Lesson 3:
Interactivity in Visual Analytics

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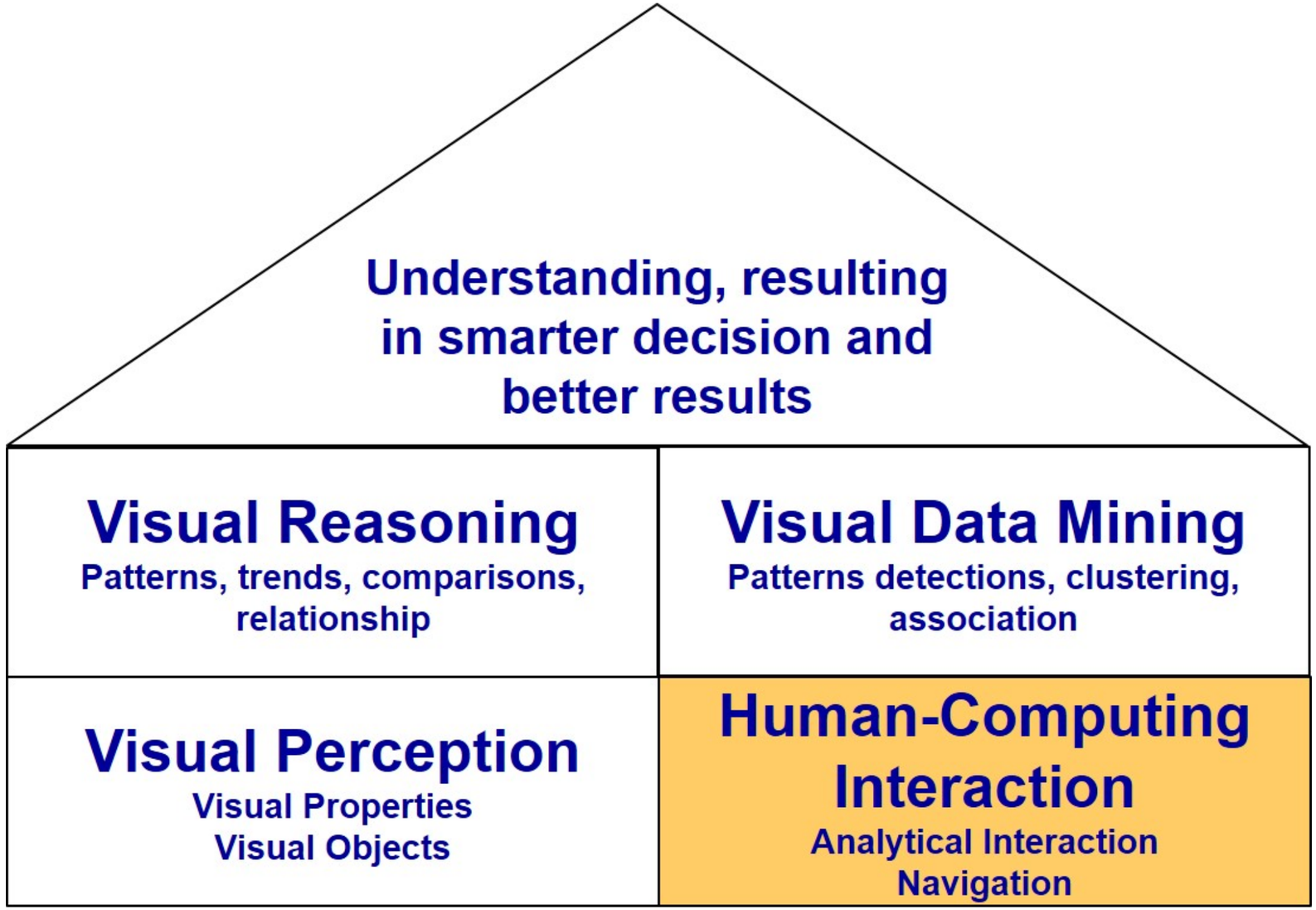
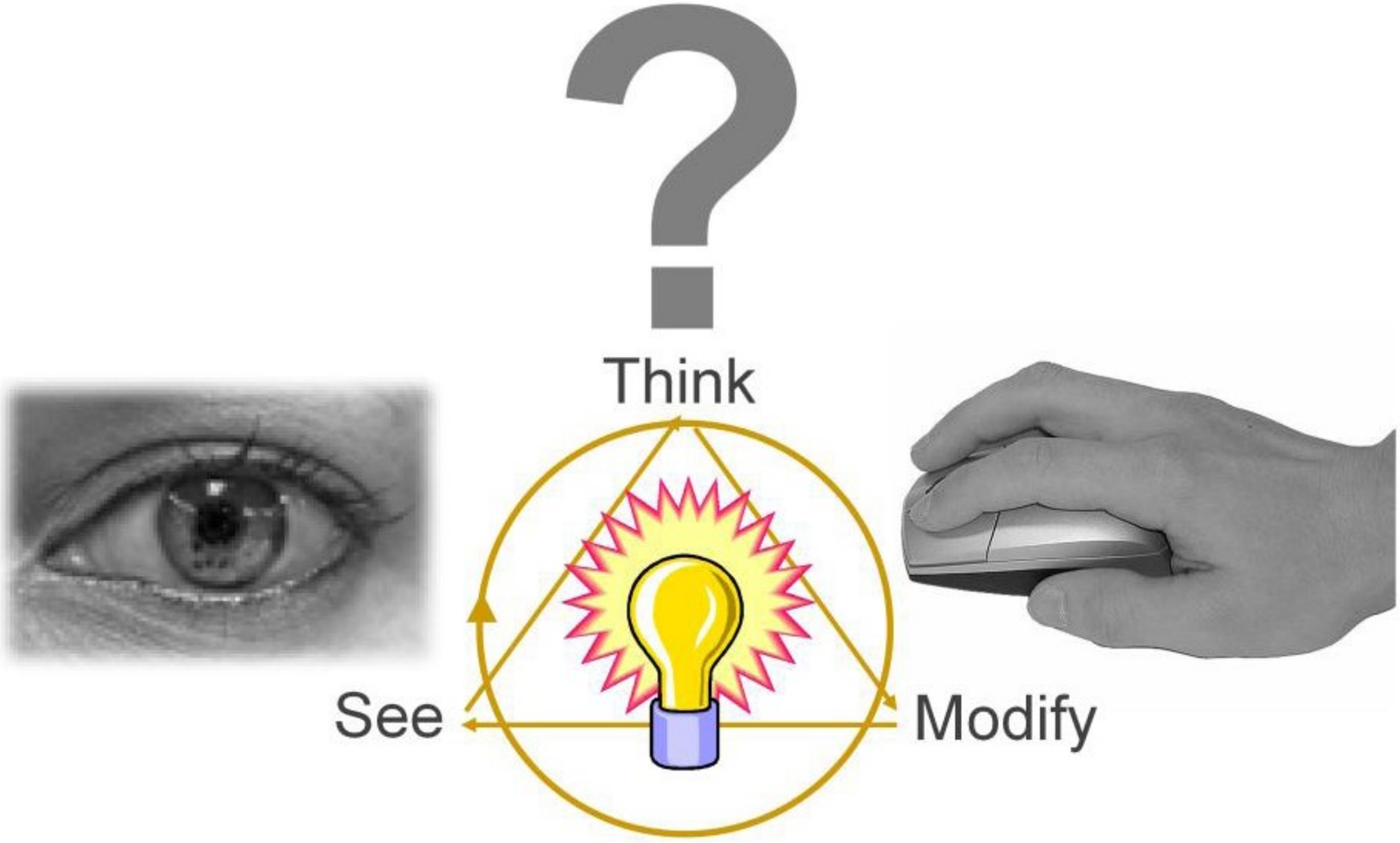
What will you learn from this lesson?

- Typology of Interactive Techniques
  - Data & view specification
  - View Manipulation
  - Process and Provenance
- Interactive Design Primitive
- Animation: Principles and Best Practices

Building Block of Visual Analytics



Revisiting Visual Analytics Framework



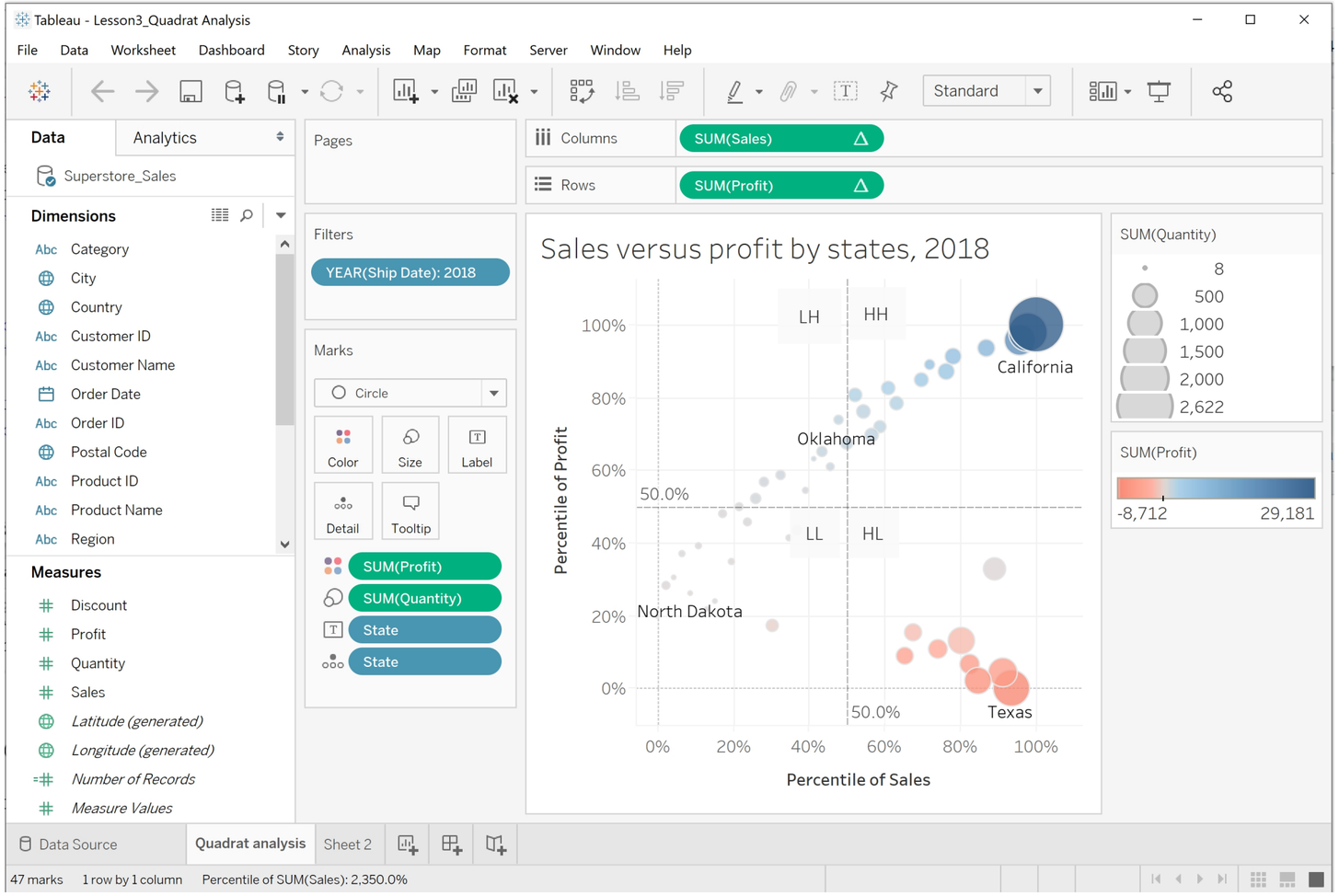
Taxonomy of Interactive Dynamics

Data and View Specification	**Visualize** data by choosing visual encodings.
	Filter out data to focus on relevant items.
	Sort items to expose patterns.
	Derive values or models from source data.
View Manipulation	**Select** items to highlight, filter, or manipulate them.
	Navigate to examine high-level patterns and low-level detail.
	Coordinate views for linked, multidimensional exploration.
	Organize multiple windows and workspaces.
Process and Provenance	**Record** analysis histories for revisitation, review, and sharing.
	Annotate patterns to document findings.
	Share views and annotations to enable collaboration.
	Guide users through analysis tasks or stories.

Source: Heer, J. & Shneiderman, B. (2012) "Interactive Dynamics for Visual Analytics" ***ACM Queue***, Vol. 55, No. 4, pp 45-54.

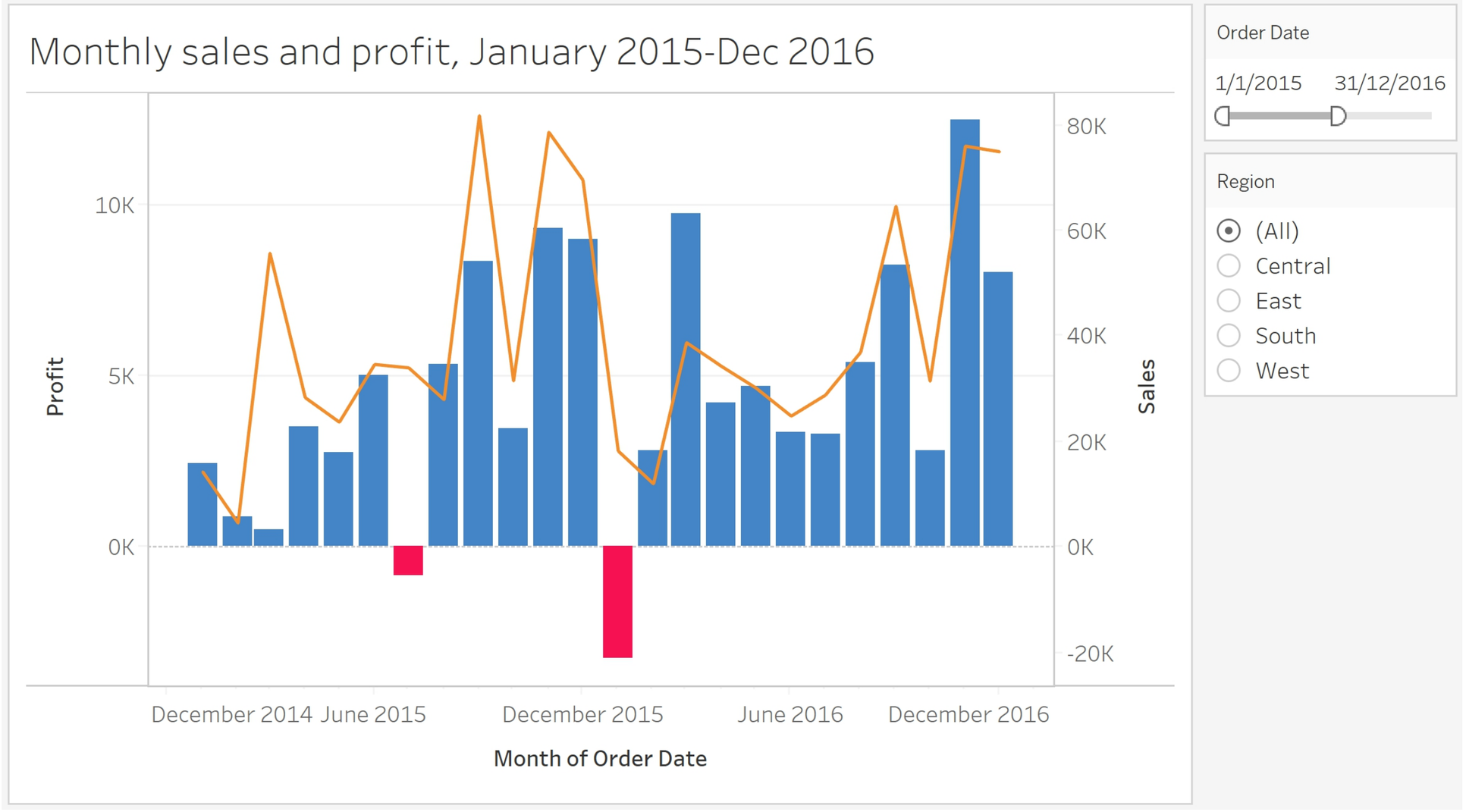
Data & view specification

- **Visualise** data by choosing visual encodings.
- **Polaris** of Tableau



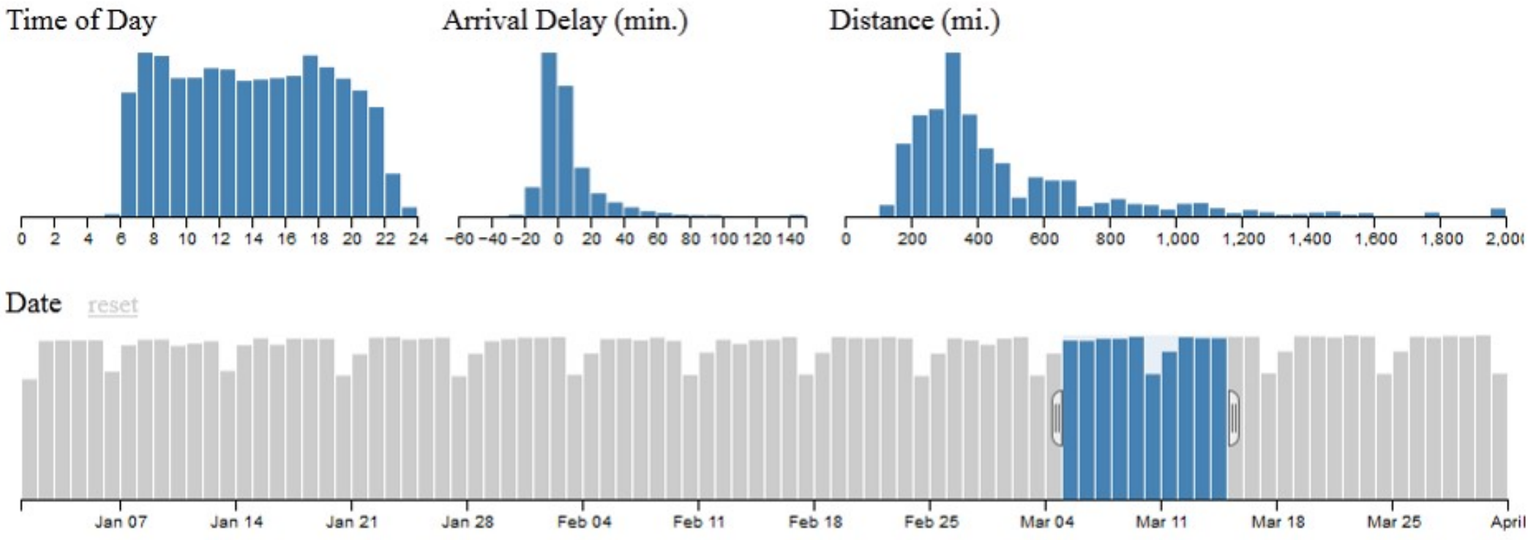
Data & view specification

- **Filter** out data to focus on relevant items.



Data & view specification

- **Slicer** is an axis-parallel selection tool, which selects a range along an axis, where the end-point of the interval can be modified dynamically.



March 14, 2001

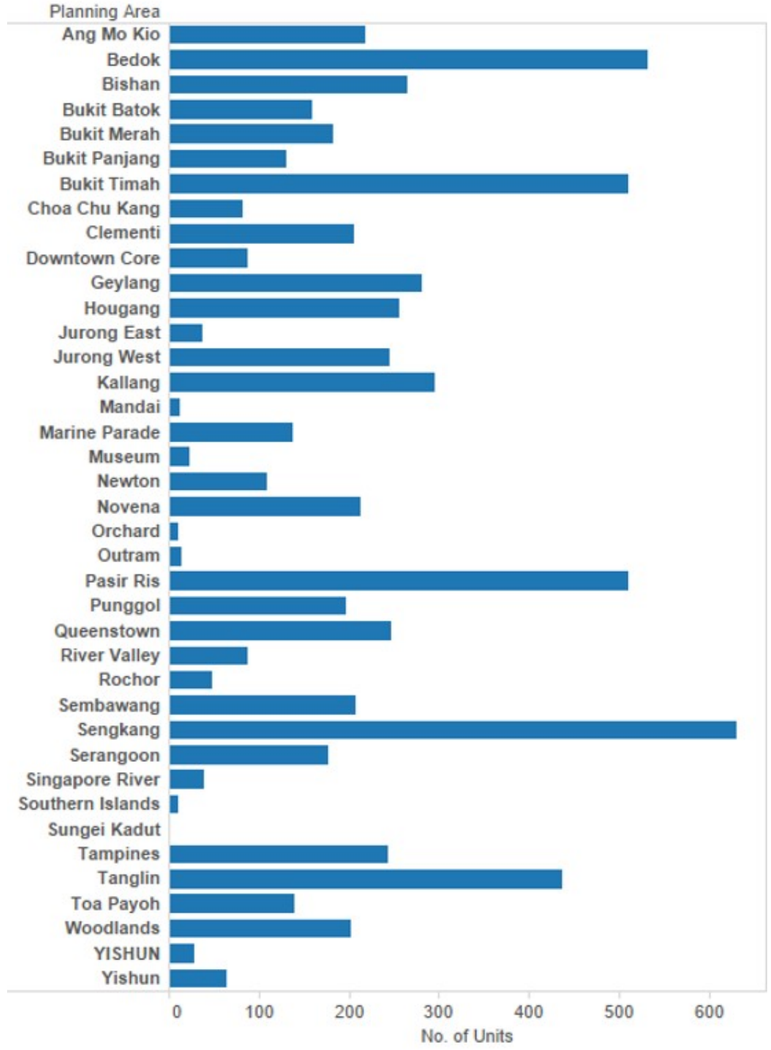
04:38 PM	ONT	SMF	389 mi.	+3 min.
11:50 PM	MDW	BWI	611 mi.	+186 min.
11:50 PM	MCI	MDW	405 mi.	−10 min.
11:49 PM	STL	MDW	251 mi.	+45 min.

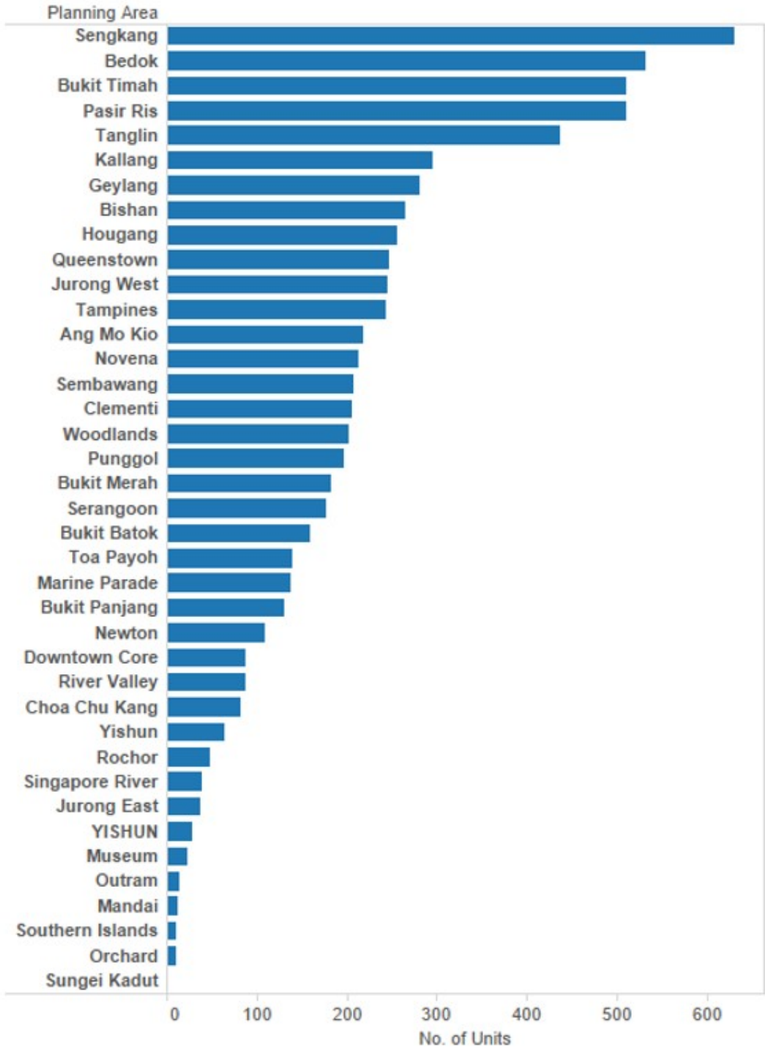
26,093 of 231,083 flights selected.

Source: crossfilter

Data & view specification

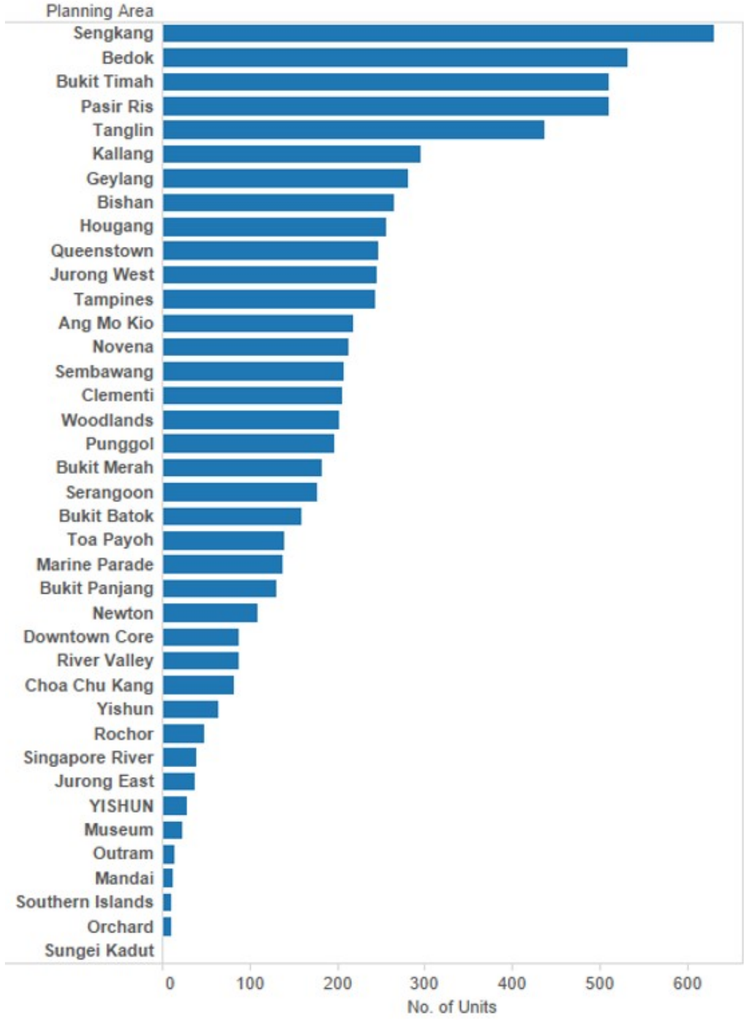
- **Sort** items to expose patterns.

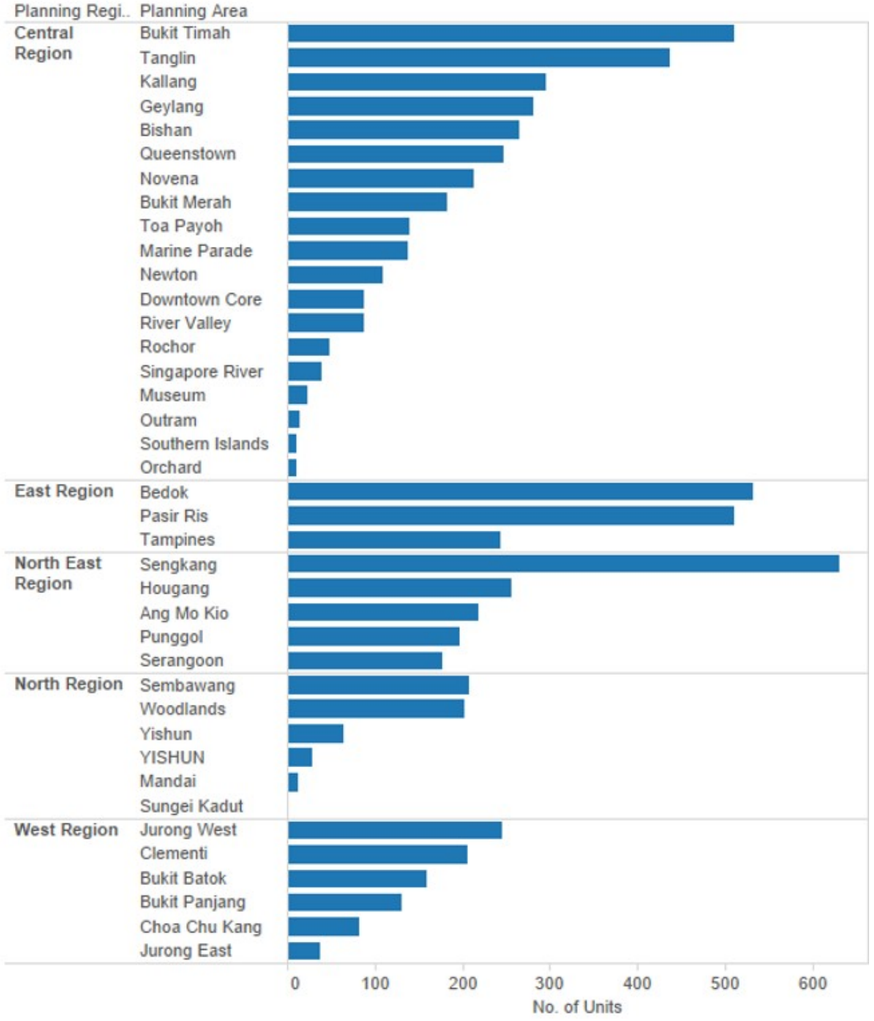




Data & view specification

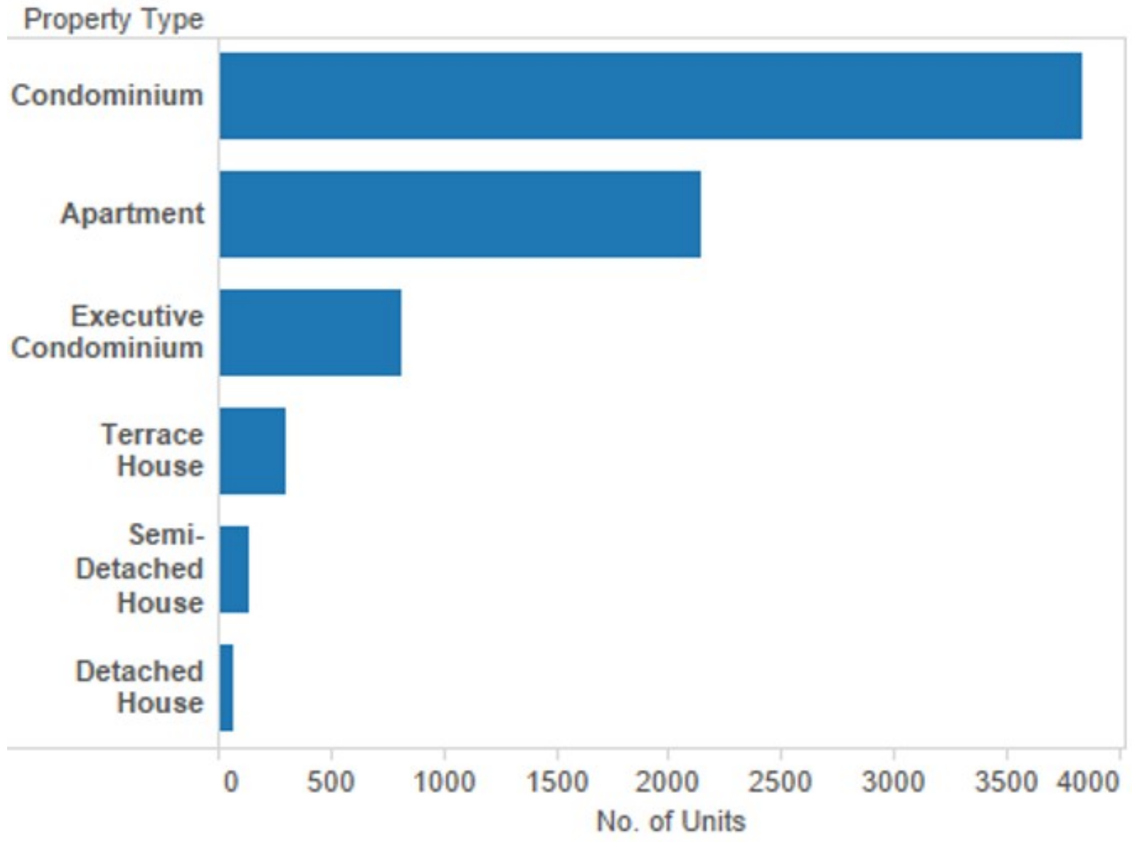
- Hierarchical sorting

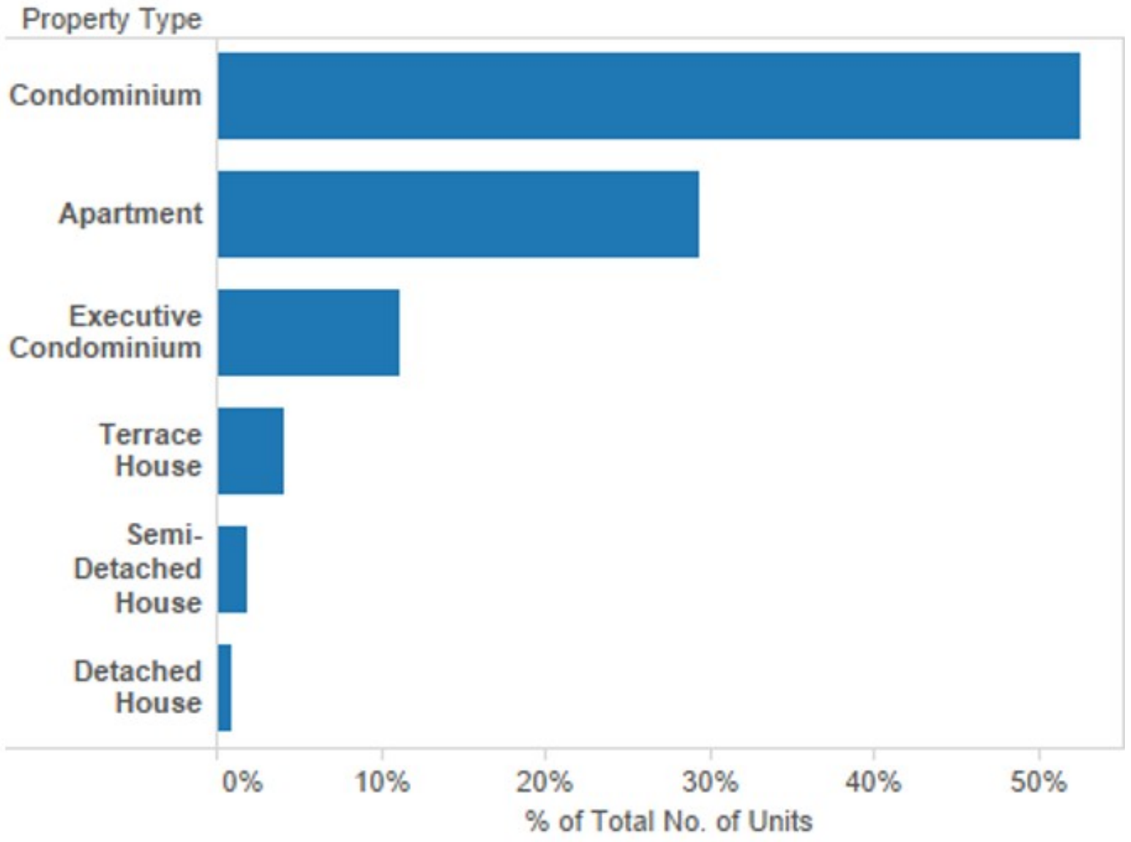




Data & view specification

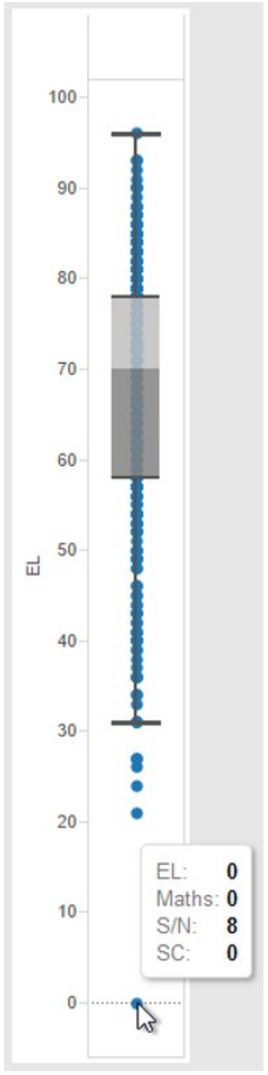
- **Derive** values or models from source data.

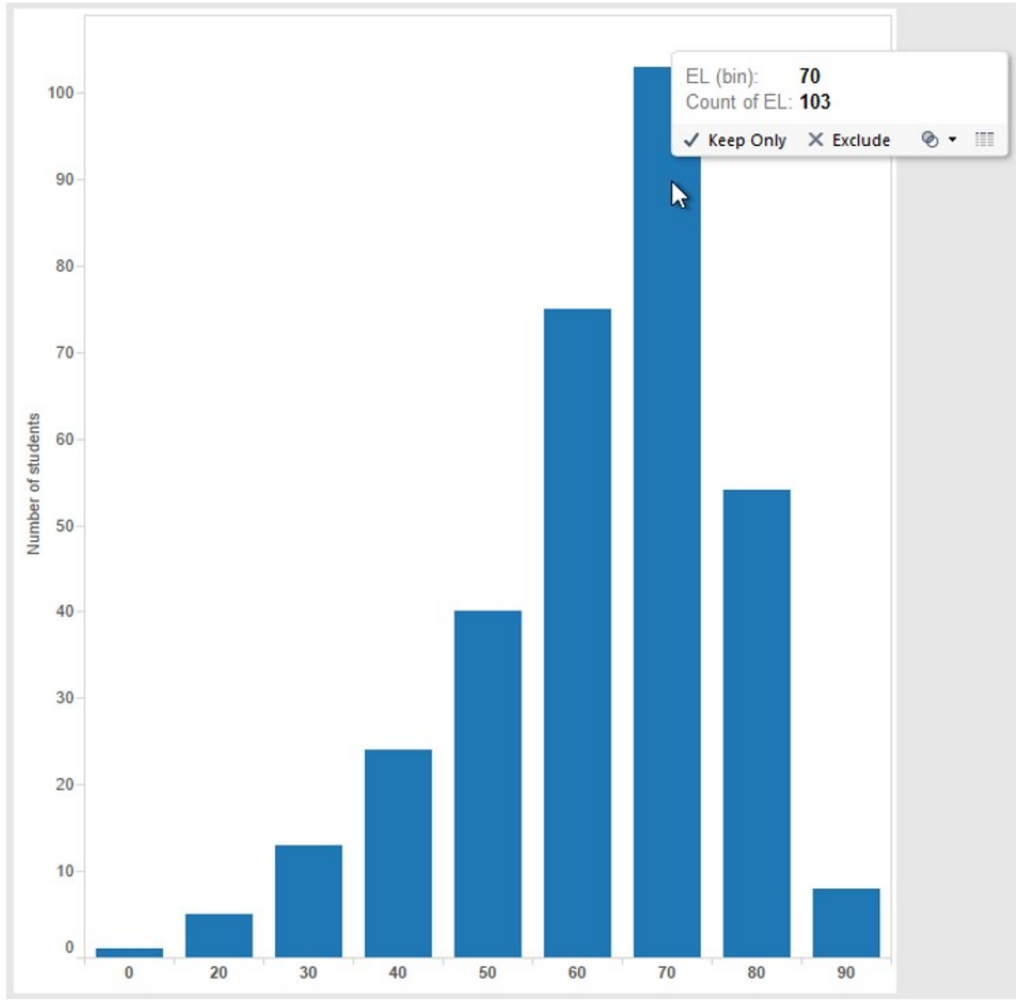




View Manipulation: Selection functions

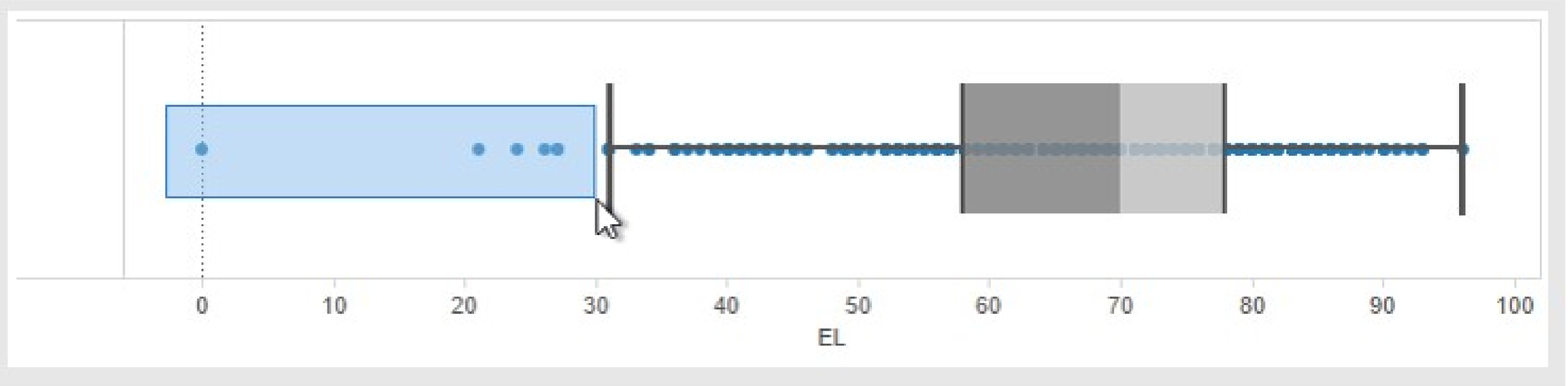
- **Pointer** selects a single object in a plot.





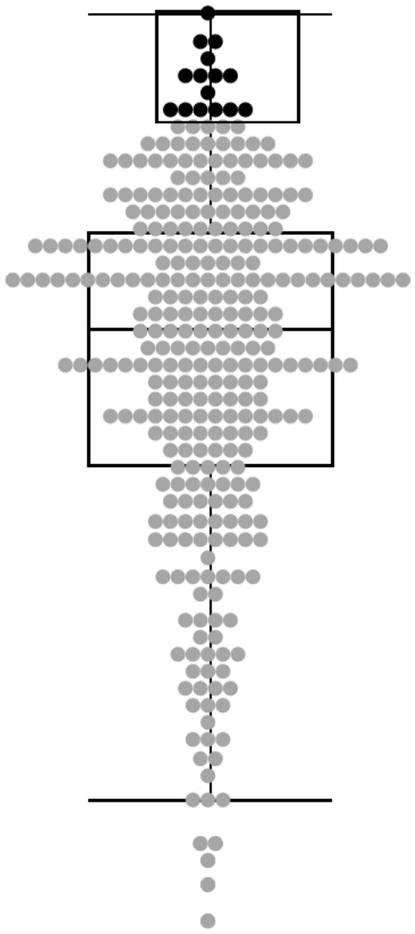
View Manipulation: Selection functions

- **Drag-box** selects a rectangular region in a box.



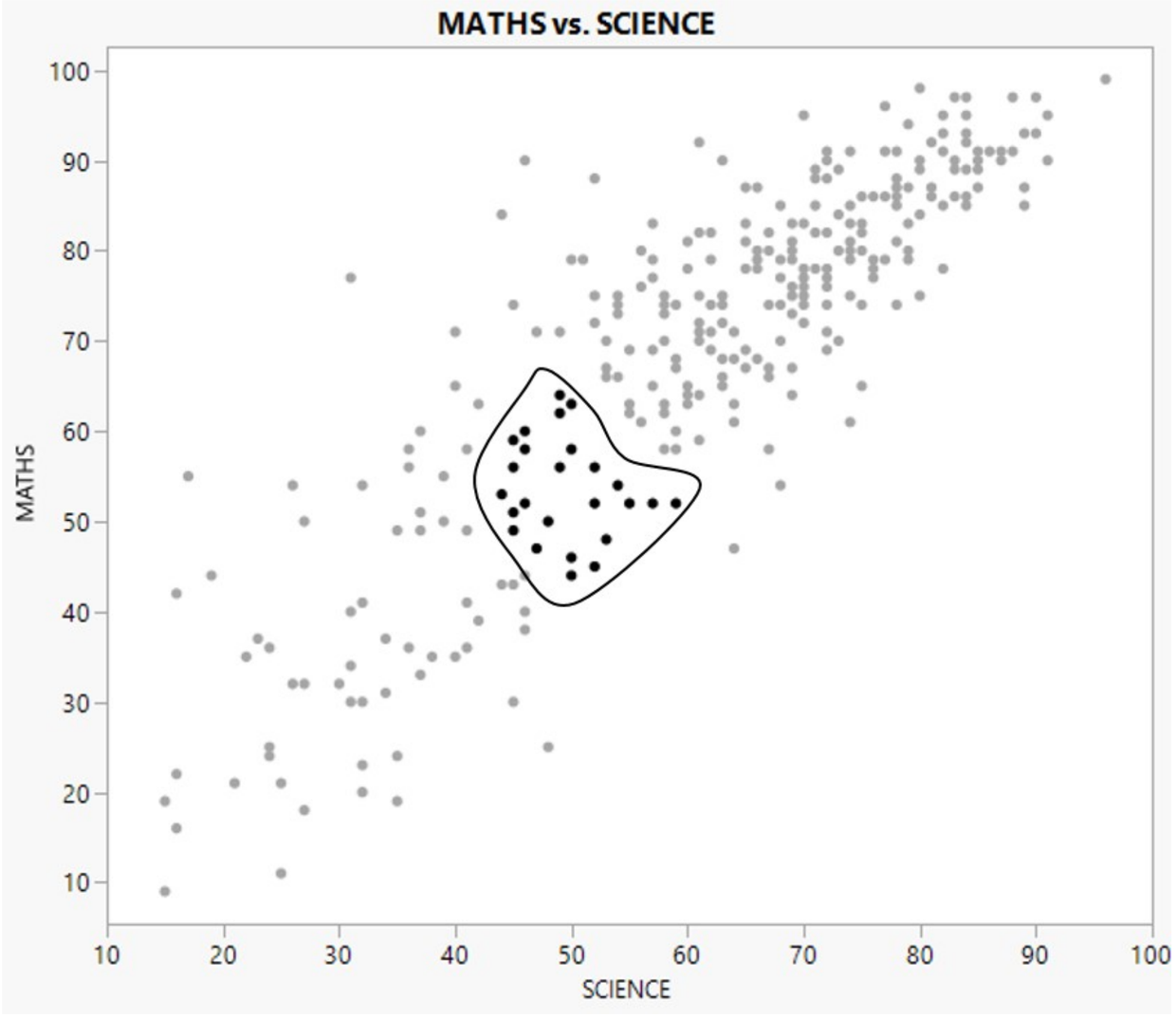
View Manipulation: Selection functions

- **Brush** is a generalisation of the drag-box. Once a rectangular region is define, the brush allows users to move that region across a plot and thus dynamically change the selected subset.

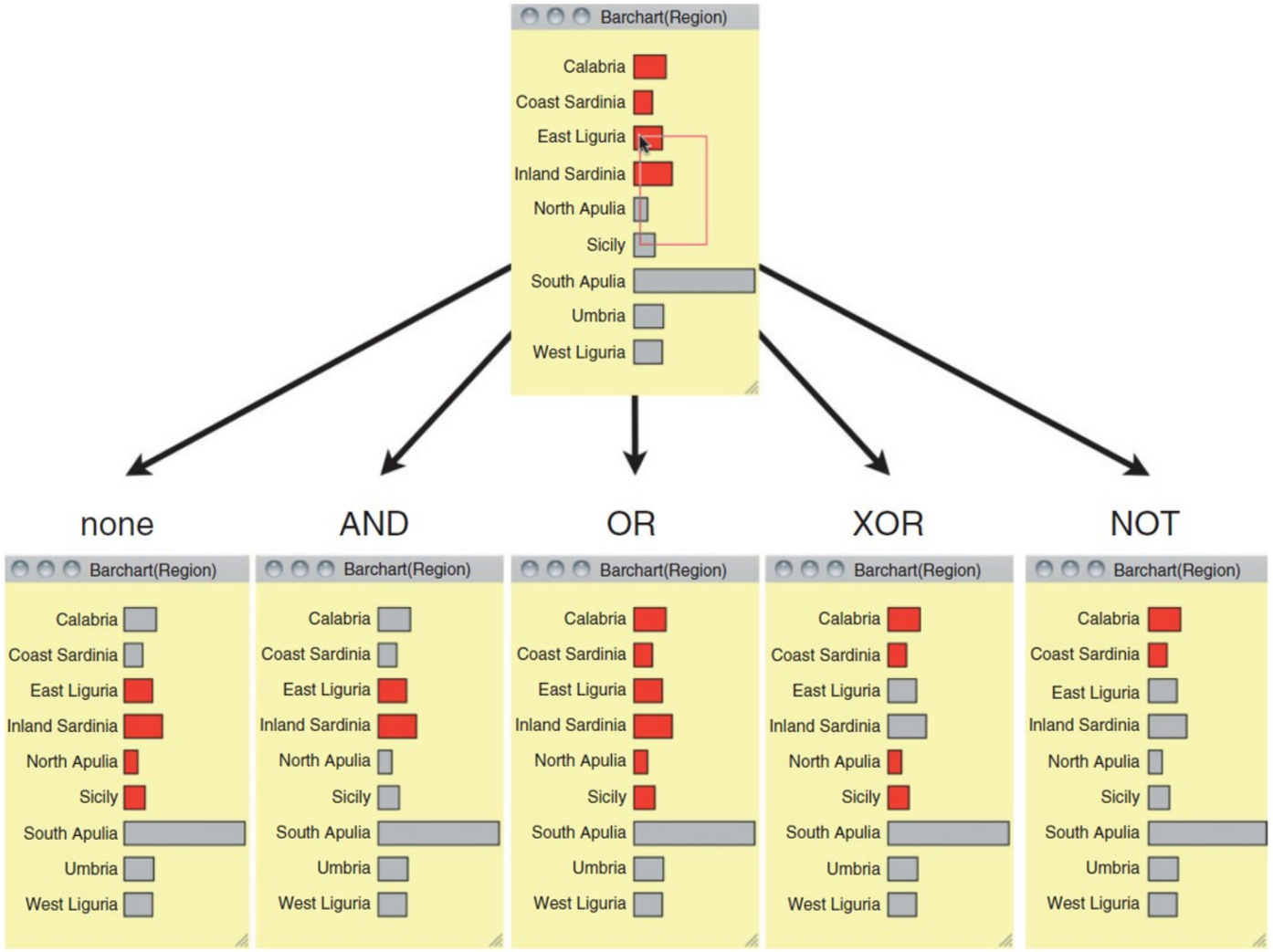


View Manipulation: Selection functions

- **Lasso** allows users to define an arbitrary contiguous shape to select data.



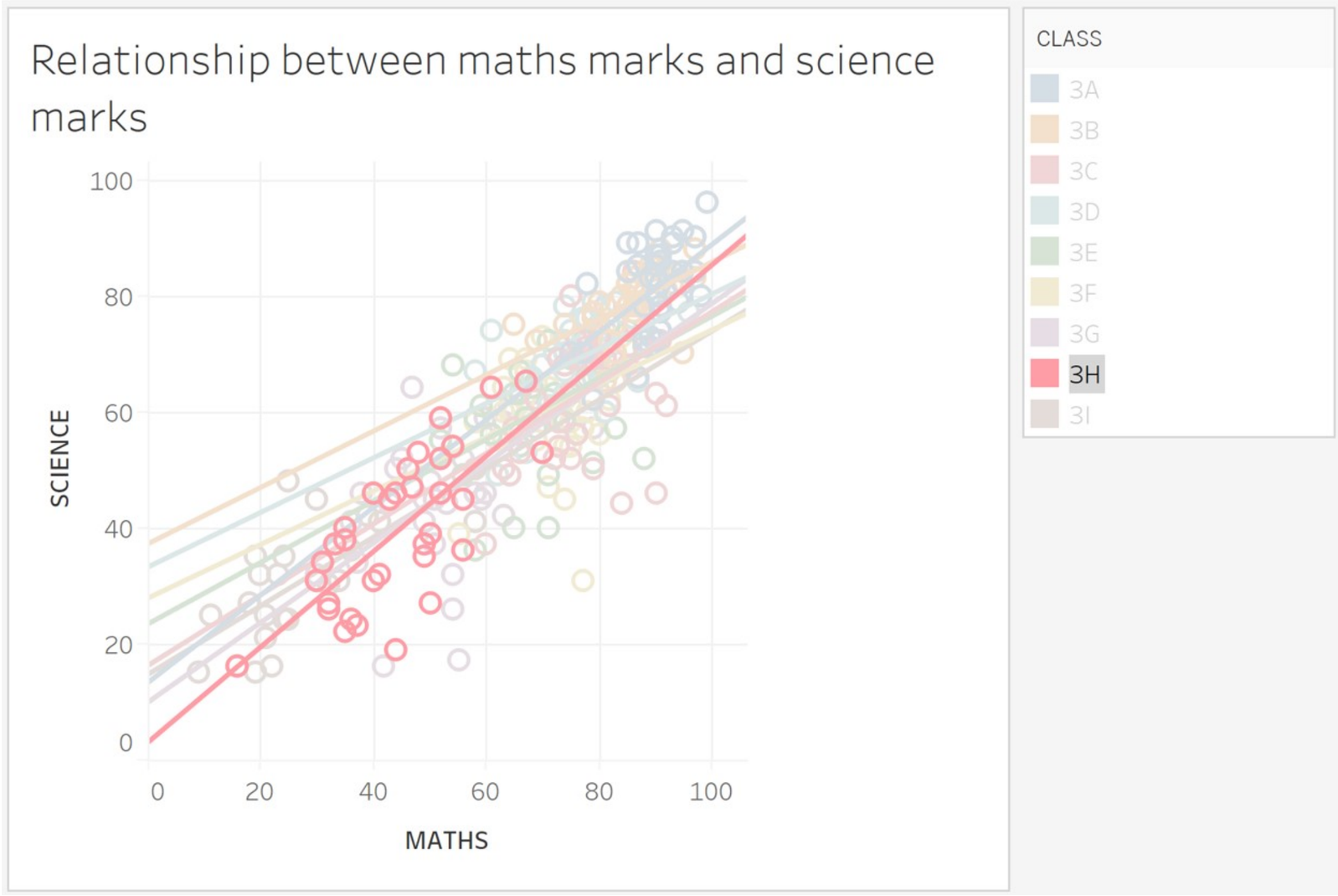
View Manipulation: Selection modes



Reference: Mondrian

View Manipulation: Highlighting

- Selected records are highlighted.



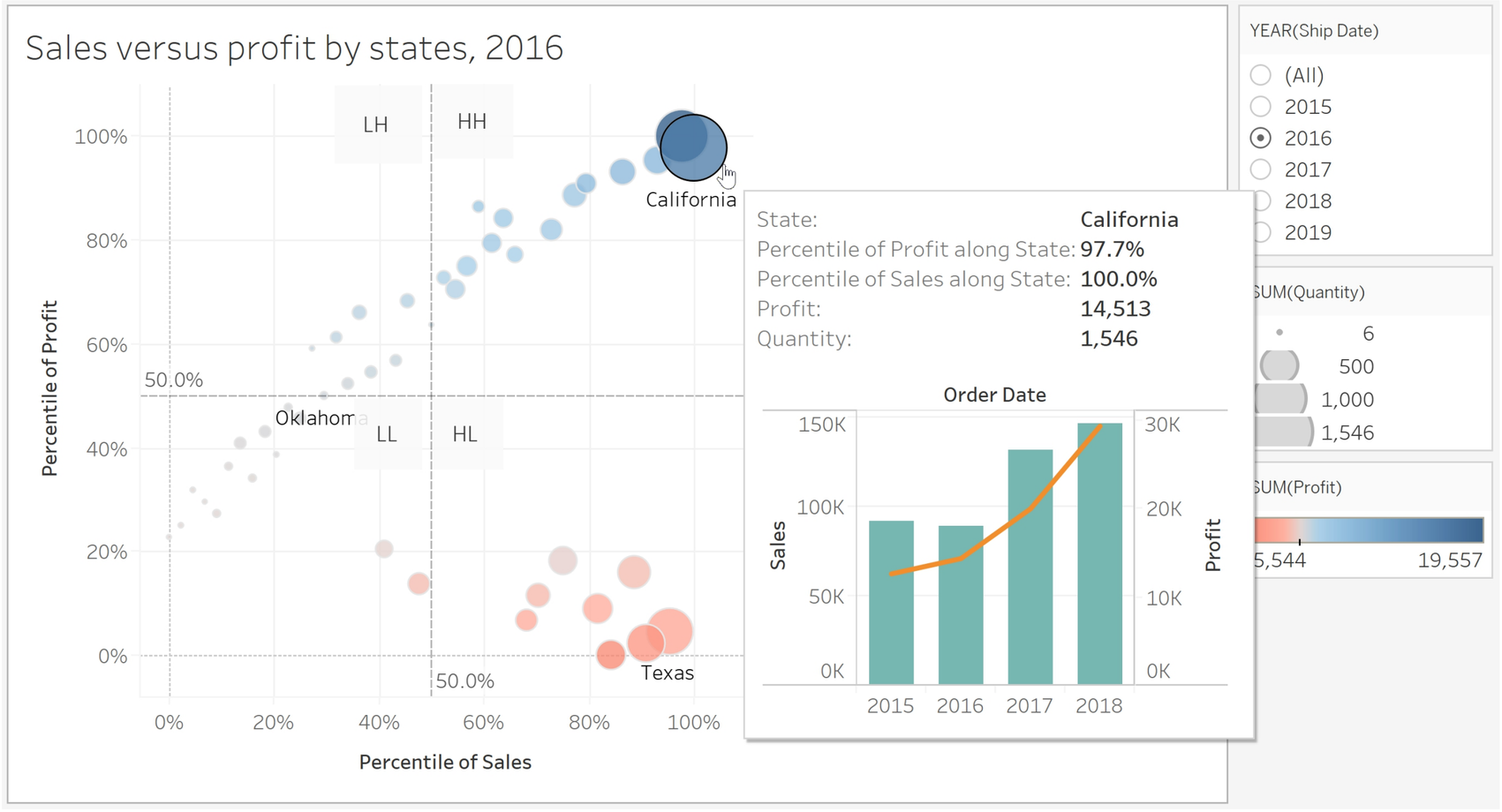
View Manipulation

- **Navigate** to examine high-level patterns and low-level detail.
- Shneiderman’s mantra

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

View Manipulation

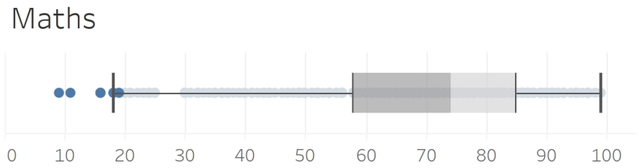
- The scatter plot provides an overview and the bar and line graphs provide detail sales and profits trends overtime.

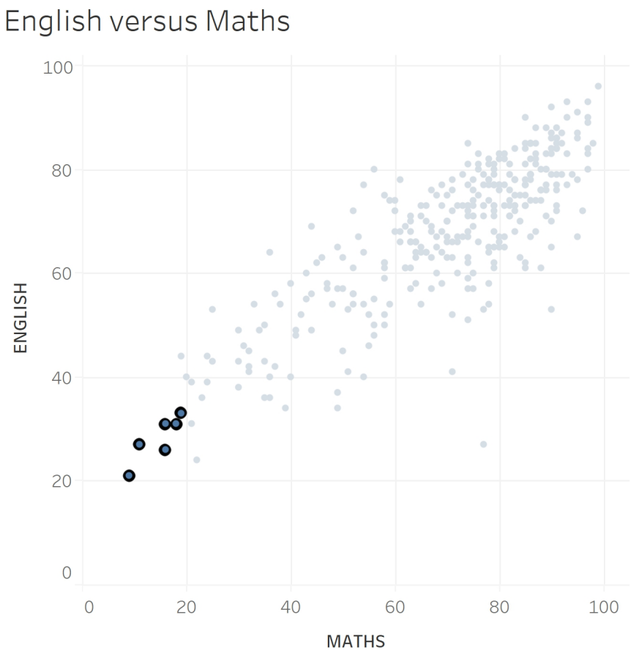


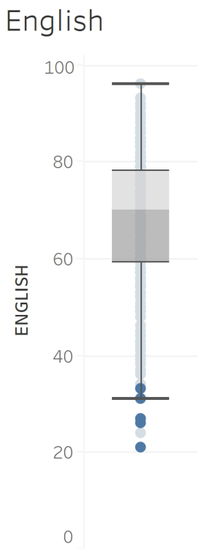
View Manipulation

- **Coordinate** views for linked, multi-dimensional exploration

Scatterplot with marginal boxplot

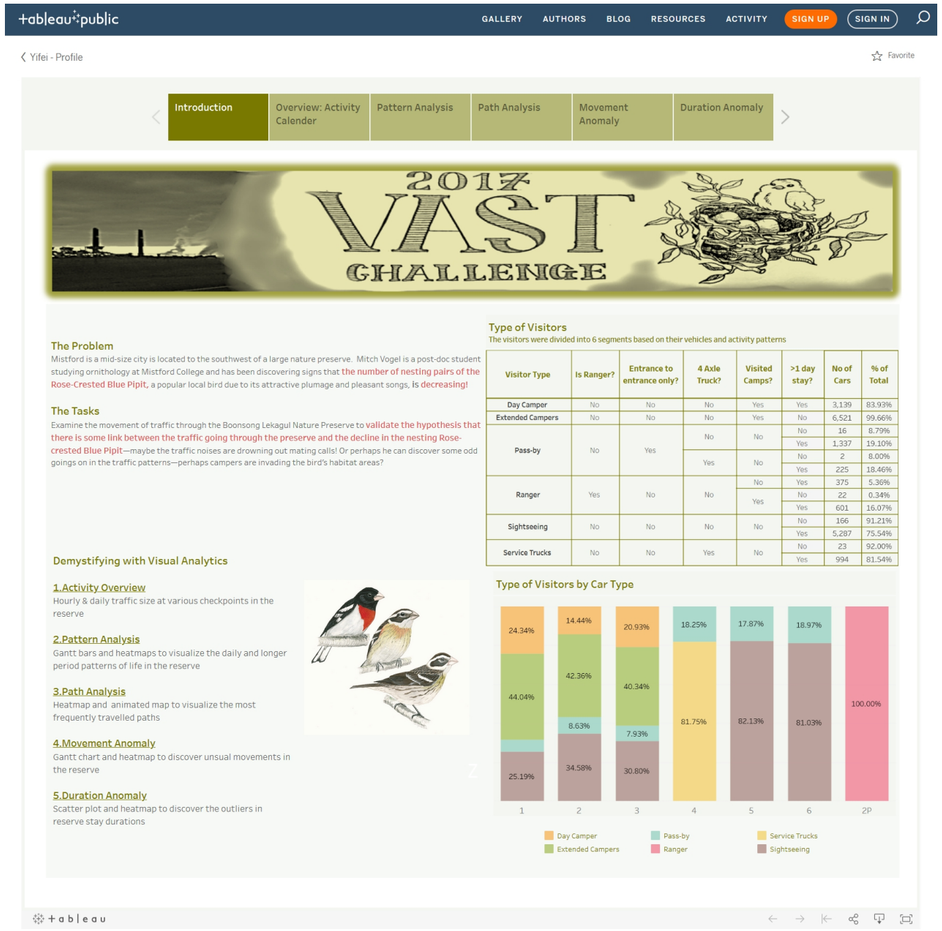






View Manipulation

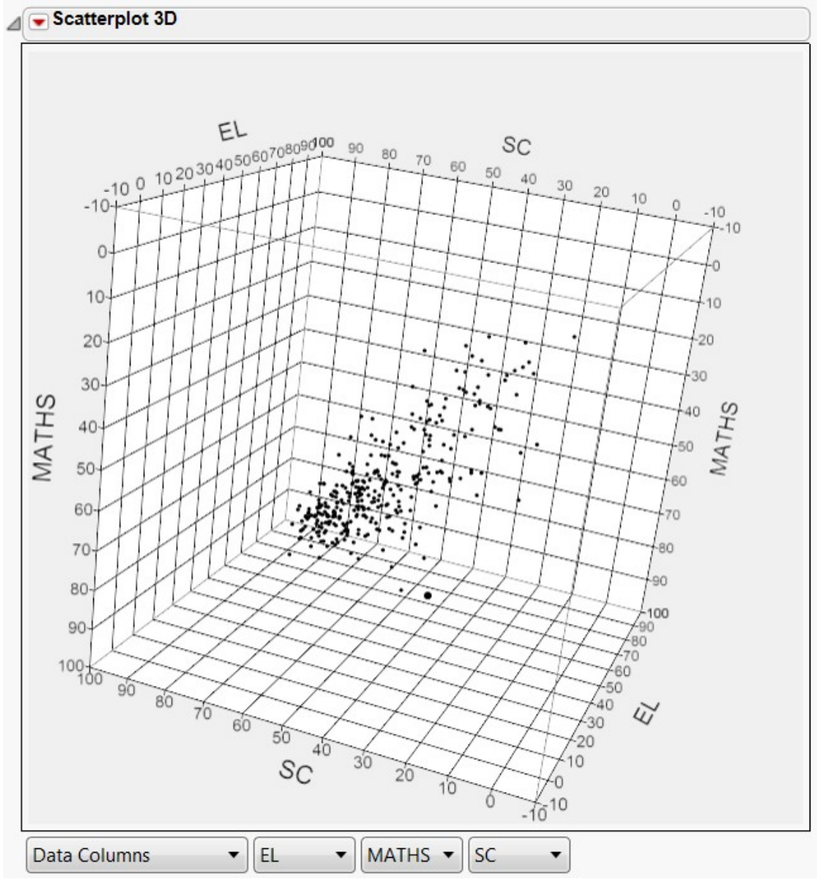
- **Organise** multiple windows and workspaces.



Source: VAST Challenge 2017 MC1 by Yifi

View Manipulation: Rotating

- Touring view with JMP’s 3D scatterplot



Process and Provenance

- **Record** analysis histories for revisitation, review and sharing.
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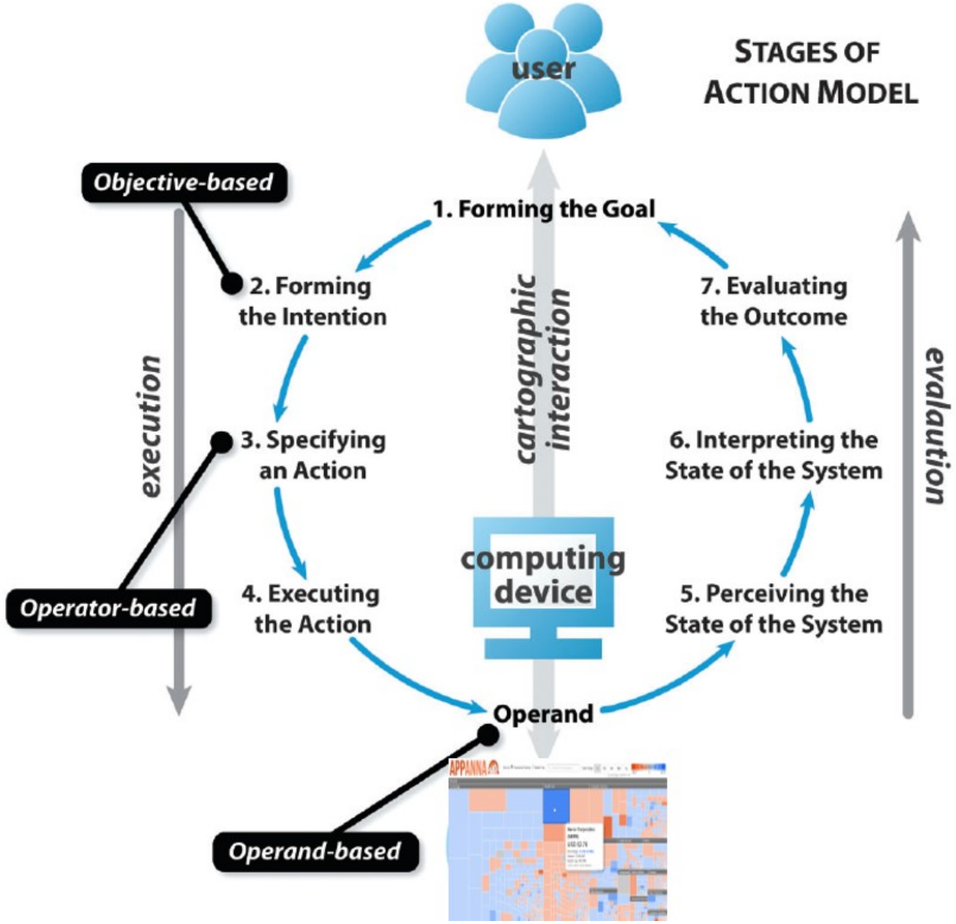
- **Guide** users through analysis tasks or stories.

Interactive Design Primitive

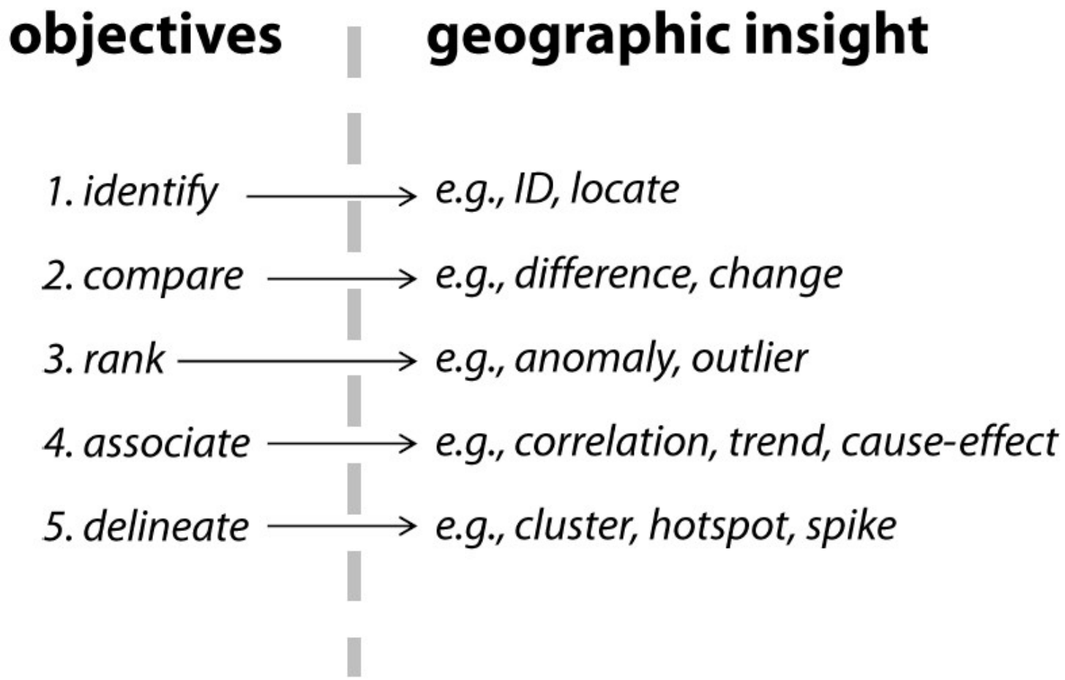
A framework for effective interactive design in visual analytics application.



Source: Roth, R.E. (2012) “Cartographic Interaction Primitive: Framework and Synthesis”. The Cartographic Journal, Vol. 49, No. 4 pp. 376-395.

Interactive Design Primitive

Visual Analytics Objective Primitives

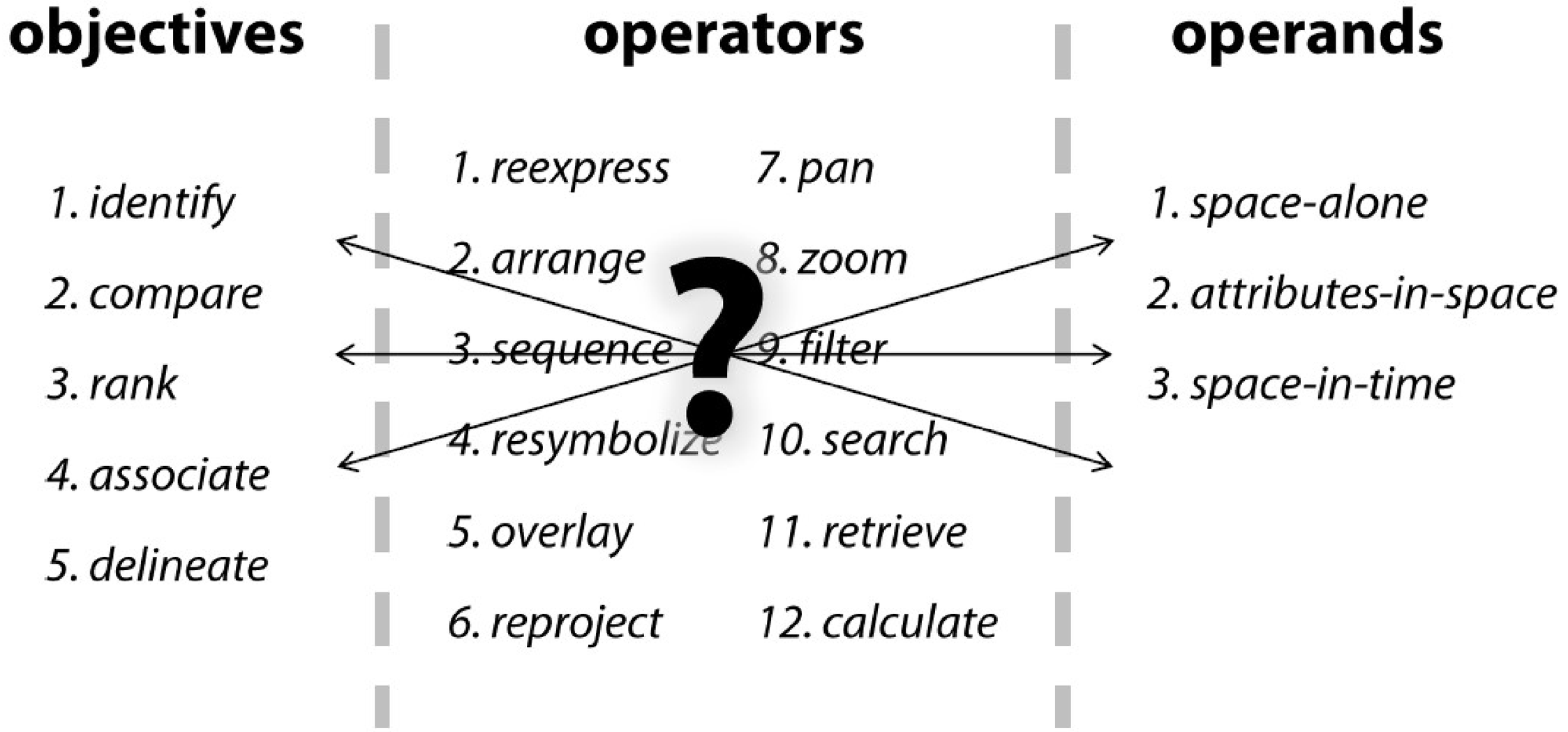


Interactive Analytics Operator Primitives

operators

1. reexpress	***7. pan***
2. arrange	***8. zoom***
3. sequence	***9. filter***
4. resymbolize	***10. search***
5. overlay	***11. retrieve***
6. reproject	*12. calculate*

Interactive Design Primitive



Animation in Visual Analytics

- The purpose of animation is to facilitate perception of changes when transitioning between related data graphics
- Do not confine to time-series data only

The Original Design

The New York Times recently published an interactive graphic for exploring different types of American households. Go check it out.

Source: How Many Households

Why using Animation in Visual Analytics

- Motion is highly effective at attracting attention.
- Animation facilitates object constancy for changing objects.
- Animated behaviours can give rise to perceptions of causality and intentionality, communicating cause-and-effect relationships and establishing narrative.
- Animation can be emotionally engaging, engendering increased interest or enjoyment.

Principles of Animation

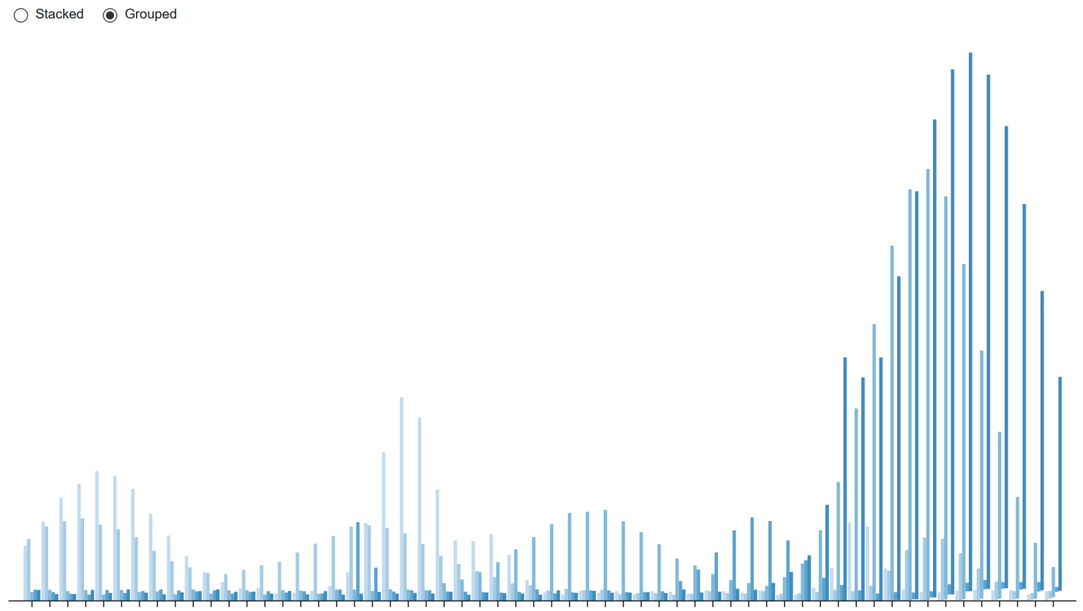
- ***Congruence*** principle states that the structure and content of the external representation should correspond to the desired and content of the internal representation.
- Maintain valid data graphics during transitions
- Use consistent semantic-syntactic mappings
- Respect semantic correspondence
- Avoid ambiguity

- ***Apprehension*** principle states that the structure and content of the external representation should be readily and accurately perceived and comprehended.
- Group similar transitions
- Minimise occlusion
- Maximise predictability
- Use simple transitions
- Use staging for complex transitions
- Make transitions as long as needed, but no longer

Source: Heer, J and Robertson G. (2007) Animated Transitions in Statistical data Graphics, IEEE Transactions on Visualization and Computer Graphics, Vol. 13, No. 6, 1240-1247 and the video.

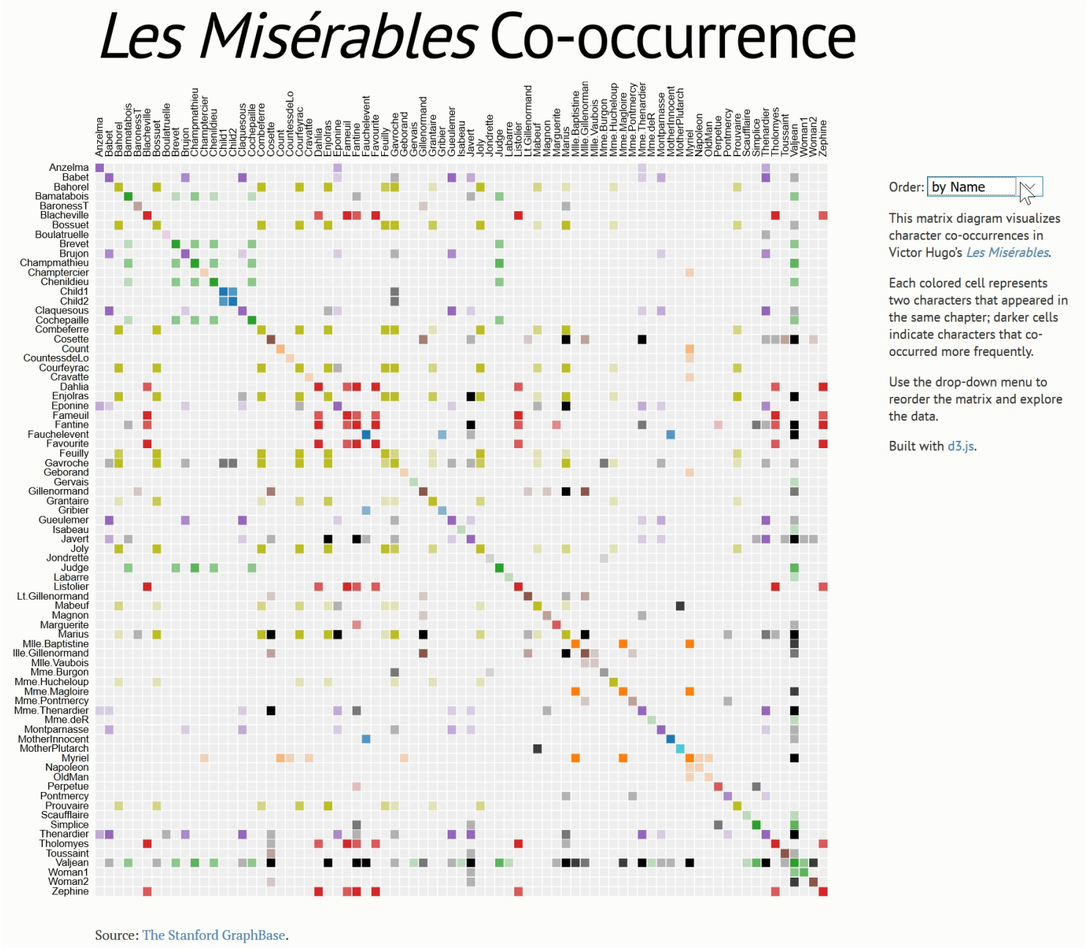
Animation in Action

Stacked-to-Grouped Bars



Source: Stacked to Grouped Bars

Animated Co-occurrence matrix



Source: Miserables

References

- Dynamics for Visual Analysis
- Animated Transitions in Statistical Data Graphics, IEEE Transactions on Visualization and Computer Graphics, Vol. 13, No. 6, 1240-1247 and the video
- Coordinated Highlighting in Context
- Cartographic Interaction Primitive: Framework and Synthesis