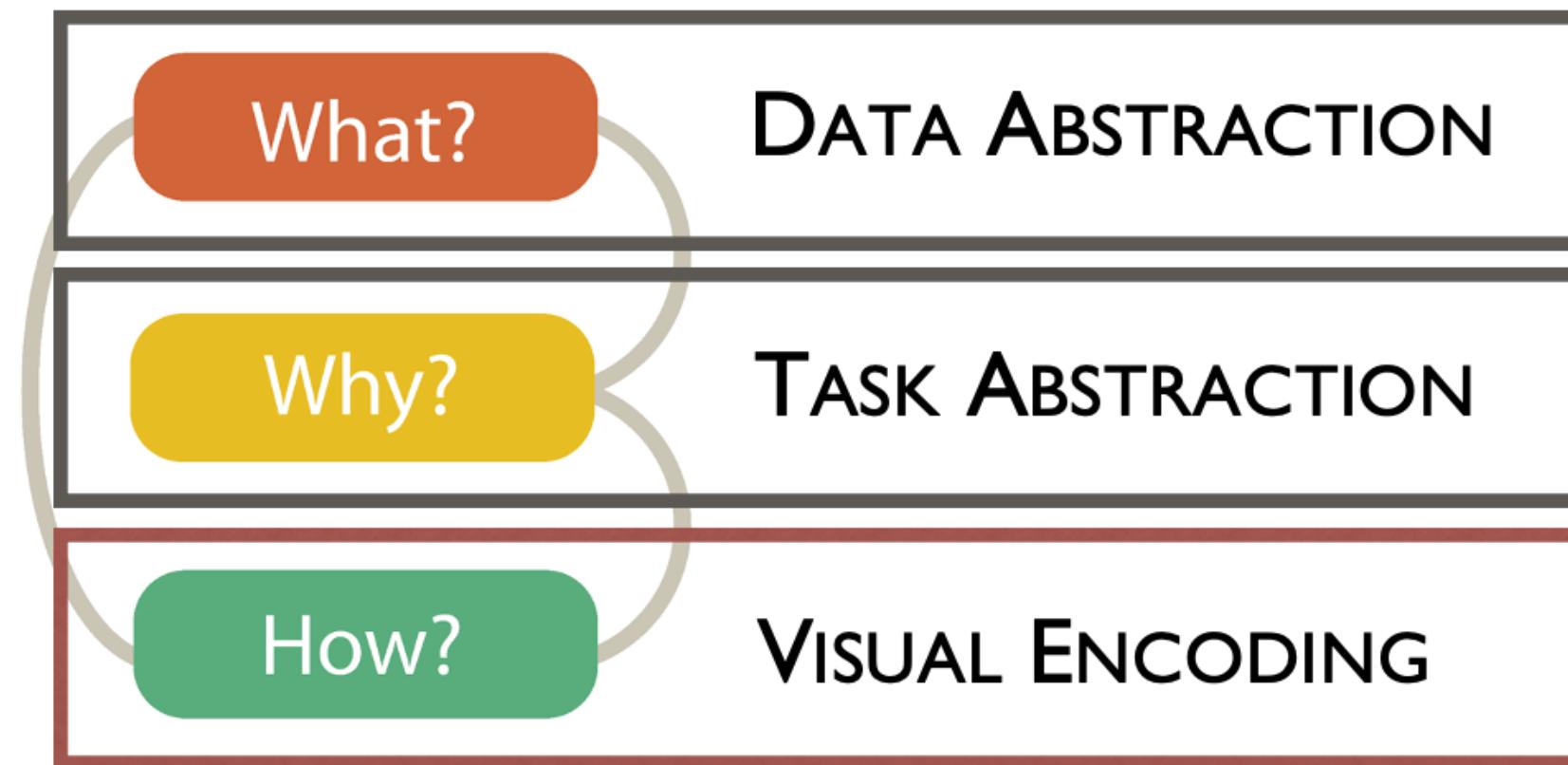
- 1.** Faceting – Split data into multiple views
- 2.** Interaction – Let user manipulate a single view
- 3.** Aggregate and Filter – Reduce amount of data visualized
- 4.** Focus+Context – Embed focused information

Visualizing Big Data

1. Faceting – Split data into multiple views
2. Interaction – Let user manipulate a single view
3. Aggregate and Filter – Reduce amount of data visualized
4. Focus+Context – Embed focused information

AGGREGATION AND FILTERING

Munzner's Design Pipeline



Caveats to Filtering & Aggregation

- Be careful not to hide important details
- Keep in mind your audience
 - Will they understand the resulting data?
 - Will they remember they're looking at reduced data?

Filtering vs. Aggregation

Filter → Eliminate (hide) elements

Aggregate → Create new element(s)
representing multiple

Filtering vs. Aggregation

Filter → Eliminate (hide) elements

Pros: • Easy to understand

• Easy to compute

Cons: • Easy for the user to forget elements

Aggregate → Create new element(s) representing multiple

Pros: • No missing elements

• Can require sophisticated expertise from the user

Cons:

Filtering

Filtering

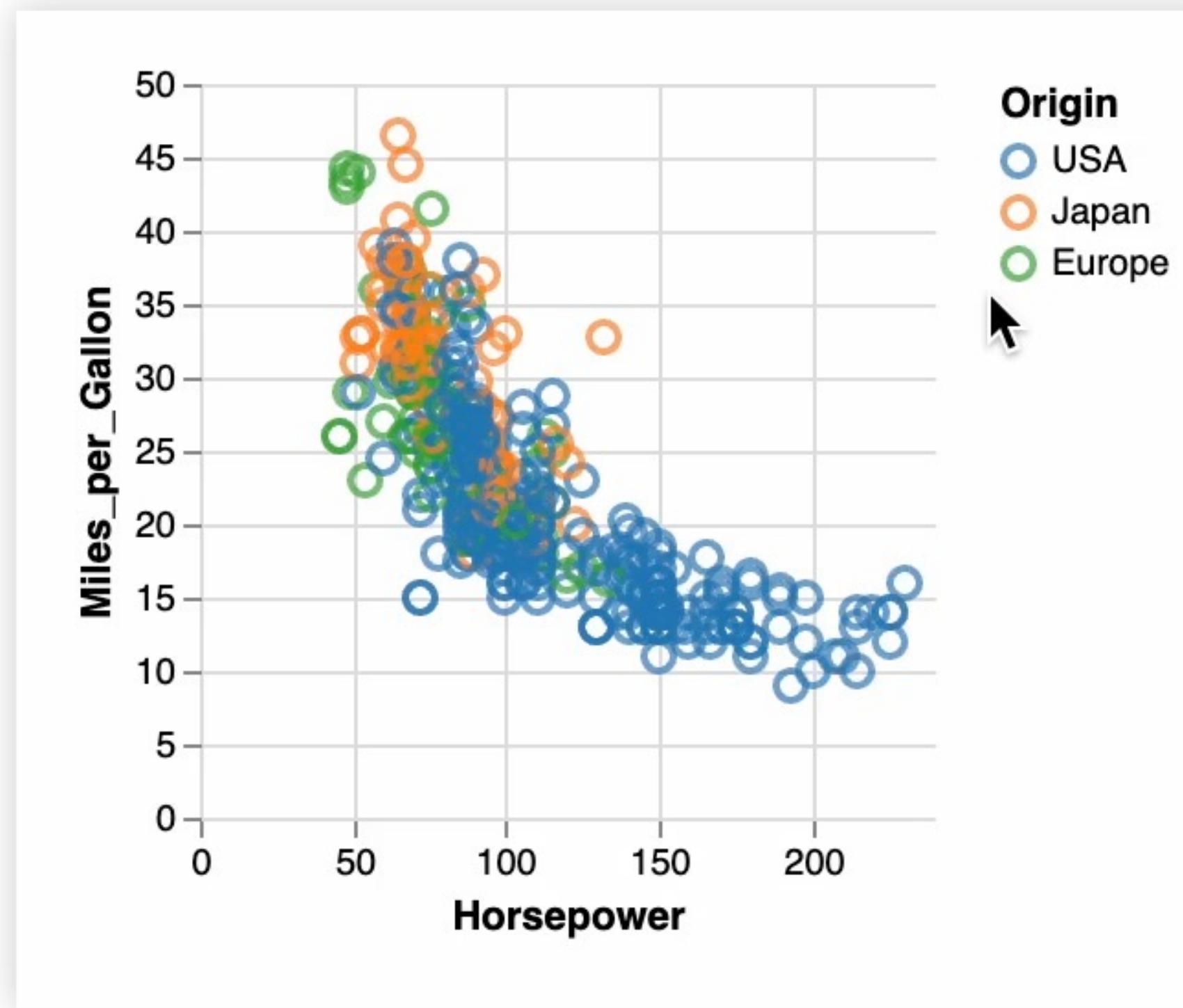
Item filtering

→ eliminate items based on value

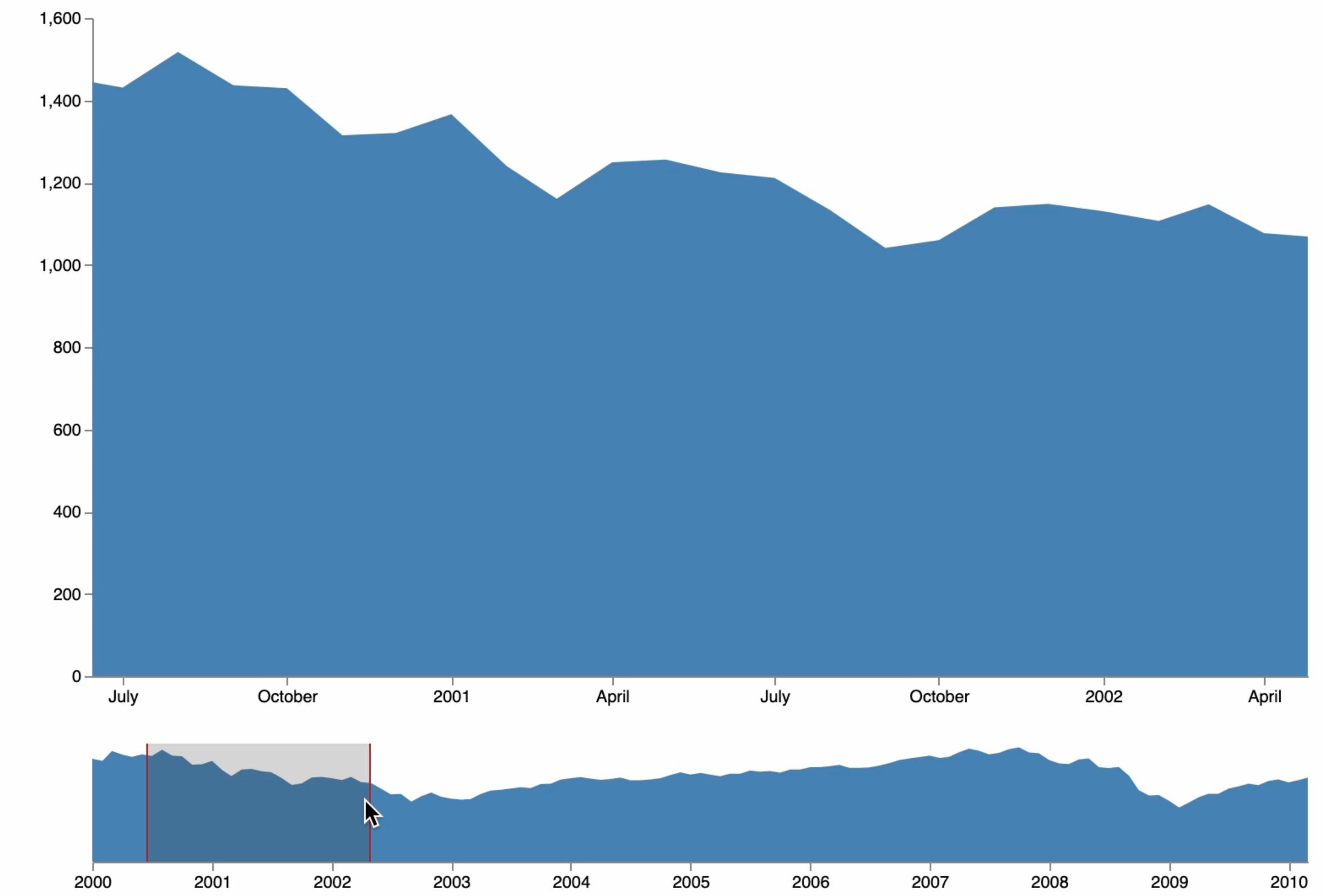
Filtering

Item filtering

→ eliminate items based on value



<https://vega.github.io/vega/examples/interactive-legend/>



<https://vega.github.io/vega/examples/overview-plus-detail/>

Filtering

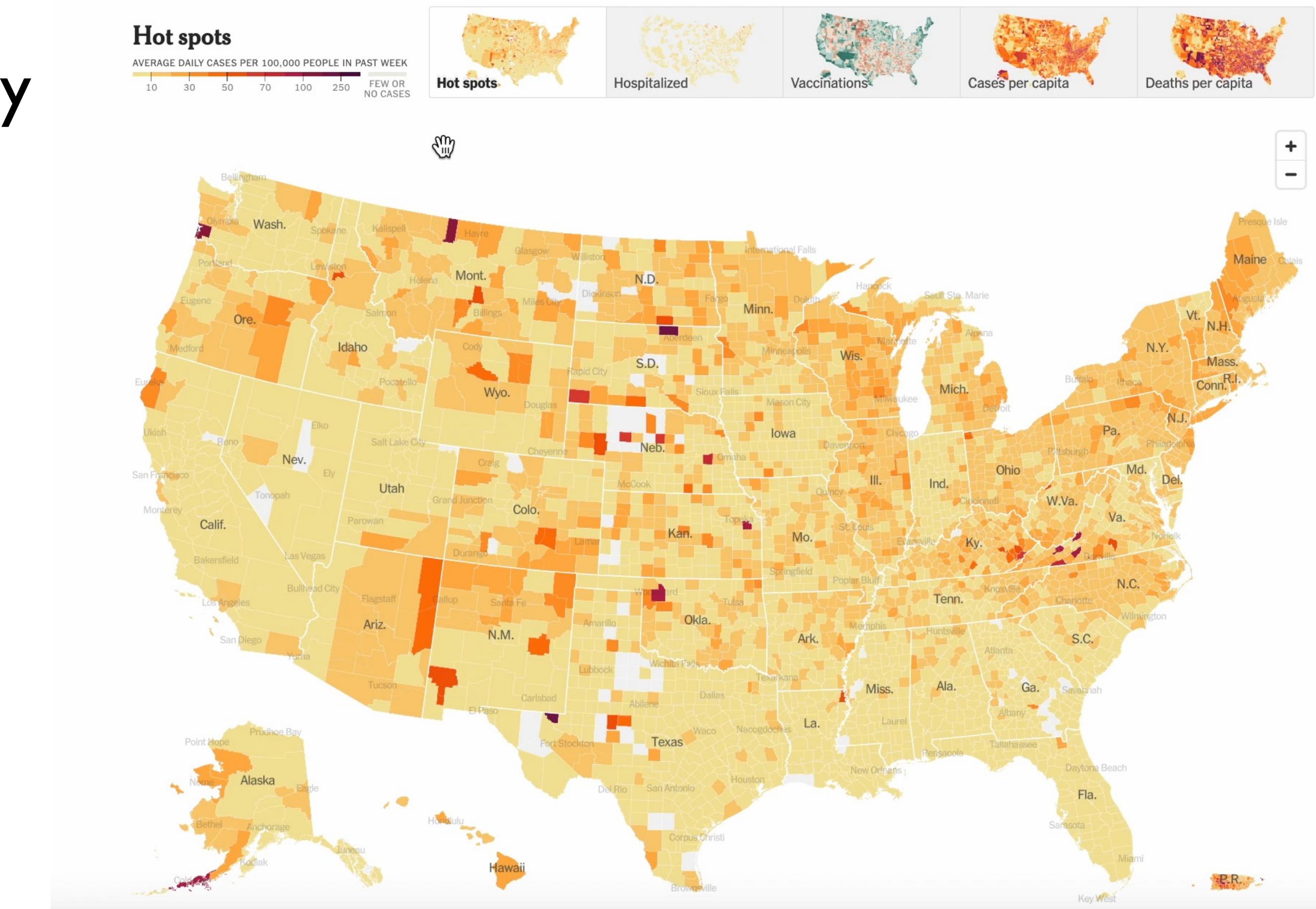
Attribute filtering

→ eliminate attributes from display

Filtering

Attribute filtering

→ eliminate attributes from display



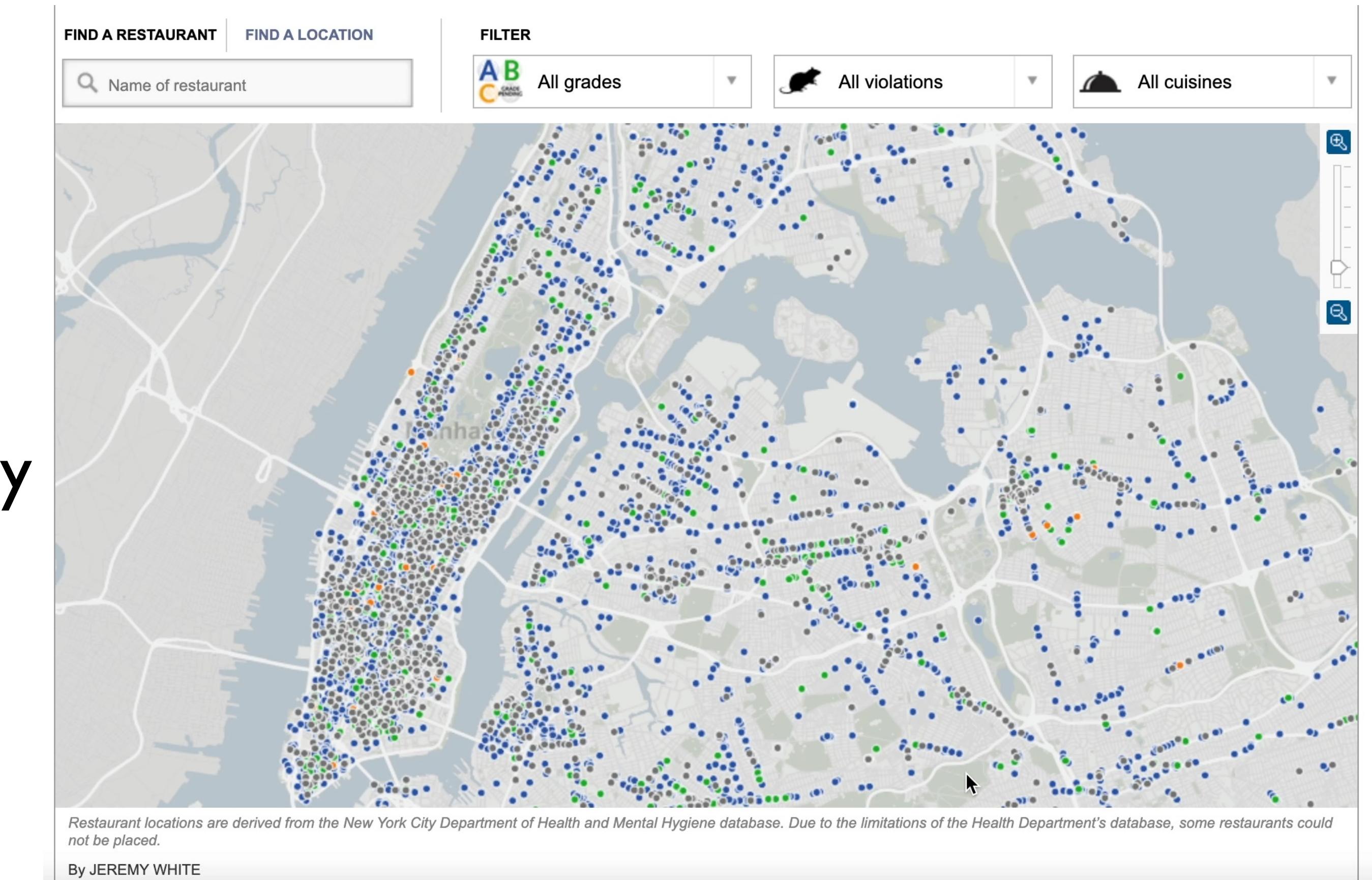
Filtering

Item filtering

→ eliminate items based on value

Attribute filtering

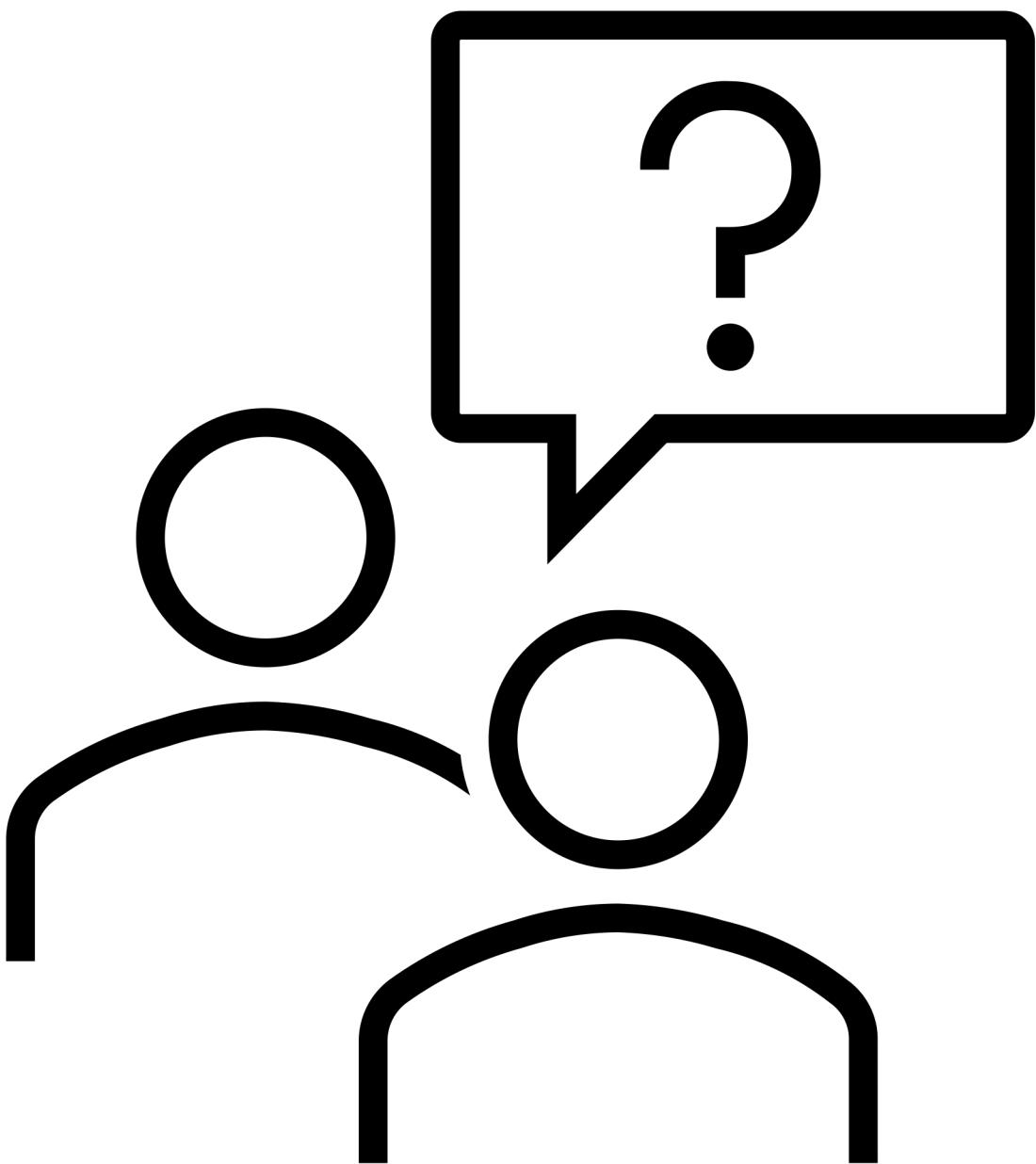
→ eliminate attributes from display



Filtering

**How can we help the user remember
that they are only viewing a subset of
the data?**

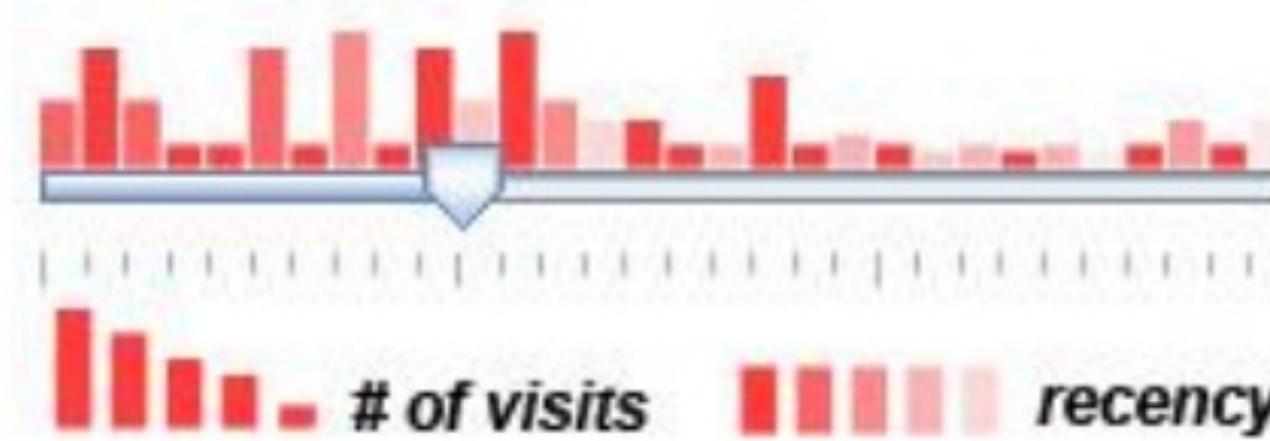
Sketch some ideas



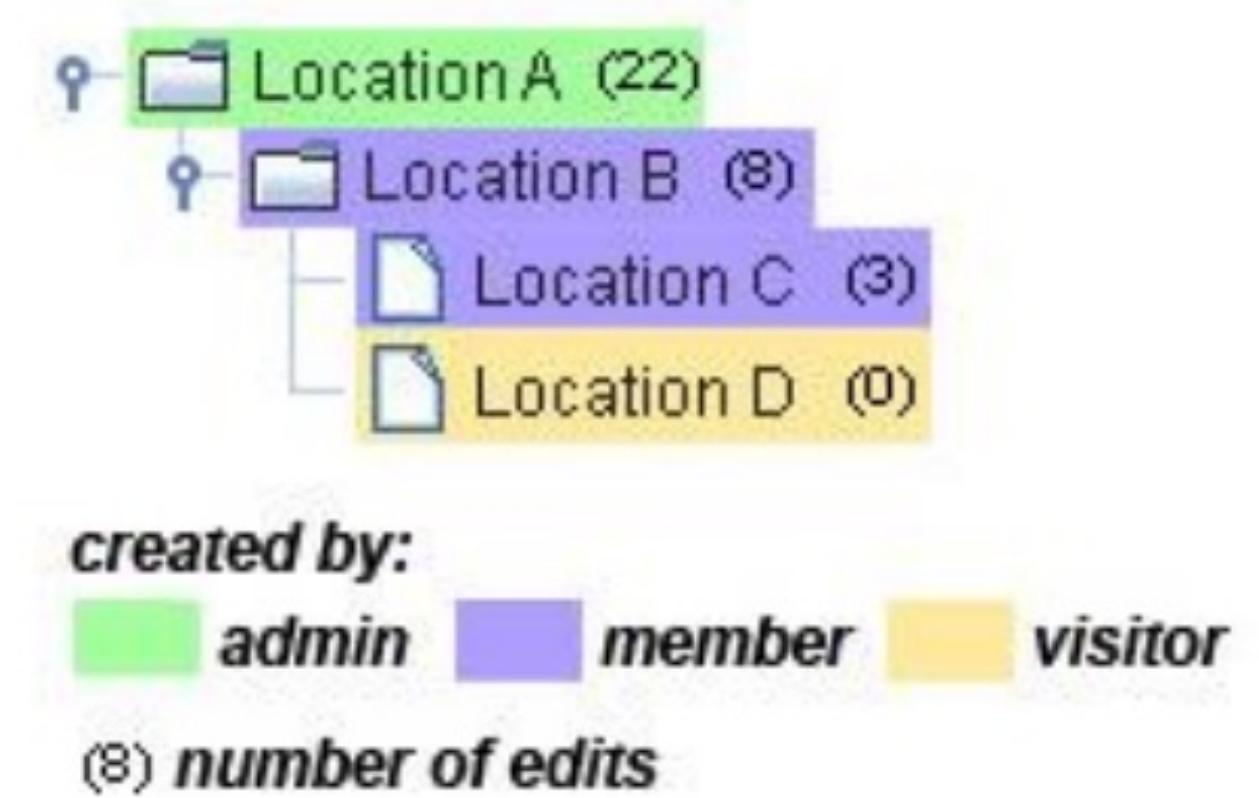
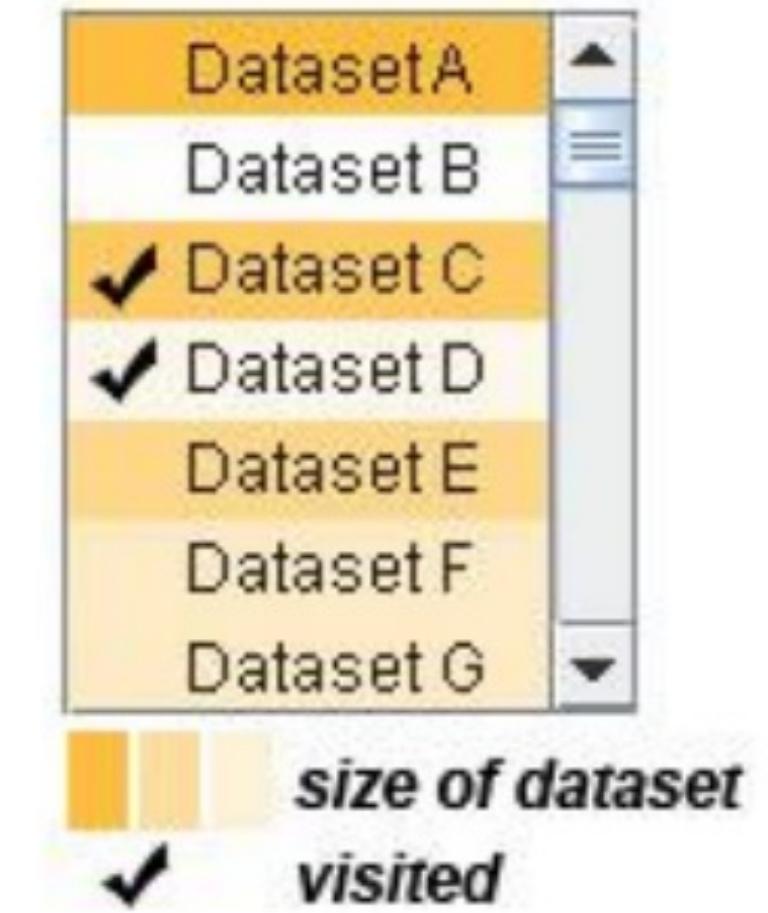
Filtering

Scented Widgets

→ Help address the risk of forgetting information



- 1st Option A
- 3rd Option B
- 2nd Option C
- 3rd Option D



Aggregation

Aggregation

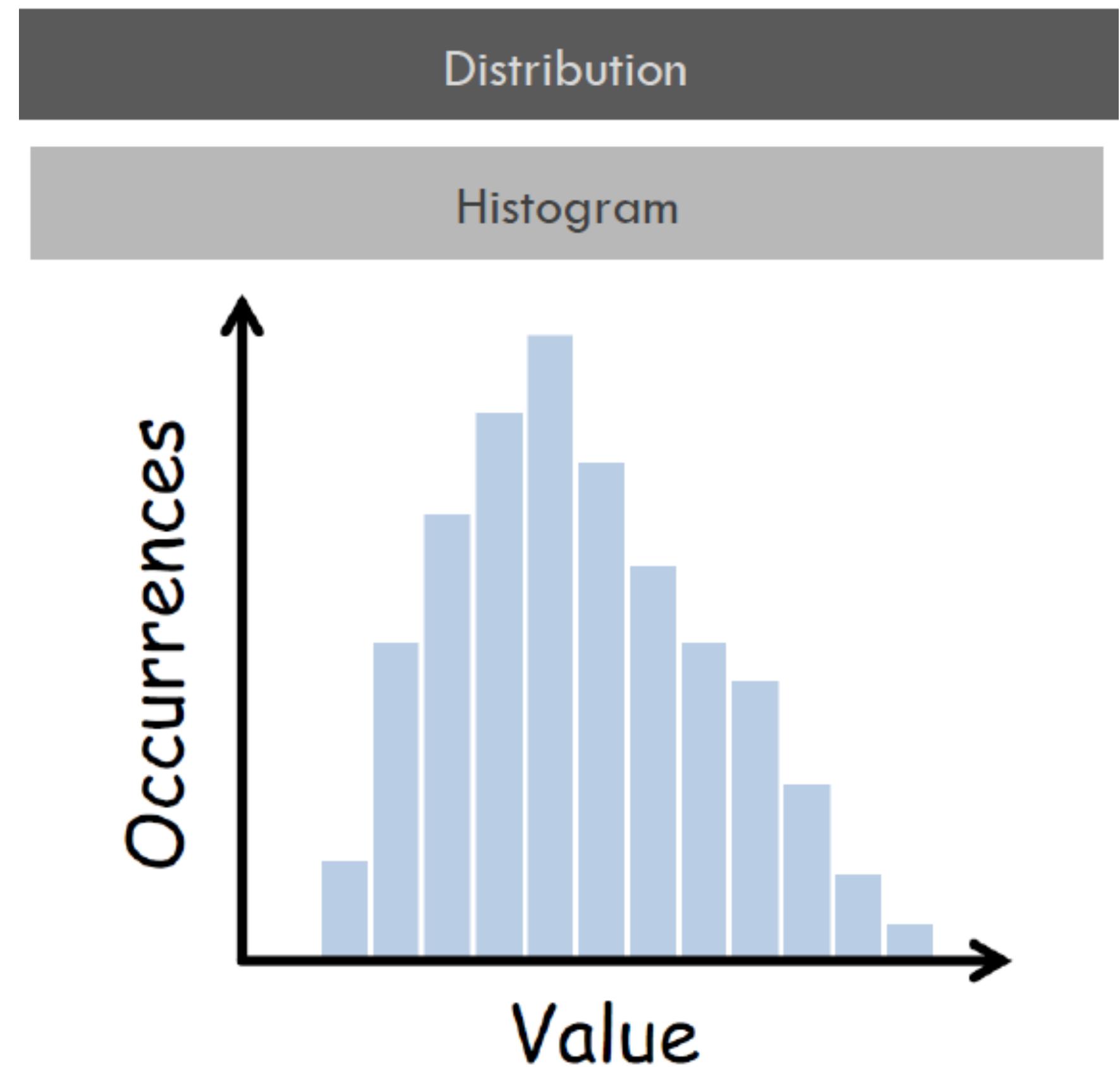
Item aggregation

→ Create one item to represent many

Aggregation

Item aggregation

→ Create one item to represent many



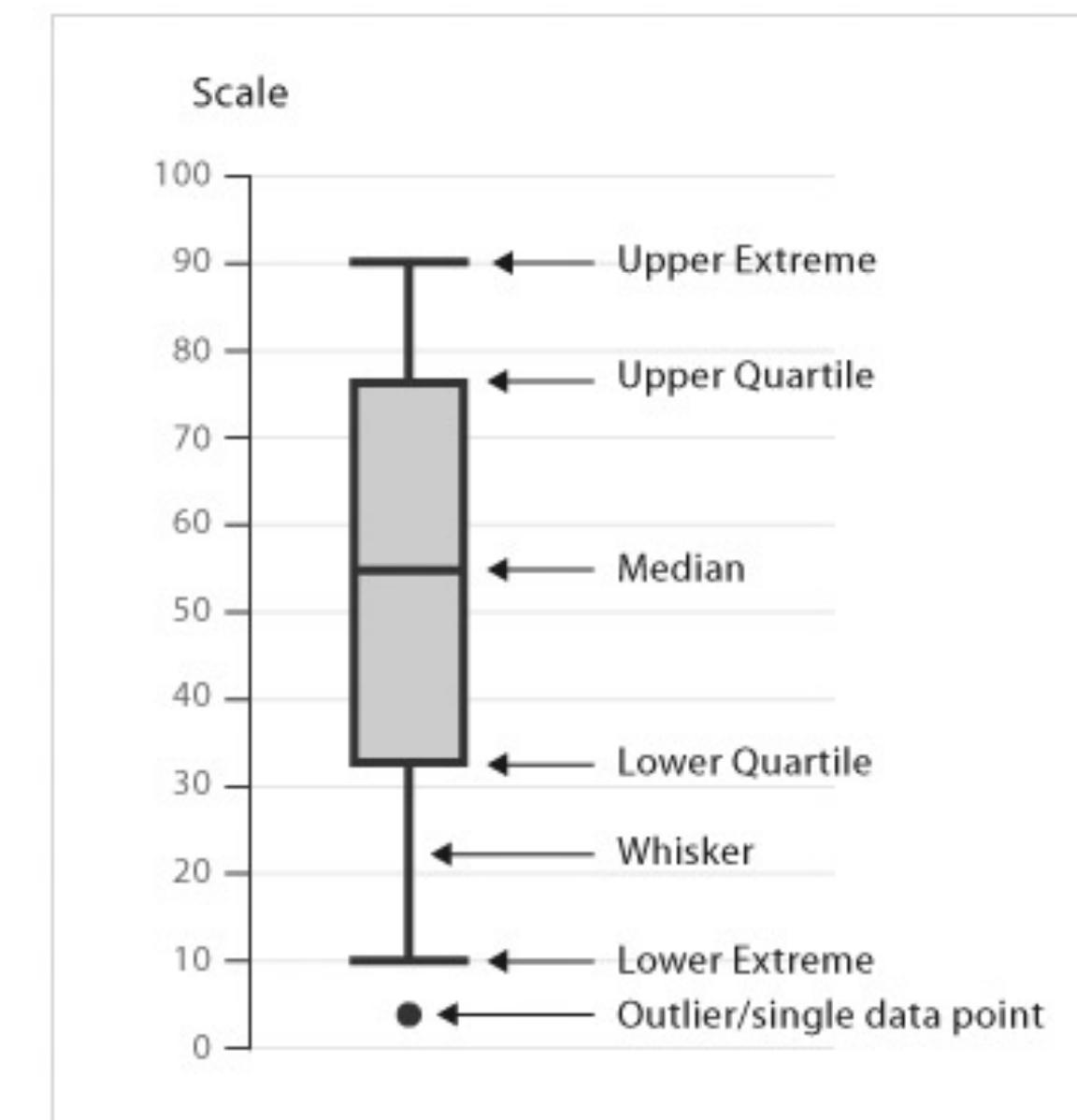
bins (aggregates) of data

Aggregation

Item aggregation

→ Create one item to represent many

Box-And-Whisker Plot



Aggregation

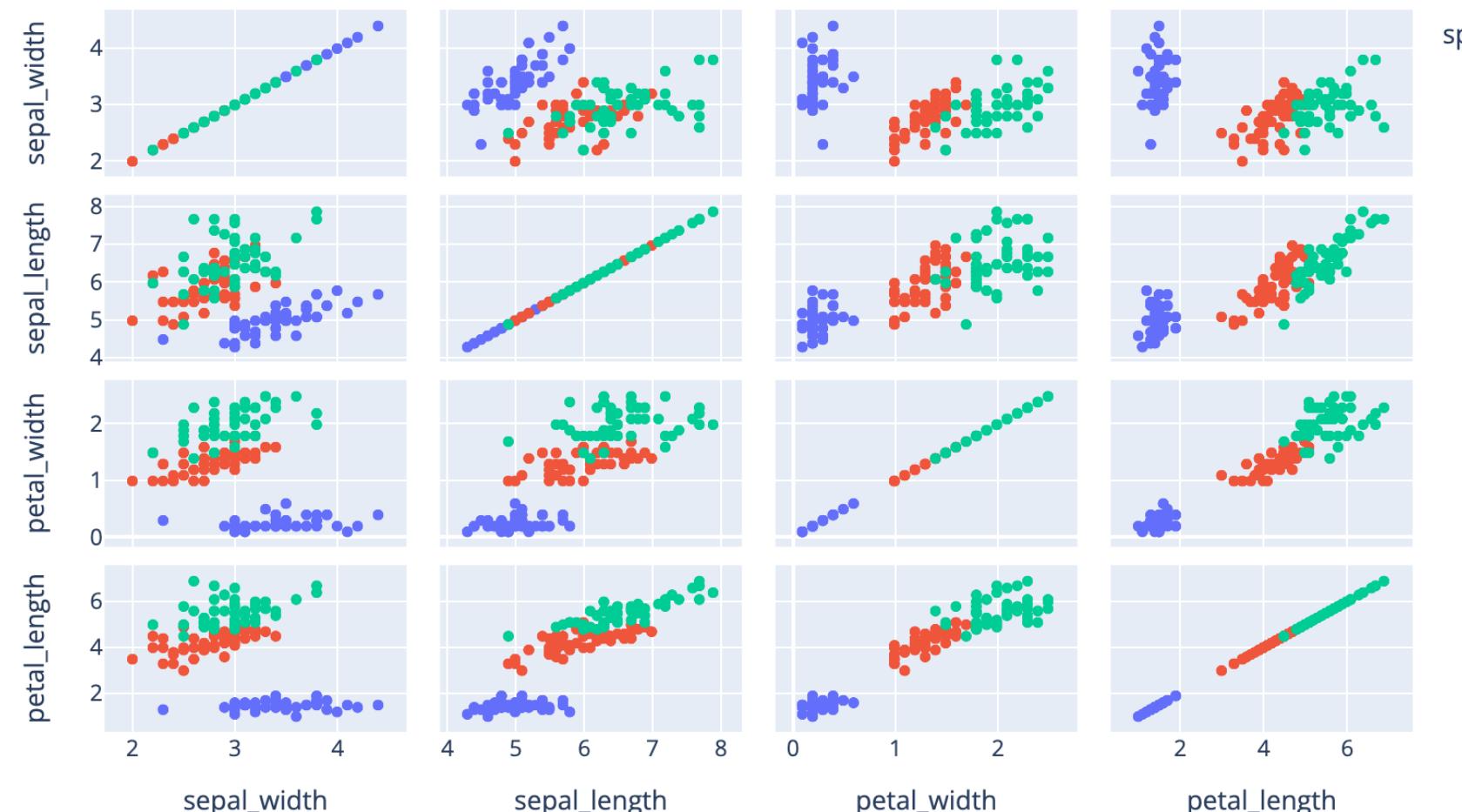
Attribute aggregation

→ Collapse / reduce attributes

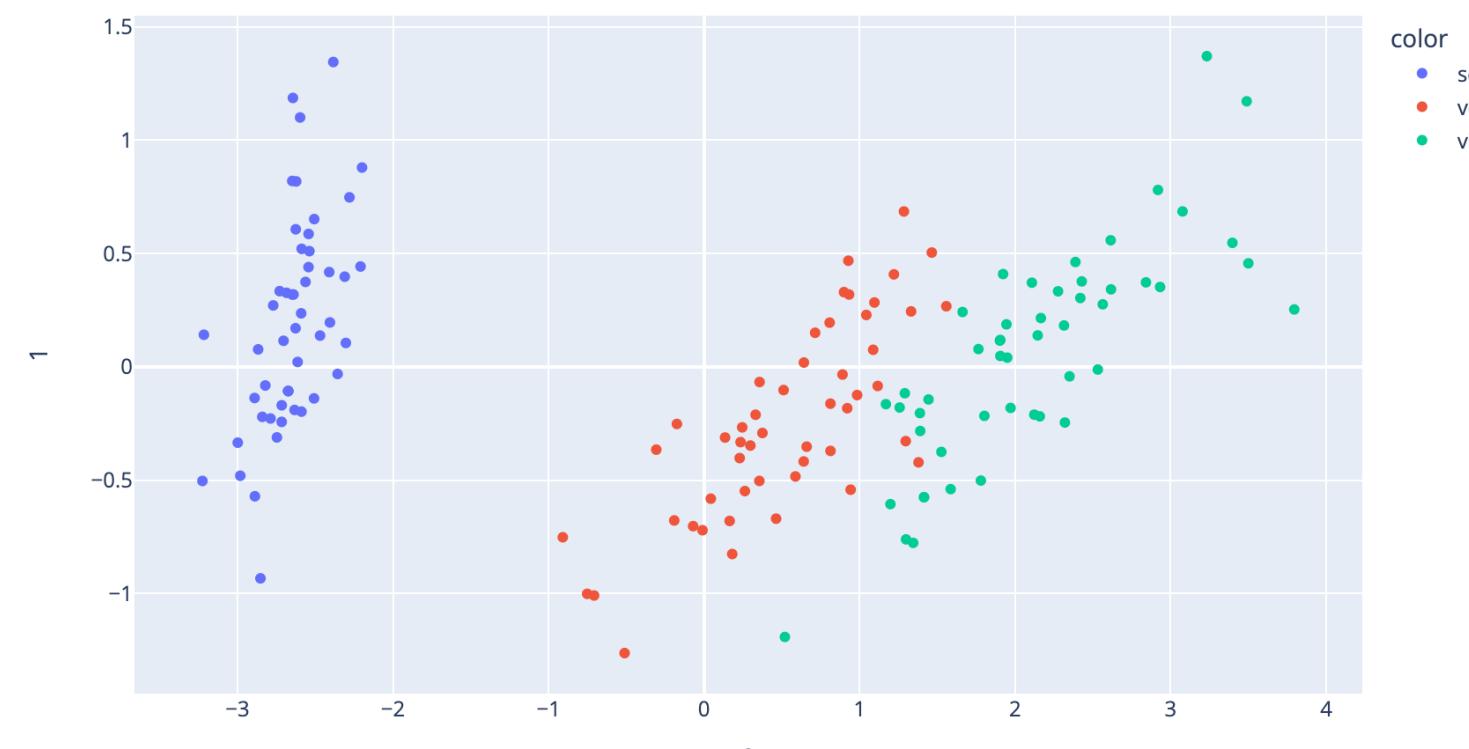
Aggregation

Attribute aggregation

→ Dimensionality reduction

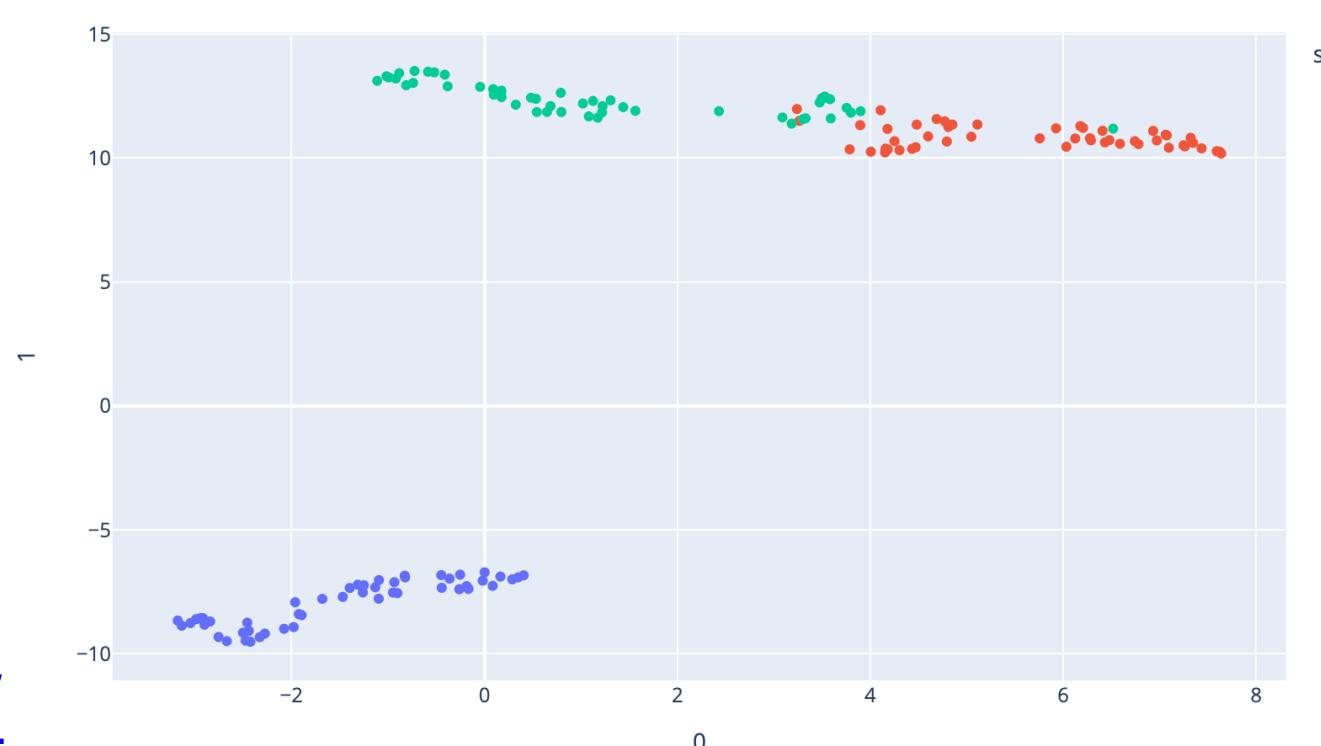


species
• setosa
• versicolor
• virginica

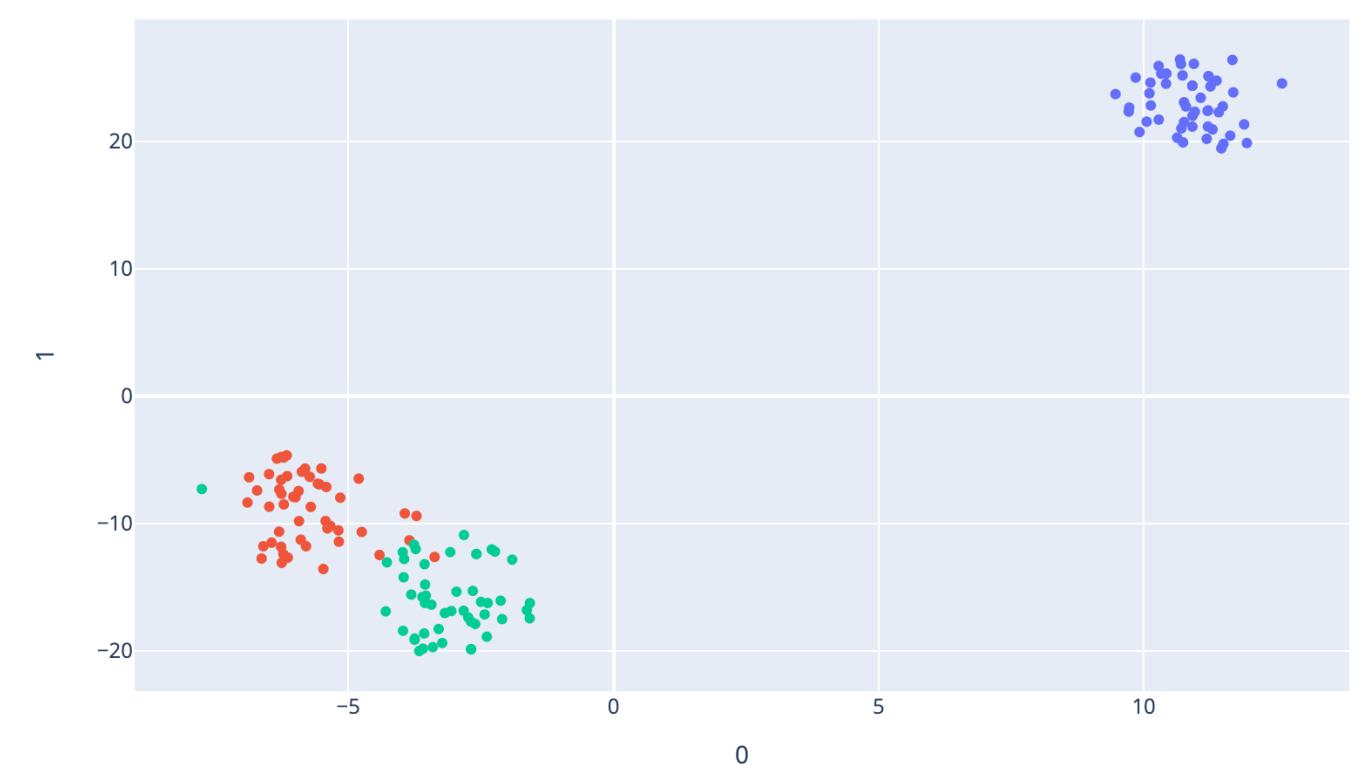


color
• setosa
• versicolor
• virginica

PCA



t-SNE



UMAP

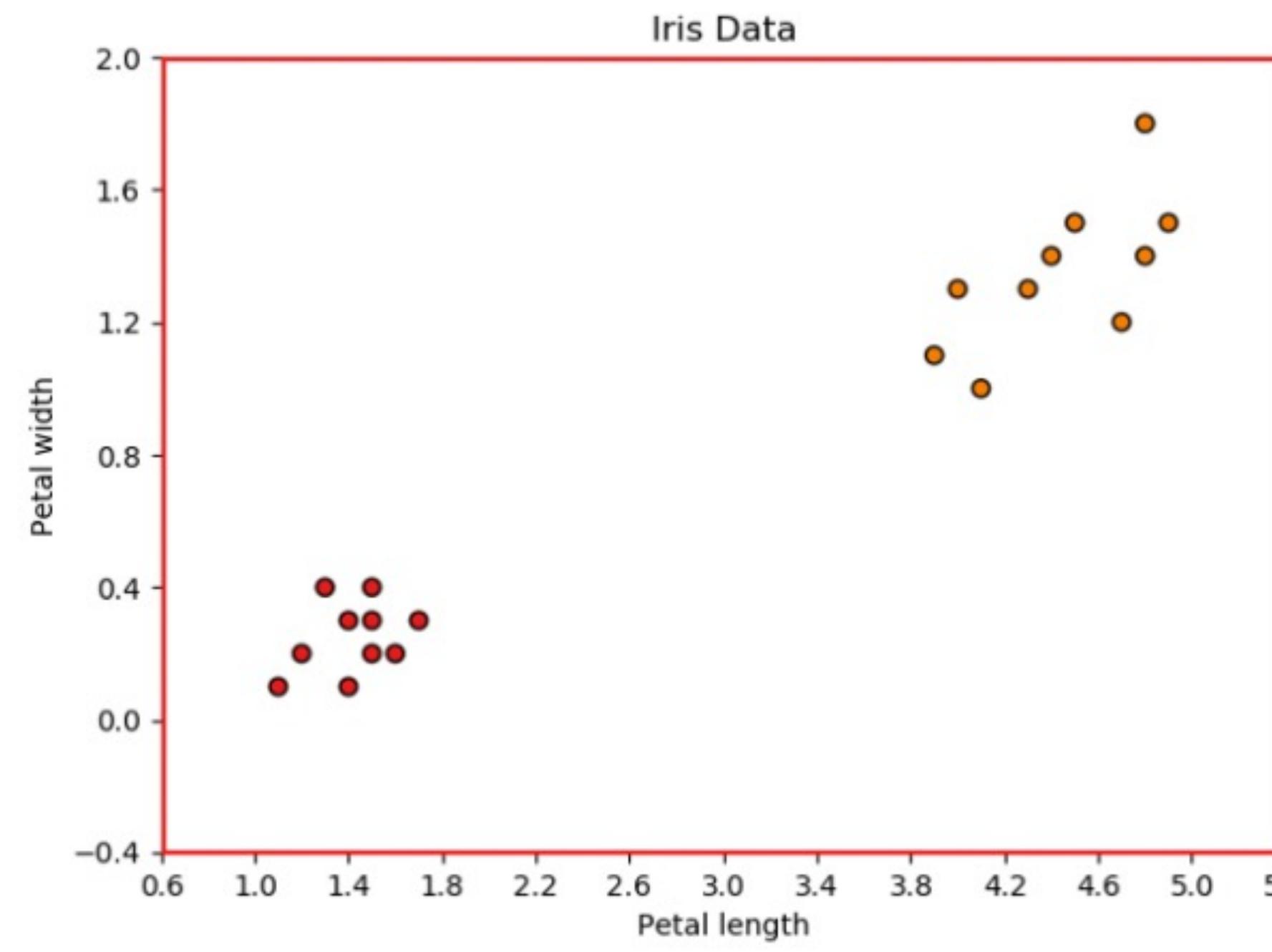
<https://plotly.com/python/pca-visualization/>

<https://plotly.com/python/t-sne-and-umap-projections/>

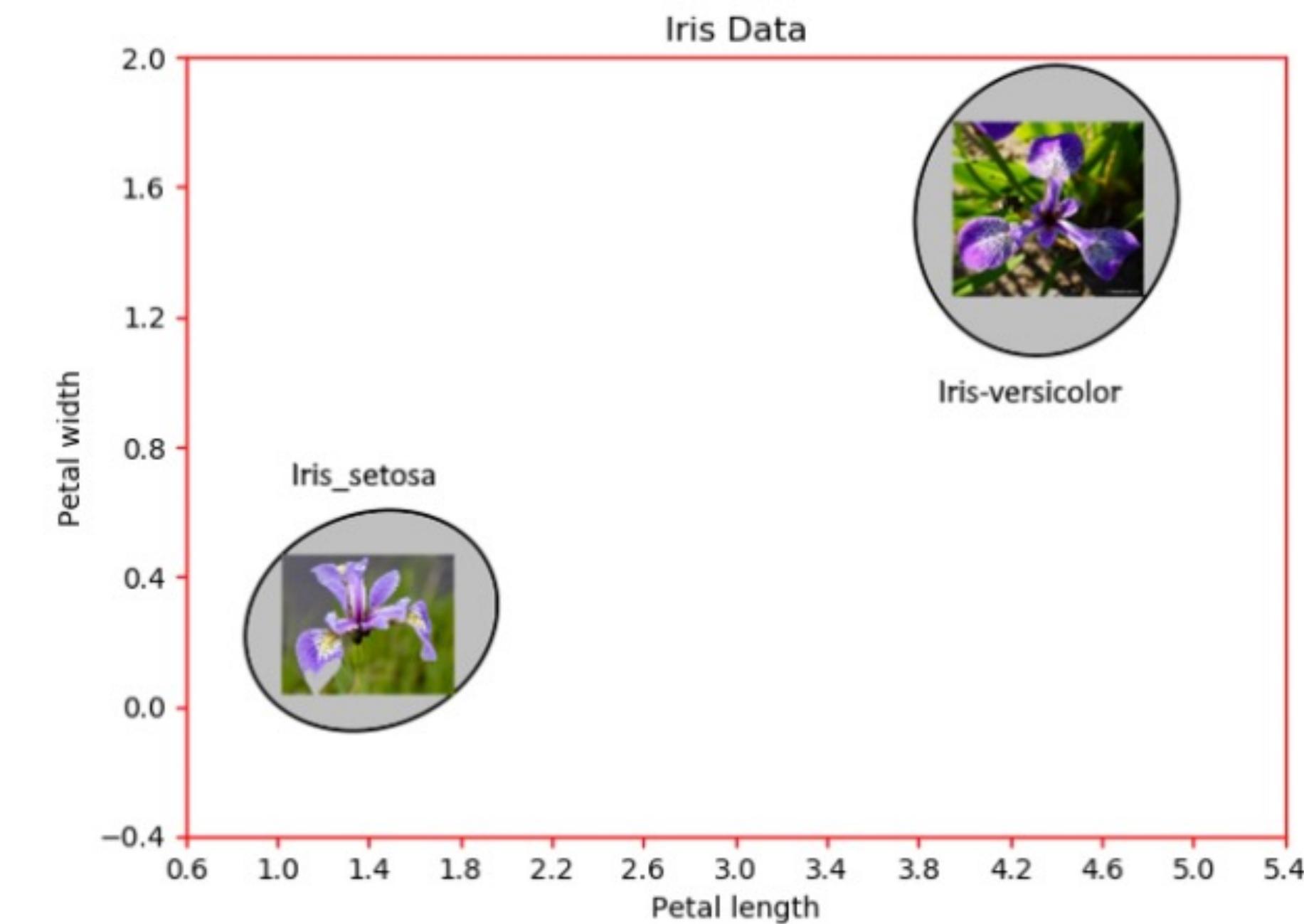
Aggregation

Attribute aggregation

→ Group by similarity measure



Training dataset.

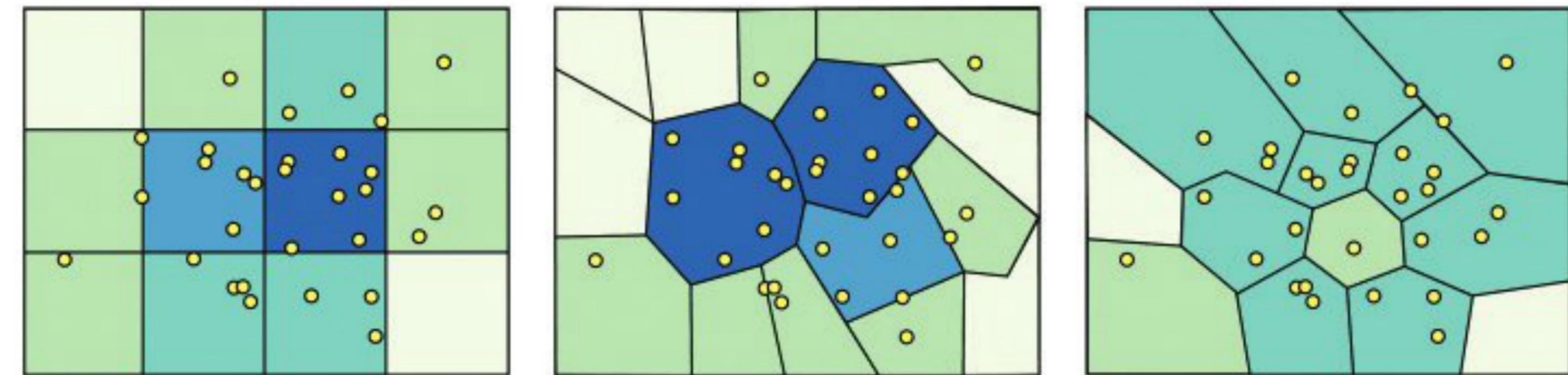


Iris dataset for two types of flowers in two features' space.

Aggregation

Spatial aggregation

→ Collapse by spatial similarity



Warning! boundary definition can dramatically change data analysis

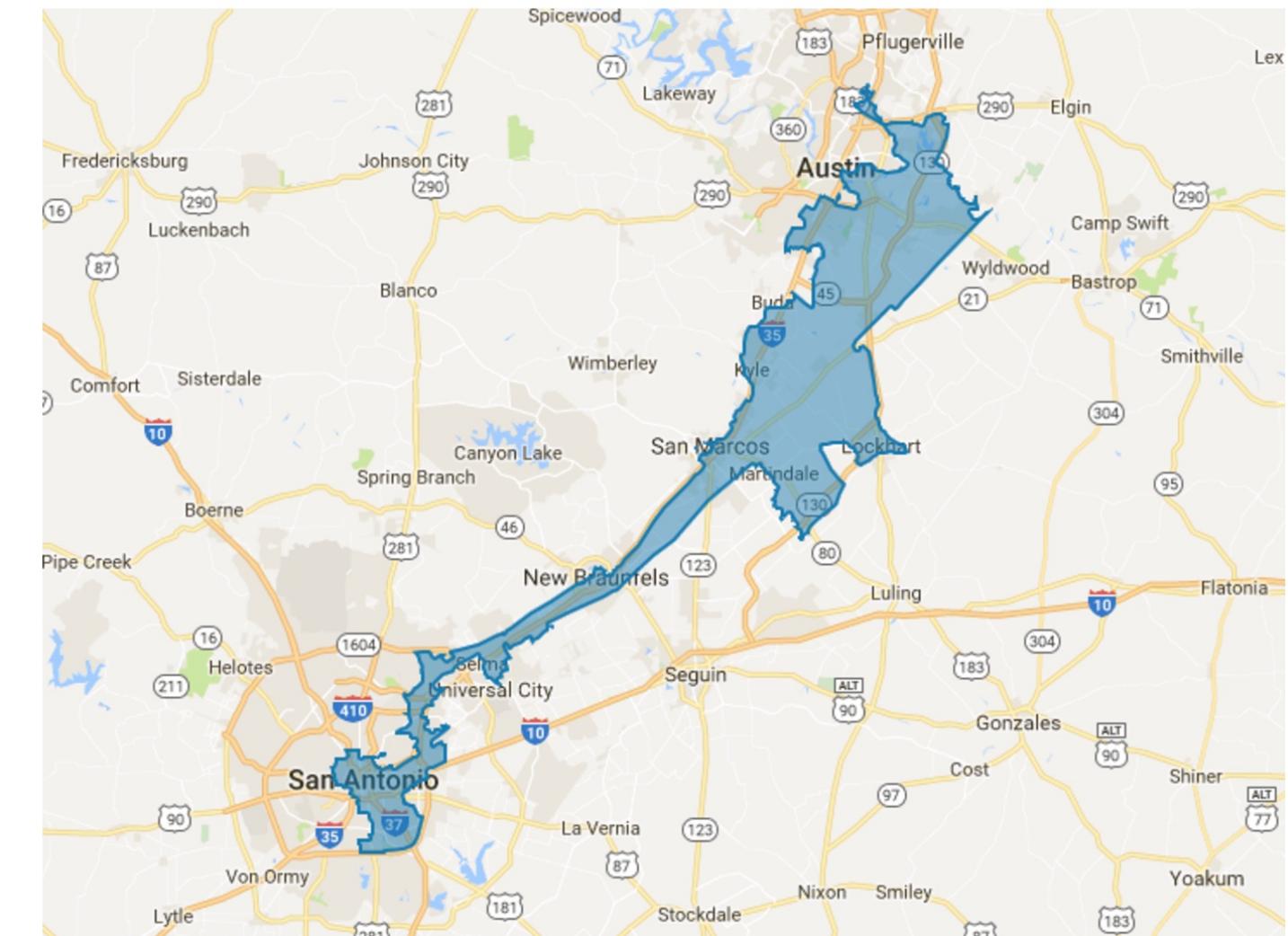
Aggregation

Spatial aggregation
→ Collapse by spatial similarity

Federal Court Rules Three Texas Congressional Districts Illegally Drawn

March 11, 2017 · 5:56 PM ET

LAUREL WAMSLEY 



A federal panel ruled Friday that three of Texas's Congressional districts, including the 35th, shown here, were illegally drawn by the state's Republicans.

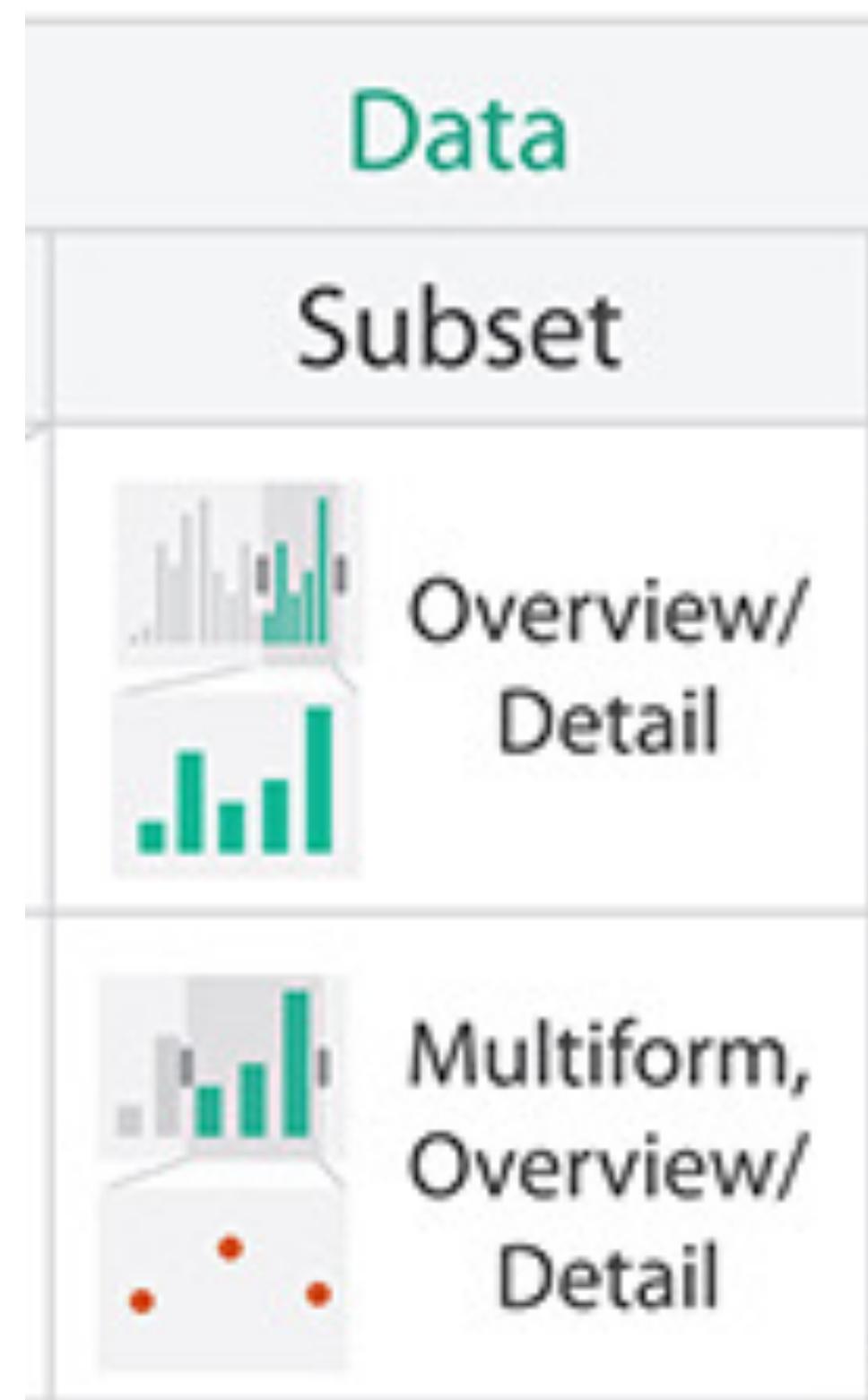
Screengrab by NPR/Google Maps

Gerrymandering

<http://www.npr.org/sections/thetwo-way/2017/03/11/519839892/federal-court-rules-three-texas-congressional-districts-illegally-drawn>

Focus+CONTEXT

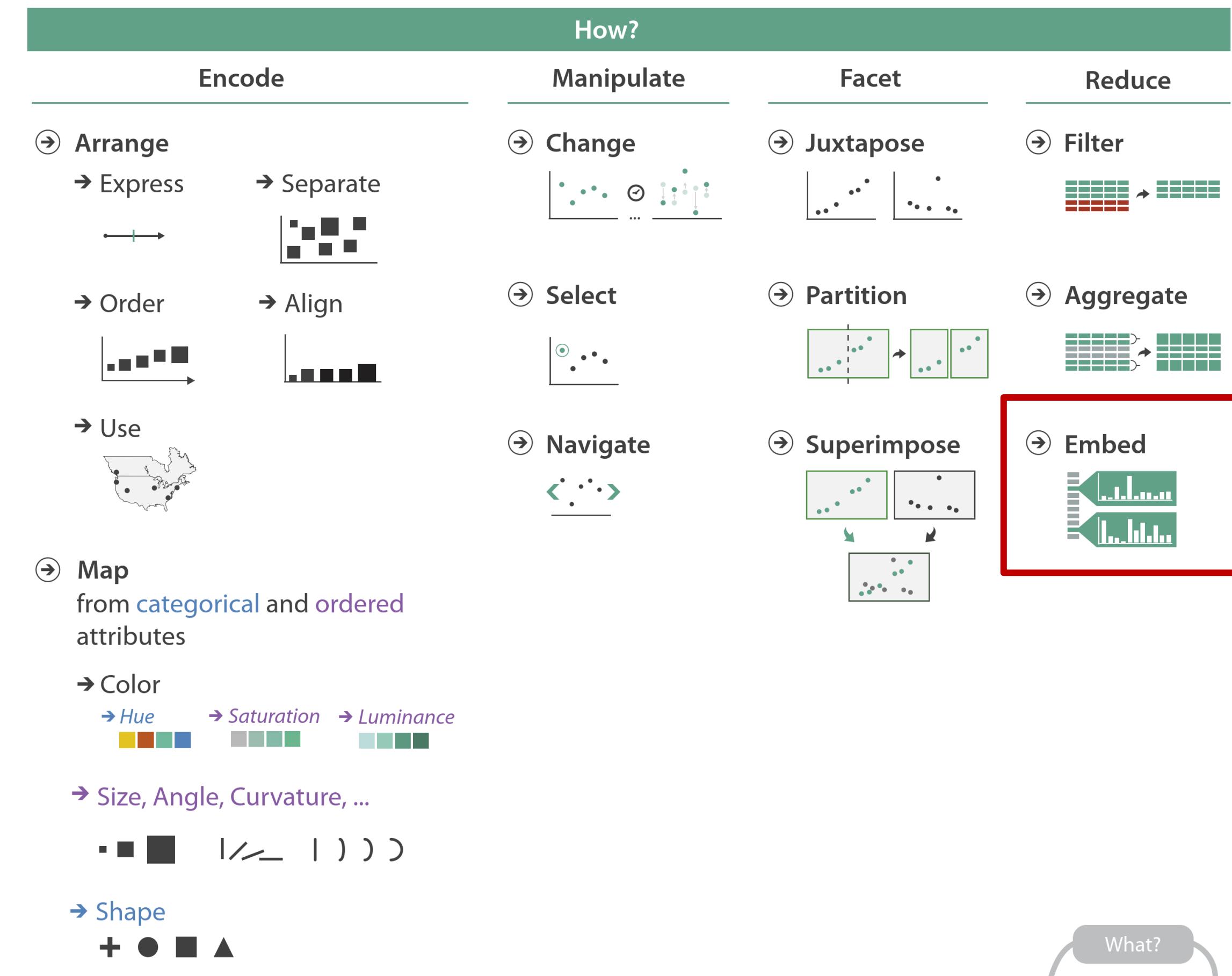
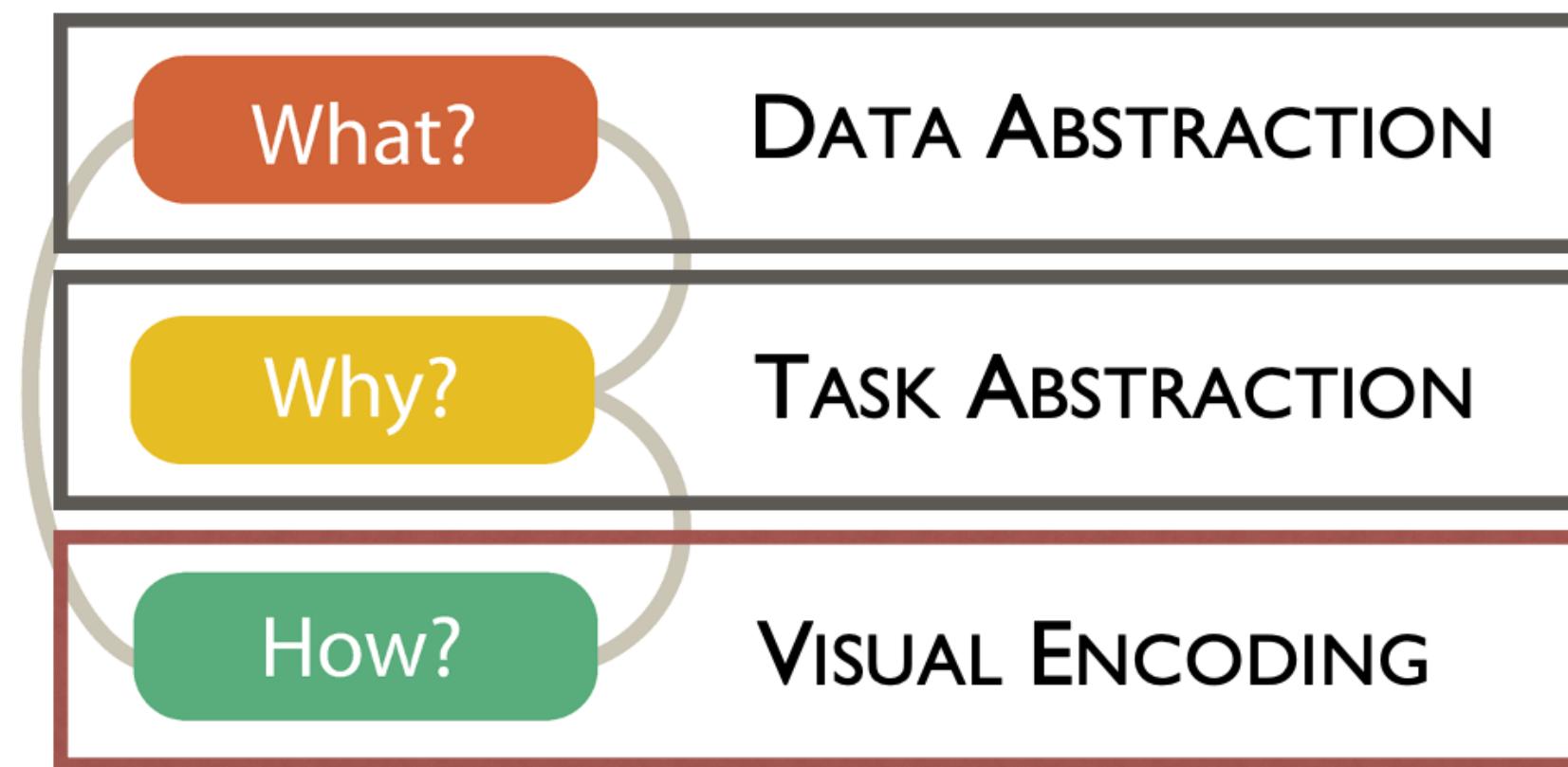
Remember this?



Overview first, zoom and filter, then details-on-demand

- Ben Shneiderman

Munzner's Design Pipeline



Focus + Context

A **Focus+Context visualization** is a visualization designed such that:

- It shows an overview of data (maybe using combined tactics of filtering and aggregation)

AND

- It allows users to select a region of interest within the overview to see more detailed information

Focus + Context

A **Focus+Context visualization** is a visualization designed such that:

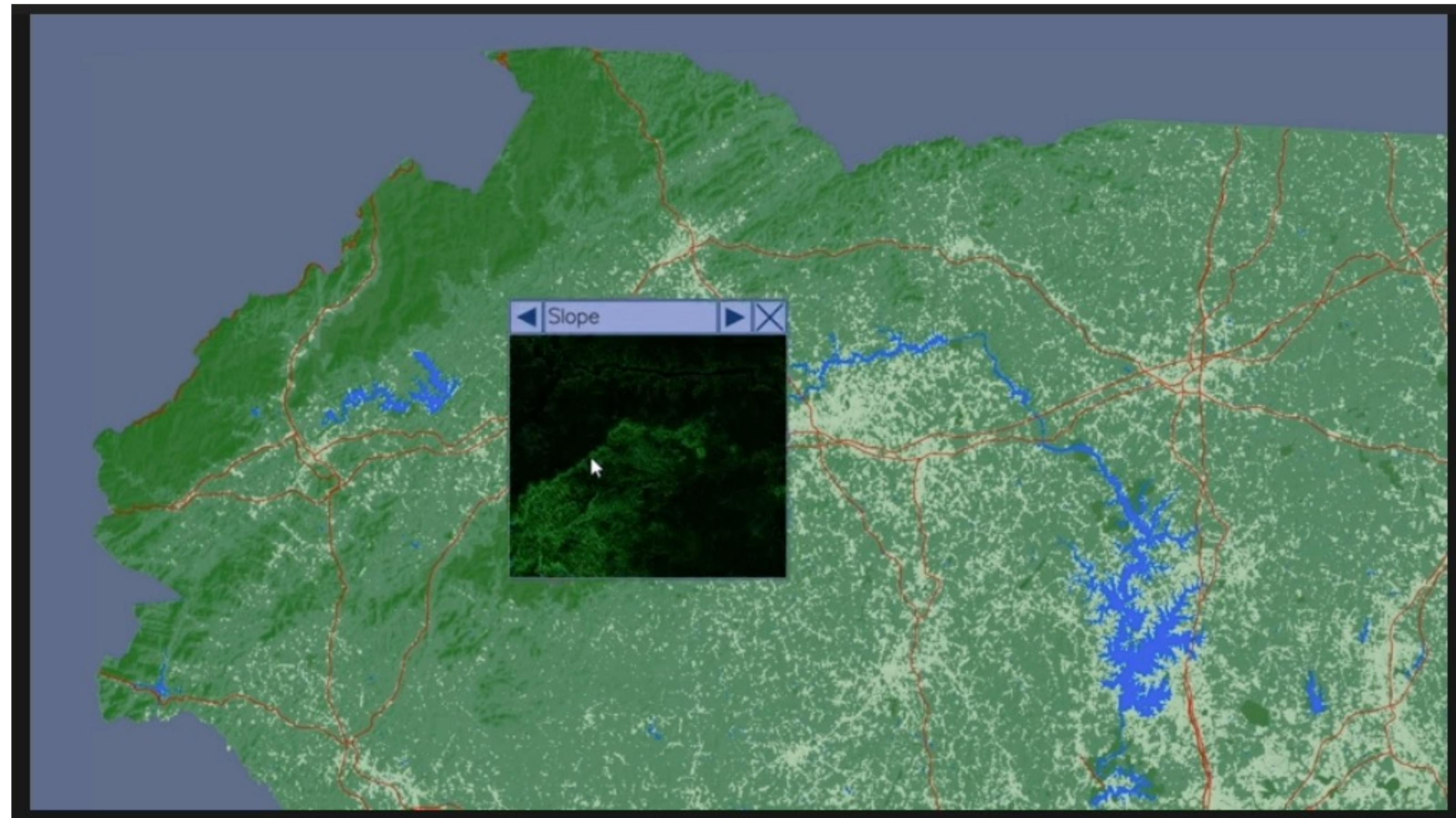
- It shows an overview of data (maybe using combined tactics of filtering and/or aggregation [**Caution: You should carefully pick what to show and hint at what you are not showing**])

AND

- It allows users to select a region of interest within the overview to see more detailed information

Focus + Context

Magic
Lens



https://www.youtube.com/watch?v=uIPq_o67wvI

Based on Slide by M. Meyer

Focus + Context

Jigsaw



<https://www.cc.gatech.edu/gvu/ii/jigsaw/>

Focus + Context

Superstore - Regional Performance



\$2,852,360

Current Year Sales

▲ 27.9% over prior (\$2,230,731)

\$1,795

Yearly Sales Per Customer

▼ 0.9% over prior year (\$1,811)

397

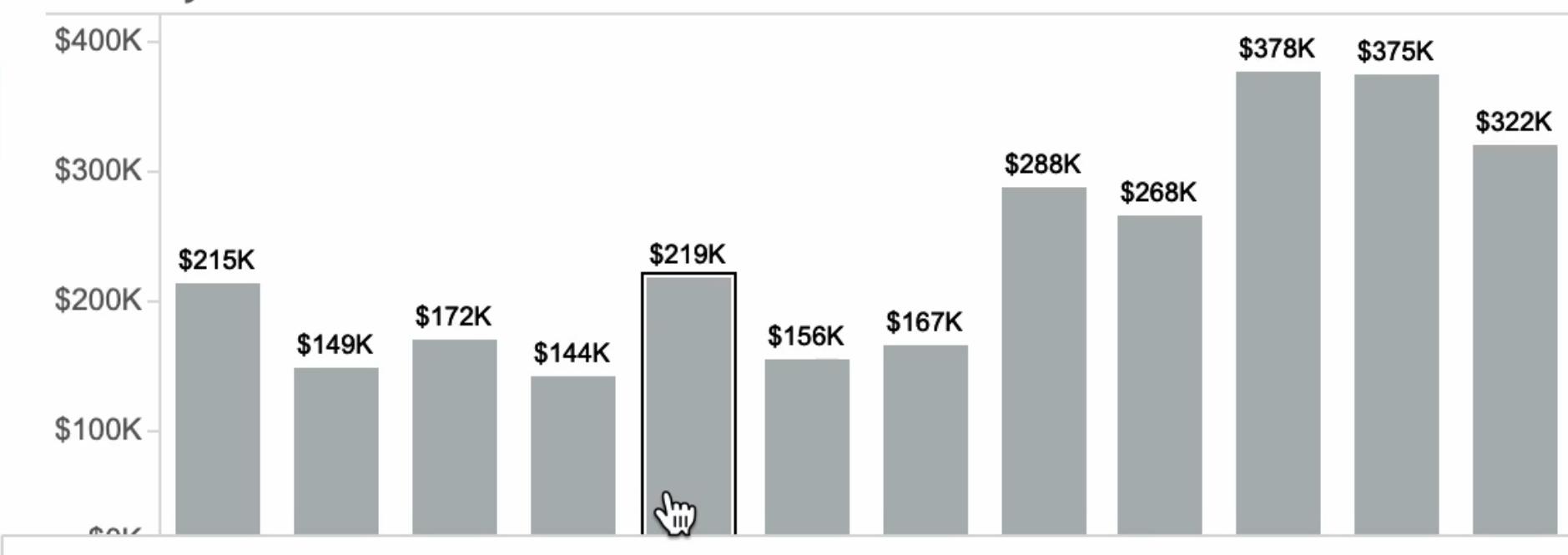
New Customers

▼ 14.1% over prior year (462)

Current Year Sales (click to filter)



Monthly Trend



⋮ + a b | e a u

← → ⌂ ⌄ ⌅ ⌆ ⌇ ⌈ ⌉

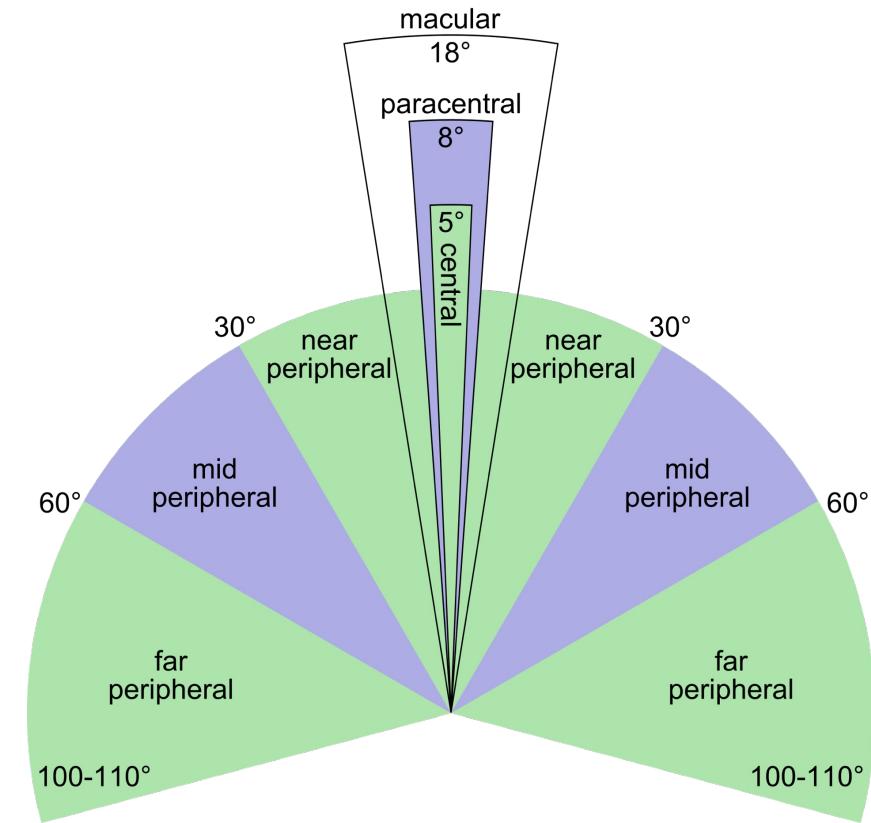
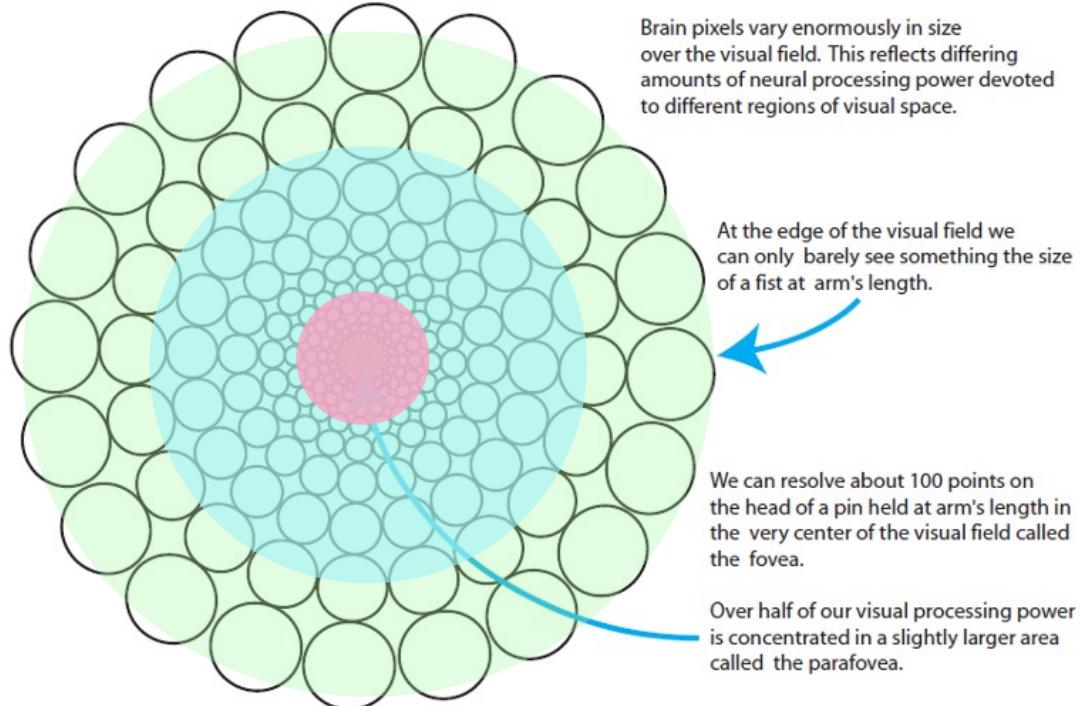
Focus + Context

Why is it effective?

|

Focus + Context

Why is it effective? → Peripheral Vision



Focus + Context

Why is it effective?

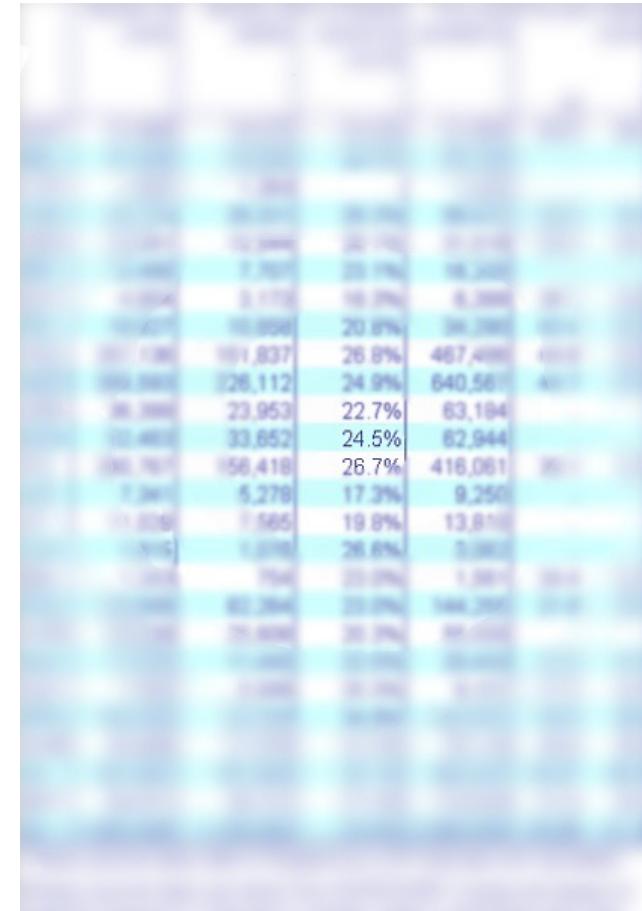


Focus + Context

Why is it effective?

→ Leverages our understanding of human visual focus⁴

→ Aggregate information outside of the user's focus, which would have melted into the periphery anyway



Focus + Context

How?

5

Focus + Context

How?

④ Embed

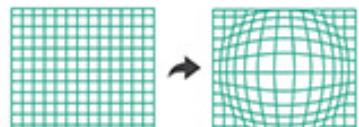
→ Elide Data



→ Superimpose Layer



→ Distort Geometry



Focus + Context

How?

→ Elide Data



7



<http://bl.ocks.org/mbostock/4339083>

Munzner's Book

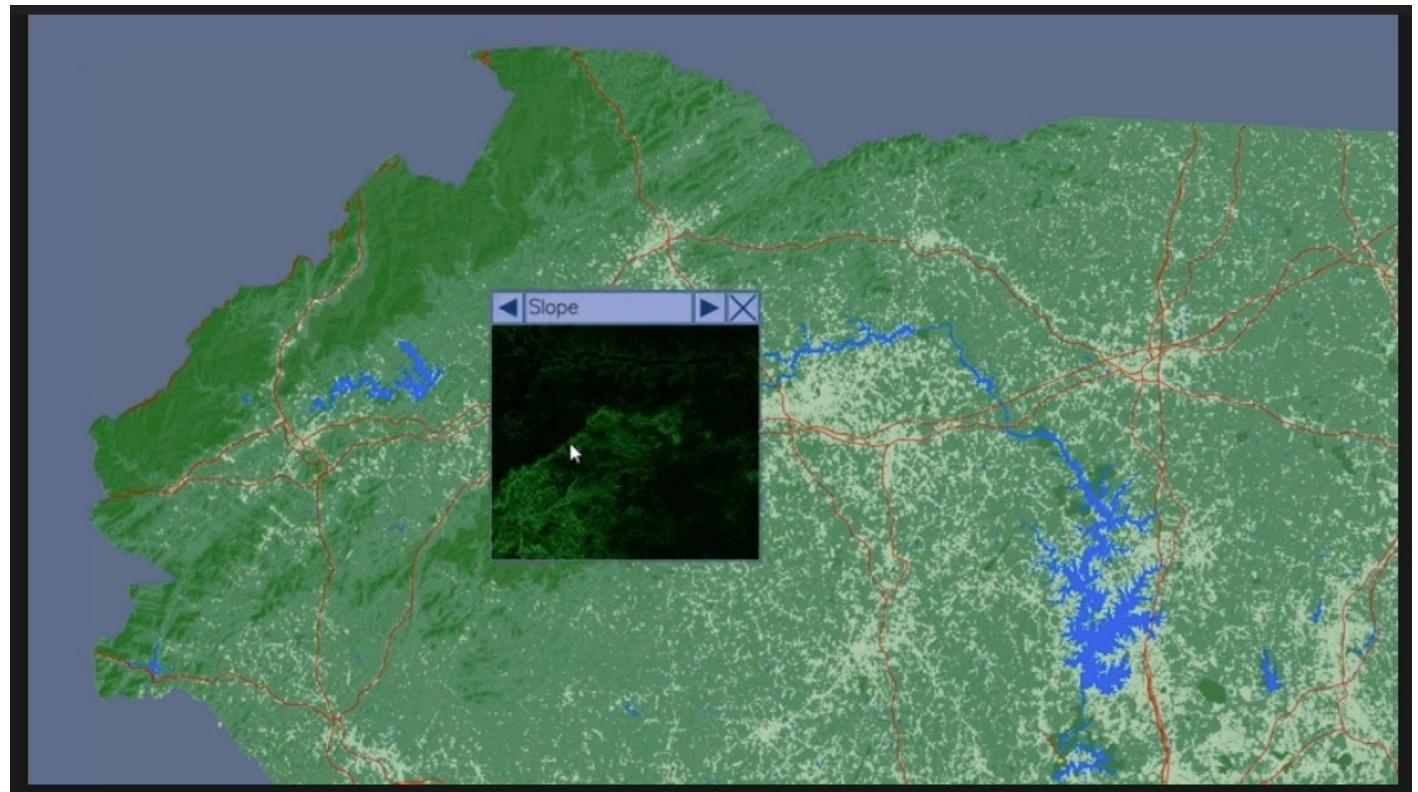
Focus + Context

How?

→ Superimpose Layer



Magic Lens

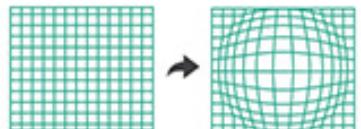


https://www.youtube.com/watch?v=uIPq_o67wI

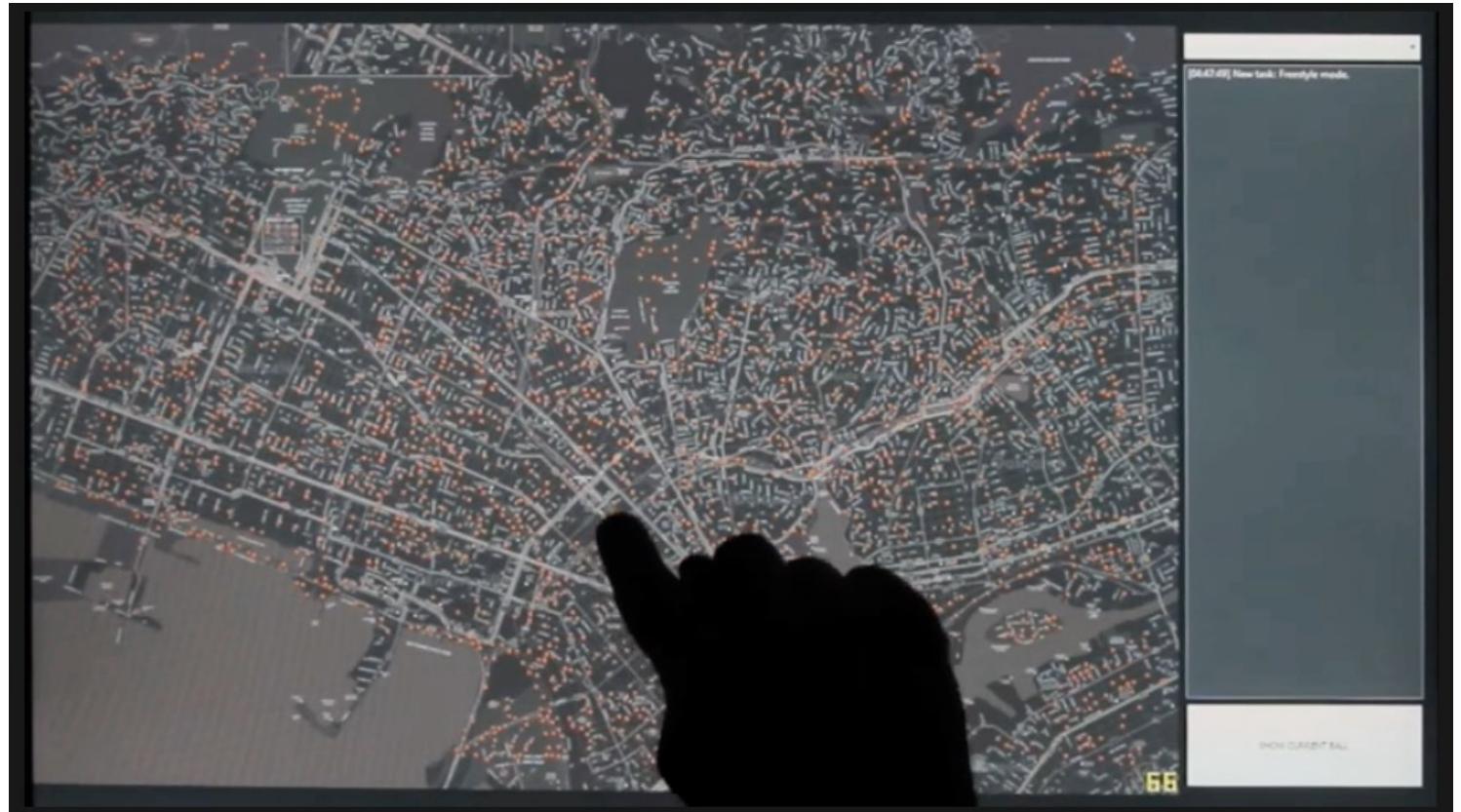
Focus + Context

How?

→ Distort Geometry



FingerGlass



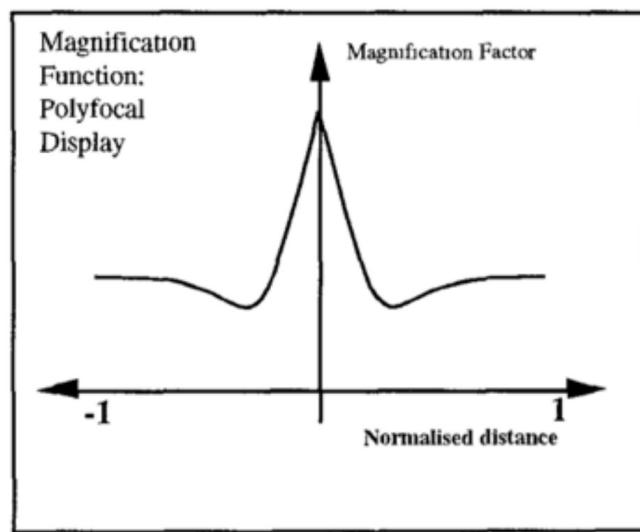
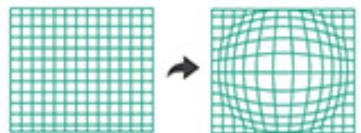
<https://www.youtube.com/watch?v=TzfXNlJtxFg>

Munzner's Book

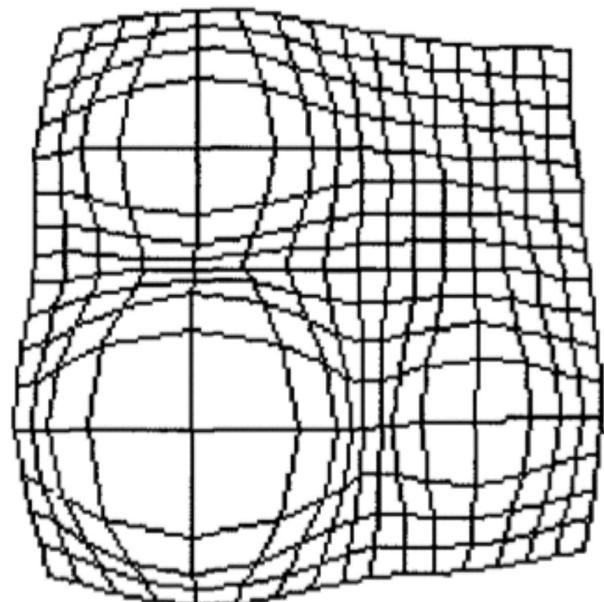
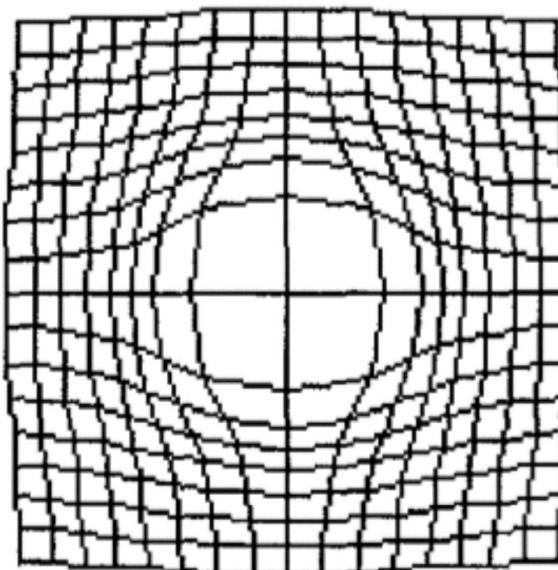
Focus + Context

How?

→ Distort Geometry



Fisheye Lens

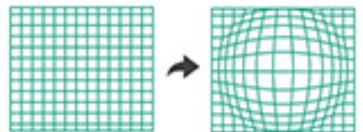


[Leung & Apperley, 1994](#)

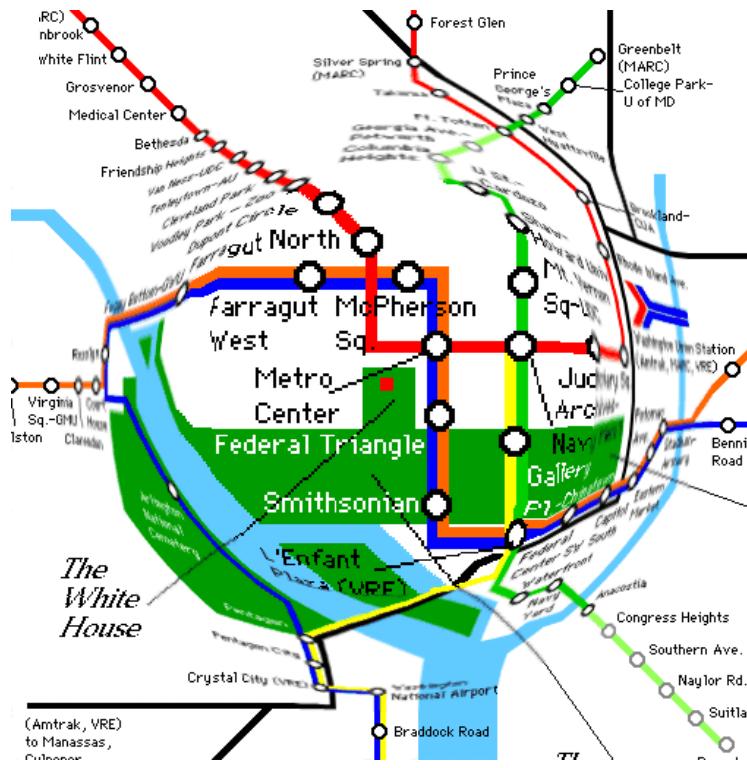
Focus + Context

How?

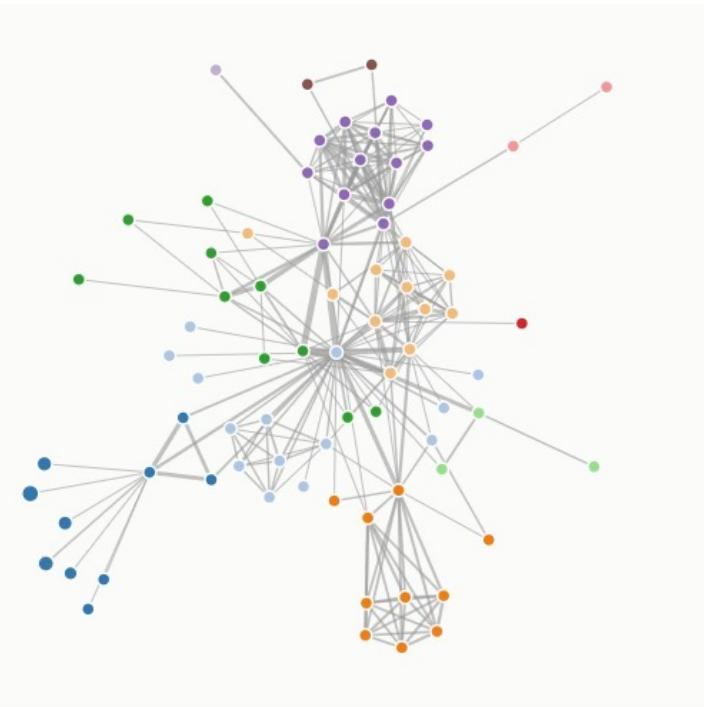
→ Distort Geometry



Fisheye Lens



[http://www.cs.umd.edu/class/fall2002/cmsc838s/
tichi/fisheye.html](http://www.cs.umd.edu/class/fall2002/cmsc838s/tichi/fisheye.html)



<https://bost.ocks.org/mike/fisheye/>

Summary

Today we:

- Reviewed Filtering and Aggregation
- Reviewed Focus+Context Designs

12

ic-11 is DUE today.
pm-02 is OUT today.